16. (1.75 points)

A reinsurance company is evaluating whether or not to write a $50 million excess of $50 million catastrophe reinsurance contract with a primary insurer. The reinsurer is currently holding $850 million of capital and is required to hold enough capital to survive a 1-in-250 event. Without the new contract, the reinsurance company has a 1-in-250 probable maximum loss (PML) of $825 million which is solely driven by the hurricane peril.

Given the following:

- The primary insurer's PMLs are driven by the hurricane and earthquake perils only.
- The primary insurer's aggregate annual PMLs by return period are as follows:

Return Period (years)	PML ($000,000)
1000	125
500	105
200	95
100	70
50	50
25	30
20	25
10	20
5	15

- The largest hurricane event in the primary insurer's event catalog is $45,000,000.

a. (1 point)

Calculate the ceded, and net, 1-in-250 PMLs for this contract for the primary insurer.

b. (0.75 point)

Evaluate whether the reinsurer should participate in this treaty.

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QUESTION 16

TOTAL POINT VALUE: 1.75 | **LEARNING OBJECTIVE(S): C1, C2**

SAMPLE ANSWERS

Part a: 1 point

Sample 1

Return Period (RP)	Exceedance Probability (EP)	Gross PML	Ceded PML	Net PML
1000	0.001	125	50	75
500	0.002	105	50	55
200	0.005	95	45	50
100	0.01	70	20	50
50	0.02	50	0	50

Interpolate Gross PML for 250 between (.002, 105) and (.005, 95)

95 + (.005-.004)/(.005-.002) = 98.33M

Ceded PML = 98.33 - 50 = 48.33

Net PML = 50 M

Sample 2

Gross PML = (.004 - .002) / (.005 - .002) × 95 + (.005 - .004) / (.005 - .002) × 105 = 98.3M

Ceded PML = 2/3 × 45 + 1/3 × 50 = 46.6m
Net PML = 2/3 × 50 + 1/3 × 55 = 51.6m

Sample 3

Assume contract is occurrence XOL and hurricane largest event is larger than EQ.

Therefore, no EQ event large enough to hit layer & ceded PML is 0.

Net PML is equal to gross: 1/500 = .002, 1/200 = .005
Linearly interpolate: (105) – (0.004 – 0.002) / (0.005 – 0.002) × 10 = 98.3

Part b: 0.75 point

Sample 1

Reinsurer new PML = 825 + 48.33 = 878.33

The PML 873.33 is the max number. PML cannot be added.
We need to re-run model to see the marginal impact 873.33 is greater than capital of 850M.
However, if we re-run model and incorporate the diversification benefit from EQ exposure due to

this new contract, the PML may be reduced to an acceptable level. Therefore, the reinsurer should accept.

Sample 2
The reinsurer's 1-in-250 PML is driven completely by hurricane, so it should participate in the treaty to diversify the perils it is exposed to. Since the largest hurricane event for the primary insurer is 45m, the reinsurer will not increase its exposure to hurricane – only earthquake. This means the reinsurer's 1:250 should not grow by taking on additional EQ exposure. This is all, of course, on a modeling basis. There is potential for the model to be wrong, but the reinsurer should diversify.

Sample 3
Maximum Hurricane loss is 45M which is below retention and would trigger no payment from reinsurer. PML for hurricane would not increase (stay at 825M) for reinsurer. PML for EQ would increase by ceded PML. Total aggregated PML = Sq Root($46.67^2 + 825^2$) = 826.32 < 850.
Yes, Reinsurer should participate.

Sample 4
The reinsurer has 850-825 = 25 M of available capital. The 48.3 M PLM could seem too high, but it depends how this possible loss is correlated with the current book of business.

Since the current book is solely driven by hurricane peril and that this proposed contract is driven by both hurricane peril and EQ peril,

I would recommend to accept. Furthermore, the insurer never registered a hurricane >45M which is under the attachment point of the treaty.

Sample 5
Assume contract is occurrence XOL and hurricane largest event is larger than EQ.
Therefore, no EQ event large enough to hit layer & ceded PML is 0. The reinsurer should participate in the treaty because there are no chances of loss hitting the layer. Typically, reinsurers will write cat insurance if Pr(L > Prem + Surplus) < p where p is desired insolvency threshold & L is the PML.

EXAMINER'S REPORT

Candidates were expected to be able to apply reinsurance terms using an exceedance probability curve, as well as understand the effect of catastrophe risk in portfolio management.

Due to the ambiguity in outlining the type of reinsurance contract being offered and the primary insurer's PML table incorrectly being labeled "aggregate," this question was ruled to be defective. This defect was addressed through the grading of the question, as discussed herein. The intent of the question was for the PML table to be interpreted as occurrence. Most candidates answered the question as intended, as if it were an OEP.

Part a

Candidates were expected to interpolate the exceedance probabilities and then correctly apply the reinsurance contract terms to calculate the primary insurer's 1-in-250 ceded and net PML.

Candidates who misinterpreted the PML table and attempted to create their own OEP table received partial credit if the reinsurance terms were applied correctly. Also, candidates who did not interpolate using exceedance probabilities were awarded partial credit if the reinsurance terms were applied correctly.

Candidates who calculated AALs and applied reinsurance terms to these totals received no credit, as the question asks for the 1:250 PML.

The fact that the PML table was labeled "aggregate" did not seem to cause many candidates issues. Many candidates performed the calculations as if the table was on an occurrence basis, as the question intended. The candidates who recognized the issue and stated their assumptions were graded as if their assumptions held. Candidates who stated a valid reason for not interpolating, and then applied the reinsurance terms correctly were given full credit.

Common mistakes included:

- Using return period years for interpolation
- Switching the weights to be applied in the interpolation calculation
- Switching the ceded/net losses for the primary insurer.

Part b

Candidates were expected to recognize the diversification benefit to the reinsurer by writing the treaty, the effect this has on the reinsurer's capital, and then recommend taking on the risk.

Candidates who recognized the error in the question and provided sound arguments were given full credit for this part.

Generic arguments about reinsurance or answers given from the primary insurer's perspective were not given credit, as it did not address the information given in the question. For example, "if the premium charged is adequate, the reinsurer should write the contract," would receive no credit. Only arguing about potential "free cover" was also not given credit.

Some candidates incorrectly viewed this question from an experience/exposure rating perspective. This was not accepted, as the question deals with catastrophe modeled losses.

Part b becomes unanswerable with the assumption that the treaty is per-occurrence, combined with an aggregate PML table as we do not have enough information. Candidates who recognized this issue and explained why received full credit.

Common mistakes included:

- Ignoring the diversification effect
- Directly adding the primary insurer's 1:250 PML to the reinsurer's current PML.