**Two-sample t-tests**

**QUESTION 4.**  2012

A team of earth scientists was mapping the distribution of acid sulphate soils near estuaries in northern NSW. They were interested in whether remediation works had affected the pH of soils. They obtained the following pH data from 8 sites that had remediation works, and 8 sites that had not been manipulated.

|  |  |
| --- | --- |
| Remediated sites | Un-manipulated sites |
| 6.7 | 6.6 |
| 7.1 | 6.7 |
| 6.9 | 6.8 |
| 7.0 | 7.2 |
| 6.6 | 7.0 |
| 6.6 | 6.9 |
| 7.2 | 7.1 |
| 7.5 | 6.8 |

Answer all parts 4A to 4D.

**4A)** What statistical test could you use to detect whether the remediation efforts had altered the pH of soil? (2 marks)

**4B)** Conduct the test, and give the value of the test statistic. (6 marks)

**4C)** Is your null hypothesis rejected or retained? (2 marks)

**4D)** The sites belonged to a few different land use categories (farmland, bushland and heathland). Suggest a new sampling design, or new analyses, that would ensure that the data were not confounded by possible differences in soil pH among the land use categories? (10 marks)

**QUESTION 2.**  2014

A team of environmental managers was concerned about the effects of increased soil salinity on native mammal populations in the arid zone of NSW. They conducted spotlight surveys for kangaroos at night at 10 sites, half of which were affected by soil salinity and half of which were unaffected by increased salinity. They obtained the following data:

|  |  |  |
| --- | --- | --- |
| Site | Soil salinity | Kangaroos  (number per survey) |
| 1 | Saline | 0 |
| 2 | Saline | 5 |
| 3 | Saline | 3 |
| 4 | Saline | 6 |
| 5 | Saline | 4 |
| 6 | Natural | 12 |
| 7 | Natural | 9 |
| 8 | Natural | 8 |
| 9 | Natural | 10 |
| 10 | Natural | 9 |

Answer all parts 2A to 2D.

**2A)** What statistical test could you use to detect whether the abundance of kangaroos differed between areas affected and those unaffected by soil salinity? (2 marks)

**2B)** Conduct the test, and give the value of the test statistic. (8 marks)

**2C)** Is your null hypothesis rejected or retained? (2 marks)

**2D)** Write a paragraph that you could provide to the landholders that explains the results of the test (8 marks)

**QUESTION 2: 2008**

An environmental scientist was interested in how land management affected water quality in rivers. She compared the salinity of 5 rivers in areas of farmland to 5 rivers in forested areas and received the following data (measured as EC, electrical conductivity):

|  |  |
| --- | --- |
| Rivers in farmland | Rivers in forest |
| 850 | 307 |
| 551 | 298 |
| 639 | 478 |
| 567 | 687 |
| 403 | 523 |

1. What statistical test would be suitable to contrast the salinity between the two types of rivers? (2 marks)
2. For the test you have chosen, state the null and alternative hypotheses (3 marks)
3. What is the value of the test statistic? (use appropriate formulae and values from tables below) (5 marks)
4. Is your null hypothesis rejected or retained? (use appropriate formulae and values from tables below) (2 marks)
5. Provide a brief written statement that interprets the results (3 marks)

Samples were also classified into those that were above or below the limit recommended by the World Health Organisation for drinking water (EC= 800). She was interested in testing whether the 10 samples differed from previous sampling in the same area that had found 40% of samples unsuitable for drinking.

1. What statistical test would be suitable to test this hypothesis? (2 marks)
2. Present the value of the test statistic chosen and state whether the null hypothesis is rejected or retained (use appropriate formulae and values from tables below) (3 marks)

**QUESTION 4.**  2013

A team of marine biologists was interested in how ocean acidification due to increased atmospheric CO2 was affecting the growth of corals. For three months, they grew coral fragments in each of two treatments: 1) a control treatment at ambient pH, and 2) a treatment at lowered pH. Each coral fragment was held in a separate tank with an independent water supply. They recorded the size of each fragment at the beginning and end of the experiment, and obtained the following data set:

|  |  |  |
| --- | --- | --- |
| Treatment | Initial size  (cm) | Size at 3 months  (cm) |
| Ambient pH | 6.5 | 12.3 |
| Ambient pH | 7.5 | 13.1 |
| Ambient pH | 8.3 | 10.8 |
| Ambient pH | 6.9 | 9.8 |
| Ambient pH | 7.1 | 12.6 |
| Low pH | 6.6 | 6.4 |
| Low pH | 6.1 | 6.3 |
| Low pH | 8.0 | 7.8 |
| Low pH | 7.8 | 7.9 |
| Low pH | 7.4 | 7.3 |

Answer all parts 4A to 4D.

**4A)** What statistical test could you use to detect whether lowered pH affects the growth of coral? (2 marks)

**4B)** Conduct the test, and give the value of the test statistic. (8 marks)

**4C)** Is your null hypothesis rejected or retained? (2 marks)

**4D)** Did the corals grow at lowered pH? Support your answer with the results of a statistical test that would effectively test this hypothesis (8 marks)