King Saud University
College of Computer and Information Sciences
Information Systems Department

Course Code/Title: IS 466 (Decision Support System)
TOTAL MARKS: 40
Exam: **FINAL** **Semester / Year**: Spring 2016-17
Exam date: May 11, 2017
Time Allowed: 90 minutes

Student ID: _____ Name: _____

EXAM POLICY&ETHICS:

- Read the paper carefully, should have any query be asked within first 15 minutes.
- Closed-book exam, no course-related papers are allowed.
- During examination, any form of communications with peer students is strictly forbidden.
- Students will not be allowed to attend the exam if arrived 20 minutes after the exam starts.
- Mobile phones should strictly be off.

QUESTIONS/ STUDENT OUTCOMES: This exam covers the following student outcomes (SOs):

Outcomes Covered	Questions	TOTAL
	Question 1	**/10**
	Question 2	**/6**
	Question 3	**/4**
	Question 4	**/6**
	Question 5	**/6**
	Question 6	**/8**
	Total	**/40**

Question No. 1. (10 marks) Select the correct answers from the following MCQs.

1. Which of the following statements is true?
   (i) The EVPI can be determined without using probabilities.
   (ii) **A decision tree usually begins with a decision node.**
   (iii) Payoff tables will always contain positive numbers.

2. A bad decision is:
   (i) does not employ appropriate decision modeling techniques
   (ii) does not use all available information
   (iii) does not consider all alternatives
   (iv) **all the above**

3. When a forecast is close to the actual values and considered as a 'good' forecast then the measure of forecast error called MAPE is:
   (i) close to 1
   (ii) close −1
   (iii) close to 0
   (iv) close to 0.5

4. The weight values used in the weighted moving average are:
   (i) each weight is assigned an equal value
   (ii) determined by a formula.
   (iii) **assigned some arbitrarily chosen values, where most recent has high weighted.**
   (iv) assigned so that the sum of the weights is equal to 10.

5. The maximin criterion is a feature of which of the following?
   (i) Decision-making under certainty
   (ii) Optimization
   (iii) **Decisio**n-making under uncertainty
   (iv) Deterministic model

6. In order to use Bayes' Theorem to calculate the P(A/B), it is necessary to know which of the following:
   (i) P(B) and P(B/A)
   (ii) **P(A), P(B), and P(B/A)**
   (iii) P(A) and P(B/A)
   (iv) P(A) and P(B)

7. The EVSI is always:
   (i) smaller than the expected value of the best decision without sample information
   (ii) greater than the EVPI
   (iii) **non-negative**

8. When making a decision under risk, which of the following is a valid decision-making criterion?
   (i) **Minimize** expected opportunity loss
   (ii) Maximin
   (iii) Minimax regret
   (iv) Maximax

9. Which of the following occurs in decision making under uncertainty?
   (i) Conditional probabilities.
   (ii) Equally likely probabilities for all states of nature.
   (iii) **A payoff table for each possible combination of decisions and outcomes.**
   (iv) Exactly one state of nature.

10. The expected value of perfect information is calculated by subtracting:
   (i) **the maximum EV from the expected return with perfect information.**
   (ii) EVSI from the expected return with perfect information.
   (iii) the maximum EV from the minimum expected opportunity loss.
   (iv) the minimum expected opportunity loss from the expected opportunity loss with perfect information.

11. Which of the following statements is true?
(i) The maximax criterion is a conservative approach to decision making.
(ii) **Someone who is indifferent to risk would have a utility function that is a straight line.**
(iii)Prior probabilities are probability estimates after a test market.
(iv)Maximin, maximax, and minimax regret criterion all lead to the same optimal decision.

12. A joint probability is:
(i) P(B).
(ii) P(B/A).
(iii)P(A/B).
(iv)**P(A and B).**

13. The minimax criteria finds the alternative that:
(i) **minimize the maximize the opportunity loss of all the alternatives**
(ii) minimize the maximize the profit of all the alternatives

14. Annual time series data of air conditioner sales will consist of what time series components?
(i) Cycles, Random
(ii) Trend, Cycles
(iii)Seasonality, Random
(iv)**Trend, Cycles, Random**

15. Which of the following statements is true?
(i) MAD penalizes a forecasting technique more for larger errors than MSE does.
(ii) Trend always measures the linear increase in a certain variable over time.
(iii)**Cyclical variations cover longer periods of time than do seasonal variations**.
(iv)Business cycles are seasonal variations.

16. A forecasting model with $\alpha = 0.4$ will respond more quickly to past changes in the data than a forecasting model with $\alpha =$ _____?
(i) 0.5
(ii) 0.8
(iii)0**.2**
(iv)0.4

17. One way to increase the probability of identifying the optimal decision when using a simulation is to:
(i) use a discrete instead of continuous random variable.
(ii) change the assignment of the random numbers.
(iii)**increase the number of iterations of the simulation.**
(iv)include more random variables in the simulation.

18. What kind of probabilities is found by summing all the previous probabilities up to the current random variable value?
(i) **Cumulative**
(ii) Marginal
(iii)Conditional
(iv)Joint

19. Given a _____ and a set of _____ , the _____ defines a mapping between them.
(i) Classification , database, classes
(ii) **Database, classes, classification problem**
(iii)Classes, classification problem, database
(iv)Database, classification problem, classes

20. _____ type of modeling system which does not interfere with the real-world system.
(i) Analytical
(ii) **Simulation**
(iii)Hybrid
(iv)All of above

Question No. 2. Consider the following payoff table with three state, three decision problem and two decision makers with corresponding utility values. Find the optimal decision for decision maker I and decision maker II under the "Expected Utility Criterion"? (6 points)

Decision	The Payoff Table		
Alternative	S1	S2	S3
Currency	100,000	40,000	-60,000
Holding	50,000	20,000	-30,000
Gold	20,000	20,000	-10,000
Prob.	0.1	0.3	0.6

Decision	Utility	
Amount	Decision Maker I	Decision Maker II
100,000	100	100
50,000	94	58
40,000	90	50
20,000	70	40
-10,000	50	16
-30,000	40	10
-60,000	30	5

	Decision Maker I				Decision Maker II			
Alternative	S1	S2	S3	Expected Utility	S1	S2	S3	Expected Utility
Currency	100	90	0	37	100	50	0	25
Holding	94	70	40	54.4	58	40	10	23.8
Gold	70	70	50	**58**	40	40	16	**25.6**
Probability								

Question No. 3. Consider the payoff table for decision making under risk, find the optimal decision under the "Expected value Criterion"? (4 points)

Decision	The Expected value Criteria					
Alternative	Large Rise	Small Rise	No Change	Small Fall	Large Fall	Expected value
Gold	-100	100	200	300	0	100
Stock	200	150	150	-200	-150	95
Bond	250	200	150	-100	-150	130
C/D account	60	60	60	60	60	60
Prior Prob.	0.2	0.3	0.3	0.1	0.1	

Question No. 4. (6 marks)The daily demand of with probabilities are given in the following table.

a) Calculate the cumulative probability and random interval, simulate the demand for the given random numbers.

No.	Daily Demand	Probability	Cumulative Probability	Random # Interval
1	10	0.1	0.1	01-10
2	15	0.15	0.25	11-25
3	20	0.2	0.45	26-45
4	25	0.15	0.6	46-60
5	30	0.05	0.65	61-65
6	35	0.2	0.85	66-85
7	40	0.05	0.9	86-90
8	45	0.1	1.0	91-100

Random Number	Simulate Daily Demand
52	25
37	20
82	35
69	35
98	45
96	45
33	20
50	25
88	40
90	40
	330

b) Calculate the average simulated daily demand = 330/10 = 33.0

c) Calculate the expected daily demand without simulation?

Expected demand = $\sum$((i demand value) × (Probability of i demand value))

= (10 × 0.10) + (15 × 0.15) +(20 × 0.20) +(25 × 0.15) + (30 × 0.05) + (35 × 0.20) +(40 × 0.05) +(45 × 0.10) =**26**

Question No. 5. (6 marks) Suppose we have five symbols A B C D E with probabilities:

P_A= 1/4 P_B= 1/8 P_C= 1/8 P_D= 1/4 P_E= 1/4

Calculate (i) entropy (H) and (ii) information quantity (I) ?

H(A) = $\log_2(P_A)$ = 2 bits
H(B) = $\log_2(P_B)$ = 3 bits
H(C) = $\log_2(P_C)$ = 3 bits
H(D) = $\log_2(P_D)$ = 2 bits
H(E) = $\log_2(P_E)$ = 2 bits

Information Quantity (I) = ¼(2) + 1/8(3) + 1/8(3) + 1/4(2) + ¼(2) **= 2.5**

If code (**A**) = 01, code (**B**) = 001, code (**C**) = 101, code (**D**) = 10, code (**E**) = 11

So string of 5 symbols **ADDCBE** is _01101010100111 (14 bits)

For **ADDCBE** symbols we need ___14____ bits, the average bits per symbol is _2.33_____

Question No. 6. (8 marks)Let **S** is the sample of training data, in which **s** is element from S

p element of class P: buys_computer = "yes"

n element of class N: buys_computer = "no"

age	income	student	credit_rating	buys_computer
<=30	high	no	fair	no
<=30	high	no	excellent	no
31…40	high	no	fair	yes
>40	medium	no	fair	yes
>40	low	yes	fair	yes
>40	low	yes	excellent	no
31…40	low	yes	excellent	yes
<=30	medium	no	fair	no
<=30	low	yes	fair	yes
>40	medium	yes	fair	yes
<=30	medium	yes	excellent	yes
31…40	medium	no	excellent	yes
31…40	high	yes	fair	yes
>40	medium	no	excellent	no

age	pi	ni	I(pi,ni)
<=30	3	1	0.81
31 - 40	4	2	0.918
>40	2	2	0.971

a. Calculate the information quantity { I(p,n)} needed to decide whether s belongs to P or N?

I(p,n) = -9/14{log2 (9/14)} -5/14{log2(5/14)} = 0.940

b. Find (i) Entropy (E) and (ii) gain (G) for attribute **age** E(age) = 0.694 and Gain (age) = 0.246?

E(age) = 4/14(0.971) + 6/14(0) + 4/14(0.971) = 0.910
Gain (age) = I(p,n) – E(age) = 0.940 – 0.910 = 0.03