14. (2 points)

An insured is written under a retrospective rating plan with a minimum and a maximum premium with the following parameters:

Loss Conversion Factor	1.07
Expected Loss	\$825,000
Expenses	\$20,000
$\varphi(r_G)$	0.40
$\varphi(r_H)$	0.80
r_G	1.21
r_H	0.50

a. (1 point)

Calculate the basic premium.

b. (1 point)

Upon renewal, the insured requests that a per occurrence claim limit of \$200,000 be added to the current policy. The pricing actuary estimates that, on average, the insured will have \$400,000 of losses that exceed this per occurrence limit during the next policy period. To calculate the expected increase to the basic premium, the actuary loads the \$400,000 for expenses and profit.

Fully discuss the appropriateness of the actuary's methodology.

CONTINUED ON NEXT PAGE

QUESTION 14	
TOTAL POINT VALUE: 2	**LEARNING OBJECTIVE(S): B5**
SAMPLE ANSWERS	

Part a: 1 point

Sample 1

$B = e - (c-1)*E[A] + cI$

$= 20{,}000 - (1.07 -1)*(825{,}000) + 1.07 (E[A] * (0.4 - (0.8+0.5-1)))$

$= 20{,}000 - 57{,}750 + 88{,}275$

$= 50{,}525$

Sample 2

$\psi(r_H) = 0.8 + 0.5 - 1 = 0.3$

$I = (0.4 - 0.3) * 825{,}000 = 82{,}500$

$B = e - (c-1)*E[A] + cI = 20{,}000 - (1.07-1)*825{,}000 + 1.07*82{,}500 = 50{,}525$

Sample 3

Assume this is balance plan.

$\phi(r_H) - \phi(r_G) = (E+e-H/T)/cE$

$H = (B + cr_HE)*T$

$H/T = B + cr_HE$

$\phi(r_H) - \phi(r_G) = (E+e-(B+cr_HE))/cE$

$B + cr_HE = E + e - cE(\phi(r_H) - \phi(r_G))$

$B = E + e - cE(\phi(r_H) - \phi(r_G)) - cr_HE$

$= 825{,}000 + 20{,}000 - 1.07 * 825{,}000 * (0.8 - 0.4) - 1.07 * 0.5 * 825{,}000$

$= 845{,}000 - 353{,}100 - 441{,}375$

$= 50{,}525$

Sample 4

Assume "expense" of 20k excludes LAE and refers to overhead expense.

$B = e + cI$

$\psi(r_H) = r - (1 - \phi(r_H)) = 0.5 - (1 - 0.8) = 0.3$

$I = (0.4 - 0.3) * 825{,}000 = 82{,}500$

$B = 20{,}000 + 1.07*82{,}500 = 108{,}275$

Sample 5

$\psi(r_G) = \phi(r_G) + r_G - 1$

$0.4 = \phi(r_G) + 1.21 -1$

$\phi(r_G) = 0.19$

$I = (\phi(r_G) - \psi(r_H)) * E[A] = (0.19 - 0.8) * 825{,}000 = -503{,}250$

$B = e - (c-1)*E[A] + cI = 20{,}000 - (1.07-1)*825{,}000 + 1.07*(-503{,}250) = -576{,}228$

This problem seems flawed: savings is higher @ the "H" which implies a negative net insurance charge. But solved based on information given in problem.

Sample 6

$\psi(r_G) = \phi(r_G) + r_G - 1$
$0.4 = \phi(r_G) + 1.21 - 1$
$\phi(r_G) = 0.19$

Assume there is a typo in the question and $\psi(r_H) = 0.08$, not 0.8. Otherwise, we get a large negative basic premium.

$B = e - (c-1)*E[A] + cI$
$= 20{,}000 - 0.07 * 825{,}000 + 1.07 * (0.19 - 0.08) * 825{,}000$
$= 59{,}352.50$

Part b: 1 point

Sample 1

- Some of the limited losses will also be capped by the maximum ratable loss -> Overlap between per-occurrence limit & aggregate limit is not removed in the actuary's method.
- Because per-occurrence limit reduces the variance of the loss distribution -> charge for limited loss should be lower
- Over estimate insurance by using unlimited table M values
- Overall, the actuary will over price the risk.

Sample 2

- There is an overlap between the per occ limit and the agg limit set by the max premium (takes longer to reach max given limited losses), so it is not appropriate to load the full amount of $400,000 into the premium.
- This will result in overcharging the insured.
- The actuary should use a limited table M by using limited losses to per occ limit and add charge to per occ in excess of agg limit or a table L instead.

Sample 3

- It's not correct. Since the inclusion of per-occurrence limit will make the limited aggregate loss distribution less likely to reach the aggregate loss corresponding to max premium comparing to the unlimited aggregate loss distribution, thus the net insurance charge for the policy will be less. There's overlap of loss excess of per-occurrence limit and insurance charge of aggregate loss distribution. As a result, the actuary should not load the full 400,000.

Sample 4

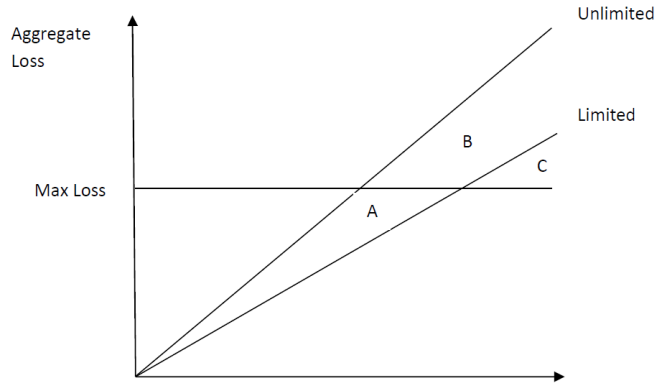
- This is not appropriate. The presence of a per occurrence limit decreases the volatility in agg loss distribution in comparing a table M, thus $\phi(r_G)$ will decrease. There will be less loss in excess of agg limit of limited loss compared to unlimited loss.
- Adding 400,000 excess per occurrence loss to basic premium in (a) will overestimated the basic premium, due to the overlap of maximum premium and per occurrence excess charge.

Sample 5

- The actuary needs to use a limited Table M or Table L to account for the per-occurrence limit being added. The insurance charge portion of the basic premiums needs to be modified to account for the per-occurrence limit (which will lead to less variance in aggregate losses and a different charge). The current table M charge will be too large since it's based on agg losses with no occ limit, so the insured would be charged for the occ limit twice if the actuary adds on expected losses exceeding the occ limit without adjusting the insurance charge portion of the basic premium.

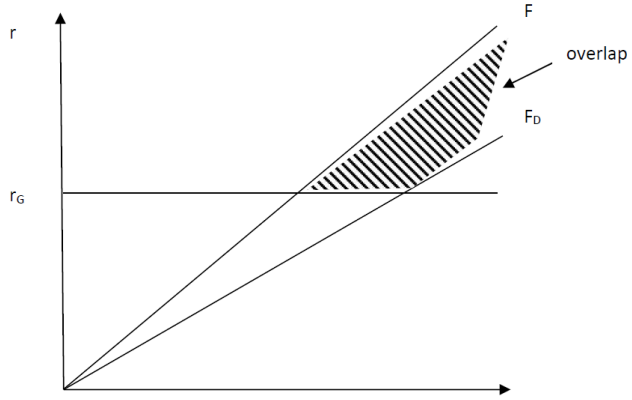
Sample 6

- This is inappropriate as by adding per occurrence limit it will reduce variance of losses & likelihood of hitting agg limit. This would result in a lower insurance charge as part of B. Without lowering insurance charge would be on overcharge as there would be an overlap in what insurance charge is and losses excess of occ. Need to lower insurance charge in addition to account losses excess occ.



Sample 7

- k*E[A] = 400,000
  Per occ limit = 200,000
  They can use limited table M, so
  $B = e - (c-1)*E[A] + c\,(\phi(r_G)^* - \psi(r_H)^*)*E[A_D] + ckE[A]$
- The method of this actuary is inappropriate because they will have a basic premium too high than correct b. The charge needs to diminish to be correct b in his approach because now he is double counting for losses that are above per occurrence limit and above maximum loss (overlap).



SAMPLE ANSWERS AND EXAMINER'S REPORT

EXAMINER'S REPORT

Candidates were expected to understand the actuarial principles and concepts underlying the construction of a retrospective rating plan. Candidates were expected to understand how to calculate a basic premium, and how the interaction between a per occurrence limit and an aggregate limit impacts the basic premium in a retrospective rating plan.

Part a

Candidates were expected to know how to calculate the insurance charge (I) and basic premium (B) given the other parameters of a retrospective rating plan.

$I = [\phi(r_G) - \psi(r_H)] * E(A)$

$B = e - (c-1)*E(A) + cI$

The symbol φ used in the exam for insurance charges confused some candidates because they were more familiar with the symbol ϕ for insurance charges. Consequently, some candidates interpreted the insurance charges given in the question as insurance savings (ψ). Those who did this and also stated a reason why the savings, entry ratios, or calculated charges didn't make sense received full credit if no other errors were made.

Common mistakes included:

- Using the wrong formula for I
- Using the wrong formula for B (commonly adding (c-1)*E(A) rather than subtracting it).

Part b

Candidates were expected to fully describe the reason Table M cannot be used without adjustment in the presence of a per occurrence limit. Candidates were expected to explain the overlap that occurs between losses excess of the per occurrence limit and the aggregate limit. They were then expected to assess the impact of the overlap on the basic premium and conclude that the actuary's methodology overstates the basic premium.

Some candidates discussed expenses and profit, rather than losses. Partial credit was awarded for valid expense and profit arguments.

Common mistakes included:

- Offering a solution of limited Table M, Table L or ICRLL, rather than explaining the problem that they solve
- Drawing a Lee Diagram, but not identifying the correct area of overlap
- Stating the actuary's method overestimated the basic premium without supporting reasons
- Stating the actuary's method is a reasonable way to account for the excess portion of expected loss
- Stating the actuary's method will underestimate the charge because there is an overlap with the aggregate limit
- Stating that per occurrence will change/impact insurance charges and savings, so need adjustment; but without explanations
- Not stating that the actuary's estimate of the increase in premium is too high.