

EM384: Analytical Methods for Engineering Management
AT 23-2
Name:
Section :



Homework Set 8

This assignment is worth 20 points, and is due NLT 1700 the day of Lesson 32. **Late submissions will be penalized 1 point (5% of the assignment) for each 24-hour period late after the due time - with assignments turned in more than 7 days late receiving 0 points.**

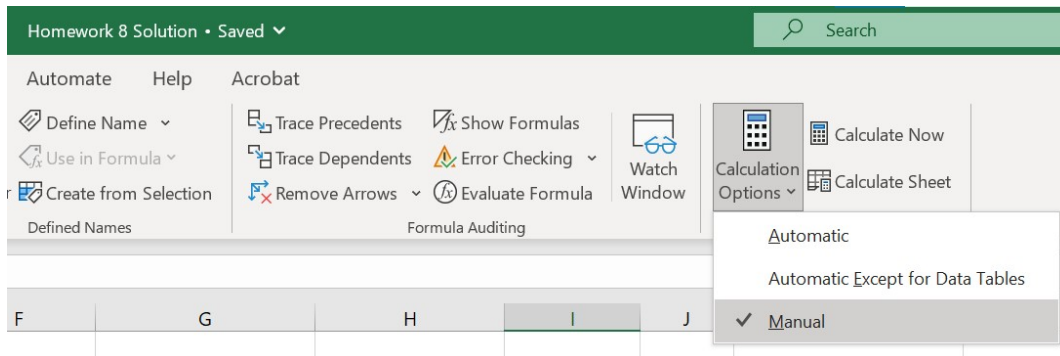
- **Documentation.** This deliverable is an individual assignment. Any assistance received must be documented in detail. Document all sources in accordance with the Office of the Dean Pamphlet "Documentation of Academic Work," (June 2015), Appendix E, and course guidance. e-Acknowledge documentation must be turned in through CIS at the time of submission. The deliverable is considered late until all portions of the assignment and the documentation are submitted.
- **Turn-In Requirement:** You will turn in **two files** to microsoft Teams: **One PDF file** (this assignment with your responses filled in the blanks), and **one Excel file** (extension .xlsx) with your model, with the following naming convention:

Section_LastName_FirstName_EM384_Homework_8

Remember that engineering management is about communicating. You will be graded on the clarity and structure of your work.

- **Acknowledgement Statement:** This assignment must be accompanied by a signed e-Acknowledgement Statement (DAW) to be eligible for graded credit. If you submit your files(s) but fail to sign the e-Acknowledgement Statement, your assignment will be considered late until the e-Acknowledgement Statement is signed.
- **Guidelines for Documenting Assistance:** For this assignment, individual work is highly encouraged, but collaboration between individuals is allowed. **ALL collaboration must be documented.** Any discussion of this problem set with anyone other than an EM384 instructor requires documentation. Documentation must be specific and detail the topics discussed and actions taken.
- You must be very specific (which problem, what assistance, etc.) when explaining any assistance used in your documentation or you will be deducted at a higher penalty. Assistance *may* result in a deduction of points in accordance with a holistic assessment by your instructor.
- Sharing of electronic files via email or any other electronic means is **strongly discouraged**. **Using, copying, or being dictated someone else's work will result in a greater point deduction.**

Before turning in your Excel file, **lock your random variables** by navigating to **Formulas, Calculation Options**, and select **Manual**. On your PDF submission, report the answers **only after completing all problems and once you have locked your excel formulas**. This ensures that your random variables do not regenerate and freezes the last version of your simulations in place.



1. **Snow Cone Heaven (10 Points)** You are the proud owner of Mr Cookie's Snow Cone Delights LLC, which serves frosty treats on hot summer days. A blue snow cone sells for \$2.10, an orange snow sells for \$2.50, a green snow cone sells for \$2.65, and the red snow cone (prized by children), sells for \$3.00. You want to estimate your future revenue stream based on some assumptions about customers, namely:

- When a customer arrives, they order at random a blue, orange, green or red snow cone, with each alternative equally likely.
 - Customers who order one snow cone also order a second snow cone with probability $p_1 = 0.3$. The color of the snow cone is randomly selected with all alternatives equally likely.
 - Customers who order a second snow cone are so satisfied that they order a third snow cone after a few minutes with probability $p_2 = 0.5$. The color of the snow cone is randomly selected, with all alternatives equally likely.
 - Customers always tip on the second snow cone only, and their tip is modeled as the continuous random variable $X \sim \text{Uniform}(0, 1)$.
- (a) In an Excel sheet named *Snow Cone*, Simulate 1000 customers arriving at Mr Cookie's Snow Cone Delights LLC and record the revenue from each customer.
 - (b) Create a histogram of the results of your simulation. Format your horizontal axis tick marks to 'number', and 1 decimal place. Change the number of bins to 50, and create a title for your histogram.
 - (c) Based on your simulation results, what is the expected revenue from a customer chosen at random? Ensure your answer is also calculated in your Excel model.

Your answer:

- (d) Based on your simulation results, what is the expected number of snow cones purchased by a customer chosen at random? Ensure your answer is also calculated in your Excel model.

Your answer:

2. **A Dueling Problem (5 Points)**. Duels in the town of Worcestershire rarely lead to fatalities. On the appointed day, each dueler arrives sometime chosen at random uniformly between 5am and 7am, and departs exactly 10 minutes after they arrive, honor served, unless their opponent arrives during the same time interval, in which case they fight.

In an Excel Sheet named *Dueling Town*, create a Monte Carlo simulation to **determine the probability that a duel leads to violence**. Simulate at least 10,000 iterations, and report your answer below.

Number of iterations you simulated:

Your answer:

3. **ATM Time (5 Points)**. As the branch manager for Crypto Moon Bank in Las Vegas, you have noticed that customers don't want to wait in line to use your ATM. You decide to have your analyst collect some data and model the interarrival times of customers as an Exponential random variable by observing their behavior.

This is what your analyst reports:

Customers arrive at the ATM every P minutes, where P is an exponential random variable with mean 3 minutes. If they see another customer at the ATM then they leave without withdrawing money. Otherwise, they spend exactly 2 minutes at the ATM, and then leave. This behavior occurs continuously, day and night, regardless of the time of day.

In an Excel sheet named *ATM Time*, create a Monte Carlo simulation to **determine the fraction of customers that leave without withdrawing money**. Simulate at least 10,000 customers arriving in a row. Report your answer below.

Number of iterations you simulated:

Your answer: