Math 1180 - Mathematics for Life Scientists

Computer Assignment 6 - Random Variables

Due Tuesday, March 7, 2006

Getting Started

Warm up Maple for today's problems with the commands

```
> iread(histplot);
> iread(draw);
> with(stats);
> iread(iter);
```

Problems

1. Recall the method for generating "random numbers" between 0 and 1:

   ```
   > number := x -> stats[random,uniform[0,1]](1);
   ```

   These numbers are associated with the p.d.f. $f(x) = 1$ for $0 \leq x \leq 1$. Here are the commands to make a data set of 50 such numbers called *dat*, and find their average, type

   ```
   > dat := [seq(number(),i=1..50)];
   > describe[mean](dat);
   ```

   There are a bunch other useful **describe** commands that we will meet later.

   (a) Find the average of your 50 numbers.

   (b) Use the definition to find the mathematical expectation of random numbers with p.d.f. $f(x)$.

   (c) Try the same steps but make `dat` include 500 numbers instead. Is the result closer to the mathematical expectation?

2. The command `histplot` (note the `iread(histplot)` command above) can be used to plot a probability distribution as a histogram. To enter a probability distribution, type

   ```
   > a := [1,2,3,4];
   > p := [.1,.6,.2,.1];
   ```

   The array a lists the possible values, and p the probabilities. In this case, the random variable take the value 1 with probability 0.1 and so forth. To plot a histogram, type

   ```
   > histplot(a,p);
   ```

   To pick a random sample of these events, use the command

```
> draw(a,p);
```

This pulls a 1 with probability 0.1, a 2 with probability 0.6 and so on.

(a) Draw 50 events (using the **seq** command) and save the result as *dat*2. Compare the fraction of 1's, 2's, 3's and 4's with what you see on the histogram. A clever way to do this uses the **transform** command as follows

```
> transform[tally](dat2);
```

(b) Find the average of your 50 numbers.

(c) Use the definition to find the expectation. How close is it to the average?

3. Suppose that the p.d.f. for the time X a molecule leaves a cell is equal to

$$f(x) = 2.5e^{-2.5x}$$

for $x \geq 0$.

(a) Use integration to compute the c.d.f. $F(x)$.

(b) Plot f and F on one graph for $0 \leq x \leq 2$.

(c) Compute the probability that the time lies between 1 and 1.5 and mark the associated area on your graph of f.

(d) Compute the probability that the time is less than 0.6 and indicate this on your graphs of f and F.

(e) Find the median.

(f) Use integration to find the expectation. Does it match the median?