RMS® CCRA® Training Program
Financial Modeling Exercise 3

ANSWER KEY

You are analyzing a single-location, single policy California Earthquake account. The location has only one building. After running a RiskLink® DLM scenario analysis under the distributed mode, you get the following ground-up loss results:

Ground-Up Loss Data	
Mean Loss	$43,578,292
Standard Deviation	$26,279,065
Exposure	$100,000,000

The only existing insurance structure consists of a limit and a deductible coded at the policy level:

Insurance Structure	
Deductible	$2,000,000
Limit	$25,000,000

a) Calculate the expected mode client and gross losses.

Answer: *Client Loss = Min (Ground-Up Loss, Deductible) = Min ($43,578,292, $2,000,000) = $2,000,000*

Gross Loss = Min (Ground-Up Loss – Deductible, Limit) = Min ($41,578,292, $25,000,000) = $25,000,000

b) Using the provided spreadsheet (Exercise 3 calculator.xls), calculate the client and gross losses working under the distributed mode.

Answer: *Client Loss = $1,982,193*
Gross Loss = $20,814,524

- Explain why the distributed mode results are different from the expected mode results.

Answer: *The losses are different because under the distributed mode not only the mean loss is used, but also the distribution around it. The distributed mode recognizes that there is a positive probability for the actual ground-up loss to be both bigger and smaller than its mean value. The expected mode assumes that every time the event occurs, it will generate a loss equal to its mean value.*

- Why are the losses higher under one mode than under the other?

  Answer: *For both the client loss and the gross loss, the expected mode results are higher than the distributed mode. This happens because the event mean loss is greater than the deductible, and than the deductible plus the limit. From the client loss perspective, the expected mode assumes that every single time the event occurs the deductible will be exhausted and therefore the loss paid by the insured will max out. The distributed mode recognizes that, even though the mean loss is bigger than the deductible, there is a positive probability that the ground-up loss will not exhaust the deductible and therefore generate a client loss smaller than $2,000,000. An analogous analysis can be done for the gross loss, this time considering the probability that the ground-up loss will be smaller than the limit plus the deductible.*

- Are the differences bigger for the client losses or the gross losses? Why?

  Answer: *The differences between expected and distributed losses are much bigger for the gross losses. The reason for this is that the magnitude of the probability ignored by the expected mode is much bigger in the gross loss case than in the client loss case. For the client loss calculation, the expected mode ignores the probability of the ground-up loss being smaller than the deductible (from the provided spreadsheet, this probability is equal to 1.88%). For the gross loss case, the expected mode ignores the probability of the ground-up loss being smaller than the limit plus the deductible (from the provided spreadsheet, this probability is equal to 32.17%).*

c) Suppose that the account, instead of containing one building, contains ten buildings.

- What do you think will happen to the standard deviation? Why?

  Answer: *The standard deviation will be reduced because now the location risk will be more diversified. With the introduction of the ten separate buildings (as opposed to one), the less than perfect correlation between the buildings will reduce the magnitude of the standard deviation. This is analogous to the risk of a portfolio of investments. If it is invested in only one stock, or only one sector, the risk is very high. If the investments of the portfolio are diversified across different sectors, the low correlation between investments will lower the overall risk of the portfolio.*

- Use the spreadsheet (Exercise 3 calculator.xls) to calculate the adjusted standard deviation by filling in the correct number of buildings in the field under Aggregate Data Information, and recalculate the client and gross losses with the new ground-up distribution under the distributed mode.

  Answer: *Adjusted Ground-Up Standard Deviation = $11,903,949*
  Client Loss = $2,000,000
  Gross Loss = $24,638,812

Compare these results with the ones from a) and b), and explain why the losses are behaving the way they are.

Answer: *The distributed results using the adjusted standard deviation are much closer to the expected mode results. Intuitively, when the standard deviation is reduced, we are getting closer to the expected mode methodology (that assumes a standard deviation equal to zero). Mathematically, the probabilities ignored by the expected mode are now much smaller when calculated with the adjusted standard*

deviation (probability of the ground-up loss being smaller than the deductible = 0.00000055%, probability of the ground-up loss being smaller than the limit plus the deductible = 8.15%)

d) Review the ground-up distribution from question c), which is the one corresponding to the account with ten buildings, and suppose that the insurance structure changes to:

Insurance Structure	
Deductible	$70,000,000
Limit	$30,000,000 (unlimited)

Compute the new client and gross losses under the distributed mode using the spreadsheet calculator (Exercise 3 calculator.xls).

Answer: *Client Loss = $43,528,326*
Gross Loss = $49,966

Explain the results.

Answer: *The client loss is much higher than before because the deductible has increased as well; in fact, the client loss is now almost as big as the ground-up loss because the probability of not exhausting the deductible is very big (98.62%). Because of the same reason, the gross loss is much smaller now that there is only a 1.38% probability of the ground-up loss being greater than the deductible and therefore generating a gross loss.*

e) Suppose that after an update to the earthquake model, the new ground-up mean loss decreased, but the ground-up standard deviation increased. The ground-up numbers, before and after the update, are shown below:

Ground-Up Loss Data		
	Before EQ Model Update	**After EQ Model Update**
Mean Loss	$43,578,292	$39,220,463
Standard Deviation *	$26,279,065	$36,790,691
Exposure	$100,000,000	$100,000,000

**Assumes one building*

- Using the insurance structure detailed in d), calculate the new client and gross losses under the distributed mode. Did they increase or decrease?

  Answer: *Client Loss = $38,983,309.66 (decreased by 10.44%)*
  Gross Loss = $237,153.34 (increased by 374.63%)

- How would you explain that one of these financial perspectives has an opposite behavior to the one seen in the ground-up Losses? *Hint:* Use the provided spreadsheet (Exercise 3 - comparison of 2 GU distributions.xls) to graph the distributions before and after the update of the model.

  Answer: *Even though the client losses decreased by 10.44%, the gross loss increased by 374.63%. This is explained by the fact that the standard deviation increased by 40%. Now, the distribution around the mean ground-up loss is much more spread out resulting in a fatter tail that translates into a higher probability of exhausting the deductible (4.03% vs. the 1.38% calculated before the update of the earthquake model).*