

4.1 Probability Basics

GOALS:

1. Long term: want to predict from data with an associated confidence, or reliability, computed from probability of occurrence.
2. Find probability of equally likely outcomes.
3. Determine basics properties of probabilities.

Study 4.1, # 3, 13(9), 17(~13), 23(~19)

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4.1 Probability Basics

Sampling: all individuals equally likely to be selected

Need to understand probability of occurrence

Equally Likely Outcomes

$$\text{Probability of event} = \frac{f}{N}$$

Where f = number of ways the event can occur
and N = total number of possible outcomes

$$\text{Since } f \leq N, \quad 0 \leq \frac{f}{N} \leq 1$$

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4.1 Probability Basics

Basic Properties of Probability

1. $0 \leq p \leq 1$
2. If event can NOT happen,
 $p = 0$
3. If event MUST happen,
 $p = 1$

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4.1 Probability Basics

Given:

Governor (G)
Lt. Governor (L)
Secretary of State (S)
Attorney General (A)
Treasurer (T)

Find:

- a) List samples of size 3 w/o replacement.
- b) Prob G, A, and T obtained
- c) Prob G and T included in sample
- d) Prob G included.

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GLS _____

LSA _____

SAT

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To Find Number of Possibilities, find ${}_n C_r$

On Calculator:

1. Enter the total number of items available, in this case 5
2. Select the calculator button MATH/ PRB
#3: ${}_n C_r$
3. Enter the number of items you are selecting, in this case 3
4. Hit Enter

$$\begin{aligned}
 {}_n C_r &= {}_5 C_3 = \frac{5!}{3! 2!} \\
 &= \frac{5 \cdot 4 \cdot 3!}{3! \cdot 2} \\
 &= \frac{20}{2} = 10
 \end{aligned}$$

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Probability of event = $\frac{f}{N}$

b) $P(G\&A\&T) = \frac{f}{N} = \underline{\hspace{2cm}}$

- GLS GLA GLT
- GSA GST
- GAT

c) $P(G\&T) = \frac{f}{N} = \underline{\hspace{2cm}}$

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d) $P(G) = \frac{f}{N} = \underline{\hspace{2cm}}$

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Probability of event = $\frac{f}{N}$

b) $P(G\&A\&T) = \frac{f}{N} = \frac{1}{10}$

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c) $P(G\&T) = \frac{f}{N} = \frac{3}{10}$

c) $\frac{{}^3C_1}{{}^5C_3}$ choose 1 from remaining 3

d) $P(G) = \frac{f}{N} = \frac{6}{10}$

d) $\frac{{}^4C_2}{{}^5C_3}$ choose 2 from remaining 4

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4.1 Probability Basics

Given, in thousands:

Size	Frequency
2	34,454
3	17,525
4	15,075
5	6,863
6	2,307
7+	1,179

US family selected at random. Find:

- a) Prob has 2 persons
- b) Prob more than 3 people
- c) Prob between 1 and 3, inclusive
- d) Prob 1 or more persons

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To Find Number of Possibilities, add frequencies

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$$\text{a) } P(2) = \frac{f}{N} = \frac{\quad}{77403}$$

$$\text{b) } P(>3) = \frac{f}{N} = \frac{\quad}{77403}$$

$$\text{c) } P(1,2,\text{or}3) = \frac{f}{N} = \frac{\quad}{77403}$$

$$\text{d) } P(1 \text{ or more}) = \frac{f}{N} = \frac{\quad}{77403}$$

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$$\text{a) } P(2) = \frac{f}{N} = \frac{34454}{77403} = 0.445$$

□

$$\text{b) } P(>3) = \frac{f}{N} = \frac{15075+6863+2307+1179}{77403} = \frac{25424}{77403} = 0.328$$

$$\text{c) } P(1,2,\text{or}3) = \frac{f}{N} = \frac{34454+17525}{77403} = \frac{51979}{77403} = 0.672$$

$$\text{d) } P(1 \text{ or more}) = \frac{f}{N} = \frac{77403}{77403} = 1$$

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$${}_n C_r = \frac{n!}{r!(n-r)!}$$

$$\begin{aligned} {}_5 C_4 &= \frac{5!}{4!1!} \\ &= \frac{5 \cdot \cancel{4!}}{\cancel{4!}} = 5 \end{aligned}$$

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