Unit 8 Lesson 2b: Adding & Multiplying Probabilities

Learning Targets:

I can define conditional probability and explain the difference between dependent and independent events.
I can apply the concepts of dependent and independent events and conditional probability to calcuate probabilities.
I can determine if an event is mutually exclusive and determine the probabilities.

Compound (composite) Event: consists of 2 or more simple events

P(event 1 **OR** event 2) **ADD**

Mutually Exclusive or NOT Mutually Exclusive

*you must decide if they can happen at the same time

KeyConcept Addition Rules for Probability

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

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

If two events A and B are not mutually exclusive, the probability that A or B will occur is

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

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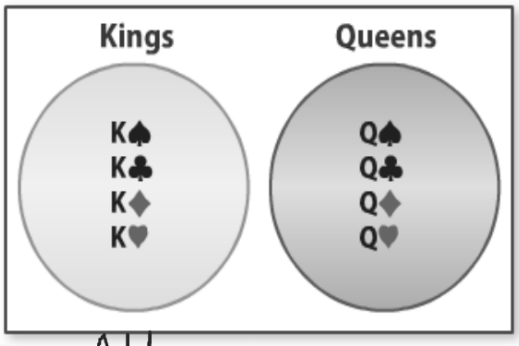
Mutually Exclusive



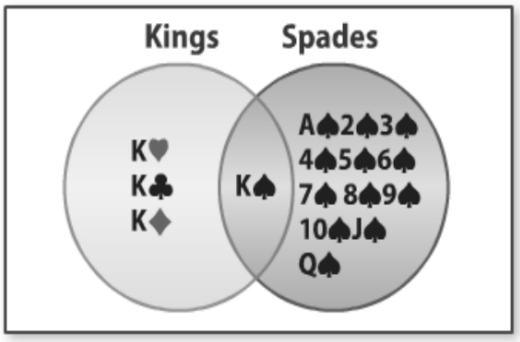
Add

P(King or Queen)=

$P(K) + P(Q)$

$\frac{4}{52} + \frac{4}{52} = \frac{8}{52} = \frac{2}{13}$

Not Mutually Exclusive



P(King or Spade)=

$P(K) + P(\text{spade}) - P(\text{King and spade})$

$\frac{4}{52} + \frac{13}{52} - \frac{1}{52} = \frac{16}{52} = \frac{4}{13}$

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Example 1:

A card is drawn at random from a standard deck of 52 cards.

a) Determine the probability of drawing a heart or a club:

P(heart or clubs)

P(H or C) add ME

$P(H) + P(C)$

$\frac{13}{52} + \frac{13}{52} = \frac{26}{52}$

$= \frac{1}{2}$ or 0.5

b) Determine the probability of drawing a ~~heart or a club~~ ace or diamond:

P(ace or diamond) add Not ME

$P(A) + P(D) - P(A \text{ and } D)$

$\frac{4}{52} + \frac{13}{52} - \frac{1}{52} = \frac{16}{52} = \frac{4}{13} \approx 0.308$

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P(event 1 **AND** event 2) **MULTIPLY**

Decide if INDEPENDENT or DEPENDENT

***Does one event in any way affect the outcome (or the odds) of the other event?

★ If two events A and B are **independent**, then the probability that A **AND** B will occur is:

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

KeyConcept Probability of Independent Events

If two events *A* and *B* are independent, then the probability that *A* and *B* will occur is

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

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If two events A and B are **dependent**, then the probability that A and B will occur is:

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

ie: Draw a card and without putting it back, draw another card.

KeyConcept Probability of Dependent Events

If two events A and B are dependent, then the probability that A and B will occur is

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

Conditional Probability: The probability of an event A occurring given that event B has already occurred and is represented by P(B | A), read the probability of B given A.

Given "A", we know "A" happend.
Now what's the probability of "B"?

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Example 2:

A coin is tossed and a die is rolled. What is the probability of the coin landing on tails and rolling an even number?

mult
indep

P(tails and even) =

P(tails) • P(even)

$\frac{1}{2} \cdot \frac{3}{6} = \frac{3}{12} = \frac{1}{4} = 0.25$

Example 3:

A box of chocolates contians 8 milk chocolates and 5 dark chocolates. You randomly pick a chocolate and eat it. Then you randomly pick another piece. What is the probability the first piece is milk chocolate and the second piece is dark chocolate?

mult
dep.

P(milk and dark)

$P(\text{milk}) \cdot P(\text{dark} \mid \text{milk})$

$\frac{8}{13} \cdot \frac{5}{12} = \frac{40}{156} = \frac{10}{39} \approx 0.256$

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Example 4:

Nate has a box of dog toys that contains 8 squeaky toys, 5 plush toys, and 2 bones. If he selects a toy at random from the box, what is the probability that it is a plush toy or a bone?

P(Plush or bone) add ME

$P(\text{Plush}) + P(\text{Bone})$

$$\frac{5}{15} + \frac{2}{15} = \boxed{\frac{7}{15} \approx 0.467}$$

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Example 5: Two dice are rolled.

	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)

a) Determine the probability of rolling a sum of 5 or 8.

add

ME

P(sum of 5 or 8)

$P(\text{sum of 5}) + P(\text{sum of 8})$

$$\frac{4}{36} + \frac{5}{36} = \frac{9}{36} = \frac{1}{4} = 0.25$$

b) Determine the probability of rolling a sum less than four or doubles.

add

Not ME

P(sum < 4 or doubles)

$P(\text{sum} < 4) + P(\text{doubles}) - P(\text{sum} < 4 \text{ and doubles})$

$$\frac{3}{36} + \frac{6}{36} - \frac{1}{36} = \frac{8}{36} = \frac{2}{9} \approx 0.222$$

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Example 6:

Three students pick a prize from a bag that contains 4 pairs of sunglasses, 5 keychains, and 6 car air fresheners. What is the probability that the first student draws a pair of sunglasses, the second draws a car air freshener, and the third student draws a keychain?

mult
dependent

P(sunglasses and airfreshener and keychain)

$$\frac{4^2}{15_3} \cdot \frac{6^2}{14_7} \cdot \frac{8}{13} = \frac{4}{91} \approx 0.044$$

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Example 7:

In a Spanish class, there are 10 sophomores, 8 juniors and 2 seniors. Of these students, 9 sophomores, 2 juniors and 1 senior are female. A student is selected at random.

CLASS	Sophomore	Junior	Senior	TOTAL
Female	9	2	1	12
Male	1	6	1	8
TOTAL	10	8	2	20

a) *P*(a sophomore or female)

or → add, Not ME

$P(\text{Soph}) + P(\text{Female}) - P(\text{Soph and female})$

$\frac{10}{20} + \frac{12}{20} - \frac{9}{20} = \boxed{\frac{13}{20} = 0.65}$

b) *P*(a junior or male)

or → add, NOT ME

$P(\text{Junior}) + P(\text{Male}) - P(\text{Jun. and male})$

$\frac{8}{20} + \frac{8}{20} - \frac{6}{20} = \frac{10}{20} = \frac{1}{2} = 0.5$

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Example 8:

Group	Condition Improves (*Y*)	Condition Does Not Improve (*N*)
Treatment (*T*)	1600	400
Control (*C*)	1200	800

A drug company conducted an experiment to determine the effectiveness of a certain new drug. Test subjects were randomly assigned to one of the two groups: a treatment group, which received the drug, or a control group, which received a placebo instead of the drug. The contingency table shows the results.

Find the probability that a test subject's condition improved given that he or she was in the treatment group.

$$P(Y|T) = \frac{1600}{2000} = \frac{4}{5} = 0.8$$