Assigning Probabilities

STAT 330 - Iowa State University

Outline

In this lecture students will learn two ways to begin assigning probabilities to events using the probability axioms.

Assigning Probabilities

There are 2 main approaches to assign probabilities to events at this point.

1. When we know events are disjoint (easy!).
    - Let A be a collection of of k outcomes $(\omega_1, \ldots, \omega_k)$ that are all *pairwise disjoint*.
    - Use Kolmogorov's axiom 3: $\mathbb{P}(A) = \mathbb{P}(\cup_{i=1}^{k} \omega_i) = \sum_{i=1}^{k} \mathbb{P}(\omega_i)$.

Example 9: Roll a die. Suppose event A is rolling an even number. (Assume all numbers are equally likely $\rightarrow \mathbb{P}(\omega) = \frac{1}{6}$ for all ω)
$\Omega = \{1, 2, 3, 4, 5, 6\}$
$A = \{2, 4, 6\}$

$$\begin{aligned}\mathbb{P}(A) &= \mathbb{P}(\text{“2” or “4” or “6”}) \\ &= \mathbb{P}(\text{“2”} \cup \text{“4”} \cup \text{“6”}) \\ &= \end{aligned}$$

Assigning Probabilities cont.

2. When events may or may not be disjoint (harder).
    - Start with known probability of some of the events.
    - Use this information and Kolmogorov's axioms to deduce probabilities of other events.
    - Drawing Venn diagrams will simplify the problem

Example 10: Suppose in a small college of 1000 students, 650 students own Iphones, 400 students own MacBooks, and 300 students own both.
Define events: I = "owns Iphone", and M = "owns MacBook".

Known
$\mathbb{P}(I) = 0.65$
$\mathbb{P}(M) = 0.40$
$\mathbb{P}(I \cap M) = 0.30$

Assigning Probabilities cont.

a. What is the probability of owning an Iphone or a MacBook?

b. What is the probability of owning neither an Iphone nor a MacBook?

c. What is the probability of owning only an Iphone? (ie. owning an iphone and no MacBook)

d. What is the probability of not owning an Iphone?

Recap

Students should now be comfortable using the probability axioms to begin assigning probabilities to simple and more complex events.