Spring 2026: Mathematical Statistics
Recitation 2 Problems
Feb. 6, 2026

1. [4.74] The number of offspring of an organism is a discrete random variable with mean μ and variance σ^2. Each of its offspring reproduces in the same manner. Find the expectation and variance of the number of offspring in the third generation.

2. [5.18] Suppose that a company ships packages that are variable in weight, with an average weight of 15 lb and a standard deviation of 10 lb. Assuming that the packages come from a large number of different customers so that it is reasonable to model their weights as independent random variables, find the probability that 100 packages will have a total weight exceeding 1700 lb.

3. Find the mean and variance of $X \sim \text{Gamma}(\alpha, \lambda)$ in terms of α and λ.

   (a) Find the moment generating function of the gamma distribution.
   [Hint: No need to compute complicated integrals here. Recall that the pdf of the gamma distribution integrates to 1.]

   (b) Find the mean and variance of X.

4. Show that if X_i are independent, identically distributed exponential random variables, $X_i \sim \text{Exp}(\lambda)$, then
$$Y_i = \sum_{i=1}^{n} X_i \sim \text{Gamma}(n, \lambda).$$