FINAL EXAM
SECOND SEMESTER SESSION 2011/2012

COURSE CODE / NAME : STQS1023 / STATISTICS FOR INFORMATION TECHNOLOGY
DATE : 07 JUNE 2012 (THURSDAY)
TIME : 2.30 – 5.00 P.M. (2 ½ HOURS)
VENUE : BK8 (FWB), BK7 (FWB)

INSTRUCTION :

1. This examination booklet contains THIRTY (30) structured questions on FIFTEEN (15) printed pages excluding the cover page and the list of formula pages. The list of formula is attached at page SIXTEEN(16) to page NINETEEN (19).
2. Answer ALL QUESTIONS in the space provided WITHIN THIS EXAM BOOKLET.
3. SUBMIT THIS EXAM BOOKLET containing your complete answer to the exam invigilator.

MATRIC NO : ____________________________

( with word )

IDENTIFICATION CARD NO. :

LECTURER : ____________________________

GROUP : ________ TABLE NO. : ________

DO NOT OPEN THIS EXAMINATION PAPER UNTIL INSTRUCTED
ANSWER ALL QUESTIONS

1. Which of the following variables are quantitative and which are qualitative? Classify the quantitative variables as discrete or continuous.

   a. Color of eyes of people

   (1 mark)

   b. Price of a concert ticket

   (1 mark)

   c. Number of televisions owned by families

   (1 mark)

2. You select 45 students from a class of 100 at random and ask them if they enjoy their math classes. You next enter the name and response of each of the students into a database for future reference. Identify the population, the sample, and the variables. Will the data collected be quantitative or qualitative?

(4 marks)
3. A researcher asks 24 mothers, who work outside their homes, whether or not they
would work outside their homes if they had enough money to live comfortably. The
following are the responses of these 24 mothers. (N stands for no, Y represents yes, and
D means does not know).

\[
\begin{array}{cccccccc}
N & D & Y & D & N & N & Y & N \\
N & N & D & Y & Y & Y & N & N \\
N & N & D & Y & D & & & \\
\end{array}
\]

Prepare a frequency distribution table and find the relative frequencies and percentages
for all categories.  

(3 marks)

4. The following table gives the frequency distribution of weekly salaries of 200 workers.

<table>
<thead>
<tr>
<th>Weekly Salaries ($)</th>
<th>( f )</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 to less than 400</td>
<td>18</td>
</tr>
<tr>
<td>400 to less than 500</td>
<td>22</td>
</tr>
<tr>
<td>500 to less than 600</td>
<td>27</td>
</tr>
<tr>
<td>600 to less than 700</td>
<td>55</td>
</tr>
<tr>
<td>700 to less than 800</td>
<td>30</td>
</tr>
<tr>
<td>800 to less than 900</td>
<td>33</td>
</tr>
<tr>
<td>900 to less than 1000</td>
<td>15</td>
</tr>
</tbody>
</table>

a. List the class midpoints.  

(1 mark)
b. Do all classes have the same width? If yes, what is that width? (1 mark)

c. Prepare the relative frequency and percentage distribution columns. (2 marks)

5. The following data give the food expenditures (in dollars) for the past month for nine families.

421  365  478  292  584  433  385  659  510

Construct a box plot. (4 marks)
6. The following data give the repair costs (\$) for a sample of 10 cars repaired at an auto garage during the past month.

\[
195 \quad 87 \quad 234 \quad 73 \quad 59 \quad 143 \quad 121 \quad 97 \quad 167 \quad 206
\]

Find the variance, and standard deviation. \((3 \text{ marks})\)

7. An ordinary deck of playing cards has 52 cards. There are four suits (spades, hearts, diamonds and clubs). Each suit contains 13 cards. Spades and clubs are black. Hearts and diamonds are red. If one of the cards is selected at random, what is the probability that the card is
   a. a hearts. \((2 \text{ marks})\)
   b. not a diamond. \((2 \text{ marks})\)
8. Based on Question no. (7), let $A =$ event the cards is selected a spade. Construct a Venn diagram to show that the event the cards is selected is not a spade. 

(2 marks)

9. The following table gives a two-way classification of 1000 couples based on whether one or both spouses work and whether or not they have children.

a. $P$ (both spouses work or have no children) 

(2 marks)

b. $P$ (only one spouse works or have children) 

(2 marks)

10. The probability that a faculty member at a large university is a female is 0.60. The probability that a faculty member is a female and holds a doctoral degree is 0.24. Find the probability that a randomly selected faculty member from this university holds a doctoral degree given she is a female. 

(2 marks)
11. When a balanced dice is rolled, 6 equally likely outcomes are possible. Let \( X \) denotes the value of the dice.

   a. Find the possible values of the random variable \( Y \)?
   
   (1 mark)

   b. Find \( P(X = 6) \)
   
   (1 mark)

12. The editor of a journal historically accepts 15 percent of articles submitted for publication. Using the binomial formula, find the probability that in a random sample of eight articles submitted to this journal, the editor will accept exactly three for publication.
   
   (2 marks)
13. On average, 9.2 customers visit a store per hour. Calculate the probability that during a given hour exactly nine customers will visit this store. Use the Poisson formula. (2 marks)

14. Determine the following probabilities for the standard normal distribution.
   a. $P(0 \leq z \leq 2.32)$ (2 marks)
   b. $P(-2.71 \leq z \leq 0)$ (2 marks)
15. The waiting times for all customers at a supermarket produce a normal distribution with a mean of 6.5 minutes and a standard deviation of 2.5 minutes. Find the percentages that the waiting time for a randomly selected customer at this supermarket will be more than 5.25 minutes.

(3 marks)

16. The weekly earnings of all workers at a very large company produce a normal distribution with a mean of $2010 and a standard deviation of $360. Find the probability that the weekly earnings of a randomly selected worker from this company will be between $1740 and $2676.

(3 marks)
17. Players of a casino game pick a number from 1 to 36. A roulette wheel is then spun, and players win if their number comes up, and lose if it does not. Players can choose only one number per spin. Assume that a player plays the game 360 times. Using the normal approximation to the binomial distribution, calculate the probability that the player wins exactly nine times.

(5 marks)

18. The heights of all female college basketball players have a normal distribution with a mean of 68 inches and a standard deviation of 2 inches. You extract a random sample of 49 female college basketball players. Find the percentages that the mean height of the sample will be between 68.25 and 68.5 inches.

(4 marks)
19. The weekly earnings of all families in a large city have a mean of RM 780 and a standard deviation of RM 150. You select a random sample of 36 families from this city. Find the probability that the mean weekly earnings of the sample will be less than RM 748.75.

(3 marks)

20. Identify the $z$ value for a 95% and 99% confidence interval for the population mean.

(1 mark)

21. A scientist is studying the paramecium, a one-celled organism, under a microscope. There are 1500 paramecia in the slide he is studying, and the standard deviation of their lengths is 0.12 mm. He views a sample of 30 paramecia, and finds that the mean length of these 30 specimens is 0.25 mm. What is the point estimate of the mean length of the entire paramecium population in the slide? Find a 95% confidence interval for the mean length of the population.

(5 marks)
22. Candidates for administrative support positions at a large company must take a keyboarding test as part of the hiring process. We choose five of the candidates at random and find that the mean keyboard speed of the five candidates is 54.7 words per minute with a standard deviation of 3.21 words per minute. Construct a 98% confidence interval for the mean keyboard speed of all candidates, assuming a normal distribution for the population.

(4 marks)

23. Find the probability value (p-value) for each of the following hypothesis tests:

\[ H_0 : \mu = 50, \quad H_1 : \mu \neq 50, \quad n = 60, \quad \bar{x} = 47, \quad \sigma = 10 \]

(2 marks)

24. Write the null and alternative hypotheses for each of the following examples. Determine if each is a case of a two-tailed, a left-tailed, or a right-tailed test.

a. The one-gallon apple juice jugs contain on average less than one gallon of juice.

(2 marks)
b. The mean height of all college female basketball players is different from 68 inches.

(2 marks)

25. An auto company claims that the mean value of cars owned by all people in Thailand is $11,250. A sample of 500 cars gave a mean value of $10,840 with a standard deviation of $2475. Test at the 1% significance level (using critical-value approach) if the mean value of cars owned by all people in Thailand is less than $11,250.

(4 marks)

26. A health club manager claims that its members lose an average of 15 pounds during the first six months of membership. A sample of 15 members of this health club showed that they lost on average 11.5 pounds during the first six months of membership with a standard deviation of 2.2 pounds. Test at the 5% significance level if the mean weight lost during the first six months of their membership by all members of this health club is less than 15 pounds.

(4 marks)
27. The following table gives information on yearly incomes and the values of the cars (both in thousands of dollars) driven by a sample of six persons.

<table>
<thead>
<tr>
<th>Yearly Income</th>
<th>Value of Car</th>
</tr>
</thead>
<tbody>
<tr>
<td>46</td>
<td>18</td>
</tr>
<tr>
<td>27</td>
<td>12</td>
</tr>
<tr>
<td>62</td>
<td>37</td>
</tr>
<tr>
<td>31</td>
<td>10</td>
</tr>
<tr>
<td>17</td>
<td>6</td>
</tr>
<tr>
<td>21</td>
<td>13</td>
</tr>
</tbody>
</table>

Construct a regression model with yearly income as the independent variable and value of the car owned as the dependent variable.

(9 marks)
28. By referring the Table in Question no. (27), calculate the coefficient of determination.

(2 marks)

29. By referring the Table in Question no. (27), find the value of the car owned by a person with a yearly income of $40,000.

(2 marks)

30. A test designed to measure the level of type A personality behavior was administered to a group of individuals. The scores on the test range from 5 to 50 and the higher the score, the more the type A behavior. In addition, the systolic blood pressure was determined for each individual. The results appear in the following table:

<table>
<thead>
<tr>
<th>Type A Score</th>
<th>Systolic Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>133</td>
</tr>
<tr>
<td>14</td>
<td>130</td>
</tr>
<tr>
<td>20</td>
<td>135</td>
</tr>
<tr>
<td>30</td>
<td>140</td>
</tr>
<tr>
<td>40</td>
<td>145</td>
</tr>
</tbody>
</table>

Plot a scatter diagram for these data.

(2 marks)
END OF QUESTIONS
APPENDIX

List of Formula

NOTATION  The following notation is used on this card:

- \( n \) = sample size
- \( \bar{x} \) = sample mean
- \( s \) = sample stdv
- \( d \) = paired difference
- \( Q_1 \) = first quartile
- \( Q_3 \) = third quartile
- \( P \) = population proportion
- \( \hat{p} \) = sample proportion
- \( N \) = population size
- \( \mu \) = population mean
- \( \sigma \) = population stdv
- \( \bar{x} \) = observed frequency
- \( E \) = expected frequency

CHAPTER 3  Descriptive Measures

• Sample mean: \( \bar{x} = \frac{\sum x_i}{n} \)

• Range: Range = Max − Min

• Sample standard deviation:

\[ s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}} \quad \text{or} \quad \sigma = \sqrt{\frac{\sum x_i^2 - (\sum x_i)^2/n}{n-1}} \]

• Interquartile range: IQR = \( Q_3 \) − \( Q_1 \)

• Lower limit = \( Q_1 - 1.5 \cdot \text{IQR} \)

• Upper limit = \( Q_3 + 1.5 \cdot \text{IQR} \)

• Population mean (mean of a variable): \( \mu = \frac{\sum x_i}{N} \)

• Population standard deviation (standard deviation of a variable):

\[ \sigma = \sqrt{\frac{\sum(x_i - \mu)^2}{N}} \quad \text{or} \quad \sigma = \sqrt{\frac{\sum x_i^2 - (\sum x_i)^2/N}{N}} \]

• Standardized variable: \( z = \frac{x - \mu}{\sigma} \)

CHAPTER 4  Probability Concepts

• Probability for equally likely outcomes:

\[ P(E) = \frac{f}{N} \]

where \( f \) denotes the number of ways event \( E \) can occur and \( N \) denotes the total number of outcomes possible.

• Special addition rule:

\[ P(A \text{ or } B \text{ or } C \text{ or } \ldots) = P(A) + P(B) + P(C) + \ldots \]

(A, B, C, \ldots mutually exclusive)

• Complementation rule: \( P(E) = 1 - P(\text{not } E) \)

• General addition rule: \( P(A \text{ or } B) = P(A) + P(B) - P(A \cap B) \)

• Conditional probability rule: \( P(B | A) = \frac{P(A \cap B)}{P(A)} \)

• General multiplication rule: \( P(A \cap B \cap C \cdots) = P(A) \cdot P(B) \cdot P(C) \cdots \)

(A, B, C, \ldots \ldots independent)

• Rule of total probability:

\[ P(B) = \sum_{j=1}^{m} P(A_j) \cdot P(B | A_j) \]

\( A_1, A_2, \ldots, A_m \) mutually exclusive and exhaustive

• Bayes's rule:

\[ P(A_i | B) = \frac{P(A_i) \cdot P(B | A_i)}{\sum_{i=1}^{m} P(A_i) \cdot P(B | A_i)} \]

\( A_1, A_2, \ldots, A_m \) mutually exclusive and exhaustive

• Factorial: \( k! = k(k - 1) \cdots 2 \cdot 1 \)

• Permutations rule: \( _nP_r = \frac{n!}{(n - r)!} \)

• Special permutations rule: \( _nP_1 = n! \)

• Combinations rule: \( _nC_r = \frac{n!}{r!(n - r)!} \)

• Number of possible samples: \( _nC_n = \frac{n!}{n!(n - n)!} \)

CHAPTER 5  Discrete Random Variables

• Mean of a discrete random variable \( X \): \( \mu = \Sigma xP(X = x) \)

• Standard deviation of a discrete random variable \( X \):

\[ \sigma = \sqrt{\Sigma (x - \mu)^2 P(X = x)} \quad \text{or} \quad \sigma = \sqrt{\Sigma x^2 P(X = x) - \mu^2} \]

• Factorial: \( k! = k(k - 1) \cdots 2 \cdot 1 \)

• Binomial coefficient: \( \binom{n}{x} = \frac{n!}{x!(n - x)!} \)

• Binomial probability formula:

\[ P(X = x) = \binom{n}{x} p^x (1 - p)^{n-x} \]

where \( n \) denotes the number of trials and \( p \) denotes the success probability.

• Mean of a binomial random variable: \( \mu = np \)

• Standard deviation of a binomial random variable: \( \sigma = \sqrt{np(1 - p)} \)

• Poisson probability formula: \( P(X = x) = e^{-\lambda} \frac{\lambda^x}{x!} \)

• Mean of a Poisson random variable: \( \mu = \lambda \)

• Standard deviation of a Poisson random variable: \( \sigma = \sqrt{\lambda} \)

CHAPTER 7  The Sampling Distribution of the Sample Mean

• Mean of the variable \( \bar{X} \): \( \mu_{\bar{X}} = \mu \)

• Standard deviation of the variable \( \bar{X} \): \( \sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}} \)
CHAPTER 8  Confidence Intervals for One Population Mean

- Standardized version of the variable $X$:
  $$ z = \frac{X - \mu}{\sigma / \sqrt{n}} $$

- $t$ interval for $\mu$ (or known, normal population or large sample):
  $$ X \pm t_{n-1} \cdot \frac{\sigma}{\sqrt{n}} $$

- Margin of error for the estimate of $\mu$: $E = z_{n-1} \cdot \frac{\sigma}{\sqrt{n}}$

- Sample size for estimating $\mu$:
  $$ n = \left( \frac{z_{n-1} \cdot \sigma}{E} \right)^2 $$
  rounded up to the nearest whole number.

- Studentized version of the variable $X$:
  $$ t = \frac{X - \mu}{s / \sqrt{n}} $$

- $t$ interval for $\mu$ (or unknown, normal population or large sample):
  $$ X \pm t_{n-1} \cdot \frac{s}{\sqrt{n}} $$
  with df = $n - 1$.

CHAPTER 9  Hypothesis Tests for One Population Mean

- $t$-test statistic for $H_0: \mu = \mu_0$ (or known, normal population or large sample):
  $$ t = \frac{X - \mu_0}{s / \sqrt{n}} $$

- $t$-test statistic for $H_0: \mu = \mu_0$ (or unknown, normal population or large sample):
  $$ t = \frac{X - \mu_0}{s / \sqrt{n}} $$
  with df = $n - 1$.

- Wilcoxon signed-rank test statistic for $H_0: \mu = \mu_0$ (symmetric population):
  $$ W = \text{sum of the positive ranks} $$

CHAPTER 14  Descriptive Methods in Regression and Correlation

- $S_{xx}$, $S_{yx}$, and $S_{yy}$:
  $$ S_{xx} = \Sigma (X - \bar{X})^2 = \Sigma X^2 - (\Sigma X)^2 / n $$
  $$ S_{yx} = \Sigma (X - \bar{X})(Y - \bar{Y}) = \Sigma X Y - (\Sigma X)(\Sigma Y) / n $$
  $$ S_{yy} = \Sigma (Y - \bar{Y})^2 = \Sigma Y^2 - (\Sigma Y)^2 / n $$

- Regression equation: $\hat{Y} = b_0 + b_1 X$
  $$ b_1 = \frac{S_{yx}}{S_{xx}} $$
  $$ b_0 = \frac{1}{n} \Sigma Y - b_1 \Sigma X $$

- Total sum of squares: $SST = \Sigma (Y - \bar{Y})^2 = S_{yy}$

- Regression sum of squares: $SSR = \Sigma (\hat{Y} - \bar{Y})^2 = S_{yx}^2 / S_{xx}$

- Error sum of squares: $SSE = \Sigma (Y - \hat{Y})^2 = S_{yy} - S_{yx}^2 / S_{xx}$

- Regression identity: $SST = SSR - SSE$

- Coefficient of determination: $r^2 = \frac{SSR}{SST}$

- Linear correlation coefficient:
  $$ r = \frac{\frac{1}{n} \Sigma (X_i - \bar{X})(Y_i - \bar{Y})}{s_x s_y} $$
  or
  $$ r = \frac{S_{yx}}{\sqrt{S_{xx} S_{yy}}}$$. 

17
### TABLE II
Areas under the standard normal curve

<table>
<thead>
<tr>
<th>Second decimal place in z</th>
<th>0.00</th>
<th>0.005</th>
<th>0.01</th>
<th>0.015</th>
<th>0.02</th>
<th>0.025</th>
<th>0.03</th>
<th>0.035</th>
<th>0.04</th>
<th>0.045</th>
<th>0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
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<td>-3.6</td>
<td>-3.5</td>
<td>-3.4</td>
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<td>-3.2</td>
<td>-3.1</td>
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<td>0.00002</td>
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</tbody>
</table>

### TABLE II (cont.)
Areas under the standard normal curve

<table>
<thead>
<tr>
<th>Second decimal place in z</th>
<th>0.00</th>
<th>0.005</th>
<th>0.01</th>
<th>0.015</th>
<th>0.02</th>
<th>0.025</th>
<th>0.03</th>
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<th>0.045</th>
<th>0.05</th>
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<td>0.0500</td>
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</tr>
<tr>
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