Math4310/Biol6317, Fall 2011
Problem Set 7, due Thursday, Oct 13

Problem 1. In this problem we will verify that standardized means of iid normal data follow Gossett's t distribution. Randomly generate $1,000 \times 20$ normals with mean 5 and variance 2. Place these results in a matrix with $1,000$ rows. Using two `apply` statements on the matrix, create two vectors, one of the sample mean from each row and one of the sample standard deviation from each row. From these $1,000$ means and standard deviations, create $1,000$ outcomes which come from a t distribution. Now use R's `rt` function to directly generate $1,000$ outcomes of t random variables with 19 df. Compare the pth quantiles for $p = 0.1$, $p = 0.2$, $\ldots$, and $p = 0.9$ for both the constructed t random variables and R's t random variables. Do the quantiles seem to agree?

Problem 2. Forced expiratory volume FEV is a standard measure of pulmonary function. We would expect that any reasonable measure of pulmonary function would reflect the fact that a person's pulmonary function declines after age 20. Suppose we test this hypothesis by looking at 10 nonsmoking males ages 35-39, heights 68-72 inches and measure their FEV initially and then once again 2 years later. We obtain this data.

FEV	Year 0	Year 2		Year 0	Year 2
Person			Person		
1	3.22	2.95	6	3.25	3.20
2	4.06	3.75	7	4.20	3.90
3	3.85	4.00	8	3.05	2.76
4	3.50	3.42	9	2.86	2.75
5	2.80	2.77	10	3.50	3.32

Create the relevant confidence interval and interpret.

Problem 3. You have conducted a Bernoulli experiment with $n = 10$ trials and observed 10 successes. Find a 95% confidence interval for the true success probability p. Compare with the confidence interval that you would obtain by assuming that the sample proportion $\hat{p}$ is normally distributed.

Problem 4. In a trial to compare a new fertilizer A with a commercially available fertilizer B, 260 bean sprouts received A and 289 received B for a 3-month period. The mean growth lengths were 9.78 inch with (sample) standard deviation 7.51 inch for A and 12.83 inch with (sample) standard deviation 8.31 inch for B. Is this good evidence that, in general, one of these fertilizers is better than the other at improving growth? If so, within what limits would the average annual difference in growth be expected to be?