

Sample Questions for Industrial Engineering and Operations Research Part

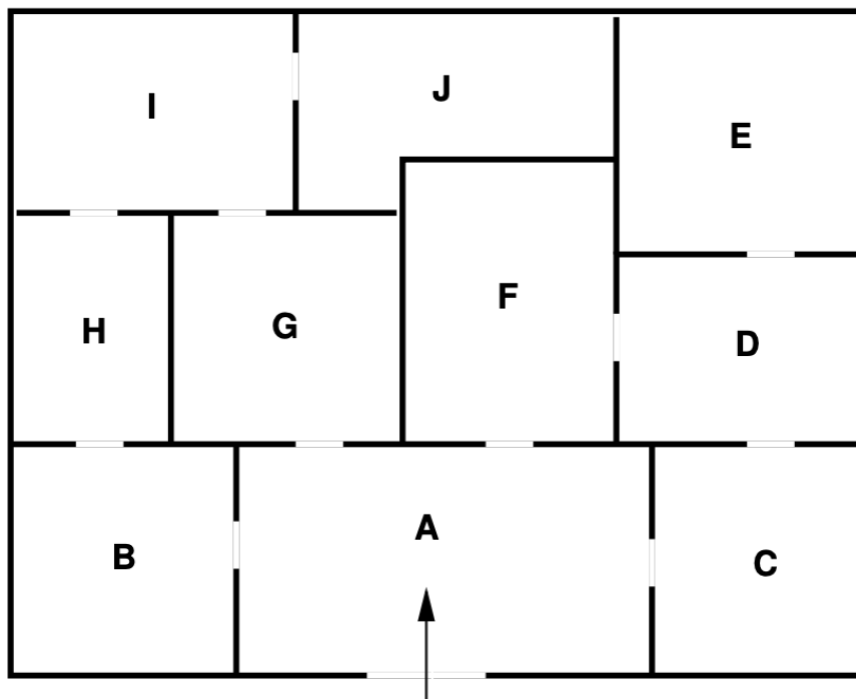
This is a closed book test

Q1: IIT Bombay Central Library after having gone through renovations is having a hard time during out security issues. The central librarian must decide how many guards should be employed to control the wings. In an ideal situation every wing A through J will have a guard. However, budget cuts have forced them to station guards at each door, guarding two wings at once. For example, the guard standing at the door between wing A and wing B can guard both the wings.

- Formulate a mathematical program to minimize the number of guards.
- Formulate a mathematical program to determine a shortest path to enter the wing A and traverse all the wings and return back to wing A.

(Please clearly write all your parameters, decision variables, objective function and constraints)

(10 marks)



Q2: An auto components manufacturer has set up a production process for machining a part. The part has one CTQ with a customer spec of 10 ± 0.03 mm. The CTQ can be approximated by a Normal Distribution. The machine is expected to operate 7 hrs/shift with 3 shifts/day. The plant works for 350 days/year. The cycle time for producing the part is 15 sec.

Even though the process is initially on target (i.e. with a mean = 10 mm) and in control with a process standard deviation of 0.01 mm, the production manager knows that over a period of time, a shift can be expected. She has therefore decided to use a standard \bar{x} -bar control chart for the CTQ, with a sample size of 10, control limits at $\pm 3\sigma$ and a sampling frequency of 1 sample per hr. The variable cost of inspection is Rs 10 per unit and the fixed cost is Rs 100. Historical records show that the process has a tendency to shift, on an average, every 500 hr (i.e. the time between process shifts follows exponential distribution). The control chart uses the rule of “one point falling out side control limits” to declare a process out of control. Every time a process goes out of control, it takes two supervisors on an average 1 hr to investigate and 2 hr to restore the process. The average shift in mean can be assumed to be 0.01 mm. The hourly rate for a supervisor is Rs 200 and the downtime cost be assumed to be 5 times the expected profit per hr. The expected profit per unit is Rs 100.

All the parts will be inspected 100% at the customer’s end and any part with an out-of-spec dimension will be rejected. The approximate cost of rejecting a piece at this stage is Rs. 1000.

Answer the following question. State any other assumption you want to make with a justification

a. What is the cost per piece contribution of this control plan? **(10 marks)**

Note: make of a quadratic loss function at appropriate places)?

b. Given a shift in the process mean by 0.01 mm, plot the probability of detection as a function of number of samples taken in sequence. **(2.5 marks)**

c. What is the process capability (Use C_p , C_{pk} and C_{pmk}) of the process when in control and out of control? **(2.5 marks)**