

OPRE 6302 Sample Final ¹

I understand that

- This is a closed books/notes exam but I can use a calculator.
- A cheat sheet including complex formulas is provided so I will NOT bring my own.
- I will choose the most appropriate answer for the questions. I will NOT get any credit by marking multiple choices for a single question. When changing my answers, I will erase the paper properly.
- I will NOT forget to define any variables I introduce.
- I will NOT use laptops, cellular phones, any cellular communication device, and I will turn off all these devices before starting my exam.
- My conduct during the exam will reside entirely within the limits of the UTD regulations governing scholastic honesty -detailed in the handbook of operating procedures Title V Chapter 49.

NAME (please print): _____

Question	Out of	Points
1		
2		
3		
Total	100	

Q1. Put **T** before a statement if you think that statement is true. Otherwise put **X**.

1. () In service industries (such as education) products (such as final exams) can be nonstandard; that is, their quality (difficulty) can vary over time. T
2. () The rental price of a room becomes the cost of overage when finding the optimal overbooking limit. X, rental price is the cost of underage when overbooking
3. () Basestock is just another name for order-up-to level. T

¹This is a sample as such it only indicates the type of the questions but not the number of questions

Q2: Choose the most appropriate answer and mark your answer on this paper.

1. The difference(s) between the Newsvendor model and the Order up-to model is/are
- a. In the newsvendor model the inventory gets obsolete after one period
 - b. The number of replenishments in the Order up to model are unlimited
 - c. Only a
 - d. Only b
 - e. Both a and b

E

2. Instock probability is the
- a. percentage of the demand met with the on-hand inventory
 - b. percentage of the orders met with the on-hand inventory
 - c. probability of meeting the demand with on-hand inventory
 - d. probability of meeting the demand with inventory position
 - e. percentage of the demand met with the inventory position

C

3. Expected shortage per season
- a. is the on-hand inventory minus the expected demand
 - b. decreases as the demand increases
 - c. is nonzero only when the expected demand is more than on-hand inventory
 - d. can be negative
 - e. none of the above

E

4. The EOQ model is most relevant for which one of the following?
- ordering items with nonstationary demand
 - determination of safety stock
 - ordering perishable items
 - ordering when the demand is constant
 - ordering multiple types of items at once to save on fixed ordering costs

D

5. Which of the following is true regarding the R-chart and the \bar{X} chart?
- a. Both the \bar{X} chart and the R-chart detect changes in variability
 - b. Both the \bar{X} chart and the R-chart detect changes in mean
 - c. The \bar{X} chart detects changes in the mean, while the R-chart detects changes in variability
 - d. The R-chart detects changes in the mean, while the \bar{X} chart detects changes in variability
 - e. Both the \bar{X} chart and the R-chart detect both the changes in variability and in mean

C

6. Where/when would it be the worst to discover a defect?

- a. Before the bottleneck
- b. After the bottleneck
- c. After the sales
- d. After a painting operation
- e. When the raw materials are received

C

7. Which of the following is a measure of customer service?

- a. The fixed cost of ordering
- b. In-stock probability
- c. Expected leftover sales
- d. Number of times an order is placed in a year
- e. None of the above

B

8. Which one of the following quantities cannot be altered by the Newsvendor order quantity?

- a. Expected Lost Sales
- b. Expected Profit
- c. Expected Demand
- d. Expected Fill Rate
- e. Expected Leftover Inventory

C

An air cargo company must decide how to sell its capacity. It could sell a portion of its capacity with long-term contracts. A long-term contract specifies that the buyer will purchase a certain amount of cargo space at a certain price. The long-term contract rate is currently \$1,500 per standard unit of space. If long-term contracts are not signed, then the company can sell its space on the spot market. The spot market price is volatile, but the expected future price is around \$2,000. In addition, spot market demand is volatile: sometimes the company can find customers, other times it cannot on a short-term basis. Let us consider a specific flight on a specific date. The company's capacity is 70 units. The company expects that the spot market demand is normally distributed with mean 65 and standard deviation 10. On average it costs the company \$1000 in fuel, handling and maintenance to fly a cargo unit.

a. Suppose the company relied exclusively on the spot market, that is, it signed no long term contracts. What would be the company's expected profits?

ANSWER: Company makes $2000 - 1000 = 1000$ for each unit carried. The expected number of sales is expected demand 65 minus the expected shortages. For expected shortages, $z = (70 - 65)/10 = 0.5$ and $L(z = 0.5) = 0.2$. The expected shortage is $10 * 0.2 = 2$. So expected sales is $65 - 2 = 63$. The profit is \$63 K.

b. Suppose the company relied exclusively on long term contracts. What would be the company's expected profits?

ANSWER: Assuming that all the capacity can be sold on a long term contract, the profit is $500 * 70 = 35$ K.

c. If the company uses a booking limit of 10 for the long term contracts, what is the probability of meeting the spot market demand?

ANSWER: Since 60 units is protected for the spot market, we want $Prob(N(65, 10^2) \leq 60) = Prob(z \leq -0.5) = Prob(z \geq 0.5) = 1 - Prob(z \leq 0.5) = 1 - 0.69 = 0.31$.

PromptAir collects the data for the tardiness of the departures of their scheduled flights. A flight is called tardy if it departs 10 minutes after its scheduled departure time. The data are collected only for tardy flights. For a tardy flight, the amount of tardiness is the number of minutes by which the flight departs after its scheduled departure time. By the definition of tardy, all the tardiness amounts in the collected data set are more than 10 minutes. PromptAir uses \bar{x} -bar control charts with $UCL=34$, $LCL=22$ with a sample size of 10 flights. When the sample size is 10, $A_2 = 0.3$, $D_3 = 0.2$, $D_4 = 1.8$ and $d_2 = 3.1$.

a) What is the average of sample mean tardiness (of the samples of size 10)?

ANSWER: Average of sample means $= (34+22)/2 = 28$ minutes.

b) Suppose that the PromptAir is using the tabulated values of A_2 , D_3 , D_4 and d_2 while making the control charts. What is the average range \bar{R} for the tardiness data?

ANSWER: $A_2\bar{R} = UCL - \text{Average of Sample Means}$ so $\bar{R} = (34 - 28)/0.3 = 20$ minutes.

c) After gathering enough data, PromptAir fits a distribution to the tardiness data to find out that the tardiness of the sample means has a sampling distribution which is normal with $\mu = 30$ and $\sigma = 10$. What is α =Type I probability with control limits $UCL=34$ and $LCL=22$? Use normdist function in your answer.

ANSWER: Type I probability $= \text{Prob}(\text{seems out of control when actually in control}) = \text{Normdist}(22,30,10,1) + (1 - \text{Normdist}(34,30,10,1))$.

[Local Warming] Since Global Warming is a hot topic and itself is becoming warmer, a group of OM students wanted to check if temperatures are rising locally in Dallas. They have downloaded a temperature data file TXDALLAS.txt from www.engr.udayton.edu/weather/citylistUS.htm. The table below is obtained from the Dallas temperature file. It lists daily temperatures on the 1st, 6th, 11th, 16th, 21st, 26th, 31st of every August since 2001.

	Day of August							Row sum	Row Average
	1	6	11	16	21	26	31		
2001	89.0	88.9	87.2	83.7	87.1	83.8	73.9	593.6	84.8
2002	87.3	87.4	79.7	80.9	87.7	82.5	82.0	587.5	83.9
2003	89.7	93.7	85.8	87.3	89.0	83.2	78.1	598.1	85.4
2004	85.8	82.6	82.6	78.3	75.7	87.0	78.4	570.4	81.5
2005	87.4	82.7	83.3	79.8	87.9	89.7	84.0	594.8	85.0
2006	89.7	91.6	92.2	92.8	92.8	92.1	83.3	634.5	90.6
2007	80.0	78.7	85.9	86.4	80.7	82.3	84.6	578.6	82.7
Column sum	603.3	593.6	595.9	586.7	601.9	604.9	571.2	4157.5	593.9
Column Average	86.2	84.8	85.1	83.8	85.9	86.4	81.6	593.9	84.8

a) To study local warming over time, shall we make samples by rows or by columns in the table above? Explain.

ANSWER: Samples are in the rows. Data in columns overlap so it cannot be used to study changes over time.

b) By using the sample range of the temperature data and the appropriate value of d_2 for 99.74% confidence, find the standard deviation of the sample means.

ANSWER: Sample ranges for years 2001, ..., 2007 are 15.1, 8, 8.3, 11.3, 9.9, 9.5, 7.7 and the average is $\bar{R} = 10$. Since the sample size is 7, $d_2 = 2.7$. Then $\sigma_{\bar{X}} = 10/2.7 = 3.7$.

c) Suppose that $\sigma_{\bar{X}} = 2$, find UCL and LCL for an X-bar chart to see if average August temperatures are in control with $z = 3$ (i.e., $\alpha=0.26\%$). Do you detect local warming in Dallas?

ANSWER:

$$\text{UCL} = \text{Average of Sample Means} + z \cdot \text{StDev of Sample Means} = 84.8 + 3 \cdot 2 = 90.8$$

$$\text{LCL} = \text{Average of Sample Means} - z \cdot \text{StDev of Sample Means} = 84.8 - 3 \cdot 2 = 78.8$$

Since all the sample average temperatures belong to (78.8, 90.8), we fail to detect local warming in Dallas if $\alpha=0.26\%$.

d) Type I error probability in c) is 0.26%, which is the probability of saying that there is local warming (i.e., the temperature is out of control) when indeed there is no local warming (i.e., the temperature is in control). Since the consequences of ignoring local warming is huge when it does exist – with respect to the consequences of Type I error, we can afford to make a higher type I error. Repeat part c) with a type I error of 5% which corresponds to $z = 2$.

ANSWER:

$$\text{UCL} = \text{Average of Sample Means} + 2 \cdot \text{StDev of Sample Means} = 84.8 + 2 \cdot 2 = 88.8$$

$$\text{LCL} = \text{Average of Sample Means} - 2 \cdot \text{StDev of Sample Means} = 84.8 - 2 \cdot 2 = 80.8$$

Since all the sample average temperatures are larger than 80.8, there is no local cooling. The August average of 90.6 in 2006 is above the upper control limit 88.8, we detect local warming in Dallas if $\alpha=5\%$.

[Local Newsstand] On consecutive Saturdays, Jim, the owner of a local newsstand, purchases a number of copies of Time magazine. He pays \$1 for each copy and sells each for \$3. Jim has kept a careful records of the demand for the journal to conclude that the weekly demand has mean 12 and standard deviation 4, and can be approximated by a normal distribution.

a) What are C_o and C_u ?

ANSWER: $C_o = 1$ and $C_u = 2$.

b) What is the optimal number of Time to purchase to minimize the total expected underage and overage costs?

ANSWER: Critical ratio is $2/3=0.66$. From the normal table in the formula sheet $z = 0.4$. Thus, $Q = 12+0.4*4 = 13.6$.

c) What is the expected weekly shortage of the Time magazines if 14 magazines are ordered every Saturday?

ANSWER: The corresponding $z = (14-12)/4 = 0.5$. $L(z) = 0.2$. The expected shortage is $\sigma*L(z) = 4*0.2 = 0.8$.

d) What are expected sales and expected left over inventory with an order of 14 magazines?

ANSWER: Expected sales= μ -expected lost sales= $12-0.8=11.2$ Expected left over inventory= $14-11.2=2.8$.

e) What are the expected total underage cost and the expected total overage costs with 14 magazines?

ANSWER: Expected total underage cost= C_u *Expected shortage= $2*0.8=1.6$.

Expected total overage cost= C_o *Expected leftover inventory= $1*2.8=2.8$.