1. **Learning Objectives:**
   1. The candidate will understand how to evaluate healthcare intervention programs.

**Learning Outcomes:**
(1a) Describe, compare and evaluate programs.

(1c) Apply the actuarially adjusted historical control methodology.

**Sources:**
Duncan, Chapter 8, 12

**Commentary on Question:**
*Commentary listed underneath question component.*

**Solution:**
(a) Compare and contrast total savings and return on investment (ROI) for measuring results of a disease management (DM) program.

**Commentary on Question:**
*Most candidates performed well on this part of the question.*

- Total savings shows dollars versus ROI shows a ratio/percent.
- ROI favored by DM industry for reporting the value of a DM program.
- Total savings alone doesn’t provide the whole picture (i.e. ROI is needed to complete the cost-benefit analysis of a program).
- Total savings helps determine if a program delivers meaningful savings, absolutely or on a per member per month basis (e.g. a program can have a high ROI, but if the program is small, total savings will have a negligible impact on health plan trend).
- ROI can mask a positive marginal savings opportunity due to intervention on the marginal population. Savings measured on a per member (or per chronic member) per month may provide more insight into program value than does an ROI measure.
- No agreement in the industry regarding the calculation of either the savings or the components that should be included in cost.
- As the number of programs and particularly their overlap increases, savings calculations and drawing conclusions and comparisons between program ROIs becomes increasingly difficult.
1. Continued

- Definitional issues and random variability in the components that are used in their calculations can be misleading for comparing actual program outcomes to what was expected or planned.

(b) Describe the interaction among risk, program cost, and savings as they relate to the risk management economic model.

**Commentary on Question:**
*Candidates generally struggled on this question. Many candidates described the risk management economic model instead of properly describing the interaction of risk, program cost and savings.*

- A small percentage of the population will account for a disproportionately large percentage of expenses.
- With increasing population penetration, risk of the population being penetrated decreases.
- As risk decreases with greater penetration, the marginal cost of an additional intervention exceeds the marginal savings.

(c) Critique the vendor’s assertion. Show your work.

**Commentary on Question:**
*Most candidates calculated the savings due to averted admissions correctly. Many candidates, however, did not add the averted admissions cost to the total cost without the DM program.*

- Total Savings due to Averted Admissions =
  - \((\frac{20,000}{12,000}) \times (\frac{375,000}{1,000}) \times 8,350 = 12,525,000\)

- Total Cost of Member Population without DM program =
  - \((125,000 \times $4,000) + 12,525,000 = 512,525,000\)

- Total Savings to Total Cost without DM program =
  - \(\frac{12,525,000}{512,525,000} = 2.44\%\)

- The vendor’s assertion is incorrect. The DM program does not save the health plan at least 2.5% of its total costs. The DM program savings are just shy of 2.5% of the health plan’s total costs.
2. **Learning Objectives:**
   1. The candidate will understand how to evaluate healthcare intervention programs.

**Learning Outcomes:**
(1a) Describe, compare and evaluate programs.

(1b) Estimate savings, utilization rate changes and return on investment.

**Sources:**
Duncan, Chapter 11

**Commentary on Question:**
*Commentary listed underneath question component.*

**Solution:**
(a) Describe a propensity score.

- A composite variable that summarizes multiple characteristics inherent in a population into a single variable value.
- Allows for matching treatment members with controls members on a single score rather than directly on multiple characteristics.
- Mathematically equals \( \exp[\alpha + \beta X] / (1 + \exp[\alpha + \beta X]) \).
- Defines the probability of the member being in the treatment group.
- Estimated using a logit function or logistic regression analysis.
- Multiple characteristics on which the score may be estimated can include age, gender, other demographics, education level, medical utilization, etc.
- Cannot be rated on unobservable variables like willingness to participate.

(b) Describe different matching techniques for applying propensity score matching.

**Commentary on Question:**
*Candidates generally did very well on this part of the question.*

Nearest neighbor matching
- First member of the comparison population with the “closest” propensity score is selected
- Selection should be done randomly; otherwise, the order in which matching is done can affect the outcome
- Matching can either be with or without replacement

Caliper Matching
- Match is made if the member and match’s propensity scores are within a fixed distance
2. Continued

Mahalanobis Metric Matching
- Mahalanobis distance is a metric used to measure the dissimilarity between two vectors

Stratification Matching
- Uses coarsened exact matching, in which observations are stratified and then matched by stratum

(c) Calculate the propensity score for each treatment and control group member. Show your work.

Commentary on Question:
Candidates needed to fully calculate the propensity score and not just the “log odds ratio” to receive full credit on this part of the question.

Control Member 1
\[
\exp[3.04 - 0.001*31 + 0.06*1 - 0.1*28] / (1 + \exp[3.04 - 0.001*31 + 0.06*1 - 0.1*28]) = 0.5668
\]

Control Member 2
\[
\exp[3.04 - 0.001*55 + 0.06*0 - 0.1*24] / (1 + \exp[3.04 - 0.001*55 + 0.06*0 - 0.1*24]) = 0.6422
\]

Treatment Member 1
\[
\exp[3.04 - 0.001*44 + 0.06*0 - 0.1*24] / (1 + \exp[3.04 - 0.001*44 + 0.06*0 - 0.1*24]) = 0.6447
\]

Treatment Member 2
\[
\exp[3.04 - 0.001*62 + 0.06*1 - 0.1*23] / (1 + \exp[3.04 - 0.001*62 + 0.06*1 - 0.1*23]) = 0.6766
\]

(d) Interpret the propensity score for Treatment Member 1.

Commentary on Question:
Simply stating that the propensity score is a probability or that there’s a 64.5% probability that Treatment Member 1 is in the treatment group is not a full interpretation of the propensity score.

A 44 year-old male with a BMI of 24 has a 64.5% probability of being in the treatment group.
2. Continued

(e) Demonstrate, using nearest neighbor matching with replacement, that propensity score matching reduces the variability in the average age and BMI between members of the treatment and control groups. Show your work.

Commentary on Question:
Some candidates chose to calculate the reduction in variance between the control and treatment groups after matching, which was also an acceptable answer.

Treatment member 1 should be matched with control member 2 since the propensity score 0.6447 for treatment member 1 is “closest” to the propensity score 0.6422 for control member 2.

Treatment member 2 should be matched with control member 2 since the propensity score 0.6766 for treatment member 2 is “closest” to the propensity score 0.6422 for control member 2.

Average age of treatment members before matching = (44 + 62) / 2 = 53
Average BMI of treatment members before matching = (24 + 23) / 2 = 23.5
Average age of control members before matching = (31 + 55) / 2 = 43
Average BMI of control members before matching = (28 + 24) / 2 = 26
Average age of treatment members after matching = (44 + 62) / 2 = 53
Average BMI of treatment members after matching = (24 + 23) / 2 = 23.5
Average age of control members after matching = 55
Average BMI of control members after matching = 24

Difference in age between treatment and control members before matching = 43 – 53 = -10
Difference in BMI between treatment and control members before matching = 26 – 23.5 = 2.5
Difference in age between treatment and control members after matching = 55 – 53 = 2
Difference in BMI between treatment and control members after matching = 24 – 23.5 = 0.5

(f) Explain differences between propensity scoring and risk adjustment.

- The propensity score is usually based on a wider range of independent variables than the risk score.
- Risk adjustment will almost always take into account more detailed diagnosis variables than propensity scoring.
- Risk adjustment is often applied at the population level to adjust for inherent differences in populations.
- Propensity scoring is generally used to match members one-for-one based on their propensity scores.
2. Continued

- Risk adjustment uses the entire population.
- Propensity score matching can result in many members of the population being discarded when there is incomplete overlap between populations.
- Risk adjustment is a well-known technique among actuaries and among insurers and government officials.
- Propensity scoring is the method of choice in health services research.
3. Learning Objectives:
2. The candidate will understand how to evaluate health insurance organization risk and mitigation strategies.

Learning Outcomes:
(2a) Evaluate an enterprise risk management (ERM) system.

Sources:
Financial Enterprise Risk Management 2nd edition, Sweeting, Chapter 8, Risk Identification

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a) Verify the accuracy of the following statements regarding a wide range of contributors to your committee. Justify your answers.

(i) The committee should be comprised of director level and above associates from the department most affected by the new product

(ii) All levels of seniority should be included on the committee

(iii) Shorter term employees should be excluded due to their lesser knowledge base

(iv) The committee should include only members of the pricing organization and its affiliates

Commentary on Question:
Candidates generally did well on this part of the question.

(i) False – the committee should have employees and directors from all departments

(ii) True

(iii) False – the committee should have a mix of longer term and shorter term employees

(iv) False – stakeholders who are external to the organization should be included
3. Continued

(b) Describe the following risk identification techniques:

(i) Brainstorming

(ii) Independent group analysis

(iii) Gap Analysis survey

(iv) Delphi Technique survey

Commentary on Question:
Most candidates lacked the necessary detail to receive full credit on this part of the question. Many candidates defined the terms but did not include sufficient detail in their description of the techniques.

(i) Brainstorming:

a. an unrestrained or unstructured group discussion
b. led by an experienced facilitator in order to draw out as many viewpoints as possible, broad range of points is investigated, and each point is discussed in depth
c. No ideas should initially be censored, as they could lead to other better suggestions
d. Facilitator organizes the risks into appropriate groups, removing irrelevant ones
e. Facilitator does not need to be an expert, helps if members are familiar with risks of the organization

(ii) Independent Group Analysis

a. All participants write down in silence and without collaboration ideas on the risks that may arise
b. Facilitator aggregates the ideas and leads a discussion to determine the exact nature of the risks and the distinctions between the two
c. The relative importance of the risks is discussed and the risks are ranked independently and anonymously
3. Continued

(iii) Gap Analysis Survey

a. This technique asks two types of question – to identify both
   1. the desired level of risk exposure, and
   2. actual levels of risk exposure
b. The two types of question will be asked of the different people (i.e. senior leaders asked about desired level of risk exposure, lower level employees asked about actual level of risk exposure)

(iv) Delphi Technique

a. Acknowledged experts are asked to comment on risks anonymously and independently, results need to be properly analyzed rather than simply being aggregated.
b. Uses an initial survey followed by subsequent surveys based on the initial survey’s results. This is continued until consensus is met on the nature and importance of the risks faced. Design of initial questionnaire is important, but not as important as the subsequent revisions.

(c) Describe the disadvantages of the following risk identification techniques:

(i) Brainstorming

(ii) Surveys

Commentary on Question:
Some candidates failed to recognize that this question asks for only the disadvantages of these risk identification techniques and included advantages as well. No credit was given or taken for listing advantages.

(i) Brainstorming – Disadvantages

a. Free riders can exist. Each member should be required to lead the discussion on a particular risk category
b. All participants need to be in the same location
c. Having all participants together could lead to convergent thinking – ideas are influenced by prior contributions
d. Open nature of brainstorming can lead to a lack of completeness
3. Continued

(ii) Surveys – Disadvantages

a. Heavily influenced by way questions are asked (framing)
b. Low response rate could invalidate a risk identification exercise
c. Multiple choice must be used to quantitatively analyze the results –
   Multiple choice limits the responses available
d. Weighting needed to offset bias
4. Learning Objectives:
2. The candidate will understand how to evaluate health insurance organization risk and mitigation strategies.

Learning Outcomes:
(2a) Evaluate an enterprise risk management (ERM) system.
(2c) Integrate reinsurance arrangements within an overall risk management strategy.

Sources:
GHS-122-18: Why are Many Co-Ops Failing?
GHS-123-18: Enterprise Risk Management: Parts One, Two and Three
GHS-121-18: Enterprise Risk Management, Ratings Direct

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a) Describe advantages and disadvantages of each proposal.

Commentary on Question:
Many candidates performed well on this part of the question. Those who did not receive full credit often did not provide a thorough description of the advantages or disadvantages.

Rental Provider Network:
Advantages:
• Renting a network will enable the CO-OP to meet state or marketplace network adequacy standards without a lot of work
• The network will be available in a short time frame
Disadvantages:
• It is difficult to control costs or manage the quality of care
• The CO-OP cannot directly negotiate with providers

Third Party Administrator:
Advantages:
• Contracting with TPA’s will enable the CO-OP to meet tight deadlines
Disadvantages:
• Many TPAs have experience working with self-funded employer plans, however are less familiar with fully insured plans and the regulatory requirements and compliance needs specific to these products.
• Long term contracts with TPAs create challenges when changes are necessary to meet market needs
4. Continued

Platinum Plan Offering:
Advantages:
• Offering Platinum plans are attractive to consumers with significant health needs
Disadvantages:
• Declining to sell Platinum plans could potentially reduce the exposure to expensive claims and potentially sicker mix of enrollees

(b)
(i) Describe traditional risk management
(ii) Describe enterprise risk management (ERM)

Commentary on Question:
Many candidates tried to define each of the approaches to risk management, rather than describe, in detail, the various aspects of each.

Traditional Risk Management
• Clinically focused approach and examines risks individually
• Risk management activities center on ways to mitigate the impact of adverse events on operations and finances
• This model maintains that risks are best managed within the functional silos of finance, insurance, human resources and safety and holds that shareholder value is maximized through partial or full risk transfer
• Fails to appreciate relationships among risks and lacks optimization of collective risk evaluation and management through an enterprise approach
• Lacks common definition of risk and universal measures to gauge the effectiveness of risk management efforts

Enterprise Risk Management:
• ERM recognizes a broad range of risks confronted by the organization and acknowledges those risks represent either sources of capital or potential for losses
• When recognized as capital, risks can be viewed as having either negative or a positive potential.
• A holistic approach is critical to managing diverse risks.
• An enterprise wide view recognizes all the potential threats to the organizations business and strategic objectives
• Uses common metrics across risk domains to determine the effectiveness of risk management approaches.
• With an integrated, enterprise-wide view of risk, the risk manager has a much more strategic position, focusing on opportunities as well as risks.
4. Continued

(c) Describe the health insurance risk controls the CO-OP should implement around underwriting, pricing, and claim management to generate positive ratings for their ERM program.

**Commentary on Question:**

Many candidates did not specifically articulate how the various risk controls can be applied to UW, pricing and claim management keeping their responses broad in respect to risk.

- Use a disciplined underwriting process with clearly defined limits (e.g. concentration limits and minimum enrollment requirements) and authorities.
- Perform active monitoring and analysis of claim experience (incidence rates and severity), which provide feedback into the pricing and projection process.
-Judiciously perform reviews and audits of underwriting and claim management.
- Perform an ongoing review of health care trends, medical advances, and medical costs and assesses their impact as well as mitigation strategies. In addition, the insurer uses multiple medical care cost forecasting techniques.
- When possible, stagger rate renewals throughout the year to facilitate prompt pricing adjustments.
- Carefully select reinsurance coverage, balancing risk retention and risk transfer.
- Incentive structure is tied to the portfolio-based performance targets that balance risk and rewards.
- The insurer uses standard policy provisions that are applied to all providers and consistently maintains pricing power and has the ability to negotiate favorable terms with sponsors and networks.
- The insurer maintains multiple providers in the portfolio; when possible, provider contract renewals are staggered throughout the year.
5. Learning Objectives:
1. The candidate will understand how to evaluate healthcare intervention programs.

Learning Outcomes:
(1a) Describe, compare and evaluate programs.

(1d) Calculate chronic and non-chronic trends in a manner that reflects patient risk.

Sources:
Healthcare Risk Adjustment and Predictive Modeling, Duncan (2nd edition), Chapter 4, Clinical Identification Algorithms

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)
(i) Construct a code grouping system using three severity levels for the codes given above.

(ii) Calculate the average and relative PMPY costs. Show your work.

Commentary on Question:
Almost every candidate received full credit for Part (a) as they were able to categorize the diagnosis codes into low, medium, and high costs, and then calculate the average and relative costs for each severity grouping.

(i) Sort the Average Cost PMPY for all given diagnosis codes in ascending order. Group the resulting diagnosis codes into 3 severity levels. This may vary by candidate, but there must be 3 severity levels with similar cost codes.


Surprisingly, a few candidates grouped the diagnosis codes 10K to 19K, 20K to 29K, and 30K+

(ii) Severity 1 Average Cost: \((10K + 11K + 12K)/3 = 11K\)
Severity 2 Average Cost: \((18K + 19K + 20K)/3 = 19K\)
Severity 3 Average Cost: \((29K + 30K + 31K)/3 = 30K\)

Total Average Cost: \((11K + 19K + 30K)/3 = 20K\)

Severity 1 Relative Cost: \(11K/20K = 0.55\)
Severity 2 Relative Cost: \(19K/20K = 0.95\)
Severity 3 Relative Cost: \(30K/20K = 1.50\)
5. Continued

(b) Rank the members to maximize the focus of the DM program. Justify your answer.

Commentary on Question:
Many candidates did not calculate the relative cost for each member against 20K (i.e., candidates did not divide by 20K), but rather calculated 18K – 11K, 19K – 19K, and 20K – 30K, to get 7K, 0, and -10K, then ranked them in the same order (i.e., Member 1, Member 2, and Member 3) to receive some credit for the correct ranking.

Relative cost for Member 1 = 18K/20K = 90%
Relative cost for Member 2 = 19K/20K = 95%
Relative cost for Member 3 = 20K/20K = 100%

Relative cost for the severity level for Member 1 = 55%
Relative cost for the severity level for Member 2 = 95%
Relative cost for the severity level for Member 3 = 150%

Member 1 maximizes the focus of the DM program because the relative cost for member 1 (90%) is higher than the relative cost for the severity level for member 1 (55%).

Member 2 is the next member to maximize the focus of the DM program because the relative cost for member 2 (95%) is equal to the relative cost for the severity level for member 2 (95%).

Member 3 is the last member to maximize the focus of the DM program because the relative cost for member 3 (100%) is less than the relative cost for the severity level for member 3 (150%).

(c) Describe sensitivity and specificity knowing that the measure of interest is diabetes.

Commentary on Question:
Most candidates did very well on this part of the question.

Sensitivity – would be calculated as the percentage of members of the population with diabetes who are correctly identified

or

the percentage of “true positives” that are correctly identified as such.

Specificity – the number of health individuals correctly identified (and not incorrectly identified as having diabetes
5. **Continued**

or

the percentage of “true negatives” correctly identified.

(d) Describe the dilemma you have in balancing the sensitivity of your model versus the specificity of your model.

**Commentary on Question:**
*Most candidates did well on this part of the question.*

The analyst must decide how to establish the balance between the sensitivity of the model capturing as many disease members as possible, and the risk of including some false positives,

and

The specificity of the model reducing the likelihood of false positives, but at the risk of excluding some true positives.

For underwriting purposes, want to use a more-specific algorithm.

For case management, want to use a more-sensitive algorithm.
6. **Learning Objectives:**
3. The candidate will understand how to apply risk adjustment in actuarial work.

**Learning Outcomes:**
(3a) Describe and compare risk adjustments based on commonly used clinical data and grouping methods.

**Sources:**
Healthcare Risk Adjustment and Predictive Modeling, Duncan (2nd edition), Ch 22
Intro to Risk Adj: Accountable Care Organization (Sec 22.1-22.5 only)

**Commentary on Question:**
*Generally candidates struggled with this question. Many candidates failed to provide meaningful differences between ACOs and DM programs, sometimes confusing the two. Candidates who excelled were able to provide thoughtful commentary on how ACOs are relatively new and need to learn from DM programs to be more effective.*

**Solution:**
Compare and contrast accountable care organizations (ACOs) to disease management (DM) programs.

- ACOs represent a reaction to the typical nurse call-center-based chronic DM program
- Providers felt excluded from many DM programs. Missing link for insurer-sponsored DM programs was a strong tie to the patient’s physician
- DM programs had the advantage of years of development, experimentation and economies of scale. Data and analytics resources available to many ACOs are less mature than those used by DM companies.
- Best DM programs operated sophisticated data analytics, gap identification, and outreach and engagement initiatives
- ACO makes the PCP responsible for patient’s care.
- ACOs started without the infrastructure and experience of the DM programs
- ACOs have the disadvantage of diseconomies of scale.
- PCP alone does not have the bandwidth to manage all of the needs of a chronically-ill patient panel.
- Because of the open nature of ACOs, some patients will seek care outside the practice.
- It will take many years for ACOs to achieve the completeness of a good payer claims database.
- ACOs emphasis on the EMR/EHR (Electronic Medical/Health Record) which is a repository of data often in note, rather than in machine-readable form – lack analytical capabilities.
- Sponsors of the ACO want a positive return earlier (year 1) than later (year 3+)
- ACO needs to understand the importance of planning and understanding where the opportunity exists to develop the interaction with each patient – resources need to be managed effectively
7. **Learning Objectives:**
3. The candidate will understand how to apply risk adjustment in actuarial work.

**Learning Outcomes:**
(3b) Apply risk adjustment to underwriting, pricing, claims and care management situations.

(3c) Apply applicable Actuarial Standards of Practice.

**Sources:**
ASOP 45 (excluding appendices)
Duncan, Healthcare Risk Adjustment and Predictive Modeling, Chapter 13

**Commentary on Question:**
Generally candidates did well on this question. The most effective candidates provided a robust set of alternative methodologies for evaluating risk scores on members with limited data.

**Solution:**
(a) Calculate the PMPM payment to the health plan. Show your work.

**Commentary on Question:**
Most candidates did well on this question. Those who struggled tended to assume the question pertained to risk adjustment for the commercial population under ACA. Removing the administrative load from the risk premium prior to applying the risk adjustment factor was also an acceptable response.

Total risk factor for Member 1 = 1.00 * 1.15 * 1.07 = 1.2305
Total risk factor for Member 2 = 0.88 * 1.00 * 0.78 = 0.6864
Total risk factor for Member 3 = 0.95 * 1.01 * 1.00 = 0.9595
Total risk factor for Member 4 = 1.00 * 1.03 * 0.99 = 1.0197
Relative risk factor = (1.2305 + 0.6864 + 0.9595 + 1.0197) / 4 = 0.9740
PMPM payment to the health plan = $300 * 0.9740 + $45 = $337.20

(b) Identify approaches from ASOP 45 for assigning risk scores to individuals with limited data.

**Commentary on Question:**
Many candidates did not elaborate on alternative methodologies that may result in a reasonable estimate for members with limited data. Other reasonable answers were also awarded credit.

Assign an age/gender factor
Assign an average risk score for the scored individuals
Exclude them from the analysis while also dampening the results
Use results from a prior year’s cohort of individuals with limited data