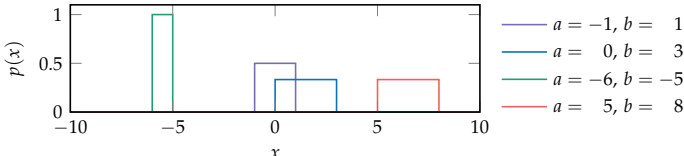
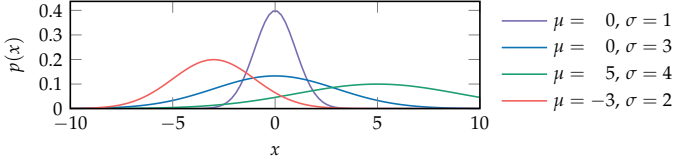


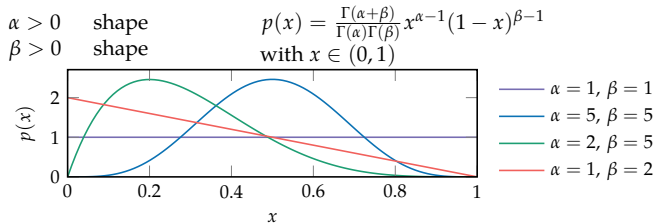
B Probability Distributions

This appendix summarizes several families of probability distributions relevant to the topics introduced in this book.¹ The distributions are represented by either probability mass functions or probability density functions, and the relevant functions are provided, along with the parameters that govern each distribution. Plots show how the various parameters influence the distribution. The index includes page references to where these distributions are used in the body of the book. Some distributions are *univariate*, meaning that they are distributions over a scalar variable; others are *multivariate*, meaning that they are distributions over multiple variables.

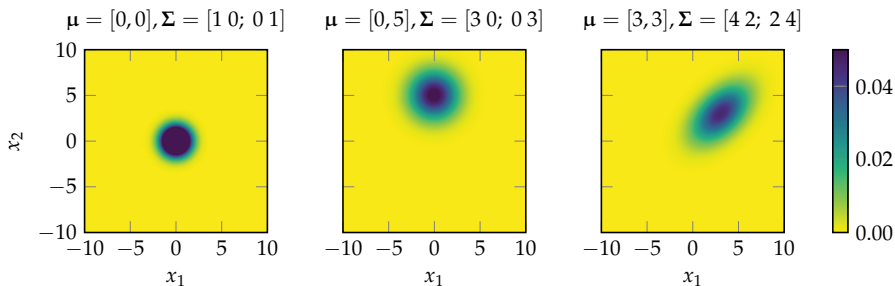
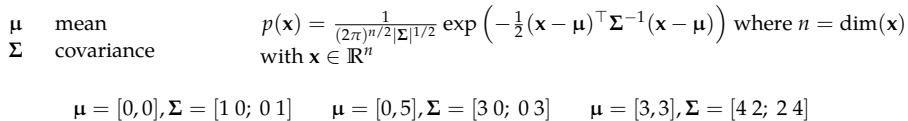
¹These distributions are implemented in `Distributions.jl`. M. Besançon, T. Papamarkou, D. Anthoff, A. Arslan, S. Byrne, D. Lin, and J. Pearson, “Distributions.jl: Definition and Modeling of Probability Distributions in the JuliaStats Ecosystem,” 2019. arXiv: 1907.08611v1.

| Name | Parameters | Distribution Function |
|--|------------------------------------|---|
| Uniform $\mathcal{U}(a, b)$ | a lower bound b upper bound | $p(x) = \frac{1}{b-a}$ with $x \in [a, b]$ |
| | |  <p>The plot shows four rectangular probability mass functions for the Uniform distribution. The x-axis ranges from -10 to 10, and the y-axis ranges from 0 to 1. The distributions are: a blue rectangle from $x = -1$ to $x = 1$ with height 1; a light blue rectangle from $x = 0$ to $x = 3$ with height 1/3; a green rectangle from $x = -6$ to $x = -5$ with height 1; and a red rectangle from $x = 5$ to $x = 8$ with height 1/3.</p> |
| Gaussian (univariate) $\mathcal{N}(\mu, \sigma^2)$ | μ mean σ^2 variance | $p(x) = \frac{1}{\sigma} \phi\left(\frac{x-\mu}{\sigma}\right)$ where $\phi(x) = \frac{1}{\sqrt{2\pi}} \exp(-x^2/2)$ with $x \in \mathbb{R}$ |
| | |  <p>The plot shows four Gaussian probability density functions. The x-axis ranges from -10 to 10, and the y-axis ranges from 0 to 0.4. The distributions are: a blue curve centered at $\mu = 0$ with $\sigma = 1$ (height ~0.4); a light blue curve centered at $\mu = 0$ with $\sigma = 3$ (height ~0.15); a green curve centered at $\mu = 5$ with $\sigma = 4$ (height ~0.1); and a red curve centered at $\mu = -3$ with $\sigma = 2$ (height ~0.2).</p> |

Beta
Beta(α, β)



Gaussian
(multivariate)
 $\mathcal{N}(\mu, \Sigma)$



Dirichlet
Dir(α)

