ORIE 3120: Industrial Data and Systems Analysis
Spring 2020
Homework #4
Due Date: 2/28/2020 (Friday) 2:30pm

Upload 1 file to gradescope: A pdf containing the answers to all questions and screenshots of the .xls or .xlsx file containing the spreadsheet created in question 4.

Question 1 (25 points). The Ithaca Science Center is ordering t-shirts to sell in their souvenir shop. Each t-shirt costs the Science Center $7.00 to purchase. The holding cost per t-shirt is due solely to lost interest, and is $2.00 per year. Each order costs $50 to process and ship. Demand for the t-shirts is constant over time, and is 350 per year. Each t-shirt sells for $12.99 each. The lead time is 3 weeks.

a) Find the optimal number of t-shirts that the Science Center should order in each batch.

b) Find the inventory level that would trigger a replenishment order.

c) Find the average inventory level under the optimal order quantity.

d) What is the smallest price that the Science Center can charge for their t-shirts and not lose money? Assume that they operate their system using the optimal order quantity from (a).

e) Suppose that the supplier requires t-shirts to be ordered in multiples of 10 shirts. What is the optimal order quantity that meets this requirement?

Question 2 (25 points)
In the analysis of EOQ in class, we assumed that the cost of placing an order for x units was $c(x) = K + cx$. What is the optimal order quantity if the cost is $c(x) = K + dx^2$?

Question 3 (25 points)
In the analysis of EOQ in class, we assumed that the cost per unit time for holding x units was hx. What is the optimal order quantity if the cost per unit time for holding x units is hx^2?

Question 4 (25 points)
Create an Excel spreadsheet that implements the algorithm on slide 37 Lecture 8 (the bisection algorithm). Given this mean m, and a number q strictly between 0 and 1, this spreadsheet should find an integer Q* such that P(D<=Q*) >= q and P(D<=Q*-1) < q.

Assume that D has the Poisson distribution. The Poisson distribution is a discrete probability distribution often used for modeling demand. The probability mass function for a Poisson with mean m is $P(D=k) = m^k \exp(-m) / m!$, for k = 0, 1, 2, … The cumulative distribution function for D can be computed using Excel's POISSON.DIST function. Take a moment to read about

POISSON.DIST in [Excel's online help]() to see how it works. For example, to compute P(D <= 13) when D has a mean of 10, use POISSON.DIST(13,10,TRUE).

Here is a screenshot of what your completed spreadsheet will look like, run using q=0.5 and a Poisson distribution with mean 10.

	A	B	C	D	E
1	10	<- Mean of Poisson			
2	0.5	<- q			
3					
4	L	U	Q	P(D<=Q)	Done?
5	0	100	50	1	No
6	0	50	25	0.99998232	No
7	0	25	13	0.86446442	No
8	0	13	7	0.22022065	No
9	7	13	10	0.58303975	No
10	7	10	9	0.45792971	No
11	9	10	10	0.58303975	Yes
12	9	10	10	0.58303975	Yes
13	9	10	10	0.58303975	Yes
14	9	10	10	0.58303975	Yes
15	9	10	10	0.58303975	Yes
16	9	10	10	0.58303975	Yes
17	9	10	10	0.58303975	Yes
18	9	10	10	0.58303975	Yes
19	9	10	10	0.58303975	Yes

This solution uses these Excel functions, which you can read about in the Excel help or online:

- POISSON.DIST
- ROUND
- IF

It starts with initial values for L and U in row 4 (the value of U must be chosen large enough that P(D<=Q) is above q), and with the mean of the Poisson and q in rows 1 and 2. In each row, columns C, D, and E are computed from the values to their left, and columns A and B are computed from values above. When the spreadsheet has "Yes" in the Done column, the solution is found in the U column.

Use your spreadsheet to find Q* for a Poisson distribution with mean 10 for q=0.7. include a screenshot of your spreadsheet along with your calculated value for Q* in your pdf submission.