Last Lecture

- Standard deviation
- Sum of Squares
- Coefficient of variation
- Standard error
- Confidence intervals

Hypothesis testing

- Applied in both scientific practice and in statistical analysis
- Karl Popper, a philosopher of science, proposed that scientific hypotheses are those that are ‘falsifiable,’ i.e. able to be discarded when new evidence is collected.
- In statistical analysis, we construct a ‘null’ hypothesis, in which no effect (no difference, or no relationship) exists, then we collect data and determine whether we can reject this null hypothesis.

Fisherian hypothesis testing

- Construct null hypothesis ($H_0$)
- Choose test statistic that measures deviation from $H_0$, with known sampling distribution (e.g. $t$ statistic)
- Collect data and compare value of test statistic from your sample to its sampling distribution
- Determine $P$ value of obtaining our value of statistic, if null hypothesis applies.
- Reject $H_0$ if $P$ is small, retain it otherwise.

Extension of Fisherian view

- Pose two hypotheses at outset.
- Null hypothesis, as above, suggests no effect.
- Alternative hypothesis suggests an effect.
- By rejecting $H_0$, provisional acceptance of $H_A$ is implied.

Example of hypothesis testing

- One sample $t$ test (formula 3.2, page 35)
  - Specify null hypothesis (e.g. $\mu = 0$, or any other number)
  - Take a random sample from population
  - Compare sample mean to population value (by subtraction)
  - Divide difference between sample and specified value by standard error to calculate $t$ statistic
  - Evaluate $t$ statistic against $t$ distribution

More about $t$ distribution

- Probability distribution of ratio of difference between sample statistic and population value to standard deviation of sample statistic (page 12)
- $T$ values can be positive or negative
- Is symmetrical and similar to normal distribution
- With increasing sample size, becomes taller and thinner (fig. 1.2)
More about one sample t test

- Critical values of t correspond to X axis, but are set by area beneath curve
- Area is defined by the null hypothesis
  - If Ho states that sample does not differ from population value, then it could be either larger or smaller, and area is defined in both directions- two tailed test
  - If Ho is that a value is ‘not bigger’ or ‘not smaller’ than population mean, area is defined on left or right (i.e. one direction)- one tailed test

Remarks

- $P$ value represents probability that a result would occur, over the long run, if Ho is true, not the probability that a specific result would occur by chance.
- Failing to reject H_o does not mean you accept it, just that you must suspend judgement for the moment.
- There may be bias in the literature against ‘negative’ results.

Decision errors (Figs 3.2, 3.3)

- Type I error- mistaken rejection of H_o. Referred to as alpha. Results from fact that, by chance, your sample may differ from the population parameter
- Type II error- mistaken acceptance of an incorrect H_o and rejection of H_A. More than one H_A possible. Type II error decreases with increasing distance between sample mean and population parameter.