# Chapter 4.3 Probability Distribution

Jim Albert and Monika Hu

Chapter 4 Discrete Distributions

# A Probability Distribution

- Suppose $X$ is a discrete random variable that only assigns probability to a discrete set of values.
- The function $f(x)$ is a probability mass function (pmf) for $X$ if the function satisfies two properties.

1. $f(x) \geq 0$ for each possible value $x$ of $X$
2. $\sum_x f(x) = 1$

- You can check that the function $f()$ in our coin-tossing example satisfies the two properties.

# Graphing a Probability Distribution.

- One graphically displays a probability distribution with a bar graph.

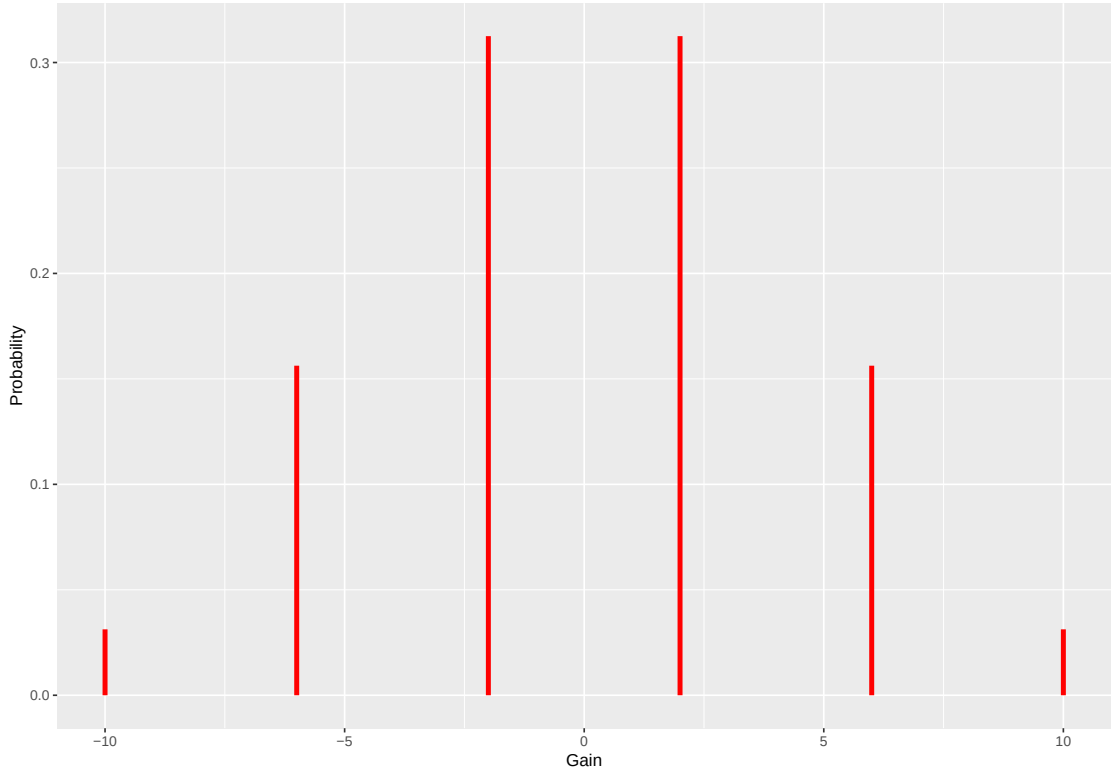


Figure 1: Probability distribution of the net gains for Peter in the Peter-Paul game.

# Comments

- This figure shows that it is most likely for Peter to finish with a net gain of $+2$ or $-2$ dollars.
- Also note the symmetry of the graph – the symmetry about the value 0 indicates that this game is fair.

# Simulating the Peter-Paul Gam

- One can simulate this game in R. A function `one_play()` is written which will play the game one time, returning the net gain for Paul.

```
one_play <- function(){
  flips <- sample(c("H", "T"),
                  size = 5,
                  replace = TRUE)
  2 * sum(flips == "H") -
      2 * sum(flips == "T")
}
```

# Playing the Game Many Times

- The `replicate()` function is used to simulate 1000 plays of the game and the net gains are stored in the vector `G`.
- The figure on the next slide constructs a bar graph of the net gains, – it resembles the graph of the probability distribution of $G$.

```
G <- replicate(1000, one_play())
bar_plot(G)
```

# Bar Graph of Net Games in Simulation