UNIVERSITY OF SWAZILAND

FACULTY OF COMMERCE

DEPARTMENT OF BUSINESS ADMINISTRATION

FINAL EXAMINATION PAPER

MAY 2007

(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 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) 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.

GOOD LUCK!!!

SECTION A (ANSWER ANY TWO QUESTIONS)

Q1. Y Ltd 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 Y Ltd 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 two 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. (5marks).

(b). Show that P_o (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. (10marks).

(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:

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

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

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

And $\rho = \frac{\lambda}{c\mu}$ (10marks).

Q2. From this LP equation:

Max: $150x_1 + 200x_2 + 60x_3$

S.t.

$3x_1 + 5x_2 + 3x_3 \leq 40$

$5x_1 + 5x_2 + x_3 \leq 50$

$x_1, x_2, x_3 \geq 0.$

Required:

(a). Formulate the duality of this LP equation (5marks).

(b). Use the simplex method to solve the answer to ***part a*** (20marks).

Q3. From the following activities:

Activity:	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*
Preceding Activity(s):	-	-	-	*B*	*C,D*	*A,D*	*D*	*A*	*A,G*	*G*	*G*	*E,F,H,I,J,K*
Time weeks:	*2*	*4*	*3*	*3*	*1*	*3*	*6*	*4*	*2*	*3*	*5*	*1*

The whole process must be completed within a period of 17weeks.

(a). Draw the network diagram to represent the activities. Can it be completed within the specified time frame? (15marks).

(b). If it is necessary to reduce the time taken to complete the job, which activity(s) should be investigated and why? (4marks).

(c). Explain the difference between total float, free float and independent float. Show that activity **I** has a free float of 3 weeks, of which 2 weeks is independent float.(6marks).

SECTION B (ANSWER ANY TWO QUESTIONS)

Q4 (a). Lorries enter a cold store unloading area randomly throughout the week, 24 hours, 7 days a week, at a mean rate of 2.5 per hour. If it takes exactly 15 minutes to unload each lorry, for what number of hours in a week will the unloading bay be unable to cope? (7marks).

(b). The demand for a stores item is Poisson with a mean number of 5 per 5 working days. What is the probability that the time between requests is:

(i). greater than 2 days? (3marks).

(ii). between 3 and 4 days? (3marks).

(iii). less than 1 day? (3marks).

(c). New clients visit a solicitor's office at random throughout the week. One solicitor is designated to deal with the initial interviews. The office is open from 9am to 5pm. The mean arrival rate is 2 per hour, and it takes an average of 20 minutes to deal with each client. Assume Poisson processes for both arrival and service times.
Calculate:

(i). how many clients on average will be waiting to see the solicitor? (3marks).

(ii). how long will they have to wait on average? (3marks).

(iii). what is the probability that no one will be waiting when a client arrives? (3marks).

Q5. 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	1	0	0
0.8	0	0.1	0.1
0.2	0.2	0.4	0.2

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).

Q6. 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:

Total audience	*4000*	*4500*	*5000*	*5500*	*6000*
Probability	*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 (4marks).
(b). Maximin payoff (4marks).
(c). Minimax opportunity loss (4marks).
(d). Maximum expected payoff (4marks).
(e). Minimum expected opportunity loss (4marks).
(f). Value of perfect information. (5marks).