Introduction to Variables
Math 101, Littlefield[1]

A ***variable*** is just a name that stands in for a number whose value we don't know yet.

Suppose we have the expression 4+5 .

This is equivalent to the expression a+b where a=4 and b=5.

The names "a" and "b" just stand in for the numbers "4" and "5". So a and b are variables.

Variables are useful because they allow us to replace lots of similar expressions involving numbers with a single expression involving variables.

For example, we know from arithmetic that 5+10=10+5, 4+6=6+4, 2+3=3+2, 149+2119=2119+149, and so on. There are an infinite number of similar expressions.

Using variables, we can represent this infinity of expressions with a single simple rule:

a + b = b + a , for all values of a and b.

Similarly, we can represent the areas of all rectangles by a single formula:

Area = Length * Width

In this formula, the variables are the multiple-letter names Area, Length, and Width, and it must be understood that we are talking about a rectangle. The formula is not true for other figures.

Variables are also useful because they allow us solve equations — to figure out what the values of variables must be, by manipulating equations.

Variables are commonly represented using several different notations:

1. **Single letter.** This notation is very concise and allows multiplication to be implied by just writing the two letters next to each other: ab = a*b . However, it can also become confusing when you run out of letters that "make sense". Also, implied multiplication is NOT accepted by most computer programs, including Excel and other spreadsheets.
2. **Multiple-letter names.** This notation is less concise in some cases, but generally it is much more clear for simple formulas that are attached to specific applications. It can also be more concise. It lets us write
   *Area = Length * Width*
   instead of
   A = LW
   where A = area,
   L = length,
   and W = width

Multiplication should always be explicit when using multiple-letter names. If you leave out the multiplication operator, readers are left to wonder whether Side Length is a single variable (SideLength) with a bit of extra space between two letters, or is two variables that are supposed to be multiplied together (Side*Length).

It is fairly common for multiple-letter names to allow the underscore character in addition to letters. This is handy as an unambiguous way of separating English words within a single variable: Side_Length .

It is also fairly common for multiple-letter names to allow digits in addition to letters and the underscore characters.

3. **Indexed names.** This notation combines a fixed name with a variable number. In algebra, the index is usually written as a subscript: X_1 versus X_2, or $Area_1$ versus $Area_2$. If an indefinite number of such variables is needed, the index is often written as a variable itself.

4. **Spreadsheet cell identifiers.** This notation is used in spreadsheets. It combines a column name with a row number, for example **D5** means whatever is in the column named D, in the row numbered 5. This notation and its meaning is very similar to indexed names. The main difference is that the graphical user interface of a spreadsheet program allows a variable to be "dragged" from one place to another. This dragging operation changes the name of the variable as a side effect – something that for sure never happens with pencil and paper!