1016-351-01
Probability

Problem Set 4

Assigned 2011 September 27
Due 2011 October 4

Show your work on all problems! If you use a computer to assist with numerical computations, turn in your source code as well.

1 Devore Chapter 3, Problem 70

2 Devore Chapter 3, Problem 76

3 Devore Chapter 3, Problem 86

4 Devore Chapter 3, Problem 88

5 Computational Exercise (Extra Credit)

The hypergeometric distribution

$$h(x;n,M,N) = \frac{\binom{M}{x}\binom{N-M}{n-x}}{\binom{N}{n}} \tag{5.1}$$

can be approximated by a binomial distribution

$$b(x;n,p) = \binom{n}{x} p^x (1-p)^{n-x} \tag{5.2}$$

with $p = M/N$, when M, N, and $N - M$ are all large.

a. Using a computer, plot the pmfs $h(x; 10, 12, 20)$ and $b(x; 10, .6)$ over the range of possible x values. (Recall that if you use matplotlib, the binomial coëfficient can be imported from scipy with `from scipy import comb`.)

b. Using a computer, plot the pmfs $h(x; 10, 120, 200)$ and $b(x; 10, .6)$ over the range of possible x values.

c. Another large-number approximation is that the binomial distribution tends towards the Poisson distribution

$$p(x;\mu) = \frac{e^{-\mu}\mu^x}{x!}\ . \tag{5.3}$$

On the same set of axes, plot the Poisson pmf $p(x; 3)$ and the binomial pmfs $b(x; 12, .25)$ and $b(x; 300, .01)$, for x between 0 and 12, inclusive. (If you use matplotlib, you can also import a factorial function from scipy with `from scipy import factorial`.)