Statistics 10 Lecture 13 Expected Values and Standard Errors (Chapter 17)

1. Review the Expected Value for a SUM (17.1)

The EXPECTED VALUE FOR A SUM in Chapter 17 is <u>the number of draws from a box times the average of the tickets in that box</u>. The draws must be random with replacement for this to work. Associate Expected Value with the idea of a "most likely outcome"

2. The Standard Error for a SUM (17.2)

The standard error is a measure of the chance error. An outcome (sum) from some number of draws will be around an expected value but it can (and will be) off by chance error.

Formula: standard error of a sum = square root (number of draws) times the standard deviation (SD) of the box.

So for a coin box, in 10 tosses, the standard error = $\sqrt{10}$ ** 0.5 = 1.6 (approximately)*

3. Using the Normal Curve with Expected Values and Standard Errors (17.3)

This section ties it all together. You can borrow the normal curve to make statements about random processes (such as draws from a box, coin tosses, craps, M & Ms from packages, whatever).

All that is required is that you

(a) calculate the expected value of the box, in this case, a SUM or TOTAL and

(b) calculate the Standard Error based on both the number of draws and the SD (standard deviation) of the box

Then, you can calculate standard units with a familiar formula that has been modified:

$$Z = \frac{\text{(observed sum - expected sum)}}{\text{Standard Error}}$$

Example. *Let's go back to the 9 heads in 10 tosses of a coin idea. More formally, the Standard Error for the coin toss situation where you are interested in the expected total number of heads (or the sum of heads in 10 tosses) is* $\sqrt{10}$ ** [(1-0)**$\sqrt{((.5*.5)}$ *]. Let's see how likely it is to get 9 heads in 10 tosses.*

SE = 1.5811 and Z = ((9-5) / 1.5811) = 2.52 or about 2.55. The area between + and - 2.55 is 98.92% which leaves 1% total outside of the area. So the chance of getting 9 heads or better is about 1/2 of a percent. The chance of getting 6 heads or more is about 25%

4. SHORT CUTS & COUNTING (17.4 and 17.5)

Finding Standard Deviations in this chapter can be difficult. Freedman offers you some handy short cuts

(a) If you have a situation with only two numbers, a quick formula for the standard deviation is:

*(big number - small number) ** $\sqrt{\textit{fraction with big number} - \textit{fraction with small number}}$

(b) If you have a situation with only two numbers and you can make one of them a zero and the other a one, then the formula becomes: $\sqrt{\textit{fraction with big number} - \textit{fraction with small number}}$

(c) In all other situations, you will need to "expand" the box by converting fractions into real relative values sometimes, for example, suppose you have 3 numbers in a box in the following proportions:

-1	0	+1
1/6	1/2	1/3

This is the same as: -1, 0, 0, 0, 1, 1 and the average is .16667 and the S.D. is .6872. So if you had 12 draws from this box, you would expect a sum of 2 and a standard error of $\sqrt{12}$ * .6872 or 2.38