SOCIETY OF ACTUARIES

General Insurance
Further Topics

Exam GI 301

Date: Thursday, November 20, 2025

IINSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has 11 questions numbered through 11 with a total of 50 points.

   The points for each question are indicated at the beginning of the question.

2. While every attempt is made to avoid defective questions, sometimes they do occur. If you believe a question is defective, the supervisor or proctor cannot give you any guidance beyond the instructions provided in this document.

Written-Answer Instructions

1. Each question should be answered in the Excel file. Graders will only look at work in the Excel file.

2. Calculations should be done in Excel and entered as formulas. Performing calculations on scratch paper or with a calculator and then entering the answer in the cell will not earn full credit. Formatting of cells or rounding is not required for credit. Rows can be inserted to the answer input area as required to provide space for your answer.

2. The answer should be confined to the question as set.

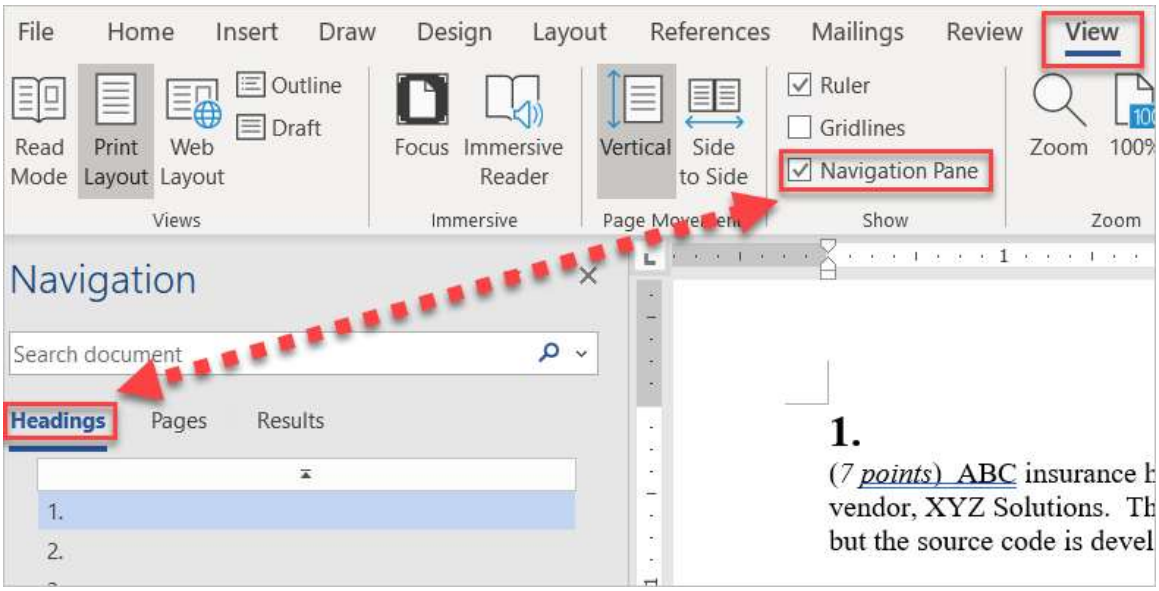
3. Prior to uploading your Excel file, the file should be saved and renamed with your unique candidate number in the filename.

4. The Excel file that contains your answers must be uploaded before the five-minute upload period expires.

Navigation Instructions

Open the Navigation Pane to jump to questions.

Press Ctrl+F, or click View > Navigation Pane:



1.

Provide the response for this question in the Excel spreadsheet.

(*5 points*) You have developed an ultimate claims reserve estimate using a chain ladder approach. The data and analysis are on the tab "Q01" in the provided Excel file.

The chain ladder approach assumes the development factors are uncorrelated between development years.

You are using the following methods to test for correlation:

- Pearson correlation
- Spearman rank correlation

(a) (*0.5 points*) Provide two reasons why the Spearman rank correlation is better.

(b) (*3.5 points*) Calculate the p-values using the two methods.

(c) (*1 point*) Evaluate whether the development factors are uncorrelated using the results in (b).

2.

Provide the response for this question in the Excel spreadsheet.

(*5 points*) You have been provided data extracted from a triangle of cumulative paid losses. The data are on the tab "Q02" in the provided Excel file.

You plan to apply Clark's stochastic reserving model using the loglogistic distribution function and the Cape Cod method.

Clark states the following:

I. The Cape Cod method is generally preferred over the LDF method.

II. The loglogistic distribution function provides the form of loss development, but it is not the distribution of any observed random variable.

(a) (*2 points*) State the following:

(i) Clark's reasoning for statement I.

(ii) The observed random variables in Clark's approach.

(iii) The distribution that Clark assumes for the random variables in (ii).

The data in tab "Q02" contains the calculation of the maximum likelihood estimates for the model's three parameters.

(b) (*2 points*) Estimate the process variance for the reserve, using Clark's approach and the information in tab "Q02".

Your colleague stated that the semi-parametric bootstrap as described by Taylor and McGuire can be applied to Clark's model as an alternative way to estimate the variance of reserves.

(c) (*1 point*) Critique your colleague's statement.

3.

Provide the response for this question in the Excel spreadsheet.

(*4.5 points*) You are provided the following information as of December 31, 2024.

Accident Year (AY)	Cumulative Reported Claims (000) Excess of 500,000 Limit						
	12	**24**	**36**	**48**	**60**	**72**	**84**
2018	325	1,463	**N/A**	1,932	2,029	2,070	2,080
2019	138	635	794	889	900	923	
2020	94	404	517	584	592		
2021	243	1,166	1,469	1,601			
2022	561	2,300	2,852				
2023	297	1,247					
2024	469						

The reported claims for AY 2018 at 36 months of development are not available due to a data issue.

(a) (*1 point*) Calculate total IBNR for claims excess of 500,000 limits using volume weighted average loss development factors.

You are given the following additional information based on historical data:

	12-24	**24-36**	**36-48**	**48-60**	**60-72**	**72-84**	**84-Ult**
Age-to-Age Factors (Unlimited Reported Claims)	1.350	1.130	1.050	1.020	1.010	1.002	1.000
Severity Relativity 500,000 to Unlimited (Rt)	0.832	0.694	0.650	0.633	0.627	0.623	0.620

(b) (*1.25 points*) Calculate total IBNR for the claims excess of 500,000 limits using Siewert's formula.

(c) (*1 point*) Identify two reasons why alternative approaches should be considered for estimating the IBNR based on the results in (a) and (b).

3. Continued

You are considering using the increased limit factor (ILF) method and are given the following additional information:

Accident Year	Ultimate Claims (000) at Basic Limit
2023	4,013
2024	4,657

- The basic limit is 500,000.
- A large claim loading of 1.46 as of January 1, 2024 cost level was selected for ratemaking purposes.
- The annual trend factor for the large claim loading is 5%.

(d) (*1.25 points*) Calculate IBNR for AYs 2023 and 2024 for the claims excess of 500,000 limits using the ILF method.

4.

Provide the response for this question in the Excel spreadsheet.

(*3.5 points*) You are using a balanced scorecard approach described in "A Framework for Assessing Risk Margins" by Marshall et al. (Marshall) to measure the internal systemic risk coefficient of variation (CoV) for a line of business.

Internal Systemic Risk - Balanced Scorecard			
Risk Component	**Weight**	**Risk Indicator**	**Score**
Specification error	25%		
Parameter selection error	45%		
Data error	30%		

You are given the following information regarding an analysis completed for that line's claim liabilities:

	Potential Risk Indicator
I	A GLM model is used in the assessment of random effects for the liabilities.
II	Comprehensive reasonableness checks on the valuation model outcomes are conducted by the actuarial peer review team.
III	An actuary reviewed the data used for the valuation model and identified a significant data issue.
IV	The company recently implemented a claim cost reduction initiative.
V	A new variable has been tested and added to the valuation model due to the recent claim process change.

(a) (*1.5 points*) Identify one risk indicator from the list of potential risk indicators above for each risk component. Justify your selection.

You have assigned a score of 2 for higher risk and 4 for lower risk.

(b) (*0.75 points*) Select a score of 2 or 4 for each risk indicator identified in (a).

4. Continued

You are provided with the following coefficient of variation (CoV) scale.

Score from balanced scorecard	CoV
1.0-2.5	15.0%
2.5-3.5	9.0%
3.5-4.5	6.0%
4.5-5.0	5.0%

(c) (*0.5 points*) Calculate the internal systemic risk CoV based on the completed balanced scorecard from (a) and (b) and the CoV scale provided.

You are given the following additional information.

- The central estimate for claim liabilities is 750 million.
- The independent risk CoV is 7.5%.
- The external systemic risk CoV is 10%.
- Claim liabilities are assumed to be normally distributed. The z-value of the 75th percentile of the normal distribution is 0.674.

(d) (*0.75 points*) Calculate the required risk margin for claim liabilities at a 75% probability of adequacy.

5.

Provide the response for this question in the Excel spreadsheet.

(*3 points*) You are given the following as of December 31, 2024:

Accident Year	Paid Claims	Case Reserves	Ultimate Claims Based Upon		Selected Ultimate Claims
			Reported Development Method	Expected Claims Ratio Method	
2020	44,203	11,183	63,304		63,304
2021	29,239	21,587	61,783	63,590	61,783
2022	25,200	34,502	81,662	77,446	79,554
2023	11,374	18,692	53,864	56,789	55,327
2024	6,829	27,016	76,250	66,523	66,523

The following was recorded as of March 31, 2025:

Accident Year	Paid Claims	Case Reserves
2021	30,790	20,572
2022	27,173	33,935
2023	12,904	20,178
2024	7,803	28,706

Compare actual minus expected results as of March 31, 2025, for each of accident year 2021 to 2024, assuming ultimate claims are based upon each of the following:

(i) Selected

(ii) Reported development method

6.

Provide the response for this question in the Excel spreadsheet.

(*3.5 points*) You are given:

- An insured's home is valued at 25,000.
- The insurance policy has an 80% coinsurance requirement and a 1,000 per claim deductible.
- The deductible applies after coinsurance.

(a) (*1 point*) Calculate the insured's retained loss for the following claim and insured amount scenarios.

(i) Claim amounts: 18,000, 21,500 and 25,000

(ii) Policy insured amounts: 16,000, 19,000, 22,000

You are given:

- An insured's home is valued at 250,000.
- The home is insured by an all-perils policy with an insured value of 200,000.
- The policy includes an 85% coinsurance clause.
- The policy has an earthquake (EQ)deductible of 10%, applicable to insured value, and a 3,000 deductible for other insured perils (OIP).
- The deductible applies after coinsurance.
- The home is destroyed by an earthquake during the policy period.

(b) (*0.5 points*) Calculate the amount the insurer would pay to the insured for the loss of their home.

An insurer only writes property policies with a 2,000 deductible. The insurer is considering doubling the deductible for all policies.

(c) (*2 points*) Explain what the insurer should expect regarding the frequency, severity and total claims if it made this change. State all assumptions.

7.

Provide the response for this question in the Excel spreadsheet.

(*5 points*) You are conducting a risk classification analysis for a book of business that has only two rating variables. Rates are calculated as the base rate times the type of use relativity times the territory relativity. The base rate is 630.17.

You are given:

Type of Use	Territory	Earned Exposures	Frequency per Exposure	Claim Severity
A	Rural	2,000	0.0450	13,333
B	Rural	900	0.0444	9,000
A	Suburban	3,600	0.0500	14,000
B	Suburban	2,000	0.0500	9,000
A	Urban	5,400	0.0556	15,750
B	Urban	3,500	0.0457	6,750

(a) (*1.5 points*) Apply a one-way analysis to each rating variable to determine their relativities.

(b) (*1.5 points*) Assess whether the one-way analysis is suitable to determine the relativities for both rating variables.

The minimum bias method is used to obtain the final relativities. The process starts with the one-way analysis relativities for the "Territory" rating variable.

(c) (*2 points*) Calculate the revised relativities for "Type of Use" that result from a single iteration of the minimum bias method.

8.

Provide the response for this question in the Excel spreadsheet.

(*6 points*)

(a) (*1 point*) Compare retrospective rating to experience rating.

An insurer is reviewing the claims experience for three companies, each seeking individual rating for their coverage, and are given the following claims experience.

Accident Year	Claims Experience (in millions)		
	Company A	Company B	Company C
2019	1.5	0.3	0.9
2020	1.4	0.0	1.0
2021	1.2	0.0	1.1
2022	1.1	7.0	1.3
2023	1.2	0.0	1.5
2024	0.9	0.0	1.5

- During the experience period, each company had similar coverage.
- Each company's claims experience is fully credible.
- All claims are developed to ultimate value.
- The annual claims trend is 0%, applicable to both frequency and severity.
- Past claims experience is a reasonable indicator for future claims experience.

(b) (*1.5 points*) Evaluate each company for retrospective rating, from the perspective of the insurance company.

The insurer has offered each company the choice of either a fixed-premium policy or a retrospectively rated policy for 2026. The policy details are the same for each company.

- The price of the fixed premium policy is 1.75 million.
- The price of the retrospective rated policy is 0.35 million plus 120% of claims with a total maximum premium of 3.75 million.

(c) (*2 points*) Recommend for each company the policy that should be selected. Justify your recommendation.

With retrospective rating, the insurer will need to estimate an asset for the additional premium it will be due as claims develop. This is often referred to as the retro reserve.

(d) (*1.5 points*) Compare the Berry approach to estimate the retro reserve to the approach used by Teng and Perkins.

9.

Provide the response for this question in the Excel spreadsheet.

(*5 points*) You are given:

- Primary Insurer Company (PIC) writes policies up to a limit of 500,000.
- There is a per occurrence excess of loss treaty with reinsurance company RB Reinsurance (RB) for 300,000 excess of 200,000.

Accident Year	Gross Reported Claims ('000)					Gross Ultimate Claims ('000)	Gross Earned Premium ('000)
	12	24	36	48	60		
2020	6,894	9,983	12,155	15,047	17,866	18,759	31,401
2021	6,240	9,121	12,074	16,435		20,490	33,634
2022	7,544	10,268	13,607			22,046	39,005
2023	7,787	10,810				22,573	37,051
2024	7,903					23,347	38,507

Accident Year	Net Reported Claims ('000)				
	12	24	36	48	60
2020	6,878	9,886	11,991	14,724	17,361
2021	6,240	9,121	12,074	15,963	
2022	7,451	10,053	13,173		
2023	7,663	10,649			
2024	7,892				

Accident Year	Ceded Reported Claims ('000)				
	12	24	36	48	60
2020	16	97	164	323	505
2021	0	0	0	472	
2022	93	215	434		
2023	124	161			
2024	11				

PIC calculates ceded ultimate claims as the difference between gross and net ultimate claims calculated using the reported development methodology. PIC assumes a tail factor of 1.05 for development beyond 60 months.

9. Continued

(a) (*2 points*) Calculate ceded ultimate claims for each accident year from PIC's perspective.

RB calculates its ceded ultimate claims using the Bornheutter Ferguson methodology.

RB Selected LDF				
12-24	**24-36**	**36-48**	**48-60**	**60+**
1.800	1.600	1.500	1.300	1.100

- The reinsurance premium is 3% of earned premium.
- The expected loss ratio is 60%.

(b) (*2 points*) Calculate RB's loss ratio for each accident year.

(c) (*1 point*) State four reasons why a reinsurer's estimate of the primary insurer's ultimate ceded claims may be different from the primary insurer's estimate.

10.

Provide the response for this question in the Excel spreadsheet.

(*4.5 points*) A direct insurance company is considering the following annual quota share reinsurance contract:

- Reinsurance inception date: January 1, 2026
- Reinsurance premium: 1,000,000
- 50% of reinsurance premium paid at inception date and 50% paid on July 1, 2026
- Reinsurance commission: 30%, paid with the reinsurance premium
- All reinsured losses are paid on January 1, 2029
- The treaty's ultimate loss ratio is represented by the following discrete distribution:

Probability	Ultimate Loss Ratio
4%	120%
6%	75%
90%	60%

The annual risk-free rate on investments is 3%.

(a) (*2 points*) Apply the following methods to determine whether this reinsurance contract transfers sufficient risk to permit reinsurance accounting using

(i) Expected Reinsurer Deficit (ERD) with a 1% threshold

(ii) The 10-10 rule

(b) (*1 point*) Describe two advantages and one disadvantage of the ERD method over the 10-10 rule for assessing risk transfer.

An alternative measure of risk transfer is the Risk Coverage Ratio (RCR).

(c) (*1.5 points*)

(i) Describe what RCR measures.

(ii) State both versions of the formula for RCR (i.e., with and without ERD in the formula). Define all of the terms included in each formula.

11.

Provide the response for this question in the Excel spreadsheet.

(*5 points*) Catastrophe models are often used instead of historical data to predict future losses from catastrophe events.

(a) (*0.5 points*) State two advantages of using catastrophe models instead of historical data.

A reinsurance company is renewing property catastrophe excess-of-loss covers from two companies, X and Y. You are given each company's event loss table (ELT). The events are assumed to be independent random variables, each following a Bernoulli distribution.

Event *i*	Probability	Losses (000)	
		Company X	Company Y
1	0.00010	300,000	350,000
2	0.00050	100,000	102,500
3	0.00075	75,000	85,000
4	0.00100	45,000	50,000
5	0.00125	25,000	23,500
6	0.00250	17,500	20,000
7	0.00750	12,500	15,000
8	0.01000	10,000	9,000
9	0.02500	5,000	7,000
10	0.05000	2,000	3,000

(b) (*1.5 points*)

(i) Calculate the occurrence exceedance probabilities (OEP)

(ii) Plot the OEP curve for Company X.

The reinsurance company calculates risk loads using the Marginal Variance (MV) method applied to an ELT.

The MV risk load multiplier, λ, is 0.00000002.

(c) (*2 points*) Calculate the renewal risk load for Company X and Y.

(d) (*1 point*) Calculate the renewal risk load for Company X and Y using the Shapley Method.

****END OF EXAMINATION****