Statistics 4861/6861

Assignment 4: (150 points) Due: Monday November 17

1. Write a function that computes the convolution of two vectors. The function prototype is:
   conv <- function(x,y)

   Here x and y are numerical vectors. Be sure to include error checks and header comments. Email the file containing your function to me. The first line of the file should be
   name = 'Albert Einstein'
   for a student named Albert Einstein.
   Then the function should follow.

   Also bring a printout out on November 17 of your function, and the results of running a script to solve the problems below.

   (a) Let Y be the sum of 25 throws of a die. Use your conv() function to calculate the pdf of Y. Call it y.pdf in your R script. Print the values of y.pdf in your script. Calculate P(79 <= Y <= 96) and also P(70 <= Y <= 105). Obviously you can do these calculations from the pdf of Y. Do exercise caution on using the correct indices from Y. That is, you must know which index of the y.pdf vector corresponds to P(Y = 0). Then of course you know which index corresponds to P(Y=79), etc.

   (b) X ~ binom(10, 0.3) and Y ~binom(12,0.3). Z = X + Y. Use your conv() function to compute the pdf of Z. Confirm that it corresponds (within the inevitable round-off error) to the pdf of a binomial random variable with n = 22 trials and p = 0.3. You can do this by subtracting the pdf you calculated from the one given by the R dbinom() function.

   (c) Enter the commands below into your console

```
n = 0:100
y = cos(n*(pi/6)) + n/10
 f = c(1,-sqrt(3),1)/(2-sqrt(3))
 z = conv(f,y)
 plot(y,type = 'l')  # plot the input as a line
 lines(z)              # plot the output of the convolution
                       #  pause here to study the plot. Then type the next command.
 lines(c(0,n/10), col = 'blue')
```

   Put the resulting plot into the document you turn in. If your function is working correctly the z vector will match c(0,n/10) very closely except for the first and last couple points. Think of the sequence (n/10) as being an underlying sequence that describes something that increases linearly. Suppose that what you observe is y, which is the underlying sequence corrupted by a noisy sequence (here represented as cos(n*(pi/6))). This is an example of filtering a time series sequence. An example of filtering a time series sequence you may have read about is a 50 day moving average of a stock price.