UGANDA MARTYRS UNIVERSITY, NKOZI
FACULTY OF SCIENCE.
END OF SEMESTER 1 EXAMINATION.
STA:1101 INTRODUCTION TO STATISTICS
YEAR 2012/2013

DATE: 17ᵀᴴ DECEMBER 2012
TIME: 9:00 am- 12:00pm

Instructions:
- Attempt any four questions
- Read through the paper carefully and follow instructions on the answer booklet.
- Calculators and mathematical tables may be used.
- Neat work is highly recommended.

Question 1

(a) i) Define the term statistics.   (*2 marks*)

   (ii) Give the importance of statistics   (*9 marks*)

 (b) Define the term stem and leaf display   (*2 marks*)

   (c) The following data represent the costs of a sample of 30 postal mailings (in US $) by a company.

13.7 12.8 15.5 14.7 13.3 12.1 11.8 20.9 11.9 13.9
17.2 12.8 13.3 17.8 13.2 13.2 13.6 13.5 13.6 15.5
 13.6 15.0 18.6 14.1 19.2 13.5 15.1 12.0 12.0 12.8

   (i) Using dollars as a stem and cents as a leaf construct a stem and leaf plot of the data.   (*4 marks*)
   (ii) What does the stem and leaf tell you about the costs?   (*2 marks*)
   (iii) What is the modal cost?   (*2 marks*)
   (iv) How many values (costs) are larger than 4.3?   (*2 marks*)
   (v) State the range of the data   (*2 marks*)

Question 2

(a) Explain different ways of how data can be collected and represented
                                                                                (*8 marks*)
(b) The following table summarizes the number of days taken by 60 customers to pay what they owe to a certain company.

31 30 36 39 31 36 34 37 33 34
27 22 31 18 38 19 40 25 29 45
31 29 32 23 28 32 28 32 28 32

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29 28 29 41 30 41 32 29 33 46
44 28 21 22 52 42 14 29 23 37
38 21 37 33 32 29 35 35 24 26

(i) construct the frequency distribution for the data set starting with 10-14
(*6 marks*)

(ii) Draw a histogram for the data set and use it to estimate the mode.
(*6 marks*)

(iii) Compute the mean and median of the data   (*5 marks*)

Question 3

(a) i) Define a discrete random variable   (*2 marks*)

(ii)   When a pair of dice is tossed the sum is noted. Write down the discrete probability distribution.   (*5 marks*)

(b) Define a binomial distribution   (*3 marks*)

(c) The components produced by a particular machine are tested by taking samples containing 5 components and noting the number of rejects in each. The given table shows the results for 100 samples.

Number of rejects (x)	0	1	2	3	4	5
Frequency (f)	10	27	31	20	9	3

(i) Calculate the mean and variance of the number of rejects (*5 marks)*

(ii) Estimate the probability p that a component selected at random is a reject.   (*3 marks*)

(iii) By assuming that the number of rejects in a sample of 5 components has a binomial distribution with parameters n=5 and p, write down the theoretical mean and variance   (*2marks*)

(iv) Obtain the expected frequency distribution for 100 samples.(*5 marks)*

Question 4

(a) Define a continuous probability distribution.   (*2 marks*)

(b) The number of minutes that a flight from Arua to Entebbe is early or late is a random variable whose p.d.f is

$$f(x)= \begin{cases} \dfrac{1}{288}(36-x^2) & -6<X<6 \\ 0; & \text{elsewhere} \end{cases}$$

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Where negative values indicate that the flight is early and positive indicate late. Find the probability that one of these flights will be

(i)   at least 2 minutes early.   (*3 marks*)

(ii)   between 1 and 3 minutes early   (*3 marks*)

(iii)   exactly 5 minutes late   (*3 marks*)

c) Define a poisson distribution and give three examples (*5 marks*)

(d) On average a certain intersection results in 3 traffic accidents per month. What is the probability that in a given month at this intersection

i)   Exactly 3 accidents will occur.   (*3 marks*)

ii)   Less than 3 accidents will occur   (*3 marks*)

iii)   At least 3 accidents will occur.   (*3 marks*)

Question 5

a) Given a uniform distribution density as

$$f(x) = \begin{cases} \dfrac{1}{\beta - \alpha} & \text{for } \alpha < x < \beta \\ 0, & \text{elsewhere.} \end{cases}$$

$\alpha < \beta$, α, β are constants.

Show that;

(i) Mean $(E(x)) = \dfrac{1}{2}(\beta + \alpha)$ (*4 marks*)

(ii) $Var(x) = \dfrac{(\beta - \alpha)^2}{12}$ (*5 marks*)

(b) In acertain experiment the error made in obtaining the density of a substance is a random variable with uniform density, with $\alpha = -0.015$ and $\beta = 0.015$.

Find the probability that such an error will;

(i)   be between - 0.002 and 0.003   (*3 marks*)

(ii)   exceed 0.005 in absolute value   (*3 marks*)

(c) State the characteristics of a normal distribution   (*3 marks*)

(d) A recent study of the hourly wages of maintenance crews for major airlines showed that the mean hourly salary was$16.50, with a standard deviation of 3.50. If we select a crew member at random, what is the probability the crew member earns:

(i) Between $16.50 and $20.0 per hour?   (*4 marks*)

(ii) More than $20.0 per hour?   (*3 marks*)

Question 6

(a) Define the following terms

   (i)   Scatter diagram   **(2 marks)**

   (ii) Regression equation.   **(2 marks)**

b) A scientist, working in an a gricultural research station, believes there is a relationship between the hardness of shells of eggs laid by chickens and the amount of a certain food supplement put into the diet of the chickens. He selects ten chickens of the same breed and collects the following data.

Chicken	A	B	C	D	E	F	G	H	I	J
Amount of food supplement x (g)	118	136	156	150	140	170	155	160	131	114
Hardness of shells y	27	30	37	38	32	36	42	36	44	38

   (i)   Draw a scatter diagram of this data.

                                                            (4 marks)

   (ii)   Calculate Spearman's rank correlation coefficient and comment on your answer.   **(8 marks)**

c) The owner of Maumee Motors wants to study the relationship between age of a car and its selling price. Listed below is a random sample of 12 used cars sold at Maumee Motors during the last year.

car	Age(years)	Selling Price ($000)
1	9	8.1
2	7	6.0
3	11	3.6
4	12	4.0
5	8	5.0
6	7	10.0
7	8	7.6
8	11	8.0
9	10	8.0
10	12	6.0
11	6	8.6
12	6	8.0

   (i)   Determine the regression equation.   **(7 marks)**

   (ii)   Estimate the selling price of a 10-year-old car   **(2 marks)**