SOCIETY OF ACTUARIES

General Insurance
Further Topics

Exam GI 301

Date: Friday, March 27, 2026

INSTRUCTIONS 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.

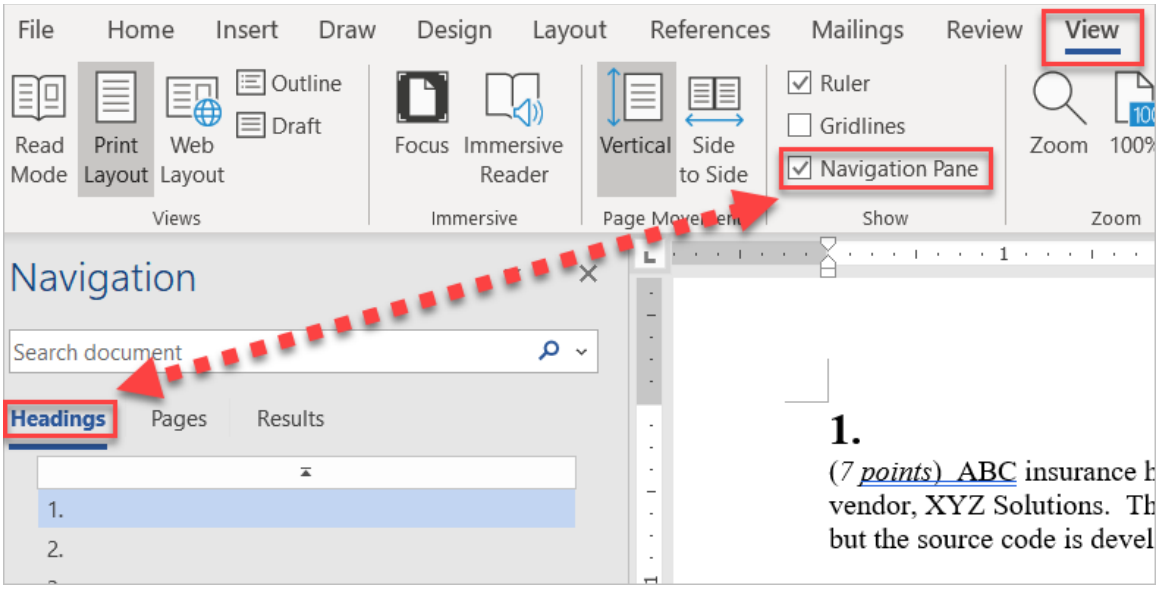
3. Prior to uploading your Excel file, the file should be saved and renamed with your unique candidate number in the filename.

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.

(*6 points*) You are given an incurred loss development triangle (tab "Q01" in the provided Excel file). The development triangle has been completed using a chain ladder approach with weighted average development factors. There are concerns about the potential for a calendar year effect in the data.

(a) (*1 point*) Explain how calendar year effects might impact a chain ladder model.

(b) (*4 points*) Analyze the development triangle for calendar year effects using Mack's L-S triangle approach, in which development factors are classified as above the median (L), below the median (S), or at the median (*).

(c) (*1 point*) Interpret the results of the analysis performed in (b). [*Does there appear to be a calendar year effect underlying this data set?*]

2.

Provide the response for this question in the Excel spreadsheet.

(*5 points*) You plan to apply Clark's stochastic reserving model using the loglogistic distribution function [with distribution function $G(x) = x^{\omega} / (x^{\omega} + \theta^{\omega})$] and the Cape Cod method.

The following are the maximum likelihood estimates of the model's three parameters:

- $\omega = 2$
- $\theta = 10$
- $ELR = 0.7$

For accident year X:

- Onlevel premium is 15,000
- Developed losses are 2,500 at 12 months and 7,000 at 21 months

(a) (*2 points*) Calculate the maximum likelihood estimates of the incremental losses for the periods 0-12 and 12-21 months for accident year X.

(b) (*1 point*) Calculate the estimated reserve for accident year X as of 21 months, assuming no further development information is available.

Clark's method provides the coefficient of variation (standard deviation divided by the expected value) of the estimated reserve. Consider a situation where the selected reserve is based on, but not identical to the maximum likelihood estimate. Clark asks if the standard deviation of the selected reserve could be obtained by multiplying that reserve by the coefficient of variation obtained from his model.

(c) (*2 points*) Identify one reason why the answer should be "no" and one reason why it should be "yes."

3.

Provide the response for this question in the Excel spreadsheet.

(*3.75 points*) You are given the following information for a line of business (LOB1). The information was based on a consultant's study using a large sample of industry data from accident years (AYs) 2019 to 2023.

Selected Age-to-Age Reported Age-to-Age Development Factors						**Selected Ultimate Severity Relativity (R^L)**
	12-24	**24-36**	**36-48**	**48-60**	**60-Ult**	
Total Limits	1.425	1.156	1.084	1.037	1.000	
1,000,000 Limits	1.373	1.128	1.062	1.019	1.000	0.865
500,000 Limits	1.341	1.096	1.049	1.008	1.000	0.757

(a) (*1 point*) Calculate LOB1 severity relativities for each limit, at each stage of development (from one to four years), using Siewert's formula.

You are analyzing claims development for TUV Insurance and are provided:

TUV Insurance, LOB1 Selected Age-to-Age Reported Claims Development Factors					
	12-24	**24-36**	**36-48**	**48-60**	**60-Ult**
500,000 Limits	1.228	1.117	1.052	1.007	1.000

TUV Insurance, LOB1 Reported Claims (000) as of December 31, 2025			
Accident Year (AY)	**500,000 Limits**	**1,000,000 Limits**	**Total Limits**
2021	2,408	3,702	3,874
2022	2,520	3,365	3,691
2023	2,241	3,172	3,515
2024	2,477	3,159	3,933
2025	2,303	3,086	4,019

(b) (*1.75 points*) Calculate TUV's LOB1 ultimate claims for the layer 500,000 to 1,000,000 using TUV selected development factors and the severity relativities from part (a).

(c) (*1 point*) Evaluate the applicability of using the relativities from part (a) for TUV's analysis. Assume TUV's risk profile is similar to that for the industry.

4.

Provide the response for this question in the Excel spreadsheet.

(*4.5 points*) In "A Framework for Assessing Risk Margins" by Marshall et al. (Marshall), hindsight analysis may be used to help select coefficients of variation (CoVs) for use in a risk margin analysis.

(a) (*1 point*) Describe how a mechanical hindsight analysis could be used to assess each of the following:

(i) Independent risk

(ii) Internal systemic risk

Marshall mentioned the use of external benchmarking in the selection of an insurer's coefficients of variation (CoVs) and/or risk margins.

(b) (*1 point*) Discuss the usefulness and limitations of external benchmarking.

The following CoV scale was provided for an insurer's risk margin analysis regarding internal systemic risk.

Score from balanced scorecard assessment	Commercial General Liability	Personal Automobile Liability	Homeowners
1.0 to 1.5	15.0%	17.5%	25.0%
1.5 to 2.0	14.0%	13.0%	20.5%
2.0 to 2.5	10.0%	10.5%	17.0%
2.5 to 3.0	9.0%	8.5%	14.0%
3.0 to 3.5	7.0%	7.0%	11.5%
3.5 to 4.0	6.0%	6.0%	9.5%
4.0 to 4.5	5.5%	5.5%	8.0%
4.5 to 5.0	5.0%	5.0%	7.0%

In the development of this CoV scale, a score in the range of 1 to 5 was selected for each risk component (where 5 represents best practice and 1 represents very poor practice).

(c) (*1 point*) Describe two potential problems with this CoV scale.

4. **Continued**

Emerging risks are not random (e.g., cyber, climate). These risks add uncertainty regarding both the amount of the insurance liabilities and the inability of the actuarial modeling systems in place to detect them.

(d) (*1.5 points*) Explain how emerging risks should be reflected within the three sources of uncertainty for a class of business.

- Independent risk (IND)
- Internal systemic risk (ISR)
- External systemic risk (ESR)

5.

Provide the response for this question in the Excel spreadsheet.

(*3 points*) You are given the following claims information for a liability line of business:

Accident Year	As of December 31, 2025			As of March 15, 2026	
	Paid Claims	**Reported Claims**	**Selected Ultimate Claims**	**Paid Claims**	**Reported Claims**
2019	6,738	6,738	6,738	6,793	6,816
2020	3,613	3,643	3,747	3,695	3,712
2021	3,675	3,884	4,082	3,962	4,150
2022	2,678	3,098	3,776	2,924	3,347
2023	2,496	3,724	5,157	3,001	4,086
2024	2,365	5,004	7,291	2,981	5,011
2025	655	1,970	6,154	2,829	2,924
2026				72	601

The selected ultimate claims were based upon an average of several methods using both paid and reported claims. The paid claims development method uses the following age-to-ultimate development factors. It was assumed that there was no development in paid and reported claims after 84 months.

12 months	**24 months**	**36 months**	**48 months**	**60 months**	**72 months**	**84 months**
7.7643	3.5522	1.9001	1.3300	1.1100	1.0080	1.0000
2.5 months	**14.5 months**	**26.5 months**	**38.5 months**	**50.5 months**	**62.5 months**	**74.5 months**
29.7497	5.7474	2.7335	1.6996	1.2523	1.0785	1.0060

(a) (*1.5 points*) Calculate actual minus expected claims paid for the period January 1, 2026 to March 15, 2026, for each accident year from 2019 to 2025.

(b) (*1.5 points*) Evaluate the results from part (a) including the following:

(i) Any anomalies in the results

(ii) Potential reasons for these anomalies

(iii) Additional steps that should be taken to evaluate the development from December 31, 2025, to March 15, 2026

6.

Provide the response for this question in the Excel spreadsheet.

(*3.5 points*) The Actuarial Standards Board of the American Academy of Actuaries includes an Actuarial Standard of Practice (ASOP) on Risk Classification (ASOP 12).

Risk characteristics are important structural components of a risk classification system and ASOP 12 requires the actuary to consider seven issues in the selection of risk characteristics. One of these issues is the relationship of risk characteristics and expected outcomes.

(a) (*1.5 points*) Describe three other issues the actuary should consider as noted in ASOP 12.

Generalized linear models (GLMs) may be used for classification ratemaking. It can be shown that a GLM is equivalent to the minimum bias method by making certain assumptions for the GLM.

(b) (*1 point*) Identify the following assumptions for the GLM that make it equivalent to the minimum bias method with categorical variables and multiplicative relativities.

(i) Probability distribution used to model the pure premium

(ii) Type of link function used [where $\mu_{ij} = \mu\, r_i^{(1)} r_j^{(2)}$]

(iii) Bias function, $b(\boldsymbol{p}, \boldsymbol{\mu})$ where $\boldsymbol{p}$ is the matrix of observed pure premiums, $\boldsymbol{\mu}$ is the matrix of expected values from the link function used and **w** is the matrix of exposures for the pure premiums.

(c) (*1 point*) Identify one advantage and one disadvantage from using a GLM instead of the minimum bias method for classification ratemaking.

7.

Provide the response for this question in the Excel spreadsheet.

(*4.75 points*) You are conducting an increased limits analysis using censored data. You are given the following information:

Policy Limits	Claim Range		Count in Interval	Capped Claims
	From	To		
100,000	0	100,000	1,803	123,055,000
300,000	0	100,000	781	54,993,000
	100,000	300,000	1,020	161,242,000
600,000	0	100,000	926	64,386,000
	100,000	300,000	955	146,459,000
	300,000	600,000	312	112,590,000

(a) (*2 points*) Calculate the limited average severity for the layer 100,000 to 300,000.

(b) (*2 points*) Calculate the increased limit factor (ILF) for a 600,000 limit, assuming the basic limit is 100,000.

(c) (*0.75 points*) Describe two challenges in determining ILFs for high limits using empirical data.

8.

Provide the response for this question in the Excel spreadsheet.

(*4 points*) You are provided the following claims information for a large commercial risk:

Claims Reporting Pattern (%)					
Accident Year	**Report Year (RY)**				
	0	**1**	**2**	**3**	**4**
2020	43.1%	27.7%	20.9%	6.5%	1.8%
2021	42.9%	26.7%	21.9%	6.9%	1.6%
2022	42.0%	26.2%	22.8%	7.5%	1.5%
2023	40.4%	25.0%	24.8%	8.5%	1.3%
2024	36.8%	22.9%	31.1%	8.0%	1.2%
2025	34.3%	26.0%	32.0%	6.7%	1.0%
>2025	*37.0%*	*24.5%*	*30.0%*	*7.5%*	*1.0%*

Accident Year	**Ultimate Claims (000)**
2020	785
2021	877
2022	1,034
2023	985
2024	1,225
2025	1,350

Exposures are assumed to remain constant while accident year claims are expected to rise 4% annually after 2025. The risk has had claims-made coverage since January 1, 2021.

(a) (*2.5 points*) Calculate total claims for the following policies:

(i) Third-year claims-made policy effective January 1, 2024

(ii) All claims-made policies from 2021 to 2025 in total

(iii) Mature claims made policy effective January 1, 2026.

8. Continued

Beginning January 1, 2026, the risk purchases annual occurrence policies instead of claims made policies.

The risk intends to purchase a tail coverage policy (effective January 1, 2026) to ensure that they do not have a gap in coverage.

(b) (*1 point*) Calculate the expected claims for this policy.

(c) (*0.5 points*) Calculate the gap in claims covered if the policy from part (b) had a retroactive date of January 1, 2024.

9.

Provide the response for this question in the Excel spreadsheet.

(*5 points*) Your reinsurance company is evaluating a proposed casualty per occurrence excess treaty covering the layer 3,000,000 excess of 1,000,000.
The following information has been provided:

Subject Premium	Underlying Limit	Policy Limit
3,000,000	0	1,000,000
4,000,000	0	3,000,000
5,000,000	1,000,000	2,500,000
2,000,000	1,000,000	4,000,000
6,000,000	0	4,500,000

Increased limits factors (ILF) above basic limits of 1,000,000 are calculated using the following formula:
ILF = A * LN (Policy Limit) + B, where A is 0.2848 and B is -2.935.

- The expected loss ratio is 60%.

(a) (*4 points*) Calculate the expected losses in the layer using an exposure rating approach.

You are also using an experience rating approach to calculate expected losses. Trended losses must be capped at applicable policy limits.

(b) (*1 point*) Describe two methods for handling trend and policy limits and the underlying assumption of each method.

10.

Provide the response for this question in the Excel spreadsheet.

(*5 points*) Q Re is renewing its earthquake catastrophe excess-of-loss contracts for insurance companies, U and V. The following event loss table (ELT) was produced by a catastrophe model applied to these accounts. The events in the ELT were modeled as independent random variables using the Bernoulli distribution.

Event *i*	Probability of event *i*	Loss to U in thousands	Loss to V in thousands
1	0.00010	241,400	285,500
2	0.00050	96,600	94,600
3	0.00100	82,000	91,700
4	0.00500	53,100	57,900
5	0.00800	24,100	38,600
6	0.01250	12,600	11,600
7	0.02500	5,800	6,300
8	0.04000	2,400	2,900

(a) (*0.5 points*) Identify two limitations of using catastrophe models in predicting future losses arising from catastrophe events.

(b) (*1.5 points*) Calculate the following:

(i) Occurrence exceedance probabilities (OEP) for each event.

(ii) Return period for U having a loss of at least 80 million.

(iii) Tail Value at Risk (TVaR) for V having a loss of at least 90 million.

Q Re calculates premium as the sum of the expected loss and a risk load, with a provision for expenses equal to 5% of the total premium.

Q Re calculates the renewal risk load between U and V using the Marginal Surplus (MS) method and the following assumptions:

- Required return on marginal surplus equals 10%
- Z-score multiplier equals 1.5

(c) (*2 points*) Calculate the renewal premiums for U and V.

(d) (*1 point*) Explain why the sum of the renewal premiums for U and V will not equal the renewal premium for U and V combined, indicating which amount would be greater than the other.

11.

Provide the response for this question in the Excel spreadsheet.

(*5.5 points*) SF Insurance (SFI) cedes its catastrophe claims in the layer 200 million excess 50 million to RB Re. RB Re charges SFI 15 million for this coverage.

The probability of SFI having a catastrophe claim in a year is 7%. The probability of two catastrophes in a year is assumed to be zero.

SFI's catastrophe claims distribution, when a catastrophe occurs, is modeled by the following discrete distribution:

SFI Catastrophe Claim Amount	**Probability of Claim Amount**
(in millions)	(when a catastrophe occurs)
50	43.75%
100	25.00%
150	12.50%
200	9.38%
250	5.63%
300	1.88%
400	1.25%
500	0.63%

Evaluate whether SFI's catastrophe reinsurance with RB Re passes the risk transfer test using the following methods:

(i) Risk coverage ratio (RCR), in % form, with a threshold of 90%

(ii) Right-tailed deviation (RTD) using $\alpha = 5$

****END OF EXAMINATION****