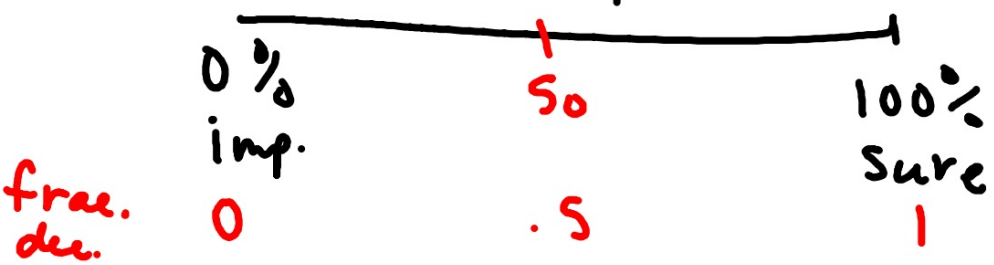
Geometry 13.2
Use permutations with probability
Use combinations with probability

outcome
sample space
factorial (!)
permutation order matters
combination order irrel.
probability how likely is it?

$5! = 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$

$4! = 4 \cdot 3 \cdot 2 \cdot 1$



KeyConcept Factorial

Words The factorial of a positive integer n, written $n!$, is the product of the positive integers less than or equal to n.

Symbols $n! = n \cdot (n - 1) \cdot (n - 2) \cdot \ldots \cdot 2 \cdot 1$, where $0! = 1$

6 order matter
permutation

How many ways can A B C stand in a row?

B L P P L B $3 \cdot 2 \cdot 1$

B P L L P B $= 6$

P B L L B P

24

A B C D A D B C $4 \cdot 3 \cdot 2 \cdot 1$

A B D C A D C B

A C B D $= 24$

A C D B

Example 1 Probability and Permutations of *n* Objects

SPORTS Chanise and Renee are members of the lacrosse team. If the 20 girls on the team are each assigned a jersey number from 1 to 20 at random, what is the probability that Chanise's jersey number will be 1 and Renee's will be 2?

$$\frac{1}{20\ 19} = \frac{1}{380}$$

$$\frac{1}{20} \cdot \frac{1}{19} =$$

GuidedPractice

2. A student identification card consists of 4 digits selected from 10 possible digits from 0 to 9. Digits cannot be repeated.

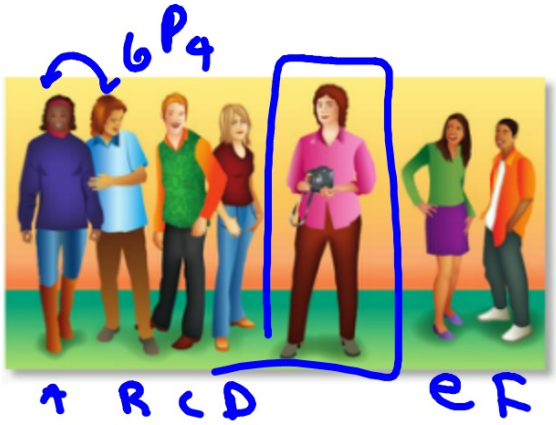
A. How many possible identification numbers are there? $10 \cdot 9 \cdot 8 \cdot 7 = 5040$

B. Find the probability that a randomly generated card has the exact number 4213. $\frac{1}{5040}$

4213
4231

$P = \frac{S}{P}$

probability: #success/# possible



Group photo: Choose 4 from a group of 6

$$\frac{6}{4}\cdot\frac{5}{3}\cdot\frac{4}{2}\cdot\frac{3}{1} = \frac{360}{24}$$

$$= 15$$

Combination - order irrelevant

$${}_6C_4$$

FCP

Example 2 Probability and ${}_nP_r$

A class is divided into teams each made up of 15 students. Each team is directed to select team members to be officers. If Sam, Valencia, and Deshane are on a team, and the positions are decided at random, what is the probability that they are selected as president, vice president, and secretary, respectively?

S V D

PsxPvxPd

15 14 13

${}_{15}P_3$

$\frac{1}{2730}$

Permutations with repetition

CAT

BOO

CAT ACT TAC

CTA ATC TCA

$= 6$

$\frac{6}{2}$

BOO OBO OOB

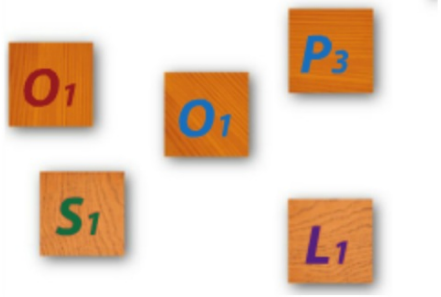
BOO OBO OOB

$= 3$

distinguishable

POOLS POOLS SPOOL SPOOL

$$\frac{5 4 3 \cancel{2} 1}{\cancel{2}} = 60$$



$$\frac{n!}{r!}$$

Distinguishable permutations #letters/#repeats

KeyConcept Permutations with Repetition

The number of distinguishable permutations of n objects in which one object is repeated r_1 times, another is repeated r_2 times, and so on, is

$$\frac{n!}{r_1! \cdot r_2! \cdot \ldots \cdot r_k!}.$$

Example 3 Probability and Permutations with Repetition

GAME SHOW On a game show, you are given the following letters and asked to unscramble them to name a U.S. river. If you selected a permutation of these letters at random, what is the probability that they would spell the correct answer of MISSISSIPPI?

letters
repeats

$$\frac{11!}{4!\,4!\,2!} = \frac{11\cdot 10\cdot 9\cdot 8\cdot 7\cdot 6\cdot 5\cdot 4\cdot 3\cdot 2\cdot 1}{4\cdot 3\cdot 2\cdot 1\cdot 4\cdot 3\cdot 2\cdot 1\cdot 2\cdot 1}$$

How many are there? One will be correct.

$$\frac{1}{(34650)}$$

linear

$5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$

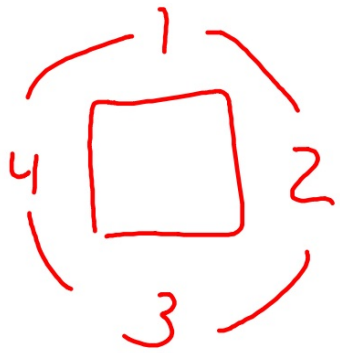
120

circular

$\frac{1}{5} \cdot \cancel{5} \cdot 4 \cdot 3 \cdot 2 \cdot 1$

$4 \cdot 3 \cdot 2 \cdot 1$

Is it a different arrangement?
1/5*5*4*3*2*1 Why?



13.2

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