Lesson 5

A-level Applied Mathematics

Statistics : Hypothesis Testing : Year 1

5.1 Examination Questions

Question 1

S2 Examination Question from Thursday 24th May 2012, Q2

A test statistic has a distribution B(25, p)

Given that

$$H_0 : p = 0.5 \qquad H_1 : p \neq 0.5$$

(a) find the critical region for the test statistic such that the probability in each tail is as close as possible to 2.5 %

[3 marks]

(b) State the probability of incorrectly rejecting H_0 using this critical region.

[2 marks]

Question 2

S2 Examination Question from Monday 22nd June 2015, Q2

The proportion of houses in Radville which are unable to receive digital radio is 25 %. In a survey of a random sample of 30 houses taken from Radville, the number, X, of houses which are unable to receive digital radio is recorded.

(a) Find $P(5 \leqslant X < 11)$

[3 marks]

A radio company claims that a new transmitter set up in Radville will reduce the proportion of houses which are unable to receive digital radio. After the new transmitter has been set up, a random sample of 15 houses is taken, of which 1 house is unable to receive digital radio.

(b) Test, at the 10 % level of significance, the radio company's claim.
State your hypotheses clearly.

[5 marks]

Question 3

S2 Examination Question from Monday 27th June 2016, Q2

In a region of the UK, 5 % of people have red hair. In a random sample of size *n*, taken from this region, the expected number of people with red hair is 3.

(a) Calculate the value of *n*

[2 marks]

A random sample of 20 people is taken from this region.
Find the probability that

(b) **(i)** exactly 4 of these people have red hair

(ii) at least 4 of these people have red hair

[5 marks]

Patrick claims that *Reddman* people have a probability greater than 5 % of having red hair. In a random sample of 50 *Reddman* people, 4 of them have red hair.

(c) Stating your hypotheses clearly, test Patrick's claim.
Use a 1 % level of significance.

[5 marks]

Question 4

S2 Examination Question from Monday 1st June 2009, Q4

Past records suggest that 30 % of customers who buy baked beans from a large supermarket buy them in single tins. A new manager questions whether or not there has been a change in the proportion of customers who buy baked beans in single tins.

A random sample of 20 customers who had bought baked beans was taken.

(a) Using a 10 % level of significance, find the critical region for a two-tailed test to answer the manager's question. You should state the probability of rejection in each tail which should be less than 0.05.

[5 marks]

(b) Write down the actual significance level of a test based on your critical region from part (a)

[1 mark]

The manager found that 11 customers from the sample of 20 had bought baked beans in single tins.

(c) Comment on this finding in the light of your critical region found in part (a)

[2 marks]

Question 5

S2 Examination Question from Wednesday 9th June 2010, Q6

A company claims that a quarter of the bolts sent to them are faulty. To test this claim the number of faulty bolts in a random sample of 50 is recorded.

(a) Give two reasons why a binomial distribution may be a suitable model for the number of faulty bolts in the sample.

[2 marks]

(b) Using a 5 % significance level, find the critical region for a two-tailed test of the hypotheses that the probability of a bolt being faulty is 0.25. The probability of rejection in either tail should be as close as possible to 0.025

[3 marks]

(c) Find the actual significance level of this test

[2 marks]

In the sample of 50 the actual number of faulty bolts was 8

(d) Comment on the company's claim in the light of this value.
Justify your answer

[2 marks]

The machine making the bolts was reset and another sample of 50 bolts was taken. Only 5 were found to be faulty.

(e) Test at the 1 % level of significance whether or not the probability of a faulty bolt has decreased. State your hypotheses clearly.

[6 marks]

Question 6

S2 Examination Question from Friday 24th May 2013, Q6

In a manufacturing process 25 % of articles are thought to be defective.

Articles are produced in batches of 20

(a) A batch is selected at random. using a 5 % significance level, find the critical region for a two tailed test that the probability of an article chosen at random being defective is 0.25

You should state the probability in each tail, which should be as close as possible to 0.025

[5 marks]

The manufacturer changes the production process to try to reduce the number of defective articles.

She then chooses a batch at random and discovers there are 3 defective articles.

(b) Test at the 5 % level of significance whether or not there is evidence that the changes to the process have reduced the percentage of defective articles.

State your hypotheses clearly.

[5 marks]