

2003 National Exams

98-Mec-B5

PRODUCTION PLANNING AND MANUFACTURING

3 Hours Duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. Any non-communicating calculator is permitted. This is an Open Book exam. Note to candidates you must indicate the type of calculator being used, i.e., write the name and model designation of the calculator, on the first inside left hand sheet, of the exam work book.
3. Any five questions constitute a complete paper. Only the first five questions as they appear in your answer book will be marked.
4. All questions are of equal value.

Question 1

- a) The time between failures (TBF) for a certain assembly is exponentially distributed with a mean of 100 hours. Suppose the TBF had been normally distributed with a mean of 100 hours and standard deviation of 20 hours. What value of mission time (TBF) based on the exponential would have the same reliability as a 100-hour mission time based on normality?
- b) It is expected that the average time to repair a failure on a certain product is 4 hours. Assume that repair time is exponentially distributed. What is the chance that the time for a repair will be between 3 and 5 hours?

Question 2

- a) The specifications on the diameter of a wrist Pin are 1.000 inch ± 0.002 inch. Twenty samples five pins show the average to be 1.001 inches and the average of the twenty ranges to be 0.002 inch. Are the specifications capable of being met by the process that makes the wrist pins? What assumption is necessary?
- b) The head of an automobile engine must be machined so that both the surface that meets the engine block and the surface that meets the valve covers are flat. These surfaces must also be 4.875 inches ± 0.001 inch apart. Presuming that the valve cover side of the head is finished correctly, compare the capability of two processes for performing the finishing of the engine block side of the head. A broach set up to do the job gave an average thickness of 4.877 inches with an average range of 0.0005 inch for 25 samples of 4 each. A milling machine gave an average of 4.875 inches and average range of 0.001 inch for 20 samples of 4 each.

Question 3

Suppose that we are considering the installation of a small computer to accomplish internal tasks of payroll computation, invoicing, and other routine - accounting. The purchase price is quoted as \$300,000. and the salvage value five years later is expected to be \$100,000. The operating costs are expected to be \$1 00,000. per year, mainly for personnel to program, operate, and maintain the computer. What is the present value of the costs to own and operate the computer over its five-year economic life? The value of money in the organization is 15 percent.

An aggressive marketer of a new office copier has made its machine available for sale as well as lease. The idea of buying a copying machine seems revolutionary, but less so when we examine our present costs, which come to \$6,500 per year for lease plus per copy charges of 2 cents per page. If we own a machine, the cost of paper and maintenance is projected to be \$1,500 per year. The new copier costs \$10,000, installed, and is assumed to have an economic life of five years and a salvage value of \$2,000. (assume 50,000 pages per year).

- a) What is the projected unadjusted rate of return if we install the copier?
- b) If incremental taxes for the project are \$1,000, what is the adjusted rate of return?

Question 4

- a) What common components of demand do we wish to take into account in a forecasting system for operations?
- b) What is the general structure of adaptive forecasting systems?
- c) How is economic forecasting different from regression analysis?

Question 5

Develop an inventory control system for a new product just starting production when the following information is given:

- a) Production economic lot size is 1000 units.
- b) Production rate (supplied daily to inventory) is 50 units per day.
- c) Usage rate is 20 units per day
- d) Production start up takes 10 ± 5 days after an order is placed.
- e) Annual cost of storing 1 unit is \$5.00
- f) Production cost of product is \$15.00.
- g) 240 production and sales days per year.

Question 6

A large number of semiautomatic machines produce identical products. Time studies reveal the following time in minutes for one man to service one machine:

Load machine	3.1
Remove finished product	0.6
Inspect finished product	2.4
Pack finished product	1.9
Walk to next machine	0.4

The machine takes 41.3 minutes to produce a finished product. Machine operators are paid \$4.90 per hour, and the burden rate for the machine is \$18.00 per hour. What is the lowest cost per unit to produce the product with the optimum ratio of men to machines?

Question 7

- a) Control charts are maintained on the weight of an item. After a base period of 30 samples of size 3, $\Sigma X = 12930$ g and $\Sigma R = 123$ g.
- Compute the control limits and estimate the standard deviation of the item weights. (Assume that base period observations indicate the process to be in control.)
 - If the process average of the weights shifts to 433 g, how long will it take to detect the shift using the control limits in part (a)?
- b) Production is started to produce a newly designed component. To monitor the length, \bar{X} and R charts are started based on 25 subgroups of four items each. For these 25 subgroups, $\Sigma \bar{X} = 500$ cm and $\Sigma R = 153.2$ cm. Determine the 3σ control limits. What is the probability that a shift of 2 cm in the process average would be detected on the first subgroup observed after the shift?