

# **Part II**

## **Probability**

Chapters 3 and 4 provide a foundation in probability and a small amount of inferential statistics. In most books, probability appears in the context of statistics. I prefer to think of probability as a subject in its own right. Descriptive statistics is essential background for probability and appears in Section 3.1. I can then present probability as the study of mathematical models of data sets. This viewpoint places the focus on probability distributions, which play a prominent role in the characterization of data and are needed to run simulations for stochastic dynamical system models.

Much of statistics is concerned with the assessment of inferences, and one can see Chapter 3 and Sections 4.1–4.3 as providing the necessary background for the brief treatment of inferential statistics that occupies Section 4.4. A full treatment of this subject lies beyond the scope of this book. I do not present analysis of variation, which asks questions such as, “Does this characteristic explain variation in that characteristic?” My treatment of inferential statistics is limited to questions such as, “Is the population from which this data was collected different from the general population?,” which can be addressed using the standard distributions that characterize simple data sets. Section 4.4 focuses on using probability models, with minimal attention to the statistical rules of thumb that convert probability results into answers of “yes” or “no.”

Conditional probability (Sections 4.6 and 4.7) is normally presented before probability distributions and could be studied immediately after Section 3.2. I have placed this material at the end of Part II so as not to interrupt the flow toward Section 4.4. I also believe that it is better pedagogy to focus on independent random variables in detail before examining dependence.

The problem sets include several case studies that are split over multiple sections:

| Section                   | 3.1, 3.4 | 3.5   | 3.6    | 3.6, 3.7 | 4.2    | 4.4   | 4.5    |
|---------------------------|----------|-------|--------|----------|--------|-------|--------|
| Dopamine and psychosis    | 3.1.3    |       |        |          | 4.2.1  | 4.4.2 | 4.5.1  |
| Fruit fly egg production  | 3.1.4    |       |        |          | 4.2.2  | 4.4.3 | 4.5.2  |
| Weight gain in rats       | 3.1.5    |       |        |          | 4.2.3  | 4.4.4 | 4.5.3  |
| Blood pressure medication | 3.1.6    |       |        |          |        | 4.4.6 |        |
| Resting pulse rates       | 3.1.7    |       | 3.6.9  |          | 4.2.5  |       |        |
| Left-handed presidents    | 3.4.5    |       |        |          |        | 4.4.8 |        |
| Chest sizes of soldiers   |          | 3.5.2 | 3.6.6  |          |        |       |        |
| Cuckoo egg measurements   |          | 3.5.3 | 3.6.7  |          |        |       |        |
| Butterfat in cow milk     |          | 3.5.4 | 3.6.12 | 3.6.13   | 4.2.4  | 4.4.5 | 4.5.4  |
| Iris sepal lengths        |          | 3.5.5 | 3.5.6  | 3.6.10   | 3.6.11 | 4.2.7 | 4.5.5  |
| Malaria parasite counts   |          |       |        |          | 3.7.6  |       | 4.5.9  |
| Spiders under boards      |          |       |        |          | 3.7.7  |       | 4.5.10 |
| Nerve pulse times         |          |       |        |          | 3.7.13 | 4.2.8 |        |

The accompanying sketch shows the interdependencies of the sections in Part II and connections to prerequisite topics.

