Statistics for Information Technology

Chapter 4: Probability and Counting Rules

Edit: 2025

Outline

Sample Spaces and Probability

The Addition Rules for Probability

The multiplication Rules for Probability

Counting Rules

Probability and Counting Rules

Introduction

Introduction

Probability as a general concept can be defined as the chance of an event occurring

Sample Spaces and Probability

Definition

A **probability experiment** is a chance process that leads to well-defined results called outcomes

An **outcome** is the result of a single trial of a probability experiment.

Sample Spaces and Probability

Definition

A **sample space** is the set of all possible outcomes of a probability experiment.

An **event** consists of a set of outcomes of a probability experiment

Example

Experiment	Sample Space	
Toss one coin	Head, Tail	S = { H, T }
Roll a dice	1, 2, 3, 4, 5, 6	S = { 1,2, 3, 4, 5, 6 }
Answer a question	True, false	S = { T, F }


Example Rolling Dice

Find the sample space for rolling two dice.

13 Bad

(1, 3) Good

	Die 2					
Die 1	1	2	3	4	5	6
1	(1, 1)	(1, 2)	(1, 3)	(1, 4)	(1, 5)	(1, 6)
2	(2, 1)	(2, 2)	(2, 3)	(2, 4)	(2, 5)	(2, 6)
3	(3, 1)	(3, 2)	(3, 3)	(3, 4)	(3, 5)	(3, 6)
4	(4, 1)	(4, 2)	(4, 3)	(4, 4)	(4, 5)	(4, 6)
5	(5, 1)	(5, 2)	(5, 3)	(5, 4)	(5, 5)	(5, 6)
6	(6, 1)	(6, 2)	(6, 3)	(6, 4)	(6, 5)	(6, 6)

Example Drawing A Card

Find the sample space for drawing one card from an ordinary deck of cards.

A ♥	2 ♥	3 ♥	4 ♥	5 ♥	6 ♥	7 ♥	8 ♥	9 ♥	10 ♥	J ♥	Q ♥	K ♥
A ♦	2 ♦	3 ♦	4 ♦	5 ♦	6 ♦	7 ♦	8 ♦	9 ♦	10 ♦	J ♦	Q ♦	K ♦
A ♠	2 ♠	3 ♠	4 ♠	5 ♠	6 ♠	7 ♠	8 ♠	9 ♠	10 ♠	J ♠	Q ♠	K ♠
A ♣	2 ♣	3 ♣	4 ♣	5 ♣	6 ♣	7 ♣	8 ♣	9 ♣	10 ♣	J ♣	Q ♣	K ♣

Example Gender of Children

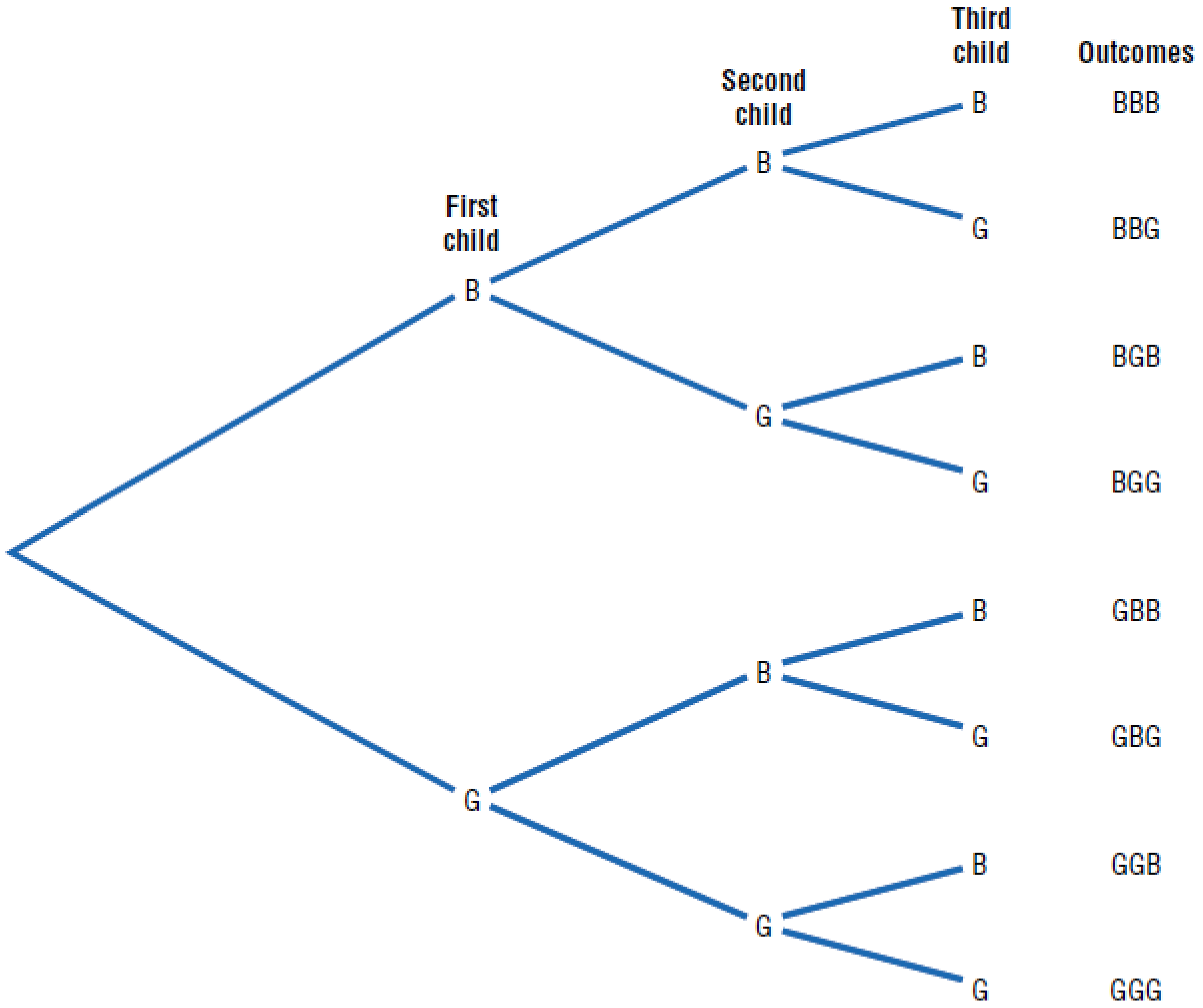
Find the sample space for the gender of the children if a family has three children. Use B for boy and G for girl.

BBB BBG BGB GBB GGG GGB GBG BGG

Tree diagram

A **tree diagram** is a device consisting of line segments emanating from a starting point and also from the outcome point. It is used to determine all possible outcomes of a probability experiment.

Tree diagram



Events

An **event** consists of a set of outcomes of a probability experiment

There are three basic interpretations of probability

- Classical probability
- Empirical or relative frequency probability
- Subjective probability

Classical Probability

Definition

Classical probability uses sample spaces to determine the numerical probability that an event will happen

Formula for Classical Probability

The probability of any event E is

$$\frac{\text{Number of outcomes in } E}{\text{Total number of outcomes in the sample space}}$$

This probability is denoted by

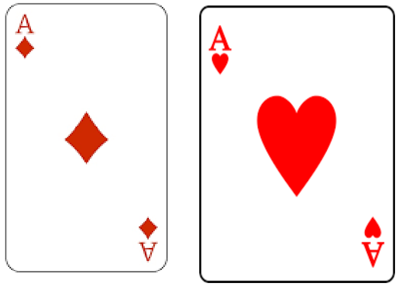
$$P(E) = \frac{n(E)}{n(S)}$$

This probability is called *classical probability,* and it uses the sample space S.

Example Drawing Cards

Find the probability of getting a red ace when a card is drawn at random from an ordinary deck of cards.

Solution



There are 52 cards $\quad n(S) = 52$

There are 2 red aces $\quad n(E) = 2$

$$P(E) = n(E) / n(S)$$

$$P(E) = 2 / 52 = .0385$$

Example Gender of Children

If a family has three children, find the probability that two of the three children are girls.

Solution

BBB BBG BGB GBB GGG GGB GBG BGG $n(S) = 8$

two of the three children are girls

BBB BBG BGB GBB GGG GGB GBG BGG $n(E) = 3$

$P(E) = 3 / 8 = .375$

Example Drawing Cards

A card is drawn from an ordinary deck. Find these probabilities.

a. Of getting a jack

b. Of getting the 6 of clubs (i.e., a 6 and a club)

c. Of getting a 3 or a diamond

d. Of getting a 3 or a 6

Example Drawing Cards

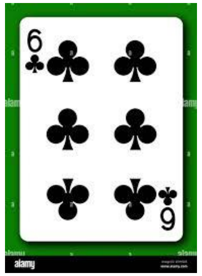
A card is drawn from an ordinary deck. Find these probabilities.

a. ได้ไพ่ตัวอักษร J

b. ได้ไพ่ 6 ดอกจิก

c. ได้ไพ่ 3 หรือ ไพ่ข้าวหลามตัด

d. ได้ไพ่ 3 หรือ 6



Probability

Probability Rule 1

The probability of any event E is a number (either a fraction or decimal) between and including 0 and 1. This is denoted by $0 \leq P(E) \leq 1$.

Probability Rule 2

If an event E cannot occur (i.e., the event contains no members in the sample space), its probability is 0.

Example Rolling a Die

When a single die is rolled, find the probability of getting a **9**.

Solution 1,2,3,4,5,6

It's impossible to get 9

Probability is $P(9) = 0/6 = 0$

Probability

Probability Rule 3

If an event E is certain, then the probability of E is 1.

Probability Rule 4

The sum of the probabilities of all the outcomes in the sample space is 1.

Example Rolling a Die

When a single die is rolled, what is the probability of getting a number less than 7?.

Solution

1,2,3,4,5,6 E ={ 1,2,3,4,5,6 }

All outcomes are less than 7

P(number less than 7) = 6/6 = 1

Empirical Probability

empirical probability relies on actual experience to determine the likelihood of outcomes.

Formula for Empirical Probability

Given a frequency distribution, the probability of an event being in a given class is

$$P(E) = \frac{\text{frequency for the class}}{\text{total frequencies in the distribution}} = \frac{f}{n}$$

This probability is called *empirical probability* and is based on observation.

Example Travel Survey

In the travel survey just described, find the probability that a person will travel by airplane over the Thanksgiving holiday.

Method	Frequency
Drive	41
Fly	6
Train or bus	3
	50

$P(E) = f/n$

$P(E) = 6/50$

$P(E) = 0.12$

Example Distribution of Blood Types

In a sample of 50 people, 21 had type O blood, 22 had type A blood, 5 had type B blood, and 2 had type AB blood. Set up a frequency distribution and find the following probabilities.

Method	Frequency
Drive	41
Fly	6
Train or bus	3
	50

P(E) = f/n

P(E) = 6/50

P(E) = 0.12

Example Distribution of Blood Types

In a sample of 50 people, 21 had type O blood, 22 had type A blood, 5 had type B blood, and 2 had type AB blood. Set up a frequency distribution and find the following probabilities.

Method	Frequency
Drive	41
Fly	6
Train or bus	3
	50

P(E) = f/n

P(E) = 6/50

P(E) = 0.12

Example Roll Dice

For example, in the roll of a fair die, each outcome in the sample space has a probability of . Hence, the sum of the probabilities of the outcomes is as shown.

Outcome	1		2		3		4		5		6
Probability	$\frac{1}{6}$		$\frac{1}{6}$		$\frac{1}{6}$		$\frac{1}{6}$		$\frac{1}{6}$		$\frac{1}{6}$
Sum	$\frac{1}{6}$	$+$	$\frac{1}{6}$	$+$	$\frac{1}{6}$	$+$	$\frac{1}{6}$	$+$	$\frac{1}{6}$	$+$	$\frac{1}{6} = \frac{6}{6} = 1$

Complementary Events

The **complement of an event** E is the set of outcomes in the sample space that are not included in the outcomes of event E.

The complement of E is denoted by $\bar{E}$ (read "E bar").

Rule for Complementary Events

$$P(\bar{E}) = 1 - P(E) \quad \text{or} \quad P(E) = 1 - P(\bar{E}) \quad \text{or} \quad P(E) + P(\bar{E}) = 1$$

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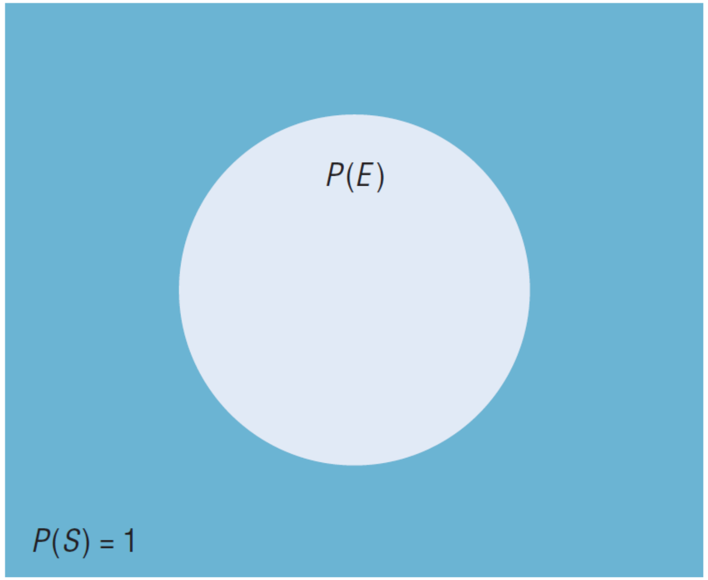
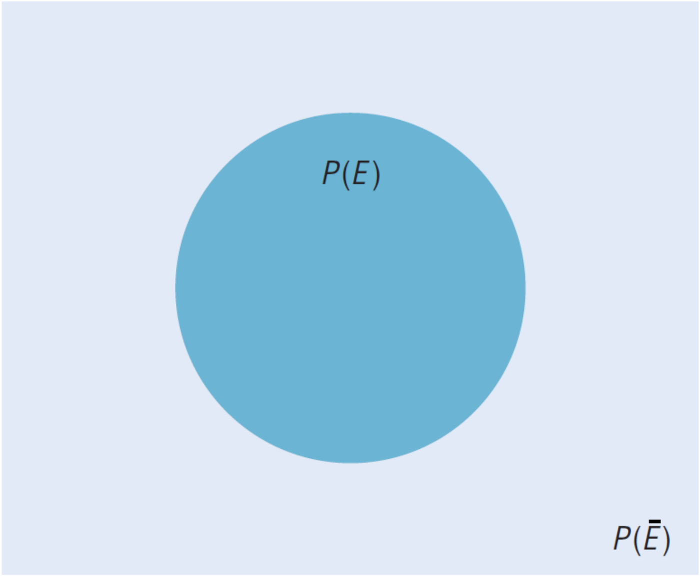
Complementary Events



(a) Simple probability



(b) $P(\bar{E}) = 1 - P(E)$

The Addition Rules for Probability

Addition Rule 1

When two events A and B are mutually exclusive, the probability that A or B will occur is

$$P(A \text{ or } B) = P(A) + P(B)$$

Example Selecting a Doughnut

A box contains 3 glazed doughnuts, 4 jelly doughnuts, and 5 chocolate doughnuts. If a person selects a doughnut at random, find the probability that it is either a glazed doughnut or a chocolate doughnut.

$$P(\text{glazed or chocolate}) = P(\text{glazed}) + P(\text{chocolate})$$

$$= 3/12 \quad + \quad 5/12\,)$$

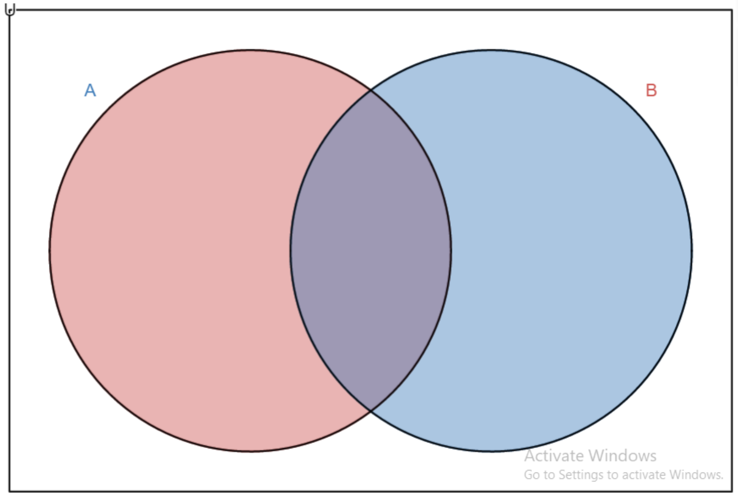
$$= 8/12$$

The Addition Rules for Probability

Addition Rule 2

If A and B are *not* mutually exclusive, then

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$



Example Selecting a Medical Staff Person

In a hospital unit there are 8 nurses and 5 physicians; 7 nurses and 3 physicians are females. If a staff person is selected, find the probability that the subject is a nurse or a male.

Staff	Females	Males	Total
Nurses	7	1	8
Physicians	3	2	5

Example Selecting a Medical Staff Person

In a hospital unit there are 8 nurses and 5 physicians; 7 nurses and 3 physicians are females. If a staff person is selected, find the probability that the subject is a nurse or a male.

$$P(\text{nurse or male}) = P(\text{nurse}) + P(\text{male}) - P(\text{male nurse})$$

$$= 8/13 + 3/13 - 1/13$$

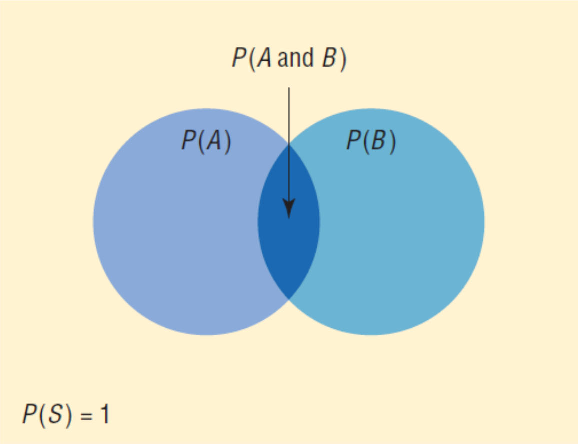
$$= 10/13$$

The Addition Rules for Probability

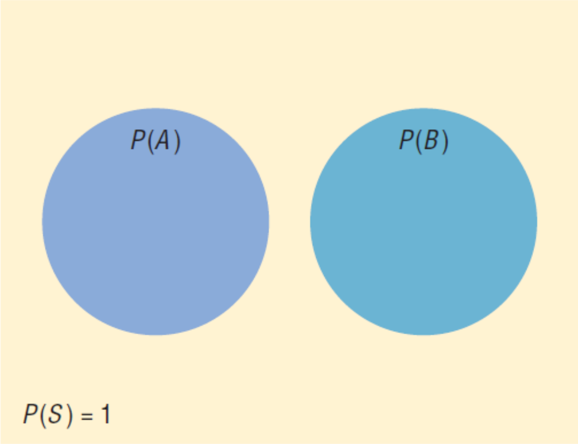
Addition Rule 2

If A and B are *not* mutually exclusive, then

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$



(b) Nonmutually exclusive events
$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$



(a) Mutually exclusive events
$P(A \text{ or } B) = P(A) + P(B)$

The Multiplication Rules and Conditional Probability

Two events *A* and *B* are **independent events** if the fact that *A* occurs does not affect the probability of *B* occurring.

Multiplication Rule 1

When two events are independent, the probability of both occurring is

$$P(A \text{ and } B) = P(A) \cdot P(B)$$

Example Tossing a Coin

A coin is flipped and a die is rolled. Find the probability of getting a head on the coin and a 4 on the die.

$$P(\text{head and } 4) = P(\text{head}) \times P(\text{Dice})$$

$$= (1/2)(1/6)$$

$$= 1/12$$

The Multiplication Rules and Conditional Probability

When the outcome or occurrence of the first event affects the outcome or occurrence of the second event in such a way that the probability is changed, the events are said to be **dependent events**

Multiplication Rule 2

When two events are dependent, the probability of both occurring is

$$P(A \text{ and } B) = P(A) \cdot P(B|A)$$

Conditional Probability

The conditional probability of an event *B* in relationship to an event *A* was defined as the probability that event *B* occurs after event *A* has already occurred.

Formula for Conditional Probability

The probability that the second event *B* occurs given that the first event *A* has occurred can be found by dividing the probability that both events occurred by the probability that the first event has occurred. The formula is

$$P(B|A) = \frac{P(A \text{ and } B)}{P(A)}$$

Example Selecting Colored Chips

A box contains ***black chips*** and ***white chips***. A person selects two chips without replacement. If the probability of selecting a black chip *and* a white chip is 15/56 , and the probability of selecting a black chip on the first draw is 3/8 , find the probability of selecting the white chip on the second draw, *given* that the first chip selected was a black chip.

Example Selecting Colored Chips

black chip *and* a white chip is 15/56 ,
a black chip on the first draw is 3/8
find the probability of selecting the white chip on the second draw,
given that the first chip selected was a black chip.

$$P(W \mid B) = \frac{P(W \text{ and } B)}{P(B)} = \frac{15/56}{3/8}$$

$$= \frac{15}{56} \div \frac{3}{8} = \frac{15}{56} \cdot \frac{8}{3} = \frac{\overset{5}{\cancel{15}}}{\underset{7}{\cancel{56}}} \cdot \frac{\overset{1}{\cancel{8}}}{\underset{1}{\cancel{3}}} = \frac{5}{7}$$

Example Survey on Women in the Military

A recent survey asked 100 people if they thought women in the armed forces should be permitted to participate in combat. The results of the survey are shown.

Gender	Yes	No	Total
Male	32	18	50
Female	8	42	50
Total	40	60	100

Example Survey on Women in the Military

Gender	Yes	No	Total
Male	32	18	50
Female	8	42	50
Total	40	60	100

Find these probabilities.
a. The respondent answered yes, given that the respondent was a female.
b. The respondent was a male, given that the respondent answered no.

Example Survey on Women in the Military

Gender	Yes	No	Total
Male	32	18	50
Female	8	42	50
Total	40	60	100

M respondent was a male *Y* respondent answered yes
F respondent was a female *N* respondent answered no

a. The respondent answered yes, given that the respondent was a female.

$$P(Y \mid F) = \frac{P(F \text{ and } Y)}{P(F)} = \frac{8/100}{50/100} = 8/50$$

Example Survey on Women in the Military

Gender	Yes	No	Total
Male	32	18	50
Female	8	42	50
Total	40	60	100

M respondent was a male *Y* respondent answered yes
F respondent was a female *N* respondent answered no

b. The respondent was a male, given that the respondent answered no.

$$P(M \mid N) = \frac{P(M \text{ and } N)}{P(N)} = \frac{18/100}{60/100} = 18/60$$

Counting Rules

Many times a person must know the number of all possible outcomes for a sequence of events. To determine this number, three rules can be used: the *fundamental counting rule*, the *permutation rule*, and the *combination rule*.

Fundamental Counting Rule

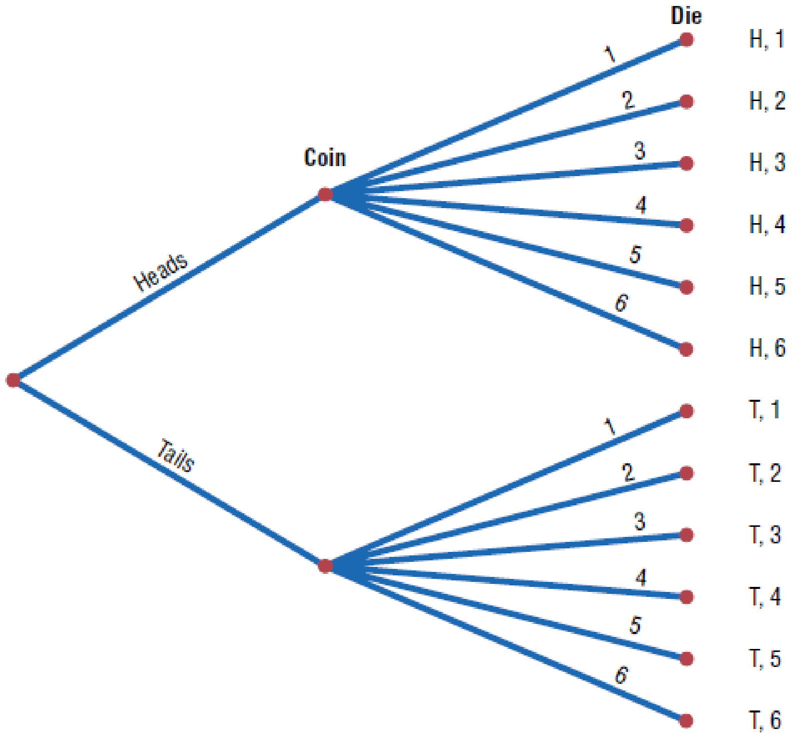
In a sequence of n events in which the first one has k_1 possibilities and the second event has k_2 and the third has k_3, and so forth, the total number of possibilities of the sequence will be

$$k_1 \cdot k_2 \cdot k_3 \cdots k_n$$

Note: In this case *and* means to multiply.

Example Tossing a Coin and Rolling Dice

A coin is tossed and a die is rolled. Find the number of outcomes for the sequence of events.



$(2)(6) =$ 12 possibilities

Example Types of Paint

Apaint manufacturer wishes to manufacture several different paints. The categories include

Color	Red, blue, *white*, black, green, brown, yellow
Type	Latex, oil
Texture	Flat, semigloss, high gloss
Use	Outdoor, indoor

How many different kinds of paint can be made if you can select one color, one type, one texture, and one use

Example Types of Paint

Color	Red, blue, *white*, black, green, brown, yellow
Type	Latex, oil
Texture	Flat, semigloss, high gloss
Use	Outdoor, indoor

Color		Type		Texture		Use	
$\boxed{7}$	$\cdot$	$\boxed{2}$	$\cdot$	$\boxed{3}$	$\cdot$	$\boxed{2}$	$= 84$

Example Distribution of Blood Types

There are four blood types, A, B, AB, and O. Blood can also be Rh+ and Rh-. Finally, a blood donor can be classified as either male or female. How many different ways can a donor have his or her blood labeled

Blood Type	Rh	Sex	
4	2	2	$(4)(2)(2) =$ 16 possibilities

Factorial Notation

Factorial Formulas

For any counting n

$$n! = n(n-1)(n-2)\cdots 1$$
$$0! = 1$$

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

$9! \quad = \quad 9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$

notation $\quad 0! \quad = \quad 1$

Permutations

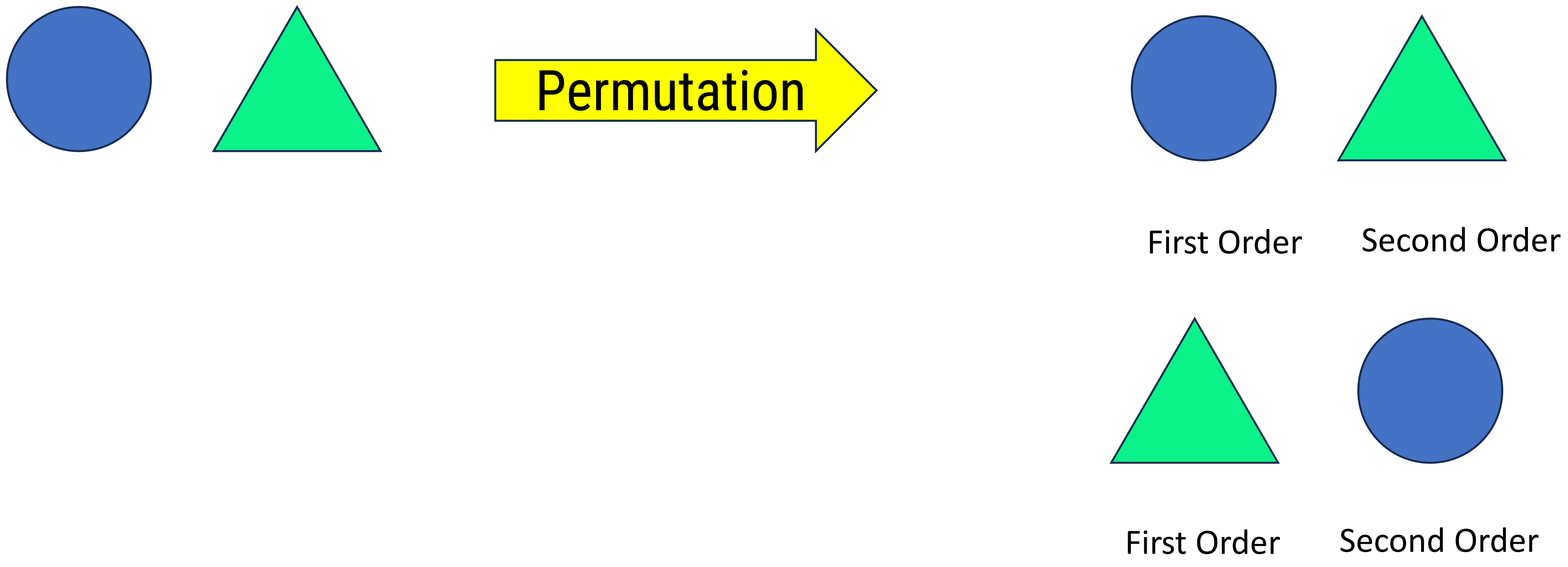
A **permutation** is an arrangement of *n* objects in a specific order.

Permutation Rule

The arrangement of n objects in a specific order using r objects at a time is called a *permutation of n objects taking r objects at a time*. It is written as ${}_nP_r$, and the formula is

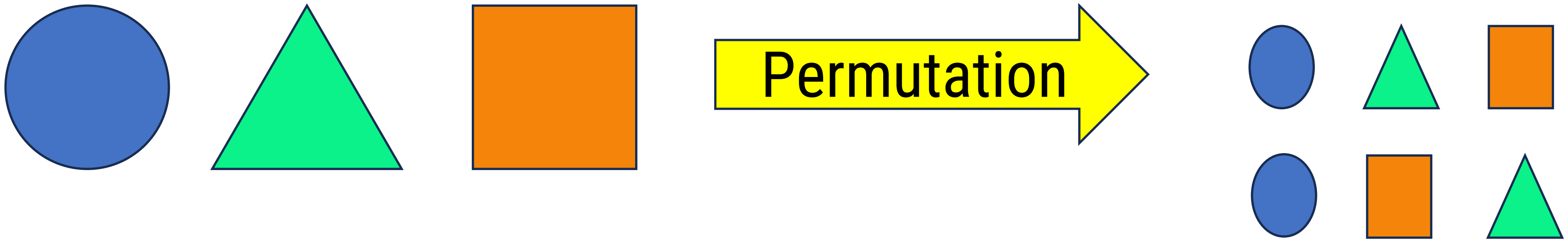
$$ {}_nP_r = \frac{n!}{(n-r)!} $$

Permutations

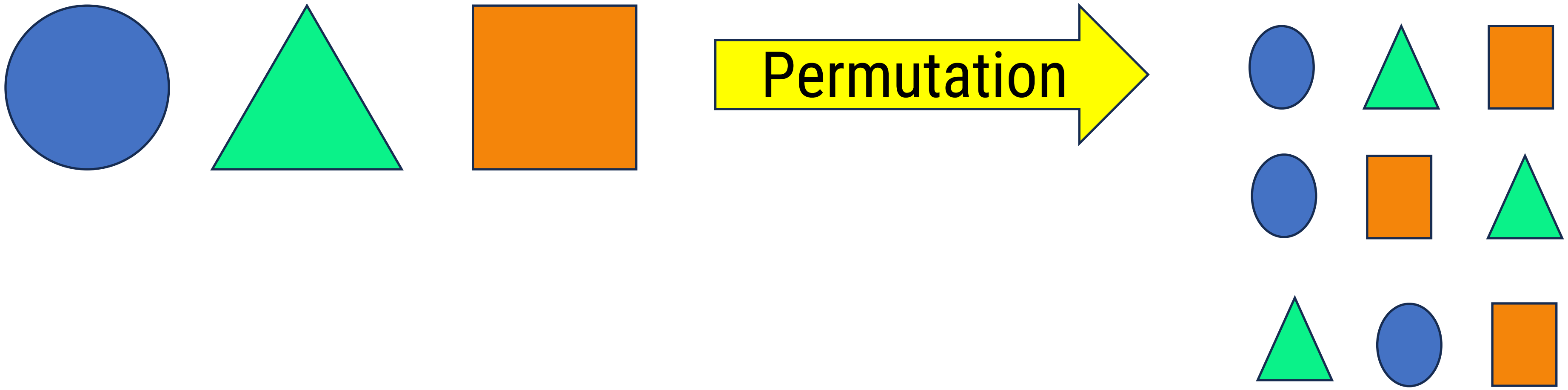


Permutations

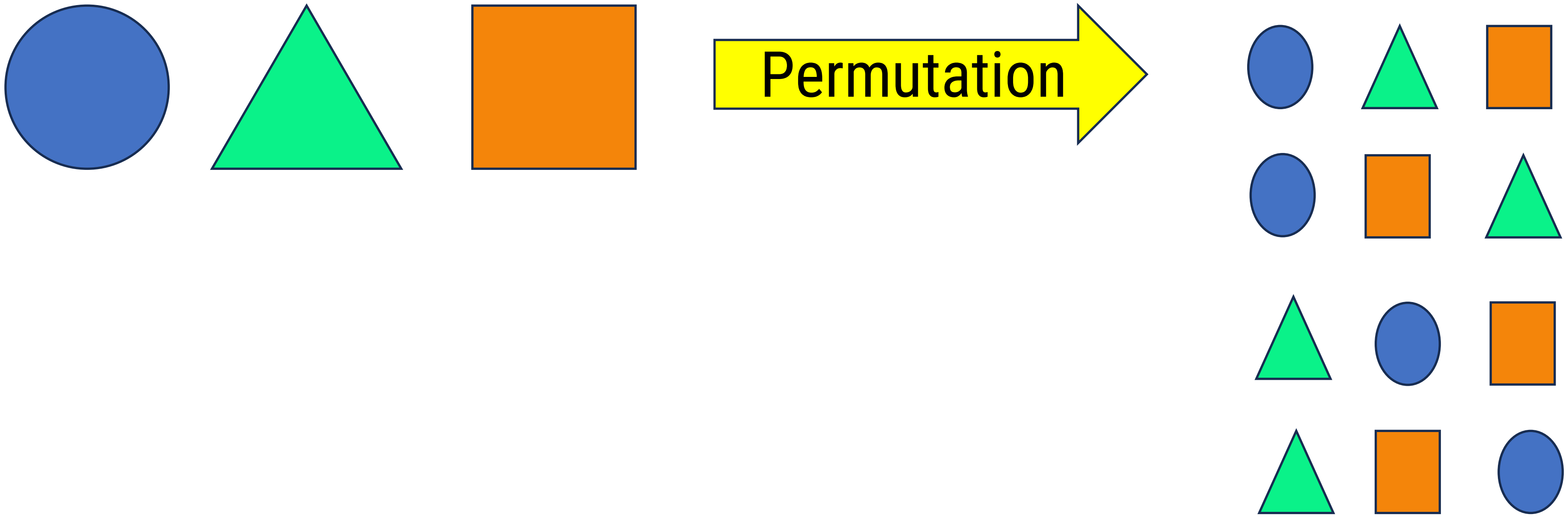
Permutations



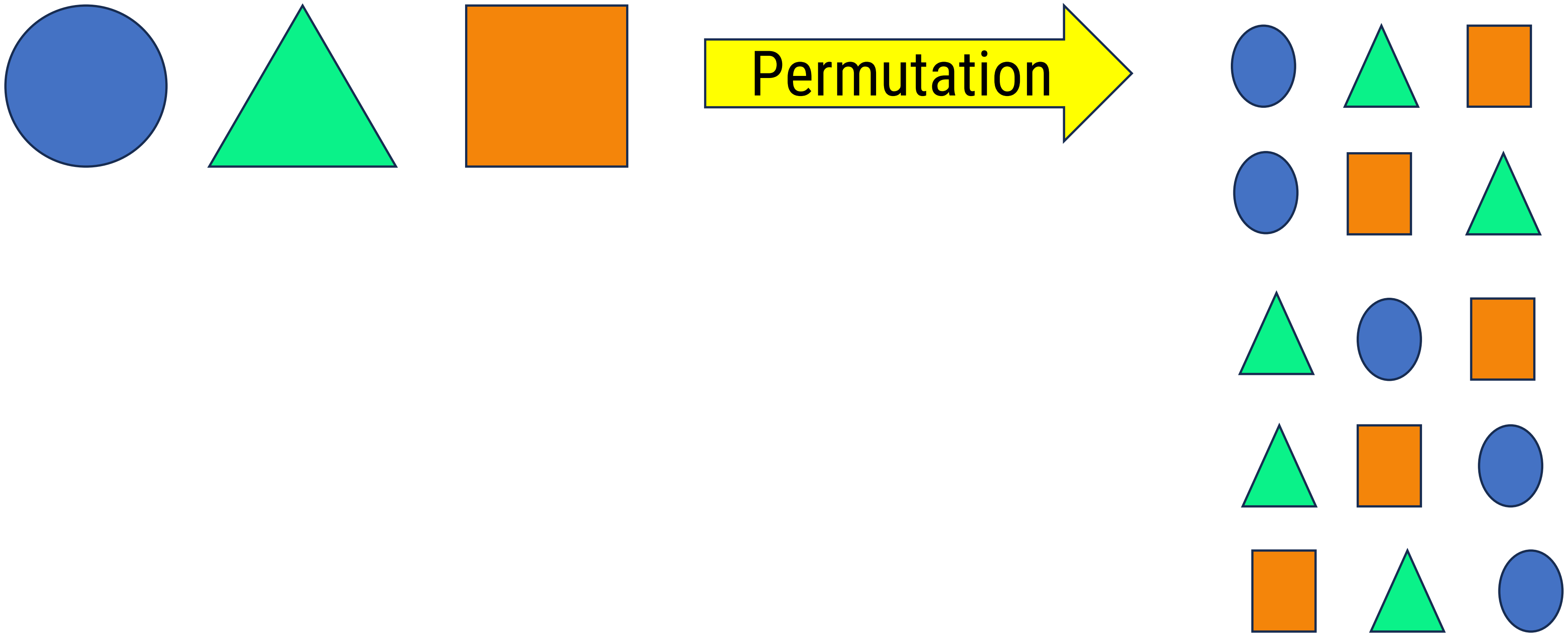
Permutations



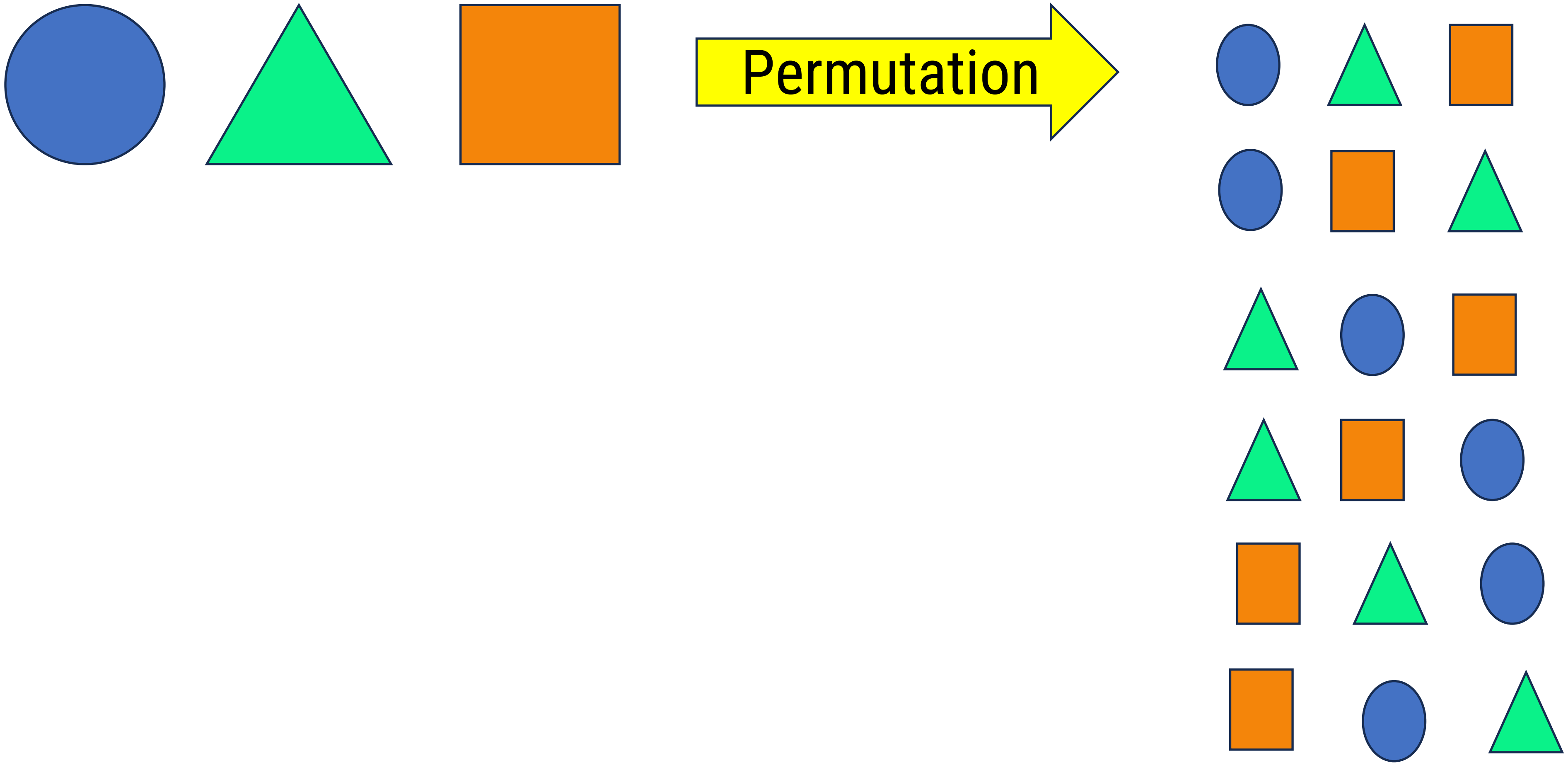
Permutations



Permutations



Permutations



Permutations

$${}_{n}P_{r} = \frac{n!}{(n-r)!}$$

$${}_{6}P_{2} = \frac{6!}{(6-2)!} = \frac{6 \cdot 5 \cdot \cancel{4 \cdot 3 \cdot 2 \cdot 1}}{\cancel{4 \cdot 3 \cdot 2 \cdot 1}} = 6 \cdot 5 = 30$$

$${}_{5}P_{5} = \frac{5!}{(5-5)!} = \frac{5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}{1} = 120$$

Example Television News Stories

A television news director wishes to use 3 news stories on an evening show. One story will be the lead story, one will be the second story, and the last will be a closing story. If the director has a total of 8 stories to choose from, how many possible ways can the program be set up?

$$8P3 = \frac{8!}{(8-3)!} = \frac{8 \cdot 7 \cdot 6 \cdot 5!}{5!} = (8)(7)(6) = 336$$

Example School Musical Plays

A school musical director can select 2 musical plays to present next year. One will be presented in the fall, and one will be presented in the spring. If she has 9 to pick from, how many different possibilities are there?

$$9P2 = \frac{9!}{(9-2)!} = \frac{9 \cdot 8 \cdot 7!}{7!} = (9)(8) = 72$$

Combinations

A selection of distinct objects without regard to order is called a **combination.**

Combination Rule

The number of combinations of r objects selected from n objects is denoted by ${}_nC_r$ and is given by the formula

$$ {}_nC_r = \frac{n!}{(n-r)!r!} $$

Combinations

$$\binom{n}{r} = {}_nC_r = \frac{\text{n!}}{r!\,(n-r)!}$$

$$\binom{5}{2} = \frac{5!}{2!\,(5-2)!} = \frac{5!}{2!\,3!} = \frac{(5)(4)(3)(2)(1)}{(2)(1)(3)(2)(1)}$$

$$= (5)(2)$$

$$= 10$$

Combinations

$$\binom{n}{r} = {}_{n}C_{r} = \frac{\mathrm{n}!}{r!\,(n-r)!}$$

$$\binom{5}{3} = \frac{5!}{3!\,(5-3)!} = \frac{5!}{3!\,2!} = \frac{(5)(4)(3)(2)(1)}{(3)(2)(1)(2)(1)}$$

$$= (5)(2)$$

$$= 10$$

Example Letters

Given the letters A, B, C, and D, list the permutations and combinations for selecting two letters.

Permutation

AB	BA	CA	DA
AC	BC	CB	DB
AD	BD	CD	DC

Combination

AB	~~BA~~	~~CA~~	~~DA~~
AC	BC	~~CB~~	~~DB~~
AD	BD	CD	~~DC~~

Example Letters

Given the letters A, B, C, and D, list the permutations and combinations for selecting two letters.

$$\binom{4}{2} = \frac{4!}{2!\,(2)!} = \frac{(4)(3)(2)(1)}{(2)(1)(2)(1)}$$

$$= (2)(3)$$

$$= 6$$

Example Book Reviews

A newspaper editor has received 8 books to review. He decides that he can use 3 reviews in his newspaper. How many different ways can these 3 reviews be selected?

$$\binom{8}{3} = \frac{8!}{3!\,(5)!} = \frac{(8)(7)(6)}{(3)(2)(1)}$$

$$= (2)(3)$$

$$= 6$$

Example Committee Selection

In a club there are 7 women and 5 men. A committee of 3 women and 2 men is to be chosen. How many different possibilities are there?

Select 3 women from 7 women

Select 2 men from 5 men

$$\binom{7}{3}$$

$$\binom{5}{2}$$

Example Committee Selection

In a club there are 7 women and 5 men. A committee of 3 women and 2 men is to be chosen. How many different possibilities are there?

$$\binom{7}{3}\binom{5}{2} = \frac{7!}{3!\,(4)!} \text{ X } \frac{5!}{2!\,(3)!}$$

$$= (35)(10)$$

$$= 350$$

Summary of Counting

Rule	Definition	Formula
Fundamental counting rule	The number of ways a sequence of n events can occur if the first event can occur in k_1 ways, the second event can occur in k_2 ways, etc.	$k_1 \cdot k_2 \cdot k_3 \cdots k_n$
Permutation rule	The number of permutations of n objects taking r objects at a time (order is important)	${}_nP_r = \dfrac{n!}{(n-r)!}$
Combination rule	The number of combinations of r objects taken from n objects (order is not important)	${}_nC_r = \dfrac{n!}{(n-r)!r!}$

Homework

1. **รหัสไปรษณีย์** มีรหัสไปรษณีย์แบบ 5 หลักได้กี่รหัส

- ถ้าสามารถใช้ตัวเลขซ้ำกันได้? เช่น 72133, 77777
- ถ้าไม่สามารถใช้ตัวเลขซ้ำกันได้? เช่น 72130, 76543

2. ลำดับการตีลูก (Batting Order)

ผู้จัดการทีมเบสบอลสามารถจัดลำดับการตีลูกให้ผู้เล่น 9 คนได้กี่วิธี?

Homework

3. วิดีโอเกม

สามารถจัดตลับวิดีโอเกม 7 แบบที่แตกต่างกันบนชั้นวางได้กี่วิธี?

4. การจัดที่นั่ง

สามารถจัดที่นั่งให้วิทยากร 5 คนที่นั่งเรียงกันบนเวทีได้กี่วิธี?

Homework

5. การจัดแสดงแชมพู

ผู้จัดการร้านต้องการจัดแสดงแชมพู 8 ยี่ห้อที่แตกต่างกันในแถว สามารถจัดได้กี่วิธี?

6. โปรแกรมการแสดง

มีวงดนตรี 3 วง และนักแสดงตลก 2 คน (แสดงไม่พร้อมกัน) กำลังจะแสดงในงานแสดงความสามารถของนักเรียน สามารถจัดลำดับการแสดงได้กี่วิธี?

Homework

6. Evaluate each of these.

a. $8!$
b. $10!$
c. $0!$
d. $1!$
e. ${}_7P_5$
f. ${}_{12}P_4$
g. ${}_5P_3$
h. ${}_6P_0$
i. ${}_5P_5$
j. ${}_6P_2$

a. ${}_5C_2$
b. ${}_8C_3$
c. ${}_7C_4$
d. ${}_6C_2$
e. ${}_6C_4$
f. ${}_3C_0$
g. ${}_3C_3$
h. ${}_9C_7$
i. ${}_{12}C_2$
j. ${}_4C_3$

Homework Permutaion and Combination

7. การเลือกโปสเตอร์

ผู้ซื้อคนหนึ่งตัดสินใจจะสต็อกโปสเตอร์ 8 แบบ สามารถเลือกโปสเตอร์ 8 แบบนี้ได้กี่วิธี ถ้าหากมีโปสเตอร์ให้เลือกทั้งหมด 20 แบบ

8. การเลือกโปสเตอร์

บริษัท Anderson Research ตัดสินใจทดสอบการตลาดสินค้าใน 6 พื้นที่ สามารถเลือกพื้นที่ 3 พื้นที่มาใช้ในการทดสอบ **โดยคำนึงถึงลำดับการทดสอบ** ได้กี่วิธี?

Homework Permutation and Combination

9.การเลือกหนูทดลอง

นักวิจัยสามารถเลือกหนูทดลอง 5 ตัวจากหนูทั้งหมด 20 ตัว **และกำหนดให้แต่ละตัวเข้าทดสอบที่แตกต่างกัน** ได้กี่วิธี

10. การเลือกละครเพลง

กลุ่มการแสดงละครตัดสินใจเลือกละครเพลง (Musicals) 2 เรื่อง และละครดราม่า (Dramas) 3 เรื่อง จากละครเพลง 11 เรื่อง และละครดราม่า 8 เรื่อง เพื่อแสดงตลอดปี จะมีวิธีเลือกได้กี่วิธี

Probability and Counting Rules

The counting rules can be combined with the probability rules in this chapter to solve many types of probability problems

Example Four Aces

Find the probability of getting 4 aces when 5 cards are drawn from an ordinary deck of cards.

$$P(E) = \frac{n(E)}{n(S)}$$

$$= \frac{48}{2{,}598{,}960}$$

$n(S)$ = 52C5

$n(S)$ = 2,598,960

$n(E)$ = 4C4 (48)

$n(E)$ = 48

Example Defective Transistors

A box contains 24 transistors, 4 of which are defective. If 4 are sold at random, find the following probabilities.

a. Exactly 2 are defective.
b. All are defective.
c. None is defective.
d. At least 1 is defective.

	24	
20		4

$$P(E) = \frac{n(E)}{n(S)}$$

n(S) = 24C4

n(S) = 10,626

Example Defective Transistors

A box contains 24 transistors, 4 of which are defective. If 4 are sold at random, find the following probabilities.

a. Exactly 2 are defective.

20	4
2	2
20C2	4C2
190	6

$$P(E) = \frac{n(E)}{n(S)}$$

$$= \frac{(190)(6)}{10{,}626} = 0.11$$

Example Defective Transistors

A box contains 24 transistors, 4 of which are defective. If 4 are sold at random, find the following probabilities.

b. All are defective

20	4
0	4
20C0	4C1
1	4

$$P(E) = \frac{n(E)}{n(S)}$$

$$= \frac{4}{10,626}$$

Example Defective Transistors

A box contains 24 transistors, 4 of which are defective. If 4 are sold at random, find the following probabilities.

c. None is defective

20	4
4	0

20C4

4,845

$$P(E) = \frac{n(E)}{n(S)}$$

$$= \frac{4845}{10,626}$$

Example Defective Transistors

A box contains 24 transistors, 4 of which are defective. If 4 are sold at random, find the following probabilities.

c. At least 1 is defective

อย่างน้อย 1 ชิ้น

1, 2, 3, 4

20	4
3	**1**

20	4
1	**3**

20	4
2	**2**

20	4
0	**4**

Example Defective Transistors

A box contains 24 transistors, 4 of which are defective. If 4 are sold at random, find the following probabilities.

c. At least 1 is defective

20	4
4	**0**

P(At least 1 is defective) =1 - P(no defectives)

$$=1 - \frac{4845}{10,626} \qquad = \frac{5,781}{10,626}$$

Example Magazines

A store has 6 *TV Graphic* magazines and 8 *Newstime* magazines on the counter. If two customers purchased a magazine, find the probability that one of each magazine was purchased.

n(S)= 14C2

P(1 *TV Graphic* and 1 *Newstime*) = 6C1 · 8C1

146C2

$$= \frac{48}{91}$$

6	8
1	**1**

HOMEWORK

Socks in a Drawer A drawer contains 11 identical red socks and 8 identical black socks. Suppose that you choose 2 socks at random in the dark.

a. What is the probability that you get a pair of red socks?
b. What is the probability that you get a pair of black socks?
c. What is the probability that you get 2 unmatched socks?
d. Where did the other red sock go?