Math 142: Wednesday, Oct 2nd, Day 14 Notes

Agenda for Wednesday, Oct 2nd 2024

Coming up

- ! **HW 9** and **Excel Assignment 2** due today, Wednesday, Oct 2nd
- ! **HW 10** will be posted this evening(due next Wednesday)
- Student Hours today 3:45-5pm and Thursday, 1-2:15pm in C162
- Zoom Study Night with the Tutoring Center, this Sunday 4-8pm (details on Canvas Announcement)

Recall:

$0 \le P(A) \le 1$

Experiment, Sample space, event, probability, Properties of probability, Complement Rule and Compound events.

A its complement A' , $P(A') = 1 - P(A)$ *

Consider a standard deck of cards.

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♠	A♠

S=

sample space

$n(S) = 52$

A = event of getting a face card

$P(A) = \frac{12}{52} = \frac{3}{13}$

$P(A') = 1 - P(A) = 1 - \frac{3}{13} = \frac{13}{13} - \frac{3}{13} = \frac{10}{13}$

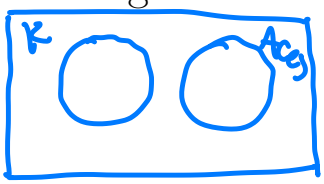
Probabilities involving "OR"

Mutually exclusive events are events that have no outcomes in common (or events that can't happen at the same time).

Example 1. Are the following events mutually exclusive?

1. Let A be the event of "drawing a King" out of a deck of cards and B be the event of "drawing an Ace".

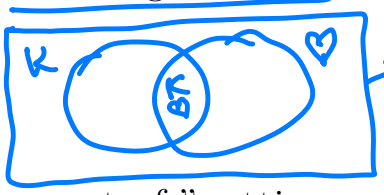
yes



sample space (52 cards)

2. Let A be the event of "drawing a King" out of a deck of cards and B be the event of "drawing a Heart".

No



52 cards

3. Let A be the event of "getting an A" and B the event of "getting a B" in this class.

yes

Addition Rule for mutually exclusive events:

For two mutually exclusive events A and B, the probability that one **or** the other occurs is the sum of the probabilities of the two events

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

can be extended to more than two mutually exclusive events

ex: A = King, B = Ace

$$P(A \text{ or } B) = \frac{4}{52} + \frac{4}{52} = \frac{8}{52} = \frac{2}{13}$$

The general additional rule

The Addition Rule doesn't work for events that aren't mutually exclusive. If the probability of owning a smartphone is 0.50 and the probability of owning a computer is 0.90, the probability of owning a smartphone **or** a computer may be pretty high, but it is not 1.40!

We'd like to generalize the Addition Rule to include events that aren't mutually exclusive.

Example 2. A survey of college students asked the questions: "Are you currently in a relationship?" and "Are you involved sports?" The survey found that 33% were currently in a relationship, and 25% were involved in sports. Eleven percent responded "yes" to both.

$P(R) = 0.33$, $P(Sp) = .25$, $P(R \text{ and } Sp) = .11$

1. What's the probability that a randomly selected student is in a relationship **or** is involved in sports?

$$P(R \text{ or } Sp) = P(R) + P(Sp) - P(R \text{ and } Sp)$$
$$= 0.33 + 0.25 - 0.11$$
$$= \boxed{0.47}$$

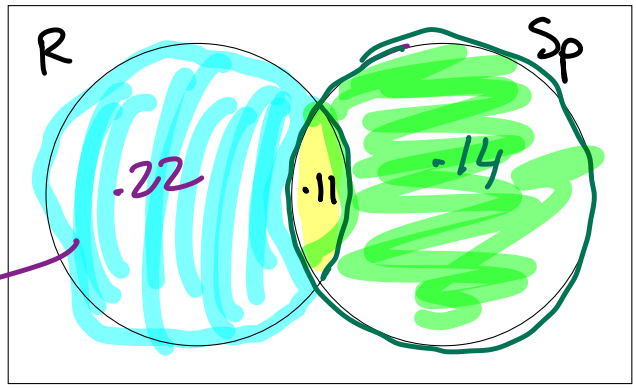
General Addition Rule:

For any events A and B, the probability that A **or** B occurs is the sum of the probabilities of the two events minus the probability that both A and B occur.

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

2. We can use a Venn Diagram to answer the following questions.

P(R)=.33
P(Sp)=.25



.33-.11

.25-.11
.14

What is the probability that a randomly selected student:

(a) is not in a relationship and is not involved in sports?

.53

(b) is in a relationship but not involved in sports?

.22

(c) either is in a relationship or is involved in sports, but not both?

.36

Probabilities involving "AND"

Independent events : Two events A and B are independent events, if the outcome of one event doesn't influence the outcome of the other.

Example 3. Are the following events independent?

1. Probability of your "flight being on time on Monday 8am" is $P(F) = .85$. Are the events "flight being on time this Monday" and "flight being on time the following Monday" independent?

yes

2. Consider drawing two cards (one at a time) from a deck of cards **with replacement**. Let A be the event of "drawing a King the first time" and B be the event of "drawing a King the second time".

yes

3. Consider drawing two cards (one at a time) from a deck **without replacement**. Let A be the event of "drawing a King the first time" and B be the event of "drawing a King the second time".

NO

Multiplication Rule for independent events

For two independent events A and B , the probability that both A and B occur is the product of the two events.

probabilities

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

ex 2: $P(\text{King}_{\text{1st}} \text{ and } \text{King}_{\text{sec}}) = \frac{4}{52} \cdot \frac{4}{52} = \frac{1}{169}$

Example 4. When you get to the light at W Washington St and Lancer Ln, the light is red, green, or yellow. Suppose we know that probability of green light is $P(G) = 0.35$ and $P(Y) = 0.04$.

1. What is the probability of ~~green~~? R

   $P(R) = 0.61$

2. What is the probability that on your morning commute you find the light red both Monday and Tuesday?

   $P(R \text{ and } R) = P(R) \cdot P(R) = (0.61)(0.6)$

   (Mon, Tues)

3. What is the probability of not encountering a red light?

   $P(R') = 1 - P(R) = 1 - 0.61 = 0.39$ or $.35 + .04 = .39$

4. What is the probability that on your morning commute you don't encounter a red light until Wednesday?

   $P(R' \text{ and } R' \text{ and } R) = P(R') \cdot P(R') \cdot P(R)$

   $= (0.39)(0.39)(0.61)$

   $= 0.0928$

5. What is the probability that on your morning commute all week(Mon-Friday) you'll have to stop **at least once**?

   $1 - P(R' \text{ and } R' \text{ and } R' \text{ and } R' \text{ and } R')$

   $1 - P(R') \cdots P(R')$

   $1 - (0.39)^5$

   0.991