AMERICAN UNIVERSITY OF BEIRUT

SULIMAN OLAYAN SCHOOL OF BUSINESS

DCSN 200: OPERATIONS MANAGEMENT

FINAL EXAM
June 10, 2011

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.

- Do not start the exam **(do not turn to the next page)** until instructed to do so
- 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
- When you start the exam, make sure that your exam paper has **12** pages
- You must hand in every page of the exam when you finish, including the formula sheet. If any page has become detached, your name must be written on it
- Write your answers in the space provided. Be concise and follow the instructions closely. If you run out of space, continue on the back of the page, but indicate this fact clearly.

"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.
SHORT QUESTIONS (17 points)

1. **(2 points)** Explain how just-in-time processes relate to the quality of an organization's outputs.

2. **(3 points)** Perform a Pareto analysis on the following information:

Reason for unsatisfying check-out at store	Frequency
Unfriendly cashier	27
Incorrect change	4
Cashier too slow	9
Price check	34
Poorly bagged merchandise	2
Slow receiving check approval	3

3. **(2 point)** What is the basic objective of a process control system?

4. **(2 point)** Explain the purpose of assembly line balancing. Briefly describe its benefits.

5. **(2 point)** What is the primary management challenge when implementing yield management?

6. **(2 points)** Why are x-bar and R-charts usually used together?

7. **(2 points)** How sensitive is the EOQ to variations in demand or costs?

8. **(2 points)** Compare the assumptions of the production order quantity model to those of the basic EOQ model. Point out to the similarities and differences.

PART II. SHORT PROBLEMS

Problem 1 (12points)

As an Operations Manager, you need to make some decisions regarding the procurement of bolts. You wish to choose the most capable supplier from among three different suppliers: Supplier A, Supplier B, and Supplier C. You require that the diameter at the end of the bolt has specifications of 1.500 ± 0.009 cm. Each of the three suppliers have reported the sample mean and sample standard deviation of their bolt diameters computed from random samples taken from their production runs. The suppliers' statistics are provided in the following table.

Supplier	Sample Mean (cm)	Sample Standard Deviation (cm)
A	1.500	0.0030
B	1.500	0.0022
C	1.495	0.0015

1. **(2 points)** List the different reasons that make the process capability index a suitable criterion to express process performance.

2. **(8 points)** Based on the sample data provided, which supplier will you choose? Why?

3. **(2 points)** What other management tools, besides process capability, would you advise using? Explain.

Problem 2 (12points)

Suppose that the next season's demand for industrial printers faced by XeroS is random and also depends on the price set by XeroS. The price demand function is: $\boldsymbol{d(p) = A - 2 \cdot p}$, where *A* depends on how next season's economy behaves and *p* is the unit price of a printer. If the economy is POOR, then *A*=20; if the economy is GOOD, then *A*=50. The probabilities of POOR and GOOD are respectively 60% and 40% (see table).

Economy	**Probability**	***A***
POOR	60%	20
GOOD	40%	50

The number of units available in stock (at the beginning of the season) is 30 and there is NO possibility of replenishment. The holding cost is $5/unit (for any remaining units at the end of the season) and the stockout cost is $10/unit.

XeroS needs to set *one* fixed price, *p* for the season: the values of *p* can either be $7 OR $10. Which of the two prices do you recommend XeroS charges? Explain your answer carefully.

Hint: Select the price that leads to the highest expected profit for next season.

PART III. EXTENDED PROBLEMS

Problem 1 (20points)

This question focuses on a factory that manufactures plastic dolls. Each doll is made up of a head, two arms, two legs, and a torso. The factory would like to produce 95 dolls in each 8 hour working day. The process for producing a doll can be summarized as follows:

Task	Task Time (Minutes)	Predecessors
1. Mold head, arms, legs, and torso	5	--
2. Trim excess plastic from arms and legs	3	1
3. Trim excess plastic from head	2	1
4. Trim excess plastic from torso	2	1
5. Print Box	3	--
6. Paint face on head	3	3
7. Sew hair to head	5	6
8. Snap legs, arms, head, and torso together	2	2, 4, 7
9. Package	5	5, 8

1. **(5 points)** Draw the precedence diagram for the tasks at the doll manufacturer.

2. **(3 points)** Determine the desired cycle time.

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

4. **(4 points)** 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.

5. **(3 points)** Calculate the efficiency of the line obtained in part 4 assuming the cycle time obtained in part 2. Explain what the efficiency score you obtained means for the production line. (If you weren't successful at completing part 4 or part 2, make and clearly state any reasonable assumption for these values.

6. **(3 points)** For technology related reasons, Task 4 CANNOT currently be combined with any other task and has to be a workstation by itself. How does this impact your efficiency?

Problem 2 (17points)

Having setup and balanced the assembly line for manufacturing dolls, the manufacturer wants to focus on quality. To this end, the director of operations at the doll factory has established the following process for checking quality. Every day, one doll is randomly selected and the doll is examined for defects – for example, strength of the head, leg, and arm connections to the torso are tested, the quality of the painted face is evaluated, the thickness and stitching of the hair is evaluated, etc. Each part that doesn't meet the desired specifications is logged as a defect. The following data, results for 10 working days (week 1 and Week 2) at the factory, were carefully monitored by quality control, in order to build a control chart.

Day	Number of defects per doll per day
Monday	4
Tuesday	3
Wednesday	3
Thursday	4
Friday	5
Monday	3
Tuesday	2
Wednesday	2
Thursday	3
Friday	5

1. **(2 points)** What kind of control chart would you use to monitor this process? Why?

2. **(4 points)** What are the 3-sigma control limits for this process?

3. Draw below the control chart that you specified in part 1 of this question.
   a. **(3 points)** Plot the 10 data points for Week 1 and Week 2. Do you recognize any special behavior? Give an explanation for that behavior

   b. **(2 points)** Control for the <u>subsequent</u> **Week 3** by adding the following data to your previous chart.

Day	Number of defects per doll per day
Monday	8
Tuesday	7
Wednesday	7
Thursday	8
Friday	10

4. **(3 points)** On which day of Week 3 did you recognize you are out-of control? Could you suggest a more comprehensive (i.e. better) way to measure whether your system is out of control? *Hint: look for a way that could support early detection of control issues.*

THE FOLLOWING QUESTION IS INDEPENDENT OF QUESTIONS 2 TO 4.

5. **(3 points)** What other control chart can be used in measuring defect rate. What would you need to do to transform the chart suggested in part 1 into the chart you are suggesting now?

Problem 3 (22points)

Assume that a retailer is facing a constant demand D=12,500 units/year for a smart phone (1 year=50weeks). The retailer is looking for a supplier in China.

Two suppliers were able to meet the quality criteria set by the retailer. The retailer has to pick one of the two.

Both of them charge the same unit cost of c1 = c2 = $100 per unit and charge the same transportation cost per order equal to $650/order. The difference is the following.

- CASE 1: Supplier 1 is selected. The retailer receives the order in one batch, one week after the order is placed
- CASE 2: Supplier 2 is selected. The retailer begins receiving the order two weeks after the order is placed. In this case, the order arrives in small batches of 350 units per week.

Suppose the total holding cost (also known as the *carrying cost*) is constant and equal to $100/unit/year. For accounting purposes, the retailer wants to order a quantity of 1000 units every four weeks.

THE FOLLOWING QUESTIONS ARE INDEPENDENT FROM EACH OTHER

1. **(3 points)** What is the ROP of the retailer? Consider both cases (CASE 1 and 2).

2. **(3 points)** Which supplier do you recommend the retailer selects? Explain.

3. **(4 points)** Suppose, the retailer can negotiate the cost, c1 of Supplier 1. Find the value of c1 that makes the retailer indifferent between the two suppliers.

4. Suppose the retailer is not constrained by any accounting issues, and is considering a different ordering policy (that is, a policy *other than* ordering 1000 units every four weeks)
   a. **(4 points)** Which quantity do you recommend the retailer order instead (consider both cases: CASE 1 and 2)?

   b. **(4 points)** What is the total cost in each case? Which supplier do you recommend that the retailer select and why?

5. **(4 points)** Assume that demand per week is not constant but random with an average of 250 units per week and a standard deviation of 90 units. What is the ROP in each case given a desired service level of 95% ($Z_{95\%}$=1.64). Would this make you change your mind about which supplier to select? Explain why or why not.

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 + $z\sigma_{DLT}$,

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

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

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

Sample Size	Mean Factor
2	1.880
3	1.023
4	0.729
5	0.577