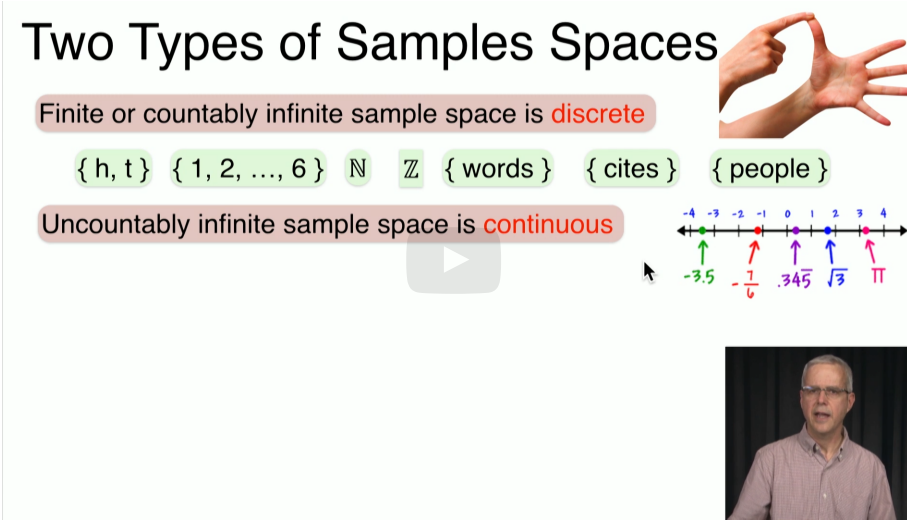
Problem Sets due Jun 1, 2022 17:13 +03

Video



9:10 / 17:27 1.0x

instead of x like y and z and so on.

And just like here we'll stat with x,

but if we need more variables then we denote y and z,

but again they'll be capital Y and capital Z

to indicate that they are random.

Alright, now next we want to talk

about probability of the outcome.

So intuitively, the probability, or likelihood,

of an outcome, x omega

omega is the sample space and then some

value x is we denote this by P(x),

or the probability that this random variable capital X

gets the the value of small x,

is the fraction of times that this little x

5.1_Probability_Introduction

POLL

Which of the following outcomes are random (not certain) when rolling a six-sided dice?

RESULTS

A real number.	**8%**
An even number.	**73%**
A positive number.	**19%**

Submit

Results gathered from 26 respondents.

FEEDBACK

The outcome of dice is certainly real and positive, but it may or may not be even, so it is random.

---

1 (Graded)

1/1 point (graded)

Which of the following outcomes are random (not certain) after throwing a six-sided dice?

- [x] Get number 3
- [x] Get an even number
- [ ] Get a positive number

✔

Explanation
- True. We may get e.g. 4 as an outcome, which is not 3.
- True. We may get e.g. 3 as an outcome, which is not even.
- False. All outcomes of a six-sided dice are positive.

Submit You have used 1 of 2 attempts

Answers are displayed within the problem

2 (Graded)

1/1 point (graded)
Imagine a single experiment where we flip a coin 6 times, and get “head, tail, head, head, head, head”.

Which of the following statements hold?

- [ ] The coin is not fair.
- [ ] The coin's "tail" probability is $1/6$.
- [x] The sequence "head, tail, head, head, head, head" is an outcome in the sample space.
- [ ] The sample space of the experiment is {head, tail}.

✔

Explanation
- False. The outcome is random and the coin may be fair.
- False. In this experiment 1 out of 6 outcomes was "tail", but the coin's "tail" probability may differ.
- True. The sample space consists of all secquences of six "head" and "tail", and this is one of them.
- False. The sample space is a set of tuples
$\{(\text{head, head, head, head, head, head}), (\text{head, head, head, head, head, tail}), \cdots, (\text{tail, tail, tail, tail, tail, tail})\}$
.

Submit You have used 4 of 4 attempts

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Distribution Types

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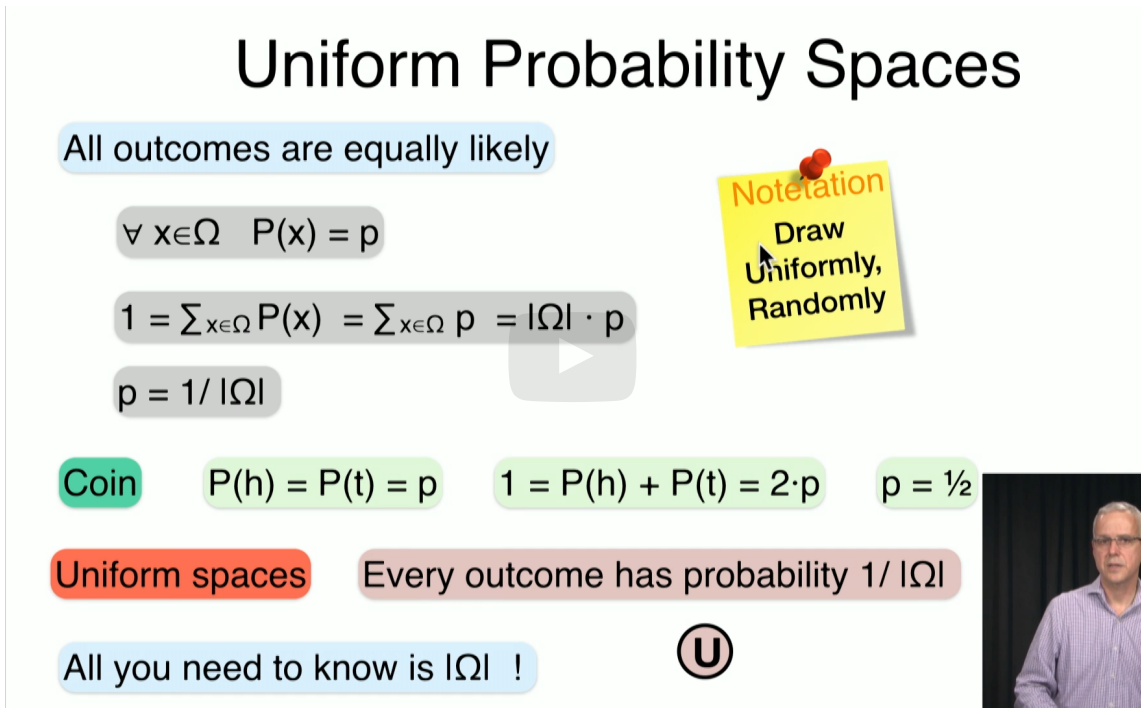

2:30 / 8:34 1.0x

We'll say that we'll flip a coin,

or toss a coin, and the results are equally likely.

In other words, the space is uniform.

That means the probability of heads

is equal to the probability of tails.

As we saw in the previous slide,

that means that each of them has a probability

which is one over the size of the sample space,

or one over two.

If we take a fair die,

the possible outcomes are one up to six.

The size of the sample space is six.

Therefore, if you roll the die,

if we assume the die's fair,

the faces are equally likely

5.2_Probability_Distribution_Types

POLL

An outcome in a uniform probability space has probability 1/10, what is the size of the sample space?

RESULTS

5	0%
10	100%
20	0%
None of the above	0%

Submit

Results gathered from 26 respondents.

FEEDBACK

The answer is 10.

1 (Graded)

1/1 point (graded)

Which of the following sample spaces are uniform?

- [ ] {land,sea} for a randomly point on a globe
- [x] {odd, even} for a random integer from {1,2,. . . ,100}
- [ ] {leap year, non-leap year} for a random year before 2019
- [ ] {two heads, two tails, one head and one tail} when flipping two fair coins

- [ ] {two heads, two tails, one head and one tail} when flipping two fair coins
- [x] {distance to origin} for a random point in {−3, −1, 1, 3} × {−4, −2, 2, 4}

✔

Explanation

- False. About 70% of the times will be "sea".
- True. Half the time we'll observe even, and half odd.
- False. "non-leap year" is roughly three times more likely.
- False. "one head and one tail" is more likely.
- True. There are four distances, and each shared by 4 of the 16 points.

? **Hint (1 of 1):** The last part, observe that the 16 points are at four different distanes from the origin. The question asks whether these four distances are equally likely.

Next Hint

Submit You have used 3 of 3 attempts

Answers are displayed within the problem

2 (Graded)

1/1 point (graded)

Given an uniform probability space $\Omega = \{1, 2, 3, \cdots, 100\}$, what is the probability that the outcome contains the digit 1 (e.g. $19, 91$)?

20/100 ✔ **Answer:** 1/5

$\frac{20}{100}$

Explanation

There are 20 of them. Note that 11 should not be counted twice.

Submit You have used 2 of 4 attempts

Answers are displayed within the problem

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Video

UCSDSE212017-V020700

10:27 / 15:54 1.0x HD

the size of the space.

And the question is whether we can have a simple formula

for the probability of an event.

And the answer is yes, because the probability of an event

in an equiprobable space is, as we saw,

is just the summation of all element probabilities,

all elements in E, in the event.

And because we are talking about a uniform space,

then each probability, the probability of every element

is one over omega, so we are summing over all

5.3_Probability_Events

POLL

What is the probability of drawing a Red Ace from a standard deck of cards?

RESULTS

1/52	**31%**
2/52	**65%**
4/52	**4%**

- None of the above 0%

Submit

Results gathered from 26 respondents.

FEEDBACK

Both "heart ace" and "diamond ace" are "red ace". Since the sample space is uniform, the answer is 2/52.

1

0 points possible (ungraded)

Which of the following holds for every event A?

- [x] $P(A) \geq 0$ ✔
- [ ] $P(A) \leq 1$ ✔
- [x] $P(A) + P(A^c) = 1$ ✔
- [ ] $P(A) = P(A^c)$
- [x] $A = \emptyset \quad \Rightarrow \quad P(A) = 0$ ✔
- [ ] $P(A) = 0 \quad \Rightarrow \quad A = \emptyset$

✖

Explanation

- True. $0 \leq P(A) \leq 1$.
- True. Same as above.
- True.

- False.
- True. Note that $A \cap \emptyset = \emptyset, A \cup \emptyset = \emptyset$ for any A.
$P(A) = P(A \cup \emptyset) = P(A) + P(\emptyset)$, hence $P(\emptyset) = 0$.
- False. Suppose a uniform sample space Ω has infinite number of elements. Then for some events A with finite size (i.e. $|A| is finite$), $P(A) = \frac{|A|}{|\Omega|}$.

Submit You have used 3 of 3 attempts

Answers are displayed within the problem

2

0 points possible (ungraded)
Which of the following always hold for events A and B?

- [x] $A \subseteq B \quad \Rightarrow \quad P(A) \leq P(B)$
- [ ] $P(A) \leq P(B) \quad \Rightarrow \quad A \subseteq B$

Explanation
- True.
- False. Let A be the event of getting a head from a tossed coin, and B be the event of getting a tail. $P(A) = P(B) = \frac{1}{2}$, but $A \not\subseteq B$.

Submit You have used 1 of 3 attempts

Answers are displayed within the problem

3 (Graded)

1/1 point (graded)
Which of the following implies $P(S - T) = P(S) - P(T)$ for events S and T?

- [x] $T \subseteq S$
- [x] $T \subset S$
- [x] $S = T$
- [ ] $S \subseteq T$

Explanation

Note that $P(S-T) = P(S \cup T) - P(T)$.
When $T \subseteq S$, $T \subset S$, and $S = T$, we have $S \cup T = S$, hence $P(S-T) = P(S) - P(T)$.
When $S \subseteq T$, we have $S \cup T = T$, hence $P(S-T) = 0$.

Submit

You have used 3 of 3 attempts

Answers are displayed within the problem

4

0 points possible (ungraded)

50% of UCSD students play soccer, 40% play basketball, and 30% play both. What is the probability that a random UCSD student does not play any of the two games.

- ( ) 0
- ( ) 0.1
- (•) 0.4
- ( ) 0.6

Explanation

Let A be the event that a student play soccer, B be the event that a student play basketball. Then $A \cap B$ is the event that a student play both. We already know $P(A) = 0.5, P(B) = 0.4, P(A \cap B) = 0.3$, hence $P(A \cup B) = P(A) + P(B) - P(A \cap B) = 0.6$. The probability that a random UCSD student does not play any of the two games is $1 - P(A \cup B) = 0.4$.

Submit You have used 1 of 2 attempts

Answers are displayed within the problem

5

0 points possible (ungraded)

Which of the following are events in the sample space $\Omega = \{1, 2, 3, 4, 5\}$?

- [x] $\{1, 2, 3\}$
- [x] $\emptyset$
- [x] Ω
- [x] $\{1\}$
- [ ] $\{0, 3, 4\}$

Explanation

- True.
- True.
- True.
- True.
- False. $\{0, 3, 4\}$ is not a subset of Ω.

Submit

Submit You have used 1 of 3 attempts

Answers are displayed within the problem

6

0 points possible (ungraded)

For the uniform space $\{1, 2, \ldots, 10\}$, find:

- $P(\{\text{primes}\})$,

4/10

Answer: 0.4

$\frac{4}{10}$

Explanation

$\{\text{primes}\} = \{2, 3, 5, 7\}$. Its probaility is $P(\{\text{primes}\}) = \frac{|\text{primes}|}{|\Omega|} = 2/5$.

- $P(\{\text{multiples of } 3\})$.

3/10

Answer: 0.3

$\frac{3}{10}$

Explanation

$\{\text{primes}\} = \{3, 6, 9\}$. Its probaility is $P(\{\text{multiples of } 3\}) = \frac{|\text{multiples of } 3|}{|\Omega|} = 3/10$.

Submit You have used 2 of 3 attempts

Answers are displayed within the problem

7

0 points possible (ungraded)

A bag contains 5 red and 3 blue balls.

- Pick one ball at random and observe its random color. What is the size of the color sample space.

8

✖ **Answer:** 2

8

Explanation
The sample space is $\{\text{Red}, \text{Blue}\}$.

- What is $P(\text{blue})$?

3/8

✔ **Answer:** 0.375

$\frac{3}{8}$

Explanation
$\frac{|\{\text{blue}\}|}{\Omega} = \frac{3}{8} = 0.375$.

- Two balls added to the bag and now $P(\text{blue}) = 0.4$. How many of the two balls are blue?

1

✔ **Answer:** 1

1

Explanation
If a blues balls are added, $P(\text{blue}) = \frac{3+a}{8+2} = 0.4$. Hence $a = 1$.

- Two balls are removed from the original bag and now $P(\text{blue}) = 0.5$. How many of the two balls were blue?

0

✔ **Answer:** 0

0

Explanation
If a blues balls are removed, $\frac{3-a}{8-2} = 0.5$. Hence $a = 0$.

Submit You have used 4 of 4 attempts

Answers are displayed within the problem

8

0 points possible (ungraded)

Six balls are numbered 1, 2, 3, 4, 5, and 6. What is the chance that the numbers on three balls, picked simultaneously and randomly, will sum to a multiple of 3?

- 1/3
- 1/4
- 2/5 ✔
- 4/15 ✖

Explanation

The number of ways to pick 3 balls is $\binom{6}{3} = 20$. 8 of them have their sum as a multiple of 3.

Submit You have used 2 of 2 attempts

Answers are displayed within the problem

9 (Graded)

9/9 points (graded)

A standard poker deck has 52 cards, of 13 ranks $\{A, 2, \ldots, 10, J, Q, K\}$ and 4 suits $\{diamonds, clubs, hearts, spades\}$. What is the probability that a hand of five cards contains:

- a queen of hearts,

0.0962

✔ **Answer:** 5/52

0.0962

Explanation

The probability that there's no queen of hearts is $\binom{51}{5}/\binom{52}{5} = 47/52$. Thus the probability that there's a queen of hearts is $1 - 47/52 = 5/52$.

- at least one queen,

0.3412

✔ **Answer:** 0.3412

0.3412

Explanation

Similar to above, probability that there's no queen is $\binom{48}{5}/\binom{52}{5} = 0.65884$. Thus the probability that there's a queen is $1 - 0.65884 = 0.34115$.

- at least one heart?

0.7785

✔ **Answer:** 0.7785

0.7785

Explanation

Following the same principle, probability that there's a hearts is $1 - \binom{39}{5}/\binom{52}{5} = 0.7785$.

Submit

You have used 1 of 4 attempts

Answers are displayed within the problem

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Repeated Experiments

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Part 1

times the same thing minus one,

because you cannot select the same element twice.

Okay and this concludes part one

and what we want to do next is talk about part two,

which is what happens when the order matters

or does not matter.

See you then.

End of transcript. Skip to the start.

Part 2

So there's no issue in that, and everything else

also the same probability.

So what are we going to do next time?

We're going to start applying what we

have been learning to games of chess.

See you then.

End of transcript. Skip to the start.

5.4a_Probability_Repeated_Experiments

5.4b_Probability_Repeated_Experiments

POLL

Which of the following are independent repetitive experiments?

RESULTS

card draws with replacement	**74%**
card draws without replacement	**13%**

card draws without replacement 13%

neither 13%

Submit

Results gathered from 23 respondents.

FEEDBACK
Card draws with replacement will be independent repetitive experiments.

1

0 points possible (ungraded)
You have two fair coins. If you flip a head with the first coin, what is the probability of flipping a head with the second?

- 1
- 0
- $\frac{1}{2}$
- $\frac{1}{4}$

Explanation
Flipping the first and the second coin are independent.

Submit You have used 1 of 2 attempts

Answers are displayed within the problem

2 (Graded)

1/1 point (graded)
A bag has 3 red and 3 green apples. You start by randomly selecting one red apple from the bag. Which of the following has the highest probability?

- Select another red apple after replacing the first.
- Select another red apple without replacing the first.
- Select a green apple after replacing the first red apple.
- Select a green apple without replacing the first red apple.

Explanation
- After replacement, there are 3 green and 3 red apples. The probability to select a red one is $\frac{1}{2}$.
- Withtout replacement, there are 3 green and 2 red apples. The probability to select a red one is $\frac{2}{5}$.
- After replacement, there are 3 green and 3 red apples. The probability to select a red one is $\frac{1}{2}$.
- Without replacement, there are 3 green and 2 red apples. The probability to select a red one is $\frac{3}{5}$.

Submit You have used 2 of 2 attempts

Answers are displayed within the problem

3

0 points possible (ungraded)

Roll two fair and distinguishable six-sided dice. What is the probability that the outcome of the second die is strictly greater than the the first?

5/12

Answer: 5/12

$\frac{5}{12}$

Explanation

The outcomes that give rise to this event are $(1,2),(1,3),\ldots,(1,6)$, $(2,3),(2,4),\ldots,(2,6)$, $(3,4),\ldots,(3,6)$, $(4,5),(4,6),(5,6)$, where in each ordered pair, the numbers correspond to the first and second die respectively. It can be easily verified that there are 15 such outcomes, each of probability $1/36$, thus $15 \times 1/36 = 5/12$.

Submit You have used 1 of 4 attempts

Answers are displayed within the problem

4 (Graded)

3/3 points (graded)

5 Engineers and 3 artists align at random along line. What is the probability that the first and last are Engineers?

- 3/14
- 8/16
- 9/14
- 5/14

Explanation

The 5 engineers and 3 artists can line up in $\binom{8}{3}$ ways, each corresponding to one choice of the the 3 artist locations out of the total 8. Note that all these arrangments are equaly likely, hence this space is uniform.

If the first and last are engineers, then there are 6 locations left, and the number of ways to coose the locations of the artists is $\binom{6}{3}$.

Hence the probability that the first and last are engineers is

$$\frac{\binom{6}{3}}{\binom{8}{3}} = \frac{6\cdot5\cdot4}{8\cdot7\cdot6} = \frac{5}{14}.$$

In the sequential probability section we will see an easier way to find the answer.

Submit You have used 1 of 2 attempts

Answers are displayed within the problem

5

0 points possible (ungraded)

Which of the following are distributed uniformly when rolling two fair dice?

- [x] The outcome (number) of the first die, e.g., "4", or "6",
- [x] The ordered pair of outcomes, e.g., $(1,3)$, $(3,1)$, or $(6,6)$,
- [ ] The unordered pair of outcomes, e.g., $\{1,3\}$ or $\{6,6\}$,
- [ ] the difference between the first and second outcomes, e.g. $(1,3) \to -2$,
- [ ] the difference between the first and second outcomes mod 6, e.g. $(1,3) \to (-2)_6 = 4$,
- [ ] The absolute value of difference$(1,3) \to |1-3| = 2$,
- [x] The lower of the two outcomes, e.g. $(1,3) \to 1$,
- [x] the sum of the two outcomes, e.g. $(1,3) \to 4$.

✖

Explanation

- True.
- True.
- False. $P(\{1,3\}) = \frac{2}{36} \neq P(\{6,6\}) = \frac{1}{36}$.
- False. $P(\text{difference is } 0) = \frac{6}{36} \neq P(\text{difference is } 1) = \frac{5}{36}$.
- True.
- False. $P(\text{absolute difference is } 0) = \frac{6}{36} \neq P(\text{absolute difference is } 1) = \frac{10}{36}$.
- False. $P(\text{minimum is } 1) = \frac{11}{36} \neq P(\text{minimum is } 2) = \frac{9}{36}$.
- False. $P(\text{sum is } 2) = \frac{1}{36} \neq P(\text{sum is } 3) = \frac{2}{36}$.

Submit You have used 3 of 3 attempts

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Games of Chance

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Video

So to summarize, we talked about the basics of roulette.

We calculated some simple probabilities.

We saw how much you expect to win

if you play a lot of times.

And what are we going to do next?

We're going to talk about dominoes.

See you then.

End of transcript. Skip to the start.

5.5_Games_of_Chance_Roulette

Unless otherwise stated, in this and subsequent sections, a *die* refers to a fair six-sided die, and a *deck of cards* refers to a standard 52-card deck with four suits (Clubs, Diamonds, Hearts, and Spades) and thirteen ranks (2,..., 10, jack, Queen, King, and Ace).

POLL

What is the probability that two cards drawn from a standard deck without replacement have the same rank?

RESULTS

1/13	**5%**
1/17	**49%**
2/52	**14%**
None of the above	**32%**

Submit

Results gathered from 37 respondents.

FEEDBACK

There are 13 different ranks.

The number of ways to two cards from a specific rank is (4 choose 2).

Hence the probability is 13 * (4 choose 2) / (52 choose 2) = 3 / 51 = 1/17

1

0 points possible (ungraded)

What is the probability that a random four-card hand consists of a single suit?

What is the probability that a random four-card hand consists of a single suit?

- ○ $\frac{4}{52}$
- ○ $\frac{13}{52}$
- ○ $\binom{13}{4}/\binom{52}{4}$
- ◉ $\binom{4}{1}\cdot\binom{13}{4}/\binom{52}{4}$

✔

Explanation

There are $\binom{4}{1}$ ways to choose the suit (e.g. hearts) and $\binom{13}{4}$ ways to draw 4 cards from this suit.
Yet the total number of ways to draw 4 cards is $\binom{52}{4}$.
Hence, the probability is $4\binom{13}{4}/\binom{52}{4}$.

Submit You have used 1 of 2 attempts

Answers are displayed within the problem

2

0 points possible (ungraded)

Find the probability that a five-card hand contains:

- the ace of diamonds,

0.0962 ✔ **Answer:** 0.09615

0.0962

Explanation

The number of hands containing the ace of diamonds is $\binom{51}{4}$, corresponding to the choice of the remaining 4 cards from the other 51. Hence the probability is $\binom{51}{4}/\binom{52}{5} = 5/52$.

- at least an ace,

0.34 ✔ **Answer:** 0.3412

0.34

Explanation

The number of ways to draw 5 cards without any ace is $\binom{48}{5}$. By the complement rule, the answer is $1 - \binom{48}{5}/\binom{52}{5} = 0.3412$.

- at least a diamond.

0.77 ✔ **Answer:** 0.7785

0.77

Explanation

The number of ways to draw 5 cards without any diamond is $\binom{39}{5}$. $1 - \binom{39}{5}/\binom{52}{5} = 0.7785$.

Submit You have used 1 of 4 attempts

Answers are displayed within the problem

3

0 points possible (ungraded)

Five cards are dealt from a poker deck. What is the probability of:

- three-of-a-kind (three cards of one rank and two cards of two other ranks),

0.0211

Answer: 0.0211

0.0211

Explanation

We deal with the 3 cards of the same rank first, and then the 2 remaining cards with different ranks.
The are 13 ranks. The number of ways to get 3 cards of a particular rank, (e.g. ace) is $\binom{4}{3} = 4$. In total the number of ways to get 3 cards of the same rank is $13 \cdot 4$.
The remaining 2 cards cannot have the same rank as the one we choose the first step, so there are 12 cards left. Since 4 suits can be chosen for each card, the number of ways in total is $\binom{12}{2} \cdot 4^2$.
The answer is $13 \cdot 4 \cdot \binom{12}{2} \cdot 4^2 / \binom{52}{5} = 0.0211$.

- two pairs (two pairs of same-rank cards),

0.0475

Answer: 0.0475

0.0475

Explanation

We first deal with the rank of the 2 pairs, and then the one left over.
There are $\binom{13}{2}$ ways to choose 2 ranks out of 13. The number of ways get 2 cards of a probaility of a particular rank, (e.g. ace), is $\binom{4}{2}$. We do the same for both the pair, so the total number of ways is $\binom{13}{2} \cdot \binom{4}{2}^2$,
For the one left over, there are 11 ranks left that can be chosen, and 4 suit can be chosen for each rank. The number of ways is $11 \cdot 4$.
The answer is $\binom{13}{2} \cdot \binom{4}{2}^2 \cdot 11 \cdot 4 / \binom{52}{5} = 0.0475$.

- one pair (a pair of same-rank cards, and the other three cards of three different ranks).

0.4226

Answer: 0.4226

0.4226

Explanation

We first deal with the rank of the pair, and then the three left over.
There are $\binom{13}{1} = 13$ ways to choose a ranks out of 13. The number of ways get 2 cards of a probaility of a particular rank, (e.g. ace), is $\binom{4}{2}$. The total number of ways is $13 \cdot \binom{4}{2}$,
For the one left over, there are 12 ranks left that can be chosen, and 4 suit can be chosen for each rank. The number of ways is $\binom{12}{3} \cdot 4^3$.
The answer is $13 \cdot \binom{4}{2} \cdot \binom{12}{3} \cdot 4^3 / \binom{52}{5} = 0.4226$.

Submit You have used 1 of 4 attempts

Answers are displayed within the problem

4

0 points possible (ungraded)

A 52-card deck is randomly split into four 13-card hands. Find the probability that:

- each hand has an ace,

0.1

✔ **Answer:** 0.1055

0.1

Explanation

There are $4!$ ways to assign 4 aces to 4 hands. There are $\binom{48}{12,12,12,12}$ ways to assign the remaining 48 cards equally to 4 hands (12 for each). The answer is $4!\binom{48}{12,12,12,12}/\binom{52}{13,13,13,13} = 0.1055$.

- one hand has all four aces.

0.003

✖ **Answer:** 0.0106

0.003

Explanation

There are 4 ways to assign all 4 aces to one hand. There are $\binom{48}{9,13,13,13}$ ways to assign the remaining 48 cards to 4 hands (9 for the one which gets 4 aces, and 13 for the others). The answer is $4\binom{48}{9,13,13,13}/\binom{52}{13,13,13,13} = 0.0106$.

Submit You have used 4 of 4 attempts

Answers are displayed within the problem

5 (Graded)

6/6 points (graded)

Assume that in blackjack, an ace is always worth 11, all face cards (Jack, Queen, King) are worth 10, and all number cards are woth the number they show. Given a shuffled deck of 52 cards:

- What is the probability that you draw 2 cards and they sum 21?

0.0483

✔ **Answer:** 0.0483

0.0483

Explanation

The possible combinations that sum to 21 are (A, 10), (A, J), (A, Q), (A, K). The number of them is $16 \cdot 4$. The answer is $16 \cdot 4/\binom{52}{2} = 0.0483$.

- What is the probability that you draw 2 cards and they sum 10?

0.0407

✔ **Answer:** 0.0407

0.0407

Explanation

The possible combinations that sum to 10 are (2, 8), (3, 7), (4, 6), (5, 5). The number of them is $3 \cdot 4^2 + \binom{4}{2}$. The answer is $\left(3 \cdot 4 \cdot 4 + \binom{4}{2}\right)/\binom{52}{2} = 0.0407$.

- Suppose you have drawn two cards: 10 of clubs and 4 of hearts. You now draw a third card from the remaining 50. What is the probability that the sum of all three cards is strictly larger than 21?

0.54

✔ **Answer:** 0.54

0.54

Explanation
To exceed 21, the third card belongs to { A, 8, 9, 10, J, Q, K }. As one 10 was drawn, $4 \cdot 7 - 1 = 27$ choices are left. The answer is $27/50 = 0.54$.

Submit You have used 1 of 4 attempts

Answers are displayed within the problem

6

0 points possible (ungraded)
Three dice are rolled. What is the probability that the three outcomes

- contain at least a `1', e.g., 5,1,2,

- are all distinct, e.g., 3,2,5,

- in the order rolled, form an increasing consecutive sequence, e.g., 2,3,4.

- can be arranged to form a consecutive sequence, e.g., 3,2,4 that can form 2,3,4?

Submit You have used 0 of 4 attempts

7 (Graded)

4/4 points (graded)
An instructor assigns 10 problems and says that the final exam will consist of a random selection of 5 of them. If a student knows how to solve 7 of the problems, what is the probability that he or she will answer correctly

- all 5 problems,

0.0833 **Answer:** 0.083333

0.0833

Explanation
The student answers all 5 correctly in the event that all 5 questions appear from the 7 questions that he/show knows to solve. Thus the probability is $\binom{7}{5}/\binom{10}{5} = 0.083333$.

- at least 4 problems?

0.5 **Answer:** 0.50

0.5

Explanation

The student answers at least 4 correctly at least 4 questions appear from the 7 questions that he/show knows to solve. Thus the probability is $\binom{7}{4} \times \binom{3}{1} / \binom{10}{5} + \binom{7}{5} / \binom{10}{5} = 0.50$.

Submit You have used 1 of 4 attempts

Answers are displayed within the problem

8

0 points possible (ungraded)

Let X be the number of draws from a deck, without replacement, till an ace is observed. For example for draws Q, 2, A, $X = 3$. Find:

- $P(X = 10)$,

- $P(X = 50)$,

- $P(X < 10)$?

Submit You have used 0 of 4 attempts

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Axioms

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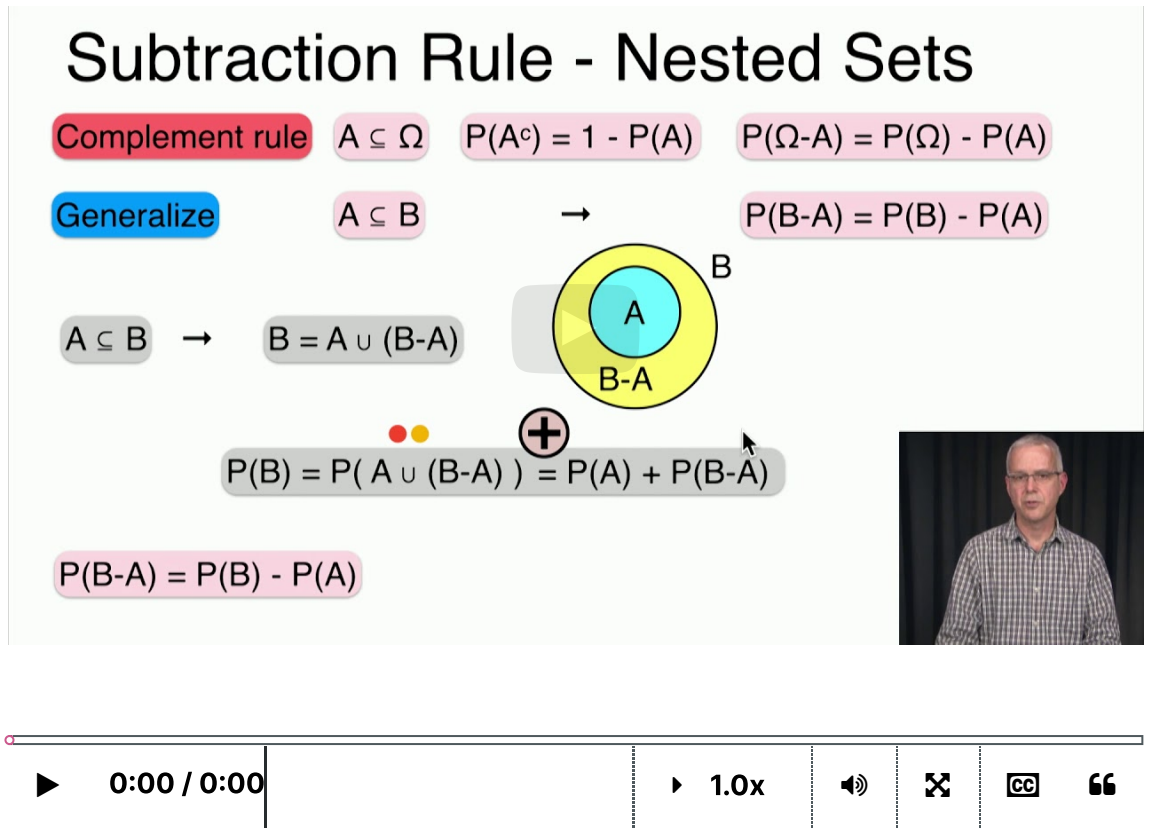
Axioms



Start of transcript. Skip to the end.

Hello and welcome back.

So we have talked about different properties of probability

and now we would like to start in some sense afresh

by defining a set of axioms

and showing that we can prove many of the results,

that we have observed before.

So we'll have only three axioms

5.6_Probability_Axioms

POLL

Does P(A)=0 imply that A is the empty set?

RESULTS

Yes	**26%**
Not necessarily	**74%**

Submit

Results gathered from 38 respondents.

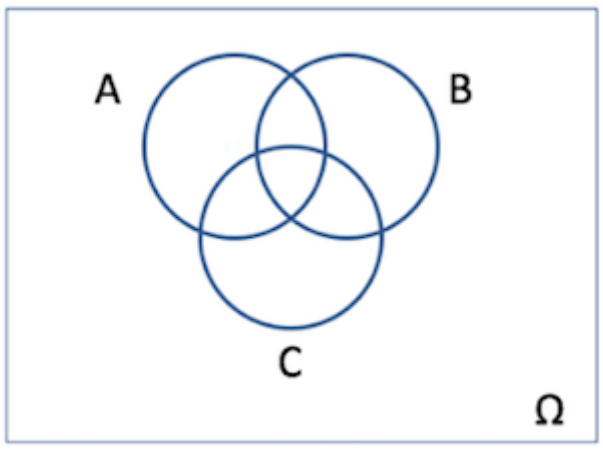
FEEDBACK

It is possible that P(A)=0 for a non-empty set A.

1

0 points possible (ungraded)

For any three events A, B, and C, we have $P(B) =$



- [ ] $P(A \cap B) + P(B \cap C) + P(B \cap A^c \cap C^c)$
- [x] $P(A \cap B) + P(B \cap C) - P(A \cap B \cap C) + P(B \cap A^c \cap C^c)$
- [ ] $P(A^c \cap C^c) + P(A \cap B) + P(B \cap C)$
- [ ] $P(\Omega) - P(A) - P(C) + P(A \cap B \cap C)$

✔

Answer
Correct: Video: Total Probability

Explanation

- False. It is $P(B) + P(A \cap B \cap C)$.

- True.

- False. This includes the events outside of the three circles.

- False. Same as above.

Submit You have used 2 of 2 attempts

Answers are displayed within the problem

2 (Graded)

1/1 point (graded)
Under which of the following probability assignments does $S = \{a_1, a_2, a_3\}$ become a probability space?

- [ ] $P(a_1) = 0.2,\ P(a_2) = 0.3,\ P(a_3) = 0.4$
- [x] $P(a_1) = 0.2,\ P(a_2) = 0.3,\ P(a_3) = 0.5$
- [ ] $P(a_1) = 0.3,\ P(a_2) = -0.2,\ P(a_3) = 0.9$
- [x] $P(a_1) = 0.2,\ P(a_2) = 0,\ P(a_3) = 0.8$

✔

Explanation
Two necessary conditions:
1. The probability P of the events satisfies $0 \leq P \leq 1$.
2. All Ps sum up to 1.

Submit You have used 1 of 3 attempts

Answers are displayed within the problem

3

0 points possible (ungraded)
Which of the following **always** holds?

- [ ] $A \subset B \quad \Rightarrow \quad P(A) < P(B)$

- [ ] $A \subseteq B \quad \Rightarrow \quad P(A) \leq P(B)$,

- [ ] $A \subset B \quad \Rightarrow \quad P(A) < P(B)$,

- [x] $A \subset B \quad \Rightarrow \quad P(A) \leq P(B)$.

Explanation

The only tricky part may be the third. Note that because elements may have 0 probabilities, non-empty events may also have zero probability. Hence A may be a strict subset of B and yet have the same probability. For example, if the sample space is $\{a, b\}$ and $P(a) = 1$ while $P(b) = 0$, then $P(\{a\}) = P(\{a, b\})$.

Submit You have used 3 of 3 attempts

Answers are displayed within the problem

4

0 points possible (ungraded)

Which of the following statements are true?

- [ ] If $P(E) = 0$ for event E, then $E = \emptyset$.

- [x] If $E = \emptyset$, then $P(E) = 0$.

- [ ] If $E_1 \cup E_2 = \Omega$, then $P(E_1) + P(E_2) = 1$.

- [x] If $P(E_1) + P(E_2) = 1$, then $E_1 \cup E_2 = \Omega$.

- [ ] If $E_1 \uplus E_2 = \Omega$, then $P(E_1) + P(E_2) = 1$.

- [x] If $P(E_1) + P(E_2) = 1$, then $E_1 \uplus E_2 = \Omega$.

Explanation

- False. E is not necessary to be $\emptyset$.
- True.
- False. Let $\Omega = \{1, 2, 3\}, E_1 = \{1, 2\}, E_2 = \{2, 3\}$. $E_1 \cup E_2 = \Omega$, but $P(E_1) + P(E_2) = \frac{4}{3}$.
- False. Let $\Omega = \{1, 2, 3\}, E_1 = \{1, 2\}, E_2 = \{1\}$. $P(E_1) + P(E_2) = 1$, but $E_1 \cup E_2 \neq \Omega$.
- True.
- False. Same as option 4.

? **Hint (1 of 1):** Recall that $A \uplus B$ means $A \cup B$ when A and B are disjoint. Next Hint

Submit You have used 3 of 3 attempts

Answers are displayed within the problem

Answers are displayed within the problem

5 (Graded)

7/7 points (graded)

Suppose A, B are events that $P(A) = 0.65$, $P(B) = 0.5$ and $P(A \cap B) = 0.25$. What are the following probabilities?

- $P(A^c)$

0.35

✔ **Answer:** 0.35

0.35

Explanation

$P(A^c) = 1 - P(A) = 0.35$.

- $P(B^c)$

0.5

✔ **Answer:** 0.5

0.5

Explanation

$P(B^c) = 1 - P(B) = 0.5$.

- $P(A \cup B)$

0.9

✔ **Answer:** 0.9

0.9

Explanation

$P(A \cup B) = P(A) + P(B) - P(A \cap B) = 0.9$.

- $P(A - B)$

0.65-0.25

✔ **Answer:** 0.4

$0.65 - 0.25$

Explanation

$P(A - B) = P(A \cup B) - P(B) = 0.4$.

- $P(B - A)$

0.5-0.25

✔ **Answer:** 0.25

$0.5 - 0.25$

Explanation

$P(B - A) = P(A \cup B) - P(A) = 0.25$.

- $P(A \Delta B)$

0.65

✔ **Answer:** 0.65

0.65

Explanation

$P(A \Delta B) = P(A \cup B) - P(A \cap B) = 0.65$.

- $P((A \cup B)^c)$

0.1

✔ **Answer:** 0.1

0.1

Explanation

$P((A \cup B)^c) = 1 - P(A \cup B) = 0.1.$

Submit You have used 4 of 4 attempts

Answers are displayed within the problem

6

0 points possible (ungraded)

Let P be a probability function on $S = \{a_1, a_2, a_3\}$. Find $P(a_1)$ if:

- $P(\{a_2, a_3\}) = 3P(a_1)$

- $P(a_1) = 2P(a_2) = 3P(a_3)$

Submit You have used 0 of 4 attempts

7

0 points possible (ungraded)

Let X be distributed over $\Omega = \{1, 2, \ldots, 100\}$ with $P(X = i) = \frac{i}{k}$ for some integer k. Find:

- k

- $|E|$ where $E = \{x | x \in \Omega, x \text{ is multiples of } 3\}$,

- $P(E)$.

Submit You have used 0 of 4 attempts

8

0 points possible (ungraded)

Consider a die where the probability of rolling $1, 2, 3, 4, 5$ and 6 are in the ratio $1:2:3:4:5:6$. What is the probability that when this die is rolled twice, the sum is 7?

Submit You have used 0 of 4 attempts

9

0 points possible (ungraded)

Jack solves a Math problem with probability 0.4, and Rose solves it with probability 0.5. What is probability that at least one of them can solve the problem?

- 0.7
- 0.9
- 0.6
- Not enough information ✔

✖

Explanation

Let A be the event that Jack solves the problem, B be the event that Rose solves the problem.
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$, but $P(A \cap B)$ is missed here.

Submit You have used 2 of 2 attempts

Answers are displayed within the problem

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Video

18:07 / 18:07 1.0x

is bigger than or equal to the probability of its subset,

but as we saw, sometimes we don't quite grasp it that way,

okay, and what are we going to do next time?

We'll discuss conditional probability.

See you then.

End of transcript. Skip to the start.

5.7_Probability_Inequalities

POLL

Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations. Which is more probable?

RESULTS

Linda is a bank teller	**74%**
Linda is a bank teller and is active in the feminist movement	**26%**

Submit

Results gathered from 39 respondents.

FEEDBACK

It is more probable that Linda is a bank teller than Linda is both a bank teller and an activist.

---

1 (Graded)

2/2 points (graded)

Which of the following holds for all events A and B

a. in any probability space:

- [x] $A \supseteq B \quad \longrightarrow \quad P(A) \geq P(B)$
- [ ] $P(A) \geq P(B) \quad \longrightarrow \quad A \supseteq B$
- [ ] $|A| \geq |B| \quad \longrightarrow \quad P(A) \geq P(B)$
- [ ] $P(A) \geq P(B) \quad \longrightarrow \quad |A| \geq |B|$

✔

Explanation

1. $A \supseteq B \quad \longrightarrow \quad P(A) = P(B) + P(A \setminus B) \geq P(B)$.
2. A and B can be nonempty and disjoint with $P(A) \geq P(B)$, then A does not contain B.
3. B can be a singleton with higher probability than a set A with two elements.
4. Similar counter-example to 3.

b. in any **uniform** probability space:

- [x] $A \supseteq B \quad \longrightarrow \quad P(A) \geq P(B)$

- [ ] $P(A) \geq P(B) \quad \longrightarrow \quad A \supseteq B$
- [x] $|A| \geq |B| \quad \longrightarrow \quad P(A) \geq P(B)$
- [x] $P(A) \geq P(B) \quad \longrightarrow \quad |A| \geq |B|$

✔

Explanation

1. Follows from the result for general spaces.
2. Similar counter-example to part a.
3. I uniform sample spaces S, for any event E, $P(E) = |E|/|S|$, hence $|A| \geq |B| \quad \longrightarrow \quad P(A) \geq P(B)$.
4. Again, follows since for any event E, $P(E) = |E|/|S|$.

Submit You have used 2 of 4 attempts

Answers are displayed within the problem

2 (Graded)

2/2 points (graded)

Let Ω be any sample space, and A, B are subsets of Ω. Which of the following statements are always true?

- [ ] If $|A| + |B| \geq |\Omega|$, then $P(A \cup B) = 1$
- [ ] If $|A| + |B| \geq |\Omega|$, then $P(A) + P(B) \geq 1$
- [x] If $P(A) + P(B) > 1$, then $A \cap B \neq \emptyset$
- [ ] If $P(A) + P(B) > 1$, then $P(A \cup B) = 1$

✔

Explanation

Let $\Omega = \{1, 2, 3\}$, and $P(1) = P(2) = 0.1, P(3) = 0.8$.

- False. Let $A = B = \{1, 2\}$. $|A| + |B| = 4 > |\Omega|$, but $P(A \cup B) = 0.2$.
- False. Let $A = B = \{1, 2\}$. $|A| + |B| = 4 > |\Omega|$, but $P(A) + P(B) = 0.4$.
- True.
- False. Let $A = B = \{3\}$. $P(A) + P(B) = 1.6 > 1$, but $P(A \cup B) = 0.8$.

Submit You have used 2 of 4 attempts

Answers are displayed within the problem

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