Meeting 5

Development Economics Cohort

Aldrich Wang, Ziz Zhou

Oeconomica, University of Chicago

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Overview

1. Recap of Last Meeting
2. Probability Rules
   - The Complement Rule
   - Addition Rules (for 2 cases)
   - Partition Rule and Containment Rule
3. Conditional Probability
   - Table Example
   - Dice Example
4. R - IHDS Workbook

Overview

Recap of Last Meeting

- $A \cap B = \{\omega \in \Omega : \omega \in A \text{ and } \omega \in B\}$;
- $A \cup B = \{\omega \in \Omega : \omega \in A \text{ or } \omega \in B\}$;
- $A^c = \{\omega \in \Omega : \omega \notin A\}$;
- Multiple intersections: $\bigcap_{i \geqslant 1} A_i = A_1 \cap A_2 \cap A_3 \cap \ldots$;
- Multiple unions: $\bigcup_{i \geqslant 1} A_i = A_1 \cup A_2 \cup A_3 \cup \ldots$.

Overview

Probability Rules

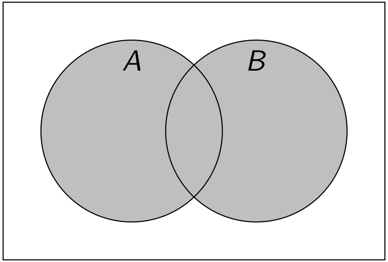
- After learning about basic probability and set theory, let's merge these two concepts;
- Let $A, B \subset \Omega$ be two events in the sample space, and we will work on them for the entire presentation.

The Complement Rule

- $\mathbf{P}(A^C) = 1 - P(A)$;
- Let's implement this rule into real practice. Imagine you are rolling a fair six-sided die, what is the probability that the number is not a 1?
- Imagine a box consisting of 60% red balls and 40% blue balls, and you are told to get three balls from the box (with replacement). What is the probability that you get at least one red ball out of three?

Addition Rules (for 2 cases)

- General Addition Rule: $\mathbf{P}(A \cup B) = \mathbf{P}(A) + \mathbf{P}(B) - \mathbf{P}(A \cap B)$;
- Addition Rule (A, B **mutually exclusive**): $\mathbf{P}(A \cup B) = \mathbf{P}(A) + \mathbf{P}(B)$, where A, B m.e. means $A \cap B = \emptyset$.



Partition Rule and Containment Rule

- Partition: $\mathbf{P}(A) = \mathbf{P}(A \cap B) + \mathbf{P}(A \cap B^C)$ - think about it: sample space $\Omega = B \cup B^C$;
- Containment: $\mathbf{P}(A) \leqslant \mathbf{P}(B)$ if $A \subseteq B$, and this rule should be very intuitive.

Overview

Conditional Probability

- Conditional probability is a measure of the probability of the occurrence an event given that another event has already occurred.
- Let $A, B \subset \Omega$ be two events, and assume that $\mathbf{P}[B] > 0$. The conditional probability of A given B, denoted by $\mathbf{P}[A|B]$, is defined as $\mathbf{P}[A|B] = \frac{\mathbf{P}[A \cap B]}{\mathbf{P}[B]}$.

Table Example

Majors (Assume everyone can only do a single major.)			
Residential Commons	Math Majors	Stats Majors	Econ Majors
Woodlawn	210	320	640
I-House	123	98	530
Campus North	234	135	601
South	345	341	452
Max P	231	134	134

- Calculate: $\mathbf{P}[Woodlawn]$, $\mathbf{P}[South|Econ]$, $\mathbf{P}[Math|North]$.

Dice Example

Let's introduce our best friends again, two fair six-sided dice. Consider the following three events:

- A = Is the sum of the two values equal to 6?
- B = Does the first die land on 1?
- C = Does the second die land on 4?

Calculate the following: $\mathbf{P}[A]$, $\mathbf{P}[A|B]$, and $\mathbf{P}[A|C]$.

Overview