Unit 2: Probability and distributions

1. Probability and conditional probability

Sta 104 - Summer 2018, Term 2

Duke University, Department of Statistical Science

Prof. White

Slides posted at *https://www2.stat.duke.edu/courses/Summer18/sta104.001-2/*

Announcements

- Lab 1 is due today 12:45 pm
- Problem set 2 is due Wednesday 11:55 pm
- Performance Assessment 2 is due Wednesday 11:55 pm
- Readiness Assessment 3 is Thursday in class
- Lab 2 is due Thursday 12:45 pm

Readiness assessment

- 15 minutes individual – Sakai. Turn on your webcams and begin.
- 10 minutes team – Sakai

1. Disjoint and independent do not mean the same thing

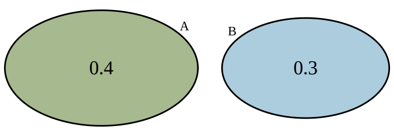
- *Disjoint (mutually exclusive) events* cannot happen at the same time
  - A voter cannot register as a Democrat and a Republican at the same time
  - But they might be a Republican and a Moderate at the same time – *non-disjoint events*
  - For disjoint A and B: $P(A \text{ and } B) = 0$
- If A and B are *independent events*, having information on A does not tell us anything about B (and vice versa)
  - If A and B are independent:
    - $P(A \mid B) = P(A)$
    - $P(A \text{ and } B) = P(A) \times P(B)$

2. Application of the addition rule depends on disjointness of events

- *General addition rule:* P(A or B) = P(A) + P(B) - P(A and B)
- A or B = either A or B or both

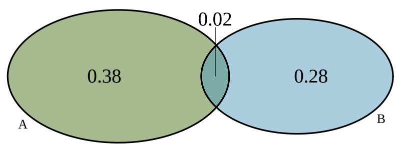
disjoint events:

P(A or B)
= P(A) + P(B) - P(A and B)
= 0.4 + 0.3 - 0 = 0.7



non-disjoint events:

P(A or B)
= P(A) + P(B) - P(A and B)
= 0.4 + 0.3 - 0.02 = 0.68



3. Bayes' theorem works for all types of events

- *Bayes' theorem:* $P(A \mid B) = \frac{P(A \text{ and } B)}{P(B)}$
- ... can be rewritten as: $P(A \text{ and } B) = P(A \mid B) \times P(B)$

disjoint events:

- We know P(A | B) = 0, since if B happened A could not have happened
- P(A and B)
  = P(A | B) × P(B)
  = *0* × P(B) = 0

independent events:

- We know P(A | B) = P(A), since knowing B doesn't tell us anything about A
- P(A and B)
  = P(A | B) × P(B)
  = *P(A)* × P(B)

Application exercise: 2.1 Probability and conditional probability

See the course website for instructions.

Summary of main ideas

1. Disjoint and independent do not mean the same thing
2. Application of the addition rule depends on disjointness of events
3. Bayes' theorem works for all types of events