Axioms

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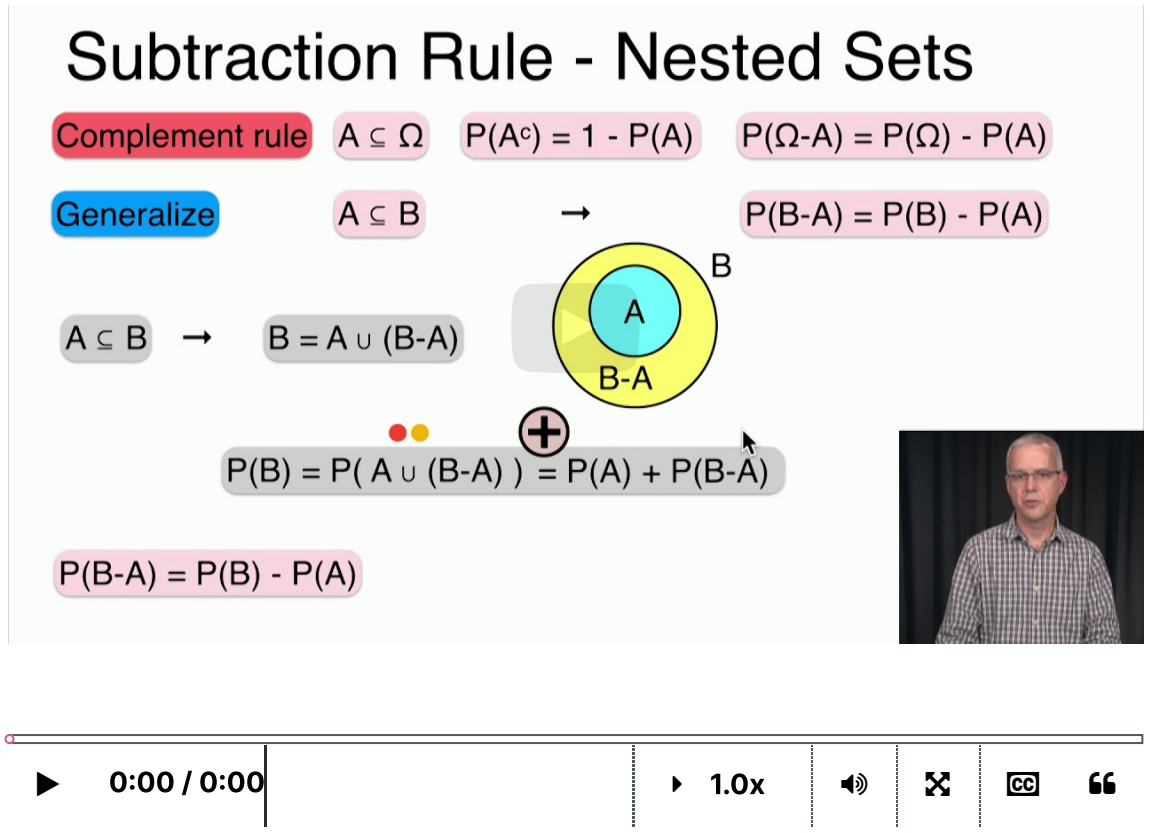
Problem Sets due Jun 1, 2022 17:13 +03 Completed

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.

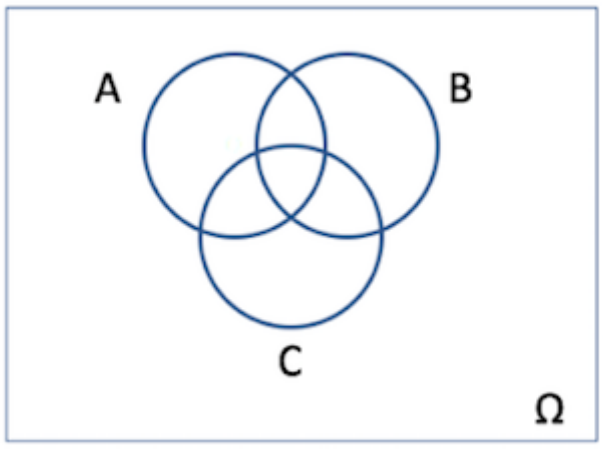
FEEDBACK

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 $P(B) =$



- $P(A \cap B) + P(B \cap C) + P(B \cap A^c \cap C^c)$
- **$P(A \cap B) + P(B \cap C) - P(A \cap B \cap C) + P(B \cap A^c \cap C^c)$**
- $P(A^c \cap C^c) + P(A \cap B) + P(B \cap C)$
- $P(\Omega) - P(A) - P(C) + P(A \cap B \cap C)$

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?

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

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

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

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

✖

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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