SOCIETY OF ACTUARIES

EXAM P PROBABILITY

EXAM P SAMPLE QUESTIONS

This set of sample questions includes those published on the probability topic for use with previous versions of this examination. Questions from previous versions of this document that are not relevant for the syllabus effective with the September 2022 administration have been deleted. The questions have been renumbered. Unless indicated below, no questions have been added to the version published for use with exams through July 2022.

Some of the questions in this study note are taken from past SOA examinations.

These questions are representative of the types of questions that might be asked of candidates sitting for the Probability (P) Exam. These questions are intended to represent the depth of understanding required of candidates. The distribution of questions by topic is not intended to represent the distribution of questions on future exams.

For questions involving the normal distribution, answer choices have been calculated using exact values for the normal distribution. Using the normal table provided and rounding to the closest value may give you answers slightly different from the answer choices. As always, choose the best answer provided from the five choices when selecting your answer.

Questions 271-287 were added July 2022
Questions 288-319 were added August 2022
Questions 234-236 and 282 were deleted October 2022
Questions 320-446 were added November 2023
Several questions that were duplicates of earlier questions were removed February 2024
Questions 447-485 were added March 2024
Questions 486-570 were added September 2024
Questions 571-627 were added December 2024

1. A survey of a group's viewing habits over the last year revealed the following information:

(i) 28% watched gymnastics
(ii) 29% watched baseball
(iii) 19% watched soccer
(iv) 14% watched gymnastics and baseball
(v) 12% watched baseball and soccer
(vi) 10% watched gymnastics and soccer
(vii) 8% watched all three sports.

Calculate the percentage of the group that watched none of the three sports during the last year.

(A) 24%
(B) 36%
(C) 41%
(D) 52%
(E) 60%

2. The probability that a visit to a primary care physician's (PCP) office results in neither lab work nor referral to a specialist is 35%. Of those coming to a PCP's office, 30% are referred to specialists and 40% require lab work.

Calculate the probability that a visit to a PCP's office results in both lab work and referral to a specialist.

(A) 0.05
(B) 0.12
(C) 0.18
(D) 0.25
(E) 0.35

3. You are given $P[A \cup B] = 0.7$ and $P[A \cup B'] = 0.9$.

Calculate $P[A]$.

(A) 0.2
(B) 0.3
(C) 0.4
(D) 0.6
(E) 0.8

4. An urn contains 10 balls: 4 red and 6 blue. A second urn contains 16 red balls and an unknown number of blue balls. A single ball is drawn from each urn. The probability that both balls are the same color is 0.44.

Calculate the number of blue balls in the second urn.

(A) 4
(B) 20
(C) 24
(D) 44
(E) 64

5. An auto insurance company has 10,000 policyholders. Each policyholder is classified as

(i) young or old;
(ii) male or female; and
(iii) married or single.

Of these policyholders, 3000 are young, 4600 are male, and 7000 are married. The policyholders can also be classified as 1320 young males, 3010 married males, and 1400 young married persons. Finally, 600 of the policyholders are young married males.

Calculate the number of the company's policyholders who are young, female, and single.

(A) 280
(B) 423
(C) 486
(D) 880
(E) 896

6. A public health researcher examines the medical records of a group of 937 men who died in 1999 and discovers that 210 of the men died from causes related to heart disease. Moreover, 312 of the 937 men had at least one parent who suffered from heart disease, and, of these 312 men, 102 died from causes related to heart disease.

Calculate the probability that a man randomly selected from this group died of causes related to heart disease, given that neither of his parents suffered from heart disease.

(A) 0.115
(B) 0.173
(C) 0.224
(D) 0.327
(E) 0.514

7. An insurance company estimates that 40% of policyholders who have only an auto policy will renew next year and 60% of policyholders who have only a homeowners policy will renew next year. The company estimates that 80% of policyholders who have both an auto policy and a homeowners policy will renew at least one of those policies next year.

Company records show that 65% of policyholders have an auto policy, 50% of policyholders have a homeowners policy, and 15% of policyholders have both an auto policy and a homeowners policy.

Using the company's estimates, calculate the percentage of policyholders that will renew at least one policy next year.

(A) 20%
(B) 29%
(C) 41%
(D) 53%
(E) 70%

8. Among a large group of patients recovering from shoulder injuries, it is found that 22% visit both a physical therapist and a chiropractor, whereas 12% visit neither of these. The probability that a patient visits a chiropractor exceeds by 0.14 the probability that a patient visits a physical therapist.

Calculate the probability that a randomly chosen member of this group visits a physical therapist.

(A) 0.26
(B) 0.38
(C) 0.40
(D) 0.48
(E) 0.62

9. An insurance company examines its pool of auto insurance customers and gathers the following information:

(i) All customers insure at least one car.
(ii) 70% of the customers insure more than one car.
(iii) 20% of the customers insure a sports car.
(iv) Of those customers who insure more than one car, 15% insure a sports car.

Calculate the probability that a randomly selected customer insures exactly one car and that car is not a sports car.

(A) 0.13
(B) 0.21
(C) 0.24
(D) 0.25
(E) 0.30

10. An actuary studying the insurance preferences of automobile owners makes the following conclusions:

(i) An automobile owner is twice as likely to purchase collision coverage as disability coverage.
(ii) The event that an automobile owner purchases collision coverage is independent of the event that he or she purchases disability coverage.
(iii) The probability that an automobile owner purchases both collision and disability coverages is 0.15.

Calculate the probability that an automobile owner purchases neither collision nor disability coverage.

(A) 0.18
(B) 0.33
(C) 0.48
(D) 0.67
(E) 0.82

11. A doctor is studying the relationship between blood pressure and heartbeat abnormalities in her patients. She tests a random sample of her patients and notes their blood pressures (high, low, or normal) and their heartbeats (regular or irregular). She finds that:

(i) 14% have high blood pressure.
(ii) 22% have low blood pressure.
(iii) 15% have an irregular heartbeat.
(iv) Of those with an irregular heartbeat, one-third have high blood pressure.
(v) Of those with normal blood pressure, one-eighth have an irregular heartbeat.

Calculate the portion of the patients selected who have a regular heartbeat and low blood pressure.

(A) 2%
(B) 5%
(C) 8%
(D) 9%
(E) 20%

12. An actuary is studying the prevalence of three health risk factors, denoted by A, B, and C, within a population of women. For each of the three factors, the probability is 0.1 that a woman in the population has only this risk factor (and no others). For any two of the three factors, the probability is 0.12 that she has exactly these two risk factors (but not the other). The probability that a woman has all three risk factors, given that she has A and B, is 1/3.

Calculate the probability that a woman has none of the three risk factors, given that she does not have risk factor A.

(A) 0.280
(B) 0.311
(C) 0.467
(D) 0.484
(E) 0.700

13. In modeling the number of claims filed by an individual under an automobile policy during a three-year period, an actuary makes the simplifying assumption that for all integers $n \geq 0$, $p(n+1) = 0.2\,p(n)$ where $p(n)$ represents the probability that the policyholder files *n* claims during the period.

Under this assumption, calculate the probability that a policyholder files more than one claim during the period.

(A) 0.04
(B) 0.16
(C) 0.20
(D) 0.80
(E) 0.96

14. An insurer offers a health plan to the employees of a large company. As part of this plan, the individual employees may choose exactly two of the supplementary coverages A, B, and C, or they may choose no supplementary coverage. The proportions of the company's employees that choose coverages A, B, and C are 1/4, 1/3, and 5/12 respectively.

Calculate the probability that a randomly chosen employee will choose no supplementary coverage.

(A) 0
(B) 47/144
(C) 1/2
(D) 97/144
(E) 7/9

15. An insurance company determines that *N*, the number of claims received in a week, is a random variable with $P[N=n] = \dfrac{1}{2^{n+1}}$ where $n \geq 0$. The company also determines that the number of claims received in a given week is independent of the number of claims received in any other week.

Calculate the probability that exactly seven claims will be received during a given two-week period.

(A) 1/256
(B) 1/128
(C) 7/512
(D) 1/64
(E) 1/32

16. An insurance company pays hospital claims. The number of claims that include emergency room or operating room charges is 85% of the total number of claims. The number of claims that do not include emergency room charges is 25% of the total number of claims. The occurrence of emergency room charges is independent of the occurrence of operating room charges on hospital claims.

Calculate the probability that a claim submitted to the insurance company includes operating room charges.

(A) 0.10
(B) 0.20
(C) 0.25
(D) 0.40
(E) 0.80

17. Two instruments are used to measure the height, h, of a tower. The error made by the less accurate instrument is normally distributed with mean 0 and standard deviation $0.0056h$. The error made by the more accurate instrument is normally distributed with mean 0 and standard deviation $0.0044h$.

The errors from the two instruments are independent of each other.

Calculate the probability that the average value of the two measurements is within $0.005h$ of the height of the tower.

(A) 0.38
(B) 0.47
(C) 0.68
(D) 0.84
(E) 0.90

18. An auto insurance company insures drivers of all ages. An actuary compiled the following statistics on the company's insured drivers:

Age of Driver	Probability of Accident	Portion of Company's Insured Drivers
16-20	0.06	0.08
21-30	0.03	0.15
31-65	0.02	0.49
66-99	0.04	0.28

A randomly selected driver that the company insures has an accident.

Calculate the probability that the driver was age 16-20.

(A) 0.13
(B) 0.16
(C) 0.19
(D) 0.23
(E) 0.40

19. An insurance company issues life insurance policies in three separate categories: standard, preferred, and ultra-preferred. Of the company's policyholders, 50% are standard, 40% are preferred, and 10% are ultra-preferred. Each standard policyholder has probability 0.010 of dying in the next year, each preferred policyholder has probability 0.005 of dying in the next year, and each ultra-preferred policyholder has probability 0.001 of dying in the next year.

A policyholder dies in the next year.

Calculate the probability that the deceased policyholder was ultra-preferred.

(A) 0.0001
(B) 0.0010
(C) 0.0071
(D) 0.0141
(E) 0.2817

20. Upon arrival at a hospital's emergency room, patients are categorized according to their condition as critical, serious, or stable. In the past year:

(i) 10% of the emergency room patients were critical;
(ii) 30% of the emergency room patients were serious;
(iii) the rest of the emergency room patients were stable;
(iv) 40% of the critical patients died;
(vi) 10% of the serious patients died; and
(vii) 1% of the stable patients died.

Given that a patient survived, calculate the probability that the patient was categorized as serious upon arrival.

(A) 0.06
(B) 0.29
(C) 0.30
(D) 0.39
(E) 0.64

21. A health study tracked a group of persons for five years. At the beginning of the study, 20% were classified as heavy smokers, 30% as light smokers, and 50% as nonsmokers.

Results of the study showed that light smokers were twice as likely as nonsmokers to die during the five-year study, but only half as likely as heavy smokers.

A randomly selected participant from the study died during the five-year period.

Calculate the probability that the participant was a heavy smoker.

(A) 0.20
(B) 0.25
(C) 0.35
(D) 0.42
(E) 0.57

22. An actuary studied the likelihood that different types of drivers would be involved in at least one collision during any one-year period. The results of the study are:

Type of driver	Percentage of all drivers	Probability of at least one collision
Teen	8%	0.15
Young adult	16%	0.08
Midlife	45%	0.04
Senior	31%	0.05
Total	100%	

Given that a driver has been involved in at least one collision in the past year, calculate the probability that the driver is a young adult driver.

(A) 0.06
(B) 0.16
(C) 0.19
(D) 0.22
(E) 0.25

23. The number of injury claims per month is modeled by a random variable N with $P[N=n]=\dfrac{1}{(n+1)(n+2)}$, for nonnegative integers, n.

Calculate the probability of at least one claim during a particular month, given that there have been at most four claims during that month.

(A) 1/3
(B) 2/5
(C) 1/2
(D) 3/5
(E) 5/6

24. A blood test indicates the presence of a particular disease 95% of the time when the disease is actually present. The same test indicates the presence of the disease 0.5% of the time when the disease is not actually present. One percent of the population actually has the disease.

Calculate the probability that a person actually has the disease given that the test indicates the presence of the disease.

(A) 0.324
(B) 0.657
(C) 0.945
(D) 0.950
(E) 0.995

25. The probability that a randomly chosen male has a blood circulation problem is 0.25. Males who have a blood circulation problem are twice as likely to be smokers as those who do not have a blood circulation problem.

Calculate the probability that a male has a blood circulation problem, given that he is a smoker.

(A) 1/4
(B) 1/3
(C) 2/5
(D) 1/2
(E) 2/3

26. A study of automobile accidents produced the following data:

Model year	Proportion of all vehicles	Probability of involvement in an accident
2014	0.16	0.05
2013	0.18	0.02
2012	0.20	0.03
Other	0.46	0.04

An automobile from one of the model years 2014, 2013, and 2012 was involved in an accident.

Calculate the probability that the model year of this automobile is 2014.

(A) 0.22
(B) 0.30
(C) 0.33
(D) 0.45
(E) 0.50

27. A hospital receives 1/5 of its flu vaccine shipments from Company X and the remainder of its shipments from other companies. Each shipment contains a very large number of vaccine vials.

For Company X's shipments, 10% of the vials are ineffective. For every other company, 2% of the vials are ineffective. The hospital tests 30 randomly selected vials from a shipment and finds that one vial is ineffective.

Calculate the probability that this shipment came from Company X.

(A) 0.10
(B) 0.14
(C) 0.37
(D) 0.63
(E) 0.86

28. The number of days that elapse between the beginning of a calendar year and the moment a high-risk driver is involved in an accident is exponentially distributed. An insurance company expects that 30% of high-risk drivers will be involved in an accident during the first 50 days of a calendar year.

Calculate the portion of high-risk drivers are expected to be involved in an accident during the first 80 days of a calendar year.

(A) 0.15
(B) 0.34
(C) 0.43
(D) 0.57
(E) 0.66

29. An actuary has discovered that policyholders are three times as likely to file two claims as to file four claims.

The number of claims filed has a Poisson distribution.

Calculate the variance of the number of claims filed.

(A) $\frac{1}{\sqrt{3}}$
(B) 1
(C) $\sqrt{2}$
(D) 2
(E) 4

30. A company establishes a fund of 120 from which it wants to pay an amount, *C*, to any of its 20 employees who achieve a high performance level during the coming year. Each employee has a 2% chance of achieving a high performance level during the coming year. The events of different employees achieving a high performance level during the coming year are mutually independent.

Calculate the maximum value of *C* for which the probability is less than 1% that the fund will be inadequate to cover all payments for high performance.

(A) 24
(B) 30
(C) 40
(D) 60
(E) 120

31. A large pool of adults earning their first driver's license includes 50% low-risk drivers, 30% moderate-risk drivers, and 20% high-risk drivers. Because these drivers have no prior driving record, an insurance company considers each driver to be randomly selected from the pool.

This month, the insurance company writes four new policies for adults earning their first driver's license.

Calculate the probability that these four will contain at least two more high-risk drivers than low-risk drivers.

(A) 0.006
(B) 0.012
(C) 0.018
(D) 0.049
(E) 0.073

32. The loss due to a fire in a commercial building is modeled by a random variable *X* with density function

$$f(x) = \begin{cases} 0.005(20-x), & 0 < x < 20 \\ 0, & \text{otherwise.} \end{cases}$$

Given that a fire loss exceeds 8, calculate the probability that it exceeds 16.

(A) 1/25
(B) 1/9
(C) 1/8
(D) 1/3
(E) 3/7

33. The lifetime of a machine part has a continuous distribution on the interval (0, 40) with probability density function $f(x)$, where $f(x)$ is proportional to $(10 + x)^{-2}$ on the interval.

Calculate the probability that the lifetime of the machine part is less than 6.

(A) 0.04
(B) 0.15
(C) 0.47
(D) 0.53
(E) 0.94

34. A group insurance policy covers the medical claims of the employees of a small company. The value, V, of the claims made in one year is described by

$$V = 100{,}000Y$$

where Y is a random variable with density function

$$f(y) = \begin{cases} k(1-y)^4, & 0 < y < 1 \\ 0, & \text{otherwise} \end{cases}$$

where k is a constant.

Calculate the conditional probability that V exceeds 40,000, given that V exceeds 10,000.

(A) 0.08
(B) 0.13
(C) 0.17
(D) 0.20
(E) 0.51

35. The lifetime of a printer costing 200 is exponentially distributed with mean 2 years. The manufacturer agrees to pay a full refund to a buyer if the printer fails during the first year following its purchase, a one-half refund if it fails during the second year, and no refund for failure after the second year.

Calculate the expected total amount of refunds from the sale of 100 printers.

(A) 6,321
(B) 7,358
(C) 7,869
(D) 10,256
(E) 12,642

36. An insurance company insures a large number of homes. The insured value, X, of a randomly selected home is assumed to follow a distribution with density function

$$f(x) = \begin{cases} 3x^{-4}, & x > 1 \\ 0, & \text{otherwise.} \end{cases}$$

Given that a randomly selected home is insured for at least 1.5, calculate the probability that it is insured for less than 2.

(A) 0.578
(B) 0.684
(C) 0.704
(D) 0.829
(E) 0.875

37. A company prices its hurricane insurance using the following assumptions:

(i) In any calendar year, there can be at most one hurricane.
(ii) In any calendar year, the probability of a hurricane is 0.05.
(iii) The numbers of hurricanes in different calendar years are mutually independent.

Using the company's assumptions, calculate the probability that there are fewer than 3 hurricanes in a 20-year period.

(A) 0.06
(B) 0.19
(C) 0.38
(D) 0.62
(E) 0.92

38. An insurance policy pays for a random loss X subject to a deductible of C, where $0 < C < 1$. The loss amount is modeled as a continuous random variable with density function

$$f(x) = \begin{cases} 2x, & 0 < x < 1 \\ 0, & \text{otherwise.} \end{cases}$$

Given a random loss X, the probability that the insurance payment is less than 0.5 is equal to 0.64.

Calculate C.

(A) 0.1
(B) 0.3
(C) 0.4
(D) 0.6
(E) 0.8

39. A study is being conducted in which the health of two independent groups of ten policyholders is being monitored over a one-year period of time. Individual participants in the study drop out before the end of the study with probability 0.2 (independently of the other participants).

Calculate the probability that at least nine participants complete the study in one of the two groups, but not in both groups?

(A) 0.096
(B) 0.192
(C) 0.235
(D) 0.376
(E) 0.469

40. For Company A there is a 60% chance that no claim is made during the coming year. If one or more claims are made, the total claim amount is normally distributed with mean 10,000 and standard deviation 2,000.

For Company B there is a 70% chance that no claim is made during the coming year. If one or more claims are made, the total claim amount is normally distributed with mean 9,000 and standard deviation 2,000.

The total claim amounts of the two companies are independent.

Calculate the probability that, in the coming year, Company B's total claim amount will exceed Company A's total claim amount.

(A) 0.180
(B) 0.185
(C) 0.217
(D) 0.223
(E) 0.240

41. A company takes out an insurance policy to cover accidents that occur at its manufacturing plant. The probability that one or more accidents will occur during any given month is 0.60. The numbers of accidents that occur in different months are mutually independent.

Calculate the probability that there will be at least four months in which no accidents occur before the fourth month in which at least one accident occurs.

(A) 0.01
(B) 0.12
(C) 0.23
(D) 0.29
(E) 0.41

42. An insurance policy pays 100 per day for up to three days of hospitalization and 50 per day for each day of hospitalization thereafter.

The number of days of hospitalization, X, is a discrete random variable with probability function

$$P[X = k] = \begin{cases} \dfrac{6-k}{15}, & k = 1, 2, 3, 4, 5 \\ 0, & \text{otherwise.} \end{cases}$$

Determine the expected payment for hospitalization under this policy.

(A) 123
(B) 210
(C) 220
(D) 270
(E) 367

43. Let X be a continuous random variable with density function

$$f(x) = \begin{cases} \dfrac{|x|}{10}, & -2 \le x \le 4 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate the expected value of X.

(A) 1/5
(B) 3/5
(C) 1
(D) 28/15
(E) 12/5

44. A device that continuously measures and records seismic activity is placed in a remote region. The time, T, to failure of this device is exponentially distributed with mean 3 years. Since the device will not be monitored during its first two years of service, the time to discovery of its failure is $X = \max(T, 2)$.

Calculate $E(X)$.

(A) $2+\frac{1}{3}e^{-6}$
(B) $2-2e^{-2/3}+5e^{-4/3}$
(C) 3
(D) $2+3e^{-2/3}$
(E) 5

45. A piece of equipment is being insured against early failure. The time from purchase until failure of the equipment is exponentially distributed with mean 10 years. The insurance will pay an amount x if the equipment fails during the first year, and it will pay $0.5x$ if failure occurs during the second or third year. If failure occurs after the first three years, no payment will be made.

Calculate x such that the expected payment made under this insurance is 1000.

(A) 3858
(B) 4449
(C) 5382
(D) 5644
(E) 7235

46. An insurance policy on an electrical device pays a benefit of 4000 if the device fails during the first year. The amount of the benefit decreases by 1000 each successive year until it reaches 0. If the device has not failed by the beginning of any given year, the probability of failure during that year is 0.4.

Calculate the expected benefit under this policy.

(A) 2234
(B) 2400
(C) 2500
(D) 2667
(E) 2694

47. A company buys a policy to insure its revenue in the event of major snowstorms that shut down business. The policy pays nothing for the first such snowstorm of the year and 10,000 for each one thereafter, until the end of the year. The number of major snowstorms per year that shut down business is assumed to have a Poisson distribution with mean 1.5.

Calculate the expected amount paid to the company under this policy during a one-year period.

(A) 2,769
(B) 5,000
(C) 7,231
(D) 8,347
(E) 10,578

48. A manufacturer's annual losses follow a distribution with density function

$$f(x) = \begin{cases} \dfrac{2.5(0.6)^{2.5}}{x^{3.5}}, & x > 0.6 \\ 0, & \text{otherwise.} \end{cases}$$

To cover its losses, the manufacturer purchases an insurance policy with an annual deductible of 2.

Calculate the mean of the manufacturer's annual losses not paid by the insurance policy.

(A) 0.84
(B) 0.88
(C) 0.93
(D) 0.95
(E) 1.00

49. An insurance company sells a one-year automobile policy with a deductible of 2. The probability that the insured will incur a loss is 0.05. If there is a loss, the probability of a loss of amount N is K/N, for $N = 1, \ldots, 5$ and K a constant. These are the only possible loss amounts and no more than one loss can occur.

Calculate the expected payment for this policy.

(A) 0.031
(B) 0.066
(C) 0.072
(D) 0.110
(E) 0.150

50. An insurance policy reimburses a loss up to a benefit limit of 10. The policyholder's loss, Y, follows a distribution with density function:

$$f(y) = \begin{cases} 2y^{-3}, & y > 1 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate the expected value of the benefit paid under the insurance policy.

(A) 1.0
(B) 1.3
(C) 1.8
(D) 1.9
(E) 2.0

51. An auto insurance company insures an automobile worth 15,000 for one year under a policy with a 1,000 deductible. During the policy year there is a 0.04 chance of partial damage to the car and a 0.02 chance of a total loss of the car. If there is partial damage to the car, the amount X of damage (in thousands) follows a distribution with density function

$$f(x) = \begin{cases} 0.5003e^{-x/2}, & 0 < x < 15 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate the expected claim payment.

(A) 320
(B) 328
(C) 352
(D) 380
(E) 540

52. An insurance company's monthly claims are modeled by a continuous, positive random variable *X*, whose probability density function is proportional to $(1 + x)^{-4}$, for $0 < x < \infty$. Calculate the company's expected monthly claims.

(A) 1/6
(B) 1/3
(C) 1/2
(D) 1
(E) 3

53. An insurance policy is written to cover a loss, *X*, where *X* has a uniform distribution on [0, 1000]. The policy has a deductible, *d*, and the expected payment under the policy is 25% of what it would be with no deductible.

Calculate *d*.

(A) 250
(B) 375
(C) 500
(D) 625
(E) 750

54. An insurer's annual weather-related loss, *X*, is a random variable with density function

$$f(x) = \begin{cases} \dfrac{2.5(200)^{2.5}}{x^{3.5}}, & x > 200 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate the difference between the 30th and 70th percentiles of *X*.

(A) 35
(B) 93
(C) 124
(D) 231
(E) 298

55. A recent study indicates that the annual cost of maintaining and repairing a car in a town in Ontario averages 200 with a variance of 260.

A tax of 20% is introduced on all items associated with the maintenance and repair of cars (i.e., everything is made 20% more expensive).

Calculate the variance of the annual cost of maintaining and repairing a car after the tax is introduced.

(A) 208
(B) 260
(C) 270
(D) 312
(E) 374

56. A random variable X has the cumulative distribution function

$$F(x) = \begin{cases} 0, & x < 1 \\ \dfrac{x^2 - 2x + 2}{2}, & 1 \le x < 2 \\ 1, & x \ge 2. \end{cases}$$

Calculate the variance of X.

(A) 7/72
(B) 1/8
(C) 5/36
(D) 4/3
(E) 23/12

57. The warranty on a machine specifies that it will be replaced at failure or age 4, whichever occurs first. The machine's age at failure, *X*, has density function

$$f(x) = \begin{cases} 1/5, & 0 < x < 5 \\ 0, & \text{otherwise.} \end{cases}$$

Let *Y* be the age of the machine at the time of replacement.

Calculate the variance of *Y*.

(A) 1.3
(B) 1.4
(C) 1.7
(D) 2.1
(E) 7.5

58. A probability distribution of the claim sizes for an auto insurance policy is given in the table below:

Claim Size	Probability
20	0.15
30	0.10
40	0.05
50	0.20
60	0.10
70	0.10
80	0.30

Calculate the percentage of claims that are within one standard deviation of the mean claim size.

(A) 45%
(B) 55%
(C) 68%
(D) 85%
(E) 100%

59. The owner of an automobile insures it against damage by purchasing an insurance policy with a deductible of 250. In the event that the automobile is damaged, repair costs can be modeled by a uniform random variable on the interval (0, 1500).

Calculate the standard deviation of the insurance payment in the event that the automobile is damaged.

(A) 361

(B) 403
(C) 433
(D) 464
(E) 521

60. A baseball team has scheduled its opening game for April 1. If it rains on April 1, the game is postponed and will be played on the next day that it does not rain. The team purchases insurance against rain. The policy will pay 1000 for each day, up to 2 days, that the opening game is postponed.

The insurance company determines that the number of consecutive days of rain beginning on April 1 is a Poisson random variable with mean 0.6.

Calculate the standard deviation of the amount the insurance company will have to pay.

(A) 668
(B) 699
(C) 775
(D) 817
(E) 904

61. An insurance policy reimburses dental expense, *X*, up to a maximum benefit of 250. The probability density function for *X* is:

$$f(x) = \begin{cases} ce^{-0.004x}, & x \geq 0 \\ 0, & \text{otherwise} \end{cases}$$

where *c* is a constant.

Calculate the median benefit for this policy.

(A) 161
(B) 165
(C) 173
(D) 182
(E) 250

62. The time to failure of a component in an electronic device has an exponential distribution with a median of four hours.

Calculate the probability that the component will work without failing for at least five hours.

(A) 0.07
(B) 0.29
(C) 0.38
(D) 0.42
(E) 0.57

63. An insurance company sells an auto insurance policy that covers losses incurred by a policyholder, subject to a deductible of 100. Losses incurred follow an exponential distribution with mean 300.

Calculate the 95th percentile of losses that exceed the deductible.

(A) 600
(B) 700
(C) 800
(D) 900
(E) 1000

64. Claim amounts for wind damage to insured homes are mutually independent random variables with common density function

$$f(x) = \begin{cases} \dfrac{3}{x^4}, & x > 1 \\ 0, & \text{otherwise,} \end{cases}$$

where x is the amount of a claim in thousands.

Suppose 3 such claims will be made.

Calculate the expected value of the largest of the three claims.

(A) 2025
(B) 2700
(C) 3232
(D) 3375
(E) 4500

65. A charity receives 2025 contributions. Contributions are assumed to be mutually independent and identically distributed with mean 3125 and standard deviation 250.

Calculate the approximate 90^{th} percentile for the distribution of the total contributions received.

(A) 6,328,000
(B) 6,338,000
(C) 6,343,000
(D) 6,784,000
(E) 6,977,000

66. Claims filed under auto insurance policies follow a normal distribution with mean 19,400 and standard deviation 5,000.

Calculate the probability that the average of 25 randomly selected claims exceeds 20,000.

(A) 0.01
(B) 0.15
(C) 0.27
(D) 0.33
(E) 0.45

67. An insurance company issues 1250 vision care insurance policies. The number of claims filed by a policyholder under a vision care insurance policy during one year is a Poisson random variable with mean 2. Assume the numbers of claims filed by different policyholders are mutually independent.

Calculate the approximate probability that there is a total of between 2450 and 2600 claims during a one-year period?

(A) 0.68
(B) 0.82
(C) 0.87
(D) 0.95
(E) 1.00

68. A company manufactures a brand of light bulb with a lifetime in months that is normally distributed with mean 3 and variance 1. A consumer buys a number of these bulbs with the intention of replacing them successively as they burn out. The light bulbs have mutually independent lifetimes.

Calculate the smallest number of bulbs to be purchased so that the succession of light bulbs produces light for at least 40 months with probability at least 0.9772.

(A) 14
(B) 16
(C) 20
(D) 40
(E) 55

69. Let X and Y be the number of hours that a randomly selected person watches movies and sporting events, respectively, during a three-month period. The following information is known about X and Y:

$E(X) = 50$, $E(Y) = 20$, $Var(X) = 50$, $Var(Y) = 30$, $Cov(X,Y) = 10$.

The totals of hours that different individuals watch movies and sporting events during the three months are mutually independent.

One hundred people are randomly selected and observed for these three months. Let T be the total number of hours that these one hundred people watch movies or sporting events during this three-month period.

Approximate the value of $P[T < 7100]$.

(A) 0.62
(B) 0.84
(C) 0.87
(D) 0.92
(E) 0.97

70. The total claim amount for a health insurance policy follows a distribution with density function

$$f(x) = \frac{1}{1000} e^{-(x/1000)}, \; x > 0.$$

The premium for the policy is set at the expected total claim amount plus 100.

If 100 policies are sold, calculate the approximate probability that the insurance company will have claims exceeding the premiums collected.

(A) 0.001
(B) 0.159
(C) 0.333
(D) 0.407
(E) 0.460

71. A city has just added 100 new female recruits to its police force. The city will provide a pension to each new hire who remains with the force until retirement. In addition, if the new hire is married at the time of her retirement, a second pension will be provided for her husband. A consulting actuary makes the following assumptions:

(i) Each new recruit has a 0.4 probability of remaining with the police force until retirement.

(ii) Given that a new recruit reaches retirement with the police force, the probability that she is not married at the time of retirement is 0.25.

(iii) The events of different new hires reaching retirement and the events of different new hires being married at retirement are all mutually independent events.

Calculate the probability that the city will provide at most 90 pensions to the 100 new hires and their husbands.

(A) 0.60
(B) 0.67
(C) 0.75
(D) 0.93
(E) 0.99

72. In an analysis of healthcare data, ages have been rounded to the nearest multiple of 5 years. The difference between the true age and the rounded age is assumed to be uniformly distributed on the interval from -2.5 years to 2.5 years. The healthcare data are based on a random sample of 48 people.

Calculate the approximate probability that the mean of the rounded ages is within 0.25 years of the mean of the true ages.

(A) 0.14
(B) 0.38
(C) 0.57
(D) 0.77
(E) 0.88

73. The waiting time for the first claim from a good driver and the waiting time for the first claim from a bad driver are independent and follow exponential distributions with means 6 years and 3 years, respectively.

Calculate the probability that the first claim from a good driver will be filed within 3 years and the first claim from a bad driver will be filed within 2 years.

(A) $\frac{1}{18}\left(1-e^{-2/3}-e^{-1/2}+e^{-7/6}\right)$
(B) $\frac{1}{18}e^{-7/6}$
(C) $1-e^{-2/3}-e^{-1/2}+e^{-7/6}$
(D) $1-e^{-2/3}-e^{-1/2}+e^{-1/3}$
(E) $1-\frac{1}{3}e^{-2/3}-\frac{1}{6}e^{-1/2}+\frac{1}{18}e^{-7/6}$

74. A tour operator has a bus that can accommodate 20 tourists. The operator knows that tourists may not show up, so he sells 21 tickets. The probability that an individual tourist will not show up is 0.02, independent of all other tourists.

Each ticket costs 50, and is non-refundable if a tourist fails to show up. If a tourist shows up and a seat is not available, the tour operator has to pay 100 (ticket cost + 50 penalty) to the tourist.

Calculate the expected revenue of the tour operator.

(A) 955
(B) 962
(C) 967
(D) 976
(E) 985

75. An insurance policy pays a total medical benefit consisting of two parts for each claim. Let X represent the part of the benefit that is paid to the surgeon, and let Y represent the part that is paid to the hospital. The variance of X is 5000, the variance of Y is 10,000, and the variance of the total benefit, $X + Y$, is 17,000.

Due to increasing medical costs, the company that issues the policy decides to increase X by a flat amount of 100 per claim and to increase Y by 10% per claim.

Calculate the variance of the total benefit after these revisions have been made.

(A) 18,200
(B) 18,800
(C) 19,300
(D) 19,520
(E) 20,670

76. A car dealership sells 0, 1, or 2 luxury cars on any day. When selling a car, the dealer also tries to persuade the customer to buy an extended warranty for the car. Let X denote the number of luxury cars sold in a given day, and let Y denote the number of extended warranties sold.

$$P[X = 0, Y = 0] = 1/6$$
$$P[X = 1, Y = 0] = 1/12$$
$$P[X = 1, Y = 1] = 1/6$$
$$P[X = 2, Y = 0] = 1/12$$
$$P[X = 2, Y = 1] = 1/3$$
$$P[X = 2, Y = 2] = 1/6$$

Calculate the variance of X.

(A) 0.47
(B) 0.58
(C) 0.83
(D) 1.42
(E) 2.58

77. The profit for a new product is given by $Z = 3X - Y - 5$. X and Y are independent random variables with Var(X) = 1 and Var(Y) = 2.

Calculate Var(Z).

(A) 1
(B) 5
(C) 7
(D) 11
(E) 16

78. A company has two electric generators. The time until failure for each generator follows an exponential distribution with mean 10. The company will begin using the second generator immediately after the first one fails.

Calculate the variance of the total time that the generators produce electricity.

(A) 10
(B) 20
(C) 50
(D) 100
(E) 200

79. In a small metropolitan area, annual losses due to storm, fire, and theft are assumed to be mutually independent, exponentially distributed random variables with respective means 1.0, 1.5, and 2.4.

Calculate the probability that the maximum of these losses exceeds 3.

(A) 0.002
(B) 0.050
(C) 0.159
(D) 0.287
(E) 0.414

80. Let X denote the size of a surgical claim and let Y denote the size of the associated hospital claim. An actuary is using a model in which
$E(X) = 5, E(X^2) = 27.4, E(Y) = 7, E(Y^2) = 51.4, Var(X+Y) = 8.$

Let $C_1 = X + Y$ denote the size of the combined claims before the application of a 20% surcharge on the hospital portion of the claim, and let C_2 denote the size of the combined claims after the application of that surcharge.

Calculate $Cov(C_1, C_2)$.

(A) 8.80
(B) 9.60
(C) 9.76
(D) 11.52
(E) 12.32

81. Two life insurance policies, each with a death benefit of 10,000 and a one-time premium of 500, are sold to a married couple, one for each person. The policies will expire at the end of the tenth year. The probability that only the wife will survive at least ten years is 0.025, the probability that only the husband will survive at least ten years is 0.01, and the probability that both of them will survive at least ten years is 0.96.

Calculate the expected excess of premiums over claims, given that the husband survives at least ten years.

(A) 350
(B) 385
(C) 397
(D) 870
(E) 897

82. A diagnostic test for the presence of a disease has two possible outcomes: 1 for disease present and 0 for disease not present. Let X denote the disease state (0 or 1) of a patient, and let Y denote the outcome of the diagnostic test. The joint probability function of X and Y is given by:

$$P[X = 0, Y = 0] = 0.800$$
$$P[X = 1, Y = 0] = 0.050$$
$$P[X = 0, Y = 1] = 0.025$$
$$P[X = 1, Y = 1] = 0.125$$

Calculate $\mathrm{Var}(Y \mid X = 1)$.

(A) 0.13
(B) 0.15
(C) 0.20
(D) 0.51
(E) 0.71

83. An actuary determines that the annual number of tornadoes in counties P and Q are jointly distributed as follows:

		Annual number of tornadoes in county Q			
		0	1	2	3
Annual number	0	0.12	0.06	0.05	0.02
of tornadoes	1	0.13	0.15	0.12	0.03
in county P	2	0.05	0.15	0.10	0.02

Calculate the conditional variance of the annual number of tornadoes in county Q, given that there are no tornadoes in county P.

(A) 0.51
(B) 0.84
(C) 0.88
(D) 0.99
(E) 1.76

84. You are given the following information about N, the annual number of claims for a randomly selected insured:

$$P(N = 0) = \frac{1}{2}, \quad P(N = 1) = \frac{1}{3}, \quad P(N > 1) = \frac{1}{6}.$$

Let S denote the total annual claim amount for an insured. When $N = 1$, S is exponentially distributed with mean 5. When $N > 1$, S is exponentially distributed with mean 8.

Calculate P(4 < S < 8).

(A) 0.04
(B) 0.08
(C) 0.12
(D) 0.24
(E) 0.25

85. Under an insurance policy, a maximum of five claims may be filed per year by a policyholder. Let $p(n)$ be the probability that a policyholder files n claims during a given year, where n = 0,1,2,3,4,5. An actuary makes the following observations:

i) $p(n) \geq p(n+1)$ for $n = 0, 1, 2, 3, 4$.
ii) The difference between $p(n)$ and $p(n+1)$ is the same for n = 0,1,2,3,4.
iii) Exactly 40% of policyholders file fewer than two claims during a given year.

Calculate the probability that a random policyholder will file more than three claims during a given year.

(A) 0.14
(B) 0.16
(C) 0.27
(D) 0.29
(E) 0.33

86. The amounts of automobile losses reported to an insurance company are mutually independent, and each loss is uniformly distributed between 0 and 20,000. The company covers each such loss subject to a deductible of 5,000.

Calculate the probability that the total payout on 200 reported losses is between 1,000,000 and 1,200,000.

(A) 0.0803
(B) 0.1051
(C) 0.1799
(D) 0.8201
(E) 0.8575

87. An insurance agent offers his clients auto insurance, homeowners insurance and renters insurance. The purchase of homeowners insurance and the purchase of renters insurance are mutually exclusive. The profile of the agent's clients is as follows:

i) 17% of the clients have none of these three products.
ii) 64% of the clients have auto insurance.
iii) Twice as many of the clients have homeowners insurance as have renters insurance.
iv) 35% of the clients have two of these three products.
v) 11% of the clients have homeowners insurance, but not auto insurance.

Calculate the percentage of the agent's clients that have both auto and renters insurance.

(A) 7%
(B) 10%
(C) 16%
(D) 25%
(E) 28%

88. The cumulative distribution function for health care costs experienced by a policyholder is modeled by the function

$$F(x) = \begin{cases} 1 - e^{-\frac{x}{100}}, & x > 0 \\ 0, & \text{otherwise.} \end{cases}$$

The policy has a deductible of 20. An insurer reimburses the policyholder for 100% of health care costs between 20 and 120. Health care costs above 120 are reimbursed at 50%.

Let *G* be the cumulative distribution function of reimbursements given that the reimbursement is positive.

Calculate *G*(115).

(A) 0.683
(B) 0.727
(C) 0.741
(D) 0.757
(E) 0.777

89. Let N_1 and N_2 represent the numbers of claims submitted to a life insurance company in April and May, respectively. The joint probability function of N_1 and N_2 is

$$p(n_1, n_2) = \begin{cases} \frac{3}{4}\left(\frac{1}{4}\right)^{n_1 - 1} e^{-n_1}\left(1 - e^{-n_1}\right)^{n_2 - 1}, & n_1 = 1, 2, 3, \ldots, \ n_2 = 1, 2, 3, \ldots \\ 0, & \text{otherwise.} \end{cases}$$

Calculate the expected number of claims that will be submitted to the company in May, given that exactly 2 claims were submitted in April.

(A) $\frac{3}{16}\left(e^2 - 1\right)$
(B) $\frac{3}{16}e^2$
(C) $\frac{3e}{4 - e}$
(D) $e^2 - 1$
(E) e^2

90. A store has 80 modems in its inventory, 30 coming from Source A and the remainder from Source B. Of the modems in inventory from Source A, 20% are defective. Of the modems in inventory from Source B, 8% are defective.

Calculate the probability that exactly two out of a sample of five modems selected without replacement from the store's inventory are defective.

(A) 0.010
(B) 0.078
(C) 0.102
(D) 0.105
(E) 0.125

91. A man purchases a life insurance policy on his 40th birthday. The policy will pay 5000 if he dies before his 50th birthday and will pay 0 otherwise. The length of lifetime, in years from birth, of a male born the same year as the insured has the cumulative distribution function

$$F(t) = \begin{cases} 0, & t \le 0 \\ 1 - \exp\left(\dfrac{1 - 1.1^t}{1000}\right), & t > 0. \end{cases}$$

Calculate the expected payment under this policy.

(A) 333
(B) 348
(C) 421
(D) 549
(E) 574

92. A mattress store sells only king, queen and twin-size mattresses. Sales records at the store indicate that the number of queen-size mattresses sold is one-fourth the number of king and twin-size mattresses combined. Records also indicate that three times as many king-size mattresses are sold as twin-size mattresses.

Calculate the probability that the next mattress sold is either king or queen-size.

(A) 0.12
(B) 0.15
(C) 0.80
(D) 0.85
(E) 0.95

93. The number of workplace injuries, N, occurring in a factory on any given day is Poisson distributed with mean λ. The parameter λ is a random variable that is determined by the level of activity in the factory, and is uniformly distributed on the interval [0, 3].

Calculate Var(N).

(A) λ
(B) 2λ
(C) 0.75
(D) 1.50
(E) 2.25

94. A fair die is rolled repeatedly. Let X be the number of rolls needed to obtain a 5 and Y the number of rolls needed to obtain a 6.

Calculate $E(X \mid Y = 2)$.

(A) 5.0
(B) 5.2
(C) 6.0
(D) 6.6
(E) 6.8

95. A driver and a passenger are in a car accident. Each of them independently has probability 0.3 of being hospitalized. When a hospitalization occurs, the loss is uniformly distributed on [0, 1]. When two hospitalizations occur, the losses are independent.

Calculate the expected number of people in the car who are hospitalized, given that the total loss due to hospitalizations from the accident is less than 1.

(A) 0.510
(B) 0.534
(C) 0.600
(D) 0.628
(E) 0.800

96. Each time a hurricane arrives, a new home has a 0.4 probability of experiencing damage. The occurrences of damage in different hurricanes are mutually independent.

Calculate the mode of the number of hurricanes it takes for the home to experience damage from two hurricanes.

(A) 2
(B) 3
(C) 4
(D) 5
(E) 6

97. Thirty items are arranged in a 6-by-5 array as shown.

A_1	A_2	A_3	A_4	A_5
A_6	A_7	A_8	A_9	A_{10}
A_{11}	A_{12}	A_{13}	A_{14}	A_{15}
A_{16}	A_{17}	A_{18}	A_{19}	A_{20}
A_{21}	A_{22}	A_{23}	A_{24}	A_{25}
A_{26}	A_{27}	A_{28}	A_{29}	A_{30}

Calculate the number of ways to form a set of three distinct items such that no two of the selected items are in the same row or same column.

(A) 200
(B) 760
(C) 1200
(D) 4560
(E) 7200

98. An auto insurance company is implementing a new bonus system. In each month, if a policyholder does not have an accident, he or she will receive a cash-back bonus of 5 from the insurer.

Among the 1,000 policyholders of the auto insurance company, 400 are classified as low-risk drivers and 600 are classified as high-risk drivers.

In each month, the probability of zero accidents for high-risk drivers is 0.80 and the probability of zero accidents for low-risk drivers is 0.90.

Calculate the expected bonus payment from the insurer to the 1000 policyholders in one year.

(A) 48,000
(B) 50,400
(C) 51,000
(D) 54,000
(E) 60,000

99. The probability that a member of a certain class of homeowners with liability and property coverage will file a liability claim is 0.04, and the probability that a member of this class will file a property claim is 0.10. The probability that a member of this class will file a liability claim but not a property claim is 0.01.

Calculate the probability that a randomly selected member of this class of homeowners will not file a claim of either type.

(A) 0.850
(B) 0.860
(C) 0.864
(D) 0.870
(E) 0.890

100. A survey of 100 TV viewers revealed that over the last year:

i) 34 watched CBS.
ii) 15 watched NBC.
iii) 10 watched ABC.
iv) 7 watched CBS and NBC.
v) 6 watched CBS and ABC.
vi) 5 watched NBC and ABC.
vii) 4 watched CBS, NBC, and ABC.
viii) 18 watched HGTV, and of these, none watched CBS, NBC, or ABC.

Calculate how many of the 100 TV viewers did not watch any of the four channels (CBS, NBC, ABC or HGTV).

(A) 1
(B) 37
(C) 45
(D) 55
(E) 82

101. The amount of a claim that a car insurance company pays out follows an exponential distribution. By imposing a deductible of *d*, the insurance company reduces the expected claim payment by 10%.

Calculate the percentage reduction on the variance of the claim payment.

(A) 1%
(B) 5%
(C) 10%
(D) 20%
(E) 25%

102. The number of hurricanes that will hit a certain house in the next ten years is Poisson distributed with mean 4.

Each hurricane results in a loss that is exponentially distributed with mean 1000. Losses are mutually independent and independent of the number of hurricanes.

Calculate the variance of the total loss due to hurricanes hitting this house in the next ten years.

(A) 4,000,000
(B) 4,004,000
(C) 8,000,000
(D) 16,000,000
(E) 20,000,000

103. A motorist makes three driving errors, each independently resulting in an accident with probability 0.25.

Each accident results in a loss that is exponentially distributed with mean 0.80. Losses are mutually independent and independent of the number of accidents.

The motorist's insurer reimburses 70% of each loss due to an accident.

Calculate the variance of the total unreimbursed loss the motorist experiences due to accidents resulting from these driving errors.

(A) 0.0432
(B) 0.0756
(C) 0.1782
(D) 0.2520
(E) 0.4116

104. An automobile insurance company issues a one-year policy with a deductible of 500. The probability is 0.8 that the insured automobile has no accident and 0.0 that the automobile has more than one accident. If there is an accident, the loss before application of the deductible is exponentially distributed with mean 3000.

Calculate the 95th percentile of the insurance company payout on this policy.

(A) 3466
(B) 3659
(C) 4159
(D) 8487
(E) 8987

105. From 27 pieces of luggage, an airline luggage handler damages a random sample of four.

The probability that exactly one of the damaged pieces of luggage is insured is twice the probability that none of the damaged pieces are insured.

Calculate the probability that exactly two of the four damaged pieces are insured.

(A) 0.06
(B) 0.13
(C) 0.27
(D) 0.30
(E) 0.31

106. Automobile policies are separated into two groups: low-risk and high-risk. Actuary Rahul examines low-risk policies, continuing until a policy with a claim is found and then stopping. Actuary Toby follows the same procedure with high-risk policies. Each low-risk policy has a 10% probability of having a claim. Each high-risk policy has a 20% probability of having a claim. The claim statuses of polices are mutually independent.

Calculate the probability that Actuary Rahul examines fewer policies than Actuary Toby.

(A) 0.2857
(B) 0.3214
(C) 0.3333
(D) 0.3571
(E) 0.4000

107. Let X represent the number of customers arriving during the morning hours and let Y represent the number of customers arriving during the afternoon hours at a diner.
You are given:

i) X and Y are Poisson distributed.
ii) The first moment of X is less than the first moment of Y by 8.
iii) The second moment of X is 60% of the second moment of Y.

Calculate the variance of Y.

(A) 4
(B) 12
(C) 16
(D) 27
(E) 35

108. In a certain game of chance, a square board with area 1 is colored with sectors of either red or blue. A player, who cannot see the board, must specify a point on the board by giving an *x*-coordinate and a *y*-coordinate. The player wins the game if the specified point is in a blue sector. The game can be arranged with any number of red sectors, and the red sectors are designed so that

$R_i = \left(\frac{9}{20}\right)^i$, where R_i is the area of the i^{th} red sector.

Calculate the minimum number of red sectors that makes the chance of a player winning less than 20%.

(A) 3
(B) 4
(C) 5
(D) 6
(E) 7

109. Automobile claim amounts are modeled by a uniform distribution on the interval [0, 10,000]. Actuary A reports *X*, the claim amount divided by 1000. Actuary B reports *Y*, which is *X* rounded to the nearest integer from 0 to 10.

Calculate the absolute value of the difference between the 4^{th} moment of *X* and the 4^{th} moment of *Y*.

(A) 0
(B) 33
(C) 296
(D) 303
(E) 533

110. The probability of x losses occurring in year 1 is $(0.5)^{x+1}$ for $x = 0, 1, 2, \ldots$.

The probability of y losses in year 2 given x losses in year 1 is given by the table:

Number of losses in year 1 (x)	Number of losses in year 2 (y) given x losses in year 1				
	0	1	2	3	4+
0	0.60	0.25	0.05	0.05	0.05
1	0.45	0.30	0.10	0.10	0.05
2	0.25	0.30	0.20	0.20	0.05
3	0.15	0.20	0.20	0.30	0.15
4+	0.05	0.15	0.25	0.35	0.20

Calculate the probability of exactly 2 losses in 2 years.

(A) 0.025
(B) 0.031
(C) 0.075
(D) 0.100
(E) 0.131

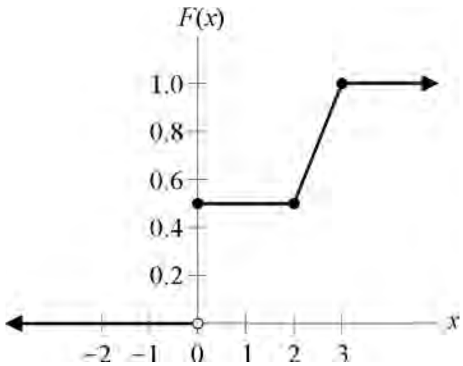
111. Let X be a continuous random variable with density function

$$f(x) = \begin{cases} \dfrac{p-1}{x^p}, & x > 1 \\ 0, & \text{otherwise} \end{cases}$$

Calculate the value of p such that $E(X) = 2$.

(A) 1
(B) 2.5
(C) 3
(D) 5
(E) There is no such p.

112. The figure below shows the cumulative distribution function of a random variable, X.



Calculate $E(X)$.

(A) 0.00
(B) 0.50
(C) 1.00
(D) 1.25
(E) 2.50

113. Two fair dice are rolled. Let X be the absolute value of the difference between the two numbers on the dice.

Calculate the probability that $X < 3$.

(A) 2/9
(B) 1/3
(C) 4/9
(D) 5/9
(E) 2/3

114. An actuary analyzes a company's annual personal auto claims, M, and annual commercial auto claims, N. The analysis reveals that Var(M) = 1600, Var(N) = 900, and the correlation between M and N is 0.64.

Calculate Var($M + N$).

(A) 768
(B) 2500
(C) 3268
(D) 4036
(E) 4420

115. An auto insurance policy has a deductible of 1 and a maximum claim payment of 5. Auto loss amounts follow an exponential distribution with mean 2.

Calculate the expected claim payment made for an auto loss.

(A) $0.5e^{-2} - 0.5e^{-12}$

(B) $2e^{-\frac{1}{2}} - 7e^{-3}$

(C) $2e^{-\frac{1}{2}} - 2e^{-3}$

(D) $2e^{-\frac{1}{2}}$

(E) $3e^{-\frac{1}{2}} - 2e^{-3}$

116. A student takes a multiple-choice test with 40 questions. The probability that the student answers a given question correctly is 0.5, independent of all other questions. The probability that the student answers more than N questions correctly is greater than 0.10. The probability that the student answers more than N + 1 questions correctly is less than 0.10.

Calculate N using a normal approximation with the continuity correction.

(A) 23
(B) 25
(C) 32
(D) 33
(E) 35

117. In each of the months June, July, and August, the number of accidents occurring in that month is modeled by a Poisson random variable with mean 1. In each of the other 9 months of the year, the number of accidents occurring is modeled by a Poisson random variable with mean 0.5. Assume that these 12 random variables are mutually independent.

Calculate the probability that exactly two accidents occur in July through November.

(A) 0.084
(B) 0.185
(C) 0.251
(D) 0.257
(E) 0.271

118. An airport purchases an insurance policy to offset costs associated with excessive amounts of snowfall. For every full ten inches of snow in excess of 40 inches during the winter season, the insurer pays the airport 300 up to a policy maximum of 700.

The following table shows the probability function for the random variable *X* of annual (winter season) snowfall, in inches, at the airport.

Inches	[0,20)	[20,30)	[30,40)	[40,50)	[50,60)	[60,70)	[70,80)	[80,90)	[90,inf)
Probability	0.06	0.18	0.26	0.22	0.14	0.06	0.04	0.04	0.00

Calculate the standard deviation of the amount paid under the policy.

(A) 134
(B) 235
(C) 271
(D) 313
(E) 352

119. Damages to a car in a crash are modeled by a random variable with density function

$$f(x)=\begin{cases} c(x^2-60x+800), & 0<x<20 \\ 0, & \text{otherwise} \end{cases}$$

where c is a constant.

A particular car is insured with a deductible of 2. This car was involved in a crash with resulting damages in excess of the deductible.

Calculate the probability that the damages exceeded 10.

(A) 0.12
(B) 0.16
(C) 0.20
(D) 0.26
(E) 0.78

120. Two fair dice, one red and one blue, are rolled.

Let A be the event that the number rolled on the red die is odd.
Let B be the event that the number rolled on the blue die is odd.
Let C be the event that the sum of the numbers rolled on the two dice is odd.

Determine which of the following is true.

(A) A, B, and C are not mutually independent, but each pair is independent.
(B) A, B, and C are mutually independent.
(C) Exactly one pair of the three events is independent.
(D) Exactly two of the three pairs are independent.
(E) No pair of the three events is independent.

121. An urn contains four fair dice. Two have faces numbered 1, 2, 3, 4, 5, and 6; one has faces numbered 2, 2, 4, 4, 6, and 6; and one has all six faces numbered 6. One of the dice is randomly selected from the urn and rolled. The same die is rolled a second time.

Calculate the probability that a 6 is rolled both times.

(A) 0.174
(B) 0.250
(C) 0.292
(D) 0.380
(E) 0.417

122. An insurance agent meets twelve potential customers independently, each of whom is equally likely to purchase an insurance product. Six are interested only in auto insurance, four are interested only in homeowners insurance, and two are interested only in life insurance.

The agent makes six sales.

Calculate the probability that two are for auto insurance, two are for homeowners insurance, and two are for life insurance.

(A) 0.001
(B) 0.024
(C) 0.069
(D) 0.097
(E) 0.500

123. A policyholder has probability 0.7 of having no claims, 0.2 of having exactly one claim, and 0.1 of having exactly two claims. Claim amounts are uniformly distributed on the interval [0, 60] and are independent. The insurer covers 100% of each claim.

Calculate the probability that the total benefit paid to the policyholder is 48 or less.

(A) 0.320
(B) 0.400
(C) 0.800
(D) 0.892
(E) 0.924

124. In a given region, the number of tornadoes in a one-week period is modeled by a Poisson distribution with mean 2. The numbers of tornadoes in different weeks are mutually independent.

Calculate the probability that fewer than four tornadoes occur in a three-week period.

(A) 0.13
(B) 0.15
(C) 0.29
(D) 0.43
(E) 0.86

125. An electronic system contains three cooling components that operate independently. The probability of each component's failure is 0.05. The system will overheat if and only if at least two components fail.

Calculate the probability that the system will overheat.

(A) 0.007
(B) 0.045
(C) 0.098
(D) 0.135
(E) 0.143

126. An insurance company's annual profit is normally distributed with mean 100 and variance 400.

Let Z be normally distributed with mean 0 and variance 1 and let F be the cumulative distribution function of Z.

Determine the probability that the company's profit in a year is at most 60, given that the profit in the year is positive.

(A) $1 - F(2)$

(B) $F(2)/F(5)$

(C) $[1 - F(2)]/F(5)$

(D) $[F(0.25) - F(0.1)]/F(0.25)$

(E) $[F(5) - F(2)]/F(5)$

127. In a group of health insurance policyholders, 20% have high blood pressure and 30% have high cholesterol. Of the policyholders with high blood pressure, 25% have high cholesterol.

A policyholder is randomly selected from the group.

Calculate the probability that a policyholder has high blood pressure, given that the policyholder has high cholesterol.

(A) 1/6
(B) 1/5
(C) 1/4
(D) 2/3
(E) 5/6

128. In a group of 25 factory workers, 20 are low-risk and five are high-risk.

Two of the 25 factory workers are randomly selected without replacement.

Calculate the probability that exactly one of the two selected factory workers is low-risk.

(A) 0.160
(B) 0.167
(C) 0.320
(D) 0.333
(E) 0.633

129. The proportion *X* of yearly dental claims that exceed 200 is a random variable with probability density function

$$f(x) = \begin{cases} 60x^3(1-x)^2, & 0 < x < 1 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate Var[$X/(1-X)$]

(A) 149/900
(B) 10/7
(C) 6
(D) 8
(E) 10

130. This year, a medical insurance policyholder has probability 0.70 of having no emergency room visits, 0.85 of having no hospital stays, and 0.61 of having neither emergency room visits nor hospital stays

Calculate the probability that the policyholder has at least one emergency room visit and at least one hospital stay this year.

(A) 0.045
(B) 0.060
(C) 0.390
(D) 0.667
(E) 0.840

131. An insurer offers a travelers insurance policy. Losses under the policy are uniformly distributed on the interval [0, 5].

The insurer reimburses a policyholder for a loss up to a maximum of 4.

Determine the cumulative distribution function, *F*, of the benefit that the insurer pays a policyholder who experiences exactly one loss under the policy.

(A) $F(x)=\begin{cases} 0, & x<0 \\ 0.20x, & 0\le x<4 \\ 1 & x\ge 4 \end{cases}$

(B) $F(x)=\begin{cases} 0, & x<0 \\ 0.20x, & 0\le x<5 \\ 1 & x\ge 5 \end{cases}$

(C) $F(x)=\begin{cases} 0, & x<0 \\ 0.25x, & 0\le x<4 \\ 1 & x\ge 4 \end{cases}$

(D) $F(x)=\begin{cases} 0, & x<0 \\ 0.25x, & 0\le x<5 \\ 1 & x\ge 5 \end{cases}$

(E) $F(x)=\begin{cases} 0, & x<1 \\ 0.25x, & 1\le x<5 \\ 1 & x\ge 5 \end{cases}$

132. A company issues auto insurance policies. There are 900 insured individuals. Fifty-four percent of them are male. If a female is randomly selected from the 900, the probability she is over 25 years old is 0.43. There are 395 total insured individuals over 25 years old.

A person under 25 years old is randomly selected.

Calculate the probability that the person selected is male.

(A) 0.47
(B) 0.53
(C) 0.54
(D) 0.55
(E) 0.56

133. An insurance company insures red and green cars. An actuary compiles the following data:

Color of car	Red	Green
Number insured	300	700
Probability an accident occurs	0.10	0.05
Probability that the claim exceeds the deductible, given an accident occurs from this group	0.90	0.80

The actuary randomly picks a claim from all claims that exceed the deductible.

Calculate the probability that the claim is on a red car.

(A) 0.300
(B) 0.462
(C) 0.491
(D) 0.667
(E) 0.692

134. George and Paul play a betting game. Each chooses an integer from 1 to 20 (inclusive) at random. If the two numbers differ by more than 3, George wins the bet. Otherwise, Paul wins the bet.

Calculate the probability that Paul wins the bet.

(A) 0.27
(B) 0.32
(C) 0.40
(D) 0.48
(E) 0.66

135. A student takes an examination consisting of 20 true-false questions. The student knows the answer to N of the questions, which are answered correctly, and guesses the answers to the rest. The conditional probability that the student knows the answer to a question, given that the student answered it correctly, is 0.824..

Calculate N.

(A) 8
(B) 10
(C) 14
(D) 16
(E) 18

136. The minimum force required to break a particular type of cable is normally distributed with mean 12,432 and standard deviation 25. A random sample of 400 cables of this type is selected.

Calculate the probability that at least 349 of the selected cables will not break under a force of 12,400.

(A) 0.62
(B) 0.67
(C) 0.92
(D) 0.97
(E) 1.00

137. The number of policies that an agent sells has a Poisson distribution with modes at 2 and 3.

K is the smallest number such that the probability of selling more than K policies is less than 25%.

Calculate K.

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

138. Two fair dice are tossed. One die is red and one die is green.

Calculate the probability that the sum of the numbers on the two dice is an odd number given that the number that shows on the red die is larger than the number that shows on the green die.

(A) 1/4
(B) 5/12
(C) 3/7
(D) 1/2
(E) 3/5

139. In 1982 Abby's mother scored at the 93rd percentile in the math SAT exam. In 1982 the mean score was 503 and the variance of the scores was 9604.

In 2008 Abby took the math SAT and got the same numerical score as her mother had received 26 years before. In 2008 the mean score was 521 and the variance of the scores was 10,201.

Math SAT scores are normally distributed and stated in multiples of ten.

Calculate the percentile for Abby's score.

(A) 89th
(B) 90th
(C) 91st
(D) 92nd
(E) 93rd

140. A certain brand of refrigerator has a useful life that is normally distributed with mean 10 years and standard deviation 3 years. The useful lives of these refrigerators are independent.

Calculate the probability that the total useful life of two randomly selected refrigerators will exceed 1.9 times the useful life of a third randomly selected refrigerator.

(A) 0.407
(B) 0.444
(C) 0.556
(D) 0.593
(E) 0.604

141. Losses covered by a flood insurance policy are uniformly distributed on the interval [0, 2]. The insurer pays the amount of the loss in excess of a deductible d.

The probability that the insurer pays at least 1.20 on a random loss is 0.30.

Calculate the probability that the insurer pays at least 1.44 on a random loss.

(A) 0.06
(B) 0.16
(C) 0.18
(D) 0.20
(E) 0.28

142. The lifespan, in years, of a certain computer is exponentially distributed. The probability that its lifespan exceeds four years is 0.30.

Let $f(x)$ represent the density function of the computer's lifespan, in years, for $x > 0$.

Determine which of the following is an expression for $f(x)$.

(A) $1-(0.3)^{-x/4}$

(B) $1-(0.7)^{x/4}$

(C) $1-(0.3)^{x/4}$

(D) $-\dfrac{\ln 0.7}{4}(0.7)^{x/4}$

(E) $-\dfrac{\ln 0.3}{4}(0.3)^{x/4}$

143. The lifetime of a light bulb has density function, f, where $f(x)$ is proportional to

$$\frac{x^2}{1+x^3}, \quad 0 < x < 5, \text{ and } 0, \text{ otherwise.}$$

Calculate the mode of this distribution.

(A) 0.00
(B) 0.79
(C) 1.26
(D) 4.42
(E) 5.00

144. An insurer's medical reimbursements have density function *f*, where *f*(*x*) is proportional to

xe^{-x^2}, for $0 < x < 1$, and 0, otherwise.

Calculate the mode of the medical reimbursements.

(A) 0.00
(B) 0.50
(C) 0.71
(D) 0.84
(E) 1.00

145. A company has five employees on its health insurance plan. Each year, each employee independently has an 80% probability of no hospital admissions. If an employee requires one or more hospital admissions, the number of admissions is modeled by a geometric distribution with a mean of 1.50. The numbers of hospital admissions of different employees are mutually independent.

Each hospital admission costs 20,000.

Calculate the probability that the company's total hospital costs in a year are less than 50,000.

(A) 0.41
(B) 0.46
(C) 0.58
(D) 0.69
(E) 0.78

146. On any given day, a certain machine has either no malfunctions or exactly one malfunction. The probability of malfunction on any given day is 0.40. Machine malfunctions on different days are mutually independent.

Calculate the probability that the machine has its third malfunction on the fifth day, given that the machine has not had three malfunctions in the first three days.

(A) 0.064
(B) 0.138
(C) 0.148
(D 0.230
(E) 0.246

147. In a certain group of cancer patients, each patient's cancer is classified in exactly one of the following five stages: stage 0, stage 1, stage 2, stage 3, or stage 4.

i) 75% of the patients in the group have stage 2 or lower.
ii) 80% of the patients in the group have stage 1 or higher.
iii) 80% of the patients in the group have stage 0, 1, 3, or 4.

One patient from the group is randomly selected.

Calculate the probability that the selected patient's cancer is stage 1.

(A) 0.20
(B) 0.25
(C) 0.35
(D) 0.48
(E) 0.65

148. A car is new at the beginning of a calendar year. The time, in years, before the car experiences its first failure is exponentially distributed with mean 2.

Calculate the probability that the car experiences its first failure in the last quarter of some calendar year.

(A) 0.081
(B) 0.088
(C) 0.102
(D) 0.205
(E) 0.250

149. In a shipment of 20 packages, 7 packages are damaged. The packages are randomly inspected, one at a time, without replacement, until the fourth damaged package is discovered.

Calculate the probability that exactly 12 packages are inspected.

(A) 0.079
(B) 0.119
(C) 0.237
(D) 0.243
(E) 0.358

150. A theme park conducts a study of families that visit the park during a year. The fraction of such families of size m is $\frac{8-m}{28}$, m = 1, 2, 3, 4, 5, 6, and 7.

For a family of size m that visits the park, the number of members of the family that ride the roller coaster follows a discrete uniform distribution on the set $\{1, \ldots, m\}$.

Calculate the probability that a family visiting the park has exactly six members, given that exactly five members of the family ride the roller coaster.

(A) 0.17
(B) 0.21
(C) 0.24
(D) 0.28
(E) 0.31

151. The following information is given about a group of high-risk borrowers.

i) Of all these borrowers, 30% defaulted on at least one student loan.
ii) Of the borrowers who defaulted on at least one car loan, 40% defaulted on at least one student loan.
iii) Of the borrowers who did not default on any student loans, 28% defaulted on at least one car loan.

A statistician randomly selects a borrower from this group and observes that the selected borrower defaulted on at least one student loan.

Calculate the probability that the selected borrower defaulted on at least one car loan.

(A) 0.33
(B) 0.40
(C) 0.44
(D) 0.65
(E) 0.72

152. An insurance company issues policies covering damage to automobiles. The amount of damage is modeled by a uniform distribution on $[0, b]$.

The policy payout is subject to a deductible of $b/10$.

A policyholder experiences automobile damage.

Calculate the ratio of the standard deviation of the policy payout to the standard deviation of the amount of the damage.

(A) 0.8100
(B) 0.9000
(C) 0.9477
(D) 0.9487
(E) 0.9735

153. A policyholder purchases automobile insurance for two years. Define the following events:

F = the policyholder has exactly one accident in year one.
G = the policyholder has one or more accidents in year two.

Define the following events:

i) The policyholder has exactly one accident in year one and has more than one accident in year two.
ii) The policyholder has at least two accidents during the two-year period.
iii) The policyholder has exactly one accident in year one and has at least one accident in year two.
iv) The policyholder has exactly one accident in year one and has a total of two or more accidents in the two-year period.
v) The policyholder has exactly one accident in year one and has more accidents in year two than in year one.

Determine the number of events from the above list of five that are the same as $F \cap G$.

(A) None
(B) Exactly one
(C) Exactly two
(D) Exactly three
(E) All

154. An insurance company categorizes its policyholders into three mutually exclusive groups: high-risk, medium-risk, and low-risk. An internal study of the company showed that 45% of the policyholders are low-risk and 35% are medium-risk. The probability of death over the next year, given that a policyholder is high-risk is two times the probability of death of a medium-risk policyholder. The probability of death over the next year, given that a policyholder is medium-risk is three times the probability of death of a low-risk policyholder. The probability of death of a randomly selected policyholder, over the next year, is 0.009.

Calculate the probability of death of a policyholder over the next year, given that the policyholder is high-risk.

(A) 0.0025
(B) 0.0200
(C) 0.1215
(D) 0.2000
(E) 0.3750

155. A policy covers a gas furnace for one year. During that year, only one of three problems can occur:

i) The igniter switch may need to be replaced at a cost of 60. There is a 0.10 probability of this.
ii) The pilot light may need to be replaced at a cost of 200. There is a 0.05 probability of this.
iii) The furnace may need to be replaced at a cost of 3000. There is a 0.01 probability of this.

Calculate the deductible that would produce an expected claim payment of 30.

(A) 100
(B) At least 100 but less than 150
(C) At least 150 but less than 200
(D) At least 200 but less than 250
(E) At least 250

156. On a block of ten houses, k are not insured. A tornado randomly damages three houses on the block.

The probability that none of the damaged houses are insured is 1/120.

Calculate the probability that at most one of the damaged houses is insured.

(A) 1/5
(B) 7/40
(C) 11/60
(D) 49/60
(E) 119/120

157. In a casino game, a gambler selects four different numbers from the first twelve positive integers. The casino then randomly draws nine numbers without replacement from the first twelve positive integers. The gambler wins the jackpot if the casino draws all four of the gambler's selected numbers.

Calculate the probability that the gambler wins the jackpot.

(A) 0.002
(B) 0.255
(C) 0.296
(D) 0.573
(E) 0.625

158. The number of days an employee is sick each month is modeled by a Poisson distribution with mean 1. The numbers of sick days in different months are mutually independent.

Calculate the probability that an employee is sick more than two days in a three-month period.

(A) 0.199
(B) 0.224
(C) 0.423
(D) 0.577
(E) 0.801

159. The number of traffic accidents per week at intersection Q has a Poisson distribution with mean 3. The number of traffic accidents per week at intersection R has a Poisson distribution with mean 1.5.

Let A be the probability that the number of accidents at intersection Q exceeds its mean. Let B be the corresponding probability for intersection R.

Calculate $B – A$.

(A) 0.00
(B) 0.09
(C) 0.13
(D) 0.19
(E) 0.31

160. Losses due to accidents at an amusement park are exponentially distributed. An insurance company offers the park owner two different policies, with different premiums, to insure against losses due to accidents at the park.

Policy A has a deductible of 1.44. For a random loss, the probability is 0.640 that under this policy, the insurer will pay some money to the park owner. Policy B has a deductible of d. For a random loss, the probability is 0.512 that under this policy, the insurer will pay some money to the park owner.

Calculate d.

(A) 0.960
(B) 1.152
(C) 1.728
(D) 1.800
(E) 2.160

161. The distribution of the size of claims paid under an insurance policy has probability density function

$$f(x) = \begin{cases} cx^a, & 0 < x < 5 \\ 0, & \text{otherwise,} \end{cases}$$

Where a >0 and c > 0.

For a randomly selected claim, the probability that the size of the claim is less than 3.75 is 0.4871.

Calculate the probability that the size of a randomly selected claim is greater than 4.

(A) 0.404
(B) 0.428
(C) 0.500
(D) 0.572
(E) 0.596

162. Company XYZ provides a warranty on a product that it produces. Each year, the number of warranty claims follows a Poisson distribution with mean c. The probability that no warranty claims are received in any given year is 0.60.

Company XYZ purchases an insurance policy that will reduce its overall warranty claim payment costs. The insurance policy will pay nothing for the first warranty claim received and 5000 for each claim thereafter until the end of the year.

Calculate the expected amount of annual insurance policy payments to Company XYZ.

(A) 554
(B) 872
(C) 1022
(D) 1354
(E) 1612

163. For a certain health insurance policy, losses are uniformly distributed on the interval $[0, b]$. The policy has a deductible of 180 and the expected value of the unreimbursed portion of a loss is 144.

Calculate b.

(A) 236
(B) 288
(C) 388
(D) 450
(E) 468

164. The working lifetime, in years, of a particular model of bread maker is normally distributed with mean 10 and variance 4.

Calculate the 12th percentile of the working lifetime, in years.

(A) 5.30
(B) 7.65
(C) 8.41
(D) 12.35
(E) 14.70

165. The profits of life insurance companies A and B are normally distributed with the same mean. The variance of company B's profit is 2.25 times the variance of company A's profit. The 14th percentile of company A's profit is the same as the pth percentile of company B's profit.

Calculate p.

(A) 5.3
(B) 9.3
(C) 21.0
(D) 23.6
(E) 31.6

166. The distribution of values of the retirement package offered by a company to new employees is modeled by the probability density function

$$f(x) = \begin{cases} \frac{1}{5} e^{-\frac{1}{5}(x-5)}, & x > 5 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate the variance of the retirement package value for a new employee, given that the value is at least 10.

(A) 15
(B) 20
(C) 25
(D) 30
(E) 35

167. Insurance companies A and B each earn an annual profit that is normally distributed with the same positive mean. The standard deviation of company A's annual profit is one half of its mean.

In a given year, the probability that company B has a loss (negative profit) is 0.9 times the probability that company A has a loss.

Calculate the ratio of the standard deviation of company B's annual profit to the standard deviation of company A's annual profit.

(A) 0.49
(B) 0.90
(C) 0.98
(D) 1.11
(E) 1.71

168. Claim amounts at an insurance company are independent of one another. In year one, claim amounts are modeled by a normal random variable X with mean 100 and standard deviation 25. In year two, claim amounts are modeled by the random variable $Y = 1.04X + 5$.

Calculate the probability that a random sample of 25 claim amounts in year two average between 100 and 110.

(A) 0.48
(B) 0.53
(C) 0.54
(D) 0.67
(E) 0.68

169. An insurance company will cover losses incurred from tornadoes in a single calendar year. However, the insurer will only cover losses for a maximum of three separate tornadoes during this timeframe. Let X be the number of tornadoes that result in at least 50 million in losses, and let Y be the total number of tornadoes. The joint probability function for X and Y is

$$p(x,y) = \begin{cases} c(x+2y), & \text{for } x = 0,1,2,3,\ y = 0,1,2,3,\ x \le y \\ 0, & \text{otherwise,} \end{cases}$$

where c is a constant.

Calculate the expected number of tornadoes that result in fewer than 50 million in losses.

(A) 0.19
(B) 0.28
(C) 0.76
(D) 1.00
(E) 1.10

170. At a polling booth, ballots are cast by ten voters, of whom three are Republicans, two are Democrats, and five are Independents. A local journalist interviews two of these voters, chosen randomly.

Calculate the expectation of the absolute value of the difference between the number of Republicans interviewed and the number of Democrats interviewed.

(A) 1/5
(B) 7/15
(C) 3/5
(D) 11/15
(E) 1

171. The random variables X and Y have joint probability function $p(x,y)$ for $x = 0,1$ and $y = 0,1,2$.

Suppose $3p(1,1) = p(1,2)$, and $p(1,1)$ maximizes the variance of XY.

Calculate the probability that X or Y is 0.

(A) 11/25
(B) 23/50
(C) 23/49
(D) 26/49
(E) 14/25

172. The number of severe storms that strike city J in a year follows a binomial distribution with $n = 5$ and $p = 0.6$. Given that m severe storms strike city J in a year, the number of severe storms that strike city K in the same year is m with probability 1/2, $m+1$ with probability 1/3, and $m+2$ with probability 1/6.

Calculate the expected number of severe storms that strike city J in a year during which 5 severe storms strike city K.

(A) 3.5
(B) 3.7
(C) 3.9
(D) 4.0
(E) 5.7

173. Let N denote the number of accidents occurring during one month on the northbound side of a highway and let S denote the number occurring on the southbound side.

Suppose that N and S are jointly distributed as indicated in the table.

$N \setminus S$	0	1	2	3 or more
0	0.04	0.06	0.10	0.04
1	0.10	0.18	0.08	0.03
2	0.12	0.06	0.05	0.02
3 or more	0.05	0.04	0.02	0.01

Calculate Var ($N \mid N + S = 2$).

(A) 0.48
(B) 0.55
(C) 0.67
(D) 0.91
(E) 1.25

174. An insurance company has an equal number of claims in each of three territories. In each territory, only three claim amounts are possible: 100, 500, and 1000. Based on the company's data, the probabilities of each claim amount are:

	Claim Amount		
	100	500	1000
Territory 1	0.90	0.08	0.02
Territory 2	0.80	0.11	0.09
Territory 3	0.70	0.20	0.10

Calculate the standard deviation of a randomly selected claim amount.

(A) 254
(B) 291
(C) 332
(D) 368
(E) 396

175. At the start of a week, a coal mine has a high-capacity storage bin that is half full. During the week, 20 loads of coal are added to the storage bin. Each load of coal has a volume that is normally distributed with mean 1.50 cubic yards and standard deviation 0.25 cubic yards.

During the same week, coal is removed from the storage bin and loaded into 4 railroad cars. The amount of coal loaded into each railroad car is normally distributed with mean 7.25 cubic yards and standard deviation 0.50 cubic yards.

The amounts added to the storage bin or removed from the storage bin are mutually independent.

Calculate the probability that the storage bin contains more coal at the end of the week than it had at the beginning of the week.

(A) 0.56
(B) 0.63
(C) 0.67
(D) 0.75
(E) 0.98

176. An insurance company insures a good driver and a bad driver on the same policy. The table below gives the probability of a given number of claims occurring for each of these drivers in the next ten years.

Number of claims	Probability for the good driver	Probability for the bad driver
0	0.5	0.2
1	0.3	0.3
2	0.2	0.4
3	0.0	0.1

The number of claims occurring for the two drivers are independent.

Calculate the mode of the distribution of the total number of claims occurring on this policy in the next ten years.

(A) 0
(B) 1
(C) 2
(D) 3
(E) 4

177. In a group of 15 health insurance policyholders diagnosed with cancer, each policyholder has probability 0.90 of receiving radiation and probability 0.40 of receiving chemotherapy. Radiation and chemotherapy treatments are independent events for each policyholder, and the treatments of different policyholders are mutually independent.

The policyholders in this group all have the same health insurance that pays 2 for radiation treatment and 3 for chemotherapy treatment.

Calculate the variance of the total amount the insurance company pays for the radiation and chemotherapy treatments for these 15 policyholders.

(A) 13.5
(B) 37.8
(C) 108.0
(D) 202.5
(E) 567.0

178. In a large population of patients, 20% have early stage cancer, 10% have advanced stage cancer, and the other 70% do not have cancer. Six patients from this population are randomly selected.

Calculate the expected number of selected patients with advanced stage cancer, given that at least one of the selected patients has early stage cancer.

(A) 0.403
(B) 0.500
(C) 0.547
(D) 0.600
(E) 0.625

179. Four distinct integers are chosen randomly and without replacement from the first twelve positive integers. Let X be the random variable representing the second largest of the four selected integers, and let p be the probability function for X.

Determine $p(x)$, for integer values of x, where $p(x) > 0$.

(A) $\dfrac{(x-1)(x-2)(12-x)}{990}$

(B) $\dfrac{(x-1)(x-2)(12-x)}{495}$

(C) $\dfrac{(x-1)(12-x)(11-x)}{495}$

(D) $\dfrac{(x-1)(12-x)(11-x)}{990}$

(E) $\dfrac{(10-x)(12-x)(11-x)}{990}$

180. An insurance policy covers losses incurred by a policyholder, subject to a deductible of 10,000. Incurred losses follow a normal distribution with mean 12,000 and standard deviation c. The probability that a loss is less than k is 0.9582, where k is a constant. Given that the loss exceeds the deductible, there is a probability of 0.9500 that it is less than k.

Calculate c.

(A) 2045
(B) 2267
(C) 2393
(D) 2505
(E) 2840

181. Losses covered by an insurance policy are modeled by a uniform distribution on the interval [0, 1000]. An insurance company reimburses losses in excess of a deductible of 250.

Calculate the difference between the median and the 20th percentile of the insurance company reimbursement, over all losses.

(A) 225
(B) 250
(C) 300
(D) 375
(E) 500

182. An insurance agent's files reveal the following facts about his policyholders:

i) 243 own auto insurance.
ii) 207 own homeowner insurance.
iii) 55 own life insurance and homeowner insurance.
iv) 96 own auto insurance and homeowner insurance.
v) 32 own life insurance, auto insurance and homeowner insurance.
vi) 76 more clients own only auto insurance than only life insurance.
vii) 270 own only one of these three insurance products.

Calculate the total number of the agent's policyholders who own at least one of these three insurance products.

(A) 389
(B) 407
(C) 423
(D) 448
(E) 483

183. A profile of the investments owned by an agent's clients follows:

i) 228 own annuities.
ii) 220 own mutual funds.
iii) 98 own life insurance and mutual funds.
iv) 93 own annuities and mutual funds.
v) 16 own annuities, mutual funds, and life insurance.
vi) 45 more clients own only life insurance than own only annuities.
vii) 290 own only one type of investment (i.e., annuity, mutual fund, or life insurance).

Calculate the agent's total number of clients.

(A) 455
(B) 495
(C) 496
(D) 500
(E) 516

184. An actuary compiles the following information from a portfolio of 1000 homeowners insurance policies:

i) 130 policies insure three-bedroom homes.
ii) 280 policies insure one-story homes.
iii) 150 policies insure two-bath homes.
iv) 30 policies insure three-bedroom, two-bath homes.
v) 50 policies insure one-story, two-bath homes.
vi) 40 policies insure three-bedroom, one-story homes.
vii) 10 policies insure three-bedroom, one-story, two-bath homes.

Calculate the number of homeowners policies in the portfolio that insure neither one-story nor two-bath nor three-bedroom homes.

(A) 310
(B) 450
(C) 530
(D) 550
(E) 570

185. Each week, a subcommittee of four individuals is formed from among the members of a committee comprising seven individuals. Two subcommittee members are then assigned to lead the subcommittee, one as chair and the other as secretary.

Calculate the maximum number of consecutive weeks that can elapse without having the subcommittee contain four individuals who have previously served together with the same subcommittee chair.

(A) 70
(B) 140
(C) 210
(D) 420
(E) 840

186. Bowl I contains eight red balls and six blue balls. Bowl II is empty. Four balls are selected at random, without replacement, and transferred from bowl I to bowl II. One ball is then selected at random from bowl II.

Calculate the conditional probability that two red balls and two blue balls were transferred from bowl I to bowl II, given that the ball selected from bowl II is blue.

(A) 0.21
(B) 0.24
(C) 0.43
(D) 0.49
(E) 0.57

187. An actuary has done an analysis of all policies that cover two cars. 70% of the policies are of type A for both cars, and 30% of the policies are of type B for both cars. The number of claims on different cars across all policies are mutually independent. The distributions of the number of claims on a car are given in the following table.

Number of Claims	Type A	Type B
0	40%	25%
1	30%	25%
2	20%	25%
3	10%	25%

Four policies are selected at random.

Calculate the probability that exactly one of the four policies has the same number of claims on both covered cars.

(A) 0.104
(B) 0.250
(C) 0.285
(D) 0.417
(E) 0.739

188. A company sells two types of life insurance policies (P and Q) and one type of health insurance policy. A survey of potential customers revealed the following:

i) No survey participant wanted to purchase both life policies.
ii) Twice as many survey participants wanted to purchase life policy P as life policy Q.
iii) 45% of survey participants wanted to purchase the health policy.
iv) 18% of survey participants wanted to purchase only the health policy.
v) The event that a survey participant wanted to purchase the health policy was independent of the event that a survey participant wanted to purchase a life policy.

Calculate the probability that a randomly selected survey participant wanted to purchase exactly one policy.

(A) 0.51
(B) 0.60
(C) 0.69
(D) 0.73
(E) 0.78

189. A state is starting a lottery game. To enter this lottery, a player uses a machine that randomly selects six distinct numbers from among the first 30 positive integers. The lottery randomly selects six distinct numbers from the same 30 positive integers. A winning entry must match the same set of six numbers that the lottery selected.

The entry fee is 1, each winning entry receives a prize amount of 500,000, and all other entries receive no prize.

Calculate the probability that the state will lose money, given that 800,000 entries are purchased.

(A) 0.33
(B) 0.39
(C) 0.61
(D) 0.67
(E) 0.74

190. A life insurance company has found there is a 3% probability that a randomly selected application contains an error. Assume applications are mutually independent in this respect.

An auditor randomly selects 100 applications.

Calculate the probability that 95% or less of the selected applications are error-free.

(A) 0.08
(B) 0.10
(C) 0.13
(D) 0.15
(E) 0.18

191. Let A, B, and C be events such that $P[\text{A}] = 0.2$, $P[\text{B}] = 0.1$, and $P[\text{C}] = 0.3$. The events A and B are independent, the events B and C are independent, and the events A and C are mutually exclusive.

Calculate $P[\text{A} \cup \text{B} \cup \text{C}]$.

(A) 0.496
(B) 0.540
(C) 0.544
(D) 0.550
(E) 0.600

192. The annual numbers of thefts a homeowners insurance policyholder experiences are analyzed over three years.

Define the following events:

i) A = the event that the policyholder experiences no thefts in the three years.
ii) B = the event that the policyholder experiences at least one theft in the second year.
iii) C = the event that the policyholder experiences exactly one theft in the first year.
iv) D = the event that the policyholder experiences no thefts in the third year.
v) E = the event that the policyholder experiences no thefts in the second year, and at least one theft in the third year.

Determine which three events satisfy the condition that the probability of their union equals the sum of their probabilities.

(A) Events A, B, and E
(B) Events A, C, and E
(C) Events A, D, and E
(D) Events B, C, and D
(E) Events B, C, and E

193. Four letters to different insureds are prepared along with accompanying envelopes. The letters are put into the envelopes randomly.

Calculate the probability that at least one letter ends up in its accompanying envelope.

(A) 27/256
(B) 1/4
(C) 11/24
(D) 5/8
(E) 3/4

194. A health insurance policy covers visits to a doctor's office. Each visit costs 100. The annual deductible on the policy is 350. For a policy, the number of visits per year has the following probability distribution:

Number of Visits	0	1	2	3	4	5	6
Probability	0.60	0.15	0.10	0.08	0.04	0.02	0.01

A policy is selected at random from those where costs exceed the deductible.

Calculate the probability that this policyholder had exactly five office visits.

(A) 0.050
(B) 0.133
(C) 0.286
(D) 0.333
(E) 0.429

195. A machine has two parts labelled A and B. The probability that part A works for one year is 0.8 and the probability that part B works for one year is 0.6. The probability that at least one part works for one year is 0.9.

Calculate the probability that part B works for one year, given that part A works for one year.

(A) 1/2
(B) 3/5
(C) 5/8
(D) 3/4
(E) 5/6

196. Six claims are to be randomly selected from a group of thirteen different claims, which includes two workers compensation claims, four homeowners claims and seven auto claims.

Calculate the probability that the six claims selected will include one workers compensation claim, two homeowners claims and three auto claims.

(A) 0.025
(B) 0.107
(C) 0.153
(D) 0.245
(E) 0.643

197. A drawer contains four pairs of socks, with each pair a different color. One sock at a time is randomly drawn from the drawer until a matching pair is obtained.

Calculate the probability that the maximum number of draws is required.

(A) 0.0006
(B) 0.0095
(C) 0.0417
(D) 0.1429
(E) 0.2286

198. At a mortgage company, 60% of calls are answered by an attendant. The remaining 40% of callers leave their phone numbers. Of these 40%, 75% receive a return phone call the same day. The remaining 25% receive a return call the next day.

Of those who initially spoke to an attendant, 80% will apply for a mortgage. Of those who received a return call the same day, 60% will apply. Of those who received a return call the next day, 40% will apply.

Calculate the probability that a person initially spoke to an attendant, given that he or she applied for a mortgage.

(A) 0.06
(B) 0.26
(C) 0.48
(D) 0.60
(E) 0.69

199. An insurance company studies back injury claims from a manufacturing company. The insurance company finds that 40% of workers do no lifting on the job, 50% do moderate lifting and 10% do heavy lifting.

During a given year, the probability of filing a claim is 0.05 for a worker who does no lifting, 0.08 for a worker who does moderate lifting and 0.20 for a worker who does heavy lifting.

A worker is chosen randomly from among those who have filed a back injury claim.

Calculate the probability that the worker's job involves moderate or heavy lifting.

(A) 0.75
(B) 0.81
(C) 0.85
(D) 0.86
(E) 0.89

200. The number of traffic accidents occurring on any given day in Coralville is Poisson distributed with mean 5. The probability that any such accident involves an uninsured driver is 0.25, independent of all other such accidents.

Calculate the probability that on a given day in Coralville there are no traffic accidents that involve an uninsured driver.

(A) 0.007
(B) 0.010
(C) 0.124
(D) 0.237
(E) 0.287

201. A group of 100 patients is tested, one patient at a time, for three risk factors for a certain disease until either all patients have been tested or a patient tests positive for more than one of these three risk factors. For each risk factor, a patient tests positive with probability *p*, where $0 < p < 1$. The outcomes of the tests across all patients and all risk factors are mutually independent.

Determine an expression for the probability that exactly *n* patients are tested, where *n* is a positive integer less than 100.

(A) $\left[1-3p^2(1-p)\right]^{n-1}\left[3p^2(1-p)\right]$

(B) $\left[1-3p^2(1-p)-p^3\right]^{n-1}\left[3p^2(1-p)+p^3\right]$

(C) $\left[1-3p^2(1-p)-p^3\right]\left[3p^2(1-p)+p^3\right]^{n-1}$

(D) $n\left[1-3p^2(1-p)-p^3\right]^{n-1}\left[3p^2(1-p)+p^3\right]$

(E) $3\left[(1-p)^{n-1}p\right]^2\left[1-(1-p)^{n-1}p\right]+\left[(1-p)^{n-1}p\right]^3$

202. A representative of a market research firm contacts consumers by phone in order to conduct surveys. The specific consumer contacted by each phone call is randomly determined. The probability that a phone call produces a completed survey is 0.25.

Calculate the probability that more than three phone calls are required to produce one completed survey.

(A) 0.32
(B) 0.42
(C) 0.44
(D) 0.56
(E) 0.58

203. Four distinct integers are chosen randomly and without replacement from the first twelve positive integers. X is the random variable representing the second smallest of the four selected integers, and p is the probability function of X.

Determine $p(x)$ for $x = 2,3,\ldots,10$.

(A) $\dfrac{(x-1)(11-x)(12-x)}{495}$

(B) $\dfrac{(x-1)(11-x)(12-x)}{990}$

(C) $\dfrac{(x-1)(x-2)(12-x)}{990}$

(D) $\dfrac{(x-1)(x-2)(12-x)}{495}$

(E) $\dfrac{(10-x)(11-x)(12-x)}{495}$

204. Losses due to burglary are exponentially distributed with mean 100.

The probability that a loss is between 40 and 50 equals the probability that a loss is between 60 and r, with $r > 60$.

Calculate r.

(A) 68.26
(B) 70.00
(C) 70.51
(D) 72.36
(E) 75.00

205. The time until the next car accident for a particular driver is exponentially distributed with a mean of 200 days.

Calculate the probability that the driver has no accidents in the next 365 days, but then has at least one accident in the 365-day period that follows this initial 365-day period.

(A) 0.026
(B) 0.135
(C) 0.161
(D) 0.704
(E) 0.839

206. The annual profit of a life insurance company is normally distributed.

The probability that the annual profit does not exceed 2000 is 0.7642. The probability that the annual profit does not exceed 3000 is 0.9066.

Calculate the probability that the annual profit does not exceed 1000.

(A) 0.1424
(B) 0.3022
(C) 0.5478
(D) 0.6218
(E) 0.7257

207. Individuals purchase both collision and liability insurance on their automobiles. The value of the insured's automobile is V. Assume the loss L on an automobile claim is a random variable with cumulative distribution function

$$F(l) = \begin{cases} \frac{3}{4}\left(\frac{l}{V}\right)^3, & 0 \le l < V \\ 1 - \frac{1}{10} e^{\frac{-(l-V)}{V}}, & V \le l. \end{cases}$$

Calculate the probability that the loss on a randomly selected claim is greater than the value of the automobile.

(A) 0.00
(B) 0.10
(C) 0.25
(D) 0.75
(E) 0.90

208. The lifetime of a machine part is exponentially distributed with a mean of five years.

Calculate the mean lifetime of the part, given that it survives less than ten years.

(A) 0.865
(B) 1.157
(C) 2.568
(D) 2.970
(E) 3.435

209. Let X be a random variable with density function

$$f(x) = \begin{cases} 2e^{-2x}, & x > 0 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate $P[X \le 0.5 \mid X \le 1.0]$.

(A) 0.433
(B) 0.547
(C) 0.632
(D) 0.731
(E) 0.865

210. Events E and F are independent. P[E] = 0.84 and P[F] = 0.65.

Calculate the probability that exactly one of the two events occurs.

(A) 0.056
(B) 0.398
(C) 0.546
(D) 0.650
(E) 0.944

211. A flood insurance company determines that N, the number of claims received in a month, is a random variable with $P[N=n]=\frac{2}{3^{n+1}}$, for $n=0,1,2,\ldots$. The numbers of claims received in different months are mutually independent.

Calculate the probability that more than three claims will be received during a consecutive two-month period, given that fewer than two claims were received in the first of the two months.

(A) 0.0062
(B) 0.0123
(C) 0.0139
(D) 0.0165
(E) 0.0185

212. Patients in a study are tested for sleep apnea, one at a time, until a patient is found to have this disease. Each patient independently has the same probability of having sleep apnea. Let r represent the probability that at least four patients are tested.

Determine the probability that at least twelve patients are tested given that at least four patients are tested.

(A) $r^{\frac{11}{3}}$
(B) r^3
(C) $r^{\frac{8}{3}}$
(D) r^2
(E) $r^{\frac{1}{3}}$

213. A factory tests 100 light bulbs for defects. The probability that a bulb is defective is 0.02. The occurrences of defects among the light bulbs are mutually independent events.

Calculate the probability that exactly two are defective given that the number of defective bulbs is two or fewer.

(A) 0.133
(B) 0.271
(C) 0.273
(D) 0.404
(E) 0.677

214. A certain town experiences an average of 5 tornadoes in any four year period. The number of years from now until the town experiences its next tornado as well as the number of years between tornados have identical exponential distributions and all such times are mutually independent

Calculate the median number of years from now until the town experiences its next tornado.

(A) 0.55
(B) 0.73
(C) 0.80
(D) 0.87
(E) 1.25

215. Losses under an insurance policy are exponentially distributed with mean 4. The deductible is 1 for each loss.

Calculate the median amount that the insurer pays a policyholder for a loss under the policy.

(A) 1.77
(B) 2.08
(C) 2.12
(D) 2.77
(E) 3.12

216. A company has purchased a policy that will compensate for the loss of revenue due to severe weather events. The policy pays 1000 for each severe weather event in a year after the first two such events in that year. The number of severe weather events per year has a Poisson distribution with mean 1.

Calculate the expected amount paid to this company in one year.

(A) 80
(B) 104
(C) 368
(D) 512
(E) 632

217. A company provides each of its employees with a death benefit of 100. The company purchases insurance that pays the cost of total death benefits in excess of 400 per year. The number of employees who will die during the year is a Poisson random variable with mean 2.

Calculate the expected annual cost to the company of providing the death benefits, excluding the cost of the insurance.

(A) 171
(B) 189
(C) 192
(D) 200
(E) 208

218. The number of burglaries occurring on Burlington Street during a one-year period is Poisson distributed with mean 1.

Calculate the expected number of burglaries on Burlington Street in a one-year period, given that there are at least two burglaries.

(A) 0.63
(B) 2.39
(C) 2.54
(D) 3.00
(E) 3.78

219. For a certain health insurance policy, losses are uniformly distributed on the interval [0, 450]. The policy has a deductible of d and the expected value of the unreimbursed portion of a loss is 56.

Calculate d.

(A) 60
(B) 87
(C) 112
(D) 169
(E) 224

220. A motorist just had an accident. The accident is minor with probability 0.75 and is otherwise major.

Let b be a positive constant. If the accident is minor, then the loss amount follows a uniform distribution on the interval $[0, b]$. If the accident is major, then the loss amount follows a uniform distribution on the interval $[b, 3b]$.

The median loss amount due to this accident is 672.

Calculate the mean loss amount due to this accident.

(A) 392
(B) 512
(C) 672
(D) 882
(E) 1008

221. An insurance policy will reimburse only one claim per year.

For a random policyholder, there is a 20% probability of no loss in the next year, in which case the claim amount is 0. If a loss occurs in the next year, the claim amount is normally distributed with mean 1000 and standard deviation 400.

Calculate the median claim amount in the next year for a random policyholder.

(A) 663
(B) 790
(C) 873
(D) 994
(E) 1000

222. Losses incurred by a policyholder follow a normal distribution with mean 20,000 and standard deviation 4,500. The policy covers losses, subject to a deductible of 15,000.

Calculate the 95^{th} percentile of losses that exceed the deductible.

(A) 27,400
(B) 27,700
(C) 28,100
(D) 28,400
(E) 28,800

223. A gun shop sells gunpowder. Monthly demand for gunpowder is normally distributed, averages 20 pounds, and has a standard deviation of 2 pounds. The shop manager wishes to stock gunpowder inventory at the beginning of each month so that there is only a 2% chance that the shop will run out of gunpowder (i.e., that demand will exceed inventory) in any given month.

Calculate the amount of gunpowder to stock in inventory, in pounds.

(A) 16
(B) 23
(C) 24
(D) 32
(E) 43

224. A large university will begin a 13-day period during which students may register for that semester's courses. Of those 13 days, the number of elapsed days before a randomly selected student registers has a continuous distribution with density function $f(t)$ that is symmetric about $t = 6.5$ and proportional to $1/(t + 1)$ between days 0 and 6.5.

A student registers at the 60th percentile of this distribution.

Calculate the number of elapsed days in the registration period for this student.

(A) 4.01
(B) 7.80
(C) 8.99
(D) 10.22
(E) 10.51

225. The loss L due to a boat accident is exponentially distributed.

Boat insurance policy A covers up to 1 unit for each loss. Boat insurance policy B covers up to 2 units for each loss.

The probability that a loss is fully covered under policy B is 1.9 times the probability that it is fully covered under policy A.

Calculate the variance of L.

(A) 0.1
(B) 0.4
(C) 2.4
(D) 9.5
(E) 90.1

226. Losses, X, under an insurance policy are exponentially distributed with mean 10. For each loss, the claim payment Y is equal to the amount of the loss in excess of a deductible $d > 0$.

Calculate Var(Y).

(A) $100 - d$
(B) $(10-d)^2$
(C) $100e^{-d/10}$
(D) $100\left(2e^{-d/10} - e^{-d/5}\right)$
(E) $(10-d)^2\left(2e^{-d/10} - e^{-d/5}\right)$

227. For a certain insurance company, 10% of its policies are Type A, 50% are Type B, and 40% are Type C.

The annual number of claims for an individual Type A, Type B, and Type C policy follow Poisson distributions with respective means 1, 2, and 10.

Let X represent the annual number of claims of a randomly selected policy.

Calculate the variance of X.

(A) 5.10
(B) 16.09
(C) 21.19
(D) 42.10
(E) 47.20

228. The number of tornadoes in a given year follows a Poisson distribution with mean 3.

Calculate the variance of the number of tornadoes in a year given that at least one tornado occurs.

(A) 1.63
(B) 1.73
(C) 2.66
(D) 3.00
(E) 3.16

229. A government employee's yearly dental expense follows a uniform distribution on the interval from 200 to 1200. The government's primary dental plan reimburses an employee for up to 400 of dental expense incurred in a year, while a supplemental plan pays up to 500 of any remaining dental expense.

Let Y represent the yearly benefit paid by the supplemental plan to a government employee.

Calculate Var(Y).

(A) 20,833
(B) 26,042
(C) 41,042
(D) 53,333
(E) 83,333

230. Under a liability insurance policy, losses are uniformly distributed on $[0, b]$, where b is a positive constant. There is a deductible of $b/2$.

Calculate the ratio of the variance of the claim payment (greater than or equal to zero) from a given loss to the variance of the loss.

(A) 1:8
(B) 3:16
(C) 1:4
(D) 5:16
(E) 1:2

231. A company's annual profit, in billions, has a normal distribution with variance equal to the cube of its mean. The probability of an annual loss is 5%.

Calculate the company's expected annual profit.

(A) 370 million
(B) 520 million
(C) 780 million
(D) 950 million
(E) 1645 million

232. The number of claims X on a health insurance policy is a random variable with $E[X^2] = 61$ and $E[(X-1)^2] = 47$.

Calculate the standard deviation of the number of claims.

(A) 2.18
(B) 2.40
(C) 7.31
(D) 7.50
(E) 7.81

233. Ten cards from a deck of playing cards are in a box: two diamonds, three spades, and five hearts. Two cards are randomly selected without replacement.

Calculate the variance of the number of diamonds selected, given that no spade is selected.

(A) 0.24
(B) 0.28
(C) 0.32
(D) 0.34
(E) 0.41

234. – 236. DELETED

237. A car and a bus arrive at a railroad crossing at times independently and uniformly distributed between 7:15 and 7:30. A train arrives at the crossing at 7:20 and halts traffic at the crossing for five minutes.

Calculate the probability that the waiting time of the car or the bus at the crossing exceeds three minutes.

(A) 0.25
(B) 0.27
(C) 0.36
(D) 0.40
(E) 0.56

238. Skateboarders A and B practice one difficult stunt until becoming injured while attempting the stunt. On each attempt, the probability of becoming injured is p, independent of the outcomes of all previous attempts.

Let $F(x, y)$ represent the probability that skateboarders A and B make no more than x and y attempts, respectively, where x and y are positive integers.

It is given that $F(2, 2) = 0.0441$.

Calculate $F(1, 5)$.

(A) 0.0093
(B) 0.0216
(C) 0.0495
(D) 0.0551
(E) 0.1112

239. The number of minor surgeries, X, and the number of major surgeries, Y, for a policyholder, this decade, has joint cumulative distribution function

$$F(x, y) = \left[1 - (0.5)^{x+1}\right]\left[1 - (0.2)^{y+1}\right],$$

for nonnegative integers x and y.

Calculate the probability that the policyholder experiences exactly three minor surgeries and exactly three major surgeries this decade.

(A) 0.00004
(B) 0.00040
(C) 0.03244
(D) 0.06800
(E) 0.12440

240. A company provides a death benefit of 50,000 for each of its 1000 employees. There is a 1.4% chance that any one employee will die next year, independent of all other employees. The company establishes a fund such that the probability is at least 0.99 that the fund will cover next year's death benefits.

Calculate, using the Central Limit Theorem, the smallest amount of money, rounded to the nearest 50 thousand, that the company must put into the fund.

(A) 750,000
(B) 850,000
(C) 1,050,000
(D) 1,150,000
(E) 1,400,000

241. An investor invests 100 dollars in a stock. Each month, the investment has probability 0.5 of increasing by 1.10 dollars and probability 0.5 of decreasing by 0.90 dollars. The changes in price in different months are mutually independent.

Calculate the probability that the investment has a value greater than 91 dollars at the end of month 100.

(A) 0.63
(B) 0.75
(C) 0.82
(D) 0.94
(E) 0.97

242. Let *X* denote the loss amount sustained by an insurance company's policyholder in an auto collision. Let *Z* denote the portion of *X* that the insurance company will have to pay. An actuary determines that *X* and *Z* are independent with respective density and probability functions

$$f(x) = \begin{cases} (1/8)e^{-x/8}, & x > 0 \\ 0, & \text{otherwise} \end{cases}$$

and

$$P[Z = z] = \begin{cases} 0.45, & z = 1 \\ 0.55, & z = 0. \end{cases}$$

Calculate the variance of the insurance company's claim payment *ZX*.

(A) 13.0
(B) 15.8
(C) 28.8
(D) 35.2
(E) 44.6

243. A couple takes out a medical insurance policy that reimburses them for days of work missed due to illness. Let X and Y denote the number of days missed during a given month by the wife and husband, respectively. The policy pays a monthly benefit of 50 times the maximum of X and Y, subject to a benefit limit of 100. X and Y are independent, each with a discrete uniform distribution on the set $\{0,1,2,3,4\}$.

Calculate the expected monthly benefit for missed days of work that is paid to the couple.

(A) 70
(B) 90
(C) 92
(D) 95
(E) 140

244. The table below shows the joint probability function of a sailor's number of boating accidents and number of hospitalizations from these accidents this year.

	Number of Hospitalizations from Accidents				
		0	1	2	3
Number of Accidents	0	0.700			
	1	0.150	0.050		
	2	0.060	0.020	0.010	
	3	0.005	0.002	0.002	0.001

Calculate the sailor's expected number of hospitalizations from boating accidents this year.

(A) 0.085
(B) 0.099
(C) 0.410
(D) 1.000
(E) 1.500

245. On Main Street, a driver's speed just before an accident is uniformly distributed on [5, 20]. Given the speed, the resulting loss from the accident is exponentially distributed with mean equal to three times the speed.

Calculate the variance of a loss due to an accident on Main Street.

(A) 525
(B) 1463
(C) 1575
(D) 1632
(E) 1744

246. Let X be the annual number of hurricanes hitting Florida, and let Y be the annual number of hurricanes hitting Texas. X and Y are independent Poisson variables with respective means 1.70 and 2.30.

Calculate $\mathrm{Var}(X - Y \mid X + Y = 3)$.

(A) 1.71
(B) 1.77
(C) 2.93
(D) 3.14
(E) 4.00

247. Random variables X and Y have joint distribution

	$X = 0$	$X = 1$	$X = 2$
$Y = 0$	1/15	a	2/15
$Y = 1$	a	b	a
$Y = 2$	2/15	a	1/15

Let a be the value that minimizes the variance of X.

Calculate the variance of Y.

(A) 2/5
(B) 8/15
(C) 16/25
(D) 2/3
(E) 7/10

248. Let X be a random variable that takes on the values –1, 0, and 1 with equal probabilities.

Let $Y = X^2$.

Which of the following is true?

(A) Cov(X, Y) > 0; the random variables X and Y are dependent.
(B) Cov(X, Y) > 0; the random variables X and Y are independent.
(C) Cov(X, Y) = 0; the random variables X and Y are dependent.
(D) Cov(X, Y) = 0; the random variables X and Y are independent.
(E) Cov(X, Y) < 0; the random variables X and Y are dependent.

249. Losses follow an exponential distribution with mean 1. Two independent losses are observed.

Calculate the expected value of the smaller loss.

(A) 0.25
(B) 0.50
(C) 0.75
(D) 1.00
(E) 1.50

250. A delivery service owns two cars that consume 15 and 30 miles per gallon. Fuel costs 3 per gallon. On any given business day, each car travels a number of miles that is independent of the other and is normally distributed with mean 25 miles and standard deviation 3 miles.

Calculate the probability that on any given business day, the total fuel cost to the delivery service will be less than 7.

(A) 0.13
(B) 0.23
(C) 0.29
(D) 0.38
(E) 0.47

251. Two independent estimates are to be made on a building damaged by fire. Each estimate is normally distributed with mean $10b$ and variance b^2.

Calculate the probability that the first estimate is at least 20 percent higher than the second.

(A) 0.023
(B) 0.100
(C) 0.115
(D) 0.221
(E) 0.444

252. The independent random variables X and Y have the same mean. The coefficients of variation of X and Y are 3 and 4 respectively.

Calculate the coefficient of variation of $\frac{1}{2}(X+Y)$.

(A) 5/4
(B) 7/4
(C) 5/2
(D) 7/2
(E) 7

253. Points scored by a game participant can be modeled by $Z = 3X + 2Y - 5$. X and Y are independent random variables with Var (X) = 3 and Var (Y) = 4.

Calculate Var (Z).

(A) 12
(B) 17
(C) 38
(D) 43
(E) 68

254. An actuary is studying hurricane models. A year is classified as a high, medium, or low hurricane year with probabilities 0.1, 0.3, and 0.6, respectively. The numbers of hurricanes in high, medium, and low years follow Poisson distributions with means 20, 15, and 10, respectively.

Calculate the variance of the number of hurricanes in a randomly selected year.

(A) 11.25
(B) 12.50
(C) 12.94
(D) 13.42
(E) 23.75

255. A dental insurance company pays 100% of the cost of fillings and 70% of the cost of root canals. Fillings and root canals cost 50 and 500 each, respectively.

The tables below show the probability distributions of the annual number of fillings and annual number of root canals for each of the company's policyholders.

# of Fillings	0	1	2	3
Probability	0.60	0.20	0.15	0.05

# of Root Canals	0	1
Probability	0.80	0.20

Calculate the expected annual payment per policyholder for fillings and root canals.

(A) 90.00
(B) 102.50
(C) 132.50
(D) 250.00
(E) 400.00

256. A loss under a liability policy is modeled by an exponential distribution. The insurance company will cover the amount of that loss in excess of a deductible of 2000. The probability that the reimbursement is less than 6000, given that the loss exceeds the deductible, is 0.50.

Calculate the probability that the reimbursement is greater than 3000 but less than 9000, given that the loss exceeds the deductible.

(A) 0.28
(B) 0.35
(C) 0.50
(D) 0.65
(E) 0.72

257. Let X be the percentage score on a college-entrance exam for students who did not participate in an exam-preparation seminar. X is modeled by a uniform distribution on $[a, 100]$.

Let Y be the percentage score on a college-entrance exam for students who did participate in an exam-preparation seminar. Y is modeled by a uniform distribution on $[1.25a, 100]$.

It is given that $E(X^2) = \dfrac{19{,}600}{3}$.

Calculate the 80$^{\text{th}}$ percentile of Y.

(A) 80
(B) 85
(C) 90
(D) 92
(E) 95

258. In a study of driver safety, drivers were categorized according to three risk factors. Exactly 1000 drivers exhibited each individual risk factor. Also, for each of the risk factors, there were exactly 400 drivers exhibiting that risk factor and neither of the other two risk factors. Finally, there were exactly 300 drivers who exhibited all three risk factors and 500 who exhibited none of the three risk factors.

Calculate the number of drivers in the study.

(A) 2000
(B) 2300
(C) 2450
(D) 2750
(E) 3500

259. An insurance company examines its pool of auto insurance customers and gathers the following information:

i) All customers insure at least one car.
ii) 64% of the customers insure more than one car.
iii) 20% of the customers insure a sports car.
iv) Of those customers who insure more than one car, 15% insure a sports car.

Calculate the probability that a randomly selected customer insures exactly one car, and that the car is not a sports car.

(A) 0.16
(B) 0.19
(C) 0.26
(D) 0.29
(E) 0.31

260. An insurance company has found that 1% of all applicants for life insurance have diabetes.

Calculate the probability that five or fewer of 200 randomly selected applicants have diabetes.

(A) 0.85
(B) 0.88
(C) 0.91
(D) 0.95
(E) 0.98

261. The probability that an agent sells an insurance policy to a potential customer during a first appointment is 0.20. The events of selling an insurance policy to different potential customers during first appointments are mutually independent.

The agent has scheduled first appointments with five potential customers.

Calculate the probability that the agent sells an insurance policy during at least two of these appointments.

(A) 0.04
(B) 0.20
(C) 0.26
(D) 0.40
(E) 0.74

262. A manufacturer produces computers and releases them in shipments of 100. From a shipment of 100, the probability that exactly three computers are defective is twice the probability that exactly two computers are defective. The events that different computers are defective are mutually independent.

Calculate the probability that a randomly selected computer is defective.

(A) 0.040
(B) 0.042
(C) 0.058
(D) 0.060
(E) 0.072

263. In any 12-month period, the probability that a home is damaged by fire is 20% and the probability of a theft loss at a home is 30%. The occurrences of fire damage and theft loss are independent events.

Calculate the probability that a randomly selected home will either be damaged by fire or will have a theft loss, but not both, during the next year.

(A) 0.30
(B) 0.38
(C) 0.44
(D) 0.50
(E) 0.56

264. In one company, 30% of males and 20% of females contribute to a supplemental retirement plan. Furthermore, 45% of the company's employees are female.

Calculate the probability that a randomly selected employee is female, given that this employee contributes to a supplemental retirement plan.

(A) 0.09
(B) 0.23
(C) 0.35
(D) 0.45
(E) 0.55

265. A health insurer sells policies to residents of territory X and territory Y. Past claims experience indicates the following:

i) 20% of the total policyholders from territory X and territory Y combined filed no claims.
ii) 15% of the policyholders from territory X filed no claims.
iii) 40% of the policyholders from territory Y filed no claims.

Calculate the probability that a randomly selected policyholder was a resident of territory X, given that the policyholder filed no claims.

(A) 0.09
(B) 0.27
(C) 0.50
(D) 0.60
(E) 0.80

266. Claim amounts are independent random variables with probability density function

$$f(x) = \begin{cases} \dfrac{10}{x^2}, & \text{for } x > 10 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate the probability that the largest of three randomly selected claims is less than 25.

(A) $\dfrac{8}{125}$

(B) $\dfrac{12}{125}$

(C) $\dfrac{27}{125}$

(D) $\dfrac{2}{5}$

(E) $\dfrac{3}{5}$

267. The lifetime of a certain electronic device has an exponential distribution with mean 0.50.

Calculate the probability that the lifetime of the device is greater than 0.70, given that it is greater than 0.40.

(A) 0.203
(B) 0.247
(C) 0.449
(D) 0.549
(E) 0.861

268. A farmer purchases a five-year insurance policy that covers crop destruction due to hail. Over the five-year period, the farmer will receive a benefit of 20 for each year in which hail destroys his crop, subject to a maximum of three benefit payments. The probability that hail will destroy the farmer's crop in any given year is 0.5, independent of any other year.

Calculate the expected benefit that the farmer will receive over the five-year period.

(A) 30
(B) 34
(C) 40
(D) 46
(E) 50

269. An insurance company has two divisions, auto and property. Total annual claims, X, in the auto division follow a normal distribution with mean 10 and standard deviation 3. Total annual claims, Y, in the property division follow a normal distribution with mean 12 and standard deviation 4.

Assume that X and Y are independent.

Calculate the probability that total overall claims, $X + Y$, will not exceed 29.

(A) 0.61
(B) 0.69
(C) 0.78
(D) 0.84
(E) 0.92

270. An industrial company provides health insurance to employees located at four different plants. Health insurance costs at each plant are independent of the costs at any other plant. Plant managers have calculated the following statistics:

Plant	Average Cost	Standard Deviation
W	2	1.0
X	2	1.0
Y	5	1.5
Z	7	2.0

Calculate the standard deviation of total company health insurance costs.

(A) 1.4
(B) 2.1
(C) 2.9
(D) 5.5
(E) 6.3

271. DELETED, DUPICATE OF 264

272. DELETED, DUPICATE OF 260

273. DELETED, DUPICATE OF 270

274. An insurance company examines its pool of auto insurance customers and gathers the following information:

i) All customers insure at least one car.
ii) 62% of the customers insure more than one car.
iii) 15% of the customers insure a sports car.
iv) Of those customers who insure more than one car, 20% insure a sports car.

Calculate the probability that a randomly selected customer insures exactly one car, and that the car is not a sports car.

(A) 0.230
(B) 0.260
(C) 0.323
(D) 0.354
(E) 0.380

275. DELETED, DUPICATE OF 259

276. DELETED, DUPICATE OF 269

277. DELETED, DUPICATE OF 258

278. DELETED, DUPICATE OF 268

279. DELETED, DUPICATE OF 267

280. DELETED, DUPICATE OF 261

281. DELETED, DUPICATE OF 265

282. DELETED, DUPICATE OF 266

283. DELETED, DUPICATE OF 263

284. An employer provides disability benefits to its employees for work-related and other injuries. The random variables *X* and *Y* denote the employer's annual expenditures for work-related and other injuries, respectively. An actuarial study reveals the following information about *X* and *Y*:

i) The density of *X* is $f(x) = \frac{1}{20\sqrt{5}} e^{\frac{-x}{20\sqrt{5}}}$, for $x > 0$.

ii) Var (*Y*) = 12,500.

iii) The correlation between *X* and *Y* is 0.20.

Calculate the variance of the employer's total expenditures for work-related and other injuries.

(A) 12,500
(B) 13,500
(C) 15,500
(D) 16,500
(E) 18,972

285. Appraisals of the value of a necklace are uniformly distributed on the interval $[\theta - 3, \theta + 1]$, where θ is the actual price the owner paid for the necklace. Four mutually independent appraisals are obtained.

Let *L* denote the lowest of the four appraisals and *H* the highest.

Calculate P[$L < \theta < H$].

(A) 0.152
(B) 0.188
(C) 0.600
(D) 0.680
(E) 0.996

286, Losses follow an exponential distribution with mean 1. Two independent losses are observed.

Calculate the probability that either of the losses is more than twice the other.

(A) $\frac{1}{6}$

(B) $\frac{1}{4}$

(C) $\frac{1}{3}$

(D) $\frac{1}{2}$

(E) $\frac{2}{3}$

287. A manufacturer produces computers and releases them in shipments of 100. From a shipment of 100, the probability that exactly three computers are defective is twice the probability that exactly two computers are defective. The events that different computers are defective are mutually independent.

Calculate the probability that a randomly selected computer is defective.

(A) 0.040
(B) 0.042
(C) 0.058
(D) 0.060
(E) 0.072

288. For a pregnant woman, a certain test will give the outcome “not pregnant” with probability 0.10. For a non-pregnant woman, the test will give the outcome “pregnant” with probability 0.20. Of women who take the test, 20% are pregnant.

Calculate the probability that a woman is pregnant, given her test outcome is “pregnant.”

(A) 0.10
(B) 0.20
(C) 0.50
(D) 0.53
(E) 0.90

289. An airport owner purchases an insurance policy to offset costs associated with excessive amounts of snowfall. For every full ten inches of snow in excess of 40 inches during the winter season, the insurer pays the airport 200 up to a policy maximum of 500.

The following table shows a probability function for the random variable *X* of winter season snowfall, in inches, at the airport.

Inches of Snowfall (*x*)	**p(*x*)**
$0 \le x < 20$	0.06
$20 \le x < 30$	0.18
$30 \le x < 40$	0.26
$40 \le x < 50$	0.22
$50 \le x < 60$	0.14
$60 \le x < 70$	0.06
$70 \le x < 80$	0.04
$80 \le x < 90$	0.04
$90 \le x$	0.00

Calculate the standard deviation of the amount paid under the policy.

(A) 163.5
(B) 187.6
(C) 208.7
(D) 234.9
(E) 336.6

290. Let $X_1, \ldots, X_{100}$ be independent identically distributed random variables such that $P[X = 0] = P[X = 2] = 0.5$. Let $S = X_1 + \cdots + X_{100}$.

Calculate the approximate value of P[*S* >115].

(A) 0.005
(B) 0.067
(C) 0.144
(D) 0.147
(E) 0.440

291. Let X and Y be discrete random variables with joint probability function

$$p(x, y) = \begin{cases} 0.250, & \text{for } x = 0, y = 0 \\ 0.250, & \text{for } x = 1, y = 0 \\ 0.125, & \text{for } x = 0, y = 1 \\ 0.375, & \text{for } x = 1, y = 1. \end{cases}$$

Calculate Corr (X, Y), the correlation coefficient of X and Y.

(A) 0.06
(B) 0.23
(C) 0.26
(D) 0.38
(E) 0.63

292. Let X and Y be discrete random variables with joint probability function

$$p(x, y) = \begin{cases} \frac{1}{21}, & \text{for } x = 0, 1, \ldots, 5 \text{ and } y = 0, \ldots, x \\ 0, & \text{otherwise.} \end{cases}$$

Calculate the variance of Y.

(A) 1.67
(B) 2.22
(C) 3.33
(D) 5.00
(E) 5.56

293. A company provides disability benefits to its employees. There are only two possible benefits: partial disability, costing the company 40, and total disability, costing the company 200. The company employs a number of married couples.

Let (X,Y) denote the company's disability costs for a randomly selected employed married couple. The joint probability function for (X,Y) is:

		x		
	$p(x,y)$	0	40	200
	0	0.9729	0.0100	0.0020
y	40	0.0100	0.0020	0.0005
	200	0.0020	0.0005	0.0001

Calculate the standard deviation of the total disability cost $X + Y$ for the married couple.

(A) 12.3
(B) 13.8
(C) 15.7
(D) 16.6
(E) 19.8

294. The probability that the economy will improve, remain stable, or decline is:

State of the Economy	Probability
Improve	0.30
Remain stable	0.50
Decline	0.20

Prices for Stock X and Stock Y will change as follows:

State of the Economy	Stock X	Stock Y
Improve	Increase 18%	Increase 15%
Remain stable	Increase 8%	Increase 7%
Decline	Decrease 13%	Decrease 6%

Determine which of the following statements about the percentage price changes for Stock X and Stock Y is true.

(A) The percentage change for Stock X has a larger variance and a larger mean.
(B) The percentage change for Stock X has a larger variance and the means are equal.
(C) The percentage change for Stock X has a larger variance and a smaller mean.
(D) The variances are equal and the percentage change for Stock X has a larger mean.
(E) Both the variances and the means are equal.

295. A company is marketing an investment opportunity to four potential customers. The company believes that its probability of making a sale is 0.5 for each of the first three customers but that it is only 0.1 for the fourth customer. The customers' purchases are independent of one another.

Calculate the probability that at most two customers purchase the investment.

(A) 0.38
(B) 0.46
(C) 0.54
(D) 0.84
(E) 0.90

296. An actuary compiles the following information about a portfolio of life insurance policies:

i) There are 150 more policies on males than there are on females.
ii) There are 100 more policies on female nonsmokers than there are on male nonsmokers.
iii) There are 350 policies on smokers.

Calculate the number of policies on female smokers within this portfolio.

(A) 50
(B) 100
(C) 200
(D) 250
(E) 300

297. The lifetime of a machine part has a continuous distribution on the interval (0, 40) with probability density function f, where $f(x)$ is proportional to $(10 + x)^{-2}$.

Calculate the probability that the lifetime of the machine part is less than five.

(A) 0.03
(B) 0.13
(C) 0.42
(D) 0.58
(E) 0.97

298. The claim, X, for a dental insurance policy is a random variable with the following probability function:

x	$P[X = x]$
0	0.5
1	0.2
2	0.3

The premium for the policy is equal to 125% of the expected claim amount.

Calculate the approximate probability that the total claims on 76 independent policies exceed the total premium collected.

(A) 0.02
(B) 0.07
(C) 0.17
(D) 0.25
(E) 0.40

299. An insurance company categorizes its policyholders into three mutually exclusive groups. A study produced the following information:

Group	Number of policyholders	Probability a policyholder has no claims
A	20,000	70%
B	45,000	90%
C	35,000	50%

Within each group, the numbers of claims made by individual policyholders are mutually independent Poisson random variables.

Calculate the expected total number of claims, in thousands, made by the 100,000 policyholders.

(A) 21
(B) 28
(C) 36
(D) 64
(E) 72

300. A group of insurance policies have all been in force for at least three years. The insurance company plans to pay a dividend on each policy in the group that had no more than one claim incurred on it in the past three years. The number of claims incurred on a policy in any year follows a Poisson distribution with mean 0.288 and the number incurred in any year is independent of the number incurred in any other year.

Calculate the probability that a policy chosen at random from the group will receive a dividend.

(A) 0.01
(B) 0.36
(C) 0.42
(D) 0.54
(E) 0.79

301. An insurance company sells a one-year insurance policy that covers fire and theft losses. The variance of the number of fire losses is 5. The variance of the number of theft losses is 8. The covariance between the number of fire and theft losses is 3.

Calculate the variance of the total number of fire and theft losses covered by this policy.

(A) 7
(B) 10
(C) 13
(D) 16
(E) 19

302. The number of automobile accidents on any day in a city has a Poisson distribution with mean 4. The number of accidents on a given day is independent of the number of accidents on any other day.

Calculate the probability that at most one accident occurs in a three-day period.

(A) $13e^{-12}$
(B) $72e^{-12}$
(C) $85e^{-12}$
(D) $5e^{-4}$
(E) $13e^{-4}$

303. An experiment consists of tossing three fair coins and is deemed a success if the result is three heads or three tails. The experiment is repeated until a success occurs.

Calculate the probability that it takes exactly three experiments to obtain a success.

(A) 0.047
(B) 0.070
(C) 0.141
(D) 0.188
(E) 0.422

304. Companies P, Q, and R use routes that take their trucks through a common inspection checkpoint each day. The number of trucks for each company that pass the checkpoint each day is as follows:

Company	Number of Trucks
P	4
Q	3
R	2
Total	9

Calculate the probability that at least one of two randomly chosen trucks is from Company P.

(A) 0.28
(B) 0.31
(C) 0.56
(D) 0.69
(E) 0.72

305. A company administers a typing test to screen applicants for a secretarial position. In order to pass the test, an applicant must complete the test in 50 minutes with no more than one error. Historical data reveals the following about the population of applicants:

i) The number of test errors follows a Poisson distribution with mean 3.
ii) The time required to complete the test follows a normal distribution with mean 45 and standard deviation 10.
iii) The number of errors and the time required to complete the test are independent.

Calculate the probability that an applicant chosen at random will pass the test.

(A) 0.10
(B) 0.14
(C) 0.19
(D) 0.84
(E) 0.89

306. An insurance company sells 40% of its renters policies to home renters and the remaining 60% to apartment renters. Among home renters, the time from policy purchase until policy cancellation has an exponential distribution with mean 4 years, and among apartment renters, it has an exponential distribution with mean 2 years.

Calculate the probability that the policyholder is a home renter, given that a renter still has a policy one year after purchase.

(A) 0.08
(B) 0.27
(C) 0.46
(D) 0.56
(E) 0.66

307. A company sells insurance policies for which benefit payments made to each policyholder are independently and identically normally distributed with mean 2475 and standard deviation 250.

Calculate the minimum number of policies that must be sold for there to be at least a 99% probability that the average benefit paid per policy will be no greater than 2500.

(A) 24
(B) 542
(C) 664
(D) 5815
(E) 6440

308. A life insurance policy pays 1000 upon the death of a policyholder provided that the policyholder survives at least one year but less than five years after purchasing the policy.

Let X denote the number of years that a policyholder survives after purchasing the policy with the following probabilities:

x	$P[X < x]$
1	0.05
2	0.12
3	0.21
4	0.33
5	0.48

Calculate the standard deviation of the payment made under this policy.

(A) 218
(B) 430
(C) 480
(D) 495
(E) 500

309. An insurer divides a city into three zones and assesses risks associated with fire loss as follows:

Zone	Probability of fire loss for a home in a given year	Percentage of insurer's fire policies
A	0.015	40%
B	0.011	35%
C	0.008	25%

Given that a fire loss occurs in a home covered by the insurer, calculate the probability that the home is in Zone A.

(A) 0.349
(B) 0.400
(C) 0.441
(D) 0.465
(E) 0.506

310. An insurer offers policies for which insured loss amounts follow a distribution with density function

$$f(x) = \begin{cases} \dfrac{x}{50}, & \text{for } 0 < x < 10 \\ 0, & \text{otherwise.} \end{cases}$$

Customers may choose one of two policies. Policy 1 has no deductible and a limit of 4, while Policy 2 has a deductible of 4 and no limit.

Given the occurrence of an insured loss, calculate the absolute value of the difference between the insurer's expected claim payments under Policies 1 and 2.

(A) 0.32
(B) 0.64
(C) 0.79
(D) 0.91
(E) 1.12

311. Employees of a large company all choose one of three levels of health insurance coverage, for which premiums, denoted by X, are 1, 2, and 3, respectively. Premiums are subject to a discount, denoted by Y, of 0 for smokers and 1 for non-smokers. The joint probability function of X and Y is given by

$$p(x,y)=\begin{cases}\dfrac{x^2+y^2}{31}, & \text{for } x=1,\ 2,\ 3 \text{ and } y=0,\ 1\\ 0, & \text{otherwise.}\end{cases}$$

Calculate the variance of $X-Y$, the total premium paid by a randomly chosen employee.

(A) 0.20
(B) 0.69
(C) 0.74
(D) 1.90
(E) 2.65

312. An actuary determines the following regarding an individual auto policyholder:

i) The probability that the auto policyholder will file a medical claim is 0.30.

ii) The probability that the auto policyholder will file a property claim is 0.42.

iii) The probability that the auto policyholder will file a medical claim or a property claim is 0.60.

Calculate the probability that the auto policyholder will file exactly one type of claim, given that the policyholder will not file both types of claims.

(A) 0.45
(B) 0.48
(C) 0.52
(D) 0.55
(E) 0.60

313. The probability that a homeowners policyholder reports a property claim in a year increases by 25% per year. Conversely, the probability that a homeowners policyholder reports a liability claim in a year decreases by 25% per year.

The probability that a homeowners policyholder reports both a property claim and a liability claim in Year 1 is 0.01. The event that a homeowners policyholder reports a property claim is independent of the event that the policyholder reports a liability claim.

Calculate the probability that a homeowners policyholder reports both a property claim and a liability claim in Year 9.

(A) 0.005
(B) 0.006
(C) 0.010
(D) 0.014
(E) 0.015

314. An auto insurance company tracks the experience of its first-year and multi-year policyholders separately. First-year policyholders account for 15% of the company's business while multi-year policyholders account for the rest.

The number of claims reported to the company in a year by a first-year policyholder follows a Poisson distribution with mean 0.50, while the number of claims reported to the company in a year by a multi-year policyholder follows a Poisson distribution with mean 0.20.

Calculate the probability that a policyholder is a first-year policyholder, given that the policyholder reports at least one claim in a year to the company.

(A) 0.246
(B) 0.277
(C) 0.306
(D) 0.476
(E) 0.685

315. The random variable $Y_1 = e^{X_1}$ characterizes an insurer's annual property losses, where X_1 is normally distributed with mean 16 and standard deviation 1.50. Similarly, the random variable $Y_2 = e^{X_2}$ characterizes the insurer's annual liability losses, where X_2 is normally distributed with mean 15 and standard deviation 2.

The insurer's annual property losses are independent of its annual liability losses.

Calculate the probability that, in a given year, the minimum of the insurer's property losses and liability losses exceeds e^{16}.

(A) 0.126
(B) 0.154
(C) 0.250
(D) 0.309
(E) 0.346

316. A health insurance company classifies applicants, depending on their health, into one of three categories: A, B, or C.

The following probabilities apply:

i) P[A] = 5P[C]
ii) P[B] = 4P[C]
iii) P[zero claims | A] = 0.1
iv) P[zero claims | B] = 0.2
v) P[zero claims | C] = 0.4

Calculate the probability that an insured was classified in category C, given that the insured had zero claims.

(A) 0.040
(B) 0.170
(C) 0.235
(D) 0.294
(E) 0.471

317. A five-year term insurance policy pays 25,000 if the insured dies in the first year. The benefit declines by 5000 per year for each of the next four years. In each of the five years covered by the policy, the probability of dying is 0.01, given that the insured is alive at the beginning of that year.

Calculate the expected benefit the insurance company will pay during the five-year term.

(A) 692
(B) 740
(C) 750
(D) 985
(E) 1225

318. Data on a certain pregnancy test show that a pregnant woman will test negative or not pregnant 10% of the time, while a non-pregnant woman will test positive 20% of the time.

Thirty percent of the women who take the test are pregnant.

Calculate the probability that a woman is pregnant given that her test outcome is positive.

(A) 0.18
(B) 0.30
(C) 0.66
(D) 0.82
(E) 0.90

319. A company is marketing an investment opportunity to four potential customers. The company believes that its probability of making a sale is 0.7 for each of the first three customers but that it is only 0.2 for the fourth customer. The customers' purchases are independent of one another.

Calculate the probability that at most two customers purchase the investment.

(A) 0.18
(B) 0.39
(C) 0.57
(D) 0.71
(E) 0.82

320. An actuary compiles a sample of 100 auto insurance claims. The sizes of these sampled claims are independently and identically distributed with mean 1000 and standard deviation 400.

Calculate the approximate probability that the sum of the sizes of the 100 claims is less than 92,000.

(A) 0.023
(B) 0.050
(C) 0.421
(D) 0.579
(E) 0.977

321. A business manufactures light bulbs and sells them in boxes of 50. Let p denote the probability that a light bulb is defective. The events that different light bulbs are defective are mutually independent.

Let X denote the number of non-defective light bulbs in a box of 50. In addition, let n be an integer such that $\mathrm{P}[X \geq n] \geq 0.95$.

Determine which one of the following statements must be true.

(A) $\sum_{k=n}^{50} \left[\frac{50!}{k!(50-k)!} \right] (1-p)^k p^{50-k} \geq 0.95$

(B) $\sum_{k=0}^{n} \left[\frac{50!}{k!(50-k)!} \right] (1-p)^k p^{50-k} \geq 0.95$

(C) $\sum_{k=n+1}^{50} \left[\frac{50!}{k!(50-k)!} \right] p^k (1-p)^{50-k} \geq 0.95$

(D) $\sum_{k=0}^{n} \left[\frac{50!}{k!(50-k)!} \right] p^k (1-p)^{50-k} \geq 0.95$

(E) $\sum_{k=n}^{50} \left[\frac{50!}{k!(50-k)!} \right] p^k (1-p)^{50-k} \geq 0.95$

322. A fair die is rolled until three sixes are obtained. Let the random variable X be the total number of rolls required.

Calculate Var (X).

(A) 5/12
(B) 18/25
(C) 15
(D) 30
(E) 90

323. A broker markets four separate products. The probabilities of selling these products to a client follow:

Product	Probability
Auto insurance	0.45
Homeowners insurance	0.55
Health insurance	0.60
Life insurance	0.60

The sales of these products are mutually independent.

Calculate the probability that the broker sells more than two products to a client.

(A) 0.24
(B) 0.30
(C) 0.39
(D) 0.61
(E) 0.76

324. An actuary determines that the daily auto accident count within a city can be modeled by a Poisson random variable with mean 4. In addition, the accident counts on different days are mutually independent.

Calculate the approximate probability that at least 6496 accidents occur during a period of 1600 days.

(A) 0.01
(B) 0.12
(C) 0.19
(D) 0.27
(E) 0.49

325. A company sponsors health insurance, life insurance, and retirement plans for its employees. Each employee selects one of two participation options:

i) participate in exactly two plans at the company's expense
ii) participate in none of the plans and receive a cash lump sum payment instead

Employee participation levels in each plan follow:

i) 62.5% of employees participate in the health insurance plan.
ii) 37.5% of employees participate in the life insurance plan.
iii) 50.0% of employees participate in the retirement plan.

Calculate the percentage of employees who participate in both the life insurance and retirement plans.

(A) 12.5%
(B) 25.0%
(C) 37.5%
(D) 50.0%
(E) 62.5%

326. The monthly commission that an agent earns is modeled by a random variable X with probability density function

$$f(x) = \begin{cases} \frac{1}{20}e^{-\frac{x}{20}}, & \text{for } x > 0 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate the probability that the commission the agent earns in a month is within 0.5 standard deviations of E(X).

(A) 0.34
(B) 0.38
(C) 0.50
(D) 0.68
(E) 0.95

327. Individual burglary claim amounts covered by policies of an insurance company are normally distributed with mean 2500 and standard deviation 500.

The probability that the mean of a random sample of 100 claims will exceed K is 0.01.

Calculate K.

(A) 2505
(B) 2512
(C) 2616
(D) 3663
(E) 4950

328. The operating cost of a new claims system is modeled by a random variable X with variance 50. In its second year of use, inflation of 3% and an additional fixed maintenance cost of 2.5 increase the operating cost of the system.

Calculate the variance of the operating cost of the claims system in its second year of use.

(A) 52
(B) 53
(C) 54
(D) 56
(E) 59

329. A geneticist compiled the following information:

i) 1/2 of children who have two left-handed parents are left-handed.
ii) 1/6 of children who have exactly one left-handed parent are left-handed.
iii) 1/16 of children who have no left-handed parents are left-handed.
iv) 1/50 of children have two left-handed parents.
v) 1/5 of children have exactly one left-handed parent.

Calculate the probability that a randomly selected left-handed child has no left-handed parents.

(A) 0.09
(B) 0.42
(C) 0.53
(D) 0.78
(E) 0.91

330. The sales for a product can be modeled by $Z = 4X - Y - 3$. X and Y are independent random variables with Var (X) = 2 and Var (Y) = 3.

Calculate Var (Z).

(A) 5
(B) 11
(C) 29
(D) 32
(E) 35

331. According to a survey, x% of respondents have health insurance, y% have disability income insurance, and z% have only health insurance.

Calculate the probability that a randomly selected respondent has only disability income insurance.

(A) $\dfrac{y-x+z}{100}$
(B) $\dfrac{y-x-z}{100}$
(C) $\dfrac{y-x-2z}{100}$
(D) $\dfrac{y-x+2z}{200}$
(E) $\dfrac{y-z}{100}$

332. Three fair dice are thrown.

Calculate the probability that the same number appears on exactly two of the three dice.

(A) 0.278
(B) 0.417
(C) 0.444
(D) 0.556
(E) 0.583

333. A group of 17 people in a study on lung cancer consists of three heavy smokers, four light smokers, and ten non-smokers. Six people from the group are chosen at random for a new treatment.

Calculate the probability that three of those chosen are non-smokers.

(A) 0.176
(B) 0.284
(C) 0.300
(D) 0.339
(E) 0.588

334. A group of health insurance policyholders is composed of 60% men and 40% women. Of the male policyholders, 20% are smokers. Given that a policyholder from the group smokes, the probability that the policyholder is female is 20%.

Calculate the percentage of female policyholders who are smokers.

(A) 7.50%
(B) 8.00%
(C) 12.00%
(D) 13.33%
(E) 20.00%

335. An inspector examines a random sample of three glasses from each incoming box of ten glasses. The inspector accepts the box of ten glasses if at least two of the three examined are found to be in good condition.

Calculate the probability that a box of ten glasses will be accepted by the inspector if the box contains exactly two glasses that are not in good condition.

(A) 0.10
(B) 0.47
(C) 0.70
(D) 0.90
(E) 0.93

336. Losses under an insurance policy are uniformly distributed on the interval [0, 100]. A deductible is set so that the expected claim payment of losses net of the deductible is 32.

Calculate the deductible.

(A) 9
(B) 18
(C) 20
(D) 36
(E) 52

337. An insurance policy has a deductible of 3. Losses under the policy are exponentially distributed with mean 10.

Calculate the expected claim payment of losses net of the deductible.

(A) 2.59
(B) 5.19
(C) 7.00
(D) 7.41
(E) 9.63

338. The table below shows the joint probability for the number of root canals and the number of fillings a dental patient undergoes this year.

	Number of Fillings					
		0	1	2	3	4
Numb er of Root Canal s	0	00. 40	00. 26	00. 05	00. 04	00. 01
	1	00. 04	00. 03	00. 03	00. 03	00. 02
	2	00. 01	00. 01	00. 02	00. 03	00. 02

Calculate the expected number of root canals the patient undergoes, given that the patient undergoes at most one filling this year.

(A) 0.11
(B) 0.15
(C) 0.17
(D) 0.33
(E) 0.91

339. Let N denote the number of items returned out of the next 500 items sold at a department store. For each item sold, the probability that the item is returned is 0.12. Returns are mutually independent.

Calculate the standard deviation of N.

(A) 7.27
(B) 7.75
(C) 12.75
(D) 20.98
(E) 52.80

340. An insurance company has a large number of claims pending. The amount, *X*, of an individual pending claim is assumed to follow a distribution with density function

$$f(x) = \begin{cases} \dfrac{2}{x^3}, & \text{for } x > 1 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate the probability that the amount of a randomly selected pending claim is less than 4, given that it is at least 3.

(A) 0.04
(B) 0.05
(C) 0.06
(D) 0.11
(E) 0.44

341. The time to death of a 70-year-old person is modeled by a random variable *X* with probability density function

$$f(x) = \begin{cases} \dfrac{k}{(x+5)^2}, & \text{for } 0 < x < 30 \\ 0, & \text{otherwise,} \end{cases}$$

where *k* is a constant.

Calculate the probability the man will live five years and then die during the following five years.

(A) 0.004
(B) 0.194
(C) 0.333
(D) 0.583
(E) 0.778

342. Let X be a Poisson random variable with cumulative distribution function F such that

$$\frac{F(2)}{F(1)} = 2.6\ .$$

Calculate E (X).

(A) 3.2
(B) 4.0
(C) 4.2
(D) 5.0
(E) 5.2

343. Let X represent the number of defective parts in a shipment of five parts.

$$P[X \geq x] = \frac{1}{2}\left(1 - \sqrt{\frac{x-1}{5}}\right), \quad x = 1, 2, 3, 4, 5$$

Calculate E(X).

(A) 0.9
(B) 1.1
(C) 2.1
(D) 2.3
(E) 3.9

344. Let X be a random variable with probability density function

$$f(x) = \begin{cases} 2x, & \text{for } 0 < x < 1 \\ 0, & \text{otherwise.} \end{cases}$$

A sample of size 3 is randomly selected from the distribution. Let Y be a random variable representing the median value from the sample.

Calculate the variance of Y.

(A) 0.019
(B) 0.030
(C) 0.056
(D) 0.500
(E) 0.714

345. An actuary wishes to predict the size *W* of a claim using a predictor *T*. Suppose that *W* and *T* are independent and normally distributed with the same mean and with variances 4 and 12, respectively.

Calculate $P[|W-T|<1]$.

(A) 0.20
(B) 0.23
(C) 0.38
(D) 0.60
(E) 0.68

346. A, B, and C are three events defined on the same sample space. A and C are mutually exclusive and B and C are mutually exclusive. The probability that at least one of the three events occurs is 0.90. The probability that exactly two of the three events occur is 0.06. The probability that exactly one of the events A or B occurs is 0.38.

Calculate P[C].

(A) 0.32
(B) 0.46
(C) 0.52
(D) 0.56
(E) 0.58

347. Let $X = 1$ if termites are present in a building and $X = 0$ if they are not.
Let $Y = 1$ if a test indicates the presence of termites in that building and $Y = 0$ if it does not.
The joint probabilities of *X* and *Y* are:

$$P[X=0, Y=0] = 0.90$$
$$P[X=1, Y=0] = 0.01$$
$$P[X=0, Y=1] = 0.05$$
$$P[X=1, Y=1] = 0.04$$

Calculate the coefficient of variation for *Y*.

(A) 0.31
(B) 0.91
(C) 0.95
(D) 3.18
(E) 4.36

348. A policyholder incurs one loss under each of three policies. Each policy has a deductible of 30. Losses under each policy are uniformly distributed on the interval [0, 100].

The three losses are mutually independent.

Calculate the probability that the policyholder will receive benefits from any of the three policies.

(A) 0.027
(B) 0.343
(C) 0.657
(D) 0.700
(E) 0.973

349. Each student in a group will take an exam in January and another in February. While 70% of the students will pass the January exam, only 50% will pass the February exam. Students who pass the January exam are twice as likely to pass the February exam as those who fail the January exam.

Calculate the probability that a randomly selected student will pass both exams.

(A) 0.35
(B) 0.41
(C) 0.45
(D) 0.50
(E) 0.59

350. A homeowner with theft insurance experiences exactly one theft this year. Loss due to theft is exponentially distributed with mean 2000. The insurer covers the loss due to theft up to a maximum of 3000.

Calculate the probability that the insurer will pay the homeowner exactly 3000 for the loss due to theft.

(A) 0.000
(B) 0.223
(C) 0.487
(D) 0.513
(E) 0.777

351. In a group of four employees, two are high-risk and two are low-risk. This year, each high-risk employee has probability 0.6 of having no accidents; each low-risk employee has probability 0.9 of having no accidents.

The occurrences of accidents among employees are independent events.

Calculate the probability that at most one employee has one or more accidents this year.

(A) 0.4536
(B) 0.5184
(C) 0.6804
(D) 0.7084
(E) 0.7452

352. A homeowner purchases flood insurance that pays a benefit based on the amount of rain that falls. No benefit is paid for rainfall amounts less than twelve inches. For every full two inches greater than twelve, the insurer pays the homeowner 5000, with a maximum payment of 18,000.

The following table displays probabilities for the rainfall amounts.

Inches of Rain (x)	Probability of being in interval
$0 \le x < 2$	0.04
$2 \le x < 4$	0.06
$4 \le x < 6$	0.07
$6 \le x < 8$	0.09
$8 \le x < 10$	0.12
$10 \le x < 12$	0.14
$12 \le x < 14$	0.18
$14 \le x < 16$	0.11
$16 \le x < 18$	0.08
$18 \le x < 20$	0.07
$20 \le x$	0.04

Calculate the standard deviation of the benefit paid under the policy.

(A) 2201
(B) 3120
(C) 3200
(D) 5452
(E) 5680

353. A community college provides life insurance to its employees. The amount of insurance, *X*, of a randomly selected employee is modeled by a distribution with density function

$$f(x) = \begin{cases} \dfrac{8}{x^3}, & \text{for } x > 2 \\ 0, & \text{otherwise,} \end{cases}$$

where *X* is measured in tens of thousands.

Calculate the probability that an employee is insured for no more than 30,000, given that the employee is insured for at least 25,000.

(A) 0.20
(B) 0.31
(C) 0.44
(D) 0.64
(E) 0.69

354. An insurance company insures male and female drivers. The probability that a randomly selected insured driver is male and has an accident is 0.30. The probability of an insured male driver having an accident is 0.50.

Calculate the probability that a randomly selected insured driver is female.

(A) 0.15
(B) 0.40
(C) 0.50
(D) 0.60
(E) 0.85

355. The number of calls received by a certain emergency unit in a day is modeled by a Poisson distribution with a standard deviation of 2.

Calculate the probability that on a particular day the unit receives at least two calls.

(A) 0.092
(B) 0.147
(C) 0.238
(D) 0.762
(E) 0.908

356. A scientist plans to repeat an experiment until a successful result is achieved. On each trial the probability of a successful result is 0.25. The outcomes of the trials are mutually independent.

Calculate the probability that more than three trials are needed to get a successful result.

(A) 0.105
(B) 0.141
(C) 0.422
(D) 0.578
(E) 0.684

357. A fair die is rolled repeatedly. Let X be the number of rolls needed to obtain a 5 and Y the number of rolls needed to obtain a 6.

Calculate $\mathrm{E}(X \mid Y = 1)$.

(A) 5.0
(B) 5.5
(C) 6.0
(D) 6.5
(E) 7.0

358. The annual number of accidents for a driver is modeled by a Poisson distribution with mean 2.5.

Calculate the mode of the annual number of accidents.

(A) 1.0
(B) 1.5
(C) 2.0
(D) 2.5
(E) 3.0

359. Every member of a certain committee is either an X or aY.

Thirty percent of the Xs on the committee are male. Forty percent of the Ys on the committee are female. Sixty percent of the committee members are Ys. A randomly selected member of the committee is male.

Calculate the probability that he is a Y.

(A) 0.36
(B) 0.48
(C) 0.60
(D) 0.67
(E) 0.75

360. An insurance company surcharges a driver, based on the year of the driver's last accident, using the following table with the current year denoted by *t*:

Year of Last Accident	t–1	t–2	t–3	t–4
Surcharge	20%	15%	10%	5%

The probability that a driver has at least one accident in any given year is 0.10, independent of the number of accidents in all other years.

Calculate the expected surcharge in year *t* for a driver who has been driving since the beginning of year $t – 4$.

(A) 4.5%
(B) 5.0%
(C) 8.6%
(D) 10.0%
(E) 19.4%

361. Auto accidents for an individual driver can result in annual losses of 0, 1000, 5000, 10,000, or 15,000 with probabilities 0.75, 0.12, 0.08, 0.04, and 0.01, respectively. An auto insurer offers a policy that insures individual drivers against such losses, subject to an annual deductible of 500.

The insurer charges an annual premium that exceeds its expected annual payment by 75 to provide for insurer expenses and profit.

Calculate the annual premium that the insurer charges.

(A) 870
(B) 945
(C) 1020
(D) 1070
(E) 1145

362. At a certain airport, 1/6 of all scheduled flights are delayed. Assume that flight delays are mutually independent events.

Use the normal approximation (with continuity correction) to calculate the probability that at least 40 of the next 180 flights are delayed.

(A) 0.011
(B) 0.014
(C) 0.018
(D) 0.023
(E) 0.029

363. In a group of 30,000 health insurance policyholders, 12,000 are in Class A and 18,000 are in Class B.

This year, each policyholder in Class A has probability 0.98 of not undergoing hospitalization; each policyholder in Class B has probability 0.995 of not undergoing hospitalization.

A randomly chosen policyholder in the group undergoes hospitalization this year.

Calculate the probability that this policyholder is in Class A.

(A) 0.011
(B) 0.020
(C) 0.396
(D) 0.400
(E) 0.727

364. A two-part machine functions when at least one of its parts is working. Both parts are working today. The future lifetime of each part is exponentially distributed with mean five years. The lifetimes of the parts are independent.

The machine functions one year from now.

Calculate the probability that both parts will be working at that time.

(A) 0.003
(B) 0.409
(C) 0.670
(D) 0.693
(E) 0.819

365. This year, a dental insurance policyholder has probability 0.70 of having no fillings, probability 0.90 of having no root canals, and probability 0.35 of having at least one filling or root canal.

Calculate the probability that a policyholder has no root canals, given that the policyholder has no fillings.

(A) 0.50
(B) 0.65
(C) 0.72
(D) 0.78
(E) 0.93

366. A mover transports ten identical boxes with fragile contents. The contents of seven of these boxes all stay intact after the move.

The mover randomly chooses five different boxes from the ten to inspect.

Calculate the probability that the contents of exactly three of these five boxes are all intact.

(A) 0.042
(B) 0.083
(C) 0.139
(D) 0.417
(E) 0.700

367. A study is to be conducted on health risk factors of insurance applicants. The study needs exactly 268 people with heart disease, 268 with diabetes and 268 with high cholesterol. The study also needs exactly 68 people with only heart disease, 68 with only diabetes and 68 with only high cholesterol. The study needs exactly 84 people with all three risk factors and 155 people with no risk factors.

Calculate the total number of people the study needs.

(A) 443
(B) 462
(C) 617
(D) 636
(E) 791

368. In a population under study it is known that 40% are smokers or have below normal lung function. Among the 25% of the population that smoke 70% have below normal lung function.

Calculate the percentage of the population that have below normal lung function.

(A) 15%
(B) 20%
(C) 33%
(D) 55%
(E) 60%

369. The death of a husband and the death of his wife are independent events. The probability that the husband dies during the next two years is 0.10. The probability that both the husband and the wife survive the next two years is 0.70.

Calculate the probability that the wife dies within the next two years.

(A) 0.100
(B) 0.118
(C) 0.143
(D) 0.200
(E) 0.222

370. Small businesses in a particular city are categorized as retail, service, transportation, or other.

In a study of the yearly bankruptcies of small businesses in this city, the following information from the past year was observed:

i) 60% of the small businesses were retail, and of those, 12% went bankrupt.
ii) 25% of the small businesses were service, and of those, 8% went bankrupt.
iii) 10% of the small businesses were transportation, and of those, 6% went bankrupt.
iv) 5% of the small businesses were other, and none of those went bankrupt.

An auditor randomly selected a small business that went bankrupt last year.

Calculate the probability that it was a service business.

(A) 0.020
(B) 0.080
(C) 0.204
(D) 0.250
(E) 0.308

371. A random variable X is normally distributed with mean 5 and standard deviation 2.

Calculate the probability that $8X - X^2 < 1$.

(A) 0.007
(B) 0.076
(C) 0.082
(D) 0.917
(E) 0.925

372. For which of the exponential, normal, and continuous uniform distributions does doubling the mean also double the median?

(A) all three
(B) all but the normal
(C) all but the uniform
(D) all but the exponential
(E) fewer than two

373. In a particular contract, there are two options available for each of two sections A and B. If X is the number of options selected for section A and Y is the number of options selected for section B, then the joint probability function of X and Y is

$$p(x,y)=\begin{cases}\dfrac{x+y+2}{36}, & \text{for } x=0,1,2 \text{ and } y=0,1,2\\ 0, & \text{otherwise.}\end{cases}$$

Calculate the variance of X.

(A) 0.56
(B) 0.64
(C) 0.83
(D) 2.00
(E) 3.36

374. A random variable X has density function

$$f(x)=\begin{cases}\dfrac{5}{72}\left[3(x-2)^2-(x-2)^4+4\right], & \text{for } 0<x<3\\ 0, & \text{otherwise.}\end{cases}$$

Calculate the mode of the distribution.

(A) 0.000
(B) 0.775
(C) 2.000
(D) 3.000
(E) The correct answer is not given by (A), (B), (C), or (D).

375. The length of time, T, in months, taken by relatives to file for a death benefit has density function

$$f(t)=\begin{cases}\dfrac{4\beta^4}{t^5}, & \text{for } t>\beta,\ 0<\beta<3\\ 0, & \text{otherwise.}\end{cases}$$

Calculate the probability that the relatives of a policyholder will not file for the death benefit in the next four months, given that the policyholder died three months ago and the relatives have not yet filed for the death benefit.

(A) $\dfrac{81}{2401}$

(B) $\dfrac{256}{2401}$

(C) $\dfrac{81}{256}$

(D) $\dfrac{2401}{81}\left(\dfrac{81-\beta^4}{2401-\beta^4}\right)$

(E) $\dfrac{2401}{256}\left(\dfrac{256-\beta^4}{2401-\beta^4}\right)$

376. A small manufacturing company, consisting of five senior employees and ten junior employees, randomly selects four employees to attend a professional conference.

Calculate the probability that at least three senior employees are chosen.

(A) 0.060
(B) 0.073
(C) 0.077
(D) 0.099
(E) 0.111

377. In a group of 3000 medical insurance policyholders, 1100 have a high resting heart rate, and 1900 have a low or normal resting heart rate. Of the policyholders with a high resting heart rate, 60 were treated for a stroke this year. Of the policyholders with a low or normal resting heart rate, 28 were treated for a stroke this year.

Calculate the probability that a randomly chosen policyholder from the group has a low or normal resting heart rate, given that this policyholder was treated for a stroke this year.

(A) 0.009
(B) 0.015
(C) 0.318
(D) 0.467
(E) 0.633

378. In a certain year, an insurance company's profit is modeled by a normal distribution with mean 6.72. The 80th percentile of the profit is 8.40.

Calculate the 90th percentile of the insurance company's profit in the year.

(A) 8.61
(B) 8.96
(C) 9.28
(D) 9.45
(E) 12.80

379. A building experiences a power failure. The probability density function of the length (in days) of this power failure is

$$f(x) = \begin{cases} \dfrac{(4-x)^3}{64}, & \text{for } 0 < x < 4 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate the median length (in days) of this power failure.

(A) 0.0
(B) $4-\sqrt[4]{128}$
(C) 0.8
(D) $4-\sqrt[3]{32}$
(E) 2.0

380. Sections of rope are cut from a spool, after which each of the rope's two ends are cleanly trimmed and capped with a metal guard. The following information is known:

i) The lengths that result by cutting a section of rope from the spool are normally distributed with mean 1205 inches and variance 5.
ii) The pieces trimmed from the two ends each have lengths that are normally distributed with mean 2 inches and variance 0.50.
iii) Without variation, each of the two guards extends exactly one inch beyond the end of the rope to which the guard is attached.
iv) The three lengths mentioned in i) and ii) are mutually independent.

Calculate the probability that the finished product, measured guard tip to guard tip, is at least 1200.

(A) 0.6915
(B) 0.8897
(C) 0.9101
(D) 0.9332
(E) 0.9999

381. The lifetime (in years) of a car is a random variable with probability density function

$$f(x) = \begin{cases} 0.0625e^{-0.0625x}, & \text{for } x > 0 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate the probability that the car's lifetime is less than 20 years, given that the car's lifetime is at least five years.

(A) 0.445
(B) 0.522
(C) 0.608
(D) 0.832
(E) 0.975

382. A company's website consists of 30 pages. Five pages contain low graphical content, ten pages contain moderate graphical content, and fifteen pages contain high graphical content. Four pages are randomly selected from the website without replacement. Let:

> X = number of pages selected which contain moderate graphical content, and
> Y = number of pages selected which contain high graphical content.

Calculate the conditional variance of Y, given that $X = 3$.

(A) 0.1875
(B) 0.2469
(C) 0.5625
(D) 0.7500
(E) 1.3125

383. A statistician models the size of unemployment claims that range from 0 to 1 using a probability density function proportional to the n^{th} root of the size of the claim, for some positive integer n.

Determine the ratio of the 30th percentile to the 20th percentile of the size of an unemployment claim.

(A) $\sqrt[n]{1.5}$
(B) $(1.5)^n$
(C) $\sqrt[n]{(1.5)^{n+1}}$
(D) $\sqrt[n+1]{(1.5)^n}$
(E) $(1.5)^{n+1}$

384. A dental insurance company offers two plans. The company's actuary makes the following observations:

i) The size of a claim under the first plan ranges from 0 to 1 and has a distribution with a density function proportional to the square of the size of the claim.

ii) For any p with $0 \le p \le 1$, the $(100p)$ percentile of the sizes of claims under the first plan equals the $(100p^2)$ percentile of the sizes of claims under the second plan.

Determine the density function for the size of a claim under the second plan, for $0 \le x \le 1$.

(A) $\frac{2}{3}x^5$

(B) $6x^5$

(C) $5x^4$

(D) $2x$

(E) $\frac{3}{2}x^{\frac{1}{2}}$

385. A computer manufacturer collects data on how long it takes before its computers fail. The time to fail, in years, follows an exponential distribution. Twenty percent of its computers fail within two years.

The probability a randomly selected computer fails before time t, in years, is 0.80.

Calculate t.

(A) 3.6
(B) 7.2
(C) 8.0
(D) 14.4
(E) 16.0

386. To discourage traffic violations, county C charges each driver a fine of 1 for the driver's first ticket of this year, 2 for the driver's second ticket of this year, and generally *n* for the driver's *n*th ticket of this year.

The number of traffic tickets a certain driver in county C receives this year is Poisson distributed with mean 4.

Calculate the expected value of the total fine this driver is charged for tickets this year.

(A) 6
(B) 8
(C) 10
(D) 12
(E) 14

387. When a computer crashes, each of the data files 1, 2,…, *d* has the same probability of being corrupted, independently of the other files. Given that a crash causes exactly two of the *d* files to be corrupted, the probability that neither of the two most recently created files are corrupted is $\frac{40}{51}$.

Calculate the probability that none of the three most recently created files are corrupted, given that a crash causes exactly two of the files to be corrupted.

(A) 0.523
(B) 0.676
(C) 0.686
(D) 0.695
(E) 0.710

388. Under an insurance policy, no benefit is paid on 75% of the claims filed. The benefits paid on the remaining claims are exponentially distributed with mean 8.

Calculate the variance of the benefit for a randomly selected claim under this policy.

(A) 2
(B) 14
(C) 16
(D) 28
(E) 32

389. Four men at a wedding party throw their hats into a big box. Later, each of them randomly selects a hat from the box and places it on his head.

Calculate the probability that none of the four men has his own hat on his head.

(A) 0.042
(B) 0.250
(C) 0.333
(D) 0.375
(E) 0.500

390. In a vacation timeshare marketing business, the value of each timeshare point is modeled by a random variable, X, which follows a gamma distribution with mean 6 and variance 18.

Calculate the probability that the value of a timeshare point exceeds 4.

(A) 0.54
(B) 0.56
(C) 0.58
(D) 0.60
(E) 0.62

391. The annual profits of each of two car insurance companies, A and B, are normally distributed with the same standard deviation.

The mean annual profit of company A is 30.

A profit of 214 is both the 96^{th} percentile of company A's annual profit and the 90^{th} percentile of company B's annual profit.

Calculate the mean annual profit of company B.

(A) 33
(B) 42
(C) 54
(D) 79
(E) 105

392. The amount of time, in years, that a refrigerator functions before breaking down is a continuous random variable with density function

$$f(x) = \begin{cases} c(x-5), & \text{for } 5 \le x \le 8 \\ c(11-x), & \text{for } 8 < x \le 11 \\ 0, & \text{otherwise,} \end{cases}$$

where c is a constant.

Calculate the probability that the refrigerator will function between six and eight years before breaking down.

(A) 0.222
(B) 0.278
(C) 0.333
(D) 0.379
(E) 0.444

393. A homeowner purchases a policy from an insurance company covering losses from hurricanes and fires. Under the policy, the insurance company pays 1000 for each loss.

In each year, the number of hurricanes is Poisson distributed, with a common mean for all years. Similarly, for each year, the number of fires is also Poisson distributed, with a common mean for all years. A hurricane occurs on average once every 10 years, while a fire occurs on average once every 50 years. The numbers of hurricanes and numbers of fires in different years are all mutually independent.

Let T be a random variable representing the total payments made by the insurance company to the homeowner over the next 40 years.

Calculate the mode of T.

(A) 2000
(B) 3000
(C) 4000
(D) 4800
(E) 5000

394. The loss, X, subject to reimbursement under an insurance policy, has density function

$$f(x) = \begin{cases} \left(\dfrac{1}{\beta}\right) e^{\frac{-(x-d)}{\beta}}, & \text{for } x \geq d \\ 0, & \text{otherwise,} \end{cases}$$

where d is the deductible, and β is a positive constant.

Determine the absolute value of the difference between the mode of X and the 10th percentile of X.

(A) $\beta \ln\left(\dfrac{11}{10}\right)$

(B) $\beta \ln\left(\dfrac{10}{9}\right)$

(C) $\beta \ln\left(\dfrac{11}{10}\right) + d$

(D) $\beta \ln\left(\dfrac{10}{9}\right) + d$

(E) $\dfrac{1}{\beta} \ln\left(\dfrac{11}{10}\right)$

395. An insurer's losses are modeled by a random variable X, with density function, f, where $f(x)$ is proportional to $\frac{1}{x^2}$, for $x > 100$, and 0, otherwise.

Calculate the median of X.

(A) 100
(B) 120
(C) 150
(D) 200
(E) 300

396. An insurance policy covers losses incurred by a policyholder, subject to a deductible of 20. Losses incurred follow a distribution with probability density function

$$f(x) = \begin{cases} kx^{0.25}, & \text{for } 0 < x < 100 \\ 0, & \text{otherwise,} \end{cases}$$

where k is a constant.

Calculate the 90th percentile of losses that exceed the deductible.

(A) 89
(B) 90
(C) 91
(D) 92
(E) 93

397. The combined results of employee satisfaction surveys taken at each of Store A and Store B are given in the following table, in which satisfaction is ranked from 0 to 5.

Satisfaction	Combined Frequencies over Stores A and B
0	9
1	6
2	12
3	6
4	6
5	9

Among only the employees of Store A, the frequency of each response is at least 4. Store A has three modes, each with a frequency of 8.

Calculate the largest possible number of modes for Store B.

(A) 0
(B) 1
(C) 2
(D) 3
(E) 5

398. Ten percent of homeowners in a certain city are classified as high-risk, and ninety percent are classified as low-risk. Each homeowner's classification remains unchanged over the next four years.

In any given year, each high-risk homeowner has probability 0.80 of experiencing no fires, and each low-risk homeowner has probability 0.99 of experiencing no fires. For each homeowner, the numbers of fires in different years are mutually independent.

A randomly chosen homeowner experiences no fires in the first and second years.

Calculate the probability that this homeowner will experience no fires in the third and fourth years.

(A) 0.9055
(B) 0.9324
(C) 0.9461
(D) 0.9548
(E) 0.9571

399. In a large population of patients, 20% have cancer. Of those who have cancer, 8% have stage IV cancer.

Patients are tested one at a time, at random, until five patients with stage IV cancer are found.

Let N represent the number of patients tested. Let C represent the number of patients tested who have cancer.

Determine the probability function, $p_{N,C}(n,c)$, for integers n and c such that $5 \le c \le n$.

(A) $p_{N,C}(n,c) = \dfrac{(n-1)!}{(n-c)!(c-5)!4!}(0.8)^{n-c}(0.184)^{c-5}(0.016)^5$

(B) $p_{N,C}(n,c) = \dfrac{(n-1)!}{(n-c)!(c-5)!4!}(0.8)^{n-c}(0.12)^{c-5}(0.08)^5$

(C) $p_{N,C}(n,c) = \dfrac{n!}{(n-c)!(c-5)!5!}(0.8)^{n-c}(0.184)^{c-5}(0.016)^5$

(D) $p_{N,C}(n,c) = \dfrac{(n-5)!}{(n-c)!(c-5)!}(0.8)^{n-c}(0.184)^{c-5}(0.016)^5$

(E) $p_{N,C}(n,c) = \dfrac{(n-1)!}{(n-c-1)!(c-4)!4!}(0.8)^{n-c-1}(0.12)^{c-4}(0.08)^5$

400. An insurance policy provides coverage for two types of claims. Let X and Y denote the numbers of monthly claims of Type I and Type II, respectively. The joint probability function of X and Y is given by

$$p(x,y) = \frac{8-2x-y}{54}, \qquad \text{for } x = 0,1,2 \text{ and } y = 0,1,2,3.$$

Calculate the probability that there are in total at least two claims on this policy in the coming month.

(A) 0.19
(B) 0.28
(C) 0.39
(D) 0.52
(E) 0.61

401. Let X be a normally distributed random variable representing the amount of an individual claim of a policyholder covered by a group health policy.

You are given that $\mathrm{Var}(X) = 250{,}000$ and $P[X<1000] = 0.3446$.

Calculate the difference between the 90^{th} percentile of X and the median of X.

(A) 241
(B) 441
(C) 641
(D) 822
(E) 980

402. The number of phone calls received per minute at a call center is modeled by a Poisson distribution. The second moment of the number of calls received per minute is 0.2756. The numbers of calls received during non-overlapping one-minute time intervals are mutually independent random variables.

Calculate the probability that more than two calls are received in a 15-minute interval.

(A) 0.655
(B) 0.781
(C) 0.805
(D) 0.850
(E) 0.918

403. Five claims are randomly selected from a group of fifteen different claims, which consists of five workers compensation claims, four homeowner claims and six auto claims.

Calculate the probability that the five claims selected consist of one workers compensation claim, three homeowner claims and one auto claim.

(A) 0.025
(B) 0.036
(C) 0.040
(D) 0.150
(E) 0.213

404. The joint probability function of X and Y is

$$p(x,y)=\begin{cases}\dfrac{24-7x-3y}{126}, & \text{for } x=0,1,2 \text{ and } y=0,1,2\\ 0, & \text{otherwise.}\end{cases}$$

Calculate Var(Y).

(A) 0.56
(B) 0.65
(C) 0.75
(D) 0.80
(E) 0.87

405. A monthly state lottery picks five distinct integers from 1 to 30 and selects one of the five to be the bonus number. An entry consists of five distinct integers from 1 to 30 with one of the numbers designated as the bonus number.

Each month there are 100,000 entries. Each entry that matches the five distinct numbers is awarded 50,000. If the bonus number is also matched, an additional 250,000 is awarded to that entry. Nothing is awarded for matching fewer than five numbers.

Calculate the expected payout from the lottery in a month.

(A) 70,172
(B) 77,190
(C) 84,731
(D) 100,000
(E) 175,431

406. The number of monthly claims on an insurance policy has a distribution given by

Number of monthly claims	Probability
0	s
1	t
2	$0.75s$
3 or more	0

A random sample of five policies is selected, and the claims for a given month are recorded. The numbers of claims on the five policies are mutually independent. Let the random variable Y denote the number of policies from the sample with fewer than two monthly claims.

Let $c = \mathrm{P}\left[Y = 5\right]$.

Determine which of the following is equal to t.

(A) $\dfrac{4-4c^{0.2}}{3}$

(B) $\dfrac{3-7c^{0.2}}{3}$

(C) $\dfrac{4c^{0.2}-4}{3}$

(D) $\dfrac{5c^{0.2}-3}{3}$

(E) $\dfrac{7c^{0.2}-4}{3}$

407. The lifetime of a new electronic device is exponentially distributed with a median of three years.

Calculate the variance of the remaining lifetime, given the device did not fail before 0.5 years.

(A) 3.8
(B) 4.3
(C) 9.0
(D) 14.7
(E) 18.7

408. A purse contains two coins, one fair and one two-headed. One of the coins is selected at random and tossed twice. Both tosses result in heads.

Calculate the probability that a third toss of the selected coin will result in heads.

(A) 1/2
(B) 9/16
(C) 5/8
(D) 4/5
(E) 9/10

409. The amount of a loss under a fire insurance policy is continuous and has cumulative distribution function

$$F(x) = \begin{cases} 0, & \text{for } x < 0 \\ c\left(\dfrac{x}{15}\right)^{\frac{4}{3}}, & \text{for } 0 \le x \le 10 \\ 1, & \text{for } x > 10, \end{cases}$$

where c is a positive constant.

The insurer reimburses each loss up to a maximum amount m. The probability that a given loss is partially reimbursed is 0.56.

Calculate m.

(A) 5.40
(B) 6.47
(C) 7.03
(D) 7.80
(E) 8.10

410. This year, a homeowner experiences no tornadoes with probability 0.80, exactly one tornado with probability 0.12, exactly two tornadoes with probability 0.05, and exactly three tornadoes with probability 0.03.

Each tornado independently results in a loss of 1 with probability 0.50 and a loss of 2 with probability 0.50.

Let *X* be the number of tornadoes that the homeowner experiences this year, and *Y* be the total amount of losses that the homeowner experiences this year due to all the tornadoes. Let $F(x, y)$ be the joint cumulative distribution function of *X* and *Y*.

Calculate $F(2,3)$.

(A) 0.0250
(B) 0.0500
(C) 0.0675
(D) 0.9325
(E) 0.9575

411. An automobile insurance company specializes in insuring high-risk drivers.

The number of accidents for a randomly selected high-risk driver in year 1 is modeled by a random variable *X*. The number of accidents for the same driver in year 2 is modeled by a random variable *Y*.

The probability mass function of *X* and *Y* is

$$p(x,y) = \begin{cases} \dfrac{(4-x)(3-y)}{60}, & \text{for } x = 0,1,2,3 \text{ and } y = 0,1,2 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate Var(*Y*).

(A) 0.56
(B) 0.67
(C) 0.75
(D) 1.00
(E) 1.44

412. Claims on a liability policy are independent and uniformly distributed on the interval [0, 10]. An auditor randomly selects three claims.

Calculate the probability that the maximum of the three claims is less than 7.

(A) 0.027
(B) 0.081
(C) 0.189
(D) 0.343
(E) 0.441

413. An auditor is examining insurance policies for fraud. A policyholder can only file one claim. The probability of any given policy having a claim is 0.90, and the probability of a claim being fraudulent is 0.20. The auditor picks five policies at random and examines them in order until he finds two fraudulent claims. He then stops examining policies. If he doesn't find two fraudulent claims, he stops after examining the fifth policy.

Calculate the expected number of policies he will examine.

(A) 4.68
(B) 4.73
(C) 4.78
(D) 4.83
(E) 4.88

414. An agent markets a new life insurance policy to nine people. Six of the nine have already purchased an insurance product from the agent.

The agent randomly selects four of the nine people for appointments today.

Calculate the probability that at least three of the four people with appointments have already purchased an insurance product from the agent.

(A) 0.10
(B) 0.12
(C) 0.14
(D) 0.48
(E) 0.60

415. A specialty store sells only baby carriages and car seats. The price of a baby carriage is 300 and the price of a car seat is 100. The proprietor knows that 60% of the people stopping at the store do not make a purchase, 20% buy a baby carriage, and 35% buy a car seat. No customer buys more than one of each item. If a customer buys both a baby carriage and a car seat, the proprietor gives a 10% discount on the total.

Calculate the revenue the proprietor expects on a day that 200 people come to the store.

(A) 8,200
(B) 17,800
(C) 18,400
(D) 18,440
(E) 29,800

416. A company has 1000 dental insurance policies. The number of claims filed by a policyholder during one year is a Poisson random variable with variance 1. The number of claims filed by these policyholders are mutually independent.

The payment for each dental claim is 100 and the annual premium for each policy is 103% of the total expected claim payments for that policy.

Calculate the probability, using the normal approximation, that the total claim payments on the 1000 policies exceeds the total premium collected.

(A) 0.001
(B) 0.159
(C) 0.167
(D) 0.488
(E) 0.500

417. On average, a certain word processing software program has a fatal crash once in every 50 instances of saving a document.

The instances of fatal crashes, while saving, are independent from one another.

Calculate the probability that the second fatal crash, while saving, occurs on the fourth instance of saving a document.

(A) 0.00038
(B) 0.00115
(C) 0.00230
(D) 0.01882
(E) 0.02000

418. A policyholder purchases car insurance for two years. In a given year, the policyholder's number of car accidents is zero with probability 0.9, exactly one with probability 0.08, and exactly two with probability 0.02. The number of accidents in the first year is independent of the number in the second.

Calculate the probability that the policyholder has one accident in each year, given that the policyholder has a total of exactly two accidents.

(A) 0.006
(B) 0.042
(C) 0.151
(D) 0.262
(E) 0.960

419. A customer purchases a lawnmower with a two-year warranty. The number of years before the lawnmower needs a repair is uniformly distributed on [0, 5].

Calculate the probability that the lawnmower needs no repairs within 4.5 years after the purchase, given that the lawnmower needs no repairs within the warranty period.

(A) 0.10
(B) 0.17
(C) 0.44
(D) 0.50
(E) 0.60

420. A scientist estimates the time (in tens of millions of years) before a major asteroid will hit the earth using a random variable X with probability density function

$$f(x) = \begin{cases} xe^{-x}, & \text{for } x > 0 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate the probability that the next time the earth is hit by a major asteroid occurs between 10 million and 20 million years from now.

(A) 0.0005
(B) 0.0867
(C) 0.3298
(D) 0.6702
(E) 0.9995

421. The lifetimes of televisions of a certain model are exponentially distributed with a median of 2.7 years.

Calculate the 87.5th percentile of the lifetimes for these televisions.

(A) 3.08
(B) 4.73
(C) 8.10
(D) 10.80
(E) 19.68

422. Events A and B are mutually exclusive, and at least one of A or B is certain to occur. Events C and D are mutually exclusive, and at least one of C or D is certain to occur.

The following probabilities are known:

i) $P[A] = 0.75$
ii) $P[D] = 0.20$
iii) $P[A \cap C] = 0.55$

Calculate $P[B \cap D]$.

(A) 0.00
(B) 0.05
(C) 0.20
(D) 0.25
(E) 0.45

423. A survey was conducted within the population of those who claim to have contributed to charity during the previous year. Results indicate that 70% of this population claimed to have contributed at least 1000, 50% overstated the value of their contributions, and 45% did both.

Assume that the survey accurately represents the population.

Calculate the probability that a randomly selected person overstated the value of his contribution, given that they claimed to have contributed less than 1000.

(A) 1/20
(B) 1/10
(C) 1/6
(D) 3/4
(E) 5/6

424. A website requires a five-character password consisting of exactly three distinct characters selected from the 26 upper-case letters of the alphabet and exactly two characters, not necessarily distinct, selected from the ten digits. The password must begin with one of the selected letters.

Calculate the maximum number of unique passwords, in millions, the site will accommodate.

(A) 3.120
(B) 4.212
(C) 4.680
(D) 8.424
(E) 9.360

425. This year, the number of tooth fillings a policyholder undergoes is Poisson distributed. The probability that the policyholder undergoes no tooth fillings this year is 0.18.

Calculate the mode of the number of tooth fillings the policyholder undergoes this year.

(A) 0
(B) 1
(C) 2
(D) 5
(E) 6

426. The time, in years, until replacement for a new telephone pole has probability density function

$$f(t) = \begin{cases} kt, & \text{for } 0 < t < 50 \\ 0, & \text{otherwise,} \end{cases}$$

where k is a constant.

Calculate the probability that a new telephone pole will be replaced within 25 years given that it is not replaced within 20 years.

(A) 0.09
(B) 0.11
(C) 0.16
(D) 0.17
(E) 0.84

427. An insurance company categorizes its policyholders into three mutually exclusive groups: high-risk, medium-risk, and low-risk. An internal study showed that 45% of the policyholders are low-risk and 35% are medium-risk. The probability of death over the next year for a high-risk policyholder is two times that for a medium-risk policyholder. The probability of death over the next year for a medium-risk policyholder is three times that for a low-risk policyholder. The probability of death of a randomly selected policyholder over the next year is 0.009.

Calculate the probability of death over the next year for a high-risk policyholder.

(A) 0.0025
(B) 0.0200
(C) 0.1215
(D) 0.2000
(E) 0.3750

428. The working lifetime of a master computer chip that regulates the electronic components of an automobile engine is exponentially distributed with a mean of 7.2 years. Under a warranty, the chip manufacturer will replace any chip that fails within *t* years. It is expected that 5% of all chips will be replaced under this warranty.

Calculate *t*.

(A) 0.007
(B) 0.369
(C) 0.416
(D) 0.501
(E) 0.720

429. A baseball-pitching machine is used for batting practice. The machine is out of adjustment such that every pitched baseball arrives at the batter's box between 0 and 2 feet higher than intended.

Let X equal the difference, in feet, between the actual arrival height and the intended arrival height of a pitched baseball.

The density of X, $f(x)$, is proportional to x.

Calculate the 80th percentile for X.

(A) 0.40
(B) 0.89
(C) 1.26
(D) 1.60
(E) 1.79

430. Two different models of televisions, A and B, have exponentially distributed lifespans, measured in years. The probability that television A and television B are still working T years from now is 0.49 and 0.70, respectively.

The variance of television A's lifespan is 5.60.

Calculate the variance of television B's lifespan.

(A) 1.40
(B) 1.80
(C) 2.80
(D) 11.20
(E) 22.40

431. Each year, a car insurance company's four quarterly profits are mutually independent and normally distributed with common mean and variance. Each quarter, the probability that the company earns a positive profit is 0.80.

Calculate the probability that the company earns an overall positive profit in a given year.

(A) 0.410
(B) 0.663
(C) 0.800
(D 0.954
(E) 0.998

432. A large life insurance company gets a steady inflow of new policyholders each month. In the past, the number of new policyholders per month, N_{past}, was normally distributed with mean 500, standard deviation σ, and $P[N_{\text{past}} < 400] = 0.1056$.

The company has just undertaken a new marketing strategy, which is projected to have a positive effect on new sales. The projected number of new policyholders per month, N_{future}, is normally distributed with mean 550 and standard deviation 1.25σ.

Calculate $P[370 < N_{\text{future}} < 730]$.

(A) 0.903
(B) 0.928
(C) 0.970
(D) 0.976
(E) 0.985

433. An insurance company sells flood and fire insurance. This year, the company's profit from selling flood insurance is normally distributed, and its profit from selling fire insurance is normally distributed with three times the mean and three times the standard deviation as from flood insurance.

The profits from the two types of insurance are independent. The probability that the company earns a positive profit from selling flood insurance this year is 0.67.

Calculate the probability that the insurance company earns an overall positive profit this year.

(A) 0.71
(B) 0.73
(C) 0.81
(D) 0.92
(E) 0.96

434. An amusement park has two roller coasters. This year, the numbers of accidents occurring on the first and second roller coasters are Poisson distributed with means $\lambda_1 = 0.5$ and λ_2, respectively. The probability that at least one accident occurs on the second roller coaster is twice the probability for the first roller coaster.

Calculate λ_2.

(A) 1.00
(B) 1.19
(C) 1.23
(D) 1.55
(E) 2.00

435. A large city police department is conducting an analysis of the annual number of car accidents in the city. The department hires an actuary who models the annual number of car accidents using an exponential distribution with a variance of 7225.

Calculate the median minus the mean of this distribution.

(A) –2217
(B) –26
(C) 0
(D) 26
(E) 2217

436. An insurance policy has been purchased for a windmill farm. The policy will pay to compensate for the loss of revenue resulting from certain weather hazards that shut down the farm. Each such loss is exponentially distributed with standard deviation 1000.

Calculate the probability that a random loss exceeds 1500 given that it exceeds the mean.

(A) 0.22
(B) 0.39
(C) 0.50
(D) 0.61
(E) 0.78

437. Data from a study shows the following about the number of injuries a football player experiences in a year:

i) The probability is 0.250 that the player experiences 1 or 2 injuries.
ii) The probability is 0.036 that the player experiences 2 or 3 injuries.
iii) The probability is 0.260 that the player experiences at least 1 injury.
iv) The probability is 0.002 that the player experiences at least 4 injuries.

Calculate the probability that the football player experiences exactly 2 injuries this year.

(A) 0.009
(B) 0.014
(C) 0.024
(D) 0.028
(E) 0.048

438. A delivery truck, when filled to capacity, can carry only three items of Type A in addition to only two items of Type B.

One day, six items of Type A and four items of Type B await delivery. The ten items are brought to the loading dock one at a time in random order.

Calculate the probability that the first five items brought to the loading dock will fill the delivery truck to capacity.

(A) 1/210
(B) 1/21
(C) 1/10
(D) 21/100
(E) 10/21

439. An insurance company's profit for one year is normally distributed with probability 0.8531 of being positive.

The company's profit the next year is normally distributed with probability 0.9192 of being positive.

The yearly profits are independent with the same mean but different standard deviations.

Calculate the probability that the insurance company earns an overall positive profit in this two-year period.

(A) 0.7842
(B) 0.7995
(C) 0.8849
(D) 0.9535
(E) 0.9929

440. Losses under a boat insurance policy are exponentially distributed. The median loss is 400.

Calculate the mean loss.

(A) 400
(B) 446
(C) 492
(D) 533
(E) 577

441. A patient must undergo hospitalization and surgery. The hospitalization and surgery charges are uniformly distributed on the intervals $[0,b]$ and $[0,2b-6]$, respectively, where b is a constant larger than 3.

The standard deviation of the hospitalization charge is 9.60.

Calculate the standard deviation of the surgery charge.

(A) 13.2
(B) 15.7
(C) 17.5
(D) 19.2
(E) 19.9

442. Let X be a random variable that is uniform on $[a, b]$. The probability that X is greater than 8 is 0.60. The probability that X is greater than 11 is 0.20.

Calculate the variance of X.

(A) 3.70
(B) 4.69
(C) 6.25
(D) 7.24
(E) 8.75

443. A continuous random variable, X, has density function $f(x)$ where

$$f(x)=\begin{cases} \dfrac{x-1}{4}, & \text{for } 1<x<3 \\ \dfrac{5-x}{4}, & \text{for } 3\le x<5 \\ 0, & \text{otherwise.} \end{cases}$$

Determine which of the following expressions equals $\mathrm{E}\left(\left| X-2 \right|\right)$.

(A) $\frac{1}{4}\int_1^2 (2-x)(x-1)\,dx+\frac{1}{4}\int_2^3 (x-2)(x-1)\,dx+\frac{1}{4}\int_3^5 (2-x)(5-x)\,dx$

(B) $\frac{1}{4}\int_1^3 (2-x)(x-1)\,dx+\frac{1}{4}\int_3^5 (x-2)(5-x)\,dx$

(C) $\frac{1}{4}\int_1^2 (x-2)(x-1)\,dx+\frac{1}{4}\int_2^3 (2-x)(x-1)\,dx+\frac{1}{4}\int_3^5 (2-x)(5-x)\,dx$

(D) $\frac{1}{4}\int_1^3 (x-2)(x-1)\,dx+\frac{1}{4}\int_3^5 (x-2)(5-x)\,dx$

(E) $\frac{1}{4}\int_1^2 (2-x)(x-1)\,dx+\frac{1}{4}\int_2^3 (x-2)(x-1)\,dx+\frac{1}{4}\int_3^5 (x-2)(5-x)\,dx$

444. The joint probability function of X and Y is given by

$$p(x,y)=\begin{cases}\dfrac{-2x-4y+xy+8}{18}, & \text{for } x=1,2,3 \text{ and } y=0,1\\ 0, & \text{otherwise.}\end{cases}$$

Calculate $\mathrm{E}\left(\dfrac{Y}{X}\right)$.

(A) 0.102
(B) 0.200
(C) 0.241
(D) 0.306
(E) 0.722

445. In a study of driver safety, drivers were categorized according to three risk factors. For each risk factor, exactly 1200 drivers exhibited that risk factor, and exactly 420 among them exhibited only that risk factor. There were exactly 320 drivers who exhibited all three risk factors and 480 who exhibited none of the three risk factors.

Calculate the number of drivers in the study.

(A) 1740
(B) 2290
(C) 2750
(D) 3440
(E) 4080

446. Once each morning and once each afternoon, the driver of a delivery truck is assigned to a route with a length that depends upon the items being delivered. The morning route is 5, 10, or 40 miles. The afternoon route is 0, 5, or 30 miles. The routes are assigned with the following probabilities:

		Length of Afternoon Route (miles)		
		0	5	30
Length of Morning Route(miles)	5	0	$2x$	$3x$
	10	0	$2x$	0
	40	y	0	0

The expected length of the assigned afternoon route is 11 miles.

Calculate the variance of the length of the afternoon route.

(A) 159.0
(B) 168.5
(C) 181.5
(D) 259.0
(E) 269.0

447. The amount of money stolen from an insured home during a burglary is modeled by a random variable that is uniformly distributed on the interval [0, 1000]. The claim payment that the insurer makes for such a loss under its homeowners policy has the following characteristics:

i) The claim payment equals a constant percentage, p, of the amount by which the loss exceeds 400.

ii) The expected claim payment is 90.

Calculate p.

(A) 15%
(B) 18%
(C) 30%
(D) 50%
(E) 75%

448. A policyholder sustains one loss covered by policy A and a second loss covered by policy B. The two losses are independent and uniformly distributed on the interval [0,10]. Each policy has a deductible of 5.

Calculate the probability that the larger of the two claim payments does not exceed t, for $0 \le t \le 5$.

(A) $\left(\frac{t}{5}\right)^2$

(B) $\left(\frac{t}{10}\right)^2$

(C) $\frac{5+t}{10}$

(D) $\left(\frac{5+t}{10}\right)^2$

(E) $1-\left(\frac{5-t}{10}\right)^2$

449. Two random variables X and Y are each defined on a set of positive integers and have joint probability function $p(x,y)$. A portion of the corresponding joint cumulative distribution function $F(x,y)$ is given in the following table:

		x			
		3	4	5	6
y	8	0.53	0.62	0.67	0.75
	9	0.65	0.76	0.84	0.93

Calculate $p(4,9) + p(5,9)$.

(A) 0.01
(B) 0.02
(C) 0.03
(D) 0.04
(E) 0.05

450. X, Y, and Z are three mutually independent Poisson random variables with common variance λ. Let $U = 100X + 150Y + 200Z$. The coefficient of variation for U is 0.90.

Calculate λ.

(A) 0.44
(B) 0.82
(C) 1.22
(D) 1.50
(E) 2.25

451. A system has three mutually independent components. Each component has a lifetime that is modeled by a random variable with density function

$$f(y) = \begin{cases} e^{-(y-5)}, & \text{for } y > 5 \\ 0, & \text{otherwise.} \end{cases}$$

The system will fail when any of the three components fail.

Calculate the expected lifetime of the system.

(A) 5.20
(B) 5.33
(C) 5.67
(D) 6.00
(E) 6.33

452. An insurance company's medical claims for individual policyholders are normally distributed with a mean of 1000 and a standard deviation of 625.

The insurance company sells the medical insurance to a group of 25 individuals whose claims are mutually independent.

The insurance company will lose money if the total claims for the 25 individuals exceeds 27,500.

Calculate the probability that the insurance company will lose money.

(A) 0.07
(B) 0.10
(C) 0.14
(D) 0.21
(E) 0.44

453. Losses under a policy are uniformly distributed on the interval [0, 480]. For each loss, the claim payment is a constant percentage of the amount in excess of a deductible of 240.

The insurer wants the variance of the claim payment for a single loss to equal 2000.

Calculate the percentage the insurer should choose.

(A) 11.1%
(B) 33.3%
(C) 57.7%
(D) 64.5%
(E) 91.3%

454. Losses under an insurance policy are uniformly distributed on [0, 1000]. The policy has a deductible of 400.

A loss occurred for which the insurance benefit was less than 400.

Calculate the probability that the benefit was more than 300.

(A) 0.100
(B) 0.125
(C) 0.250
(D) 0.750
(E) 0.875

455. Under a health insurance policy, 70% of the policyholders are low-risk and the other 30% are high-risk. For each low-risk policyholder, the number of hospitalizations experienced this year is Poisson-distributed with mean 0.05. For each high-risk policyholder, the number of hospitalizations experienced this year is Poisson-distributed with mean 0.30.

Calculate the probability that a randomly selected policyholder is low-risk, given that the policyholder undergoes no hospitalizations this year.

(A) 0.280
(B) 0.666
(C) 0.700
(D) 0.750
(E) 0.760

456. In a group of ten patients, three have high blood pressure, six have normal blood pressure, and one has low blood pressure.

Four of these ten patients are randomly selected without replacement.

Calculate the probability that exactly two of these four patients have normal blood pressure.

(A) 0.058
(B) 0.071
(C) 0.300
(D) 0.346
(E) 0.429

457. Let X denote the number of illnesses a person experiences during a one-year period. The probability function of X is:

x	Probability
0	0.28
1	0.12
2	0.42
3	0.18

If $X = 0$, then the person makes no doctor visits during the one-year period. If $X = k$, for $k = 1, 2, 3$, then the number of doctor visits is Poisson distributed with mean k.

Calculate the probability that the person makes at least one doctor visit during the one-year period.

(A) 0.18
(B) 0.39
(C) 0.61
(D) 0.72
(E) 0.89

458. An investor wants to purchase a total of ten units of two assets, A and B, with annual payoffs per unit purchased of X and Y, respectively. Each asset has the same purchase price per unit. The payoffs are independent random variables with equal expected values and with $\mathrm{Var}(X) = 30$ and $\mathrm{Var}(Y) = 20$.

Calculate the number of units of asset A the investor should purchase to minimize the variance of the total payoff.

(A) 0
(B) 2
(C) 4
(D) 5
(E) 6

459. For its group life policies, an insurer models the number of claims per group as independent Poisson random variables with common mean 16.

The insurer randomly selects 64 of its groups.

Calculate the probability that the average number of claims per group is between 15 and 18.

(A) 0.29
(B) 0.38
(C) 0.95
(D) 0.98
(E) 1.00

460. Claims under a product liability policy have the following characteristics:

i) The number of claims does not exceed two.
ii) The probability that the number of claims is exactly one is 0.08.
iii) The probability that the number of claims is exactly two is 0.02.
iv) For n = 1 or 2 claims, the total claim amount under the policy is a random variable X with cumulative distribution function

$$F(x) = 1 - \left(\frac{500n}{x}\right), \qquad \text{for } x \geq 500n.$$

Calculate the probability that there is exactly one claim, given that there is at least one claim and the total claim amount under the policy is less than or equal to 2000.

(A) 1/2
(B) 3/5
(C) 2/3
(D) 3/4
(E) 6/7

461. The number of traffic tickets a driver receives this year is Poisson distributed. The driver's probability of receiving no tickets is $e^{-1.5}$.

Calculate the probability that the driver receives at least four tickets this year, given that the driver receives at least one ticket.

(A) 0.066
(B) 0.084
(C) 0.138
(D) 0.141
(E) 0.250

462. Each person in a large population independently has probability p of testing positive for diabetes, $0 < p < 1$. People are tested for diabetes, one person at a time, until a test is positive. Individual tests are independent.

Determine the probability that m or fewer people are tested, given that n or fewer people are tested, where $1 \le m \le n$.

(A) $\dfrac{m}{n}$
(B) $(1-p)^{m-n}$
(C) $1-(1-p)^{m}$
(D) $\dfrac{1-p^{m}}{1-p^{n}}$
(E) $\dfrac{1-(1-p)^{m}}{1-(1-p)^{n}}$

463. The number of brake repair jobs a particular bus needs in a year is modeled by a Poisson distribution. The probability that the bus needs at least one brake repair job this year is 0.10.

Calculate the probability that the bus needs at least two brake repair jobs this year.

(A) 0.0052
(B) 0.0100
(C) 0.0500
(D) 0.1054
(E) 0.3303

464. The loss due to an injury in a certain sport is uniformly distributed on an interval.

The interquartile range of a random variable is defined as the difference between its 75^{th} and 25^{th} percentiles.

Determine the correct statement about the ratio of the standard deviation to the interquartile range of the loss due to a given injury in that sport.

(A) The ratio is $1:\sqrt{3}$, regardless of the endpoints of the interval.
(B) The ratio is 1:1, regardless of the endpoints of the interval.
(C) The ratio is $2:\sqrt{3}$, regardless of the endpoints of the interval.
(D) The ratio depends on the length of the interval.
(E) The ratio depends on the location of the center of the interval.

465. Homeowner losses due to tornado damage are exponentially distributed with standard deviation σ. A homeowners policy covers tornado losses in full, subject to a deductible. The probability that a random loss exceeds the deductible by at least σ is 0.20.

Calculate the probability that a random loss exceeds the deductible by at least 0.5σ.

A) 0.33
B) 0.40
C) 0.46
D) 0.54
E) 0.60

466. An individual buys an automobile policy and a homeowners policy for one year. The probability of an automobile claim is 0.10 and the probability of a homeowners claim is 0.05. Neither policy can have more than one claim. The correlation between the numbers of claims on these policies is 0.30.

Calculate the probability that both policies will have a claim.

(A) 0.005
(B) 0.006
(C) 0.025
(D) 0.033
(E) 0.045

467. Within a fleet of aircraft, planes are subject to mechanical inspection. For a randomly selected airplane, let X denote the number of inspections in the past year and Y the number of repairs. The joint probability function of X and Y is given by

$$p(x,y)=\begin{cases}\dfrac{x-2y-xy+3}{18}, & \text{for } x=1,2,3 \text{ and } y=0,1\\ 0, & \text{otherwise.}\end{cases}$$

Calculate the expected number of repairs per inspection, $\mathrm{E}\left(\dfrac{Y}{X}\right)$.

(A) 3/38
(B) 11/108
(C) 11/36
(D) 1/2
(E) 11/18

468. Drivers are classified as either high-risk or low-risk. Ten percent of drivers are classified as high-risk. The risk classification of each driver remains the same from this year to next year.

The probability that a driver classified as high-risk is involved in an accident is 0.12 for this year and, independently, 0.12 for next year. The probability that a driver classified as low-risk is involved in an accident is 0.05 for this year and, independently, 0.05 for next year.

Calculate the probability that a driver is involved in an accident next year, given that the driver is involved in an accident this year.

(A) 0.004
(B) 0.014
(C) 0.057
(D) 0.065
(E) 0.099

469. Random variable X follows a uniform distribution with mean 12 and 75^{th} percentile 18.

Calculate Var (X).

(A) 24
(B) 36
(C) 48
(D) 144
(E) 192

470. The random variable X follows a distribution with probability function

$$p(x) = \left(\frac{1}{5}\right)\left(\frac{4}{5}\right)^x, \qquad \text{for } x = 0, 1, 2, \ldots.$$

Calculate $\operatorname{Var}(X \mid X > 1)$.

(A) 13
(B) 16
(C) 20
(D) 22
(E) 24

471. An insurance policy insures against two perils. Let X and Y be the number of monthly claims for each of these perils. The joint probability function of X and Y is given by

$$p(x, y) = \frac{2x + y + 1}{36}, \quad \text{for } x = 0, 1, 2 \text{ and } y = 0, 1, 2.$$

Calculate the variance of the marginal distribution of X.

(A) 0.56
(B) 0.64
(C) 0.75
(D) 0.80
(E) 0.89

472. Basketball team Z has a 60% chance of winning any particular game. The team plays n games this season, where $n > 1$, with the outcomes of these games being mutually independent. The probability that the team wins exactly three games this season is five times the probability that the team wins exactly two games this season.

Calculate n.

(A) 6
(B) 8
(C) 10
(D) 12
(E) 14

473. Losses under a boat insurance policy are uniformly distributed on the interval [0, 1]. The policy has a fixed deductible.

The expected value of the claim payment on a given loss is 0.245.

Calculate the variance of the claim payment on a given loss.

(A) 0.020
(B) 0.054
(C) 0.062
(D) 0.083
(E) 0.114

474. A motorist currently has no traffic tickets.

The amount of time between now and when the motorist receives the first ticket is exponentially distributed with mean 0.80 years.

The motorist plans to drive more carefully after receiving the first ticket. Hence the mean time from the first ticket to the second is greater than 0.80. The amount of time between the first ticket and the second ticket is exponentially distributed and is independent of when the motorist receives the first ticket.

The variance of the number of years from now until the second ticket is 2.65.

Calculate the expected amount of time, in years, between the motorist's first and second traffic tickets.

(A) 0.83
(B) 0.96
(C) 1.42
(D) 1.85
(E) 2.01

475. Let X represent the number of defective parts in a shipment of four.

$$P[X \geq x] = \frac{1}{4}\left(1 - \frac{x-2}{3}\right)^2, \quad \text{for } x = 1, 2, 3, 4.$$

Calculate E(X).

(A) 0.83
(B) 0.96
(C) 1.39
(D) 1.81
(E) 1.83

476. An insurer sells an annual group life and disability policy.

The joint probability distribution for death and disability is:

		Annual Number of Deaths				
		0	1	2	3	4
Annual Number of Disabilities	0	0.45	0.09	0.03	0.01	0.01
	1	0.08	0.06	0.02	0.01	0.01
	2	0.07	0.05	0.02	0.01	0.00
	3	0.04	0.02	0.01	0.01	0.00

Calculate the probability of at least two disabilities, given no more than one death.

(A) 0.14
(B) 0.17
(C) 0.18
(D) 0.21
(E) 0.32

477. The time, in years, until replacement for a new telephone pole has probability density function

$$f(t) = \begin{cases} kt, & \text{for } 0 < t < 20 \\ 0, & \text{otherwise,} \end{cases}$$

where k is a constant.

Calculate the probability that a new telephone pole will be replaced within ten years given that it is not replaced within five years.

(A) 0.19
(B) 0.20
(C) 0.25
(D) 0.33
(E) 0.94

478. A company provides health insurance to employees located at four different plants. Health insurance costs at each plant are independent of those costs at any other plant. Plant managers have calculated the following statistics:

Plant	Average Cost	Standard Deviation
1	2	1
2	2	2
3	5	3
4	7	4

Calculate the standard deviation of the total company health insurance costs.

(A) 2.5
(B) 5.5
(C) 7.5
(D) 10.0
(E) 12.5

479. A patient must undergo hospitalization and surgery. The hospitalization and surgery charges are modeled by random variables uniformly distributed on the intervals $[0, c]$ and $[0, 3c-18]$, respectively, where c is a constant larger than 6.

The standard deviation of the hospitalization charge is $4\sqrt{3}$.

Calculate the standard deviation of the surgery charge.

(A) 2.8
(B) 7.3
(C) 10.4
(D) 15.6
(E) 20.8

480. In a group of 144 car insurance policyholders, each policyholder has no accidents this year with probability 0.80, one accident with probability 0.16, and two accidents with probability 0.04.

The numbers of accidents this year for different policyholders are mutually independent.

Calculate the variance of the total number of accidents this year for this group of policyholders.

(A) 3.15
(B) 34.56
(C) 37.79
(D) 46.08
(E) 54.37

481. The number of days required for a damage control team to locate and repair a leak in the hull of a ship is modeled by a discrete random variable, N. N is uniformly distributed on {1, 2, 3, 4, 5}.

The cost of locating and repairing a leak is $N^2 + N + 1$.

Calculate the expected cost of locating and repairing a leak in the hull of the ship.

(A) 11
(B) 12
(C) 13
(D) 14
(E) 15

482. A flight is delayed due to bad weather. The delay time is modeled by a random variable with a continuous uniform distribution. The expected delay time is three hours, and the standard deviation of the delay time is one hour.

Calculate the shortest possible delay time, in hours.

(A) 0.58
(B) 1.27
(C) 1.73
(D) 2.31
(E) 2.42

483. A doctor tests 100 patients for two diseases, A and B. Each patient has probability p of having disease A and probability p of having disease B, with $0 \le p \le 0.50$.

For each patient, the event of having disease A and the event of having disease B are independent. The test outcomes for different patients are mutually independent.

The variance of the number of patients who have disease A is 9.00.

Calculate the variance of the number of patients who have at least one of the two diseases.

(A) 15.39
(B) 1600
(C) 16.59
(D) 17.19
(E) 18.00

484. An insurance company has customer service operations in Denver, Philadelphia, and Salt Lake City.

Employee salaries in Denver are uniformly distributed from 25 to 90. Employee salaries in Philadelphia are uniformly distributed from 45 to x. Employee salaries in Salt Lake City are uniformly distributed from 10 to $x/3$.

The 40^{th} percentile of Denver salaries is equal to the 20^{th} percentile of Philadelphia salaries.

Calculate the median of Salt Lake City employee salaries.

(A) 12.5
(B) 17.5
(C) 25.0
(D) 35.0
(E) 60.0

485. The loss due to a warehouse robbery is modeled by a uniform distribution on the interval $\left[a, 2a\right]$, where a is a positive constant.

The ratio of the 40^{th} percentile of the loss to the p^{th} percentile of the loss equals the ratio of the p^{th} percentile of the loss to the 80^{th} percentile of the loss.

Calculate p.

(A) 56.6
(B) 58.7
(C) 60.0
(D) 61.4
(E) 65.4

486. A study of fire damage claims is conducted. Claim amounts are mutually independent and each claim amount exceeds 1000 with probability 0.20.

Calculate the probability that at least one of three randomly selected claim amounts exceeds 1000.

(A) 0.472
(B) 0.488
(C) 0.512
(D) 0.528
(E) 0.600

487. A group of students will take Exam 1. Those who pass Exam 1 will take Exam 2. Those who also pass Exam 2 will take Exam 3. For the initial group, the probability of passing Exam 1 is 0.80, the probability of passing Exams 1 and 2 is 0.48, and the probability of passing Exams 1, 2, and 3 is 0.36. A student who fails an exam stops taking exams.

Calculate the probability that a student of this group passes Exam 2, given that the student does not pass all three exams.

(A) 0.12
(B) 0.19
(C) 0.25
(D) 0.64
(E) 0.75

488. A representative of a market research firm contacts consumers by phone to conduct surveys. The specific consumer contacted by each phone call is randomly determined. The probability that a phone call produces a completed survey is 0.25.

Calculate the probability that the eighth phone call produces the third completed survey.

(A) 0.03
(B) 0.08
(C) 0.13
(D) 0.21
(E) 0.31

489. The amount of loss under an insurance policy is uniformly distributed on [10, 60]. The insurer will reimburse the full amount of the loss up to a maximum benefit. The expected benefit per loss is equal to 31.

Calculate the maximum benefit under the policy.

(A) 35
(B) 38
(C) 40
(D) 52
(E) 56

490. A person mails four packages. Two are fragile and two are not.

Each fragile package has probability 0.2 of breaking; each non-fragile package has probability 0.1 of breaking. The occurrences of packages breaking are mutually independent.

Exactly two packages break.

Calculate the probability that both broken packages were fragile.

(A) 0.032
(B) 0.040
(C) 0.167
(D) 0.336
(E) 0.609

491. Let *X* be a random variable with cumulative distribution function

$$F(x) = \begin{cases} 0, & x < 0 \\ \frac{1}{2}x^3, & 0 \le x < 1 \\ 2x - \frac{x^2}{2} - 1, & 1 \le x \le 2 \\ 1, & x > 2. \end{cases}$$

Calculate E(*X*).

(A) 3/8
(B) 25/48
(C) 2/3
(D) 1
(E) 25/24

492. A machine's lifetime X, in years, is modeled by an exponential distribution. The probability that the machine still functions after one year is 0.80.

F is the cumulative distribution function for X.

Determine $F(x)$ for $x \geq 0$.

(A) $F(x) = 0.8^x$
(B) $F(x) = 0.8^x e^{-0.8x}$
(C) $F(x) = 1 - 0.8^x$
(D) $F(x) = 1 - e^{-0.8x}$
(E) $F(x) = e^{-0.8x}$

493. An insurer sells a group life and disability policy.

The joint probability distribution for death and disability is given in the table below.

		Number of Deaths				
		0	1	2	3	4
Number of Disabilities	0	0.51	0.09	0.04	0.01	0.01
	1	0.08	0.06	0.02	0.01	0.01
	2	0.04	0.03	0.01	0.01	0.00
	3	0.03	0.02	0.01	0.01	0.00

Calculate the probability of at least two disabilities given no more than one death.

(A) 0.12
(B) 0.14
(C) 0.15
(D) 0.25
(E) 0.75

494. Each of the twelve employees of a company independently has the same probability of being accident-free this year.

The expected number of accident-free employees is 9.

Calculate the variance of the number of accident-free employees this year.

(A) 0.75
(B) 1.50
(C) 2.25
(D) 9.00
(E) 12.00

495. The heights, in feet, of basketball players in a city league are modeled by a random variable, *X*, with probability density function

$$f(x) = \begin{cases} \dfrac{3(x-6)^2}{2}, & \text{for } 5 < x < 7 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate $\text{Var}(X)$.

(A) 0.33
(B) 0.60
(C) 2.00
(D) 4.00
(E) 6.00

496. Three identical machines are purchased simultaneously and are still operating after one year. The manufacturer then buys an insurance policy that pays 1000 if any of the three machines fails during the second year of use. The three machines operate independently.

The age at failure, in years, for each of these machines has cumulative distribution function

$$F(x) = \begin{cases} 1-\left(\dfrac{1}{x}\right)^{\frac{1}{4}}, & \text{for } x \geq 1 \\ 0, & \text{otherwise.} \end{cases}$$

Note that $x \geq 1$ because each machine has already successfully completed one year of operation.

Calculate the expected claim payment for this policy.

(A) 4
(B) 159
(C) 405
(D) 595
(E) 996

497. Let *X*, *Y*, and *Z* represent three independent losses with common density function

$$f(x) = \begin{cases} \dfrac{1}{6}e^{-x/6}, & \text{for } 0 < x < \infty \\ 0, & \text{otherwise.} \end{cases}$$

Let *W* represent the minimum of the losses.

Calculate E(*W*).

(A) 1/6
(B) 1/3
(C) 1/2
(D) 2
(E) 6

498. In a large state, drivers are divided into three distinct age groups. The following table provides the probabilities that a one-car accident, involving a driver in a given age group, occurs in an urban, suburban or rural location in that state.

	Probability of accident location by age group		
Driver's age	Urban	Suburban	Rural
Under 25	7/10	1/5	1/10
25-65	1/4	3/5	3/20
Over 65	1/20	7/20	3/5

Fifty-five percent of one-car accidents involve a driver who is under 25, and fifteen percent involve a driver who is over 65.

A one-car accident occurs in a suburban location.

Calculate the probability that the driver is under 25.

(A) 0.11
(B) 0.17
(C) 0.32
(D) 0.55
(E) 0.76

499. An insurance agent sells life insurance policies. The number of life insurance policies sold in a month can be modeled by a Poisson distribution with mean 4.

The agent sold at least one life insurance policy in a particular month.

Calculate the probability that the agent sold more than three life insurance policies in that month.

(A) 0.567
(B) 0.577
(C) 0.624
(D) 0.776
(E) 0.839

500. Whether a football player is injury-free in any one season is independent of whether the player is injury-free in any other seasons. The player's probability of being injury-free for a season is the same for each season. Let x represent the player's probability of being injury-free for exactly one of the next two seasons.

Determine the player's probability of being injury-free for exactly two of the next four seasons.

(A) $0.5x$
(B) $2x$
(C) x^2
(D) $1.5x^2$
(E) $3x^2$

501. Each of ten homeowners independently has the same probability of experiencing at least one loss this year. Eight of these ten homeowners are insured.

Three of the ten homeowners experience at least one loss.

Calculate the probability that at least two of these three homeowners are insured.

(A) 0.384
(B) 0.467
(C) 0.700
(D) 0.896
(E) 0.933

502. A medical insurance policyholder just experienced a hospitalization, resulting in an undetermined financial loss that is exponentially distributed. The policyholder has Plan A, which reimburses the first two units for each hospitalization. The policyholder could have chosen Plan B, which reimburses the first ten units for each hospitalization.

The probability that this hospitalization is completely covered under Plan A is 0.15.

Calculate the probability that this hospitalization would have been completely covered had the policyholder chosen Plan B.

(A) 0.200
(B) 0.351
(C) 0.443
(D) 0.556
(E) 0.750

503. A trapeze artist has a constant probability, less than 0.5, of having an accident in any particular performance. The occurrence of an accident in any one performance is independent of the occurrence of an accident in all other performances. The probability that the artist's first accident occurs in the second performance is 0.16.

Calculate the probability that the artist's first accident occurs in the fourth performance.

(A) 0.0064
(B) 0.0256
(C) 0.0800
(D) 0.1024
(E) 0.2000

504. A construction worker experiences a back injury resulting in a loss on an insurance policy. Losses under the policy are uniformly distributed on the interval [2, 10]. The insurer reimburses the worker for 60% of this loss.

Calculate the 30^{th} percentile of the construction worker's unreimbursed loss from the back injury.

(A) 1.76
(B) 1.80
(C) 2.64
(D) 3.04
(E) 4.40

505. At a certain intersection, the number of accidents that occur per day is modeled by a Poisson distribution with mean 0.20.

The numbers of accidents that occur on different days are all mutually independent.

Calculate the probability that exactly three accidents occur at the intersection in the next seven days.

(A) 0.025
(B) 0.087
(C) 0.113
(D) 0.191
(E) 0.224

506. A college office has two student assistants, Bob and Ann, who work on alternate days. Each day, the assistant draws a morning and an afternoon assignment from a jar containing four assignments, one outdoor and three indoor.

Bob always makes his selection with replacement, while Ann makes hers without replacement.

On a particular day, one outdoor and one indoor assignment are selected.

Calculate the probability that Bob made the selections.

(A) 3/16
(B) 3/8
(C) 3/7
(D) 7/16
(E) 1/2

507. The random variable X has density function

$$f(x) = \begin{cases} cx^5 e^{-0.01x}, & \text{for } x > 0 \\ 0, & \text{otherwise,} \end{cases}$$

where c is a constant.

Calculate E(X).

(A) 100
(B) 200
(C) 300
(D) 500
(E) 600

508. A statistician determines that the probability density function $f(x)$ of the losses from construction accidents is proportional to $\dfrac{x}{\left(1+x^2\right)^9}$, for all nonnegative x.

Calculate the 2nd percentile of the losses from construction accidents.

(A) 0.003
(B) 0.020
(C) 0.045
(D) 0.050
(E) 0.222

509. A credit card protection insurance company's monthly profits are independent and normally distributed with constant mean and variance. The probability that the company earns an overall positive profit in a given year is 0.60.

Calculate the probability that the insurance company earns a positive profit in a given month.

(A) 0.51
(B) 0.53
(C) 0.60
(D) 0.81
(E) 0.96

510. A company insures two buildings for one year. Its insurer will pay the value of a loss, rounded down to the nearest million. Let X and Y represent the insurer's payments in millions on each of the buildings. The joint probability function is:

		X		
		0	1	2
Y	0	0.38	0.10	0.02
	1	0.16	0.11	0.03
	2	0.06	0.09	0.05

Calculate the expected value of the maximum of X and Y.

(A) 0.33
(B) 0.70
(C) 0.87
(D) 1.20
(E) 2.00

511. Each loss under a disability insurance policy can range from 0 to 1. The probability density function of a loss is proportional to the fifth power of the loss.

The insurer plans to implement a constant deductible *d* for each loss so that the probability that the insurer pays something for at least one of the next two losses has a specified value *P*. Assume that the next two losses are independent.

Determine the deductible *d* the insurer should charge, in terms of *P*.

(A) $\sqrt[5]{P}$
(B) $\sqrt[10]{P}$
(C) $\sqrt[10]{1-P}$
(D) $\sqrt[12]{P}$
(E) $\sqrt[12]{1-P}$

512. A random variable, *X*, denotes the number of airplanes landing each hour at a certain airport. *X* is modeled by a Poisson distribution. On average, 20 airplanes are expected to land each hour.

Calculate $\mathrm{E}(X^2)+\mathrm{E}(X)$.

(A) 40
(B) 60
(C) 420
(D) 440
(E) 820

513. A point *P* is randomly selected in the Cartesian plane in such a way that the distance from *P* to the origin has a uniform distribution on the interval [0, 3].

Calculate the variance of the area of the circle that is centered at the origin and passes through *P*.

(A) $9\pi^2/16$
(B) $3\pi^2/4$
(C) $3\pi^2/2$
(D) $36\pi^2/5$
(E) $81\pi^2/5$

514. On any given day, the number of available units, X, of a given commodity, and the market price per unit, Y, have joint probability function

$$p(x, y) = \begin{cases} \dfrac{|y - 6x - 2|}{18}, & \text{for } x = 1, 2 \text{ and } y = 10, 12, 14 \\ 0, & \text{otherwise.} \end{cases}$$

Assume that all available units will sell at the market price per unit.

Calculate the expected revenue generated by the sale of all available units.

(A) 140/9
(B) 144/9
(C) 150/9
(D) 156/9
(E) 162/9

515. Losses, X, in millions, are modeled by a distribution with density function

$$f(x) = \begin{cases} k(1 - x)^3, & \text{for } 0 < x < 1 \\ 0, & \text{otherwise,} \end{cases}$$

where k is a constant.

Claim payments are limited to a maximum of 225,000.

Calculate the median claim payment.

(A) 159,000
(B) 173,000
(C) 187,000
(D) 200,000
(E) 225,000

516. Let R be the proportion of right-handed babies among all newborns in a town each year. R has a beta distribution with density function

$$f(r)=\begin{cases} k\left[r^{\alpha-1}(1-r)^{\beta-1}\right], & \text{for } 0<r<1 \\ 0, & \text{otherwise,} \end{cases}$$

where $\alpha=13, \beta=2$, and k is a positive constant.

Calculate P[R > 0.9].

(A) 0.208
(B) 0.240
(C) 0.415
(D) 0.479
(E) 0.575

517. An insurance policy provides coverage for two types of claims. The numbers of annual claims of Type I and Type II are denoted by X and Y, respectively.

The joint probability function of X and Y is given in the following table.

			y	
		0	1	2
x	0	0.31	*p*	0.05
	1	0.21	0.13	*q*

A Type I claim costs 750, and a Type II claim costs 1000. The expected annual Type I claims cost is 345.

Calculate the variance of Y.

(A) 0.25
(B) 0.57
(C) 0.67
(D) 0.75
(E) 0.82

518. In a certain region, the number of earthquakes in the next decade is modeled by a Poisson distribution. The probability of exactly two earthquakes is 0.43 times the probability of exactly one earthquake.

Calculate the probability of at least three earthquakes in the next decade in this region.

(A) 0.010
(B) 0.012
(C) 0.045
(D) 0.056
(E) 0.080

519. A tornado occurs in each of two cities, A and B. The durations of the tornadoes in cities A and B are independent and exponentially distributed with means 5 minutes and 4 minutes, respectively.

The tornadoes in cities A and B result in damages valued at 1.00 and c per minute, respectively, where c is a constant.

The standard deviation of the total damage to the two cities is 5.20.

Calculate c.

(A) 0.05
(B) 0.13
(C) 0.36
(D) 2.35
(E) 5.51

520. The random vector (W,X,Y) has the following properties:

i) W assumes values of only 0 and 1.
ii) X and Y each assume values of only 1 and 2.
iii) $P[W = w , X = x , Y = y]$ is proportional to $x + y - w$.

Calculate $\mathrm{Var}(W \mid Y = 1)$.

(A) 51/400
(B) 15/64
(C) 6/25
(D) 3/8
(E) 2/5

521. An insurance company only sells auto insurance and property insurance. Total annual auto claims, X, follow a normal distribution with a mean of 15 and a standard deviation of 4. Total annual property claims, Y, follow a normal distribution with a mean of 20 and a standard deviation of 5.

The variables X and Y are independent.

Calculate the probability that the total overall claims, $X+Y$, is less than 45.

(A) 0.60
(B) 0.71
(C) 0.87
(D) 0.94
(E) 0.99

522. A motorist is driving without an automobile insurance policy in a region where law requires the motorist to have automobile insurance. The time in months until the motorist is charged for driving without automobile insurance is exponentially distributed with median 1.733 months.

Calculate the probability that the time until the motorist is charged is between the median and mean times until the motorist is charged.

(A) $0.5-e^{-1}$
(B) $e^{-0.16}-0.5$
(C) e^{-1}
(D) $1-e^{-1}$
(E) $0.5+e^{-1}$

523. You are given the following information about two insurance policies:

i) Losses covered by each policy follow a normal distribution with mean 8000.

ii) Losses covered by Policy I have standard deviation *k*.

iii) Losses covered by Policy II have standard deviation 1.5*k*.

The p^{th} percentile of losses covered by Policy I is equal to the 81^{st} percentile of losses covered by Policy II.

Calculate *p*.

(A) 83.2
(B) 85.7
(C) 88.2
(D) 90.6
(E) 93.2

524. In a group of 35 patients, 9 have high blood pressure, 9 have high cholesterol, and 15 have high blood pressure or high cholesterol.

From these 35 patients, a doctor needs to select a group of 8 patients for a test in which exactly 4 have high blood pressure only, exactly 1 has high cholesterol only, and exactly 2 have both high blood pressure and high cholesterol.

Calculate the number of different groups the doctor can select for this test.

(A) 90
(B) 270
(C) 5,400
(D) 47,628
(E) 238,140

525. The joint distribution of television viewers' habits in the two entertainment categories of Sports and Movies and the one non-entertainment category of News is:

Regularly watches Sports:

	Regularly watches News	Does not regularly watch News
Regularly watches Movies	0.35	0.10
Does not regularly watch Movies	0.08	0.06

Does not regularly watch Sports

	Regularly watches News	Does not regularly watch News
Regularly watches Movies	0.22	0.06
Does not regularly watch Movies	0.05	0.08

Calculate the variance of the number of entertainment categories regularly watched by those television viewers who regularly watch News.

(A) 0.242
(B) 0.388
(C) 0.400
(D) 0.478
(E) 0.571

526. A company insures homes in 50 different territories. The company models annual tornado losses within each territory by an exponential distribution with mean 100,000. Because of the local nature of most tornadoes, losses in one territory are independent of losses in other territories. Calculate the approximate probability that total annual tornado losses over all 50 territories exceed 5.5 million.

(A) 0.14
(B) 0.18
(C) 0.24
(D) 0.33
(E) 0.46

527. Let X and Y be random variables for which

i) Var (X) = Var (Y)
ii) Var $(X + Y) = 10$
iii) Var $(X - 2Y) = 16$.

Calculate $\operatorname{Cov}(X,Y)$.

(A) –1.0
(B) –0.1
(C) 0.1
(D) 1.0
(E) 2.0

528. An actuary makes the following observations about an insurer's fire and flood insurance policies:

i) The probability that a client purchases neither policy exceeds the probability that a client purchases both policies by 0.20.

ii) The probability that a client purchases both policies is positive.

iii) The probability that a client purchases a fire policy given that the client purchases a flood policy is twice the probability that a client purchases a flood policy given that the client purchases a fire policy.

Calculate the probability that a client purchases a flood policy.

(A) 0.27
(B) 0.33
(C) 0.40
(D) 0.53
(E) 0.80

529. The number of errors on an application is modeled by a Poisson random variable with variance 0.25.

The number of errors on any application is independent of the number of errors on all other applications.

Calculate the probability that two applications contain a total of more than one error.

(A) 0.03
(B) 0.09
(C) 0.30
(D) 0.61
(E) 0.91

530. A box contains three fair dice. One has faces numbered 1, 2, 3, 4, 5, and 6; one has faces numbered 2, 2, 4, 4, 6, and 6; and one has all six faces numbered 6. Two of the three dice are randomly selected and rolled.

Calculate the probability that the sum of the numbers rolled on the two dice is 11.

(A) 0.025
(B) 0.028
(C) 0.074
(D) 0.111
(E) 0.222

531. A policyholder is insured against both fire and theft claims. The probability of a fire claim is 10%. The probability of a theft claim is 30%.

Let p be the probability of having neither a fire nor a theft claim, assuming fire and theft claims are independent.

Let r be the probability of having neither a fire nor a theft claim, assuming fire and theft claims are mutually exclusive.

Calculate $p - r$.

(A) −0.06
(B) −0.03
(C) 0.00
(D) 0.03
(E) 0.06

532. In a certain region, 5% of all banks will fail in the next five years. The FDIC insures 80% of the banks in the region. Only 3% of the banks in the region insured by the FDIC will fail in the next five years.

Calculate the probability that a bank in the region that fails in the next five years is insured by the FDIC.

(A) 0.02
(B) 0.04
(C) 0.06
(D) 0.48
(E) 0.60

533. This year, each of the ten employees of a company has probability 0.2 of having at least one accident. The occurrences of accidents among different employees are mutually independent.

Of the ten employees, six are in department A. The other four are in department B.

Exactly three of the ten employees each have at least one accident.

Calculate the probability that at least one of these accidents occurs to an employee in department B.

(A) 0.201
(B) 0.500
(C) 0.590
(D) 0.784
(E) 0.833

534. In a given year, the number of accidents an auto insurance policyholder experiences is Poisson distributed with mean 0.10. The numbers of accidents by year are independent.

Calculate the probability that a policyholder's first accident occurs during the sixth year of the policy, given that the policyholder experiences no accidents during the first two years of the policy.

(A) 0.0009
(B) 0.0577
(C) 0.0705
(D) 0.0729
(E) 0.3297

535. A policyholder experiences one accident under a health insurance policy and one accident under a dental insurance policy. The health insurance policy reimburses 80% of losses. Losses under this policy have variance 40,000. The dental insurance policy reimburses 90% of losses. Losses under this policy have variance 10,000.

The policyholder's two losses are independent.

Calculate the variance of the policyholder's total unreimbursed loss under these policies.

(A) 1,700
(B) 9,000
(C) 16,300
(D) 33,700
(E) 50,000

536. A weighted six-sided die is rolled. Let A be the event that the number rolled is less than 5. Let B be the event that the number rolled is less than 4. Let C be the event that the number rolled is a 6. The probabilities of A, B, and C are 0.3, 0.1, and 0.7, respectively.

Calculate $P[A \cup B] + P[A \cup C] + P[B \cup C]$.

(A) 1.10
(B) 1.89
(C) 2.10
(D) 2.17
(E) 2.20

537. An actuary accepts an assignment to live and work in Key West, Florida for three years.

The probability that there are no hurricanes in Key West is 0.75 per year. If there is at least one hurricane in Key West in a year, then the probability is 0.35 that the actuary will need to evacuate in that year. There is no other reason for the actuary to evacuate.

The year-to-year occurrences of hurricanes in Key West are independent events.

Calculate the probability that the actuary will need to evacuate at least once from Key West before the assignment is complete.

(A) 0.088
(B) 0.219
(C) 0.240
(D) 0.422
(E) 0.578

538. Each person in a certain large population independently has probability 0.0625 of having a certain disease. People in this population are tested for the disease, until somebody is found to have the disease.

Calculate the mode of the number of people tested.

(A) 1
(B) 6
(C) 11
(D) 15
(E) 16

539. The random variables X_1, X_2, X_3 represent the values of three independent investments. Each is normally distributed with $E(X_i) = 100$ and $Var(X_i) = 27i/2$, $i = 1, 2, 3$. Let $\Phi(x)$ denote the cumulative distribution function of the standard normal variable.

Determine the probability that the average value of the three investments exceeds 106.

(A) $\Phi(2)$
(B) $\Phi(2/3)$
(C) $1 - \Phi(2/3)$
(D) $1 - \Phi(2)$
(E) $1 - \Phi\left(2/\sqrt{3}\right)$

540. An insurance company pays a benefit for a duration of one year, two years, or five years, depending upon the severity of the claim. Information about the distribution of claims in the past year by sex and duration of benefit is given in the following table:

	1 year	2 years	5 years
Male	20%	40%	40%
Female	10%	70%	20%

Males accounted for 60% of all claims.

Calculate the probability that a claimant was female, given that this claimant received a five-year benefit.

(A) 1/5
(B) 1/4
(C) 1/3
(D) 1/2
(E) 3/4

541. The lifetime of an electronic component is exponentially distributed. Given that the component lasts at least five years, the probability that it lasts at least fifteen years is 0.027.

Calculate the probability that the component lasts at least 25 years, given that it lasts at least five years.

(A) 0.0007
(B) 0.0024
(C) 0.0135
(D) 0.0162
(E) 0.0450

542. Each of the 76 employees of a company is either a low-risk or a high-risk employee. This year, each low-risk employee's number of accidents has standard deviation 0.50 and each high-risk employee's number of accidents has standard deviation 5.50. The standard deviation of the total number of accidents for all the employees is 43.00. The frequencies of accidents among the employees are independent.

Calculate the number of low-risk employees.

(A) 1
(B) 15
(C) 38
(D) 61
(E) 75

543. A renter's insurance policy pays a percentage p of the amount by which each loss exceeds a deductible d. Each policyholder reports a loss if and only if the loss exceeds the deductible.

The variance of a reported loss is v.

Determine the variance of the claim payment resulting from a reported loss.

(A) pv
(B) p^2v
(C) $p(v-d)$
(D) $p^2(v-d)$
(E) $(1-p)^2v$

544. Assume the distribution of the number of automobile claims per year for an auto insurance policyholder is described by the following table:

Number of Claims	Probability
0	0.4
1	0.3
2	0.2
3	0.1

For each claim that occurs, there is a probability of 0.5 that the claim size is 500 and a probability of 0.5 that the claim size is 1000. Claim sizes are mutually independent.

Calculate the probability that the total claim size for a randomly selected policyholder this year is greater than or equal to 2000, given that at least two claims occur.

(A) 0.14
(B) 0.25
(C) 0.29
(D) 0.46
(E) 0.88

545. The total amount of all hurricane claims filed with a company in a one-year time period is modeled by a random variable, X, with density function

$$f(x) = \begin{cases} \dfrac{1}{1,000,000} e^{-x/1,000,000}, & \text{for } x > 0 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate, to the nearest 100,000, the difference between the 15$^{\text{th}}$ and 95$^{\text{th}}$ percentiles of the total amount of hurricane claims.

(A) 1,800,000
(B) 1,900,000
(C) 2,700,000
(D) 2,800,000
(E) 3,000,000

546. A large lot of circuit boards contains 10% that are defective. A test for defective boards is correct with 80% probability if the board is defective and correct with only 40% probability if the board is not defective.

A randomly selected board is tested and the test indicates that the board is defective.

Calculate the probability that the board is defective.

(A) 2/25
(B) 1/10
(C) 2/17
(D) 4/31
(E) 2/11

547. A weather satellite is sending a binary code of 0s and 1s describing a tropical storm. Suppose 70% of the message being sent is 0s and there is an 80% chance of any particular 0 or 1 being received correctly. (If a 1 is sent and incorrectly received, it is received as a 0, and vice versa.)

Calculate the probability that a 0 was sent, given that a 1 was received.

(A) 0.16
(B) 0.34
(C) 0.37
(D) 0.63
(E) 0.90

548. Urn A contains five red chips and four white chips. Urn B contains four red chips and five white chips. Two chips are transferred from urn A to urn B. Then a single chip is drawn from urn B.

Calculate the probability that the chip drawn from urn B will be white.

(A) 0.455
(B) 0.535
(C) 0.545
(D) 0.556
(E) 0.571

549. Six people are seated randomly around a circular table. Two of the six people are left-handed.

Calculate the probability that the two left-handed people are seated next to each other.

(A) 1/6
(B) 1/5
(C) 1/3
(D) 2/5
(E) 3/5

550. In a group of nine people, five have high blood sugar. Five people are to be chosen randomly from this group of nine.

Calculate how many possible combinations contain exactly two people with high blood sugar.

(A) 10
(B) 14
(C) 40
(D) 100
(E) 126

551. A motorist makes four driving errors this year. Each error independently has probability 0.3 of resulting in an accident. The motorist's insurance company reimburses up to two accidents due to the motorist's errors this year.

Calculate the probability that these four errors result in at least one unreimbursed accident.

(A) 0.03
(B) 0.08
(C) 0.24
(D) 0.32
(E) 0.41

552. The distribution of the lifetime in years of a certain brand of lawnmower is uniform on the interval $[a, b]$, where $0 < a < b$.

Determine the 80^{th} percentile of the lifetime in years of this brand of lawnmower.

(A) $a + 0.8b$
(B) $0.2a + 0.8b$
(C) $0.8a + 0.2b$
(D) $0.8(b - a)$
(E) $0.8(b + a)$

553. A random variable X is exponentially distributed with 40^{th} percentile equal to $4\ln\left(\frac{5}{3}\right)$.

Calculate the median of X.

(A) $5\ln\left(\frac{5}{3}\right)$
(B) $4\ln 2$
(C) $5\ln\left(\frac{25}{12}\right)$
(D) 4
(E) 5

554. The base fare charged by airlines for flights from City A to City B is uniformly distributed on [100, 225]. In addition to the base fare, the airlines charge a processing fee of 15 and a 30% fuel surcharge applied to the base fare.

Calculate the standard deviation of the total charge for a flight from City A to City B.

(A) 10.8
(B) 36.1
(C) 41.1
(D) 46.9
(E) 61.9

555. The amount of beverage filled into each bottle by a bottling machine is independently and normally distributed with mean 12.0 ounces and standard deviation σ ounces. Approximately 20% of all 24-bottle cases contain more than 290 ounces of total beverage.

Calculate σ.

(A) 0.01
(B) 0.10
(C) 0.49
(D) 2.38
(E) 10.10

556. The profit on an individual insurance policy is normally distributed. The 60^{th} percentile of the profit is 1000. The 80^{th} percentile of the profit is 2000.

Calculate the 95^{th} percentile, to the nearest 100, of the profit.

(A) 2300
(B) 2400
(C) 2700
(D) 3400
(E) 3900

557. A customer just purchased a refrigerator with a five-year warranty. The number of years before the refrigerator malfunctions is exponentially distributed. The probability that the refrigerator malfunctions before the five-year warranty expires is 0.40.

Calculate the standard deviation of the number of years before the refrigerator malfunctions.

(A) 0.10
(B) 3.13
(C) 5.46
(D) 9.79
(E) 12.50

558. The probability is 0.45 that a mouse exposed to a certain disease will develop it.

The events of individual mice developing the disease are all mutually independent.

Calculate the probability that the tenth mouse exposed to the disease will be the third to catch it.

(A) 0.0014
(B) 0.0499
(C) 0.1110
(D) 0.1165
(E) 0.1665

559. Brand A air conditioning units have twice the expected life span of Brand B air conditioning units. The life span for each brand is exponentially distributed.

The probability that a Brand A air conditioning unit lasts at least 15 years is 0.046656.

Calculate the probability that a Brand B air conditioning unit lasts at least 5 years.

(A) 0.01
(B) 0.03
(C) 0.07
(D) 0.13
(E) 0.18

560. Homeowner losses due to fire are exponentially distributed with mean 6.

Homeowners insurance policy A reimburses up to a maximum of *m* for a loss due to fire.

Homeowners insurance policy B, with a different premium, reimburses up to a maximum of $m + 2$ for a loss due to fire.

Let p_A be the probability that a loss due to fire is partially unreimbursed under policy A. Let p_B be the probability that a loss due to fire is partially unreimbursed under policy B.

Determine $\frac{p_B}{p_A}$.

(A) e^{-12}
(B) $e^{-1/3}$
(C) $\frac{1-e^{-(m+2)/6}}{1-e^{-m/6}}$
(D) $\frac{1-e^{-6m-12}}{1-e^{-6m}}$
(E) $\frac{m}{m+2}$

561. From a collection of eight keys, Door A can only be opened with one key and Door B can only be opened with one other key.

Calculate the probability that among four randomly selected keys, exactly three keys will open neither door.

(A) 0.03
(B) 0.11
(C) 0.29
(D) 0.42
(E) 0.57

562. The damage from an accident at a certain intersection follows a uniform distribution on the interval $[a, b]$, where $0 < a < 3$. The probability that the damage is greater than 4, given that it is greater than 3, is 0.90. The probability that the damage is greater than 4, given that it is less than 11, is 0.70.

Calculate the unconditional probability that the damage is greater than 4.

(A) 0.70
(B) 0.75
(C) 0.80
(D) 0.85
(E) 0.90

563. Losses under a boat insurance policy are exponentially distributed with mean $\frac{400}{\ln 2}$.

For each loss, the claim payment is the amount of the loss, up to a maximum of 1000.

Calculate the expected value of a claim payment.

(A) 298
(B) 367
(C) 400
(D) 475
(E) 577

564. The length of an exchange student's phone call depends on whether the call is domestic or international. Lengths of domestic calls are exponentially distributed with a mean of 0.75 minutes, and lengths of international calls are exponentially distributed with a mean of 0.50 minutes. Each call has a 40% probability of being a domestic call and a 60% probability of being an international call.

Calculate the probability that the length of a randomly selected phone call by the student is between one and three minutes.

(A) 0.178
(B) 0.200
(C) 0.222
(D) 0.250
(E) 0.378

565. The proportion of cotton plants on a large farm infested with boll weevils is modeled by a continuous random variable with probability density function

$$f(x) = \begin{cases} 20x^3(1-x), & \text{for } 0 \le x \le 1 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate the standard deviation of the proportion of cotton plants on the farm that are infested with boll weevils.

(A) 0.032
(B) 0.178
(C) 0.476
(D) 0.690
(E) 0.959

566. The annual number of claims per policy for a class of insurance policies is modeled by a Poisson distribution with mean 1.20.

A policy is randomly selected from those policies that had at least one claim in the past year.

Calculate the probability that the selected policy had at least three claims in the past year.

(A) 0.10
(B) 0.12
(C) 0.15
(D) 0.17
(E) 0.20

567. A company tests five batteries. Each battery has a probability *p* of being defective, where *p* is a constant. The events of different batteries being defective are mutually independent.

The number of defective batteries out of the five batteries is a random variable, *N*, where $\mathrm{E}\left(N^2\right) = 1.80$.

Calculate $\mathrm{Var}(N)$.

(A) 0.80
(B) 0.98
(C) 1.15
(D) 1.67
(E) 1.80

568. Policyholders of a particular type of insurance policy will have either zero claims or one claim. The probability of zero claims is 20%. If a claim is received, the claim size follows a normal distribution with mean 50,000 and standard deviation *c*.

The probability that a randomly selected policyholder has a claim exceeding 55,000 is 0.1837.

Calculate *c*.

(A) 5546
(B) 6125
(C) 6490
(D) 6756
(E) 7120

569. An insurance policy covers a house for ten calendar years for losses due to hailstorm and theft. Only one loss due to hailstorm and only one loss due to theft are covered by the policy during any one calendar year.

For the k^{th} calendar year let H_k be the event that the policy incurs a loss due to hailstorm and let T_k be the event that the policy incurs a loss due to theft,. Suppose that the events $H_1, \ldots, H_{10}, T_1, \ldots, T_{10}$ are mutually independent, and that

$P[H_k] = 0.2,\ P[T_k] = 0.1,$ for all k.

Calculate the probability that the total number of hailstorm and theft losses covered by the policy during the ten calendar years is less than two.

(A) 0.17
(B) 0.23
(C) 0.77
(D) 0.80
(E) 0.83

570. A homeowner hires a moving company to transport ten pieces of electronic equipment to a new home. Each piece is equally likely to be damaged during the move, and the event of damage to any one piece is independent of the events of damage to the other pieces.

The homeowner fully insures two of these pieces, partially insures three of them, and leaves the other five pieces uninsured.

During the move, three pieces are damaged.

Calculate the probability that at least one damaged piece is fully insured and at least one damaged piece is partially insured.

(A) 0.242
(B) 0.250
(C) 0.325
(D) 0.378
(E) 0.400

571. Let X be a continuous random variable with density function

$$f(x) = \begin{cases} \dfrac{|x|}{10}, & \text{for } -2 < x < 4 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate Var(X).

(A) 0.25
(B) 2.52
(C) 3.32
(D) 4.13
(E) 4.93

572. In a large city, 40% of the intersections are safe, while all others are dangerous. The numbers of accidents occurring annually at individual safe and dangerous intersections are Poisson distributed with means 0.5 and 1.0, respectively.

No accidents occurred during 2004 at Thirty-Fourth Street and Vine Street, an intersection within the city.

Calculate the probability that Thirty-Fourth Street and Vine is a safe intersection.

(A) 0.24
(B) 0.40
(C) 0.46
(D) 0.52
(E) 0.62

573. A company insures 40,000 drivers. The annual number of auto accidents for individual drivers is modeled by mutually independent Poisson random variables with mean 0.16.

Calculate the coefficient of variation for the total annual number of auto accidents for all 40,000 drivers.

(A) 0.01
(B) 0.16
(C) 0.40
(D) 1.00
(E) 2.50

574. A gardener models his strawberry (S) / blueberry (B) harvest with the following joint probability distribution. Note that three of the entries are smudged and cannot be read.

		B				
		1	2	3	4	5
S	1	0.07	0.06	0.06	0.05	0.01
	2	0.07	0.10	0.08	0.05	0.03
	3	0.04	0.05	0.06	0.05	0.04
	4	0.01	0.02	?	?	?

Calculate the variance of the strawberry harvest.

(A) 1.03
(B) 1.04
(C) 1.07
(D) 1.09
(E) Cannot be determined based on information provided.

575. An insurer's quarterly profits are independent and normally distributed with mean 8 and standard deviation 24. A quarterly loss counts as a negative profit.

Let Z represent the standard normal random variable.

Determine the probability that the insurer makes an overall positive profit in a given four-quarter period.

(A) P[Z > –3.00]
(B) P[Z > –1.50]
(C) P[Z > –0.67]
(D) P[Z > –0.33]
(E) P[Z > –0.17]

576. A light bulb's lifetime in months is uniformly distributed on [0, 40].

Let a be a positive real number less than 30. The probability that the light bulb fails within 30 months, given that it is working after a months, equals 0.60.

Calculate the value of a.

(A) 6
(B) 12
(C) 15
(D) 16
(E) 18

577. A homeowners insurance company pays claims only for thefts and fires. This year, the company's total theft losses are normally distributed with mean 100 and standard deviation 40. The company's total fire losses are normally distributed with mean 150 and standard deviation 30. Theft losses are independent of fire losses.

Calculate the coefficient of variation for the company's combined theft and fire losses this year.

(A) 0.20
(B) 0.28
(C) 0.30
(D) 0.40
(E) 0.60

578. An insurance company offers two kinds of insurance: automobile insurance and homeowners insurance. This year, the company's profit from automobile insurance is normally distributed with mean 200 and standard deviation 400. The company's profit from homeowners insurance is normally distributed with mean 400 and standard deviation 300. The two profits are independent.

Let Z represent the standard normal random variable.

Determine the probability that the company's overall profit this year is positive.

(A) $P[Z > -1.83]$
(B) $P[Z > -1.20]$
(C) $P[Z > -0.86]$
(D) $P[Z > -0.83]$
(E) $P[Z > -0.50]$

579. The time T, in years, a fuse lasts is a random variable with density function

$$g(t) = \begin{cases} te^{-t}, & \text{for } t > 0 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate the probability that a fuse lasts at most two years, given that it lasts at least one year.

(A) 0.061
(B) 0.330
(C) 0.448
(D) 0.736
(E) 0.807

580. Let X_1, X_2, X_3, X_4 be independent observations of a random variable with mean 10 and standard deviation 3.

Calculate the variance of $3X_1 - X_2 - X_3 - X_4$.

(A) 27
(B) 36
(C) 54
(D) 81
(E) 108

581. The following table gives the joint probability function of two random variables X and Y:

		X		
		0	1	2
Y	0	1/6	0	1/2
	1	0	1/3	0

Calculate Cov(X,Y).

(A) –1/9
(B) 0
(C) 1/18
(D) 1/9
(E) 2/9

582. The annual amount a travel insurance company pays for claims has standard deviation 3. The 52 weekly amounts the company pays for claims are independent and have the same standard deviation.

Calculate the standard deviation of each of these weekly amounts.

(A) $\dfrac{3}{52^2}$

(B) $\dfrac{3}{52}$

(C) $\sqrt{\dfrac{3}{52}}$

(D) $\dfrac{3}{\sqrt{52}}$

(E) $3\sqrt{52}$

583. Claim amounts from accidents in an amusement park are uniformly distributed on an interval. The probability that a randomly selected claim amount is less than 12 is 0.50. The probability that a randomly selected claim amount exceeds 6 is 0.875.

Calculate the probability that a randomly selected claim amount is less than 10, given that it exceeds 6.

(A) 2/9
(B) 1/4
(C) 2/7
(D) 3/8
(E) 3/7

584. The number of thefts in any year a warehouse owner experiences is modeled by a Poisson distribution. In each year, the probability of at least one theft is 0.10, and the yearly number of thefts are independent.

Calculate the variance of the total number of thefts the owner experiences in the next 15 years.

(A) 0.11
(B) 0.41
(C) 1.35
(D) 1.50
(E) 1.58

585. The random variable Y has density function

$$f(y) = \begin{cases} \dfrac{y}{6} - \dfrac{y^2}{36}, & \text{for } 0 < y < 6 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate $\mathrm{P}[1 < Y < 3 \mid 2 < Y < 4]$.

(A) 0.111
(B) 0.241
(C) 0.481
(D) 0.500
(E) 0.885

586. An insurance company sells an automobile policy that pays 80% of any losses that exceed the deductible of 500. The loss amounts (in units of 1000) follow an exponential distribution with mean 6.

Calculate the probability that the policy payment on a randomly selected loss exceeds 5000.

(A) 0.024
(B) 0.318
(C) 0.325
(D) 0.675
(E) 0.682

587. Once each morning and once each afternoon, the driver of a delivery truck is assigned to a route with a length that depends upon the items being delivered. The morning route may be 5, 10 or 40 miles. The afternoon route may be 0, 5 or 10 miles. The probabilities with which the pairs of routes have been assigned are:

		Length of Afternoon Route (miles)		
		0	5	10
Length of Morning Route(miles)	5	0	$2p$	$3p$
	10	0	$2p$	0
	40	q	0	0

The lengths of the assigned afternoon routes have a mean of 6 miles.

Calculate the variance of the length of an afternoon route.

(A) 11.0
(B) 12.0
(C) 16.5
(D) 26.5
(E) 42.0

588. The lifetimes of light bulbs are independent and exponentially distributed with common mean 1000 hours. A lamp has a single bulb and is continuously on. Each light bulb is replaced immediately after it burns out.

Calculate the standard deviation of the time, in hours, until the failure of the fifth bulb.

(A) 71
(B) 158
(C) 1000
(D) 2236
(E) 5000

589. In a one-year period, the number of fires that occur in buildings insured by ABC insurance is Poisson distributed with mean 12. The resulting losses are independent random variables that are also independent of the number of losses, each having density function

$$f(x)=\begin{cases}\dfrac{8-x}{32}, & \text{for } 0<x<8\\ 0, & \text{otherwise.}\end{cases}$$

The payment for any loss is equal to the amount of the loss in excess of a deductible of 2.

Calculate the expected total payment that ABC must make for losses due to fire that occur in a one-year period.

(A) 8.0
(B) 13.5
(C) 16.5
(D) 30.0
(E) 32.0

590. Each of three people is holding a biased coin that has probability 0.25 of landing heads. They toss the coins simultaneously. After each round of tosses, if the outcomes are all heads or all tails, they will continue to another round; otherwise, they will stop.

Calculate the probability that there will be exactly five rounds of tosses.

(A) 0.0003
(B) 0.0029
(C) 0.0206
(D) 0.0438
(E) 0.1030

591. In a given year, a manufacturer's profit from selling warranties is normally distributed with mean 20 and variance 16.

Calculate the interval, centered at the mean, containing 25% of the probability associated with a single yearly profit.

(A) (12.2, 27.8)
(B) (14.9, 25.1)
(C) (16.0, 24.0)
(D) (17.3, 22.7)
(E) (18.7, 21.3)

592. A group of 18 patients is tested for diabetes. Each patient independently has a 0.15 probability of testing positive.

Calculate the mode of the number of patients in the group who test positive.

(A) 0
(B) 1
(C) 2
(D) 3
(E) 4

593. An insurance company's annual profit is normally distributed with mean 39. The 28^{th} percentile of the annual profit is 21.

Calculate the percentile associated with an annual profit of 3 for this insurance company.

(A) 4^{th}
(B) 6^{th}
(C) 8^{th}
(D) 10^{th}
(E) 12^{th}

594. From a standard deck of 52 playing cards, five cards are chosen without replacement.

Calculate the probability of obtaining at least two kings, but no aces or jacks.

(A) 0.0174
(B) 0.0228
(C) 0.0240
(D) 0.0298
(E) 0.0417

595. The check-out times for customers at a grocery store are modeled by a continuous uniform distribution between 1.1 and 8.6 minutes. The store would like to advertise that "no more than 5% of customers require more than y minutes to check out."

Calculate the minimum value for y.

(A) 1.475
(B) 7.125
(C) 8.170
(D) 8.225
(E) 8.545

596. An insurance company's annual profit is normally distributed. The probability that the annual profit exceeds 3.50 is 0.3264 and the probability that it exceeds 3.62 is 0.2743.

Calculate the variance of the insurance company's annual profit.

(A) 0.44
(B) 0.64
(C) 0.80
(D) 1.25
(E) 1.56

597. A theft insurance company offers two policies, A and B. Under each policy, a loss is uniformly distributed on the interval [*a*, 19].

For a loss under policy A, the deductible is 0 and the expected value of the claim payment is 10.

For a loss under policy B, the deductible is 4.

Calculate the expected value of the claim payment for a loss under policy B.

(A) 6.00
(B) 6.25
(C) 7.50
(D) 7.89
(E) 8.33

598. The profit X on an insurance policy is normally distributed with $\mathrm{E}(X^2) = 74$ and $\mathrm{P}[X > 0] = 0.92$.

Calculate the variance of the profit on this policy.

(A) 24.88
(B) 30.77
(C) 34.50
(D) 44.20
(E) 62.86

599. A random variable is exponentially distributed with mean μ.

Determine the difference between the 75$^{\text{th}}$ percentile and the 25$^{\text{th}}$ percentile of this distribution.

(A) $\dfrac{\ln 3}{\mu}$
(B) μ
(C) $\mu \ln 2$
(D) $\mu \ln 3$
(E) μ^2

600. Hospitalization losses under a certain policy are mutually independent and each has cumulative distribution function

$$F(x) = \begin{cases} 0, & \text{for } x < 0 \\ \dfrac{x + 15x^2}{16}, & \text{for } 0 \le x \le 1 \\ 1, & \text{for } x > 1. \end{cases}$$

For each hospitalization loss, the insurer reimburses up to a maximum of 0.80.

Calculate the probability that a policyholder's first partially unreimbursed hospitalization loss occurs on the third hospitalization.

(A) 0.027
(B) 0.080
(C) 0.128
(D) 0.148
(E) 0.350

601. Losses due to automobile accidents have a probability density function given by

$$f(x) = \begin{cases} \dfrac{3}{1000}\left(\dfrac{1000}{x}\right)^4, & \text{for } x > 1000 \\ 0, & \text{otherwise.} \end{cases}$$

An automobile policy has a deductible of 1100.

Calculate the expected value of the policy payout for a random loss.

(A) 140
(B) 400
(C) 413
(D) 826
(E) 1240

602. A construction worker experiences up to five accidents this year.

i) The probability of no accidents is three times the probability of exactly one accident.
ii) The probability of exactly one accident is four times the probability of exactly two accidents.
iii) The probability of exactly two accidents is five times the probability of exactly three accidents.

The probability of three or fewer accidents is 0.95.

Calculate the probability of two or fewer accidents.

(A) 0.71
(B) 0.84
(C) 0.91
(D) 0.94
(E) 0.96

603. A property-casualty insurer sells only homeowners insurance. Among the policies that the company sold, 40% belong to policyholders who have a security system for their houses and 60% belong to those who did not.

Assume in any particular year:

i) For any house without a security system, the number of break-ins follows a Poisson distribution, with mean 3.
ii) For any house with a security system, the number of break-ins follows a Poisson distribution, and the probability of no break-ins is three times that for a house without a security system.

Calculate the probability that a house has a security system, given that there are exactly two break-ins in a year.

(A) 0.11
(B) 0.27
(C) 0.40
(D) 0.45
(E) 0.55

604. In a certain region, tornados occur only during the six months from March through August. The number of tornados in each of these six months follows the same Poisson distribution and the number of tornados in different months are mutually independent.

The probability that there are no tornados in the six-month period from March through August is 0.008.

Calculate the probability that both the months of July and August are tornado-free, given that there was a tornado in June.

(A) 0.20
(B) 0.22
(C) 0.32
(D) 0.57
(E) 0.60

605. ElectroUSA is a store that sells portable music players. Ten percent of sales are Brand A and the rest are Brand B. The time, in years, until failure for Brand A is modeled by an exponential distribution with mean 2, while that for Brand B is modeled by an exponential distribution with mean 4.

A portable music player sold by ElectroUSA fails for the first time within three years of the purchase date.

Calculate the probability that it is Brand A.

(A) 0.08
(B) 0.14
(C) 0.47
(D) 0.60
(E) 0.78

606. Along a highway, automobiles are randomly selected for tire inspections. Let *X* denote the number of bad front tires and *Y* the number of bad rear tires on a randomly selected automobile. The joint distribution of *X* and *Y* is given by the probability function

$$p(x,y) = \begin{cases} \dfrac{(6-x)(3-y)}{58(1+|x-y|)}, & \text{for } x = 0,1,2 \text{ and } y = 0,1,2 \\ 0, & \text{otherwise.} \end{cases}$$

Calculate the variance of the number of bad front tires among those automobiles with one bad rear tire.

(A) 7/16
(B) 49/100
(C) 2/3
(D) 7/10
(E) 1

607. From telephone calls made to a help line, the following statistics are compiled:

i) 20% of the calls last for at least 2 minutes and less than 4 minutes.
ii) 34% of the calls last for at least 3 minutes and less than 5 minutes.
iii) 42% of the calls last for at least 4 minutes and less than 6 minutes.
iv) 38% of the calls last for at least 5 minutes and less than 7 minutes.
v) 28% of the calls last for at least 6 minutes and less than 8 minutes.

Calculate the probability that a randomly selected call will last for either at least 2 minutes and less than 3 minutes, or at least 7 minutes and less than 8 minutes.

(A) 12%
(B) 18%
(C) 24%
(D) 28%
(E) 30%

608. Six patients independently have the same probability of having a certain disease.

The probability that no patient has the disease is ten times the probability that exactly one patient has the disease.

The probability that no patient has the disease is x times the probability that exactly three patients have the disease.

Calculate x.

(A) 300
(B) 1,000
(C) 1,800
(D) 6,000
(E) 10,800

609. Losses under a theft insurance policy have cumulative distribution function

$$F(x) = \begin{cases} 0, & \text{for } x < 0 \\ c(x^2 + x), & \text{for } 0 \le x \le 5 \\ 1, & \text{for } x > 5, \end{cases}$$

where c is a constant.

The policy has a deductible of 3.2 for each loss.

Calculate the probability that the insurer will pay something to the policyholder on a given loss.

(A) 0.296
(B) 0.360
(C) 0.448
(D) 0.552
(E) 0.704

610. Losses are uniformly distributed on the interval [0, 2000]. An insurance policy pays the amount of each loss up to a maximum of m. The expected value of the claim payment on a random loss is 910.

Calculate m.

(A) 910
(B) 1150
(C) 1400
(D) 1600
(E) 1820

611. An insurer's loss severity random variable, *X*, has density function

$$f(x)=\begin{cases} c(x-5), & 5\le x\le 8 \\ c(11-x), & 8\le x\le 11 \\ 0. & \text{otherwise} \end{cases}$$

where c is a constant.

Calculate the 30$^{\text{th}}$ percentile of the loss severity.

(A) 5.47
(B) 6.14
(C) 6.80
(D) 7.06
(E) 7.32

612. For a certain product, the time until failure is modeled by a distribution with density function

$$f(x)=\begin{cases} ce^{-cx}, & x>0 \\ 0, & \text{otherwise,} \end{cases}$$

where c is a constant. The median time until failure is 10 years.

The product has a warranty that provides a payment of 35 if failure occurs in the first 5 years, 25 if failure occurs after 5 years, but within 7.5 years, and 0 if failure occurs after 7.5 years.

Calculate the expected payment under the warranty.

(A) 13.06
(B) 17.13
(C) 20.84
(D) 24.58
(E) 27.56

613. The annual numbers of accidents at two construction sites are each Poisson distributed. The probability of no accidents at the second construction site is 1.1 times this probability at the first construction site.

The standard deviation of the annual number of accidents at the first construction site is 1.50.

Calculate the standard deviation of the annual number of accidents at the second construction site.

(A) 1.28
(B) 1.36
(C) 1.40
(D) 1.47
(E) 1.65

614. An insurance company sells policies for two years. The company's profit in the first year is normally distributed with mean 660 and standard deviation 1100.

The company makes adjustments in the second year. The company's profit in the second year is normally distributed with mean μ and standard deviation 2640.

Assume that the annual profits are independent.

The probability that the company earns a positive overall profit in the two-year period is 0.8643.

Calculate μ.

(A) 1320
(B) 1940
(C) 2486
(D) 2740
(E) 3454

615. A taxicab company purchases an insurance policy that covers damages from car accidents. The number of accidents on each day is Poisson distributed with mean λ, and the number of accidents on different days are mutually independent. The expected number of accidents each week is 63.

Calculate the probability that the number of accidents in one day is two or more standard deviations below the expected number of accidents in one day.

(A) 0.006
(B) 0.021
(C) 0.116
(D) 0.156
(E) 0.207

616. Two random number generators, labeled C and D, are used to select numbers between 0 and 10. Generator C uses the continuous uniform distribution on [0, 10]. Generator D uses the discrete uniform distribution on the integers 0 through 10.

Calculate the absolute value of the difference between the standard deviation of the selection using C and the standard deviation of the selection using D.

(A) 0.00
(B) 0.02
(C) 0.28
(D) 0.50
(E) 1.67

617. A policyholder owns two properties and has hurricane insurance on both properties. One property is located in Texas. The other property is located in Florida.

Let T be the number of hurricane claims in a 5-year period for the Texas property, and let F be the number of hurricane claims in a 5-year period for the Florida property. The joint probability function for T and F is given in the following table.

Number of Hurricane Claims in 5-year period				
	Florida			
Texas	0	1	2	3
0	0.40	0.14	0.04	0.02
1	0.16	0.08	0.04	0.02
2	0.04	0.03	0.02	0.01

Calculate $\operatorname{Var}(T \mid F = 1)$.

(A) 0.18
(B) 0.24
(C) 0.45
(D) 0.49
(E) 0.80

618. The time in days, X, that an individual suffers from a common cold is continuous and uniformly distributed on $[a, b]$. The mean of X is 8.50, and the variance of X is 0.75.

Calculate the probability that a person who has suffered from a common cold for the past 7.5 days will continue to suffer from that cold for at least an additional 1.5 days.

(A) 0.33
(B) 0.40
(C) 0.50
(D) 0.60
(E) 0.83

619. The numbers of hits received by a website during the 1^{st}, 2^{nd}, …, 1440^{th} minutes of a given day are mutually independent Poisson random variables with common mean. The probability that there are exactly four hits during the 1^{st} minute is 54 times the probability that there are no hits during the 1440^{th} minute.

Calculate the number of hits the website is expected to receive between in a 60-minute period.

(A) 120
(B) 180
(C) 240
(D) 300
(E) 360

620. A broker markets four separate products. The probabilities of selling these products to a client are:

Product	Probability
Auto insurance	0.55
Homeowners insurance	0.45
Health insurance	0.50
Life insurance	0.60

The sales of these products are mutually independent.

Calculate the probability that the broker sells more than two products to a client.

(A) 0.27
(B) 0.35
(C) 0.39
(D) 0.57
(E) 0.73

621. The time between automobile accidents at a particularly dangerous intersection is exponentially distributed with mean 15 days.

There have been no accidents in the previous 10 days.

Calculate the probability that the next accident will occur more than 5 days from now, but less than 25 days from now.

(A) 0.27
(B) 0.37
(C) 0.47
(D) 0.53
(E) 0.63

622. Let X be a random variable representing the time required to fix a flat tire on a car.

You are given the following information:

i. X is uniform on $[a, b]$.
ii. The 50th percentile of X is 16.36.
iii. The standard deviation of X is 7.63.

Calculate $\frac{b}{a}$.

(A) 1.83
(B) 2.12
(C) 4.58
(D) 6.62
(E) 9.41

623. The scores on a math exam are modeled by a normal distribution. The mode of the exam scores is 56.00, and the 40th percentile is 52.20.

Calculate the percentile for an exam score of 65.50.

(A) 71st
(B) 74th
(C) 78th
(D) 81st
(E) 85th

624. An insurance company offers two kinds of insurance: automobile insurance and homeowners insurance. This year the company's profit from automobile insurance is normally distributed with a mean of 400 and a standard deviation of 200. Also this year, the company's profit from homeowners insurance is normally distributed with a mean of –100 and a standard deviation of 500. The two profits are independent.

Calculate the probability that the company's overall profit this year is positive.

(A) 0.41
(B) 0.59
(C) 0.63
(D) 0.67
(E) 0.71

625. The number of hurricanes in a year is modeled by a Poisson distribution with mean 1. The number of hurricanes in different years are mutually independent.

Calculate the probability that there are exactly ten hurricanes in a decade, given that there were exactly eight hurricanes in the first seven years of the decade.

(A) 0.053
(B) 0.125
(C) 0.130
(D) 0.191
(E) 0.224

626. An insurance company sells two types of policies. The annual number of claims for Type 1 policies follows a Poisson distribution with mean λ_1 and the annual number of claims for Type 2 policies follows a Poisson distribution with mean λ_2. The probability that a Type 1 policy has no claims in one year is one-half of the probability that a Type 2 policy has no claims in one year.

Let V_n be the variance in the annual number of claims for a Type n policy.

Calculate $V_1 - V_2$.

(A) 0.693
(B) 0.724
(C) 0.766
(D) 0.813
(E) 0.832

627. A policyholder owns a car and a truck. An auto insurer provides coverage on both vehicles.

Let X be the number of claims incurred over a five-year period on the car.
Let Y be the number of claims incurred over a five-year period on the truck.

The probability function of X and Y is shown in the table below:

		Y			
		0	1	2	3
X	0	0.06	0.10	0.12	0.02
	1	0.08	0.11	0.15	0.06
	2	0.05	0.07	0.05	0.03
	3	0.01	0.02	0.03	0.04

Calculate $\mathrm{E}(Y \mid X < 2)$.

(A) 1.30
(B) 1.37
(C) 1.41
(D) 1.45
(E) 1.53