Operations Management, FARE*3310 - Fall 2012: Assignment I

This assignment contains **THREE** questions, each with subparts. You are required to answer all questions. Total marks are out of **40**. Be sure to show your work. If you have to, make reasonable assumptions, but explain/justify any assumptions made in your answers. Please note that late assignment will be given **a zero grade**.

Due Date: Thursday, October 04, 2012, beginning of the class. This assignment makes up 5 % of your total mark.

1. [**10 points**] The **manager** for a winery has narrowed down the search for a new facility location to two communities: communities in the province of Ontario (Canada) and the state of New York (U.S.A). The plant will produce 8,000 cases of wine per day. The fixed setup costs for both locations are identical.

The **Ontario facility** can produce 8,000 cases of wine per day. The facility works two 8-hour shifts per day with labour productivity of 4 cases of wine per hour. The facility works 5 days per week. The average wage is CAN$20 per hour. The facility would use 132,000 pounds of grapes and can buy grapes at CAN$1.75 per pound. Based on location and staffing levels, the facility would be assigned an overhead allocation of CAN$1500 per day.

The **New York facility** can produce 8,000 cases of wine per day. The facility works two 8-hour shifts per day with labour productivity of 5 cases of wine per hour. The facility works 5 days per week. The average wage is U.S. $22 per hour. The facility would use 132,000 pounds of grapes and can buy grapes at U.S. $1.50 per pound. Based on location and staffing levels, the facility would be assigned an overhead allocation of U.S. $2,500 per week. Exchange rate: 1.02 US$/CAN$.

a) Calculate and compare the multi-factor (labour, input and overhead) productivity of the two options. Which location is more competitive? Which location would you suggest to the management? Why?
b) Give THREE other factors that the management team should consider before choosing a location (there may be more than 3 but only 3 are required).
c) For your preferred location in (b), suppose that the management is considering to adopt a technology that improves its output to 10,000 cases of wine per day, with additional cost of US$32,000 per week. The facility will use additional 3,300 pounds of grapes. Would it worth adopting the new technology? Why? Why not?

2. [**20 points**] Southwestern University, a large state college in Stephenville, Texas, 30 miles southwest of Dallas/Fort Worth metroplex, enrols close to 20,000 students. In a typical town-gown relationship, the school is a dominant force in the small city, with more students during fall and spring than permanent residents.

A long-time football powerhouse, SWU is a member of the Big Eleven conference and is usually in the top 20 in college football rankings. To bolster its chances of reaching the elusive and long-desired number-one ranking, in 2003, SWU hired the legendary Bo Pitterno as its head coach.

One of Pitterno's demands on joining SWU had been a new stadium. With attendance increasing, SWU administration began to face the issue head-on. After 6 months of study, much political arm wrestling, and some serious financial analysis, Dr. Joel Wisner, President of SWU, had reached a decision to expand the capacity at its on-campus stadium.

Adding thousands of seats, including dozens of luxury skyboxes, would not please anyone. The influential Pitterno had argued the need for a first-class stadium, one with built-in dormitory rooms for his players and a palatial office appropriate for the coach for a future NCCA champion team. But the decision was made, and everyone, including the coach, would learn to live with it.

The job now was to get construction going immediately after the 2009 season ended. This would allow exactly 270 days until the 2010 season opening game. The contractor, Hill Construction (Bob Hill being an alumnus, of course), signed his contract. Bob Hill looked at the tasks his engineers had outlined and looked President Wisner in the eye. "I guarantee the team will be able to take the field on schedule next year," he said with a sense of confidence. "I sure hope so," replied Wisner. "The contract penalty of $10,000 per day for running late is nothing compared to what Coach Pitterno will do to you if our opening game with Penn State is delayed or cancelled." Hill, sweating slightly, did not need to respond. In football-crazy Texas, Hill Construction would be mud if the 270-day target was missed.

Back in his office, Hill again reviewed the data (**Table 1**) and noted that optimistic time estimates can be used as crash times. HE then gathered his foremen. "Folks, if we're not 75% sure we'll finish this stadium in less than 270 days, I want this project crashed! Give me the cost figures for a target date of 250 days – also for 240 days. I want to be early, not just on time!"

a) Develop an AON network diagram for Hill Construction and determine the number of paths and the critical path. What is the expected slack for each activity?

b) What is the probability of finishing the project in 270 days?

c) Determine the probability that each of the connected paths through the project will be completed within 250 days?

d) If it is necessary to crash the construction project to 240 days, how would Hill do so, and at what costs? *As noted in the case, assume that optimistic time estimates can be used as crash times.*

e) What happens to Hill Construction if a revised optimistic, most likely and pessimistic time estimates for plumbing (i.e., Activity G) are 40 days, 45 days, and 50 days respectively? Given the agreement in the contract, would you suggest crashing the project? If yes, by how many days and why? If no, why not?

Table 1: Southwestern Project			Time estimates (days)			
			Optimistic	Most likely	pessimistic	Crash cost/day
Activity	Description	Predecessor(s)				
A	Bonding, insurance, tax structuring	None	20	30	40	$1,500
B	Foundation, concrete footings for boxes	A	20	65	80	3,500
C	Upgrading skybox stadium seating	A	50	60	100	4,000
D	Upgrading walkways, stairwells, elevators	C	30	50	100	1,900
E	Interior wiring	B	25	30	35	9,500
F	Inspection approvals	E	0.1	0.1	0.1	0
G	Plumbing	D, F	25	30	35	2,500
H	Painting	G	10	20	30	2,000
I	Hardware/AC/metal working	H	20	25	60	2,000
J	Tile/carpet/windows	H	8	10	12	6,000
K	Inspection	J	0.1	0.1	0.1	0
L	Final detail work/cleanup	I, K	20	25	60	4,500

3. [**10 point**] A quality analyst wants to construct a sample mean chart for controlling a packaging process. The analyst knows from past experience that the process standard deviation is **two** ounces. Each day last week, the analyst randomly selected four packages and weighed each. The data from that activity appears below(**Table 2**).

Table 2	**Weights (in ounces)**			
Day	Package 1	Package 2	Package 3	Package 4
Monday	23	22	23	24
Tuesday	23	21	19	21
Wednesday	20	19	20	21
Thursday	18	19	20	19
Friday	18	20	22	20

a) Calculate all sample means and the mean of all sample means. Calculate the standard error of the sampling distribution of the sample mean.
b) Calculate a Three Sigma upper and lower control limits that allow for natural variations.
c) Construct a Three Sigma control chart. Is this process in control?
d) If the analyst sets an upper control limit of 21 and a lower control limit of 19 around the target value of twenty ounces, what is the probability of concluding that this process is out of control when it is actually in control? What do you conclude about this process–is it in control?
e) On Saturday and Sunday, the analyst has taken two more random samples of four packages each and have found the following (**Table 3**):

Table 3	**Weights**			
Day	Package 1	Package 2	Package 3	Package 4
Saturday	23	24	20	24
Sunday	24	23	18	22

Given your UCL and LCL in (b), is the process in control? Explain why or why not.