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

Homework Set 9

This assignment is worth 20 points, and is due NLT 1700 the day of Lesson 35. 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 **one file** to microsoft Teams: **a Python file** (extension .py), with the following naming convention:

  Section_LastName_FirstName_EM384_Homework_9.py

  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.

Additional Instructions:

Copy the starter code contained in *Homework_9_starter_code.txt* into a new Python file, as a starting point for your homework. Libraries for use in this assignment have been imported at the beginning of the script. You may also import additional libraries at your discretion. We have defined two functions for you to use to create plots. You may also write your own code to create plots.

Recall that to print the value of a variable to the console with some explanatory text, for example x, you can use the print command as follows:

```
print('I am printing',x)
```

1. **Bus depot.** Buses arrive at a bus terminal at a rate $\lambda = 3$ buses per hour, on average.

   (a) **(2 Point)** Using a Poisson distribution, simulate (10,000 times) the number of buses that arrive at the bus terminal over the course of a 10 hour day. This should be saved as a list and available to see in the variable explorer.

   (b) **(1 Point)** Find the mean number of arrivals based on your simulation and **print your answer in the console**.

   (c) **(1 Point)** Create a histogram of your results. This should display in the 'Plots' tab of Spyder.

   (d) **(1 Point)** Create an ECDF plot of the arrival data you simulated. This should display in the 'Plots' tab of Spyder.

   (e) **(2 Points)** In Python, using your simulation results, find the probability that 25 buses or less arrive at the terminal. **Print your answer in the console**.

   (f) **(2 Points)** In Python, using your simulation results, find the probability that exactly 22 buses arrive at the terminal. **Print your answer in the console**.

2. **Mr Cookie's brownies.** Mr Cookie has decided to expand into the brownie business. He figures that he can increase his revenue based on the customers he already has. Mr Cookie will buy cookies and Brownies at wholesale and resell them at retail.

   (a) **(8 Points)** Create a profit model in Python for Mr Cookie's business. Use the table below for the deterministic and stochastic parameters that should go in your model. Simulate 10,000 days for Mr cookie's business, and **print the average profit in the console**.

Brownie Demand	Discrete Uniform between 200 and 250
Cookie Demand	Discrete Uniform between 550 and 650
Brownies bought wholesale	Continuous Uniform between 220 and 240
Cookies bought wholesale	Continuous Uniform between 580 and 650
Brownie wholesale Cost	Normal with $\mu = \$1.50$ and $\sigma = \$0.20$
Cookie wholesale Cost	Normal with $\mu = \$0.40$ and $\sigma = \$0.03$
Brownie retail price	\$2.50
Cookie retail price	\$1.00
Daily fixed cost	\$250

   (b) **(1 Point)** Create a histogram of the daily profit from your simulation result. This should display in the 'Plots' tab of Spyder.

   (c) **(2 Points)** Based on your simulation, what is the probability that Mr cookie makes more than \$250 profit in a day? **Print your answer in the console**.