Lab/HW 9: Sampling

Your lab/homework must be submitted in with two files: (1) R Markdown format file; (2) a pdf or html file, unless otherwise stated. Other formats will not be accepted. Your responses must be supported by both textual explanations and the code you generate to produce your result.

Part I - Discrete Sampling

1. Provide a proof that our method of sampling for discrete distributions (finite or infinite) works. I.e. explain why in the samples we generate the probability of a certain outcome, say, 3, is indeed equal to p_3 as a result of the sampling algorithm we discussed in class.
2. Generate 10000 draws from the geometric distribution with parameter `p` (do not use the built in function in R. Please use the methods we saw in class for sampling from discrete distributions in general). The geometric distribution counts of the number failures before the first success.
3. Plot a histogram of your results and add to it a curve for the PMF of the true distribution.

Part II - Sampling from the Normal Distribution

1. Implement the Box-Muller algorithm (last section of Lecture 9) in a function generating `n` standard normal draws (make sure that you are drawing the minimal required number of uniform values, think about modulus and integer part of division). Demonstrate that you got the correct length for your output for both odd and even `n` values.
2. Verify that your draws are indeed $N(0, 1)$ by comparing a histogram of the draws to the theoretical density and computing mean and sd for a large sample.
3. Write a function that calls the previous function and transforms the $N(0, 1)$ draws to $N(\mu, \sigma)$. Test it with a histogram and a curve of the density function.