IEDA 2010 Introduction of Industrial Engineering and Decision Analytics

Sample Midterm Examination

Time Allowed:2 hours

Name: _____

Student ID: _____

Signature: _____

Part I (20%): MC questions. Choose the most suitable answer and write down your answer in the table provided at the end of this part.

1. The two general approaches to forecasting are:
A) mathematical and statistical
B) qualitative and quantitative
C) judgmental and qualitative
D) historical and associative
E) precise and approximation

2. The forecasting method which uses anonymous questionnaires to achieve a consensus forecast is:
A) sales force opinions
B) consumer surveys
C) the Delphi method
D) time series analysis
E) executive opinions

3. Accuracy in forecasting can be measured by:
A) MSE
B) MRP
C) MAPE
D) MTM
E) A & C

4. Given forecast errors of 4, 8, and -3, what is the mean absolute deviation?
A) 4
B) 3
C) 5
D) 6
E) 12

5. Revenue management is concerned with:
A) a process designed to determine the best use of funds generated through sales
B) the use of marketing tools to increase revenue
C) the use of pricing to increase the profit generated from a limited supply of supply chain assets
D) the use of accounting tools to monitor cash flow
E) the appropriate use of operational tools to improve operational efficiency with a view to increase revenue

6. Which of the following smoothing constants would make an exponential smoothing forecast equivalent to a naive forecast?
A) 0
B) .01
C) .1
D) .5
E) 1.0

7. Which of these products would be most apt to involve the use of a newsvendor model?
A) gold coins
B) hammers
C) fresh fish
D) calculators
E) frozen corn

8. Which of the following is not a cause of the bullwhip effect?
A) Aligning incentives across the supply chain
B) Order batching
C) Long lead time
D) Inflated orders placed by the retailers
E) Price fluctuations

9. The term Bullwhip Effect is most closely related to:
A) Assertive customers
B) Demand variations
C) Inventory turnover
D) Return of inventory
E) Inventory security

10. In the quantity discount model, with carrying cost stated as a percentage of unit purchase price, in order for the EOQ of the lowest curve to be optimum, it must:
A) have the lowest total cost
B) be in a feasible range
C) be to the left of the price-break quantity for that price
D) have the largest quantity compared to other EOQ's
E) none of the above

Answer of Part I

1)		**6)**	
2)		**7)**	
3)		**8)**	
4)		**9)**	
5)		**10)**	

Part II (80%): Please answer all questions and write down your answers in the provided spaces.

1. A plastics manufacturer uses a certain chemical at a rate of 20 barrels per week. The cost incurred each time an order is placed is $1000. Each barrel costs $500, and the holding (or carrying) cost is 30% of the material cost (i.e., cost per barrel) per year. Assume there are 50 working weeks in a year.

   a) What is the optimal order quantity?
   b) The supplier offers a 3% discount on the price of the chemical (i.e., the price will be $485 per barrel) if the manufacturer orders 300 barrels or more each time. Should the manufacturer change its order quantity? If so, what is the new order quantity? Please support your answer with quantitative analysis (compute cost numbers for each scenario).

2. A restaurant is considering implementing overbooking due to customer no-shows. The restaurant has 100 seats. The forecast of the number of no-shows is as follows.

Number of no-shows	Probability
0	5%
1	5%
2	5%
3	10%
4	15%
5	20%
6	15%
7	10%
8	5%
9	5%
10	5%

When making a reservation, each customer has to prepay $120 to the restaurant. If the customers do not show up finally, the restaurant will not return the $120 prepaid expense. If the customers show up but cannot get any seat after reservation, the restaurant has to return the $120 prepaid expense and give a coupon to each of these customers. Each coupon costs the restaurant $80. Assume each customer will make one reservation and occupy one seat. The demand of making reservation is very large such that you can assume it is infinite.

a) What is the optimal overbooking limit (i.e., the maximum reservations above the available 100 seats) that the restaurant should accept?
b) If the restaurant accepts 106 reservations, what is the expected total cost incurred due to bumped customers?

3. You have been given the most recent 20 quarters (t) of data on the sales (x) of brand A phones as the following table. You decide to use the multiplicative Holt-Winter method to forecast future sales. Your initial estimates of alpha, beta, and gamma are 0.2, 0.3, and 0.2. However, you lose some data by coincidence.

	Year				
Quarter	1	2	3	4	5
1	151	165		240	
2	228	223	336	383	471
3		269			
4	433				

a) Luckily, you have processed the data and recorded that $\sum_{t=1}^{20}(t)$=210, $\sum_{t=1}^{20}(t^2)$=2870, $\sum_{t=1}^{20}(x_t)$ =8060, $\sum_{t=1}^{20}(x_t t)$ =101315, $\sum_{t=1}^{20}(x_t^2) = 4261270$. Assume $x = S_0 + G_0 t$, what is your estimate of S_0 and G_0?

b) What is your estimate of $\bar{T}_{[2]}$?

c) Assume that your calculated average seasonal values are as follows: $\bar{T}_{[1]} = 0.6489, \bar{T}_{[2]} = as\ calculated\ above,\ \bar{T}_{[3]} = 0.9180, \bar{T}_{[4]} = 1.5997$, Calculate forecast for quarters 1-3.

(Keep four decimal places for all results)

4. Consider a supply chain consisting of a manufacturer and a distributor. Suppose the manufacturer is make-to-stock, namely the timing of events is as follows:
   - The distributor provides demand forecast to the manufacturer.
   - The manufacturer produces a certain amount of products based on the forecast.
   - The distributor observes demand.
   - The distributor orders from the manufacturer.

   Suppose the distributor has the following demand forecast:

Quantity	2,000	2,100	2,200	2,300	2,400	2,500	2,600	2,700
Probability	3%	8%	15%	24%	17%	18%	10%	5%

   Suppose that the manufacturer produces at a cost of $20/unit and sells to the distributor at $35/unit, and any unsold units are sold for $5/unit after the season. The distributor sells to end customers for $50/unit during the season.

   a）Consider a pay-back contract as follows. The distributor agrees to pay $5 for each unit produced by the manufacturer but not purchased by the distributor. What is the total expected profit for both parties under the contract?

   b）Is it possible to design a better contract that both parties can benefit from?

   c）Suppose that the distributor is planning to provide the following inflated demand forecast to the manufacturer:

Quantity	2,200	2,300	2,400	2,500	2,600	2,700	2,800	2,900
Probability	5%	6%	10%	17%	30%	17%	12%	3%

   If you are the distributor and you have choice of revealing the true demand forecast or the inflated one to the manufacturer, what would you do? Give detailed analysis.