When add, when to mutiply

Math 10120, Spring 2013

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The multiplication principle

Suppose an experiment has two consecutive steps, with

- m choices for the first step, and
- n choices for the second (REGARDLESS OF FIRST STEP).

Then the total number of possible outcomes for the experiment is

$$mn$$

Suppose an experiment has t consecutive steps, with

- m_1 choices for the first step,
- m_2 choices for the second (REGARDLESS OF FIRST STEP),
- m_3 choices for the third (REGARDLESS OF FIRST TWO STEPS),
- . . ., and
- m_t choices for the tth (REGARDLESS OF EARLIER STEPS).

Then the total number of possible outcomes for the experiment is

$$m_1 m_2 m_3 \ldots m_t$$

The sum principle

Suppose at the beginning of an experiment you have to choose between one of two options, with

- m outcomes if you choose the first option, and
- n outcomes if you choose the second.

Then the total number of possible outcomes for the experiment is

$$m + n$$

Suppose at the beginning of an experiment you have to choose between one of t options, with

- m_1 outcomes if you choose the first option,
- m_2 outcomes if you choose the second,
- . . ., and
- m_t outcomes if you choose the tth.

Then the total number of possible outcomes for the experiment is

$$m_1 + m_2 + \ldots + m_t$$

The bottom line

If you have to do *A* **and then** *B*: MULTIPLY!

- There are five restaurants in town, and eight movies showing. I want to eat, **and then** go to a movie. I have a total of

$$5 \times 8 = 40 \text{ options}$$

If you have to do **either** *A* **or** *B*: Add!

- There are five restaurants in town, and eight movies showing. I want to **either** eat **or** go to a movie. I have a total of

$$5 + 8 = 13 \text{ options}$$