

Operations Management Midterm 2

14/06/2012

Duration 2h30m

Remember the following tips:

- Budget your time. Skim through the exam before starting.
- Show all your work to allow us to give you partial credit if appropriate.
- Answer groups in separate pages and please write down your name in all pages.

SOLUTIONS

Good Luck!

Group 1 (30 points)

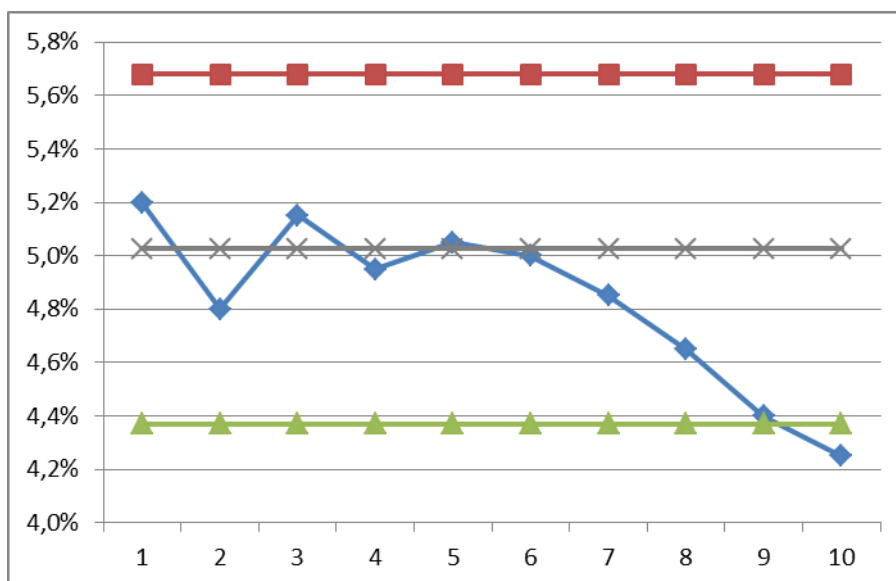
Good-old-san, a popular medication for hang-overs, is produced by Java pharmaceuticals. There are some concerns regarding quality control in recent batches. Defects are counted in a sample of 10000 units. They have gathered the following data and hired you to get some answers.

Week	1	2	3	4	5	6	7	8	9	10
Flaws	520	480	515	495	505	500	485	465	440	425
Fraction	5,20%	4,80%	5,15%	4,95%	5,05%	5,00%	4,85%	4,65%	4,40%	4,25%

- a) Calculate the 3-sigma control limits for the production process based on the first 6 weeks
- b) Plot a chart with the fraction of flaws over the 10 weeks, with the upper and lower control limits calculated in a)
- c) The number of defects has been reducing in the last weeks. Is that good? Is the process under control?

a)
 \bar{p} 5,03%
 sp 0,22%
 UCL 5,68%
 LCL 4,37%

b)



c) Generally, that's good. But since the number of defects is lower than the lower control limit, the process is not under control and the company should analyze the cause. Maybe is the quality control process that is not working well and identifying defects.

Group 2 (40 points)

The management of Saldanha Movie Theater is assessing the service level of its theater. On average 24 clients per hour enter the theater and go through one OR two steps. The **first step**, which all customers go through, is to buy a ticket at the ticket desk. Then, 75% of those go through a **second step**, where they go to buy popcorn. The average service time at the ticket counter is 2 minutes, whereas it takes 6 min to buy popcorn. After these two steps they sit down in the theater. Assume usual distributions.

When doing calculations at each sub-question clearly state what kind of system you are calculating (MM1, MMS, etc.)

- a) How many servers are needed at the ticket counter if total average waiting time in line at the ticket counter should be below 3 min? What is the waiting time in this **first step**?
- b) To make sure that the average time a given client has to wait in line at the theater is below 9min, how many servers are needed in each of the service stations? Under these conditions what is the average time a given client has to wait in line?
- c) What is the total average time spent before the customer sits down? Use the nr of servers chosen in (a) and (b)
- d) Draw the queuing system (keep it simple but clearly indicate all three elements of a waiting line: queue, channels and phases).

a) 2 servers. $W_q=0,375$ mins. $W_s=2,38$ mins

b) 2 servers in step 1 + 3 servers in step 2. $W_q1+2=1,7$ mins

c) $W_s1+2 = 2,38 + 75\% \times 7,77 = 8,20$

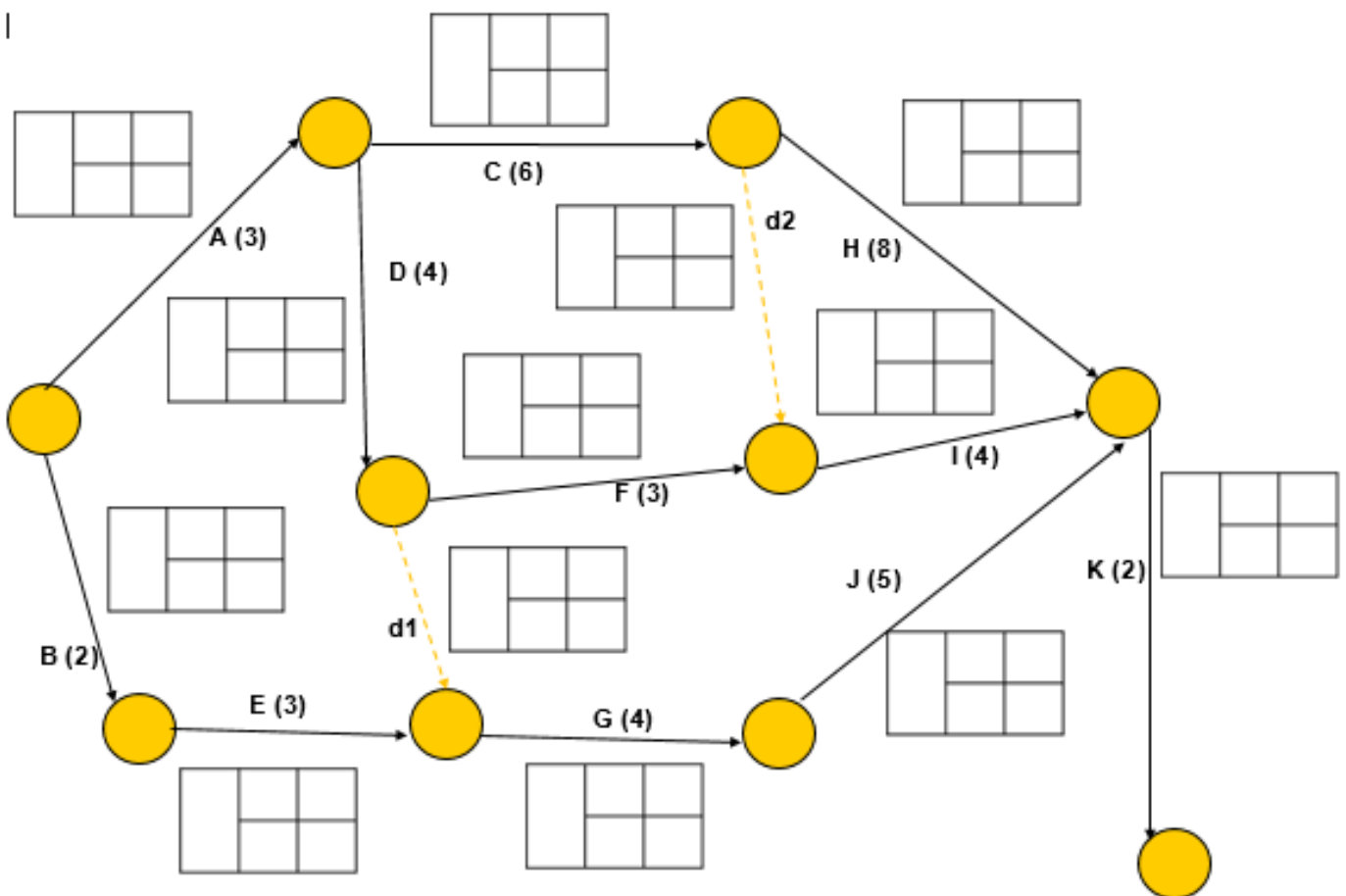
Group 3 (35 points)

Please answer this group in a separate sheet, using the last page of this exam.

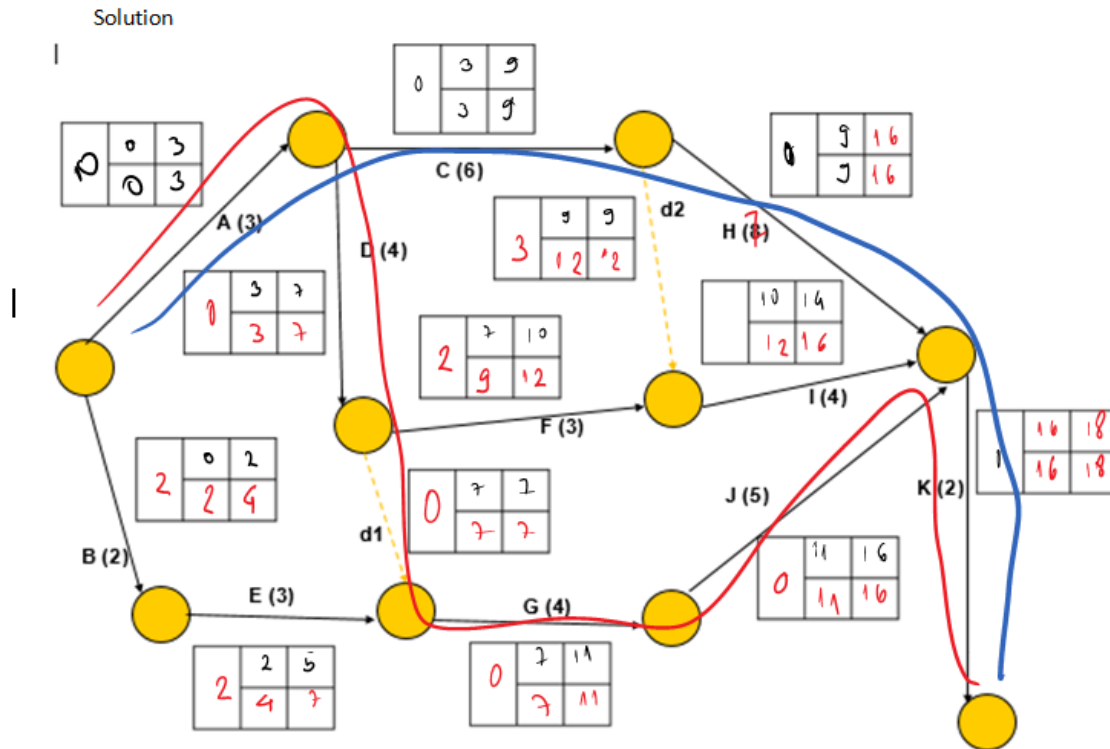
Consider the activity-on-arc network diagram for a project (figure below). Note that all durations on the diagram are in weeks. You have been asked to provide the following information about the project / to manage the project team.

- Calculate the Earliest Start, Latest Start, Earliest Finish, Latest Finish, and slack for each activity. Add these to the diagram.
- What is the critical path for this project? What is its length in weeks?
- Upon estimating the project completion time you have been asked to crash the project down for one week; you were able to pull together the information in the table below to use for project crashing. Calculate the total cost of crashing.
- What is (are) the critical path(s) for the crashed project?

Activities	Crash Cost / Week (\$)	Crash Weeks Possible
A, C, D, G, J	2 500	2
B, E, F, I, K	2 000	1
H	1 800	5



a and b) 17 weeks
c) 1800



Group 4 (30 points)

Multivet is a multinational company which core business is producing pet accessories. One of its assembly lines produces dog collars and leashes. For 2014, the factory expects to sell 6283 collars and leashes per week which represent a raise in demand so the factory should start working in 2 shifts of 8 hours, 6 days per week.

The following table defines the steps for producing the collars and leashes.

Step	Time in seconds	Immediate predecessors
A	40	-
B	14	A
C	23	B
D	35	B
E	20	C
F	11	-
G	15	E, F
H	10	-
I	27	D, H
J	7	-
K	12	G, I, J
L	20	K
TOTAL	234	

Please, present all your work with one decimal place

- Define the cycle time and the theoretical number of workstations.
- Draw the activity-on-node diagram for producing pet collars and leashes.

- c) Balance your production.
- d) Show why in 2014 they can't maintain the factory working in 1 shift of 8 hours, 5 days a week, to meet the expected demand.

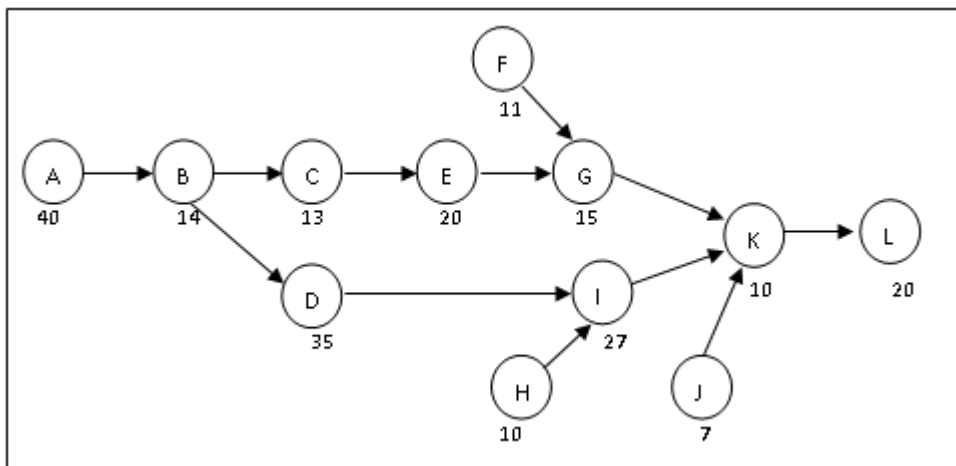
a)

Production rate = 6.283 collars / 5760 minutes = 1,1/minute

Cycle Time = 1 / 1,1 = 0,9 minutes = 55 seconds

Theoretical nr. of workstations = 236/55 = 4,3 => 5

b)



c)

Station	Candidates	Choice	Time sec	Cum time	Time Remaining (Cycle time = 55 Sec)	Idle time
1	A,F,H,J	A	40	40	15	1
	B,F,H,J	B	14	54	1	
2	C,D,F,H,J	D	35	35	20	2
	C,F,H,J	F	11	46	9	
	C,H,J	J	7	53	2	
3	C,H	C	23	23	32	2
	E,H	E	20	43	12	
	G,H	H	10	53	2	
4	G,I	I	27	27	28	1
	G	G	15	42	13	
	K	K	12	54	1	
5	L	L	20	20	35	35
TOTAL						41

d)

Cycle time = 22,9 seconds (lower than some steps)

Group 5 (15 points)

As a young entrepreneur and a Microhard enthusiast, you just had a business idea: create highly customized covers for the new Microhard Tablet, called Surface. The cover manufacturing consists of two sequential steps. First, your employee Steve needs to draw the design requested by the customer. Once this is done, Bill will finish assembling the cover. The table below provides Steve's and Bill's estimated processing times in minutes.

Cover	A	B	C	D	E	F
Steve	88	72	40	48	60	128
Bill	56	76	52	112	84	44

- Use Johnson's rule to schedule Steve and Bill (i.e. sequence the 6 covers).
- Using the results from part a), determine the completion time for each cover (in minutes starting at zero for simplicity). Construct a Gantt chart for the recommended schedule.
- Assuming that the manufacturing of all covers could be started at time zero, calculate the average flow time for the sequence determined in part a)

a)

Bike	Steve	Bill
C	40	52
D	48	112
E	60	84
B	72	76
A	88	56
F	128	44

b)

Steve		Bill	
<i>start</i>	<i>end</i>	<i>start</i>	<i>end</i>
0	40	40	92
40	88	92	204
88	148	204	288
148	220	288	364
220	308	364	420
308	436	436	480

c)

Average flow time = $(92+204+288+364+420+480)/6 = 308$ min

Group 6 (50 points)

Please answer clearly and briefly to the following questions.

1. (10 pts) When converting from a traditional buyer-supplier relationship to JIT, should a company reduce the number of its vendors or suppliers? Please answer “yes” or “no” and explain why?
2. (10 pts) What are the main implications of having a finite population vs. a infinite population in a waiting line model? Are there any differences in the distribution of arrivals?
3. (10 pts) Camilus’s customers specification limits for the fraction of defective are 0,05 and 0,08, while the process control limits are 0,05 and 0,07. After week 20 Joe’s manager realizes that the process has been producing with 0 defects for 7 consecutive days... Camilus’s manager has requested your advice. Please explain to him if the process is out of control? And why?
4. (10 pts) Give 4 examples of innovations (products or services) that were developed by users (i.e. they are user innovation).
5. (10 pts) Please mark the correct answer. No need to justify. However, wrong answers will be penalized the same points (-10 pts) that you would get with a correct answer.

Consider a single line, single server system with arrival rate (λ) and service rate (μ). If $\lambda > \mu$, thus:

- a. Customers never leave the system.
- b. Customers leave the system at the rate of λ .
- c. Customers leave the system at the rate of μ .
- d. We cannot determine the output rate since the utilization is higher than 1.