UNIVERSITY OF SWAZILAND

DEPARTMENT OF STATISTICS AND DEMOGRAPHY

MAIN EXAMINATION, 2018/19

COURSE TITLE:	INTRODUCTION TO STATISTICS
COURSE CODE:	STA 141
TIME ALLOWED:	TWO (2) HOURS
INSTRUCTION:	ANSWER ALL QUESTIONS IN SECTION A AND ANY TWO QUESTIONS IN SECTION B
SPECIAL REQUIREMENTS:	SCIENTIFIC CALCULATORS, GRAPH PAPER AND STATISTICAL TABLES

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SECTION A

Question 1

Temperature transducers of a certain type are shipped in batches of 50. A sample of 60 batches was selected, and the number of transducers in each batch not conforming to design specifications was determined, resulting in the following data:

2	1	2	4	0	1	3	2	0	5	3	3	1	3
2	4	7	0	2	3	0	4	2	1	3	1	1	3
4	1	2	3	2	2	8	4	5	1	3	1	5	0
2	3	2	1	0	6	4	2	1	6	0	3	3	3
6	1	2	3										

a. Determine frequencies and relative frequencies for the observed values of x = number of non-conforming transducers in a batch.

b. What proportion of batches in the sample have:

i. at most five nonconforming transducers?

ii. fewer than five?

iii. at least five nonconforming units? **(5+2+2+2 marks)**

Question 2

In a state where cars have to be tested for the emission of pollutants, 25% of all cars emit excessive amounts of pollutants. When tested, 99% of all cars that emit excessive amounts of pollutants will fail, but 17% of the cars that do not emit excessive amounts of pollutants will also fail. What is the probability that a car that fails the test actually emits excessive amounts of pollutants? **(9 marks)**

Question 3

In a genetics experiment, the researcher mated two *Drosophila* fruit flies and observed the traits of 300 offspring. The results are shown in the table:

	Wing Size	
Eye Colour	Normal	Miniature
Normal	140	6
Vermillion	3	151

One of these offspring is randomly selected and observed for the two genetic traits.

a. What is the probability that the fly has normal eye colour and normal wing size?
b. What is the probability that the fly has vermillion eyes?
c. What is the probability that the fly has either vermillion eyes or miniature wings, or both?

(3+3+4 marks)

Question 4

A study of the relationship between age and various visual functions (such as acuity and depth perception) reported the following observations on area of sclera lamina (mm^2) from human optic nerve heads:

2.75 2.62 2.74 3.85 2.34 2.74 3.93 3.21 3.18

2.33 3.46 4.52 2.43 3.65 2.78 3.16 3.01

a. Calculate $\sum x_i$ and $\sum x_i^2$.
b. Use the values calculated in part (a) to compute the sample variance (s^2) and then the standard deviation s. **(3+7 marks)**

Question 5

Let X be a binomial random variable with $n = 20$ and $p = .1$.

a. Calculate $P(X \leq 4)$ using the binomial formula.
b. Calculate $P(X \leq 4)$ using Table 1 in appendix I.
c. Use the Minitab output below to calculate $P(X \leq 4)$. Compare the results of parts a, b, and c.
d. Calculate the mean and standard deviation of the random variable x. **(3+2+2+3 marks)**

MINITAB output

Probability Density Function

Binomial with n = 20 and p = 0.100000

X	P(X = x)
0.00	0.1216
1.00	0.2702
2.00	0.2852
3.00	0.1901
4.00	0.0898
5.00	0.0319
6.00	0.0089
7.00	0.0020
8.00	0.0004
9.00	0.0001
10.00	0.0000
11.00	0.0000
12.00	0.0000
13.00	0.0000
14.00	0.0000
15.00	0.0000
16.00	0.0000
17.00	0.0000
18.00	0.0000
19.00	0.0000
20.00	0.0000

Question 6

Determine the following probabilities using the standard normal distribution:

(i) $P(Z < -0.6)$

(ii) $P(0.17 \leq Z \leq 2.49)$

(iii) $P(-1.57 \leq Z \leq 0.93)$

(iv) $P(Z > -1.85)$ **(2+3+3+2 marks)**

SECTION B

Question 7

David Haddad is a physical therapist at a Veterans Administration Hospital. He developed an exercise program to increase the cardiac efficiency of physically handicapped patients. As part of the program, he administered a pre-test to the 60 members of the program. The scores on this test are listed below.

84	80	68	76	88	80	84	78	92	84
96	80	84	88	70	64	92	80	68	80
80	56	80	94	76	80	70	56	84	97
56	80	90	100	88	74	88	84	80	96
84	96	68	76	58	80	84	72	92	102
88	70	100	80	84	78	84	92	64	98

a. Put the data in a frequency table of six classes. Use a class width of 8 and lower limit of 56 for class 1.
b. Construct the relative and percent frequencies
c. Construct a histogram for the data using the percent frequencies. **(10+5+5 marks)**

Question 8

a. The employee records at *Madilinki* Investments were surveyed. The age and amount of sick leave each employee took last year were recorded. The results are in the following table.

Results of Employee Survey

Ages of employees	*0–3 Sick Days*	*4–6 Sick Days*	*7 or more Sick Days*
Less than 25 years old	180	405	315
Between 25 and 40 years old	1755	540	405
More than 40 years old	720	540	540

Suppose that one of these employees is randomly selected. For this experiment, the following events are defined:

A: The employee took 0–3 sick days leave last year.
B: The employee took 4–6 sick days leave last year.
C: The employee took 7 or more sick days leave last year.

For this experiment, calculate the following conditional probabilities to three decimal places:

i. $P(A|\text{Employe is between 25 and 40 years old})$
ii. $P(C|\text{Employe is less than 25 years old})$
iii. $P(\text{Employe is more than 40 years old}|B)$
iv. $P(\text{Employe is between 25 and 40 years old}|C)$ **(3+3+3+3 marks)**

b. (i) For married couples living in a suburb, the probabilities that the husband, the wife or both will vote in a gubernatorial elections are 0.39, 0.46 and 0.31 respectively. What is the probability that either or both will vote in the election?

(ii) The probability that Henry will like a new movie is 0.70 and the probability that Jean, his girlfriend will like it is 0.60. If the probability is 0.28 that he will like it and she will dislike it, what is the probability that he will like it given that she will dislike it?

(4+4 marks)

Question 9

a. The mayor of a large metropolitan area in the East formed a panel to study the crime rate in the area. In the panel's report it was stated that 40 percent of the residents in a large section of the midtown district had suffered some kind of loss of personal property within the past five years. Subsequent to this report a sample of twelve residents in this district was taken. X is the number in the sample that suffered a loss of personal property within the past five years. Compute:
i. $P(X = 5)$
ii. $P(X \leq 3)$
iii. $P(X > 6)$ **(2+3+3 marks)**

In b and c, find the indicated probabilities for a standard variable Z. Use appendix Table 4

b. i. $P(Z < -0.85)$ ii. $P(Z < 1.33)$ **(2+2 marks)**

c. i. $P(-100 < Z < -0.25)$ ii. $P(0.50 < Z < 1.67)$ **(2+2 marks)**

In d, use Appendix Table 4 to approximate z for the indicated probabilities.

d. i. $P(Z < z) = 0.1000$ ii. $P(Z > z) = 0.2743$ **(2+2 marks)**

Question 10

The length of bus routes from any particular transit system will typically vary from one route to another. The study by a City council gives the following information on lengths in (km) for one particular system:

Length	**Frequency**
5 - < 10	6
10- < 15	7
15 - < 20	10
20 - < 25	15
25 - < 30	22
30 - < 35	18
35 - < 40	10
40 - < 45	4
45 - < 50	8

Find the:

a. Mean
b. Median
c. Mode
d. Variance and standard deviation **(3+5+5+7 marks)**

END OF EXAM!!!!!!!