Solutions to the New STAM Sample Questions

Revised July 2019 to Add Questions 327 and 328

For STAM, the SOA revised their file of Sample Questions for Exam C.
They deleted questions that are no longer on the syllabus of STAM.

They added questions 308 to 326, covering material added to the syllabus.
They later added questions 327 and 328, also covering this new material.

(STAM Sample Q.308) An insurance company sells a policy with a linearly disappearing deductible such that no payment is made on a claim of 250 or less and full payment is made on a claim of 1000 or more.
Calculate the payment made by the insurance company for a loss of 700.
(A) 450 (B) 500 (C) 550 (D) 600 (E) 700

308. D. The payment for a loss of 250 is 0. The payment for a loss of 1000 is 1000.
Linearly interpolate in order to get the payment for a loss of 700:
$\frac{700 - 250}{1000 - 250}$ (1000) = **600**.

(STAM Sample Q.309) The random variable X represents the random loss, before any deductible is applied, covered by an insurance policy.
The probability density function of X is

$f(x) = 2x, \ 0 < x < 1.$

Payments are made subject to a deductible, d, where $0 < d < 1$.
The probability that a claim payment is less than 0.5 is equal to 0.64.
Calculate the value of d.

(A) 0.1 (B) 0.2 (C) 0.3 (D) 0.4 (E) 0.5

309. C. The payment of size 0.5 corresponds to a loss of size 0.5 + d.

$$F(x) = \int_0^x 2t \ dt = x^2.$$

$0.64 = F(0.5 + d) = (0.5 + d)^2. \Rightarrow d =$ **0.3**.

(STAM Sample Q.310) You are given the following loss data:

Size of Loss	Number of Claims	Ground-Up Total Losses
0 – 99	1100	58,500
100 – 249	400	70,000
250 – 499	300	120,000
500 – 999	200	150,000
> 999	100	200,000
Total	2100	598,500

Calculate the percentage reduction in loss costs by moving from a 100 deductible to a 250 deductible.

(A) 25% (B) 27% (C) 29% (D) 31% (E) 33%

310. B. A 100 deductible eliminates all of the losses in the first interval and 100 per loss for the other intervals: 58,500 + (1000)(100) = 158,500.
With a 100 deductible the insurer pays: 598,500 - 158,500 = 440,000.
A 250 deductible eliminates all of the losses in the first two intervals and 250 per loss for the other intervals: 58,500 + 70,000 + (600)(250) = 278,500.
With a 100 deductible the insurer pays: 598,500 - 278,500 = 320,000.
The percentage reduction in loss costs by moving from a 100 deductible to a 250 deductible:
1 - 320/440 = **27.3%**.
Comment: The loss elimination ratio (compared to no deductible) for the 100 deductible is:
158,500/598,500 = 26.48%.
The loss elimination ratio (compared to no deductible) for the 250 deductible is:
278,500/598,500 = 46.53%.

$$1 - \frac{1 - 46.53\%}{1 - 26.48\%} = 27.3\%.$$

(STAM Sample Q.311) Mr. Fixit purchases a homeowners policy with an 80% coinsurance clause. The home is insured for 150,000.
The home was worth 180,000 on the day the policy was purchased.
Lightning causes 20,000 worth of damage.
On the day of the storm the home is worth 250,000.
Calculate the benefit payment Mr. Fixit receives from his policy.
(A) 15,000 (B) 16,000 (C) 17,500 (D) 18,000 (E) 20,000

311. A. The coinsurance clause requires 80% of the value of the home at the time of the event: (80%)(250,000) = 200,000. Thus Mr. Fixit is underinsured.
The payment is: (150/200) (20,000) = **$15,000**.
Comment: The insurer would not pay more than the insured value of 150,000, regardless of how large the damage was.
At page 32 of An Introduction to Ratemaking and Loss Reserving for P&C Insurance.
the coinsurance clause requires 80% of the value of the home at the time of the event rather than at the time the policy is purchased (presumably meaning the day the policy takes effect.)
In real world situations, one must carefully read the specific policy provisions.
Most commonly homeowners polices are annual; they provide coverage for events during a one year period. For example, a policy is purchased and coverage starts April 1, 2019 and ends March 31, 2020. Thus it would be very unusual for a home to increase in value from 180,000 to 250,000 while the policy was in effect.

(STAM Sample Q.312) A company purchases a commercial insurance policy with a property policy limit of 70,000. The actual value of the property at the time of a loss is 100,000.
The insurance policy has a coinsurance provision of 80% and a 200 deductible, which is applied to the loss before the limit or coinsurance are applied.
A storm causes damage in the amount of 20,000.
Calculate the insurance company's payment.
(A) 15,840 (B) 16,000 (C) 17,300 (D) 17,325 (E) 19,800

312. D. Applying the deductible first: 20,000 - 2000 = 19,800.
The coinsurance requirement is: (80%)(100,000) = 80,000, which is <u>not</u> met.
Thus the insurer pays: (19,800) (70/80) = **17,325**.
<u>Comment</u>: The insurer would not pay more than the policy limit of 70,000, less the deductible of 200, regardless of how large the damage was.

(STAM Sample Q.313) Mini Driver has an automobile insurance policy with the All-Province Insurance Company. She has 200,000 of third party liability coverage (bodily injury/property damage) and has a 1,000 deductible on her collision coverage.
Mini is at fault for an accident that injures B. Jones, who is insured by Red Deer Insurance Company.
M. Driver is successfully sued by B. Jones for Jones' injuries.
The court orders Driver to pay Jones 175,000.
Other expenses incurred are:
i) Legal fees to All-Province on behalf of Driver: 45,000
ii) Collision costs to repair Driver's car: 20,000
Calculate the total amount All-Province pays out for this occurrence.
(A) 175,000 (B) 195,000 (C) 200,000 (D) 219,000 (E) 239,000

313. E. For Collision, All-Province pays out: 20,000 - 1000 = 19,000.
For Liability, All-Province pays out the court award of 175,000 (would be limited to 200,000) plus the legal fees of 45,000 (not limited) = 220,000.
Total of payments is: 19,000 + 220,000 = **239,000**.
Comment: If the judgement to Jones had been instead 250,000, then All-Province would pay 19,000 + 200,000 + 45,000 = 264,000. Then in theory, Mini Driver would have to pay Jones: 250,000 - 200,000 = 50,000. In such situations, often the attorney for Jones would settle the case for the policy limit of 200,000.
Red Deer, which insures Jones, is not responsible for any payments in the given situation.
If Jones' car had been damaged in the accident, then since Mini Driver is at fault, All-Province would be responsible for paying for repairs to Jones' car (under Mini Driver's property damage liability.)

(STAM Sample Q.314) You are given the following earned premiums for three calendar years:

Calendar Year	Earned Premium
CY5	7,706
CY6	9,200
CY7	10,250

All policies have a one-year term and policy issues are uniformly distributed through each year.
The following rate changes have occurred:

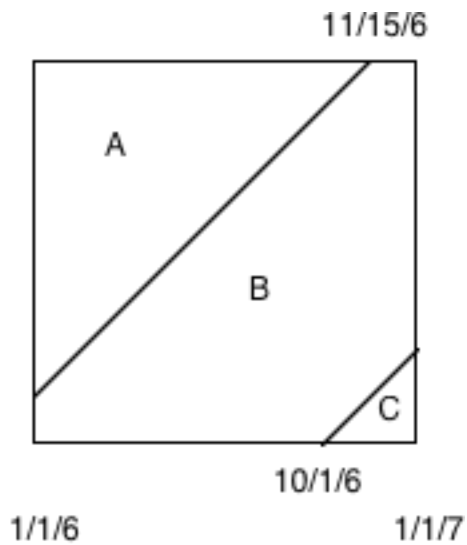
Date	Rate Change
July 1, CY3	+7%
Nov. 15, CY5	-4%
October 1, CY6	+5%

Rates are currently at the level set on October 1, CY6.
Calculate the earned premium at the current rate level for CY6.
(A) 9300 (B) 9400 (C) 9500 (D) 9600 (E) 9700

314. C. Define the July 1, CY3 rate level as 1.00.

Date	Rate Change	Rate Level Index
7/1/3		1.00
11/15/5	-4%	0.96
10/1/6	+5%	(0.96)(1.05) = 1.008

Since we have annual policies, the lines have a slope of one:



Area A = $(10.5/12)^2$ / 2 = 0.3828125.

Area C = $(1/4)^2$ / 2 = 0.03125.

Area B = 1 - 0.3828125 - 0.03125 = 0.5859375.

The average rate level for CY6 is:

(1)(0.3828125) + (0.96)(0.5859375) + (1.008)(0.03125) = 0.976813.

Thus the on level factor for CY6 premiums is: 1.008 / 0.976813 = 1.03193.

The earned premium at the current rate level for CY6 is: (1.03193)(9200) = **9494**.

<u>Comment</u>: If for example instead you defined the rate level prior to July 1, CY3 as 1.00, as long as you are consistent you should get the same final answer.

(STAM Sample Q.315) You are given:

i) Data for three territories as follows:

Territory	Earned Premium At Current Rates	Incurred Loss & ALAE	Claim Count	Current Relativity
1	520,000	420,000	600	0.60
2	1,680,000	1,250,000	1320	1.00
3	450,000	360,000	390	0.52
Total	2,650,000	2,030,000	2310	

ii) The full credibility standard is 1082 claims and partial credibility is calculated using the square root rule.

iii) The complement of credibility is applied to no change to the existing relativity.

Calculate, using the loss ratio method, the indicated territorial relativity for Territory 3.

(A) 0.52 (B) 0.53 (C) 0.54 (D) 0.55 (E) 0.56

315. C. We compare the loss ratios in each territory to that in the base territory 2:

$$\frac{\text{Loss Ratio Terr. 3}}{\text{Loss Ratio Terr. 2}} = 80.00\%/74.40\% = 1.075.$$

Prior to credibility, the indicated relativity for territory 3 is: (1.075)(0.52) = 0.559.

The credibility for territory 3 is: Min(1, $\sqrt{390/1082}$) = 60.04%.

Thus the credibility weighted indicated relativity for territory 3 is:
(0.559)(60.04%) + (0.52)(1 - 60.04%) = **0.543**.
Alternately, the credibility weighted change factor for territory 3 is:
(1.075)(60.04%) + (1)(1 - 60.04%) = 1.045.
Multiplying by the current relativity, the indicated relativity for territory 3 is:
(1.045)(0.52) = **0.543**.

Terr.	Earned Premium	Loss & ALAE	Loss Ratio	Claim Count	Cred.	Current Relativity	Indicated Relativity
1	520,000	420,000	80.77%	600	74.47%	0.60	0.638
2	1,680,000	1,250,000	74.40%	1320	100.00%	1.00	1.000
3	450,000	360,000	80.00%	390	60.04%	0.52	**0.543**
Total	2,650,000	2,030,000	76.60%	2310			

Comment: See Equations 4.10 and 4.12, as well as Exercise 4.26a in
An Introduction to Ratemaking and Loss Reserving for P&C Insurance.
This is all prior to balancing back to the desired overall rate change (or no rate change) as discussed in Section 4.8.3.
Other textbooks not on the syllabus (see for example Appendix E of Basic Ratemaking by Werner and Modlin), would proceed somewhat differently:

Terr.	Loss Ratio	Relative Loss Ratio	Claim Count	Cred.	Cred. Weighted Change	Current Relativity	Credibility Weighted Indicated Relativity	Indicated Relativity w.r.t. Base
1	80.77%	1.054	600	74.47%	1.040	0.60	0.624	0.643
2	74.40%	0.971	1320	100.00%	0.971	1.00	0.971	1.000
3	80.00%	1.044	390	60.04%	1.027	0.52	0.534	0.550
Total	76.60%	1.000	2310					

Prior to credibility, we get the change factor for each territory by comparing the loss ratio for the territory to the overall loss ratio.

$$\frac{\text{Loss Ratio Terr. 3}}{\text{Loss Ratio Overall}} = 80.00\%/76.60\% = 1.044.$$

Then the credibility weighted change factor for territory 3 is:
(1.044)(60.04%) + (1)(1 - 60.04%) = 1.026.
Thus the credibility weighted indicated relativity for territory 3 is: (1.026)(0.52) = 0.533.
However, we need to divide by the similar number for the base territory 2, in order to keep a relativity of one for the base territory: 0.533/0.971 = 0.549, a somewhat different result.
The SOA expects you proceed exactly as does the syllabus reading.

(STAM Sample Q.316)
You use the following information to determine a rate change using the loss ratio method.
(i)

Accident Year	Earned Premium at Current Rates	Incurred Losses	Weight Given to Accident Year
AY8	4252	2260	40%
AY9	5765	2610	60%

(ii) Trend Factor: 7% per annum effective
(iii) Loss Development Factor (to Ultimate): AY8: 1.08
AY9: 1.18
(iv) Permissible Loss Ratio: 0.657
(v) All policies are one-year policies, are issued uniformly through the year, and rates will be in effect for one year.
(vi) Proposed Effective Date: July 1, CY10
Calculate the required portfolio-wide rate change.
(A) -26% (B) -16% (C) -8% (D) -1% (E) 7%

316. D. The average effective date for the new rates (in effect for one year) is:
July 1, CY10 + 6 months = January 1, CY11.
The average date of loss under the new rates (annual policies) is:
January 1, CY11 + 6 months = July 1, CY11.
The average date of accident for AY8 is July 1, CY08.
Thus the trend period for AY8 is 3 years.
AY8 trended and developed losses: $(2260)(1.08)(1.07^3) = 2990$.
AY9 trended and developed losses: $(2610)(1.18)(1.07^2) = 3526$.
AY8 loss ratio: 2990/4252 = 70.32%.
AY9 loss ratio: 3526/5765 = 61.16%.
Weighted loss ratio: (40%)(70.32%) + (60%)(61.16%) = 64.82%.
Comparing to the permissible loss ratio, the indicated rate change is:
64.82% / 65.7% - 1 = **-1.3%**.

(STAM Sample Q.317) You are given:
i) Policies are written uniformly throughout the year.
ii) Policies have a term of 6 months.
iii) The following rate changes have occurred:

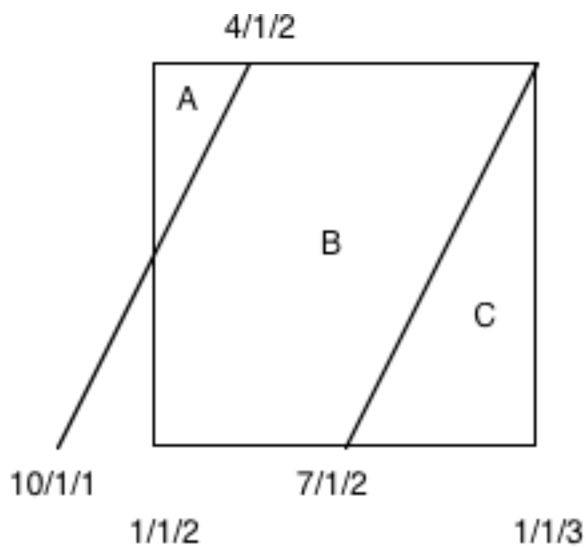
Date	Amount
October 1, CY1	+7%
July 1, CY2	+10%
September 1, CY3	-6%

Calculate the factor needed to adjust CY2 earned premiums to December 31, CY3 level.
(A) 0.97 (B) 0.98 (C) 0.99 (D) 1.00 (E) 1.01

317. E. Define the prior to Oct. 1, CY1 rate level as 1.00.

Date	Rate Change	Rate Level Index
Prior		1.00
10/1/1	+7%	1.07
7/1/2	+10%	(1.07)(1.10) = 1.177
11/1/3	-6%	(1.177)(0.94) = 1.10638

Since we have 6-month policies, the lines have slopes of: 1/(1/2) = 2.



Area A = (1/4)(1/2) / 2 = 1/16.
Area C = (1/2)(1) / 2 = 1/4.
Area B = 1 - 1/16 - 1/4 = 11/16.
The average rate level for CY2 is:
(1.00)(1/16) + (1.07)(11/16) + (1.177)(1/4) = 1.092375.
Thus the on level factor for CY2 premiums is: 1.10638 / 1.092375 = **1.0128**.
<u>Comment</u>: Similar to Sample Q. 314, except here we have 6-month rather than annual policies.

(STAM Sample Q.318) You are given the following information:

			Cumulative Loss Payments through Development Month			
Accident Year	Earned Premium	Expected Loss Ratio	12	24	36	48
AY5	19,000	0.90	4,850	9,700	14,100	16,200
AY6	20,000	0.85	5,150	10,300	14,900	
AY7	21,000	0.91	5,400	10,800		
AY8	22,000	0.88	7,200			

There is no development past 48 months.
Calculate the indicated actuarial reserve using the Bornhuetter-Ferguson method and volume-weighted average loss development factors.
(A) 22,600 (B) 23,400 (C) 24,200 (D) 25,300 (E) 26,200

318. B. The 12-24 development factor: $\frac{9700 + 10{,}300 + 10{,}800}{4850 + 5150 + 5400}$ = 30,800/15,400 = 2.00.

The 24-36 development factor: $\frac{14{,}100 + 14{,}900}{9700 + 10{,}300}$ = 29,000/20,000 = 1.45.

The 36-48 development factor: 16,200/14,100 = 1.15.
The 24-ultimate loss development factor: (1.45)(1.15) = 1.6675.
The 12-ultimate loss development factor: (2.00)(1.45)(1.15) = 3.335.
AY6 B-F Reserve: (20,000)(0.85) (1 - 1/1.15) = 2217.
AY7 B-F Reserve: (21,000)(0.91) (1 - 1/1.6675) = 7650.
AY8 B-F Reserve: (22,000)(0.88) (1 - 1/3.335) = 13,555.
Total Reserve: 2217 + 7650 + 13,555 = **23,422**.

(**STAM Sample Q.319**) You are given the following information:

i)

Accident Year	Cumulative Paid Losses through Development Month			
	12	24	36	48
AY5	27,000	49,000	65,000	72,000
AY6	28,000	57,000	71,000	
AY7	33,000	65,000		
AY8	35,000			

ii)

Interval	Selected Age-to-Age Paid Loss Development Factors
12 – 24 months	2.00
24 – 36 months	1.20
36 – 48 months	1.15
48 – ultimate	1.00

iii) The interest rate is 5.0% per annum effective.

Calculate the ratio of discounted reserves to undiscounted reserves as of December 31, CY8.

(A) 0.93 (B) 0.94 (C) 0.95 (D) 0.96 (E) 0.97

319. C. Use the given age to age development factors to complete the triangle.
For example, (35,000)(2) = 70,000. (70,000)(1.2) = 84,000. (84,000)(1.15) = 96,600.

Accident Year	Cumulative Paid Losses through Development Month			
	12	24	36	48
AY5	27,000	49,000	65,000	72,000
AY6	28,000	57,000	71,000	81,650
AY7	33,000	65,000	78,000	89,700
AY8	35,000	70,000	84,000	96,600
		Incremental Amount to be Paid		
				10,650
			13,000	11,700
		35,000	14,000	12,600

Then get the incremental amounts to be paid.
For example, 70,000 - 35,000 = 35,000. 84,000 - 70,000 = 14,000.
Then the total undiscounted reserve is:
10,650 + 13,000 + 11,700 + 35,000 + 14,000 + 12,600 = 96,950.
We discount the reserve by assuming that on average each payment is made in the middle of a year. For example, the 35,000 will be paid on average a half year from now, while the 14,000 will be paid on average 1.5 years from now.
Then the total undiscounted reserve is: $10{,}650/1.05^{0.5} + 13{,}000/1.05^{0.5} + 11{,}700/1.05^{1.5} + 35{,}000/1.05^{0.5} + 14{,}000/1.05^{1.5} + 12{,}600/1.05^{2.5} = 92{,}276$.
The ratio of discounted reserves to undiscounted reserves is:
92,276 / 96,950 = **0.952**.
Comment: A lot of computation for a question on this exam.
See Section 3.7 of An Introduction to Ratemaking and Loss Reserving for P&C Insurance.
A good first guess in this case would be on average about one year of discounting:
1/1.05 = 0.952.

(**STAM Sample Q.320**) You are given:
i)

Accident Year	Cumulative Paid Losses through Development Year						Earned premium
	0	1	2	3	4	5	
AY4	1,400	5,200	7,300	8,800	9,800	9,800	18,000
AY5	2,200	6,400	8,800	10,200	11,500		20,000
AY6	2,500	7,500	10,700	12,600			25,000
AY7	2,800	8,700	12,900				26,000
AY8	2,500	7,900					27,000
AY9	2,600						28,000

ii) The expected loss ratio for each Accident Year is 0.550.
Calculate the total loss reserve using the Bornhuetter-Ferguson method and three-year arithmetic average paid loss development factors.
(A) 21,800 (B) 22,500 (C) 23,600 (D) 24,700 (E) 25,400

320. D. For example, 7900/2500 = 3.1600. (3 + 3.1071 + 3.169)/3 = 3.0890.
(1.1807)(1.1205) = 1.3230.
Bornhuetter-Ferguson reserve for AY7: (0.55)(26,000) (1 - 1/1.3230) = 3491.

Accident Year	Cumulative Paid Losses through Development Year						Earned premium
	0	1	2	3	4	5	
AY4	1,400	5,200	7,300	8,800	9,800	9,800	18,000
AY5	2,200	6,400	8,800	10,200	11,500		20,000
AY6	2,500	7,500	10,700	12,600			25,000
AY7	2,800	8,700	12,900				26,000
AY8	2,500	7,900					27,000
AY9	2,600						28,000
		Link Ratios					
AY4		3.7143	1.4038	1.2055	1.1136	1.0000	
AY5		2.9091	1.3750	1.1591	1.1275		
AY6		3.0000	1.4267	1.1776			
AY7		3.1071	1.4828				
AY8		3.1600					
3 yr. Avg.		3.0890	1.4281	1.1807	1.1205	1.0000	
Factor to Ultimate		5.8367	1.8895	1.3230	1.1205	1.0000	
		AY9	AY8	AY7	AY6	AY5	Total
B-F Reserve		12,762	6,991	3,492	1,479	0	**24,723**

<u>Comment</u>: A lot of computation for a question on this exam.

(**STAM Sample Q.321**) You are given:
i) An insurance company was formed to write workers compensation business in CY1.
ii) Earned premium in CY1 was 1,000,000.
iii) Earned premium growth through CY3 has been constant at 20% per year (compounded).
iv) The expected loss ratio for AY1 is 60%.
v) As of December 31, CY3, the company's reserving actuary believes the expected loss ratio has increased two percentage points each accident year since the company's inception.
vi) Selected incurred loss development factors are as follows:

12 to 24 months	1.500
24 to 36 months	1.336
36 to 48 months	1.126
48 to 60 months	1.057
60 to 72 months	1.050
72 to ultimate	1.000

Calculate the total IBNR reserve as of December 31, CY3 using the Bornhuetter-Ferguson method.
(A) 964,000 (B) 966,000 (C) 968,000 (D) 970,000 (E) 972,000

321. E. For example, (1,440,000)(64%) = 921,600.
(1.5)(1.336)(1.126)(1.057)(1.050) = 2.5044.
(921,600) (1 - 1/2.5044) = 553,605.

Accident Year	Earned Premium	Expected Loss Ratio	Expected Ultimate Losses	Incurred LDF to Ultimate	B-F IBNR Reserve (million)
1	1,000,000	60%	600,000	1.2497	119,881
2	1,200,000	62%	744,000	1.6696	298,381
3	1,440,000	64%	921,600	2.5044	553,605
Total					**971,867**

Comment: Since the given LDFs are for incurred losses rather than paid losses, we are estimating the IBNR reserve, or more precisely the total reserve minus the case reserves.

(STAM Sample Q.322) You are given the following loss distribution probabilities for a liability coverage, as well as the average loss within each interval:

Size of Loss	Cumulative Probability	Average Loss
(0, 1,000]	0.358	300
(1,000, 25,000]	0.761	8,200
(25,000, 100,000]	0.879	47,500
(100,000, 250,000]	0.930	145,000
(250,000, 500,000]	0.956	325,000
(500,000, 1,000,000]	0.984	650,000
(1,000,000, 10,000,000]	1.000	3,700,000

Calculate the increased limits factor for a 1,000,000 limit when the basic limit is 100,000 and there is no loading for risk or expenses.
(A) 2.4 (B) 2.5 (C) 2.6 (D) 2.7 (E) 2.8

322. E. For example, the second interval contains losses of size 1001 to 25,000; the number of such losses is 0.761 - 0.358 = 0.403 of the total number of losses, and the average size of such losses is 8200.
For example, for the second interval, the contribution is: (0.403)(8200) = 3,304.6.
With a 100,000 limit, for the fourth and later intervals, each loss contributes 100,000; each contribution is 100,000 times the probability in the interval.
With a 1,000,000 limit, for the final interval, each loss contributes 1,000,000; the contribution is 1,000,000 times the probability in the interval.

Upper Endpoint	Cumulative Probability	Probability in Interval	Average Loss	Contribution 100,000 Limit	Contribution 1,000,000 Limit
1,000	0.358	0.358	300	107.4	107.4
25,000	0.761	0.403	8,200	3,304.6	3,304.6
100,000	0.879	0.118	47,500	5,605	5,605
250,000	0.930	0.051	145,000	5100	7,395
500,000	0.956	0.026	325,000	2600	8,450
1,000,000	0.984	0.028	650,000	2800	18,200
10,000,000	1.000	0.016	3,700,000	1600	16000
Total				21,117	59,062

Indicated ILF for a one million limit is: 59,062 / 21,117 = **2.80**.

(STAM Sample Q.323)
The following developed losses evaluated at various maximum loss sizes are given:
- The total losses limited at 50,000 from all policies with a policy limit of 50,000 or more is 22,000,000.
- The total losses limited at 50,000 from all policies with a policy limit of 250,000 or more is 14,000,000.
- The total losses limited at 250,000 from all policies with a policy limit of 250,000 or more is 25,000,000.

The base rate at the 50,000 basic limit is 300 per exposure unit, consisting of 240 pure premium, 30 fixed expense, and 30 variable expense.
Calculate the rate at the 250,000 limit.
(A) 370 (B) 400 (C) 450 (D) 480 (E) 510

323. E. For the policies with a 250,000 limit, we compare the losses with different caps: 25/14.
Thus for a 250,000 limit, the estimated pure premium is: (25/14)(240) = 428.57.
Variable expenses are 10% of the basic limit rate.
Thus the rate for a 250,000 limit is: (428.57 + 30) / (1 - 10%) = **509.52**.
Alternately, for the basic limit rate: $\frac{\text{Variable Expenses}}{\text{Losses + Fixed Expenses}}$ = 30 / (240 + 30) = 1/9.
Thus the rate is 10/9 times (Losses + Fixed Expenses).
Thus the rate for a 250,000 limit is: (428.57 + 30) (10/9) = **509.52**.
Comment: One can not determine what the losses would have been for the policies with a limit of $50,000 if there had instead been a limit of $250,000. Thus we do not use their data to determine the increased limit factor.
The indicated increased limit factor for 250,000, taking into account expenses, is:
509.52 / 300 = 1.70.

(STAM Sample Q.324) A primary insurance company has a 100,000 retention limit.
The company purchases a catastrophe reinsurance treaty, which provides the following coverage:

Layer 1: 85% of 100,000 excess of 100,000
Layer 2: 90% of 100,000 excess of 200,000
Layer 3: 95% of 300,000 excess of 300,000

The primary insurance company experiences a catastrophe loss of 450,000.
Calculate the total loss retained by the primary insurance company.
(A) 100,000 (B) 112,500 (C) 125,000 (D) 132,500 (E) 150,000

324. D. As computed below, the reinsurer pays 317,500.

Layer	Loss in Layer	Percent Paid by Reinsurer	Amount Paid by Reinsurer
Below 100,000	100,000	0%	0
100,000 to 200,000	100,000	85%	85,000
200,000 to 300,000	100,000	90%	90,000
300,000 to 600,000	150,000	95%	142,500
Above 600,000	0	0%	0
Total	450,000		317,500

Thus the primary insurer retains: 450,000 - 317,500 = **132,500**.
Alternately, one can compute the amount retained in each layer:

Layer	Loss in Layer	Percent Retained by Insurer	Amount Retained by Insurer
Below 100,000	100,000	100%	100,000
100,000 to 200,000	100,000	15%	15,000
200,000 to 300,000	100,000	10%	10,000
300,000 to 600,000	150,000	5%	7,500
Above 600,000	0	100%	0
Total	450,000		**132,500**

Comment: See Exercise 5.15 in
An Introduction to Ratemaking and Loss Reserving for P&C Insurance.

(STAM Sample Q.325) A primary liability insurer has a book of business with the following limits, premium, and increased limits factors (ILFs):

Limit	Premium	ILF
100,000	600,000	1.00
200,000	800,000	1.25
300,000	1,200,000	1.45
400,000	1,000,000	1.60
500,000	400,000	1.70

The expected loss ratio is 60% for each limit.
A reinsurer provides an excess of loss treaty for the layer 300,000 excess of 100,000.
Calculate the amount the primary insurer pays for this coverage before expenses.
(A) 840,000 (B) 847,000 (C) 850,000 (D) 862,000 (E) 871,000

325. ?. For the primary policies with a 100,000 limit, the reinsurer expects to pay nothing.
For the primary policies with a 200,000 limit, the reinsurer expects to pay for the reinsured layer from 100,000 to 400,000 as a percent: $\frac{\text{ILF(200K) - ILF(100K)}}{\text{ILF(200K)}} = \frac{1.25 - 1.00}{1.25} = 0.2$.

For the primary policies with a 300,000 limit, the reinsurer expects to pay for the reinsured layer from 100,000 to 400,000 as a percent: $\frac{\text{ILF(300K) - ILF(100K)}}{\text{ILF(300K)}} = \frac{1.45 - 1.00}{1.45} = 9/29$.

For the primary policies with a 400,000 limit, the reinsurer expects to pay for the reinsured layer from 100,000 to 400,000 as a percent: $\frac{\text{ILF(400K) - ILF(100K)}}{\text{ILF(400K)}} = \frac{1.60 - 1.00}{1.60} = 0.375$.

For the primary policies with a 500,000 limit, the reinsurer expects to pay for the reinsured layer from 100,000 to 400,000 as a percent: $\frac{\text{ILF(400K) - ILF(100K)}}{\text{ILF(500K)}} = \frac{1.60 - 1.00}{1.70} = 6/17$.

Thus the reinsurer expects to pay:
(60%)(800,000)(0.2) + (60%)(1,200,000)(9/29) + (60%)(1,000,000)(0.375)
+ (60%)(400,000)(6/17) = **629,154**.

(STAM Sample Q.326) XYZ's insurance premium is based on an experience rating plan that uses the total of the most recent three years experience compared to an expected pure premium of 475. The most recent three years experience is provided:

Year	Manual Premium	Earned Exposures	Developed Losses
CY1	350,000	600	192,000
CY2	340,000	650	340,000
CY3	365,000	625	220,000
Total	1,055,000	1,875	752,000

- Credibility is based on the formula: $Z = \frac{\text{Exposures}}{\text{Exposures + 23,000}}$.
- The CY4 manual premium for XYZ is determined to be 380,000.
- XYZ also has a schedule rating credit of 10% that is applied after the experience rating modification.

Calculate the CY4 experience rating premium for XYZ.
(A) 319,000 (B) 338,000 (C) 357,000 (D) 375,000 (E) 394,000

326. B. The observed pure premium for the three years is: 752,000 / 1,875 = 401.07.
Z = 1875 / (1875 + 23,000) = 7.54%.
Mod = (7,54%)(401.07/475) + (1 - 7.54%) = 0.988.
Premium after experience rating and schedule rating = (380,000)(0.988)(1 - 10%) = **337,896**.
<u>Comment</u>: Somewhat similar to Exercise 5.3 in
<u>An Introduction to Ratemaking and Loss Reserving for P&C Insurance</u>.
The insured has better than expected experience, so the mod is a credit.
The credibility formula is from Buhlmann Credibility with K = 23,000 exposures.
We make no use of the given historical premiums.
We do not need the other historical data broken down by year.
In practical applications, one would use data from years 1, 2, and 3, in order to experience rate the policy for year 5. The losses from year 3 would be too immature to use when one wants to experience rate the policy for year 4.

(**STAM Sample Q.327**)
An insurance company writes policies with three deductible options: 0, 100, and 500.
Policyholders report all claims that are greater than or equal to the deductible,
but do not always report claims that are less than the deductible.
For the claims that policyholders report to the insurance company, historical loss experience for the three different policy types is as follows:

	Deductible					
	0		100		500	
Size of Loss	# of Claims	Ground-up Losses	# of Claims	Ground-up Losses	# of Claims	Ground-up Losses
1 – 100	5	300	2	100	0	0
101 – 200	8	1,400	4	600	0	0
201 – 500	4	1,500	2	750	0	0
501 or greater	3	3,900	1	1,500	1	1,300
Total	20	7,100	9	2,950	1	1,300

The company wants to introduce a 200 deductible option.
Calculate the indicated relativity for the 200 deductible, using a base deductible of 100.
(A) 0.62 (B) 0.66 (C) 0.76 (D) 0.79 (E) 0.80

327. C. We can not use the data from the 500 deductible policies, as we do not know how many claims smaller than 500 there were that were not reported.
While this is also a potential problem for the data from the policies with 100 deductibles, we can use their data since we are only pricing deductible of 100 or more.
Thus we only use data from the first two sets of policies.
With a 100 deductible, the insurer would pay:
{7100 - 300 - (15)(100)} + {2950 - 100 - (7)(100)} = 5300 + 2150 = 7450.
With a 200 deductible, the insurer would pay:
{7100 - 1700 - (7)(200)} + {2950 - 700 - (3)(200)} = 4000 + 1650 = 5650.
Thus, the indicated relativity for the 200 deductible, using a base deductible of 100 is:
5650 / 7450 = **0.758**.
Comment: It would be common for the actuary to have no information on claims smaller than the deductible amount. In this question, we are specifically told that some but not all such small claims are in this data base.
A deductible eliminates each small claim, and eliminates the deductible amount from each large claim.

(**STAM Sample Q.328**) Company XYZ sells homeowners insurance policies. You are given:
i) The loss costs by accident year are:

Accident Year	Loss Cost
AY1	1300
AY2	1150
AY3	1550
AY4	1800

ii) The slope of the straight line fitted to the natural log of the loss costs is 0.1275.
iii) Experience periods are 12 months in length. In each accident year the average accident date is July 1.
iv) The current experience period is weighted 80% and the prior experience period is weighted 20% for rate development.
New rates take effect November 1, CY5 for one-year policies and will be in effect for one year.
Calculate the expected loss cost for these new rates.
(A) 2124 (B) 2217 (C) 2264 (D) 2381 (E) 2413

328. E. The annual trend factor is Exp[0.1275] = 1.136.
Since the rates will be in effect for one year, the average date of writing under the new rates will be 6 months later, or May 1, CY6.
Since the policies are annual, the average date of accident under the new rates will be 6 months later, or November 1, CY6.
Thus the trend period from AY3 is from July 1, CY3 to November 1, CY6, or $3\frac{1}{3}$ years.

Giving AY3 20% weight and AY4 80% weight:
$(20\%)(1550)(1.136^{10/3}) + (80\%)(1800)(1.136^{7/3})$ = **2413**.
Comment: Similar to Exercise 4.9 in Brown and Lennox, which instead involves policy years.
Presumably, the given loss costs have been developed to ultimate.
Alternately, the trend to be applied to AY3 can also be expressed as: Exp[(10/3)(0.1275)].
Personally, I found the wording in bullet (iv) a little confusing; they are just giving AY3 20% weight and AY4 80% weight.
Fitting a linear regression to the natural log of the loss costs:
ln[loss cost] = 6.94611 + 0.12748 t, where t = 1 corresponds to AY1.
This an example of what is called by actuaries an exponential regression, which is commonly used to trend severities or pure premiums.