JOHNS HOPKINS
CAREY BUSINESS SCHOOL

Simulation for Business Applications
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Individual Homework Number 3

Due date: Start of our next week class

Reminder 1: Please make sure your MS Word file shows your work, your graph, and your tables. Please submit your homework report in MS Word format named `FirstName-LastName.docx`. Additionally, you need to submit one separate Excel file for each of 1-a, 2, and 3-b questions. Please name each Excel file `problem-number.xlsx`

Reminder 2: Only clearly typed solutions will be accepted & graded. Any hand-written homework submission will not be accepted/graded. Please avoid including screenshots of Excel tables or graphs. You can easily import tables and graphs from Excel to word.

Late Submission Grading Rule: (0,1] hour delay: 10% deduction of homework grade, (1,2] hours delay: 20% deduction, (2,3] hours delay: 30% deduction, ... (you got the idea)

NOTE: Please make sure that your charts and your report are properly formatted. You will be graded for correctness of your answers along with format of your report and your charts. A tutorial video showing proper formatting of a chart is posted in Blackboard.

Part A: Simulation Application Questions

You need to set number of iterations to 20,000 for all @Risk simulation problems

1. **Read the problem very carefully until the end.** *Flaw of Averages is perhaps the most important reason for using simulation.* This question[1] will walk you through steps to experience flaw of averages yourself. Consider the hypothetical case of a marketing manager who has just been asked by his boss to forecast demand for a new generation microchip.

[1] taken from *The Flaw of Averages* book by Sam Savage

"That's difficult for a new product," responds the marketing manager, "but I am confident that annual demand will be between 50,000 and 150,000 units"

"Give me a number to take to the CEO and the production people," barks the boss. "I cannot tell production people to build a production line with a capacity between 50,000 and 150,000 units!"

The phrase "Give me a number" is a dependable leading indicator of an encounter with the Flaw of Averages, but the marketing manager dutifully replies: "If you need a single number, I suggest you use the average 100,000[2]"

Based on his several years of experience, the boss estimates that the variable production cost of this special microchip is going to be $ 0.10. They can sell this chip for $ 5.1. He puts together a proposal for the CEO including the following table:

Capacity Created	100,000
Average demand	100,000
Projected sold quantity	100,000
Production cost	$0.1× 100,000 = $10,000
Average Revenue	$ 5.1 ×100,000 = $510,000
Projected (average) Profit	$510,000-$10,000 = $500,000

Your responsibility in this question: Please build a Monte Carlo simulation model to test if average profit is indeed going to be $ 500,000. Your model is going to assume uncertain demand with proper shape and parameters. Once you build your model and run it for at least 20,000 iterations, answer the following questions:

(a) What is the average profit in your model? How is it different that the average profit suggested in the above table ($500,000)?

(b) What is the maximum possible profit observed in your model? How does that compare to the suggested average profit in the above table?

(c) Based on results of your model, can you say that *profit at average demand is equal to average profit*?

Hint: Profit at average demand is what you see in the above table and average profit is the average profit calculated by your simulation model.

[2]This is the average demand assuming demand is uniformally distributed between 50,000 and 150,000

2. *Probability and Expectation Computations using simulation:* On the game show "Who Wants to be a Bazillionaire?" contestants win fabulous prizes for answering silly questions. If the contestant gets the answer correct, then the winnings W are obtained by multiplying the prize (P) with the bonus multiplier (B). That is,

$$W = BP.$$

The prize P is random and uniformly distributed over the interval [$1000, $3000]. The bonus multiplier B has a discrete uniform distribution over the interval $[1, 20]$, so that it can take on the values $\{1, 2, ..., 20\}$ with equal probability.

(a) What is the expected winning?

(b) What is the probability that the winnings will be at least $20,000?

build a simple Monte Carlo simulation model to answer the above two questions. I have not provided any templates for this question; you can answer this question without a template.

3. Based on *Kayson, The EPC Company* mini-case study available in blackboard.

(a) (No need for simulation) What is the minimum and maximum finish time for the project?

(b) Using the available template, build a simulation model with proper input distributions to calculate project duration distribution. Make sure to include project duration distribution in your report.

(c) What is the minimum, average, maximum, and 90th percentile of project duration?

(d) What is the chance that project will finish in 112 weeks?

Background info: The triangular distribution (sometimes known as three-point estimation distribution) is typically used as a subjective description of a situation where there is limited (historical) sample data. In order to characterize this distribution, you need only three "inspired guesses"; minimum, maximum, and most-likely values. As an example, if exact value of an activity time in difficult to determine; based on an expert's opinion, it usually is feasible to "guess" minimum, most-likely, and maximum value for duration of that activity. Based on these expert's guesses, you are able to build a distribution for modeling uncertain duration of that activity. This approach is pretty common in project

management; where duration of activities are often uncertain and difficult to determine, due to limited or no past data.[3]

Part B: Newspaper article

4. Please read the article "*As Forecasts Go, You Can Bet on Monte Carlo*" in the course website. Explain how Monte Carlo simulation helped with emergency management and planning. Your response for this question needs to have:

   - two paragraphs, between 5 to 7 lines each; Times New Roman font, font size: 11
   - 1 inch margins in each side of the page, line spacing: 1.5

[3] There is an example in your week one handout referring to NASA using @Risk for estimating total activity time & cost of manned mission to Mars project