



MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR BACHELOR OF SCIENCE

(MATHEMATICS)

SST 401: DECISION THEORY

DATE: 1/8/2017

TIME: 8:30 – 10:30 AM

INSTRUCTIONS

Answer question ONE (Compulsory) and any other TWO questions

QUESTION ONE (30 MARKS)

1. a) Explain the meaning of the following terms as applied in decision theory
 - i. States of nature
 - ii. Maximin rule
 - iii. Opportunity loss
 - iv. Roll-back technique (8 marks)
- b) State and explain two types of nodes used in construction of decision trees. (4 marks)
- c) Differentiate between Marginal loss and Marginal profit. (4 marks)
- d) 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			
	A	B	C	D
P	8	0	-10	6
Q	-4	12	18	-2
R	14	6	0	8

Determine which alternative should the business choose, if he adopts the

- Laplace (Equally likely)) criterion. (4 marks)
 - Minimax regret criterion. (4 marks)
- e) The marginal loss on Washington Reds, a brand of apples from the state of Washington is \$35 per case and the marginal profit is \$15 per case. During the past one month, the mean sales of Washington Reds in cases was 45000 cases and the standard deviation was 4450. Assuming that the sales follow a normal distribution, determine how many cases of Washington Reds should be brought to the market. (6 marks)

2. a) Rick Miller has just opened a new bakery in Frisco, Colorado, called morning Fresh. In performing an economic analysis, Rick has determined that the marginal cost or loss for each dozen doughnuts sold is \$4. The marginal profit is estimated to be \$2.75 per dozen doughnuts. At this time Rick is considering stocking 10, 15, 20, 25, or 30 dozen doughnuts. The probability of selling 10 dozen doughnuts is 10%, 15 dozen doughnuts is 20%, and 30% chance that the bakery can sell either 20 or 25 dozen doughnuts. There is also 10% chance of selling 30 dozen doughnuts, which is considered by Rick to be the most that Morning Fresh would accommodate. Use marginal analysis to advise Rick. (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)

3. A general road constructor receives a bonus for each day of early completion of the project before the final contract deadline. He has a choice of using three different sub contractors. The ability of each of the subcontractors to finish the job is influenced by the type of weather conditions. The general contractor estimates the number of days that each subcontractor will be able to finish early for each type of weather conditions. This summary is given below along with the general contractor's estimates of the probabilities for each weather condition

	Type of weather condition			
	Number of days ahead of schedule			
	Clear (0.4)	Light rain (0.3)	Heavy rain (0.1)	Rain with heavy wind(0.2)
Subcontractor 1	14	10	9	6
Subcontractor 3	12	9	7	8
Subcontractor 3	16	11	6	5

- i Draw a decision tree representing the possible decisions and states of nature. (16 marks)
- ii Advise the contractor on which subcontractor to use. (4 marks)
4. a) In the past few years, the traffic problem in Lynn McKell's hometown have gotten worse. Now, Broad street is congested about half the time. The normal travel time for Lynn is only 15 minutes when Broad Street is used and there is no congestion. With congestion, however, it takes Lynn 40 minutes to get to work. If Lynn decides to take the expressway, it will take 30 minutes regardless of the traffic conditions. Lynn's utility for travel time is $U(15 \text{ minutes}) = 0.9$, $U(30 \text{ minutes}) = 0.7$, $U(40 \text{ minutes}) = 0.2$
- i. Determine which route will minimize Lynn's travel time. (5 marks)
- ii. Determine which route will maximize Lynn's utility. (4 marks)
- iii. With a reason is Lynn a risk seeker or a risk avoider. (1 mark)

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

Alternatives	States of nature		
	A	B	C
1	120	60	-20
2	90	80	100
3	81	81	81
4	-50	90	110

The probabilities for the states of nature are; $P(A)=0.8, P(B)=0.1$, and $P(C)=0.1$

- i) Develop the opportunity loss table. (4 marks)
 - ii) Hence use the Expected Opportunity Loss value to determine the best decision. (6 marks)
5. a) An electrical 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)
- 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)