MATH 1180
MATHEMATICS FOR LIFE SCIENTISTS
Computer Assignment VII
Due March 30, 2004

Warm up Maple for today's problems with the commands

```
> with(stats);
> iread(histplot);
> iread(binomial);
```

The "binomial" package contains three commands. The first, typed as

```
> b(k,n,p);
```

gives the value of the binomial probability distribution denoted $b(k;n,p)$, the probability of exactly k successes in n trials each with probability p. The second, typed as

```
> B(k,n,p);
```

gives the value of the binomial cumulative distribution denoted $B(k;n,p)$, the probability of k or fewer successes in n trials each with probability p. The last, typed

```
> binplot(n,p);
```

plots the binomial probability distribution for n trials with probability p.

PROBLEMS

- **1.** It is known that 30% of bears are crazed homicidal fiends (CHF's). Ten bears are captured. Plot out the binomial distribution describing the number of bears from this sample which are CHF's, compute the probability that exactly 3 are CHF's, that three or fewer are CHF's, that six or more are CHF's (this is 1 minus the probability that 5 or fewer are CHF's), and that between 2 and 4 inclusive are CHF's. Indicate these probabilities on your graph.

- **2.** If the probability that a team wins any particular game is 0.6, then the probability that it wins a 5 game series is $b(3,5,0.6) + b(4,5,0.6) + b(5,5,0.6)$. (Think about it – who would win if teams kept playing even after one team had won three games?). Figure out how to write this in terms of the cumulative distribution B, and then how to write it in general for a series of n games with probability q of winning any particular game (assume n is odd). On a single graph, plot the probabilities that a team wins a series of length 1, 5 and 101 as functions of q. Why is each curve increasing? Explain the shape of the curve with $n = 1$. Explain the shape of the curve with $n = 101$. What is the value of each curve at $q = 0.5$ and why?

- **3.** The probability p_t that a molecule is inside a cell after t time steps is

$$p_t = (0.9)^t.$$

  Input this as a Maple function. Suppose 100 molecules start out in a cell. Plot the probabilities that 50 molecules are inside at time t and that 10 are inside at time t as functions of t on a single graph with reasonable axes. Explain the shape of the curves. Is it more likely there are exactly 50 or exactly 10 molecules at time 12? What is a more likely number of molecules at this time? Compute the probability that exactly 10 molecules are inside at time 20 and indicate this point on your graph. Do the same for the probability that exactly 50 molecules are inside at time 8. Is the area under each curve equal to 1? Why or why not?