Chapter 7 The simplest type of experimental design: completely randomized, single-factor

Additional self-test questions

Q7.1 Explain what in meant by a factorial experiment.

If we explore the consequences on one or more response variables of a combination of two or more factors that we can manipulate independently, then we have a factorial experiment. The key here is that we study the consequences of a combination of factors. So, for example, an experiment that assigned dogs to one of three different diets and explored the consequences for health and well-being would not be a factorial experiment (it would be a single-factor experiment, with three levels of that factor); but an experiment that assigned dogs to a combination of one of three diets and either of two exercise regimes would be a factorial experiment (because there are multiple factors involved).

Q7.2 Explain levels of a factor by way of an example.

We want to study what additional support best helps students prepare for an exam. All students attend a lecture course. One quarter of them are randomized to receive no extra help (this is the control group), one quarter get a package of supplementary reading material, one quarter get a revision tutorial with the course leader, and one quarter get personal access to an online quiz. Our experiment has a single factor, 'type of supplementary help', and that factor has four different levels. That is, for that factor, any given experimental subject can be assigned to one of four different groups.

Q7.3 What is the value of randomization?

In the experiment described in the answer to the last question, student performance in exams will be affected by factors other than the one we are interested in (method of supplementary support). In order to make a fair comparison between the four different levels of that factor we need to ensure that there is no systematic bias across the groups in any other factor that can affect exam performance. In order to do that we do not necessarily need to identify those potentially confounding factors; if we have a large sample size and randomize correctly then we should avoid systematic bias in all potential confounders.

Q7.4 When is haphazard allocation of subjects to treatment groups just as effective as random allocation?

Never ever.

Q7.5 Give an example of a situation where we plan to perform a balanced experiment but end up with unbalanced numbers of subjects in different groups.

We have at our disposal 100 mice; these are randomized to be housed singly in one of four different types of cage, and our plan is to test whether complexity of their housing influences performance in a spatial memory test performed a month later. However, in the month before our test four of the mice fall ill and have to be removed to a different housing regime elsewhere to receive veterinary care. These four individuals have to be excluded from the experiment. Thus, instead of a planned comparison of 25–25–25–25 individuals, we end up with 24–23–24–25.

Q7.6 What are drop-out cases?

In the answer to our last question, the four mice are drop-out cases. More generally, a drop-out case is a subject that we had intended to use in our experiment but we end up having to exclude from our final reporting of results because some extraneous unplanned factor means that data cannot be collected from that subject or the data collected on that subject is expected to be strongly influenced by the extraneous unplanned factor. Returning to our mouse example, an individual would become a drop-out case if it was unavailable to take part in our spatial memory test because it was currently undergoing veterinary treatment, or might be excluded by us even if it were available if we had concerns that the drugs administered to it as part of its treatment would have a much stronger effect on performance in the test than the effect of its prior housing conditions.