

FORM TP 2015136



TEST CODE **02105020**

MAY/JUNE 2015

**C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L**

**C A R I B B E A N   A D V A N C E D   P R O F I C I E N C Y   E X A M I N A T I O N <sup>®</sup>**

**A P P L I E D   M A T H E M A T I C S**

**S T A T I S T I C A L   A N A L Y S I S**

**U N I T   1 – P a p e r   0 2**

*2 hours 30 minutes*

**14 MAY 2015 (p.m.)**

This examination paper consists of THREE sections: Collecting and Describing Data, Managing Uncertainty, Analysing and Interpreting Data.

Each section consists of 2 questions.

The maximum mark for each section is 50.

The maximum mark for this examination is 150.

This examination consists of 11 printed pages and 2 answer sheets for Question 2 (a) (iii) and (iv) and Question 6 (b) (i)–(v).

**READ THE FOLLOWING INSTRUCTIONS CAREFULLY.**

1. Answer ALL questions from the THREE sections.
2. Unless otherwise stated in a question, all numerical answers MUST be given exactly OR correct to three significant figures as appropriate.

**Examination Materials**

Mathematical formulae and tables (Revised 2010)

Electronic calculator

Ruler and graph paper

**DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.**

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**SECTION A**

**MODULE 1: COLLECTING AND DESCRIBING DATA**

**Answer BOTH questions.**

- 1.** (a) Choose the word from the brackets that describes the data in EACH of the following cases:
- (i) The types of pastry sold at a restaurant. (*quantitative, qualitative*) [1 mark]
  - (ii) The weight of a red snapper sold at a fish market. (*quantitative, qualitative*) [1 mark]
  - (iii) The number of seats available at a concert hall. (*discrete, continuous*) [1 mark]
  - (iv) The height of pea trees at six weeks old. (*discrete, continuous*) [1 mark]
  - (v) The number of kilowatt-hours of electricity used by a household in the last month. (*discrete, continuous*) [1 mark]
- (b)
- (i) Distinguish between a ‘census’ and a ‘sample survey’. [2 marks]
  - (ii) State TWO reasons why it may be necessary to take a sample. [2 marks]
  - (iii) For EACH of the following situations, state, with reason, whether it is a sample survey or a census.
    - a) Every week a store calls 15 of the 40 persons who made purchases at the store during the week to find out whether they were satisfied with the service they received. [2 marks]
    - b) The management of High Street Appliance Store called all of the 5 persons who bought stoves last week to find out if they were satisfied with the service at the store. [2 marks]
- (c) For EACH of the following, state an appropriate method of collecting data, either direct observation or personal survey.
- (i) The types of cars entering a particular car park between 9:00 a.m. and 11:00 a.m. [1 mark]
  - (ii) The types of cellphones owned by persons [1 mark]
  - (iii) The types of radio programmes that persons listen to [1 mark]

GO ON TO THE NEXT PAGE

(d) A construction company employs 5 engineers, 10 electricians, 45 masons, 30 carpenters, 10 plumbers and 25 labourers.

(i) Using the stratified random method of sampling, calculate the number of masons that will be in a sample of 25 of these employees. **[3 marks]**

(ii) State ONE advantage of using the stratified random method for collecting this sample. **[1 mark]**

(iii) In a questionnaire given to the employees, the following question was asked:

“How often do you buy lunch at the work site or do you bring lunch from home every day?”

a) State ONE reason why this is not a suitable question. **[1 mark]**

b) Rewrite the question in a more suitable manner. **[4 marks]**

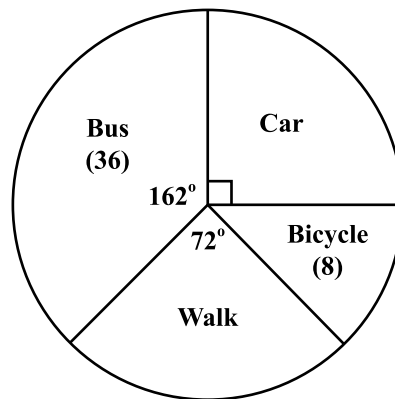
**Total 25 marks**

2. (a) The following table shows the distribution of the daily profit, in dollars, that a vendor made by selling sweets to children at a school during the lunch session over a 90-day period.

<b>Profit (dollars)</b>	<b>Number of Days</b>
30–44	16
45–59	30
60–74	21
75–89	11
90–104	12

- (i) State ONE disadvantage of displaying data in groups. **[1 mark]**
- (ii) Determine the size of the third class. **[2 marks]**
- (iii) **Using the graph paper provided**, draw a histogram to show this information. **[3 marks]**
- (iv) Use the histogram drawn in (a) (iii) above to estimate the mode of the distribution. **[3 marks]**
- (v) Calculate an estimate of the mean profit that the vendor made over the 90-day period. **[5 marks]**
- (vi) Calculate an estimate of the standard deviation of the profit made by the vendor over the 90-day period. **[4 marks]**

- (b) The following pie chart, **not drawn to scale**, shows how a sample of students travel to school. (The number of students are indicated in brackets.)



- (i) Determine the total number of students in the sample. **[3 marks]**
- (ii) Determine the size of the angle that represents the sector of bicycles. **[2 marks]**
- (iii) Calculate the number of students who walk to school. **[2 marks]**

**Total 25 marks**

**SECTION B**

**MODULE 2: MANAGING UNCERTAINTY**

**Answer BOTH questions.**

3. (a) At a cafeteria it is noted that 50% of the patrons buy French fries, and 45% buy macaroni cheese. 32% of those who buy French fries, also buy macaroni cheese.
- (i) Calculate the probability that a patron chosen at random buys
    - a) both French fries and macaroni cheese **[2 marks]**
    - b) French fries only. **[2 marks]**
  - (ii) Draw a FULLY labelled Venn diagram to show the information in (i) above. **[3 marks]**
  - (iii) State the probability that a patron buys neither French fries nor macaroni cheese. **[1 mark]**
- (b) A sample of 90 persons was asked to identify his or her favourite soft drink. The results are shown in the following table.

	<b>Male</b>	<b>Female</b>
Coco-Cola	18	10
Pepsi-Cola	20	16
Ginger ale	12	14

What is the probability that a person chosen at random from the sample

- (i) is a female? **[2 marks]**
- (ii) prefers Pepsi-Cola? **[2 marks]**
- (iii) likes Ginger ale and is a male? **[2 marks]**
- (iv) prefers Coco-Cola given that the person is a female? **[3 marks]**

- (c) A bag of sweets contains eight coffee flavoured toffees and six vanilla flavoured toffees, all identical except for flavour. Three toffees are randomly selected, **without replacement**, from the bag.
- (i) List ALL the possible selections of flavours that could be made. **[3 marks]**
  - (ii) Given that the first toffee selected was coffee flavoured, what is the probability that the second toffee selected will also be coffee flavoured? **[2 marks]**
  - (iii) Calculate the probability that EXACTLY two of the three toffees selected will be vanilla flavoured. **[3 marks]**

**Total 25 marks**

4. (a) An editorial team was examining the pages of a book for grammatical errors. The number of errors on each page was recorded in the following table.

<b>Number of Errors Found</b>	0	1	2	3	4	5
<b>Number of Pages</b>	58	74	98	65	35	20

Let  $X$  denote the number of errors found on a page.

- (i) Prepare a probability distribution table to show this information. (Give your answer to 3 decimal places.) **[3 marks]**
- (ii) Calculate  $P(2 \leq X \leq 4)$ . **[3 marks]**
- (iii) Calculate the expected number of errors per page. **[3 marks]**
- (b) A small business has 10 telephone lines. It is estimated that the probability that a line is engaged at any moment is 0.3. Given that  $Y$  is the number of telephone lines that will be engaged at any moment, and assuming that the use of any line is independent of all others:
- (i) Name the distribution of  $Y$ , and state its parameters. **[3 marks]**
- (ii) Calculate the probability that at any moment
- a) EXACTLY 4 lines will be engaged **[3 marks]**
- b) AT LEAST 1 line will be engaged. **[3 marks]**
- (c) The results of a statistics examination follow an approximate normal distribution with a mean of 68 and a standard deviation of 8. Grade A is awarded to students who score more than 82.

Determine the percentage of students who will get a Grade A. **[7 marks]**

**Total 25 marks**



**SECTION C**

**MODULE 3: ANALYSING AND INTERPRETING DATA**

**Answer BOTH questions.**

5. (a) The value of the sales invoices of a store follows a normal distribution with a known variance. A random sample of 60 sales invoices was taken from this population. A 95% confidence interval for the population mean  $\mu$  was given as  $14.06 \leq \mu \leq 19.54$ .

Calculate

- (i) the width of the interval **[2 marks]**
  - (ii) the mean of the sample **[2 marks]**
  - (iii) the standard deviation of the value of the sales invoice. **[3 marks]**
- (b) The random variable  $X$  is such that  $E[X] = 25$  and  $\text{Var}[X] = 144$ . Samples of size 81 are taken from  $X$ .
- (i) State the approximate distribution modelled by  $\bar{X}$ , giving its parameters. **[3 marks]**
  - (ii) Calculate  $P(\bar{X} < 28)$ . **[5 marks]**
- (c) The mass of packages of spice from a packaging machine is normally distributed with a mean of 48 grams and a standard deviation of 2.3 grams. After repairs to the machine, a sample of 49 packages taken from the machine gave a mean of 47.2 grams. The standard deviation remained the same.
- (i) State null and alternative hypotheses, using statistical symbols to test whether the mean mass has changed. **[2 marks]**
  - (ii) Determine the critical region(s) of the test, if the test is conducted at the 4% significant level. **[3 marks]**
  - (iii) Calculate the value of the test statistic used in this test. **[3 marks]**
  - (iv) Clearly state the conclusion of the test. **[2 marks]**

**Total 25 marks**

6. (a) For EACH of the following pairs of bivariate data, determine which variable is the independent variable.
- (i) The income of a family  
The monthly rent paid [1 mark]
  - (ii) The advertising expense of a company  
The sales of a company [1 mark]
  - (iii) The damage done to a certain home after a hurricane  
The amount of money spent in repairs to a certain home after a hurricane [1 mark]
- (b) A company, in changing some of its machines, had to train its operators to use these new machines. The following table shows the age, in years, of the operators and the length of time, in days, that it took to train these persons.

<b>Age (years) (<math>x</math>)</b>	18	20	21	27	23	34	42	38	44
<b>Length of Training Required (days) (<math>y</math>)</b>	3	5	6	8	7	11	10	9	12

- (i) Use the **graph paper provided** to plot these values in a scatter diagram. [3 marks]
- (ii) Calculate the mean age of the operators and the mean number of days required for training. (Give the answers correct to the NEAREST whole number.) [3 marks]
- (iii) Plot the point  $(\bar{x}, \bar{y})$  on the scatter diagram. [1 mark]
- (iv) The regression line of  $y$  on  $x$  generated from this data is given by
$$y = -0.05 + 0.27x.$$
Draw this line on the same graph as the scatter diagram. [3 marks]
- (v) A new operator is brought on for work. If the person is 22 years old, use the regression line to estimate the number of days that will be required for training this person. (Give the answer correct to the NEAREST whole number.) [2 marks]

- (c) The following table summarizes the examination grades for students from three schools, A, B and C. A chi-squared test is carried out to determine whether there is an association between the grade received and the school which the student attended.

School	Grade			
	I	II	III	F
A	12	16	20	8
B	10	14	11	15
C	9	12	16	22

- (i) State appropriate null and alternate hypotheses for this test. **[2 marks]**
- (ii) Determine the critical value of the test at the 5% level of significance. **[3 marks]**
- (iii) Calculate the expected number of students who attended School B and received a Grade II. **[3 marks]**
- (iv) The calculated chi-squared test value is 9.1625. Clearly state the conclusion that may be drawn from this test. **[2 marks]**

**Total 25 marks**

**END OF TEST**

**IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.**