

Lab 6b: Probability Rules I

Stat 131A, Fall 2018

Learning Objectives:

- Keep working with probability rules.
- Understand independent events.
- Multiplication rule: $P(A \text{ and } B) = P(A) P(B | A) = P(B) P(A | B)$
- Addition rule: $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

General Instructions

- Write your solutions in an `Rmd` (R markdown) file.
 - Name this file as `lab06b-first-last.Rmd`, where `first` and `last` are your first and last names (e.g. `lab06b-gaston-sanchez.Rmd`).
 - Knit your `Rmd` file as an html document (default option).
 - Submit your `Rmd` and `html` files to bCourses, in the corresponding lab assignment.
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Problem 1

One hundred tickets will be drawn at random with replacement from one of the two boxes shown below. On each draw, you will be paid the amount shown on the ticket, in dollars. Which box is better and why?

- i. [1 2]
- ii. [1 3]

Problem 2

A penny is tossed 5 times.

- a. Find the chance that the 1st toss is a head.
- b. Find the chance that the 5th toss is a head.
- c. Find the chance that the 5th toss is a head, given the first four are tails.

Problem 3

A fair die is rolled three times.

- Find the chance that the first roll is 1.
- Find the chance that the first roll is 1, the second roll is 2, and the third roll is 3.
- Find the chance that the second roll is 2, given that the first roll is 1.

Problem 4

In the box shown below, each ticket has two numbers.

[1,2 1,3 3,1 3,2]

For instance, on the ticket "1,2" the first number is 1 and the second is 2. A ticket is drawn at random. Find the chance that the sum of the two numbers is 4.

Problem 5

Repeat for the box

[1,2 1,3 1,3 3,2 3,3 3,3]

Problem 6

Repeat for the box

[1,2 1,3 1,3 3,1 3,2 3,3]

Problem 7

A box contains four tickets, one marked with a star *, and the other three with a plus +.

[* + + +]

Two draws are made at random with replacement from this box.

- What is the chance of getting a + ticket on the first draw?
- What is the chance of getting a + ticket on the second draw?
- What is the chance of getting a + ticket on the first draw, and a + ticket on the second draw?
- What is the chance of not getting the * in the two draws?
- What is the chance of getting the * at least once in the two draws?

Problem 8

For a class activity, your group has been assigned the task of generating a quiz question that requires use of the formula for conditional probability to compute $P(B/A)$. Your group comes up with the following question: “If $P(A \text{ and } B) = 0.40$ and $P(A) = 0.20$, what is the value of $P(B/A)$?” Is this okay?

Problem 9

You draw two cards from a standard deck of 52 cards without replacing the first one before drawing the second.

- Are the outcomes on the two cards independent? Why?
- Find $P(\text{Ace on 1st card and King on 2nd})$.
- Find $P(\text{King on 1st card and Ace on 2nd})$.
- Find the probability of drawing an Ace *and* a King in either order.
- Find $P(3 \text{ on 1st card and } 10 \text{ on 2nd})$.
- Find $P(10 \text{ on 1st card and } 3 \text{ on 2nd})$.
- Find the probability of drawing a 10 *and* a 3 in either order.

Problem 10

A number is drawn at random from a box. There is a 20% chance for it to be 10 or less. There is a 10% chance for it to be 50 or more. True or False: the chance of getting a number between 10 and 50 (exclusive) is 70%. Explain briefly.

Problem 11

The following pairs of events E and F relate to the same experiment. Tell in each case whether E and F are mutually exclusive events.

- A die is rolled. Event E is that it lands on an even number, and F is the event that it lands on an odd number.
- A die is rolled. Event E is that it lands on 3, and F is the event that it lands on an even number.
- A person is chosen. Event E is that this person was born in the United States, and F is the event that this person is a U.S. citizen.
- A man is chosen. Event E is that he is over 30 years of age, and F is the event that he has been married for over 30 years.

- e. A woman waiting in line to register her car at the department of motor vehicles is chosen. Event E is that the car is made in the United States, and F is the event that it is made in a foreign country.

Problem 12

Suppose that only about 14% of senior citizens (65 years old or older) in the US get the flu each year. However, about 24% of the people under 65 years old get the flu each year. In the general population, there are 12.5% senior citizens.

- a. What is the probability that a person selected at random from the general population is a senior citizen who will get the flu this year?
- b. What is the probability that a person selected at random from the general population is a person under age 65 who will get the flu this year?
- c. Answer parts (a) and (b) from a community that is 95% senior citizens.
- d. Answer parts (a) and (b) for a community that is 50% senior citizens.