

**Chi Squared Tests (Contingency Tables) (From OCR 4734)**

**Q1, Jan 2008, Q6)**

The Research and Development department of a paint manufacturer has produced paint of three different shades of grey,  $G_1$ ,  $G_2$  and  $G_3$ . In order to find the reaction of the public to these shades, each of a random sample of 120 people was asked to state which shade they preferred. The results, classified by gender, are shown in Table 1.

		Shade		
		$G_1$	$G_2$	$G_3$
Gender	Male	11	24	23
	Female	18	13	31

**Table 1**

Table 2 shows the corresponding expected values, correct to 2 decimal places, for a test of independence.

		Shade		
		$G_1$	$G_2$	$G_3$
Gender	Male	14.02	17.88	26.10
	Female	14.98	19.12	27.90

**Table 2**

- (i) Show how the value 17.88 for Male,  $G_2$  was obtained. [2]
- (ii) Test, at the 5% significance level, whether gender and preferred shade are independent. [7]
- (iii) Determine the smallest significance level obtained from tables or calculator for which there is evidence that not all shades are equally preferred by people in general, irrespective of gender. [6]

**Q2, (Jan 2010, Q7)**

A chef wished to ascertain her customers' preference for certain vegetables. She asked a random sample of 120 customers for their preferred vegetable from asparagus, broad beans and cauliflower. The responses, classified according to the gender of the customer, are shown in the table.

	Asparagus	Broad beans	Cauliflower
Female preference	31	9	25
Male preference	17	21	17

- (i) Test, at the 5% significance level, whether vegetable preference and gender are independent. [8]
- (ii) Determine whether, at the 10% significance level, the vegetables are equally preferred. [6]

**Q3, (Jun 2010, Q3)**

The developers of a shopping mall sponsored a study of the shopping habits of its users. Each of a random sample of 100 users was asked whether their weekend shopping was mainly on Saturday or mainly on Sunday. The results, classified according to whether the user lived in the city or the country, are shown in the table.

	City dweller	Country dweller
Saturday shopper	23	19
Sunday shopper	42	16

- (i) Test, at the 10% significance level, whether there is an association between the area in which shoppers live and the day on which they shop at the weekend. [8]
- (ii) State, with a reason, whether the conclusion of the test would be different at the 3% significance level. [1]

**Q4, (Jan 2011, Q7)**

- (i) When should Yates' correction be applied when carrying out a  $\chi^2$  test? [1]

Two vaccines against typhoid fever, *A* and *B*, were tested on a total of 700 people in Nepal during a particular year. The vaccines were allocated randomly and whether or not typhoid had developed was noted during the following year. The results are shown in the table.

	Vaccines	
	<i>A</i>	<i>B</i>
Developed typhoid	19	4
Did not develop typhoid	310	367

- (ii) Carry out a suitable  $\chi^2$  test at the 1% significance level to determine whether the outcome depends on the vaccine used. Comment on the result. [10]

**Q5, (OCR 4767, Jun 2013, Q4)**

An art gallery is holding an exhibition. A random sample of 150 visitors to the exhibition is selected. The visitors are asked which of four artists they prefer. Their preferences, classified according to whether the visitor is female or male, are given in the table.

		Artist preferred			
		Monet	Renoir	Degas	Cézanne
Sex	Male	8	25	18	19
	Female	18	35	10	17

- (i) Carry out a test at the 10% significance level to examine whether there is any association between artist preferred and sex of visitor. Your working should include a table showing the contributions of each cell to the test statistic. [12]
- (ii) For each artist, comment briefly on how the preferences of each sex compare with what would be expected if there were no association. [6]

**Q6, (Jun 2013, Q6)**

A random sample of 80 students who had all studied Biology, Chemistry and Art at a college was each asked which they enjoyed most. The results, classified according to gender, are given in the table.

		Subject		
		Biology	Chemistry	Art
Gender	Male	13	4	11
	Female	37	8	7

It is required to carry out a test of independence between subject most enjoyed and gender at the  $2\frac{1}{2}\%$  significance level.

- (i) Calculate the expected values for the cells. [3]
- (ii) Explain why it is necessary to combine cells, and choose a suitable combination. [2]
- (iii) Carry out the test. [8]

**Q7, (Jun 2016, Q2)**

A random sample of 200 American voters were asked about which political party they supported and their attitude to a proposed new form of taxation. The voters' responses are summarised in the table.

		Attitude		
		In favour	Neutral	Against
Party	Democrat	58	16	16
	Independent	25	4	11
	Republican	17	20	33

Carry out a  $\chi^2$  test, at the 1% level of significance, to investigate whether there is an association between party supported and attitude to the proposed form of taxation. [7]

**Q8, (Jun 2017, Q3)**

The hair colour and eye colour of 100 randomly selected people were noted. The results are shown in the table.

	Dark hair	Not dark hair
Brown eyes	36	22
Not brown eyes	16	26

Use a  $\chi^2$  test at the 5% significance level to test whether there is an association between hair colour and eye colour. [7]