

UNIVERSITY OF SWAZILAND

FACULTY OF COMMERCE

DEPARTMENT OF BUSINESS ADMINISTRATION

FINAL EXAMINATION PAPER

APRIL, 2008

(FULL TIME / IDE STUDENTS).

TITLE PAPER : MANAGEMENT SCIENCE

COURSE TITLE : BA 412

TIME ALLOWED : THREE (3) HOURS

- INSTRUCTIONS :**
- (1) TOTAL NUMBER OF QUESTIONS IN THIS PAPER IS FOUR (4)**
 - (2) THE PAPER CONSISTS OF SECTION A AND SECTION B.**
 - (3) ANSWER QUESTION IN SECTION A WHICH IS COMPULSORY AND ANY TWO (2) QUESTIONS IN SECTION B.**
 - (4) THE MARKS AWARDED 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)

Q1. Swazi Express is a small air freight company based in Matsapha and operating throughout Southern African Region. The company has six aircraft of different types, namely:

- 3 Type 'A'
- 2 Type 'B'
- 1 Type 'C'

whose operating costs and load carrying capacities are as follows:

<i>Aircraft type</i>	<i>Fixed cost (E per day)</i>	<i>Variable cost (E)</i>		<i>Capacity (kg)</i>
		<i>per km</i>	<i>per kg</i>	
A	800	0.60	30	10
B	700	0.40	35	8
C	500	1.00	25	4

For any trip, variable costs are assigned on the basis of both the distance flown and the load being carried. All fixed and variable cost components are then added to obtain the relevant total cost. On one particular day, there are five loads to be delivered to various destinations, the size of load and distances being:

<i>Load:</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
<i>Size (Kg):</i>	<i>10</i>	<i>2</i>	<i>8</i>	<i>5</i>	<i>3</i>
<i>Distance (Km):</i>	<i>200</i>	<i>550</i>	<i>320</i>	<i>280</i>	<i>450</i>

The distances given above are direct from the company's base in Matsapha to the location involved and in each case there is no return load so that the aircraft will fly back empty. This means mileage costs are incurred on both the outward and return trip, but the kilogramme cost is only incurred on the outward trip. All five return trips can be completed within one day and each aircraft can only fly one load in any one day. You may also assume that loads cannot be divided up and delivered in parts.

- (a). For each of the five loads, determine the cost of delivery using each of the feasible aircraft types. (15marks).
- (b). Set up the cost matrix for assigning each load to each particular aircraft. (5marks).
- (c). Using an appropriate procedure, decide which aircraft should be used for delivering each load so that total cost is minimised. (25marks).
- (d). What is the total cost for all the five deliveries? (5marks).

SECTION B (ANSWER ANY TWO QUESTIONS)

Q2. Solve this minimisation LP equation using simplex method:

$$\begin{aligned} \text{Minimise: } & 7x + 5y \\ \text{s.t.;} & \\ & x + y = 4 \\ & 9x + 6y \geq 30 \\ & 14x + 20y \geq 60 \\ & x, y \geq 0 \end{aligned}$$

(25marks).

Q3. The manager of a large supermarket is concerned about the long delays, which are occurring to the lorries waiting to deliver goods to the supermarket. Occasionally there are as many as 100 deliveries a week, and in some cases the lorry drivers have had to wait several hours before they can unload at the supermarket's one unloading bay. This has resulted in congestion in the streets surrounding the supermarket and frequent complaints from the lorry drivers. You have been asked to make recommendations for improving the situation and, as a first step, have collected the following data relating to the deliveries, which occurred last week:

<i>Number of lorries arriving per hour.</i>	<i>Number of hours</i>	<i>Unloading time (minutes)</i>	<i>Number of lorries</i>
0	7	0 – 20	38
1	10	20 – 40	26
2	8	40 – 60	10
3	8	60 – 80	3
4	5	80 – 100	2
5	2	100 – 120	1

Deliveries of goods are permitted between **9am and 5pm, Monday to Friday**. Any lorry that has arrived by 5pm can join the queue of lorries that are waiting to be unloaded. If necessary, the staffs of the unloading bay work overtime each evening to clear the queue of lorries, which arrived before 5pm.

Required:

(a). Explain carefully the conditions, which must be satisfied in order to apply the basic single server queuing model (M/M/1) to this situation. Explain also how you would use the data, which have been collected to test the appropriateness of the required assumptions. (It is not necessary to actually perform the tests you have described).

(5marks).

(b). Assuming that an M/M/1 model is appropriate, estimate how many lorries, on average, are waiting to be unloaded and also the time that a lorry would expect to spend at the supermarket. (10marks).

(c). The unloading bay is currently staffed by 2 employees who are each paid E100 for a 40-hour week, with any overtime being paid at time and a third. A suggestion has been made that a third person should be employed in the unloading bay which, it has been estimated, would result in a saving of 7 minutes in the average time to unload a lorry. This, it has been claimed, would not only reduce the lorry waiting time but would also produce a saving in cost to the supermarket. Analyze this suggestion and make a recommendation. (10marks).

Q4. The Department of Computer in UNISWA administers computer competency examinations every year. These exams allow students to “test out” of the introductory computer class held at the university. Results of the exams can be placed in one of the following four states:

State 1: pass all of the computer exams and be exempt from the course.

State 2: do not pass all of the computer exams on the third attempt and be required to take the course.

State 3: fail the computer exams on the first attempt.

State 4: fail the computer exams on the second attempt.

The course coordinator for the exams has noticed the following matrix of transition probabilities:

1	0	0	0
0	0	1	0
0.8	0.1	0	0.1
0.2	0.2	0.2	0.4

Currently, there are 200 students who did not pass all of the exams on the first attempt. In addition, there are 50 students who did not pass on the second attempt. In the long run, how many students will be exempted from the course by passing the exams? How many of the students will be required to take the computer course? (25marks).