



MACHAKOS UNIVERSITY

University Examinations 2020/2021 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE IN TELECOMMUNICATION AND INFORMATION TECHNOLOGY

BACHELOR OF SCIENCE IN MATHEMATICS AND COMPUTER SCIENCE

BACHELOR OF SCIENCE IN APPLIED PHYSICS AND TECHNOLOGY

BACHELOR OF SCIENCE IN ANALYTICAL CHEMISTRY

BACHELOR OF SCIENCE IN ACTUARIAL SCIENCE

BACHELOR OF ECONOMICS AND STATISTICS

BACHELOR OF SCIENCE IN MATHEMATICS

BACHELOR OF EDUCATION

BACHELOR OF ARTS

SMA 160: INTRODUCTION TO PROBABILITY AND STATISTICS

DATE: 11/8/2021

TIME: 8.30-10.30 AM

INSTRUCTIONS:

1. Answer *Question one* and any other *two* questions.
2. You must have a scientific calculator for this paper.

QUESTION ONE (30 MARKS)

- a) Explain in words each of the following terms as used in Statistics:
- i. Mean;
 - ii. Median. (4 marks)
- b) Explain each of the following terms as used in statistics:
- i. Mutually exclusive events;
 - ii. Independent events;
 - iii. Possibility space. (5 marks)
- c) Explain the term *conditional probability* as used in Statistics. (2 marks)
- d) The data given below represents the age in years of employees of an organisation.
28, 30, 33, 37, 37, 38, 42, 43, 43, 44, 45, 48, 48, 51, 55
Use the data to construct a box and whisker plot. (4 marks)

- e) The data given below shows the distribution of grades scored in a KCE mock Mathematics test by 120 form four students in a school in a certain year.

Grade scored	1	2	3	4	5	6	7	8	9
No. of Students	2	8	16	22	32	20	12	5	3

Determine the following measures about the grades scored by the students in the Mathematics test:

- Median, mean and mode;
 - Standard deviation. (7 marks)
- e) A study was carried out to determine the relationship in salaries between males and females among married couples in Kenya. A random sample of 12 couples was selected, and the monthly salary in thousand Kenya shillings was recorded for both male and female as shown in the table below.

Couple	A	B	C	D	E	F	G	H	J	K	L	M
Male	20	24	35	23	83	35	29	60	63	35	28	22
Female	23	18	28	25	64	82	45	56	24	28	16	10

- Construct in a scatter diagram to present this information. (6 marks)
- Interpret the scatter diagram constructed above. (2 marks)

QUESTION TWO (20 MARKS)

- Define the term *variable* as used in statistics, giving two examples. (3 marks)
- Explain any **three** measurement scales for statistical data as outlined by Stevens (1946), giving two examples in each case. (6 marks)
- An expert in personal finance management carried out a study to investigate the relationship between the monthly salary and the monthly sacco savings among employees in the banking sector. He took a random sample of 15 bank employees, and recorded their salary and monthly sacco savings, both in thousand Kenya shillings. The data is as shown in the table below.

Employee	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Salary	54	78	45	48	35	32	40	72	55	60	88	28	48	84	42
Savings	16	18	10	12	08	14	09	10	12	12	20	10	19	15	11

- i. Compute the Spearman's rank correlation co-efficient between the monthly salary earned and the monthly sacco savings. (8 marks)
- ii. Interpret the correlation co-efficient obtained in (i). (3 marks)

QUESTION THREE (20 MARKS)

The data given below represents the frequency distribution of marks scored in Mathematics by a random sample of 800 students who sat for KCSE examination in the year 2014.

Marks scored	00 - 09	10 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 - 99
No. of Students	6	28	90	116	136	164	120	100	32	8

- a)
 - i If the top 65% of the students are supposed to pass this examination, determine the mark which should be set as the pass-mark to achieve this. (2 marks)
 - ii Grades for results are awarded as follows:
 - *Fail* to the bottom 20%,
 - *Pass* to the next 35%,
 - *Credit* to the next 30%,
 - *Distinction* to the top 15%.
 Determine the lower and upper limits of the marks for each grade: Fail, Pass, Credit and Distinction. (9 marks)
- b)
 - i Suppose the pass-mark is set at 45 marks, determine the proportion of the students who will pass. (2 marks)
 - ii Determine the proportion of the students who will score the grades Fail, Pass, Credit and Distinction, if the grades are awarded as follows:
 - I. *Fail* for marks below 40,
 - II. *Pass* for marks between 40 and 62,
 - III. *Credit* for marks between 62 and 74,
 - IV. *Distinction* for marks above 74. (9 marks)

QUESTION FOUR (20 MARKS)

A researcher in residential housing studied the relationship between income earned and the house size occupied by residents in terms of total floor space in Machakos Town. A random sample of 12 Machakos residents was taken and the data relating their monthly income in thousand Kenya shillings and the house size in hundred square feet, was recorded as shown in the table below:

Resident	A	B	C	D	E	F	G	H	J	K	L	M
Income	54	75	36	70	15	52	32	15	85	25	48	45
House size	12	11	08	18	06	12	10	09	16	10	15	14

- a) i Compute the *Pearson's product moment* co-efficient of correlation between the income earned and the house size occupied by a resident. (6 marks)
- ii Interpret the co-efficient of correlation obtained in (a)(i) above. (2 marks)
- b) i Determine the *least squares regression line* of the house size on monthly income. (6 marks)
- ii Interpret the least squares regression line obtained in (b)(i) above. (4 marks)
- iii Using the regression line obtained in (b)(i) above, estimate by calculation the size of a house which would be occupied by a typical resident whose monthly income is Ksh 42,000. (2 marks)

QUESTION FIVE (20 MARKS)

- a) A survey on ICT usage conducted by the Ministry of Communication among 500 residents in the Municipality of Masaku yielded the following information about ownership of ICT gadgets:
- 260 residents have a desktop computer
 - 296 residents have a laptop computer
 - 204 residents have an i-pad
 - 126 residents have a desktop computer and a laptop computer
 - 90 residents have a desktop computer and an i-pad
 - 112 residents have a laptop computer and an i-pad
 - 38 residents have a desktop computer, a laptop computer and an i-pad
- i. Present this information in a Venn diagram. (5 marks)
- ii. Determine the number of residents in the study who have:
- exactly two types of ICT gadgets.
 - a laptop computer or an i-pad but not a desktop computer. (3 marks)
- b) An electronic monitoring device comprising a sound recorder and a surveillance camera is powered by a solar electric system comprising; a solar panel, a solar battery and a voltage inverter. In the solar electric system, the following actions are possible; the panel may be charging the battery or not; the battery state of charge may be full or moderate or low; and the inverter may be on or off. The panel charges the battery with a probability of $\frac{2}{5}$. If the panel is charging the battery, the battery state of charge is moderate with a probability

of $\frac{1}{2}$, and either full or low with equal probabilities; otherwise, the battery state of charge is never full, but is moderate with a probability of $\frac{2}{3}$. The inverter goes off if the battery state of charge is low; otherwise, it remains on with a probability of $\frac{5}{6}$. The monitoring device works provided the inverter is on.

- i. Present this information in a probability tree diagram;
- ii. Determine the probability that the monitoring device works;
- iii. Determine the probability that the monitoring device is not working and yet the battery state of charge is not low;
- iv. If the inverter is off, determine the probability that the panel is charging the battery.

(12 marks)