Statistical Reasoning Name:
8.2 – Counting and Probability

**The Multiplication Counting Principle**

For a process involving multiple (say *k*) steps, if there are $n\_{1}$ ways to do Step 1, $n\_{2}$ ways to do Step 2,…, and $n\_{k}$ ways to do Step *k*, then the total number of different ways to complete the process is

$$n\_{1}∙n\_{2}∙…∙n\_{k}$$

Example: Suppose you have five framed photographs of different family members that you want to arrange in a line on the top of your dresser. In how many ways can you do this?

Suppose you only want to display three of the five photographs. In how many ways can you do this?

**Factorials**

For any positive integer *n*, we define $n!$ (read as “n factorial”) as

$$n!=n\left(n-1\right)\left(n-2\right)…∙3∙2∙1$$

That is, *n* factorial is the product of the numbers starting with *n* and going down to 1.

Example: For a class with 15 students, how many different ways are there to line the students up in a single-file line?

Practice:

1) How many three-character Internet domain names are possible that consist of only letters?

2) The 28 Choices ice cream shop offers 28 flavors of ice cream, 11 different toppings, and three sizes of bowl for their ice cream sundaes.

 a) How many options are there to get a sundae with one flavor of ice cream and one topping?

 b) How many options are there to get a small sundae with two different flavors of ice cream and one topping?

**Permutations:** arrangements where the order of selection matters

**Permutation Notation**

In this case, we calculated the number of permutations of 28 people taken 3 at a time. In symbols, this is 28P3.

One way of thinking about this is by using the general rule of permutations:

nPk = $\frac{n!}{\left(n-k\right)!}$

**Combinations**: arrangements where the order of selection doesn’t matter

**Combination Notation**

In general, the number of combinations of *n* things taken *k* at a time can be found using the formula:

nCk = $\frac{nPk}{k!}=\frac{n!}{k!\left(n-k\right)!}$

**Using your calculator…**

Your calculator will calculate permutations and combinations using the notations
nPk and nCk.

*Graphing Calculators:* First type in *n* and then press MATH 🡪 to PROP and select either 2 or 3 depending on what you are calculating, press ENTER and then type in *k* and press ENTER again.

*Scientific Calculators – TI-36XPro:* First type in *n* and then press the button that says *!/nCr/nPr* until you have the function you want, then type in *k* and press ENTER.

Mr. Paradise likes to get the students in his class involved in the action. But he doesn’t want to play favorites. Each day, Mr. Paradise puts the names of all 28 of his students in a hat and mixed them up. He then draws out 3 names, one at a time. The student whose name is chosen first gets to operate the display calculator. The student whose name is chosen second is in charge of reading the homework answers. The student whose name is chosen third is in charge of writing select notes on the board. In how many different ways can Mr. Paradise assign these three jobs?

Mr. Paradise decides to randomly select three students’ homework papers to grade each day. He once again puts all 28 names in a hat, mixes them up, and draws out 3 names, one a time. With this method, in how many different ways can Mr. Paradise decide how many to grade?

Suppose we are talking about the letters in the word MATH.

a) How many ways are there to arrange three of the four letters in the word math?

 Is this a permutation or a combination?

 We can use our calculator to get the answer of:

b) How many ways are there to select three of the four letters in the word math?

 Is this a permutation or a combination?

 We can use our calculator to get the answer of:

**More Practice**

The List of Best-Selling Books contains the top ten bestsellers. A librarian wishes to display these books, but only has room for seven books on the shelf. How many ways can she arrange seven different books on the shelf?

How many five-digit numbers can be formed from the digits 1, 2, 3, 4, 5, 6 and 7 if no

digit can be used more than once?

A computer program requires a password made up of 4 characters. Each character must be either a letter or a number. Characters may be repeated.

a) How many different passwords are possible?

b) How many passwords are possible if the first character must be a digit?

In how many ways can three boys and two girls sit in a row if they are randomly seated?

In how many ways can three boys and two girls sit in a row if the boys must sit together and the girls must sit together?

How many four-letter words can be formed from the letters in the word MISTAKE?

How many different groups of four letters can be chosen in the word MISTAKE?

In how many ways can a coach choose a team of five from ten boys:
a) if there are no restrictions?

b) If two boys, John and Mark, must be on the team?

If twelve jurors are to be selected and there are 15 candidates available, how many different panels of jurors are possible?