Frequency Distribution

What Is Frequency Distribution?

Frequency Distribution

A **frequency** of a value is the number of times it occurs in a dataset. A **frequency distribution** is the number of times each variable occurs in a dataset.

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- **Relative frequency distribution**: the proportion of each value or class interval of a variable. Useful for any type of data **if we care about comparing frequencies** rather than amounts.
- **Cumulative frequency distribution**: the sum of frequencies less than or equal to each value or class interval of a variable. Useful when we want to understand how often observations fall below certain values.

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- Can be discrete or continuous:
  - **Discrete data** represents counts of individual items like number of students in a class.
  - **Continuous data** represents measurements of uncountable values like density, volume or time.

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- Can be binary, nominal or ordinal:
  - **Binary data** represents yes or no outcomes like coin flips or win/loss situations.
  - **Nominal data** represents groups without rank or order between them – like the names of species or colours.
  - **Ordinal data** represents groups that are ranked – like finishing place in a race.

Ungrouped Frequency Data – Table

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    - For **ordinal** variables, the values should be ordered from smallest to largest.
    - For **nominal** variables, the rows can be ordered arbitrarily.
2. Count the **frequencies**.

Ungrouped Frequency Data – Example 1

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Ungrouped Frequency Data – Example 1

A gardener sets up a bird feeder in his backyard. He wishes to know which type of bird species visit the feeder the most. His observations are in the following table:

Species	Frequency
Chickadee	3
Dove	1
Finch	4
Grackle	2
Sparrow	4
Starling	2

Ungrouped Frequency Data – Example 2

We observe how many times a specific type of tram (based on age) stops at a chosen station each day.

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This experiment may yield a table like this:

Type	Frequency
1990	6
1996	11
2005	3
2017	5

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   - Calculate the **range** = highest value $-$ lowest value.
   - Decide on the **class interval width**. **ALWAYS THINK** about that the best width should be! But, if you can't decide, a rule of thumb is the width

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$$\text{width} = \frac{\text{range}}{\sqrt{\text{number of inputs}}}.$$

     It is typically beneficial to round this value to an integer.
   - Calculate the **class intervals**. Each interval is of the form [lower limit, lower limit $+$ width). Simply divide the outputs into these intervals.

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52, 34, 32, 29, 63, 40, 46, 54, 36, 36, 24, 19, 45, 20, 28, 29, 38, 33, 49, 37.

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$$52, 34, 32, 29, 63, 40, 46, 54, 36, 36, 24, 19, 45, 20, 28, 29, 38, 33, 49, 37.$$

We calculate the range as highest $-$ lowest $= 63 - 19 = 44$.
We calculate the interval width as

$$\text{width} = \frac{\text{range}}{\sqrt{\text{sample size}}} = \frac{44}{\sqrt{20}} = 9.84,$$

and round it up to 10.

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and round it up to 10.
Therefore, we have the following intervals

$$[19, 29), [29, 39), [39, 49), [49, 59), [59, 69).$$

Grouped Frequency Data – Example

Counting the numbers of outputs falling into each of those intervals gives the table:

Age	Frequency
19 – 28	4
29 – 38	9
39 – 48	3
49 – 58	3
59 – 68	1

Relative Frequency Data – Table

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2. To each output add another column to represent **relative frequencies**.

Relative Frequency Data – Example

In our gardener example, the relative frequency table would look like this:

Species	Frequency	Relative Frequency
Chickadee	3	$\frac{3}{3+1+4+2+4+2} = 0.19$
Dove	1	0.06
Finch	4	0.25
Grackle	2	0.13
Sparrow	4	0.25
Starling	2	0.13

Cumulative Frequency Data – Table

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1. Create an ungrouped or grouped frequency table for **an ordinal or quantitative variable**. Cumulative frequencies make no sense for nominal variables because they're not ordered.
2. Add another column for each output with **cumulative frequency**. The cumulative frequency is the number of observations less than or equal to a certain value or class interval.

Cumulative Frequency Data – Example

Going back to our example of a sociological survey. The cumulative frequency table of the age of survey participants would look like this:

Age	Frequency	Cumulative Frequency
19 – 28	4	4
29 – 38	9	9 + 4 = 13
39 – 48	3	9 + 4 + 3 = 16
49 – 58	3	19
59 – 68	1	20

1

Graphing Frequency Distributions

Pie Charts

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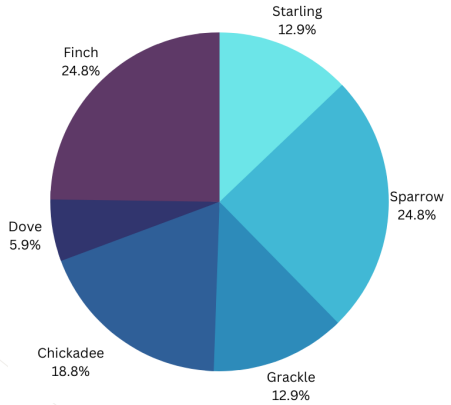
Pie Charts

This table can be organized into a pie chart like this:



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Bar charts can be used to visualize the **frequency** or **relative frequency** of **categorical data** (both **nominal** and **ordinal**).

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Species	Frequency
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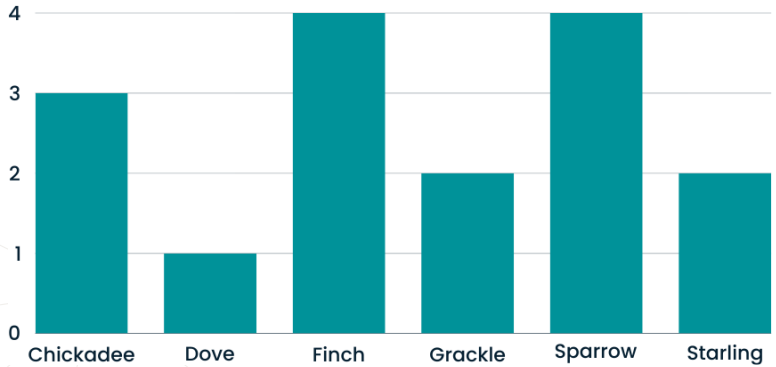
Bar Chart

We can organize this data into a bar chart:



Histogram

A histogram looks similar to a bar chart and can be used to visualize the **frequency** or **relative frequency** of a **quantitative variable**.

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Recall the table from our sociological survey example:

Age	Frequency
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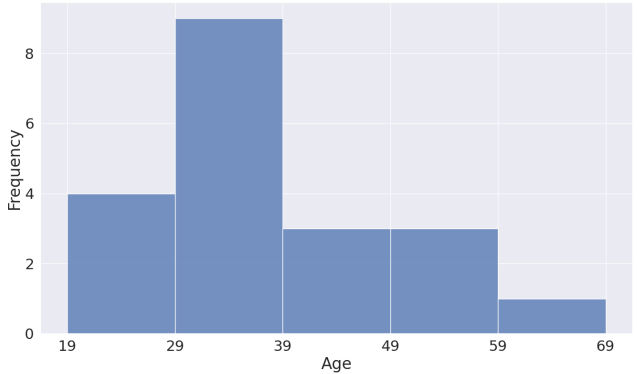
39 – 48	3
49 – 58	3
59 – 68	1

Histogram

The values can be organized into the following histogram:



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	Bar Chart	Histogram
Variable	Categorical	Quantitative
Grouping	Ungrouped (values)	Grouped (interval classes)
Order	Any	Lowest to highest

Cumulative Frequency Histogram

To visualize **cumulative frequency distribution**, one can also draw a histogram, simply replacing frequencies for cumulative frequencies.

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Recall that the cumulative frequency table from our sociological survey looked like this:

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Cumulative Frequency Graph

This data can be visualized by the following frequency histogram.