Multivariate Distributions

The world of probability and statistics doesn't limit itself to the study of single variables. Often, we are interested in the interconnections, relationships, and associations among several variables. In such a scenario, the univariate distributions that we have studied so far become inadequate. To comprehend the joint behavior of these variables and to uncover the underlying patterns of dependency, we must turn to the realm of multivariate distributions.

This chapter aims to introduce the reader to the concept of multivariate probability distributions. These are probability distributions that take into account and describe the behavior of more than one random variable. We will start our exploration with a discussion on the joint probability mass and density functions. These functions extend the concepts of probability mass and density functions for one variable to the situation where we have multiple variables.

Next, we will explore important properties of joint distributions, including the concept of marginal distribution and conditional distribution, which allow us to explore the probability of a subset of variables while conditioning on, or ignoring, other variables. We will also introduce the idea of independence of random variables in the multivariate context.

Subsequently, we will discuss some commonly used multivariate distributions such as the multivariate normal distribution, and the multivariate Bernoulli and binomial distributions. These specific distributions will provide us with practical tools for modelling multivariate data.

Finally, we will delve into covariance and correlation, two key measures that give us a sense of how two variables change together. Understanding these measures is critical for capturing the relationships in multivariate data.

This is a draft chapter from the Kontinua Project. Please see our website (https://kontinua. org/) for more details.

Answers to Exercises