

ENGINEERING TRIPOS PART IIA

Module 3E10: Operations Management for Engineers

Examples Paper II

Examples class: February 16, 2016 (4pm-6pm, Engineering LT1)

Question 1: In an assembly line operation there are nine separate tasks, and the table below gives the duration of each task, and the immediate precursors of each task. The line is a traditional, linear line rather than a manufacturing cell horseshoe.

Task	Duration (minutes)	Precursors
A	5	-
B	3	-
C	6	A
D	8	A, B
E	10	C, D
F	7	D
G	1	E, F
H	5	G
I	3	G

Balance this line for a cycle time of 16 minutes. If the cycle time could be decreased by 2 minutes, the company could save £200 per week through volume discounts for the raw material. The wage costs are £150 per week for an assembly line worker. Is it worth attempting to speed the line up?

Question 2: The demands for a product for weeks 1-20 are as follows:

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Demand	15	18	10	12	20	17	22	16	14	20	15	12	16	20	22	17	15	10	16	20

Suppose that a forecast is to be produced for the following week in each of the weeks 10-19, so that in week 10 the data up to week 10 are available, in week 11 the data up to week 11 are available, etc.

- Compare the results of using a 10-week moving average with an exponential smoothing approach, using a smoothing constant of $\alpha = 0.1$.
- What effect would increasing α have on the nature of the forecast? Under what circumstances would one use a larger smoothing constant?
- For the forecasts in part (a), calculate MAD, MSE, and MAPE.

Question 3: Consider the problem of minimising average tardiness on one machine with the following processing times and due dates:

Job	1	2	3	4
p_j	7	6	8	4
d_j	8	9	10	14

Find a production sequence using the MDD rule. Is this solution optimal?

Question 4: Joe's Auto Seat Cover and Paint Shop is bidding on a contract to do all the custom work for Ed's used car dealership. One of the main requirements in obtaining this contract is rapid delivery time, because Ed wants the cars facelifted and back on his lot in a hurry. Ed says that if Joe can refit and repaint five cars that Ed has just received in 24 hours or less, the contract will be his. Following is the time (in hours) required in the refitting shop and the paint shop for each of the five cars. Assuming that cars go through the refitting operations before they are repainted, can Joe meet the time requirements and get the contract?

CAR	Refitting Time (hours)	Repainting Time (hours)
A	6	3
B	0	4
C	5	2
D	8	6
E	2	1

Question 5: A manufacturer has sixty hours to complete the processing of ten jobs. Each job requires the same machine for the first operation which consists of Raw Processing. The technology is such that two jobs cannot be processed together. The Finishing Operation takes longer, for which as many additional workers as required can be brought in, with the proviso that only one worker can work a single job at a time, although - if necessary - jobs can be subcontracted. The cost of subcontracting a job is the same for each job. If the sixty hour deadline is to be met and we are to minimise the total cost of subcontracting jobs, provide the optimal schedule and indicate which jobs have to be subcontracted.

Job	Time (hours)	
	Raw	Finishing
A	7	6
B	7	12
C	12	0
D	10	18
E	4	9
F	14	25
G	10	14
H	11	7
I	5	13
J	4	10