Lesson 2:Organized Counting - Indirect Method and Rule of Sum

Warmup: Keishia, a triathlete, has **four pairs** of running shoes loose in her gym bag.

a) In how many ways can she pull out two matched shoes one after the other?

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b) In how many ways can she pull out **two unmatched** shoes one after the other?

Method 1: Direct Method

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Method 2: Indirect Method

Total Desired Outcomes = Total Possible Outcomes - Total Undesired Outcomes

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Sometimes we need to count actions that are **mutually exclusive** (*cannot happen at the same time*).

Additive Counting Principle:

If one mutually exclusive action can occur in m ways, a second in n ways, a third in p ways, then there are $m + n + p$ total ways in which one of these actions can occur.
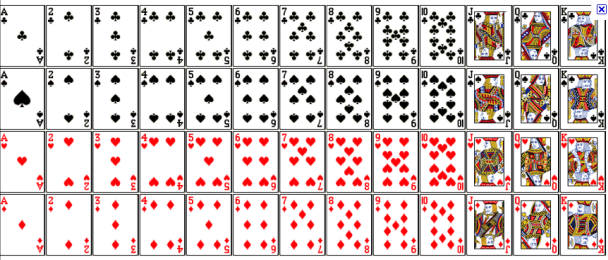
Exercise:
For each situation described, indicate which rule applies in determining the number of possibilities Fundamental Counting Principle (The Rule of Product) or the Additive Counting Principle (The Rule of Sum)

a) rolling a sum of either four or seven with two dice

b) selecting a dress, hat, and purse to wear at a wedding

c) making a sandwich with ham or salami, hot or sweet mustard on white or whole wheat bread if you must choose one of each option

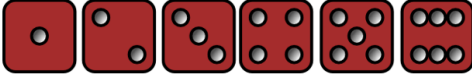d) picking a horse in either the first or second race at Woodbine Raceway

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Standard Deck of Cards

Standard 6-sided Dice

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Ex: With a pair of 6 sided-dice, in how many ways can you roll a sum of 3 or a sum of 8?

Die #2 \ Die #1	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

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Ex:

How many ways can you roll a standard pair of dice *without* getting a double (ie 2 ones)?

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Ex: From a standard deck of 52 cards, in how many ways could you choose:

(a) Two aces, one after the other?

(b) A black 8 *and* a heart, one after the other?

(c) A black 8 *or* a heart?

(d) A black 8 or a spade?

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Ex: On a multiple choice exam, there are twenty-five questions. Each question has five possible choices

(i) How many different ways are there to answer the questions on this exam?

(ii) Suppose little Jonny never chooses "(d)" as an answer. How many ways can he answer?

(iii) Suppose he never chooses the same letter twice in a row? How many ways can he answer?

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Method: Count the cases (when both the fundamental and additive principles need to be used)

Sailing ships used to send messages with signal flags flown from their masts. How many different signals are possible with a set of **four distinct coloured flags** if:

a) **two** flags are used. (The first flag must remain in the air when the second flag is raised.)

b) three flags are used. (The first flag must remain in the air when the second flag is raised, etc.)

c) four flags are used

d) a **minimum of two flags** are used for each signal.

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Let's make this a bit more challenging!

How many combinations are there for a four-letter password that must include the letter "a" but exclude the letter "z"?

a) assuming letters permitted cannot be repeated

b) assuming letters permitted may be repeated (be careful not to over count)

Hint: Indirect is easiest method, but you can do direct method by considering cases where there is one a, two a's, 3 a's and 4 a's

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