Southern New Hampshire University

DAT 610 Module Eight Exercise Guidelines and Rubric

Overview: The capital modeling approach often uses complex methods such as the Monte Carlo simulation to estimate with greater precision and confidence than a limited data set might otherwise allow.

Prompt: For this exercise, execute the steps of a Monte Carlo simulation for determining maximum annual "Collision" loss with 99.99% certainty. Use the provided IIHS Data document, which uses data from the Insurance Institute for Highway Safety (IIHS) on insurance losses by make and model.

Example R code in red:

1. Use R to draw a sample from a Poisson distribution with a mean equal to the average number of loss events per year.

```
iihs_data_EX8 <- read.csv("~/DAT 610 IIHS Data for EX 8.csv")
View(iihs_data_EX8) table(iihs_data_EX8$YEAR)
table(iihs_data_EX8$YEAR)
table(iihs_data_EX8$YEAR)*mean(iihs_data_EX8$Collision.)   # take note of these values

yearMean <- mean(table(iihs_data_EX8$YEAR))
rpois(10, yearMean)      # 10 samples
rpois(1, yearMean)       #  1 sample
```

2. Determine the average and standard deviation of the "Collision" loss amount.

```
m <- mean(iihs_data_EX8$Collision.)
s <- sd(iihs_data_EX8$Collision.)
mu <- log(m^2/sqrt(s+m^2))                # mean lognormal distribution
sigma <- sqrt(log(1+s/m^2))
```

3. Using R, draw a sample value from a lognormal distribution.

```
rlnorm(10,mu,sigma)     # 10 samples
rlnorm(1,mu,sigma)      # 1 sample
```

4. Multiply the random value drawn from the Poisson distribution by the random value drawn from the lognormal distribution. What is the amount?

5. Repeat the process four more times. What is the maximum product from the five iterations of this process? How many times would this process need to be repeated to reach a 99.9% confidence level regarding maximum likely annual loss to fraudulent claims?

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The response should address the following **critical elements**:

1. **Average Loss Frequency**
   The average loss frequency should be randomly drawn from an appropriate Poisson distribution.
2. **Average Loss Severity**
   The average loss severity should be randomly drawn from an appropriate lognormal distribution.
3. **Maximum Total Loss**
   The maximum loss should be correctly derived from Monte Carlo approximation of maximum loss distribution.
4. **Monte Carlo Extrapolation process**
   Describe the process to reach 99.9% confidence level and explain real-world situations or problems that are good candidates for Monte Carlo simulation extrapolation solutions.

Guidelines for Submission: This submission must be one to two pages in length and must use double spacing, 12-point Times New Roman font, and one-inch margins. Citations must use APA format.

Rubric

Critical Elements	Exemplary (100%)	Proficient (90%)	Needs Improvement (70%)	Not Evident (0%)	Value
Average Loss Frequency	Meets "Proficient" criteria and references a process to incorporate new results	Randomly draws average loss frequency from an appropriate Poisson distribution	Estimates/derives average loss frequency from sample file	Does not provide estimation of average loss frequency	25
Average Loss Severity	Meets "Proficient" criteria and references a process to incorporate new results	Randomly draws average loss severity from an appropriate Poisson distribution	Estimates/derives average loss severity from sample file	Does not provide estimation of average loss severity	25
Maximum Total Loss	Meets "Proficient" criteria and references a process for evaluating confidence level of Monte Carlo approximation	Derives maximum loss from Monte Carlo approximation of maximum loss distribution	Derives maximum loss from average loss frequency and severity estimates	Does not provide maximum loss estimate	25
Extrapolation	Meets "Proficient" criteria and references a process to reach any confidence level	Describes process to reach 99.9% confidence level	Describes criteria to reach 99.9% confidence level	Does not describe process	25
				Earned Total	**100%**