

ENGINEERING TRIPOS PART IIA

Module 3E10: Operations Management for Engineers

Examples Paper I

Question 1:

A cement firm has a fixed cost of setting up production of £1,500 and a variable cost of production of £5.84 per kg. The company uses an interest rate of 13 percent to account for the cost of capital, and the annual cost of storage of cement amounts to 12 percent of the cement's value. The production is set up as a continuous process and runs all year round. The firm can manufacture at a rate of 10,000 kg per day, and faces an average daily demand of 2,400kg.

- a) What is the optimal production quantity for the firm?
- b) What is the maximum level of on-hand inventory?
- c) What is the annual average cost of holding plus set up?
- d) What percentage of each cycle consists of the production portion of the cycle?
- e) If the variable costs of production were to change to £7.50 per kg, and the firm were to adjust its production accordingly so as to produce optimally, what percentage of each cycle would then consist of the production portion of the cycle?
- f) Briefly discuss at least three reasons why the application of the EOQ is not always appropriate for deciding order sizes.

Question 2:

The MS&E department coordinator who purchases blank paper for the copy machines must decide among three different suppliers. She can purchase paper from supplier A for £2.50 per pack, independent of the number of packs ordered. Supplier B provides paper for £2.40 per pack, but they do not accept orders for fewer than 3,000 packs. Supplier C provides paper for £2.30 per pack; however they do not accept orders for fewer than 4,000 packs. Assume a setup (ordering) cost of £100 and an annual requirement of 20,000 packs of paper. Also assume a 20% annual interest rate for holding cost calculations.

- a) Which supplier should the coordinator order paper from? What should be the optimal order quantity of each order?
- b) If the replenishment lead-time for paper is 2 months, determine the reorder point.

- c) Now suppose there exists only Supplier A from part (a) and a new supplier, Supplier D (Suppliers B and C do not exist). Supplier D's cost per pack is £2.55. However, Supplier D has an online ordering interface which may significantly reduce the MS&E coordinator's ordering cost. Determine the ordering cost at which the coordinator is indifferent between Supplier A and Supplier D.

Question 3:

A manufacturing company is setting up a new factory and considering two options for the key processing equipment:

Processing Option 1: A single machine A directly feeding a single machine B;
Processing Option 2: Four machines C in parallel, directly feeding any one of four machines D in parallel.

The product produced by the route AB is identical to that produced by the route CD. The factory works for eight hours per day. Processing and setup times for the four machine types are given in the table below:

Processing Option	Machine	Process time (seconds)	Setup time (seconds)
1	A	6	1500
	B	8	1000
2	C	40	50
	D	50	20

- a) For both processing options above, calculate the daily capacity of the new factory, for the cases where batch size is 10 and 500.
- b) For both processing options, and for both batch sizes:
- Calculate the utilisation rate for all four machine types, defined as the % of time in which the machine is processing.
 - Explain why your results differ for the two batch sizes.

Question 4:

Trimble Navigation produces a Global Positioning Unit (GPU) which is used in automobile navigation systems by other manufacturers. The demand and cost data for GPU over the next six weeks are as follows.

Week	1	2	3	4	5	6
Demand	150	100	200	160	200	80
Set-up Cost	150	150	150	150	200	100
Holding Cost	0.5	0.6	0.5	0.6	0.5	0.6

Initial and final inventory are zero, and the holding cost is per unit held/period for all periods. Assume that the production lead-time is equal to zero and that no shortages are allowed. Holding costs are incurred at the end of a period. Determine production lot sizes over the next 6 periods using the Least Unit Cost (LCU) heuristic. Show your calculations. What is the total cost?