UNIVERSITY OF SWAZILAND

FACULTY OF SOCIAL SCIENCES

DEPARTMENT OF STATISTICS AND DEMOGRAPHY

MAIN EXAMINATION, 2017/18

COURSE TITLE:	INFERENTIAL STATISTICS I
COURSE CODE:	STA 232/ST 232
TIME ALLOWED:	THREE (3) HOURS
INSTRUCTION:	ANSWER ALL QUESTIONS IN SECTION A & ANY TWO QUESTIONS IN SECTION B
SPECIAL REQUIREMENTS:	SCIENTIFIC CALCULATORS AND STATISTICAL TABLES

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SECTION A

Question 1

(a) Computer monitors are packed into two crates and send from Taiwan to South Africa. Each crate holds twenty monitors. Suppose crate 1 contains five defective monitors and crate 2 only one defective monitor. One crate is chosen randomly and from this crate one monitor is chosen as a random sample for testing. The monitor proves to be defective. What is the probability that the defective monitor was packed in crate 1?

(10 marks)

Question 2

It is a known fact that 10% of all light bulbs manufactured by a certain factory are defective. Suppose we want to determine the probability that in a random sample of fifteen bulbs:

(a) at most two are defective;
(b) at least four are defective;
(c) one to five light bulbs are defective. **(3+4+3 marks)**

Question 3

A fire station receives on average three fire alarm calls per normal weekday (holidays excluded). The station has five fire engines, each with its own fire fighting team. With a view to scheduling service times and maintenance of equipment, it is important to find solutions for the following problems:

a) What is the probability of exactly two fire alarm calls on a specific day?
b) What is the probability of more than five fire alarm calls within a period of three hours?
c) (i) How many alarms are received, on average, per six-hour period and (ii) per working week (Monday to Friday)?

Let X = number of fire alarms per day. **(2+3+5 marks)**

Question 4

Study the distribution of $\bar{X}$, the mean life expectancy of a sample of 120 electronic components. It is known that the mean and standard deviation of the life expectancy of all components are given by $\mu = 100$ days and $\sigma = 100$ days. Determine

a) $P(\bar{X} < 80)$;
b) $P(90 < \bar{X} < 110)$;
c) The value b for which $P(\bar{X} > b) = 0.10$ **(3+3+10 marks)**

Question 5

In a survey of study habits among first-year students at a certain university, 85 first-year students are involved in a random sample. Their average daily study time on weekdays is three and three-quarter hours, with a standard deviation of 45 minutes. Only 25 students usually study for longer than five hours per day.

a) Find a 95% confidence interval for the mean number of study hours on weekdays among first-year students at the university.
b) Determine a 99% confidence interval for the proportion of students who study more than five hours per day on weekdays.
c) If the mean number of study hours on weekdays needs to be determined accurately to within five minutes with a probability of 95%, how many students should be involved in the investigation? **(5+5+4 marks)**

SECTION B

Question 6

(a) A clothing retailer is of the opinion that customers buying on account can be encouraged to buy more if they are offered a 10% discount. This offer is made to a random sample of 200 customers who have spent E1 000 or more during the past year. After a year the sample shows a mean increase in purchases of E372.14, with a standard deviation of E489.03. The retailer intends expanding the 10% discount to all account holders if they can be sure (at 1% level of significance) that the mean increase in purchases is significantly higher than E250. **(10 marks)**

(b) An advertising company claims that the television commercial they have created to inform the public about a three-point plan for preventing HIV infection is so effective that 75% of the viewers who have seen the commercial still remember the three points after 24 hours. To test the company's claim, a random sample of 300 persons is selected, of whom 236 can remember the three-point plan after 24 hours. Does this finding substantiate with the advertising company's claim? Use $\alpha = 0.05$.**(10 marks)**

Question 7

(a) An insurance company investigates various methods of cutting down on operating costs. One problem is the excessively high monthly telephone account. A preliminary analysis of the account shows that more than half of all outgoing calls are non-official. Since unmarried staff is suspected of being largely responsible, a random sample is drawn from married and unmarried staff without the knowledge of either group. The following table is a summary of the sample information with regard to the total duration of private calls made in one month.

Sample information of non-official calls

Staff	Sample size	Mean	Variance
Single	$n_1 = 65$	$\bar{x}_1 = 5.26$	$s_1^2 = 14.5$
Married	$n_2 = 90$	$\bar{x}_2 = 3.89$	$s_2^2 = 13.7$

Test at a 5% level of significance to see if, on average, private calls by unmarried persons last longer than those by married persons. **(10 marks)**

(b) The braking distance was measured for eleven cars from a speed of 100 km/h under wet conditions and for eleven others under dry conditions. Test whether or not the mean stopping distance under wet conditions is more than 40 metres further than under dry conditions. Let $\alpha = 0.05$. Assume that the variances are equal, and that the stopping distance is normally distributed. **(10 marks)**

The observations obtained are given in the table:

Stopping distance in metres for 22 cars under different conditions

Wet conditions						Dry conditions					
108	138	113	121	126	118	62	59	67	73	69	73
116	106	102	118	140		48	58	66	76	80	

Take μ_1 and μ_2 as the mean stopping distance under wet and dry conditions respectively.

Question 8

(a) A manufacture of car parts claims that less than 10% of all parts supplied to an assembly plant fail to comply with the given specifications. A test of 235 parts produces nineteen defective parts. Test at a 5% level of significance whether the manufacture's claim is acceptable. Calculate the *p*-value for this test as well. **(10 marks)**

(b) A manufacturer of breakfast cereal uses two makes of automatic machines to fill 500 g containers with cereal. Two independent samples provide the following information:

Machine 1	Machine 2
$n_1 = 45$	$n_2 = 55$
$\bar{x}_1 = 506.3$ g	$\bar{x}_2 = 496.7$ g
$s_1 = 12.4$ g	$s_2 = 18.5$ g

Test at a 5% level of significance whether the mean mass of the containers filled by machine 1 have the same mean mass as the containers filled by machine 2. Calculate the *p*-value for the test as well. **(10 marks)**

Question 9

(a) A survey was conducted to evaluate the effectiveness of a new flu vaccine that had been administered in a small community. The vaccine was provided free of charge in a two-shot sequence over a period of 2 weeks. Some people received the two-shot sequence, some appeared for only the first shot, and others received neither. A survey of 1000 local residents the following spring provided the information shown below. Do the data present sufficient evidence to indicate that the vaccine was successful in reducing the number of flu cases in the community? **(10 marks)**

	No vaccine	One shot	Two shots	Total
Flu	24	9	13	46
No Flu	289	100	565	954
Total	313	109	578	1000

(b) The time (in minutes) it takes operators to fit a certain part before and after completing a training programme appears in columns 2 and 3 of the table below. Determine whether or not the training programme significantly decreased the mean fitting time, while assuming that the difference in fitting time is normally distributed.

The required time by eight operators before and after training

Operator (1)	**Before training** (2)	**After training** (3)	d (4)	d^2 (5)
1	23	17	6	36
2	17	14	3	9
3	16	12	4	16
4	15	13	2	4
5	19	12	7	49
6	21	20	1	1
7	13	14	-1	1
8	20	15	5	25
			27	141

(10 marks)

END OF EXAM!!!!!!!