Inequalities

Video

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Hello and welcome back.

In the last lecture, we used the probability axioms

to prove some equalities and now we would like to use them

to prove a few inequalities

and maybe along the way, we'll see an interesting question,

so again, we're going to use the three axioms,

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 **69%**
- Linda is a bank teller and is active in the feminist movement **31%**

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Results gathered from 282 respondents.

FEEDBACK

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

1

1.0/2.0 points (graded)

Which of the following holds for all events A and B

a. in any probability space:

- [x] $A \supseteq B \quad \longrightarrow \quad P(A) \geq P(B)$ ✔
- [x] $P(A) \geq P(B) \quad \longrightarrow \quad A \supseteq B$
- [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. $A \supseteq B \quad \longrightarrow \quad P(A) = P(B) + P(A \setminus B) \geq P(B)$
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 4 of 4 attempts

Answers are displayed within the problem

2

0.0/2.0 points (graded)
Let Ω be any sample space, and A, B are subsets of Ω. Which of the following statements are always true?

- [x] If $|A| + |B| \geq |\Omega|$, then $P(A \cup B) = 1$
- [x] 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 4 of 4 attempts

Answers are displayed within the problem

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