

National Exams DECEMBER 2002

98-IND-A4

Production Management

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. This is an CLOSED BOOK EXAM.  
A Sharp or Casio approved calculator models are acceptable.
3. FIVE (5) questions constitute a complete exam paper.  
The first five questions as they appear in the answer book will be marked.
4. Each question is of equal value.

Question # 1

Annual demand for a product produced in a local company is 5,000 units. The production rate is 10,000 per year. The production cost for each product is \$30. The company accountant estimates that the machine setup cost is \$500, and recommends a 20% annual interest rate for determining holding cost.

- a) What is the optimal lot size?
- b) For the solution in(a), find the maximum inventory  $I_{max}$ .
- c) For the solution in(a), what will be the annual holding cost and annual setup cost?
- d) Suppose that the machine will be used for the next three years. Since the Just-in-Time system is so popular, the company is considering reducing the production lot size by reducing the setup cost. The company can reduce the machine setup cost to \$200 per setup by investing \$2,000 to improve the machine tool. Should the company make such an investment? Why?

Question # 2

The residents of Toronto deposit their refuse on the curbside at the start of each working day. The amount of refuse placed at the curbside is an uncertain quantity whose probability distribution is given below:

Refuse (in tons)	1	2	3	4	5	6	7	8	9	10
Probability	0.02	0.08	0.15	0.2	0.165	0.16	0.03	0.135	0.035	0.025

The quantities of refuse produced on different days are independent. Refuse is collected by crews. Each crew can collect 1 ton of refuse per eight-hour working day. Each crew consists of three members and each member receives \$10/hour. Whatever refuse remains at the end of the day must be collected that evening by a special crew who pick up the surplus at a price of \$500/ton.

- a) Find the optimal number of crews to collect the refuse.
- b) For the solution in (a), what will be the expected total cost?

Question # 3

Consider the sales figures given in the table below. Forecast the sales for the 1<sup>st</sup> and 2<sup>nd</sup> half of 2002 using Ratio-to-Moving Averages (with Holt' s) method.

Period	1999		2000		2001	
	1 <sup>st</sup> Half	2 <sup>nd</sup> Half	1 <sup>st</sup> Half	2 <sup>nd</sup> Half	1 <sup>st</sup> Half	2 <sup>nd</sup> Half
Sales (\$ million)	147	176	177	242	235	303

## Question # 4

In Winters' method, the following equations are used:

$$L_t = a (Y_t / S_{t-M}) + (1-a) (L_{t-1} + T_{t-1})$$

$$T_t = b (L_t - L_{t-1}) + (1-b) (T_{t-1})$$

$$S_t = g (Y_t / L_t) + (1-g) (S_{t-M})$$

A monthly seasonality of 0.80 for January means that during January, car sales, for instance, are expected to be 80% of the sales during an average month. An alternative approach to modeling seasonality, called an additive model, is to let the seasonality factor for each month represent how far above average car sales will be during the current month. For example, if  $S_{Jan} = -50$ , the car sales during January are expected to be 50 less than car sales during an average month. If  $S_{Aug} = 90$ , the car sales during August are expected to be 90 more than car sales during an average month. Then the Winters' method equations should be modified as follows:

$$L_t = a (X) + (1-a) (L_{t-1} + T_{t-1})$$

$$T_t = b (L_t - L_{t-1}) + (1-b) (Y)$$

$$S_t = g (Z) + (1-g) (S_{t-M})$$

- Determine  $(X)$ ,  $(Y)$ , and  $(Z)$ .
- Suppose we are working with monthly data and month 12 is December, month 13 is January, and so on. Also suppose that  $L_{12} = 30$ ,  $T_{12} = -3$ ,  $S_1 = -50$ , and  $S_2 = -20$ . Assuming  $a = b = g = 0.5$  what is the forecast for car sales during month 14 using an additive model?

## Question # 5

Consider the following flow shop with 6 jobs.

Jobs	Processing Time on Machine 1	Processing Time on Machine 2
1	12	8
2	4	8
3	2	2
4	10	4
5	2	8
6	6	10

- Determine the schedule that minimizes the makespan.
- Draw the associated Gantt chart.
- Calculate the mean flow time for the schedule you found in part (a).

## Question # 6

Consider the following flow shop with 5 jobs:

Jobs	Processing Time on Machine A	Processing Time on Machine B	Processing Time on Machine C
1	18	17	24
2	22	20	25
3	14	21	16
4	19	18	21
5	20	19	22

Derive a schedule that minimizes the maximum completion time using Johnson's Method.