

UNIVERSITY OF SWAZILAND

FACULTY OF COMMERCE

DEPARTMENT OF BUSINESS ADMINISTRATION

SUPPLEMENTARY EXAMINATION PAPER

JULY, 2009

(FULL TIME / IDE STUDENTS).

- TITLE OF PAPER : MANAGEMENT SCIENCE**
- COURSE CODE : BA 412**
- TIME ALLOWED : THREE (3) HOURS**
- TOTAL MARKS : 100 MARKS**
- INSTRUCTIONS :**
- (1) TOTAL NUMBER OF QUESTIONS IN THIS PAPER IS FOUR (4)**
 - (2) THE PAPER CONSISTS OF SECTION A AND SECTION B.**
 - (3) ANSWER ALL QUESTION IN SECTION A WHICH IS COMPULSORY AND ANY TWO (2) QUESTIONS IN SECTION B.**
 - (4) THE MARKS ALLOCATED FOR A QUESTION / PART OF A QUESTION ARE INDICATED AT THE END OF EACH QUESTION / PART OF QUESTION.**
 - (5) WHERE APPLICABLE, ALL WORKINGS / CALCULATIONS MUST BE CLEARLY SHOWN.**

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

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

SECTION A (COMPULSORY) - 50 MARKS

Q1. Toyota Leites Pty is a large motor dealer with 12 showrooms in Southern Africa. In recent months, problems have arisen with the supply of new cars to customers as unanticipated delays have been occurring in the pre-delivery inspection stage. The system operated by Toyota Leites Pty is that all stocks of new cars are held in a central compound and, when a sale is made at any one of the showrooms, the order is telephoned through to the compound and the car in question is taken from stock and submitted for pre-delivery inspection at the company's main workshop. After the car has been inspected and any faults repaired, the car is delivered to the appropriate showroom for collection by the customer.

In recent months, the company has been selling new cars at a rate of about 38 per week with no significant seasonal variation. Furthermore it seems reasonable to assume that sales are occurring randomly throughout the week as no regular patterns are discernible. Pre-delivery inspection is carried out on a 'first-come-first-serve' basis and takes on average about 2 hours for all models. The workshop has 2 inspection bays and the engineers who carry out the pre-delivery inspections work a 40-hour week. When the inspection is completed, delivery to the showroom usually takes 1 working day. You may assume that inspection engineers work a 5 day week and you should ignore the effects of weekends.

Required:

(a). State four main conditions which must be satisfied by the pre-delivery inspection stage, if it is to be regarded as a multiple server (M/M/c) queuing situation. (10marks).

(b). Show that P_0 (the proportion of time that the workshop is idle) is 0.0256 and determine the average time which elapses between an order being placed and the car being delivered to the showroom. (20marks).

(c). In view of the delays which have been occurring, the company production manager has been asked to advise whether it would be worthwhile employing 2 extra engineers in the workshop at a total cost of E220 per week. It has been estimated that this would reduce the average inspection time to 1½ hours and the resulting earlier delivery would produce a saving of E2 per day for an average car as a result of earlier payment by the customer. Would you recommend that the 2 extra engineers should be employed?

You are reminded that, with an arrival rate of λ and a service rate of μ in each of 'c' channels:

$$\text{Average time in queue} = \frac{(\rho)^c P_0}{c!(1-\rho)^2 c\mu}$$

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$$\text{Average time in system} = \frac{(\rho c)^c P_0}{c!(1-\rho)^2 c\mu} + \frac{1}{\mu}$$

$$\text{Where: } P_0 = \left\{ \sum_{i=0}^{c-1} \frac{(\rho c)^i}{i!} + \frac{(\rho c)^c}{c!(1-\rho)} \right\}^{-1}$$

$$\text{And } \rho = \frac{\lambda}{c\mu} \quad (20\text{marks}).$$

SECTION B (ANSWER ANY TWO QUESTIONS) - 50 MARKS

Q2. 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:

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

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Q3. A theatre has to decide how many programmes to produce for a run of performances. The production cost of the programmes is made up of a fixed cost of E200 plus E0.30 for each copy. The programmes are sold for E0.60 each, and, in addition, there is advertising revenue of E300. From previous experience, it is estimated that the audience attendance will be:

<i>Total audience</i>	4000	4500	5000	5500	6000
<i>Probability</i>	0.1	0.3	0.3	0.2	0.1

It is expected that 40% of the audience will buy the programme.

Calculate:

- (a). Maximax payoff (10marks).
- (b). Minimax opportunity loss (10marks).
- (c). Expected payoff with perfect information (5marks).

Q4. From this LP equation:

$$\begin{aligned} \text{Min } C: & 630x_1 + 600x_2 + 708x_3 + 135x_4 \\ \text{s.t.} & \\ & \frac{7}{10}x_1 + \frac{1}{2}x_2 + x_3 + \frac{1}{10}x_4 \leq 10 \\ & x_1 + \frac{5}{6}x_2 + \frac{2}{3}x_3 + \frac{1}{4}x_4 \leq 9 \\ & x_1, x_2, x_3, x_4 \geq 0 \end{aligned}$$

- (a). Formulate the duality of this LP equation. (7marks).
- (b). Use the simplex method to solve the answer to *part a* (18marks).