

# Chapter

## Descriptive Statistics

# Chapter Outline

- 1 Frequency Distributions and Their Graphs
- 2 More Graphs and Displays
- 3 Measures of Central Tendency
- 4 Measures of Variation
- 5 Measures of Position

# Section 1

## Frequency Distributions and Their Graphs

# Section 1 Objectives

- Construct frequency distributions
- Construct frequency histograms, frequency polygons, relative frequency histograms, and ogives

# Frequency Distribution

## Frequency Distribution

- A table that shows **classes** or **intervals** of data with a count of the number of entries in each class.
- The **frequency,  $f$** , of a class is the number of data entries in the class.

Class width  
 $6 - 1 = 5$

Class	Frequency, $f$
1 - 5	5
6 - 10	8
11 - 15	6
16 - 20	8
21 - 25	5
26 - 30	4

Lower class  
limits

Upper class  
limits

# Constructing a Frequency Distribution

1. Decide on the number of classes.
  - Usually between 5 and 20; otherwise, it may be difficult to detect any patterns.
2. Find the class width.
  - Determine the range of the data.
  - Divide the range by the number of classes.
  - *Round up to the next convenient number.*

# Constructing a Frequency Distribution

3. Find the class limits.
  - You can use the minimum data entry as the lower limit of the first class.
  - Find the remaining lower limits (add the class width to the lower limit of the preceding class).
  - Find the upper limit of the first class. Remember that classes cannot overlap.
  - Find the remaining upper class limits.

# Constructing a Frequency Distribution

4. Make a tally mark for each data entry in the row of the appropriate class.
5. Count the tally marks to find the total frequency  $f$  for each class.

# Example: Constructing a Frequency Distribution

The following sample data set lists the number of minutes 50 Internet subscribers spent on the Internet during their most recent session. Construct a frequency distribution that has seven classes.

50 40 41 17 11 7 22 44 28 21 19 23 37 51 54 42 86  
41 78 56 72 56 17 7 69 30 80 56 29 33 46 31 39 20  
18 29 34 59 73 77 36 39 30 62 54 67 39 31 53 44

# Solution: Constructing a Frequency Distribution

50 40 41 17 11 7 22 44 28 21 19 23 37 51 54 42 86  
41 78 56 72 56 17 7 69 30 80 56 29 33 46 31 39 20  
18 29 34 59 73 77 36 39 30 62 54 67 39 31 53 44

1. Number of classes = 7 (given)
2. Find the class width

$$\frac{\text{max} - \text{min}}{\text{\#classes}} = \frac{86 - 7}{7} \approx 11.29$$

Round up to 12

# Solution: Constructing a Frequency Distribution

3. Use 7 (minimum value) as first lower limit. Add the class width of 12 to get the lower limit of the next class.

$$7 + 12 = 19$$

Find the remaining lower limits.

Class width = 12

Lower limit	Upper limit
7	
19	
31	
43	
55	
67	
79	

# Solution: Constructing a Frequency Distribution

The upper limit of the first class is 18 (one less than the lower limit of the second class).

Add the class width of 12 to get the upper limit of the next class.

$$18 + 12 = 30$$

Find the remaining upper limits.

Lower limit	Upper limit
7	18
19	30
31	42
43	54
55	66
67	78
79	90

Class width = 12

# Solution: Constructing a Frequency Distribution

4. Make a tally mark for each data entry in the row of the appropriate class.
5. Count the tally marks to find the total frequency  $f$  for each class.

Class	Tally	Frequency, $f$
7 – 18	I	6
19 – 30		10
31 – 42		13
43 – 54		8
55 – 66		5
67 – 78	I	6
79 – 90		2

$$\Sigma f = 50$$

# Determining the Midpoint

## Midpoint of a class

$$\frac{(\text{Lower class limit}) + (\text{Upper class limit})}{2}$$

Class	Midpoint	Frequency, $f$
7 – 18	$\frac{7+18}{2} = 12.5$	6
19 – 30	$\frac{19+30}{2} = 24.5$	10
31 – 42	$\frac{31+42}{2} = 36.5$	13

Class width = 12

# Determining the Relative Frequency

## Relative Frequency of a class

- Portion or percentage of the data that falls in a particular class.

- relative frequency =  $\frac{\text{class frequency}}{\text{Sample size}} = \frac{f}{n}$

Class	Frequency, $f$	Relative Frequency
7 – 18	6	$\frac{6}{50} = 0.12$
19 – 30	10	$\frac{10}{50} = 0.20$
31 – 42	13	$\frac{13}{50} = 0.26$

# Determining the Cumulative Frequency

## Cumulative frequency of a class

- The sum of the frequency for that class and all previous classes.

Class	Frequency, $f$	Cumulative frequency
7 – 18	6	6
19 – 30	+ 10	16
31 – 42	+ 13	29

# Expanded Frequency Distribution

Class	Frequency, $f$	Midpoint	Relative frequency	Cumulative frequency
7 – 18	6	12.5	0.12	6
19 – 30	10	24.5	0.20	16
31 – 42	13	36.5	0.26	29
43 – 54	8	48.5	0.16	37
55 – 66	5	60.5	0.10	42
67 – 78	6	72.5	0.12	48
79 – 90	2	84.5	0.04	50

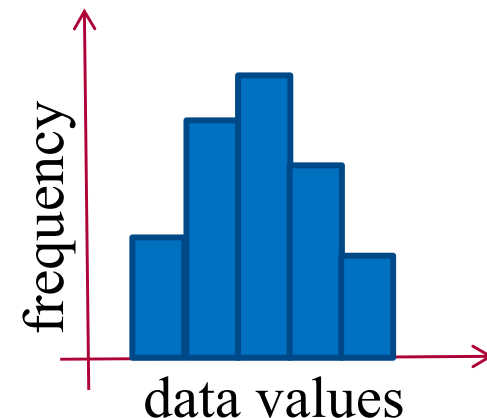
$$\Sigma f = 50$$

$$\Sigma \frac{f}{n} = 1$$

# Graphs of Frequency Distributions

## Frequency Histogram

- A bar graph that represents the frequency distribution.
- The horizontal scale is quantitative and measures the data values.
- The vertical scale measures the frequencies of the classes.
- Consecutive bars must touch.



# Class Boundaries

## Class boundaries

- The numbers that separate classes without forming gaps between them.
- The distance from the upper limit of the first class to the lower limit of the second class is  $19 - 18 = 1$ .
- Half this distance is 0.5.

Class	Class Boundaries	Frequency, $f$
7 – 18	6.5 – 18.5	6
19 – 30		10
31 – 42		13

- First class lower boundary =  $7 - 0.5 = 6.5$
- First class upper boundary =  $18 + 0.5 = 18.5$

# Class Boundaries

Class	Class boundaries	Frequency, $f$
7 – 18	6.5 – 18.5	6
19 – 30	18.5 – 30.5	10
31 – 42	30.5 – 42.5	13
43 – 54	42.5 – 54.5	8
55 – 66	54.5 – 66.5	5
67 – 78	66.5 – 78.5	6
79 – 90	78.5 – 90.5	2