AMERICAN UNIVERSITY OF BEIRUT

SULIMAN OLAYAN SCHOOL OF BUSINESS

DCSN 200: OPERATIONS MANAGEMENT

FINAL EXAM

January 27, 2010

8:00 AM – 10:00 AM

NAME _____

STUDENT ID _____

SECTION _____

INSTRUCTOR _____

This exam is administered in full observance of the Olayan School of Business Honor Code and the penalties it sets for violations of the standard of academic conduct. You are required to fully understand the code and to strongly adhere to it. In particular, cellular telephones, and computers of any shape or size are not allowed. No questions, no comments, no borrowing and no disturbance of the peace of any kind will be permitted or tolerated. You are required to stop working on the exam and hand it immediately when a proctor instructs you to do so. Any cheating or attempted cheating will subject the offender to a zero on the exam and a referral to the Student Affairs Committee for further penalties.

- You have 2 hours to complete the exam. You can answer questions in any order.
- Your understanding of the questions is part of the exam. No questions will be answered by instructors. If in doubt, write your assumptions and continue solving.
- Do not start the exam (do not turn to the next page) until instructed to do so.
- When you start the exam, make sure that your exam paper has 10 pages.

- "I vow to complete the exam on my own without giving or receiving help from anyone and to adhere to the academic integrity standards reflected in the AUB student code of conduct"

SIGNATURE _____

PART I. MULTIPLE CHOICE QUESTIONS (24 points, 2 point per question)

CIRCLE THE MOST APPROPRIATE ANSWER

1. A firm is seeking a new factory location, and is considering several countries worldwide. In some of these countries, child labor is prevalent; in others, working conditions and worker safety are inferior to conditions in the U.S. An operations manager paying attention to _____will factor these issues into the location decision.
   a. ethical and social responsibility issues
   b. critical success factors
   c. factor rating systems
   d. geographic information systems
   e. regression models

2. In a repetitive-process layout, the process of deciding how to assign tasks to workstations is referred to as
   a. station balancing
   b. process balancing
   c. task allocation
   d. line balancing
   e. work allocation

3. Daily capacity of a repetitive-process layout is determined by
   a. operating time divided by cycle time
   b. cycle time divided by operating time
   c. operating time divided by total task time
   d. total task time divided by cycle time
   e. cycle time divided by total task time

4. The central problem in repetitive-process layout planning is
   a. minimizing material handling within workstations
   b. minimizing labor movement between workstations
   c. equalizing the space allocated to the different workstations
   d. maximizing equipment utilization
   e. minimizing the imbalance in the work loads among workstations

5. Improvements in quality help firms increase sales, but always increase total cost.
   a. True
   b. False

6. Quality circle helps involve employees in solving quality-related issues.
   a. True
   b. False

7. Control charts indicate if the process under control produces items within specification limits.
   a. True
   b. False

8. Quality robustness is the ability to produce products uniformly in adverse manufacturing and environmental conditions.
   a. True
   b. False

9. The types of costs of quality do **not** include:
   a. Prediction costs
   b. Appraisal costs
   c. Internal failure costs
   d. External costs

10. Which control chart(s) should be used to control the percentage of defective parts, if a sample of 100 units is selected out of 20,000 units produced daily?
   a. $\bar{x}$-chart
   b. $\bar{x}$-chart and *R*-chart
   c. *p*-chart
   d. *c*-chart

11. An increase in demand uncertainty
   a. Should imply an increase in the safety stock
   b. Does not affect the reordering point but the quantity ordered
   c. Implies an increase in the z-value affecting the reordering point
   d. Implies a decrease in the z-value affecting the reordering point

12. "Yield management" is best described as
   a. a situation where management yields to labor demands
   b. a situation where the labor union yields to management demands
   c. a process designed to increase the rate of output
   d. capacity allocation to different classes of customers in order to maximize profits

PART II

Write your answers in the spaces provided. Be concise and follow the instructions closely. If you run out of space, continue on the back of the previous page, but indicate this fact clearly.

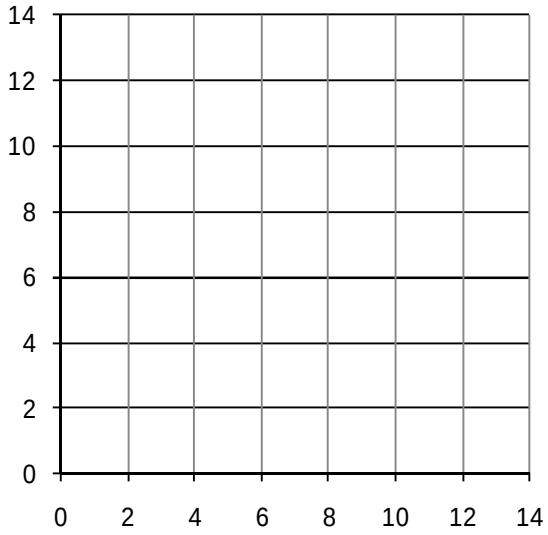
Question 1 (8 points)

A telecommunications firm is planning to lay fiber optic cable from several community college distance learning sites to a central studio, in such a way that the miles of cable are minimized. Some locations require more than one set of cables (these are the loads).

College	Map Coordinate (x, y)	Load
A	(2,12)	3
B	(6,8)	1
C	(4,3)	4

1. Calculate the location of the studio that will accomplish the objective. (6 points)

2. Indicate locations of all colleges and the studio on the following chart. (2 points)



Question 2 (14 points)

You have been asked to balance an assembly operation to achieve an output rate of 80 units per eight-hour day. Task times and precedence relationships are shown in the table.

Task	Predecessor(s)	Duration (minutes)
A	–	1.4
B	–	0.8
C	A, B	0.4
D	–	1.8
E	–	0.4
F	C	2.1
G	E, F	2.0
H	D, G	1.2

1. Draw the precedence diagram. (4 points)

2. Determine the desired cycle time. (2 points)

3. Determine the theoretical minimum number of stations needed. (2 points)

4. Assign tasks to stations in a forward manner using most following tasks priority rule. Write clearly in which order tasks are selected by the priority rule and which tasks are assigned to which station. (4 points)

5. Calculate the efficiency of the line obtained in part 4 assuming the cycle time obtained in part 2. (2 points)

Question 3 (14 points)

A company wants to control the number of complaints submitted every week in a large hospital. Every week, the number of complaints will be recorded and the control chart will be updated. The following 5 samples have been collected when the system was in control.

Week	1	2	3	4	5
Number of complaints	3	4	2	0	2

1. Calculate the upper and lower control limits for the control chart(s) using the above 5 samples. Draw the control chart(s) and indicate the 5 samples. (10 points)

2. Place on the chart(s) created in part 1 the points corresponding to the following 5 additional samples. (2 points)

Week	11	12	13	14	15
Number of complaints	3	5	4	3	5

3. Considering the 5 samples added in part 2, is the process still in control? Justify your answer briefly. (2 points)

Question 4 (22 points)

A retailer is considering inventory management of one of its products with the annual demand of 600 units (1 year = 50 weeks). The product is delivered directly from the manufacturer who guarantees that every order is delivered in 2 weeks. The retailer pays the manufacturer $150 per unit. Additionally, every time the manufacturer fills an order from the retailer, machine setup cost of $60 is charged on the retailer. Transportation from the manufacturer costs the retailer $40 per shipment (regardless of the number of units). Retailer pays warehouse charges of $5 per unit per year. Additionally, the retailer knows that every dollar that is not spent on items held in the warehouse will be invested in an endeavor which is expected to return around 20% per year.

1. Calculate the overall annual holding cost per unit and the overall cost per order paid by the retailer. (4 points)

2. If weekly demand is assumed to be constant, calculate the optimal quantity that the retailer should order each time. (2 points)

3. Calculate the total cost of the retailer in one year. (4 points)

4. How many times per year will the product be ordered? (2 points)

5. What will be the time duration between two orders? Express it in weeks. (2 points)

6. Calculate the reorder point assuming that the weekly demand and the lead time are constant. (2 points)

7. The retailer would like to order once per month (i.e., 12 times per year). What should be the cost of shipment for such policy to become optimal? (6 points)

Question 5 (10 points)

Two retailers are considering inventory management of one of the products they are both selling. Each of them has an average demand of 12 units per week with a standard deviation of 2 units per week. The supply lead time is constant and equal to 2 weeks.

1. How much safety stock should each retailer keep to achieve a service level of 95% (z = 1.64)? (4 points)

Imagine now that those two retailers are going to be combined into one integrated retailer, which will be facing the combined demand of the previous two retailers.

2. What is the average and the standard deviation of the integrated weekly demand? (2 points)

3. How much safety stock should the integrated retailer keep to achieve the same service level of 95% (z = 1.64)? (2 points)

4. What is the impact of integration on the total safety stock level? What if 30 stores where integrated? (Hint: Compare the safety stock of the integrated retailer with the combined safety stocks of the two previous retailers and conclude.) (2 points)

Question 6 (8 points)

A machine needs to be purchased to cut metal bars into pieces of varying target lengths. The typical specification calls for cutting pieces with a tolerance of ±4mm, e.g. if the target length is 500mm, then all cut pieces with length between 496mm and 504mm are acceptable. Three machines, A, B, and C, are being considered. All are able to achieve average length equal to any given target length (i.e. average length will be centered between specification limits). Machine A costs $1,000 and can cut parts with a standard deviation of 1.5mm. Machine B costs $1,200 and has standard deviation of 1mm. Machine C costs $2,000 and has standard deviation of 0.4mm.

1. Which machine would you recommend? Justify your answer briefly. (6 points)

2. Which machine would you recommend if a company were interested in implementing a Six Sigma program? Justify your answer briefly. (2 points)

Formula Sheet

Upper and lower control limits: $\bar{X} \pm z\frac{\sigma}{\sqrt{n}}$ $\bar{X} \pm A_2\bar{R}$ $D_3\bar{R}$ $D_4\bar{R}$

$$\bar{p} \pm z\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

$$\bar{c} \pm z\sqrt{\bar{c}}$$

$$Cp = \frac{\text{Upper Specification - Lower Specification}}{6\sigma}$$

$$Cpk = \min\left\{\frac{\text{Upper Specification - } \bar{X}}{3\sigma}, \frac{\bar{X} \text{ - Lower Specification}}{3\sigma}\right\}$$

ROP = Average demand during lead time + $z\sigma_{DLT}$,

$$\sigma_{DLT} = \sigma_d\sqrt{\text{lead time}}$$

ROP = Average demand during lead time + z (daily demand) σ_L

ROP = Average demand during lead time + $z\sigma_{DLT}$,

$$\sigma_{DLT} = \sqrt{(\text{Average lead time } \sigma^2_d) + (\text{Average daily demand})^2\sigma^2_L}$$

$$\text{Min number of workstations} = \frac{\sum_{i=1}^{n} \text{Time for task i}}{\text{Cycle time}}$$

$$\text{Efficiency} = \frac{\sum \text{Task times}}{\text{Actual number of workstations} * \text{largest cycle time}}$$

Sample Size n	Mean Factor A_2	Upper Range D_4	Lower Range D_3
2	1.880	3.268	0
3	1.023	2.574	0
4	.729	2.282	0
5	.577	2.115	0
6	.483	2.004	0
7	.419	1.924	0.076
8	.373	1.864	0.136
9	.337	1.816	0.184
10	.308	1.777	0.223
12	.266	1.716	0.284