Week 5 Hypothesis testing

One-sample tests for means

`bones`

Humerus bones from the same species of animal tend to have approximately the same length-to-width ratio. When fossils of humerus bones are discovered, archeologists can often determine the corresponding species of animal by examining the length-to-width ratios of the bones. It is known that species A exhibits a mean length-to-width ratio of 8.5. A set of 41 fossils of humerus bones were unearthed at an archeological site in East Africa, where species A is believed to have lived. The length-to-width ratio of each bone was calculated, and it is assumed that all bones belong to the same unknown species. Test to determine whether the true mean length-to-width ratio of all humerus bones belonging to this particular species differs from 8.5 at significance level $\alpha = 0.05$.

`irontemp`

A steel company make automotive components. When the process is stable, the target pouring temperature of the molten iron is $2550°F$. The file contains the pouring temperatures for a random sample of 10 crankshafts produced at the plant. Test to determine whether the true mean pouring temperature differs from the target temperature at significance level $\alpha = 0.05$.

`pigeons`

In a study of the diets and water requirements of spinifex pigeons living in Western Australia, sixteen pigeons were captured and the stomach contents of each was examined. The file records the weight of dry seeds found in the stomach of each pigeon. Conduct a test of the null hypothesis $H_0 : \mu = 1$ against the alternative hypothesis $H_1 : \mu \neq 1$, where μ is the true mean weight.

`pcb`

Modern technology uses lasers to inspect solder-joint defects on printed circuit boards (PCBs). A particular manufacturer of laser-based inspection equipment claims that its product can inspect on average at least 10 solder joints per second when the joints are spaced 0.1mm apart. The equipment was tested by a potential buyer on 48 different PCBs. In each case, the equipment was operated for exactly one second. The file records the number of solder joints inspected on each run.

1. Check the manufacturer's claim by testing $H_0 : \mu = 10$ against $H_1 : \mu < 10$ at significance level $\alpha = 0.05$, where μ is the true mean number of solder joints tested per second.
2. If the standard deviation of the the number of solder joints tested per second is 1.2, compute the power of the test to detect the alternative hypothesis $H_1 : \mu = 9.5$.

One-sample tests for differences

`homophon`

A *homophone* is a word whose pronounciation is the same as that of another word having a different meaning and spelling (e.g. *none* and *nun*). It is claimed that Alzheimer's patients show a significant increase in mean homophone confusion errors over time. Twenty patients suffering from Alzheimer's disease were asked to spell 24 homophone pairs given in a random order, and the number of homophone confusions was recorded for each patient. One year later,

the same test was given to the same patients. Test the claim that Alzheimer's patients show a significant increase in mean homophone confusion errors over time.

biofeed

Can a person control their blood pressure if that person is trained in a programme of *biofeedback* exercises? An experiment is conducted to show that blood pressure levels can be consciously reduced by people trained in this program. The blood pressure measurements recorded in the file are readings before and after the biofeedback training of six subjects. Test to determine whether mean blood pressure decreases after training.

One-sample tests for variances

co2

Geologists use laser Raman microprobe (LRM) spectroscopy to analyse fluid inclusions (pockets of liquid or gas) in rock. A fragment of quartz was artificially injected with several fluid inclusions of liquid carbon dioxide (CO_2) and then subjected to LRM spectroscopy. The concentration of CO_2 present in the inclusion was recorded for the same inclusion on four different days. The measurements (in moles percent) were 86.6, 84.6, 85.5 and 85.9, as recorded in the file. Test to determine whether the variance of CO_2 measurements is significantly different from 1.

mathcpu

A study was conducted to test the runtime of an algorithm for solving a polynomial zero-one mathematical programming problem. A total of 52 random problem instances were solved using the algorithm, and the time taken to reach the solution was recorded in each case. Test to determine whether the variance of the solution times is significantly different from 2 at significance level $\alpha = 0.05$.

Two-sample tests

bacteria

A factory that purifies its liquid waste discharges the water into a river. An inspector from the Environment Agency has collected six water specimens from the discharge of the factory, and six specimens from the river upstream from the factory. The file records the bacteria counts for each of the 12 specimens. Test to determine whether the mean bacteria count for the factory discharge exceeds that for the upstream location.

bulimia

Two samples of students participated in a psychology experiment. One sample consisted of 11 students known to suffer from the eating disorder *bulimia*, while the other sample consisted of 14 students with healthy eating habits. Each student completed a questionnaire from which a *fear of negative evaluation* (FNE) score was produced: the higher the score, the greater the fear of negative evaluation.

1. Test to determine whether the variance of the FNE scores for bulimic students is equal to the variance of the FNE scores for healthy students.
2. Test to determine whether there is a significant difference between the mean FNE score for bulimic students and the mean FNE score for healthy students.