EXAMINATIONS OF THE HONG KONG STATISTICAL SOCIETY

ORDINARY CERTIFICATE IN STATISTICS, 2011

MODULE 2 : Analysis and presentation of data

Time allowed: Three Hours

*Candidates may attempt **all** the questions.*

The number of marks allotted to each question or part-question is shown in brackets.

The total for the whole paper is 100.

A pass may be obtained by scoring at least 50 marks.

Graph paper and Official tables are provided.

Candidates may use calculators in accordance with the regulations published in the Society's "Guide to Examinations" (document Ex1).

1. The following data are the heights, correct to the nearest centimetre, for a group of children.

144	132	138	129	135	137	143	152	126	137
161	133	129	132	133	146	141	154	147	136

    (i)   Explain briefly the distinction between continuous and discrete data, illustrating your answer by referring to these data.

    (4)

    (ii) Draw a stem and leaf diagram of the data.

    (2)

    (iii) Find the median and the inter-quartile range of the data.

    (3)

2. On a radio programme it was stated that the trade between the USA and Canada was worth $1 million per second. Given that the combined population of the USA and Canada is about 350 million, calculate the equivalent annual trade per person.

    Discuss briefly whether or not the figure given on the radio programme seems plausible and, if appropriate, suggest a more likely figure.

    (7)

3. A shopkeeper's records show that 24% of purchases are made with cash, 36% with debit cards and 40% with credit cards. You should assume that successive purchases are independent of one another.

    Find the probabilities of the following events, giving your answers to 3 significant figures.

    (i)   The first 3 purchases on a particular day are all made with cash.

    (2)

    (ii) The first 3 purchases on a particular day are all made with the same type of payment.

    (2)

    (iii) The 3 different types of payment are used for the first 3 purchases on a particular day.

    (3)

    (iv) At least 1 of the first 5 purchases made on a particular day is made with cash.

    (3)

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4. In a recent study, 960 people aged between 25 and 30 years were asked about their academic achievements and their levels of satisfaction in their current jobs.

71 of the 960 were not able to respond because they were not currently employed.

Academic achievement was measured by qualifications obtained and categorised as 'none', 'basic', 'intermediate' or 'advanced'.

Job satisfaction was categorised as 'high', 'medium' or 'low'.

(i)   Copy the contingency table below and fill in the missing figures (marked with a dot).

(4)

		Job satisfaction			
		High	*Medium*	*Low*	
	Advanced	72	112	•	271
Academic	*Intermediate*	•	64	98	250
achievement	*Basic*	117	•	73	281
	None	•	36	•	•
		306	•	280	•

(ii) Calculate, for each of the four groups defined by academic achievement, the percentages having high and low job satisfaction.

Comment briefly on the claim that higher academic achievement leads to greater job satisfaction.

(6)

Turn over

5.   The table below gives information about annual household income for the UK in the tax year 2007–8. Two figures are given for household income: before tax and benefits were applied and after tax and benefits were applied. Households are divided, in order of income, into five equal-sized groups. Group A comprises the 20% of households with the lowest income before tax and benefits. Group E comprises the 20% of households with the greatest income before tax and benefits.

The second and third columns show the mean household incomes for each group.

Group	Mean household income before tax and benefits (£)	Mean household income after tax and benefits (£)
A	4 700	14 300
B	12 100	19 800
C	23 600	25 700
D	38 800	32 400
E	72 600	52 400

(i)   Draw two pie charts to show the proportions of total income in the five groups, the first for income before and the second for income after tax and benefits.

(6)

(ii)   Calculate for each group the ratio of mean income after tax and benefits to mean income before tax and benefits. Explain briefly what these ratios, and your two pie charts, indicate about the tax and benefit system.

(4)

(iii)   Calculate, for all households in the UK, the mean income before and after tax and benefits.

Given that in 2007–8 there were about 25 million households in the UK, calculate total household income both before and after tax and benefits. Give your answers in £ billions.

(4)

(iv)   The figure £72 600 is the mean income, before tax and benefits, for the 20% of households with the highest income. Sketch the likely distribution of incomes for this group of households. State, with a reason, whether you would expect the median income before tax and benefits for this group to be less than, approximately equal to, or greater than £72 600.

(4)

Turn over

6. 150 new recruits to a large organisation were divided at random into 5 groups of 30. The groups were given different lengths of training in the use of equipment and then were tested on their competence in using that equipment. The competence score, y, is measured out of 100, with higher scores indicating greater competence. Summary data, taken from a spreadsheet, are given below.

Group	Number in group	Training in days	Σy	Σy^2	Mean	Standard deviation
1	30	4	2193	163 372	73.1	10.278 37
2	30	6	2322	183 176	77.4	10.912 19
3	30	8	a	203 556	81.9	8.959 102
4	30	10	2547	218 666	84.9	b
5	30	12	2559	c	85.3	8.594 906

(i)   Obtain the missing figures shown as a, b, c.

(6)

(ii)   Draw a scatter diagram for mean competence and number of days of training. Comment briefly on what your diagram shows.

(4)

(iii)   Find the least squares regression line for mean competence regressed on number of days of training. Draw this line on your scatter diagram.

(6)

(iv)   Estimate the mean competence score for 7 days of training

(a)   using your regression line,

(b)   using linear interpolation.

Discuss briefly which estimate, if either, is likely to be the more accurate.

(4)

Turn over

7.   The data in the table below show average hourly wage rates in £ and numbers of employees in a particular medium-sized company. Employees are categorised as semi-skilled, skilled or managerial; the average wage rates are for the years 2000 and 2010.

Grade of employee	Year 2000		Year 2010	
	Average hourly wage, £	*Number of employees*	*Average hourly wage, £*	*Number of employees*
Semi-skilled	7.15	37	9.52	19
Skilled	9.04	24	13.25	35
Managerial	11.48	11	17.65	20

(i)   Using 2000 as base year, calculate wage cost relatives for each grade of worker in 2010.

Comment on what these figures, together with the data on numbers of employees, tell you.

(4)

(ii)   Calculate the simple mean of the wage cost relatives.

Calculate also the Paasche index of wage costs.

State what additional factor the Paasche index takes into account that the simple average does not.

(4)

(iii)   Calculate the percentage rise in the company's weekly wage costs given that in 2000 the working week was 37 hours whereas in 2010 it was 35 hours.

(4)

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8. The table to the right shows the numbers of deaths from respiratory disease in the UK in 43 successive time periods.

(i) By considering the pattern of variation in the data, explain why you can be confident that the successive time periods are months.

(3)

(ii) The table also shows the 12-monthly trend calculated by the method of moving averages. Calculate the two missing figures shown as *a* and *b*.

(4)

(iii) Given that period 1 is the month of May, calculate the average difference from trend for

(a) August,

(b) December.

(5)

(iv) State with reasons whether there appears to be a trend in these data.

(2)

Time period	Number of deaths	Moving average
1	1160	
2	1113	
3	970	
4	999	
5	1208	
6	1467	
7	2059	1468.3
8	2240	1467.3
9	1634	1468.0
10	1722	1468.2
11	1801	1465.3
12	1246	1454.2
13	1162	1427.4
14	1087	1401.4
15	1013	1419.3
16	959	1455.5
17	1179	1448.9
18	1229	1437.1
19	1655	*a*
20	2019	1443.5
21	2284	1443.6
22	1942	1443.7
23	1423	1442.5
24	1340	1436.0
25	1187	1437.5
26	1098	1454.3
27	1004	1445.1
28	970	1421.8
29	1140	1422.3
30	1110	1421.5
31	1812	1411.7
32	2263	1405.3
33	1820	1402.3
34	1846	1399.8
35	1531	1396.1
36	1215	1401.3
37	1075	*b*
38	1056	
39	975	
40	940	
41	1081	
42	1294	
43	1341	

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