Chi-squared Tests – 2021/20 GCE AS Statistics Further Mathematics A

1. Nov/2021/Paper_Y532/01/No.6

A student believes that if you ask people to choose an integer between 1 and 10, not all integers are equally likely to be chosen. The student asks a random sample of 100 people to choose an integer between 1 and 10 inclusive. The observed frequencies O, together with the values of $\frac{(O-E)^2}{E}$ where E is the corresponding expected frequency, are shown in the table.

Integer	1	2	3	4	5	6	7	8	9	10
O	7	8	20	8	7	6	19	7	8	10
$\frac{(O-E)^2}{E}$	0.9	0.4	10.0	0.4	0.9	1.6	8.1	0.9	0.4	0

(a) Show how the value of 8.1 for integer 7 is obtained. **[2]**

(b) Show that there is evidence at the 1% significance level that the student's belief is correct. **[5]**

The student wishes to suggest an alternative model for the probabilities associated with each integer. In this model, two of the integers have the same probability p_1 of being chosen and the other eight integers each have probability p_2 of being chosen.

(c) Suggest which two integers should have probability p_1 and suggest a possible value of p_1. **[2]**

2. Nov/2020/Paper_Y532/01/No.5

At a cinema there are three film sessions each Saturday, "early", "middle" and "late". The numbers of the audience, in different age groups, at the three showings on a randomly chosen Saturday are given in **Table 1**.

Observed frequencies		Session		
		Early	Middle	Late
Age group	< 25	24	20	40
	25 to 60	4	2	10
	> 60	28	22	10

Table 1

The cinema manager carries out a test of whether there is any association between age group and session attended.

(a) Show that it is necessary to combine cells in order to carry out the test. **[2]**

It is decided to combine the second and third rows of the table. Some of the expected frequencies for the table with rows combined, and the corresponding contributions to the χ^2 test statistic, are shown in the following incomplete tables.

Expected frequencies		Session		
		Early	Middle	Late
Age group	< 25	29.4	23.1	
	$\geqslant 25$	26.6	20.9	

Table 2

Contribution to χ^2		Session		
		Early	Middle	Late
Age group	< 25	0.9918	0.4160	
	$\geqslant 25$	1.0962	0.4598	

Table 3

(b) In the Printed Answer Booklet, complete both tables. **[3]**

(c) Carry out the test at the 5% significance level. **[5]**

(d) Use the figures in your completed **Table 3** to comment on the numbers of the audience in different age groups. **[2]**