UNIVERSITY OF SWAZILAND

FACULTY OF COMMERCE

DEPARTMENT OF BUSINESS ADMINISTRATION

SUPPLEMENTARY EXAMINATION PAPER

JULY 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 ALL QUESTIONS IN SECTION A AND ANY TWO (2) QUESTIONS FROM 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.

GOOD LUCK!!!

SECTION A (ANSWER THE TWO QUESTIONS)

QUESTION 1

a) Sir Khumalo, an all timer investor has E700,000 for investing in several alternatives. The alternative investments are municipal bonds with an 8.5% return, certificates of deposit with a 10% return, treasury bills with a 6.5% return , and income bonds with a 13% return. The amount of time until maturity is the same for each alternative. However, each investment alternative has a different perceived risk to the investor, thus creating a desire to diversify. The investor wants to know how much to invest in each alternative in order to maximise the return.

The following guidelines have been established for deversifying the investments and lessening the risk perceived by the investor.

i) No more than 20% of the total investment should be in income bonds.

ii) The amount invested in certificate of deposit should not exceed the amount invested in the other three alternatives.

iii) At least 30% of the investment should be in treasury bills and certificates of deposit.

iv) The ratio of the amount invested in municipal bonds to the amount invested in treasury bills should not exceed one to three.

The investor wants to invest the entire E700,000.

Required: Formulate the Linear Programming Model.   [10 marks]

b) Solve the following Linear Programming problem using Simplex Method.

Max : $4x_1$ + $6x_2$ + $3x_3$ + $1x_4$

Subject to:

$$\frac{3}{2}x_1 + 2x_2 + 4x_3 + 3x_4 \leq 550$$

$$4x_1 + 1x_2 + 2x_3 + 1x_4 \leq 700$$

$$2x_1 + 3x_2 + 1x_3 + 2x_4 \leq 200$$

$$x_1, \quad x_2, \quad x_3, \quad x_4 \quad \geq \quad 0 \qquad \text{[15 marks]}$$

QUESTION 2

The government of the Kingdom of Swaziland has decided, as a matter of top priority, to build a new road joining the two main cities of Siteki and Manzini. Because of the need to complete the project as quickly as possible, the work has been divided into five stages which are to be built simultaneously. Within Swaziland, there are six companies large enough to undertake the construction of any of the five stages and each company has been invited to submit a tender for each stage of the project. The tenders (in millions of Emalangeni) are as follows:

COMPANY	STAGE				
	1	2	3	4	5
A	49	84	63	82	68
B	53	92	62	No Bid	67
C	54	86	67	78	68
D	46	86	62	76	No Bid
E	57	94	66	83	70
F	50	82	65	80	72

Required:

a)   Assuming that none of the companies is large enough to undertake the work of more than one stage, advise the government how the five contracts should be allocated.

[20 marks]

b)   What is the minimum total cost for the project?   [5 marks]

SECTION B (ANSWER ANY TWO QUESTIONS)

QUESTION 3

The Young Shall Grow an Hauling Company has seven cabs stationed at the airport. The company has determined that during the late evening hours on weeknights, customers request cabs at a rate that follows the Poisson distribution with a mean of 6.6 per hour. Service time is exponentially defined with a mean of 50 minutes per customer.

Assume that there is one customer per cab. Determine:

i)   Average number of customer in line.   [4 marks]

ii)   Find the probability of zero customer in the system.   [4 marks]

iii)   Average waiting time for a customer not immediately served.   [4 marks]

iv)   The probability that an arrival will have to wait for service.   [4 marks]

v)   The system utilization.   [4 marks]

b.   The Young shall Grow an Hauling Company also plans to have cabs at a new rail station.
        The expected arrival rate is 4.8 customers per hour; and the Service rate (including return
        time to the rail station) is expected to be 1.5 per hour. How many cabs will be needed to
        achieve an average time in line of 20 minutes or less?   [5 marks]

QUESTION 4

Cadmus, Carna and Clytie, a firm of the Investment Consultant have been approached by one of their
clients with regard to the investment of a sum of E100,000 over a period of two years. After a
thorough survey of the available opportunities, two alternatives (A and B) are proposed, one
involving a small amount of risk, the other being risk free.

Investment A will lead to a return of either 8%, 10% or 12% in each year but, due to the nature of
the investment, there will be some correlation between year 1 and year 2 returns. This is shown by
the following table which gives the probability of various returns in year 2 given the returns in year
1.

YEAR 1	YEAR 2		
	8%	10%	12%
8%	0.6	0.3	0.1
10%	0.2	0.5	0.3
12%	0.1	0.2	0.7

At this stage, the three different returns in year 1 are considered to be equally likely. Investment B
will produce a certain return of 9.5% per year. You may ignore the effects of taxation, and you may
assume that the interest earned in Year 1 is re-invested for the second year.

Required:

Assuming that whichever alternative is chosen, the investment will be made for the full two year
period:

a) Draw a decision tree to represent the alternative courses of action and outcomes.

[15 marks]

b) On the basis of the expected value of returns, which investment would you recommend?

[5 marks]

c) What is the probability that investment B produces a greater return than investment A?

[5 marks]

QUESTION 5

Acer Computer Systems Limited are preparing a customer order. The relevant data are given below:

Activity	Immediate Preceeding activity	Time, days Optimistic	Most likely	Pessimistic	Cost, E, at Expected Duration
A	-	3	4	5	1,000
B	-	4	7	10	1,400
C	-	4	5	6	2,000
D	A	5	6	7	1,200
E	B	2	2.5	6	900
F	C	10	10.5	14	2,500
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?

[14 marks]

b)   What is the critical path? Comment on the durations of the non-critical paths.   [5 marks]

c)   What is the probability that the project could be completed without incurring any penalty charge?   [6 marks]

QUESTION 6

A certain item is produced in batches of size Q to meet a constant demand of D per year. The manufacturing cost is \$C per item and the stockholding cost is \$H per item per year. Each production run commences when stock falls to zero and the cost of setting up the production facilities is \$S per run.   You may assume that production takes place relatively quickly such that stock replenishment is effectively instantaneous.

Required:

a)   Write down an expression for the total annual production cost which comprises manufacturing, set up and stockholding costs. Show that at the economic batch quantity (EBQ), the total annual set-up cost is equal to the total annual stockholding cost. (It is not necessary to derive the expression for the EBQ).   [10marks].

b)   Experience has shown that the manufacturing cost accounts for about 75% of the total production cost when EBQ are used.

   i)   What percentage increase in total production cost will result if the batch size is increased by 50% from the EBQ?   [4 marks]

   ii)   What percentage increase in total production cost will result if the batch size is decreased by 50% from the EBQ?   [4 marks]

   iii)   If the batch size is doubled, there will be a saving of 5% in the manufacturing cost due to more efficient working. Show that this saving of 5% will not lead to a lower total annual production cost. How large a saving in manufacturing cost is necessary for it to be economical to double the batch size?   [7 marks]