

Probability and Odds

Topic 12 Lesson 1

Level 1

Formula for probability

$$P(s) = \frac{\text{\# of ways to succeed}}{\text{total possible outcomes}}$$

Odds: The ratio of the probability of success to the probability of failure. Use if they ask for ODDS of an event

$$\text{Odds} = \frac{P(s)}{P(f)}$$

Examples

A drawer has 18 pairs of socks in it; 10 black, 5 gray, and 3 white.

I) What is the probability that you will select a white pair of socks?
 $P(\text{pick white}) = \frac{\text{\# ways to get white socks}}{\text{total socks in drawer}} = \frac{3}{18} = \frac{1}{6} = 16.6\%$

II) What are the odds of you drawing a black pair of socks?
 $\frac{P(\text{black socks})}{P(\text{gray or white})} = \frac{10/18}{8/18} = \frac{10}{8} = \frac{5}{4}$ *odds of getting black socks 5:4*

III) Robbie Gould, the kicker for the Chicago Bears, makes his field goal kicks 86% of the time. What are the odds of him missing?

$$\text{Odds} = \frac{P(S)}{P(F)} = \frac{P(\text{missing})}{P(\text{making})} = \frac{14}{86} = \frac{7}{43}$$

$100\% - 86\% = 14\%$
makes 86% makes it, misses it
7:43 he misses it
 Probability $\frac{7}{50}$
 Total $7+43$

Probability: The chances of an event happening

Ex.) What is the probability of rolling a 5 on a 6-sided die?
 $P(\text{roll a 5 on a die})$

Success: When the desired outcome is attained

Ex.) Rolling a 5

Failure: Any outcome other than the desired

Ex.) Rolling a 1, 2, 3, 4, or 6

Sample Space: All possible outcomes

Universe

Ex.) 1, 2, 3, 4, 5, 6

Probability What is the probability of rolling a 5 with one die?

\# of ways can you roll a 5? 1
\# of different sides on a die? 6
 $P(\text{roll a 5 on a die}) = \frac{1}{6} = 0.166 = 16.6\%$
to turn into a percent make decimal twice

What is the probability of a boy in this class being chosen as student of the week?

$\frac{\text{Desired}}{\text{total}} \quad P(\text{pick a boy}) = \frac{\text{total boys}}{\text{total kids}} = \frac{13}{19} = 0.684 = 68.4\%$

What is the probability of rolling a 5 with two dice?

if you want events to happen together multiply
 $\frac{1}{6} \cdot \frac{1}{6} = \frac{1 \cdot 1}{6 \cdot 6} = \frac{1}{36}$

Composite Events Two or more events that cannot happen together because no characteristics are shared

Mutually Exclusive Events

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

Examples

A bag contains 5 yellow, 6 blue, and 4 white chips.

a) What is the probability that a chip will be yellow or blue?

$P(Y \text{ or } B) = P(\text{yellow}) + P(\text{blue})$
 $P(Y \text{ or } B) = \frac{5}{15} + \frac{6}{15} = \frac{11}{15}$

b) What is the probability that a chip will be yellow and blue?

$P(Y \text{ and } B) = \frac{0}{15} = 0\%$

c. P(rolling a 4 and an odd number) = 0

d. $P(4 \text{ or odd}) = \frac{1}{6} + \frac{3}{6} = \frac{4}{6} = \frac{2}{3}$
1, 3, 5

e. $P(4 \text{ and even}) = \frac{3}{6} = \frac{1}{2}$
Not mutually exclusive there is overlap 4 is even

Multiplication Principle

To find the number of ways or combinations there are

Formula: multiply the number of choices for each event

"how many ways can...
output combinations"

You have narrowed down your choices for a new car. You want the color to be red, metallic blue, or black. You don't care whether the interior is leather or cloth. You would be happy with a Ferrari, a Lamborghini, a Maserati, or a Corvette.

Color: 3 choices
Interior: 2 choices
Body: 4 choices

of dream cars? = $3 \cdot 2 \cdot 4 = 24$
Pick color Pick Int. Body



Formula for probability

$$P(s) = \frac{\text{\# of ways to succeed}}{\text{total possible outcomes}}$$

Probability

What is the probability of rolling a 5 with one die?

Success (5) = 1 way $P(\text{roll } 5) = \frac{1}{6}$
Total (all possible sides) = 6 ways = $\frac{1}{6} = 0.166$
to turn into a % move decimal twice = 16.6%

What is the probability of a boy in this class being chosen as student of the week?

Success (Boys) = 11 $\frac{11}{28} = 39.2\%$
Total (whole class) = 28

What is the probability of rolling a 5 with two dice?

if two events + to happen at the same time, multiply each probability.
Die 1 $\frac{1}{6}$ Die 2 $\frac{1}{6}$ = $\frac{1 \cdot 1}{6 \cdot 6} = \frac{1}{36} = 2.77\%$

Odds: The ratio of the probability of success to the probability of failure. Use if they ask for ODDS of an event

Odds = $\frac{P(s)}{P(f)}$ or $P(s) : P(f)$

Examples

A drawer has 18 pairs of socks in it; 10 black, 5 gray, and 3 white.

I) What is the **probability** that you will select a white pair of socks?

Ways to pick white socks $\frac{3}{18} = \frac{1}{6} = 16.6\%$
Total = 18

II) What are the **odds** of you drawing a black pair of socks?

Success (pick Bk pair) = 10
Failure (pick Whit or gray) = 5 + 3 = 8
Odds = $\frac{10}{8} = \frac{5}{4}$
5:4 pick Black socks

III) Robbie Gould, the kicker for the Chicago Bears, makes his field goal kicks 86% of the time. What are the odds of him missing?

100 - 86 = 14
Success - P(missing) = $\frac{14}{86} = \frac{7}{43}$
Failure - P(making) = $\frac{72}{86} = \frac{36}{43}$
7:43 chance he misses

Composite or Compound Events

Two or more events that cannot happen together because no characteristics are shared

Mutually Exclusive Events

Use when Problem says "OR"

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

Examples

A bag contains 5 yellow, 6 blue, and 4 white chips.

a) What is the probability that a chip will be yellow or blue?

Desired Total $\frac{5}{15} + \frac{6}{15} = \frac{11}{15}$
 $P(\text{Yellow}) + P(\text{Blue})$

b) What is the probability that a chip will be yellow and blue?

To add fractions, need common denominator.
Both yellow and blue same time $\frac{0}{15} = 0\%$

c) P(rolling a 4 and an odd number) = 0

$P(\text{roll } 4 \text{ OR odd \#})$
 $\frac{1}{6} + \frac{3}{6} = \frac{4}{6} = \frac{2}{3} = 66.6\%$

Multiplication Principle

When you want more than 1 thing to happen at a time.

Use When: Asked to find total number of ways or combinations there are, or if you want probability of multiple events in a row.

Formula: multiply the number of choices for each event

You have narrowed down your choices for a new car. You want the color to be red, metallic blue, or black. You don't care whether the interior is leather or cloth. You would be happy with a Ferrari, a Lamborghini, a Maserati, or a Corvette.

To repeat or
not to repeat?

WITHOUT repetition:

when once you have used an object, it
is no longer available as an option.

(less possibilities)

ex. How many ways can our class of
30 line up?

Fact
0! = 1

$$\frac{30 \cdot 29 \cdot 28 \cdot \dots \cdot 1}{\substack{\text{1st} \quad \text{2nd} \quad \text{3rd} \\ \text{Person Person Person} \quad \dots \quad \substack{\text{30th} \\ \text{Person}} \quad \text{"factorial"}}} = 30!$$

WITH repetition:

when once you have used an object, it
is still available as an option later.

(Same amount of possibilities)

ex. How many phone numbers can
be made in America?

$$9 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10$$

count
of
digits
with 0

$$9 \cdot 10^9$$

$$9,000,000,000$$