17. (2 points)

An actuary prices a retrospectively rated policy based on the assumption that aggregate losses follow a uniform distribution between $0 and $1,000,000. The actuary determines that the following provisions result in a balanced plan:

Standard premium	$700,000
Loss at minimum premium	$80,000
Loss at maximum premium	$750,000
Basic premium	$83,660
Loss conversion factor	1.2

Assume there are no taxes.

a. (1.5 points)

Calculate the implicit premium discount associated with the plan.

b. (0.5 point)

Briefly describe how premium discount is treated in a retrospectively rated policy compared to a guaranteed cost policy.

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QUESTION 17

Total Point Value: 2.00 **Learning Objective: B5**

Sample Answers

Part a: 1.50 points

Sample 1

$E + e = (1 - D)SP$, so need to find E and e

$E = (.5)(1,000,000) = 500,000$

$$\phi(r_G) = \frac{\left(\frac{1,000,000 - 750,000}{2}\right)\left(\frac{1,000,000 - 750,000}{1,000,000}\right)}{500,000} = .0625 \text{ or } \$31{,}250$$

$$\psi(r_H) = \frac{\left(\frac{80,000}{2}\right)\left(\frac{80,000}{1,000,000}\right)}{500,000} = .0064 \text{ or } \$3{,}200$$

$b = e - (c - 1)E + cI = e - (c - 1)E + cE\left(\emptyset(r_G) - \psi(r_H)\right)$

$83,660 = e - .2(500,000) + (1.2)(.0625 - .0064)(500,000)$

$e = 150,000$

$E + e = (1 - D)SP \Rightarrow 500,000 + 150,000 = (1 - D)(700,000)$

$D = 0.0714 = \mathbf{7.14}\%$ **($50,000)**

Sample 2

$E[R] = b + cE[L] = (1 - D)SP$, so need to find E[L] to get D

$E = (.5)(1,000,000) = 500,000$

$$\phi(r_G) = \frac{\left(\frac{1,000,000 - 750,000}{2}\right)\left(\frac{1,000,000 - 750,000}{1,000,000}\right)}{500,000} = .0625$$

$$\psi(r_H) = \frac{\left(\frac{80,000}{2}\right)\left(\frac{80,000}{1,000,000}\right)}{500,000} = .0064$$

$E[L] = E(1 - \emptyset(r_G) + \psi(r_G)) = 500(1 - 0.625 + 0.0064) = 471{,}950$

$E[R] = 83{,}660 + 1.2(471{,}950) = 650{,}000$

$(1 - D)(700{,}000) = 650{,}000$

$D = 0.0714 = \mathbf{7.14}\%$ **($50,000)**

Sample 3

$E + e = (1 - D)SP$, so need to find $E + e$ to get D

$$\phi(r_H) - \phi(r_G) = \frac{(e + E) - H}{cE} \quad OR \quad \frac{(1 - D)SP - H}{cE}$$

$H = 83{,}660 + 1.2(80{,}000) = 179{,}660$

$$\phi(r_G) = \frac{\left(\frac{1{,}000{,}000 - 750{,}000}{2}\right)\left(\frac{1{,}000{,}000 - 750{,}000}{1{,}000{,}000}\right)}{500{,}000} = 0.0625$$

$$\phi(r_H) = \frac{\left(\frac{1{,}000{,}000 - 80{,}000}{2}\right)\left(\frac{1{,}000{,}000 - 80{,}000}{1{,}000{,}000}\right)}{500{,}000} = 0.8464$$

$$\phi(r_H) - \phi(r_G) = 0.8464 - 0.0625 = \frac{(e + E) - 179{,}660}{1.2(500{,}000)} \quad OR \quad \frac{(1 - D)SP - 179{,}660}{1.2(500{,}000)}$$

$e + E = (1 - D)SP = (1 - D)(700{,}000) = 650{,}000$

$D = 0.0714 = \mathbf{7.14}\%$ **($50,000)**

Part b: 0.50 points

Sample 1

In a retrospectively rated policy, the premium discount is realized as a reduction to expenses in the basic premium, whereas in a guaranteed cost policy, the premium discount is explicitly deducted from the standard premium.

Sample 2

In both retro and guaranteed cost policies, the premium discount accounts for reduction in expense ratio as premium increases. The discount is the same in a guaranteed cost policy and retrospectively rated policy when the plans are balanced.

Examiners Report

Part a:

- Many candidates received full credit on this subpart.
- Candidates were expected to be able to calculate expected loss given a uniform distribution constrained by a min/max loss amount. Successful candidates often drew a picture of the loss distribution as a reference.
- Common errors included:
    - Switching E[A], E[L] and E in the various calculations
    - Calculating E[L] incorrectly – Candidates often drew a picture of the Lee diagram. However, they would incorrectly account for the area of all the pieces under the curve.
    - Mixing dollar values and percentages in the same formula inappropriately (e.g. calculating charge and savings as a ratio to $1M and then later multiplying by $500K, or multiplying by $500K when the calculated charges are already in dollar terms).

Part b:

- Candidates were expected to understand that "premium discount" refers to the discount resulting from a reduction in fixed expense as a percentage of premium. Some candidates erroneously interpreted "discount" as a lower-than-expected premium in a retro policy due to:
    - actual losses emerge lower than expected
    - premium minimum/maximum
    - net insurance charge
- Successful candidates understood to speak to treatment in both guaranteed cost and retro policies.