**10.2 Counting Outcomes – Overview**

**Definitions / Key Ideas**

**Fundamental Counting Principle**: If a job consists of *n* separate tasks, the first of which can be done *k1* ways, the second *k2* ways and so on, then the total job can be done ways.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Task 1 | Task 2 |  | Task *n* | Total Outcomes |
| *k1* | *k2* |  | *kn* |  |

**Example**: Flip a coin and roll a 4-sided die.

How many total outcomes are there?

**Example**: Sally has 6 pairs of socks, 4 shorts, 5 shirts, and 3 sunglasses. How many ways can she get dressed?

**With or without replacement**:We need to into account take whether or not objects can be repeated in our calculations.

**Example**s: a) How many passwords can you make if it requires 4 digits?

b) How many passwords can you make if it requires 4 digits, but you cannot repeat digits?

**Factorials**: *n!* (read "n factorial") is the product of all numbers less than and including *n*

**Example**: For the 9 starting players on a baseball team, how many different batting orders are there?

**Combinations and Permutations**

* We often want to be able to count the number of ways that we can choose members from a group of objects (without replacement).
  + “Selecting *r* objects from a total of *n* objects*”.*
* There are two methods to count in these scenarios, the only difference is if order matters or order doesn’t matter.

**Permutations**: Order matters. When you are selected is important. Your position has meaning.

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Description automatically generated with medium confidence**Combinations:** Order does not matter. It does not matter when you are selected, only if you were selected.

**Examples**: Decide if we should use permutations or combinations to count the total number of outcomes (possible ways to select our group). Then count the number of outcomes.

1. There are 8 runners in a race. How many ways can they place 1st, 2nd, and 3rd?
2. Out of 12 students, how many ways can we select a committee of four students?
3. We are forming a committee and we need to select a president, vice president and secretary. How many ways can this be done if there are 10 members?

Logo, company name

Description automatically generated**Permutations with Repeated Objects**: Counting the number of distinct ways we can arrange all *n* objects when some of the objects are the same (repeated, specifically *k1* are alike, *k2* are alike, and so on).



**Example**: Harmony was born on 05/19/1991. How many eight-digit codes could she make using the digits in her birthday?