

the justification. Here both of these descriptions will be used for any situation where randomly reordering observations is used to determine the significance level of a test statistic.

1.2 Examples of Randomization Tests

To clarify the procedures and principles that are used with randomization testing, it will be helpful to consider some detailed examples at this point.

Example 1.1 Mandible Lengths of Male and Female Golden Jackals

The data shown below are mandible lengths in millimeters for male and female golden jackals (*Canis aureus*) for 10 of each sex in the collection in the British Museum of Natural History in London:

Males	120	107	110	116	114	111	113	117	114	112
Females	110	111	107	108	110	105	107	106	111	111

The lengths were measured as part of a study by Higham et al. (1980) on the relationship between prehistoric canid bones from Thailand and similar bones from modern species. For the present example, the question addressed is whether there is any evidence of a difference in the mean lengths for the two sexes.

Data like the above are often collected in the belief that there will be a difference in the results for the two groups. In fact, it is a reasonable supposition that male jackals will tend to be larger than females. The result expected before collecting the data was therefore that the male mean would be higher than the female mean. This can be tested indirectly by setting up a null hypothesis that says that any difference between the two sample means is purely due to chance. If this null hypothesis is consistent with the data, then there is no reason to reject this in favor of the alternative hypothesis — that males have a higher mean.

It may seem strange to test the hypothesis of interest by setting up a null hypothesis and seeing how the data compare with this. However, there is frequently little choice in the matter. It is possible to work out probabilities of different sample results or to generate possible sample results using the null hypothesis. To do this for the hypothesis that is