MACHAKOS UNIVERSITY

University Examinations 2019/2020
SCHOOL OF PURE AND APPLIED SCIENCES
DEPARTMENT OF MATHEMATICS, STATISTICS AND ACTUARIAL SCIENCE
FOURTH YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR
BACHELOR OF SCIENCE (STATISTICS AND PROGRAMMING0

SST 401 -DECISION THEORY

DATE: **TIME:**

INSTRUCTIONS:
Answer question ONE and any other TWO questions

QUESTION ONE (30 MARKS)

a) Explain the meaning of the following terms as applied in decision theory
   i) States of nature
   ii) Pay-off
   iii) Decision tree diagram (6 marks)

b) Differentiate between each of the following terms as applied in decision theory
   i) Decision node and outcome node
   ii) Marginal profit and Marginal loss (4 marks)

c) A businessman has three alternatives open to him each of which can be followed by any of the four possible events. The conditional payoff(insh) for each action-event is as shown below;

Alternatives	Payoff conditional on events			
	P	Q	R	S
A	8	0	-10	6
B	-4	12	18	-2
C	14	6	0	8

Determine which alternative the business should choose, if he adopts the Laplace decision criterion (5 marks)

d) Morning daily newspaper are placed in an automatic vending machine. The newspaper cost 10 cents each to manufacture and sales for 25 cents each. Any newspapers not sold by the end of the day are of little value and are sent for recycling. If the newspapers are all sold, the machine is not replenished until next day. The overall daily sale including home delivery and all other outlets of newspaper has averaged 80,000 units with a standard deviation of 4000 units. Assuming demand is normally distributed, determine how many newspaper should the company print each daily (5 marks)

e) A manager has a choice between;

i) A risky contract promising sh 7 million with a probability0.6 and sh 4 million with a probability 0.4 and

ii) A diversified portfolio consisting of two contracts with independent outcomes each promising sh 3.5 million with probability 0.6 and sh 2 million with probability 0.4.

i) Construct a decision tree. (7 marks)

ii) Using the decision tree diagram in (i) above and the EMV criterion, help the manager to make a choice. (3 marks)

QUESTION TWO (20 MARKS)

a) Bev's Bakery specializes in sourdough bread. Each morning. Bev must decide how many loaves to bake for the day. Each loaf costs $0.35 to make and sells for $1.15.Bread left over at the end of the day gets spoiled and is thrown away. Past data indicate that demand is as follows

Number of loaves	Probability
15	0.05
16	0.05
17	0.10
18	0.10
19	0.20
20	0.40
21	0.05
22	0.05

Determine the optimal quantity for Bev to bake to maximize production. (8 marks)

b) A company has three different security systems models namely: standard, deluxe, and super. An analysis of the probable acceptance of the models has been carried out and the pay –off table is shown below;

Model acceptance	Acceptance probability	Profit sh'000' (Model type) Standard	Deluxe	Super
Excellent	0.2	60	100	20
Moderate	0.5	40	60	80
Poor	0.3	20	0	-40

i) Decide which model should be introduced to the market using:

- Expected pay off criterion (4 marks)
- Maximax decision criterion. (4 marks)

ii) In the context of this question outline briefly the limitations of the two decision criteria used. (2 marks)

iii) What would be the value of knowing the model acceptance level before making the decision on which model to produce? (2 marks)

QUESTION THREE (20 MARKS)

a) The following payoff table provides the profits for each of four alternatives in each of the three states of nature;

Alternatives	States of nature		
	X	Y	Z
D1	120	60	-20
D2	90	80	100
D3	81	81	81
D4	-50	90	110

The probabilities for the states of nature are; P(X)=0.8,P(Y)=0.1,and P(Z)=0.1

i) Develop the opportunity loss table. (4 marks)

ii) Hence use the Expected opportunity Loss value to determine the best decision. (6 marks)

b) A security company has to decide whether to develop a new type of security device. If it does go ahead, successful completion depends on a research breakthrough. There is thought to be a 60 per cent chance of achieving. If the device is successfully developed, the payoff is a profit of $900000; if the development is attempted but not completed, there will be a loss of $400000.All overheads and other sunk costs should be ignored.

i) Draw a decision tree for the information (3 marks)

ii) Determine the expected monetary value (EMV) of the whole decision (2 marks)

iii) Explain whether the term "perfect information" mean that the payoff of $900000 would certainly be achieved (2 marks)

iv) Calculate the expected value of the perfect information. (3 marks)

QUESTION FOUR (20 MARKS)

a) In the past few years, the traffic problem in McKell's hometown have gotten worse. Now Broad street is congested about half the time. The normal travel time for McKell is only 15 minutes when Broad Street is used and there is no congestion. With congestion, however, it takes McKell 40 minutes to get ton work. If McKell decides to take the expressway, it will take 30 minutes regardless of the traffic conditions. McKell's utility for travel time is (15minutes) =0.9,U(30minutes)=0.7,U(40 minutes)=0.2

i. Determine which route will minimize McKell's travel time. (5 marks)

ii. Determine which route will maximize McKell's utility. (4 marks)

iii. With a reason is McKell a risk seeker or a risk avoider. (1 mark)

b) Consider the following pay-off table

	Act					
Event	probability	A1	A2	A3	A4	A5
E1	0.2	10	20	10	15	20
E2	0.2	-5	10	-5	10	-5
E3	0.6	15	5	10	10	10

i. Construct an opportunity loss table (4 marks)

ii. Calculate the expected loss for each act (5 marks)

iii. Which act yields the lowest expected opportunity loss (1 mark)

QUESTION FIVE

a) Consider the following pay-off matrix table

	Act			
Event	Probability	C1	C2	C3
B1	0.3	10	20	30
B2	0.5	40	-10	20
B3	0.2	20	50	50

i) Determine which act to choose using the maximum expected pay-off (4 marks)

ii) Determine the expected pay-off under certainty(with perfect information. (4 marks)

iii) Using the answers in (i) and (ii) above calculate the expected value of perfect information. (2 marks)

b) Developing a small driving range for golfers of all abilities has been a desire of John. He however, believes that the chance of a successful driving range is only about 40%.A friend of John has suggested that he conduct a survey in the community to get a better feeling of the demand for such a facility. There is a 0.9 probability that the research will be favorable if the driving range facility will be successful. It is also estimated that there is a 0.8 probability that the marketing research will be unfavorable if indeed the facility will be unsuccessful. Using Bayes theorem determine the chances of a successful driving range given a favorable result from the marketing survey. (10 marks)

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