Bayesian Statistics, Assignment for Tuesday, Sept. 3

From *Statistical Treatment of Experimental Data*

Study pp. 16-35. Also photocopy or print out pp. 38-91.

For Problem Set 2

The volume of a sphere

1. The volume of a sphere is $V = \frac{4}{3}\pi r^3$. Suppose that is the true volume and with some error due to error in the radius you have found $V + \Delta V = \frac{4}{3}\pi(r + \Delta r)^3$. You'll be using those two formulae shortly.

(a) Write out the first four rows (rows 0, 1, 2, and 3) of Pascal's triangle and use row 3 of the triangle to efficiently expand $(r + \Delta r)^3$ into four terms.

(b) Without throwing any small quantities away yet, simplify $\frac{\Delta V}{V} = \frac{V + \Delta V - V}{V}$ as much as you can.

(c) Now throw away the terms that have $(\Delta r)^2$ or $(\Delta r)^3$ in them. Your final answer for $\frac{\Delta V}{V}$ will be pleasantly simple.

Turn to pp. 34-37 of Young's *Statistical Treatment of Experimental Data*

2. Do Parts (a) and (b) of Problem 2 on p. 34. The answer to (b) is not $1 - 1/6 - 1/6 = 2/3$. It is trickier than that and that is the point.

3. Do Problem 5 on p. 35. The answer to the birthday problem is surprising!

4. Do Problem 7 on p. 35 and see note below.

5. Do Problem 15 on p. 37 and again see note below. Simplify as much as you possibly can before busting out your calculator.

NB: When a problem has a lot of possibilities in it (like 10 socks or 30 committee members), I highly recommend making a smaller problem and making a list of every possibility to see what is going on. Then write down the formula that you think is applicable and check that it agrees with the list. Once you have fully understood the smaller problem and checked your formula, then you can blindly and confidently apply your formula to whatever larger problem you were originally asked to do.