## BRONZE

**Q1.**

A university foreign language department carried out a survey of prospective students to find out which of three languages they were most interested in studying.

A random sample of 150 prospective students gave the following results.

| | | Language | | |
|---|---|---|---|---|
| | | French | Spanish | Mandarin |
| Gender | Male | 23 | 22 | 20 |
| | Female | 38 | 32 | 15 |

A test is carried out at the 1% level of significance to determine whether or not there is an association between gender and choice of language.

(a) State the null hypothesis for this test.

**(1)**

(b) Show that the expected frequency for females choosing Spanish is 30.6

**(1)**

(c) Calculate the test statistic for this test, stating the expected frequencies you have used.

**(3)**

(d) State whether or not the null hypothesis is rejected. Justify your answer.

**(2)**

(e) Explain whether or not the null hypothesis would be rejected if the test was carried out at the 10% level of significance.

**(1)**

**(Total for question = 8 marks)**

SILVER

**Q2.**

The discrete random variable $X$ follows a Poisson distribution with mean 1.4

(a) Write down the value of

(i) $P(X = 1)$

(ii) $P(X \leq 4)$

**(2)**

The manager of a bank recorded the number of mortgages approved each week over a 40 week period.

| Number of mortgages approved | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Frequency | 10 | 16 | 7 | 4 | 2 | 0 | 1 |

(b) Show that the mean number of mortgages approved over the 40 week period is 1.4

**(1)**

The bank manager believes that the Poisson distribution may be a good model for the number of mortgages approved each week.

She uses a Poisson distribution with a mean of 1.4 to calculate expected frequencies as follows.

| **Number of mortgages approved** | 0 | 1 | 2 | 3 | 4 | 5 or more |
|---|---|---|---|---|---|---|
| **Expected frequency** | 9.86 | $r$ | 9.67 | 4.51 | 1.58 | $s$ |

(c) Find the value of $r$ and the value of $s$ giving your answers to 2 decimal places.

**(2)**

The bank manager will test, at the 5% level of significance, whether or not the data can be modelled by a Poisson distribution.

(d) Calculate the test statistic and state the conclusion for this test. State clearly the degrees of freedom and the hypotheses used in the test.

**(6)**

**(Total for question = 11 marks)**

GOLD

**Q3.**

Abram carried out a survey of two treatments for a plant fungus. The contingency table below shows the results of a survey of a random sample of 125 plants with the fungus.

| | | **Treatment** | | |
|---|---|---|---|---|
| | | No action | Plant sprayed once | Plant sprayed every day |
| **Outcome** | Plant died within a month | 15 | 16 | 25 |
| | Plant survived for 1 – 6 months | 8 | 25 | 10 |
| | Plant survived beyond 6 months | 7 | 14 | 5 |

Abram calculates expected frequencies to carry out a suitable test. Seven of these are given in the partly-completed table below.

| | | **Treatment** | | |
|---|---|---|---|---|
| | | No action | Plant sprayed once | Plant sprayed every day |
| **Outcome** | Plant died within a month | | | 17.92 |
| | Plant survived for 1 – 6 months | 10.32 | 18.92 | 13.76 |
| | Plant survived beyond 6 months | 6.24 | 11.44 | 8.32 |

The value of $\sum \frac{(O-E)^2}{E}$ for the 7 given values is 8.29

Test at the 2.5% level of significance, whether or not there is an association between the treatment of the plants and their survival. State your hypotheses and conclusion clearly.

**(7)**

**(Total for question = 7 marks)**