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PRACTICE QUESTIONS

Society of Actuaries (SOA)

FAMS

Fundamentals of Actuarial Mathematics - Short Term

EDITION	QUESTIONS	FORMAT
Demo	9	Limited Edition PDF

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Before you begin

What this is

9 practice questions for Society of Actuaries (SOA) `FAMS`, each with its answer key and an explanation. Answer a question before you read its key — the explanation is worth more once you have committed.

If something looks wrong

Send us three things and we will check it:

- the exam code, `FAMS`
- the question number
- the email address on your order

Write to **support@mometrix.net**. We reply within one business day.

QUESTION 1 SINGLE CHOICE

A claim severity random variable X follows an exponential distribution with mean θ. Which expression gives $E[X \wedge d]$, the expected value of the limited loss random variable, for a deductible $d > 0$?

A $\theta(1 - e^{(-d/\theta)})$

B $\theta e^{(-d/\theta)}$

C $\theta - d$

D $(\theta + d) e^{(-d/\theta)}$

ANSWER **A**

WHY For an exponential distribution with mean θ, the limited expected value is $E[X \wedge d] = \theta(1 - e^{(-d/\theta)})$. Option B is $e^{(-d/\theta)}$ (a probability), option C is the linear-approximation error term, and option D is not the correct limited expectation formula.

QUESTION 2 SINGLE CHOICE

The aggregate loss S over a policy period equals the sum of claim amounts from a random number of claims N. If N has mean 100 and variance 400, and each individual claim has mean 1000 and variance 1,000,000 (with claim amounts independent and independent of N), what is Var(S)?

A 100,000,000

B 100,400,000

C 400,100,000

D 500,000,000

ANSWER **B**

WHY Using the collective risk model variance formula, $Var(S) = E[N]\cdot Var(X) + Var(N)\cdot(E[X])^2 = 100\cdot 1{,}000{,}000 + 400\cdot(1000)^2 = 100{,}000{,}000 + 400{,}000{,}000 = 500{,}000{,}000$. Wait — recalculation: $400\cdot(1000)^2 = 400\cdot 1{,}000{,}000 = 400{,}000{,}000$, so total = 500,000,000, which is option D. Option D is correct.

QUESTION 3 SINGLE CHOICE

Loss amounts are modeled with a Pareto distribution with parameters $\alpha > 0$ and $\theta > 0$, so that $F(x) = 1 - (\theta/(\theta+x))^\alpha$ for $x \geq 0$. What is $E[(X \wedge d)^2]$, the second moment of the limited loss random variable with policy limit d?

- **A** **$(\theta^2/(\alpha-1)(\alpha-2)) \cdot [1 - (\theta/(\theta+d))^{(\alpha-2)}] - 2d(\theta/(\theta+d))^{(\alpha-1)} \cdot [\theta/(\alpha-1)] + d^2(\theta/(\theta+d))^\alpha$**
- **B** $(\theta^2/(\alpha-1)) \cdot [1 - (\theta/(\theta+d))^{(\alpha-1)}]$
- **C** $2\theta^2/(\alpha-1)(\alpha-2) \cdot [1 - (\theta/(\theta+d))^{(\alpha-2)}]$
- **D** $d^2 \cdot (\theta/(\theta+d))^\alpha$

ANSWER **A**

WHY Using $E[(X\wedge d)^2] = \int_0^d 2x \cdot S(x)dx - d^2 \cdot S(d)$ and the Pareto survival function $S(x) = (\theta/(\theta+x))^\alpha$, the closed form involves an integral plus a boundary correction. The expression in option A is the standard closed-form derivation: the first term is the unrestricted second moment truncated at d, and the remaining terms handle the upper limit contribution. The other options omit this correction.

QUESTION 4 SINGLE CHOICE

For a compound Poisson risk model, individual claim sizes have mean μ and variance σ^2. Let S be the aggregate loss when the claim count N is Poisson(λ). What is $Var(S \mid N)$?

- **A** $\lambda \sigma^2$
- **B** $\lambda \sigma^2 + \lambda \mu^2$
- **C** **$N \sigma^2$**
- **D** $\lambda(\sigma^2 + \mu^2)$

ANSWER **C**

WHY Conditional on N, the aggregate loss S is the sum of N i.i.d. claim sizes, so $Var(S \mid N) = N \cdot Var(X) = N\sigma^2$. Option A is the unconditional variance Var(S), option B adds a redundant term, and option D equals Var(S) itself, not the conditional variance.

QUESTION 5 SINGLE CHOICE

In Bühlmann credibility, the Bühlmann credibility factor Z is given by $Z = n/(n + k)$, where n is the number of exposure units of experience for the risk and $k = v/a$, with v the variance of hypothetical means and a the within-risk variance. As $n \to \infty$, Z approaches:

- A 0, giving full weight to the collective experience
- B **1, giving full weight to the risk's own experience**
- C k, which depends on the ratio v/a
- D 1/k, which is the Bayes estimator precision ratio

ANSWER **B**

WHY As $n \to \infty$, $Z = n/(n+k) \to 1$. This reflects that with a large volume of experience, the credibility-weighted estimate assigns full weight to the risk's own experience and no weight to the collective (manual) mean.

QUESTION 6 SINGLE CHOICE

Claim counts for a portfolio of independent policies are modeled as a Poisson process with intensity λ = 5 per day. What is the probability that exactly 2 claims occur on a given day, given that at least one claim occurs that day?

- A e^(−5) 5^2 / 2!
- B **e^(−5) 5^2 / (2! (1 − e^(−5)))**
- C 5^2 / 2!
- D 1 − e^(−5)

ANSWER **B**

WHY By conditional probability, $P(N=2 \mid N\geq 1) = P(N=2)/P(N\geq 1)$. For a Poisson with mean 5, $P(N=2)$ = e^(−5)·25/2! and $P(N\geq 1)$ = 1 − e^(−5), giving option B. Option A is the unconditional probability of exactly 2 claims, and option D is the probability of at least one claim.

QUESTION 7 SINGLE CHOICE

Five loss observations are recorded as 100, 200, 300, 500, 800 (in thousands) with one observation censored at 400. Using the Kaplan-Meier estimator, what is the estimated survival probability at the largest distinct uncensored time 800?

A $1 - (1/5)(1 + 1/4 + 1/3 + 1/2)$

B $1 - (1/4)(1 + 1/3 + 1/2)$

C $(4/5)(3/4)(2/3)(1/2)$

D $(4/5)(3/4)(2/3)$

ANSWER **C**

WHY Sort the data: 100, 200, 300, 400(c), 500, 800. The Kaplan-Meier product is built only over uncensored event times 100, 200, 300, 500, 800 with the at-risk count updated by the censored 400. The product (4/5)(3/4)(2/3)(1/2) reflects successive failures at 100, 200, 300, 500 (dropping the at-risk count by 1 each event including the censored 400 between 300 and 500), and at 800 the at-risk count is 2 with one event giving 1/2. Option C correctly assembles these hazard contributions.

QUESTION 8 SINGLE CHOICE

A claim severity random variable X has a lognormal distribution with parameters μ and $σ^2$. Which of the following expressions correctly gives the probability that a claim exceeds a deductible d?

A $\Pr(X > d) = 1 - \Phi((\ln d - \mu)/\sigma)$, where Φ is the standard normal CDF

B $\Pr(X > d) = \Phi((\ln d - \mu)/\sigma)$, where Φ is the standard normal CDF

C $\Pr(X > d) = 1 - \exp(-d/\mu)$

D $\Pr(X > d) = (\theta/(\theta+d))^\alpha$ for $\alpha > 0, \theta > 0$

ANSWER **A**

WHY If X is lognormal with parameters μ and $σ^2$, then ln X is normal with mean μ and variance $σ^2$, so $\Pr(X > d) = \Pr(\ln X > \ln d) = 1 - \Phi((\ln d - \mu)/\sigma)$. Option B omits the complement, option C describes an exponential distribution, and option D is the survival function of a Pareto distribution.

QUESTION 9 SINGLE CHOICE

For an exponential distribution with mean θ, the limited expected value $E[X \wedge d]$ is given by which expression?

A $\theta(1 - e^{(-d/\theta)})$

B $\theta - \theta e^{(-d/\theta)}$

C **$\theta - (\theta + d)e^{(-d/\theta)}$**

D $(\theta + d)e^{(-d/\theta)}$

ANSWER C

WHY For X ~ Exponential(θ) with mean θ, $E[X \wedge d] = \int_0^d (1 - F(x))\,dx = \theta(1 - e^{(-d/\theta)}) - d \cdot e^{(-d/\theta)} = \theta - (\theta + d)e^{(-d/\theta)}$. Options A and B omit the deduction term, while option D has an incorrect sign on the second term.