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**UNIVERSITY OF SWAZILAND**

**FACULTY OF COMMERCE**

**DEPARTMENT OF BUSINESS ADMINISTRATION**

**FINAL EXAMINATION PAPER**

**MAY 2005**

**TITLE PAPER : MANAGEMENT SCIENCE**

**COURSE TITLE : BA 412 (FULL TIME / I.D.E. STUDENTS)**

**TIME ALLOWED : THREE (3) HOURS**

- INSTRUCTIONS :**
- (1) TOTAL NUMBER OF QUESTIONS IN THIS PAPER IS SIX (6)**
  - (2) THE PAPER CONSISTS OF SECTION A AND SECTION B.**
  - (3) ANSWER ANY TWO (2) QUESTIONS FROM EACH SECTION.**
  - (4) THE MARKS AWARDED FOR A QUESTION /PART OF A QUESTION ARE INDICATED AT THE END OF EACH QUESTION / PART OF QUESTION.**
  - (5) ALL WORKINGS MUST BE CLEARLY SHOWN.**

**NOTE: MAXIMUM MARKS WILL BE AWARDED FOR GOOD QUALITY LAYOUT, ACCURACY, AND PRESENTATION OF YOUR WORK.**

**THIS PAPER MUST NOT BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR.**

**!!!GOOD LUCK!!!**

**SECTION A (Answer any two questions).**

**Q1.** One-Stop Computer Systems are preparing a customer order. The relevant data are given below:

Activity	Immediate preceding Activity	Time, days			Cost, E, at expected duration
		Optimistic	Most likely	Pessimistic	
A	-	3	4	5	1000
B	-	4	7	10	1400
C	-	4	5	6	2000
D	A	5	6	7	1200
E	B	2	2.5	6	900
F	C	10	10.5	14	2500
G	D,E	3	4	5	800
H	G,F	1	2	9	300

The project's indirect costs are E300 per day. The contract with the customer specifies a penalty of E100 per day if the project is not finished by the end of day 15.

**Required:**

- (a). Draw the network. What is the overall expected project completion time? What is the associated cost? (14marks).
- (b). What is the critical path? *Comment* on the durations of the *non-critical* paths. (5marks).
- (c). What is the probability that the project could be completed without incurring any penalty charge? (6marks).

**Q2.** The quarterly sales of a product are monitored by a *multiplicative time series model*. The trend in sales is described by:

$$Y = 100 + 5x$$

where *Y* denotes sales volume and *x* denotes the quarterly time period.

The trend in sales for the most recent quarter (first quarter 2000, when  $x = 20$ ) was 200 units. The average seasonal variations for the product are as follows:

<i>Quarter</i>	<i>First</i>	<i>Second</i>	<i>Third</i>	<i>Fourth</i>
<i>Seasonal effect</i>	0	-20%	40%	-20%

The price of a unit was E1000 during the first quarter of 2000. This price is revised every quarter to allow for inflation, which is running at 2% a quarter.

**Required:**

- (a). Produce sales volume forecasts for the three remaining quarters of 2000, both actual and deseasonalised. (10marks).
- (b). Produce forecasts for (actual) sales revenue for the three remaining quarters of 2000, stating any assumptions. (10marks).
- (c). Explain briefly, in terms suitable for a management report, how the product has been performing to date. (5marks).

**Q3.** The woodworking firm, Vibra, employs five joiners. Each man has different abilities and skills, and takes a different amount of time to do each job. At present, there are five jobs to be allocated. The times are given below:

		<i>Time per job (hours)</i>				
		<i>Job 1</i>	<i>Job 2</i>	<i>Job 3</i>	<i>Job 4</i>	<i>Job 5</i>
<i>Employees</i>	M1	25	16	15	14	13
	M2	25	17	18	23	15
	M3	30	15	20	19	14
	M4	27	20	22	25	12
	M5	29	19	17	32	10

**Required:**

The jobs have to be assigned one job to one man. How should this be done in order to minimize the total man-time needed to finish all of the jobs? (25marks).

**SECTION B (Answer any two questions).**

**Q4.** A particular project comprises 10 activities, which have the following durations and precedence:

<u>Activity</u>	<u>Duration, days</u>	<u>IPA</u>
A	6	-
B	1	A
C	2	A
D	1	B
E	1	D
F		B
G	1	C
H		F, G
I	4	E, H
J	5	I

Activities **F** and **H** have uncertain durations, which at this stage are difficult to estimate.

**Required:**

- (a). Draw a suitable network to represent the inter-relationships between the 10 activities. (7marks).
- (b). What is the minimum time that the project could take, ignoring the effects of activities F and H? (3marks).
- (c). If the project must be completed in 19 days, what restrictions does this place on the durations of activities F and H? (6marks).
- (d). After further investigation, it is estimated that the expected times for activities F and H are two days and one day respectively. Furthermore, it may be assumed that a Poisson distribution may represent the uncertainty in these two activity durations. On the basis of this, what is the probability that the project will be completed in no more than 19 days?

A selection of Poisson probabilities is given in the following table:

Mean ( $\mu$ )	Probability of				
	0	1	2	3	4 or more
1	0.368	0.368	0.184	0.061	0.019
2	0.135	0.271	0.271	0.180	0.143

(9marks).

**Q5.** Solve this minimization LP problem *using simplex method*:

$$\begin{array}{l}
 \text{Minimise:} \quad 7x \quad + \quad 5y \\
 \text{Subject to:} \\
 \quad \quad \quad x \quad + \quad y \quad = \quad 4 \\
 \quad \quad \quad 9x \quad + \quad 6y \quad \geq \quad 30 \\
 \quad \quad \quad 14x \quad + \quad 20y \quad \geq \quad 60 \\
 \quad \quad \quad \quad \quad \quad x, y \quad \geq \quad 0
 \end{array}$$

(25marks).

**Q6.** Green Ltd is a large, independent retailer of electronic and audio equipment. One of their more popular lines is a stereo radio cassette player. The demand is 500 per quarter, spread evenly over the year. This item costs Green E50.00 to buy direct from the manufacturer. The cost of placing an order is estimated to be E50.00 and the cost of holding the radios in stock is charged at 15% per annum of the average stock value.

The manager of Greens is considering reducing the stocks held of this item in order to help improve the company's cashflow. He has estimated that the cost of administering an out-of-stock ordering system, together with a charge for any lost sales and loss of goodwill, amounts to E5.00 per radio per year.

**Required:**

- Determine the minimum value of the total variable costs of stocking the radios if stock-outs are permitted. What is the optimum order size? (7marks).
- How much could be saved if a system of planned shortages was introduced? Assume stock-outs are supplied from the next order. What is the new optimum order quantity? (18marks).