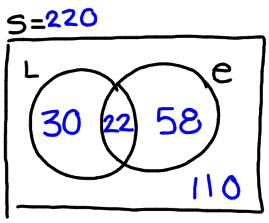
Homework Questions???

#5d, 11ab, 8, 15

5d)



$P(\text{lakeshore without power}) = \frac{30}{220}$

$= \frac{3}{22}$

11. a) $H = \{\text{Hania is first}\}$

$A = \{\text{Aaron is last}\}$

$P(H \cup A) = P(H) + P(A) - P(H \cap A)$

$= \frac{1 \times 7!}{8!} + \frac{7! \times 1}{8!} - \frac{1 \times 6! \times 1}{8!}$

Total: 8!

Hania first:

$\underset{H}{\underline{1}}\ \underline{7!}\ \underline{\quad}\ \underline{\quad}\ \underline{\quad}\ \underline{\quad}\ \underline{\quad}$

Aaron last:

$\underline{7!}\ \underline{\quad}\ \underline{\quad}\ \underline{\quad}\ \underline{\quad}\ \underline{\quad}\ \underline{\cancel{1}\ 7}$ A

Hania first + Aaron last:

$\underset{H}{\underline{1}}\ \underline{\quad}\ \underline{6!}\ \underline{\quad}\ \underline{\quad}\ \underline{\quad}\ \underline{\cancel{1}\ 6}$ A

b) $P(H \cup A') = P(H) + P(A') - P(H \cap A')$

15. a) $K = \{\text{king}\}$

$R = \{\text{red face card}\}$

$P(K \cup R) = P(K) + P(R) - P(K \cap R)$

$= \frac{\cancel{2}\ 3}{50} + \frac{5}{50} - \frac{\cancel{1}\ 2}{50}$

$= \frac{6}{50}$

$= \frac{3}{25}$

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MDM 4UI

Data Management

Lesson 21: Independent & Dependent Events

Learning Goal:

Students can solve probability problems involving both independent and dependent compound events.

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Consider the following experiments which involve *compound events* (i.e. two or more separate events):

EXPERIMENT 1:

A coin is flipped and turns up heads. What is the probability the second flip will turn up heads?

$F = \{\text{flipping heads}\}$

$P(F) = \frac{1}{2}$ ← will have the same prob. every time

EXPERIMENT 2:

The queen of hearts is drawn from a deck of cards (without replacement). What is the probability that the next card will be a heart?

$H = \{\text{heart}\}$

$P(H) = \frac{12}{51}$

this is a conditional probability since it was impacted by the previous "event" (a heart being drawn on the first draw)

Normally $P(H) = \frac{13}{52}$

since $\frac{12}{51} \neq \frac{13}{52}$, it's conditionally ∴ it's dependent

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INDEPENDENT EVENTS:

In some situations involving compound events, the occurrence of one event has no effect on the occurrence of another. In such cases, the events are **independent**. (flipping a coin, rolling a die, etc.)

PRODUCT RULE FOR INDEPENDENT EVENTS:

In general, the probability of two independent events can be calculated using the following rule:

$$P(A \cap B) = P(A) \times P(B)$$

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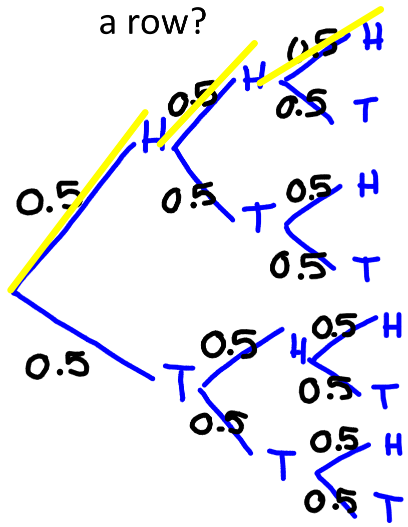
EX. 1. A coin is tossed 3 times. What is the probability of getting 3 heads in a row?



P(flipping 3 heads) = $0.5 \times 0.5 \times 0.5$

$= 0.125$

∴ there is a 12.5% chance

EX. 2. A coin is flipped while a die is rolled. What is the probability of flipping heads and rolling 5 in a single trial?

H = {flipping heads}

F = {rolling 5}

$P(H \cap F) = P(H) \times P(F)$

$= \frac{1}{2} \times \frac{1}{6}$

$= \frac{1}{12}$

using a tree diagram would give you the same result.

DEPENDENT EVENTS:

In some cases, the probable outcome of an event, B, depends directly on the outcome of another event, A. When this happens, the events are said to be **dependent**.

The *conditional probability* of B, $\boldsymbol{P(B|A)}$, is the probability that B occurs, given that A has already occurred.

PRODUCT RULE FOR DEPENDENT EVENTS:

For dependent events, we use the conditional probability for the second event. So, the probability that both events will occur can be found using the following rule:

$$P(A \cap B) = P(A) \times P(B \mid A)$$

EX. 3. A professional hockey team has 8 wingers. Three of these wingers are 30-goal scorers, or "snipers". Every fall the team plays an exhibition match with the club's farm team. In order to make the match more interesting for the fans, the coaches agree to select 2 wingers at random from the pro team to play for the farm team. What is the probability that 2 snipers will play for the farm team?

conditional prob.

OPTION #1: Using dep events

$$P(\text{two snipers}) = \frac{3}{8} \times \frac{2}{7}$$

$$= \frac{6}{56}$$

$$= \frac{3}{28}$$

OPTION #2: Using combinations

$$P(2 \text{ snipers}) = \frac{\binom{3}{2}}{\binom{8}{2}}$$

$$= \frac{3}{28}$$

EX. 4. Serena's computer sometimes crashes while she is trying to use her e-mail program, OutTake. When OutTake "hangs" (stops responding to commands), Serena is usually able to close Out Take without a system crash. In a computer magazine, she reads that the probability of OutTake hanging in any 15-minute period is 2.5%, while the chance of OutTake and the operating system failing together in any 15-minute period is 1%. Given that OutTake is hanging, what is the probability that the operating system will crash?

$H = \{\text{OutTake "hangs"}\}$

$C = \{\text{system crashes}\}$

$P(C|H)$

$P(C \cap H) = P(H) \times P(C|H)$

$0.01 = 0.025 \times P(C|H)$

$\frac{0.01}{0.025} = \frac{0.025 \times P(C|H)}{0.025}$

$\therefore P(C|H) = 0.4$

$\therefore$ there is a 40% chance that the system will crash if email is already "hanging"

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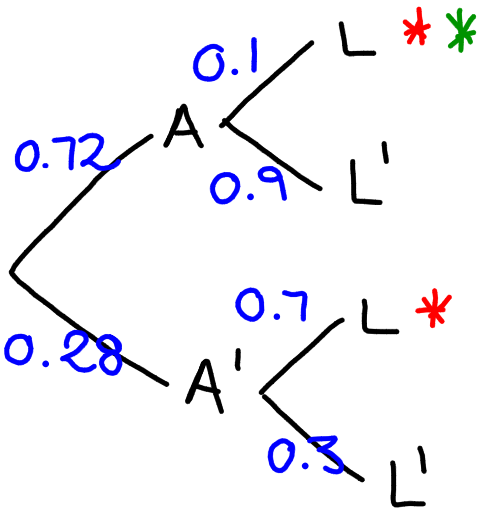
NOTE: There is a useful rearrangement of the Product Rule for Dependent Events.

$$P(B \mid A) = \frac{P(A \cap B)}{P(A)}$$

prob. of what is given (already happened)

EX. 5. Miguel remembers to set his alarm clock 72% of the time. When he does remember to set his alarm clock, the probability that he will be late for school is 0.10. When he does not remember to set it, the probability that the will be late for school is 0.70. Miguel was late today. Determine the probability that the remembered to set his alarm clock.



A = {sets alarm}

L = {late}

$$P(A|L) = \frac{P(A \cap L)}{P(L)}$$ ← * ← *

$$= \frac{0.72(0.1)}{0.72(0.1)+0.28(0.7)}$$

$$= \frac{0.072}{0.266}$$

$$= 0.27$$

∴ 27% chance that he set his alarm

Consider the following scenarios:

SCENARIO 1:

What is the probability of drawing a black card or a 9 of hearts from a standard deck of cards?

SCENARIO 2:

What is the probability of drawing a black card and a 9 of hearts, one after the other (with replacement)?

Scenario 1 is an example involving mutually exclusive events.

Scenario 2 is an example involving two independent events.

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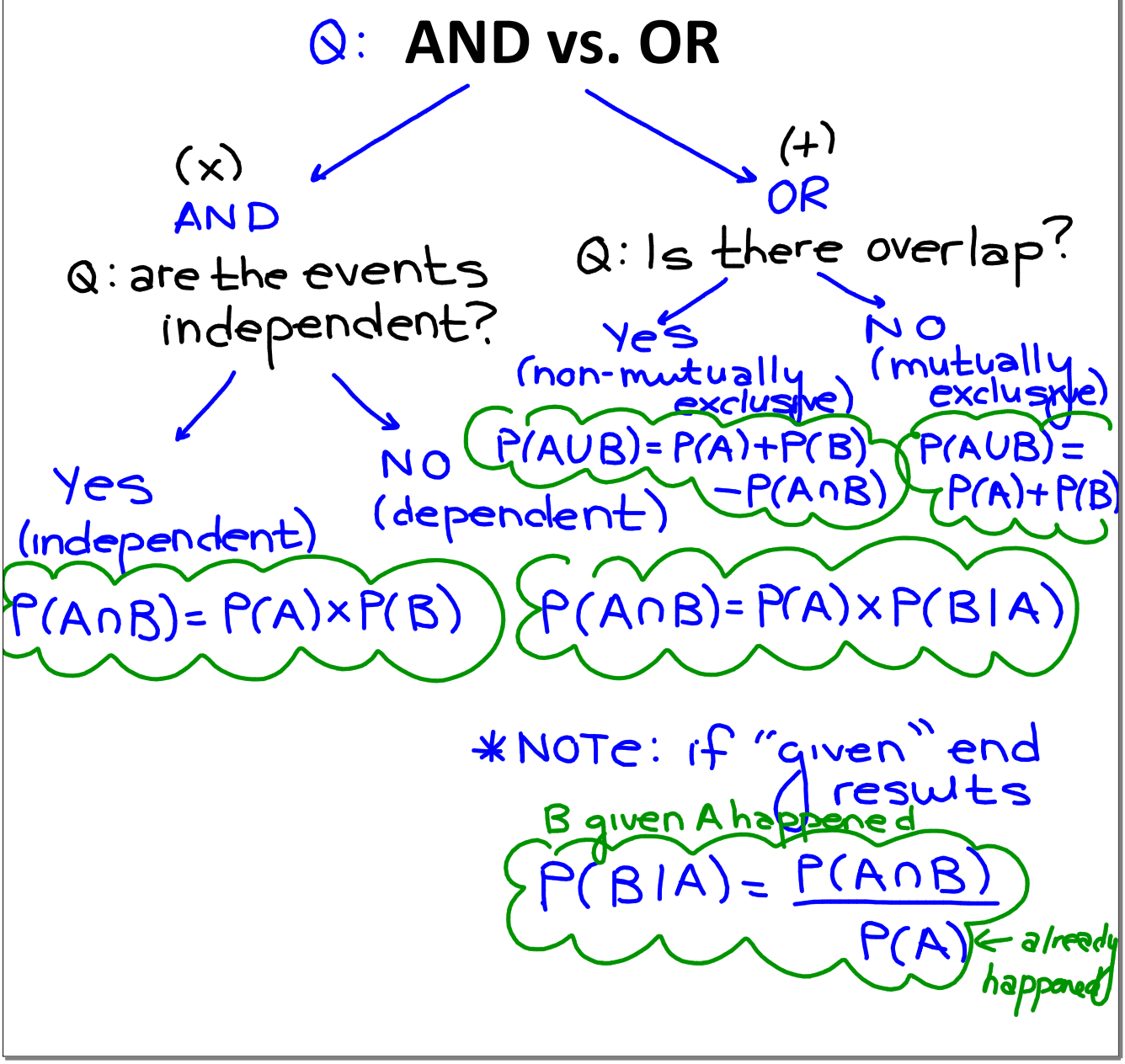
Q: How are "mutually exclusive/non-mutually exclusive" events different than "independent/dependent" events?



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Homework: p. 334 #2, 3, 4, 5, 8, 14-17