Session 4 - 5

Descriptive Statistics - Data Visualization

Prof. Jigar M. Shah

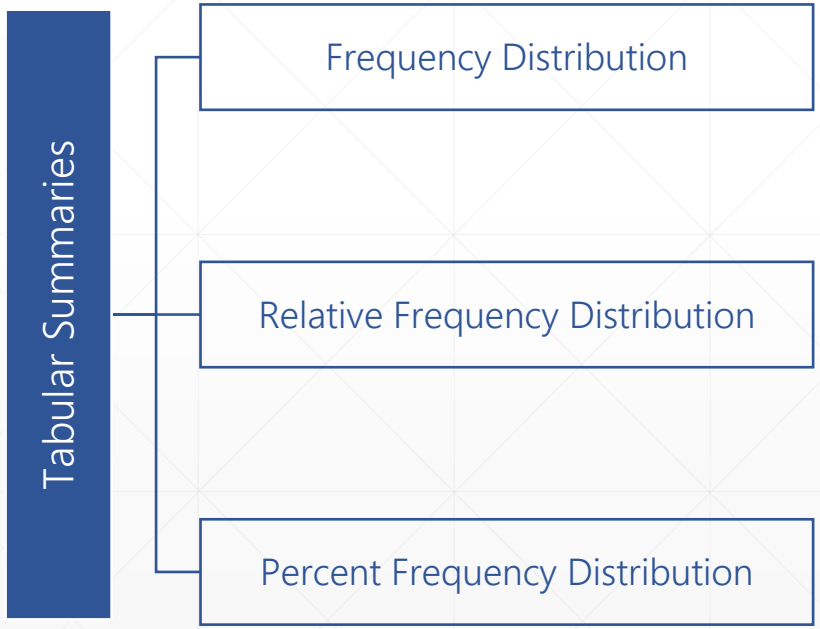
Descriptive Statistics - Data Visualization

- Qualitative Data
  - Tabulation
  - Graphical Visualization
- Quantitative Data
  - Tabulation
  - Graphical Visualization

Descriptive Statistics - Data Visualization

Qualitative Data

- Tabulation

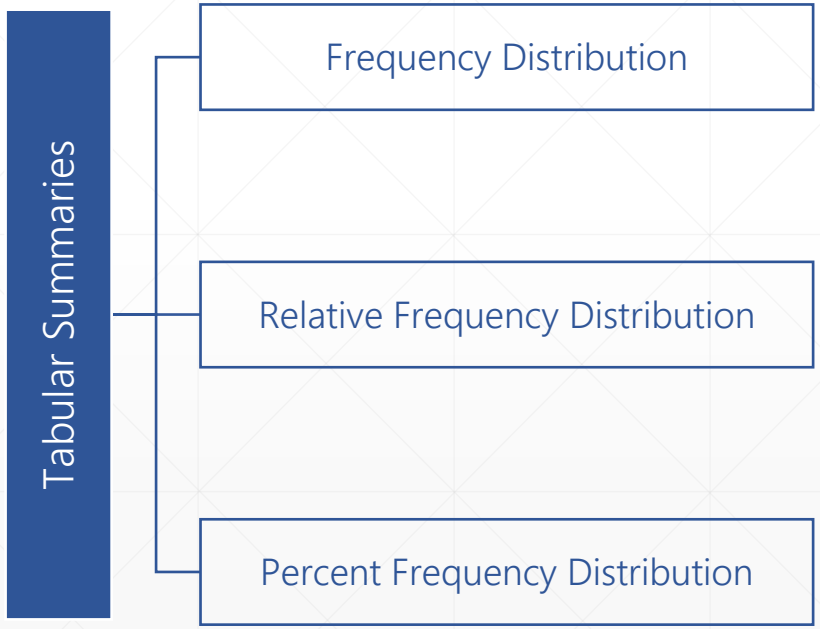


Frequency Distribution	
Frequency	No. of times a particular distinct value occurs
Frequency Distribution	Tabulation of data showing frequency of items in each of several non-overlapping classes

Descriptive Statistics - Data Visualization

Qualitative Data

- Tabulation



Relative Frequency Distribution	
Relative Frequency	Fraction or proportion of observed values belonging to a particular class
Relative Frequency Distribution	Tabulation of data showing relative frequency of items in each of several non-overlapping classes
Relative Frequency	$= \frac{\text{Frequency}}{\text{No. of Observations}} = \frac{f_i}{n}$

where f_i = frequency of the i^{th} value of the variable

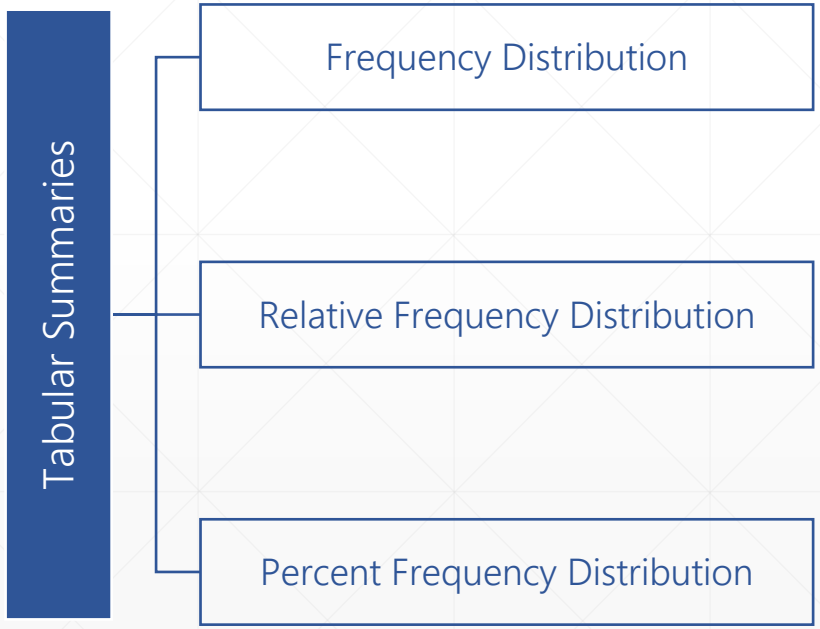
$n = \sum_{i=1}^{k} f_i$ = total no. of observations

k = the no. of different values for the variable

Descriptive Statistics - Data Visualization

Qualitative Data

- Tabulation



Percent Frequency Distribution	
Percent Frequency	Percentage of the observed values belonging to a particular class
Relative Frequency Distribution	Tabulation of data showing percent frequency of items in each of several non-overlapping classes
Percent Frequency	$= \text{Relative Frequency} \times 100 = \frac{f_i}{n} \times 100$

where f_i = frequency of the i^{th} value of the variable

$n = \sum_{i=1}^{k} f_i$ = total no. of observations

k = the no. of different values for the variable

Descriptive Statistics - Data Visualization

Qualitative Data

- Tabulation

Sprite	Coca Cola	Coca Cola	Sprite	Coca Cola	Mountain Dew	Sprite	Coca Cola	Coca Cola	Pepsi
Sprite	Limca	Limca	Coca Cola	Mountain Dew	Coca Cola	Limca	Coca Cola	Mountain Dew	Coca Cola
Pepsi	Mountain Dew	Sprite	Sprite	Coca Cola	Coca Cola	Pepsi	Sprite	Pepsi	Limca
Mountain Dew	Pepsi	Coca Cola	Coca Cola	Sprite	Pepsi	Mountain Dew	Pepsi	Pepsi	Pepsi
Coca Cola	Pepsi	Mountain Dew	Mountain Dew	Pepsi	Coca Cola	Pepsi	Limca	Pepsi	Sprite

Soft Drinks Preference Data from a Sample of 50 Students

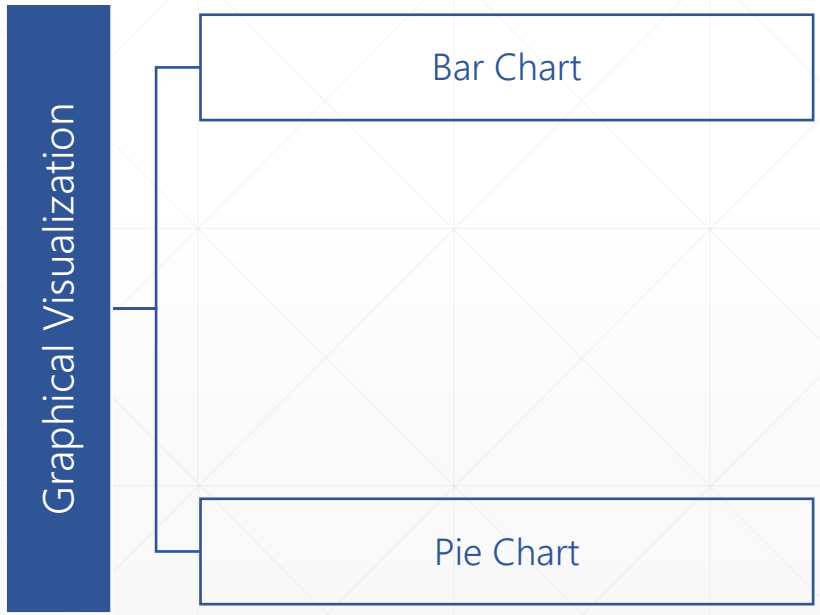
Soft Drink Preference	Frequency	Relative Frequency	Percent Frequency
Coca Cola	15	15 ÷ 50 = 0.30	0.30 × 100 = 30
Limca	5	5 ÷ 50 = 0.10	0.10 × 100 = 10
Mountain Dew	8	8 ÷ 50 = 0.16	0.16 × 100 = 30
Pepsi	13	13 ÷ 50 = 0.26	0.26 × 100 = 36
Sprite	9	9 ÷ 50 = 0.18	0.18 × 100 = 18
Total	50	1.00	100

- Sum of frequencies in any frequency distribution always equals the no. of observations
- Sum of relative frequencies in any frequency distribution always equals 1
- Sum of percent frequencies in any frequency distribution always equals 100

Descriptive Statistics - Data Visualization

Qualitative Data

- Graphical Visualization



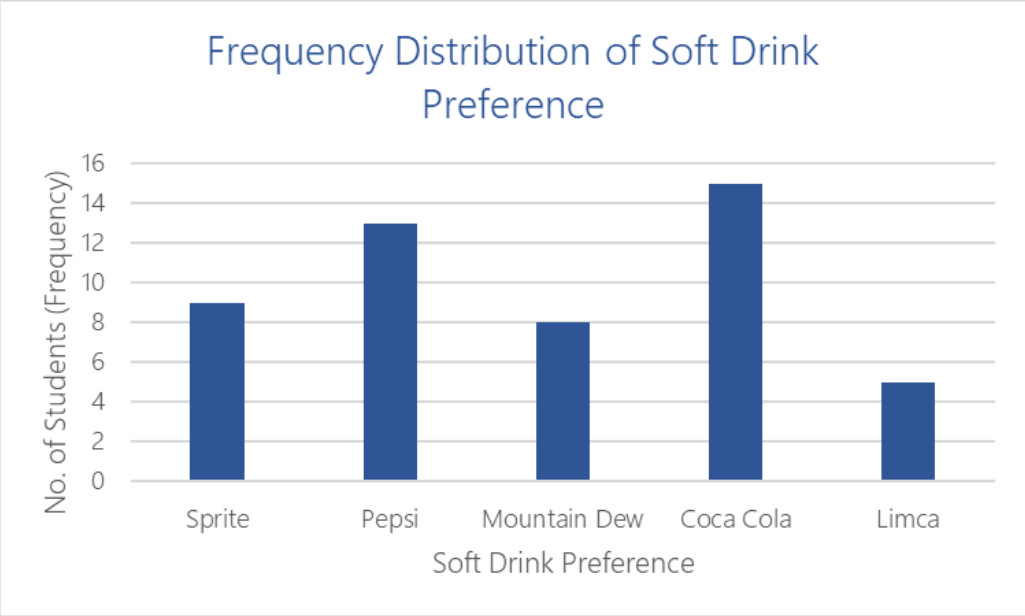
Bar Chart

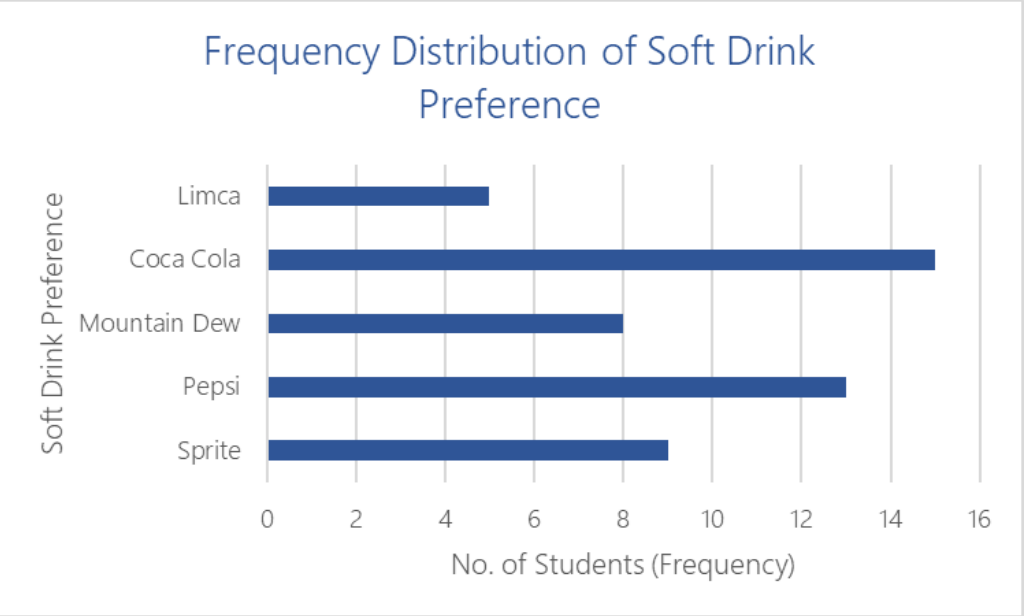
- A graphical representation of a qualitative / categorical data set in which a rectangle or bar is drawn over each category or class
- Bars may be vertical or horizontal, having the same width
- Length or height of each bar represents the frequency or percentage of observations or some other measure associated with the category
- Bars of different categories do not touch each other (as each class or category is separate)
- Bars may all be of the same or different colors depicting different categories
- Multiple variables can be graphed on the same bar chart
- Frequencies, relative frequencies, or percent frequencies can be used to label / scale the bar chart (often relative frequencies are used)

Descriptive Statistics - Data Visualization

Qualitative Data

- Graphical Visualization
  - Bar Chart





Descriptive Statistics - Data Visualization

Qualitative Data

- Graphical Visualization

Horizontal Bar Chart

- Uses horizontal bars instead of vertical bars
- Bars are placed on the vertical axis
- Frequencies, relative frequencies or percent frequencies are displayed on the horizontal axis
- Lengths (instead of the heights) of the bars correspond to the values (frequencies, relative frequencies or percent frequencies) to be represented

Pie Chart

- A graphical representation of a qualitative / categorical data set in the form of a circle divided into slices corresponding to the categories or classes to be displayed
- Sizes of the slices are proportional to the frequency or percentage of observations or some other measure associated with the categories or classes
- Sizes of slices (in °) for classes or categories are computed by multiplying their respective relative frequencies by 360°

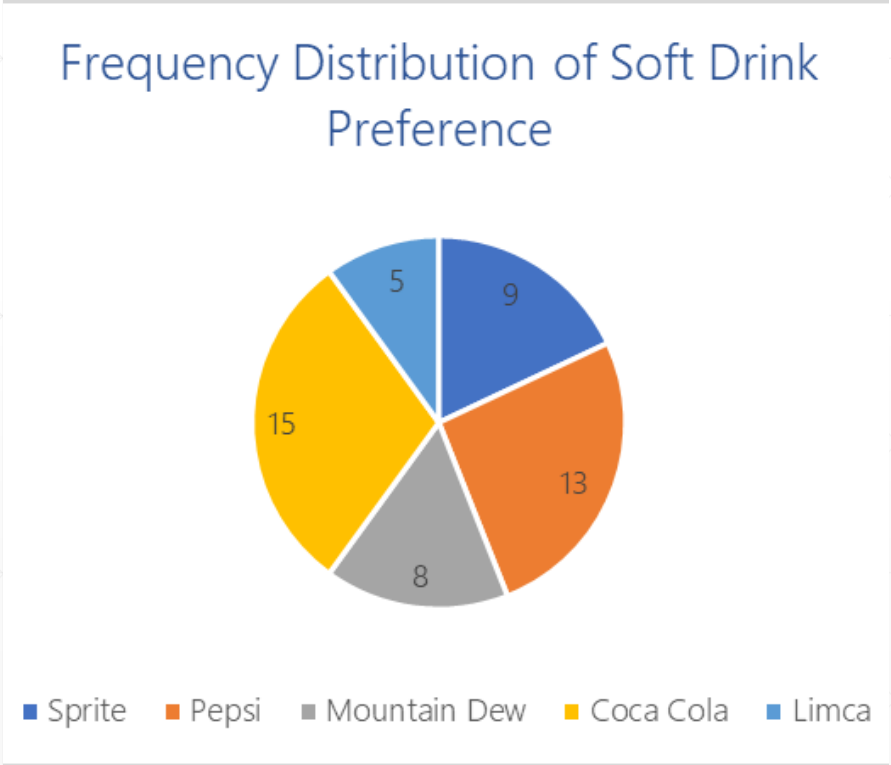
Descriptive Statistics - Data Visualization

Qualitative Data

- Graphical Visualization
  - Pie Chart

Soft Drink Preference	Relative Frequency	Slice Size
Coca Cola	15 ÷ 50 = 0.30	0.30 × 360° = 108°
Limca	5 ÷ 50 = 0.10	0.10 × 360° = 36°
Mountain Dew	8 ÷ 50 = 0.16	0.16 × 360° ≈ 57°
Pepsi	13 ÷ 50 = 0.26	0.26 × 360° ≈ 94°
Sprite	9 ÷ 50 = 0.18	0.18 × 360° ≈ 65°
Total	1.00	360°

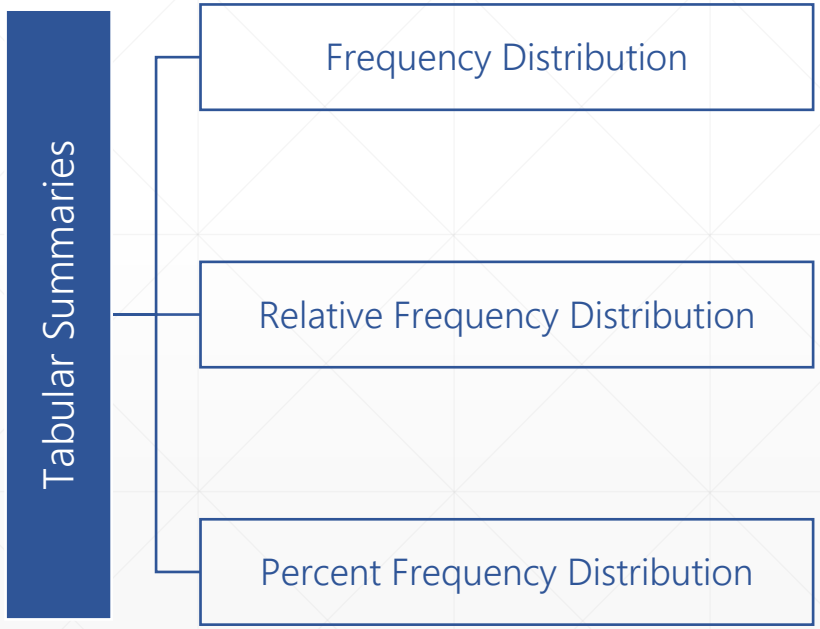
Sum of sizes of all the slices in any pie chart always equals 360°



Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation



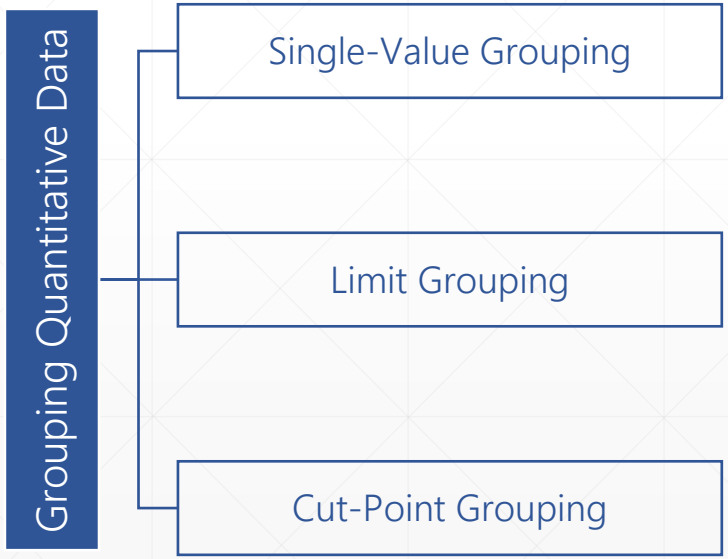
Frequency Distribution	
Frequency	No. of times a particular distinct value occurs
Frequency Distribution	Tabulation of data showing frequency of items in each of several non-overlapping classes

- For quantitative data special care must be taken in defining the non-overlapping classes / categories to be used
- Classes must be all-inclusive & mutually exclusive

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation
  - Frequency Distribution



Frequency Distribution	
Single-Value Grouping	• Grouping quantitative data such that each class represents a single possible value • Such classes that represent single values each are called single-value classes • Distinct values of the observations are used as classes, just like that for qualitative data • Particularly suitable for discrete data when there are only a few distinct values

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation
  - Frequency Distribution
    - Single-Value Grouping

1	3	3	0	3
1	2	1	3	2
1	1	1	1	1
2	5	4	2	2
6	2	3	1	1
3	1	2	2	1
3	3	2	3	3
4	6	2	1	1
2	2	2	1	5
4	2	3	3	1

TV Ownership in 50 Randomly Selected Households

No. of TVs	Frequency
0	1
1	16
2	14
3	12
4	3
5	2
6	2
Total	50

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation
  - Frequency Distribution

Frequency Distribution	
	• Grouping quantitative data such that each class contains a range of values • Each class has its own class limits that define the range of values it can take • The smallest value that could go in a class is called the lower limit of the class, and the largest value that could go in the class is called the upper limit of the class
Limit Grouping	• Lower Class Limit - smallest value that could go in a class • Upper Class Limit - largest value that could go in a class • Class Width - difference between the lower class limit of a class & the lower class limit of the next-higher class • Class Mark or Class Midpoint - average of the lower class limit & upper class limit of a class • Useful when data with too many distinct values are expressed as whole numbers

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation
  - Frequency Distribution
    - Limit Grouping

Forming Groups using Limit Grouping	
1. Determine no. of classes using Struges' Formula	$k = 1 + 3.322 \log_{10} N$ where k is the approximate no. of classes N is the total frequency
2. Determine width of each class	$\text{Approximate No. of Classes} = \frac{\text{Largest Value - Smallest Value}}{\text{No. of Classes}}$

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation
  - Frequency Distribution
    - Limit Grouping

Forming Groups using Limit Grouping

3. Determine class limits
   - Lower limit of the first class must be ≤ to the smallest data value
   - Each data item must belong to one & only one class

$$\text{Lower Class Limit}_{k+1} = \text{Lower Class Limit}_k + \text{Class Width}_k$$

where $\text{Lower Class Limit}_{k+1}$ is the lower class limit of class no. k+1

$\text{Lower Class Limit}_k$ is the lower class limit of class no. k

Class Width_k is the class width of class no. k

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation
  - Frequency Distribution
    - Limit Grouping

70	62	75	57	51
64	38	56	53	36
99	67	71	47	63
55	70	51	50	66
64	60	99	55	85
89	69	68	81	79
87	78	95	80	83
65	39	86	98	70

Days to Maturity for 40 Short-Term Investments

Days to Maturity	Frequency	Lower Class Limit	Upper Class Limit	Class Width	Class Mark
30 – 39	3	30	39	40 - 30 = 10	(30 + 39) ÷ 2 = 34.5
40 – 49	1	40	49	50 - 40 = 10	(40 + 49) ÷ 2 = 44.5
50 – 59	8	50	59	60 - 50 = 10	(50 + 59) ÷ 2 = 54.5
60 – 69	10	60	69	70 - 60 = 10	(60 + 69) ÷ 2 = 64.5
70 – 79	7	70	79	80 - 70 = 10	(70 + 79) ÷ 2 = 74.5
80 – 89	7	80	89	90 - 80 = 10	(80 + 89) ÷ 2 = 84.5
90 – 99	4	90	99	100 - 90 = 10	(90 + 99) ÷ 2 = 94.5
Total	40				

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation
  - Frequency Distribution

Frequency Distribution	
Cut-Point Grouping	• Method of grouping quantitative data by using cut-points • Useful for continuous data (expressed in decimals) with too many distinct values • Each class contains a range of values and has a lower cut-point & an upper cut-point • Lower Class Cut-Point - smallest value that could go in a class (same as the lower limit of the class in limit grouping) • Upper Class Cut-Point - smallest value that could go in the next-higher class i.e. lower class cut-point of the next-higher class (same as lower limit of the next higher class in limit grouping) • Class Width - difference between lower class cut-point & upper class cut-point of a class • Class Mark or Class Midpoint - average of the lower class cut-point & upper class cut-point of a class

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation
  - Frequency Distribution
    - Cut-Point Grouping

Forming Groups using Cut-Point Grouping	
1. Determine no. of classes using Struges' Formula	$k = 1 + 3.322 \log_{10} N$ where k is the approximate no. of classes N is the total frequency
2. Determine width of each class	$\text{Approximate No. of Classes} = \frac{\text{Largest Value - Smallest Value}}{\text{No. of Classes}}$

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation
  - Frequency Distribution
    - Cut-Point Grouping

Forming Groups using Cut-Point Grouping

3. Determine class cut-points
   - Lower limit of the first class must be ≤ to the smallest data value
   - Each data item must belong to one & only one class

$$\text{Upper Class Cut-Point}_k = \text{Lower Class Cut-Point}_k + \text{Class Width}_k$$

$$\text{Lower Class Cut-Point}_{k+1} = \text{Upper Class Cut-Point}_k$$

where $\text{Upper Class Cut-Point}_k$ is the upper class cut-point of class no. k

$\text{Lower Class Cut-Point}_k$ is the lower class cut-point of class no. k

Class Width_k is the class width of class no. k

$\text{Lower Class Cut-Point}_{k+1}$ is the lower class cut-point of class no. k+1

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation
  - Frequency Distribution
    - Cut-Point Grouping

58.6	126.5	81.1	59.9
84.1	79.7	74.8	71.9
70.4	66.4	78.2	79.6
77.1	94.8	84.8	82.6
75.9	98.9	78.8	78.7
73	82.8	80.8	68
86.7	64.8	75.2	71.9
68.4	68.6	97.3	
73.3	85	62	
77.2	66	85.6	

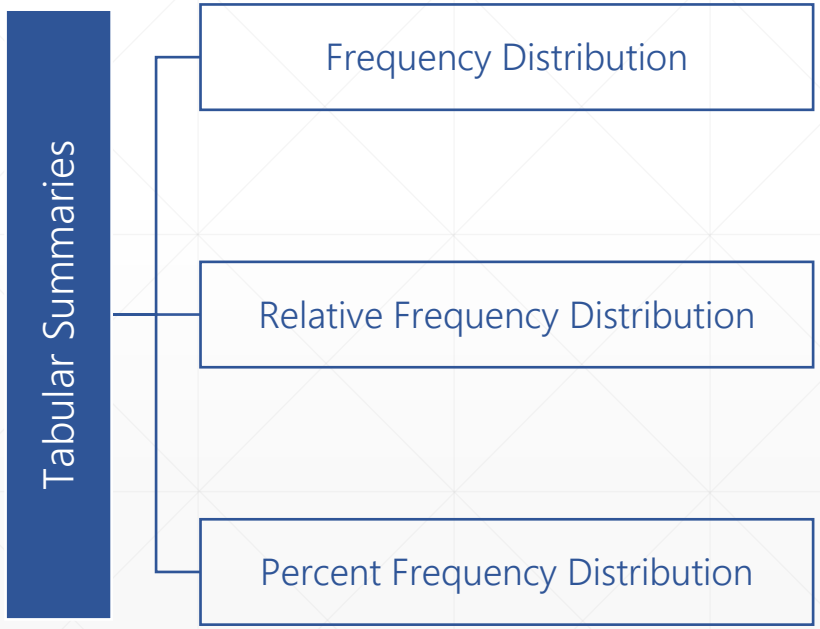
Weights, in kg, of 37 males aged 18–24 years

Weight	Frequency	Lower Class Cut-Point	Class Width	Upper Class Cut-Point	Class Mark
55 – less than 65	4	55	10	55 + 10 = 65	(55 + 65) ÷ 2 = 60
65 – less than 75	11	65	10	65 + 10 = 75	(65 + 75) ÷ 2 = 70
75 – less than 85	15	75	10	75 + 10 = 85	(75 + 85) ÷ 2 = 80
85 – less than 95	4	85	10	85 + 10 = 95	(85 + 95) ÷ 2 = 90
95 – less than 105	2	95	10	95 + 10 = 105	(95 + 105) ÷ 2 = 100
105 – less than 115	0	105	10	105 + 10 = 115	(105 + 115) ÷ 2 = 110
115 – less than 125	0	115	10	115 + 10 = 125	(115 + 125) ÷ 2 = 120
125 – less than 135	1	125	10	125 + 10 = 135	(125 + 135) ÷ 2 = 130
Total	37				Note: Class Width of 10 is used

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation



Relative Frequency Distribution	
Relative Frequency	Fraction or proportion of observed values belonging to a particular class
Relative Frequency Distribution	Tabulation of data showing relative frequency of items in each of several non-overlapping classes
Relative Frequency	$= \frac{\text{Frequency}}{\text{No. of Observations}} = \frac{f_i}{n}$

where f_i = frequency of the i^{th} value of the variable

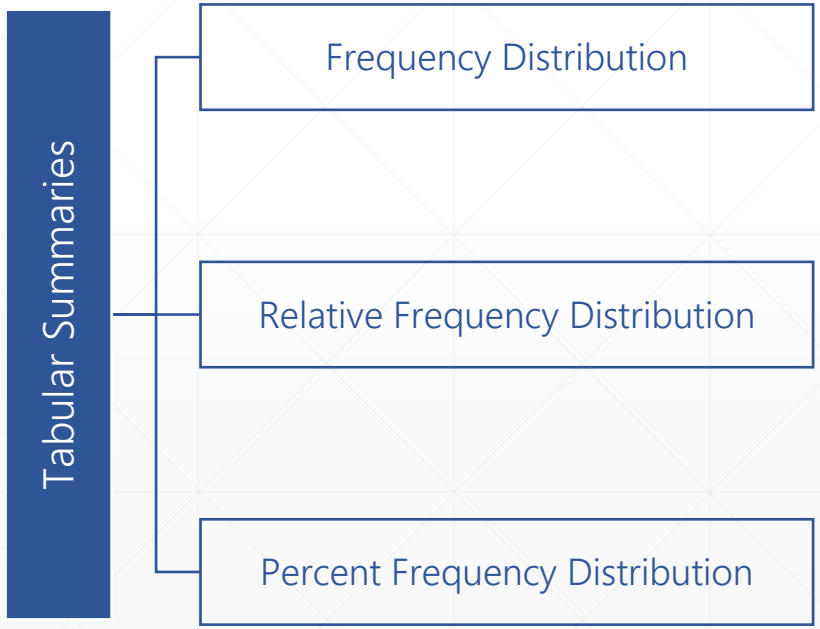
$n = \sum_{i=1}^{k} f_i$ = total no. of observations

k = the no. of different values for the variable

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation



Percent Frequency Distribution	
Percent Frequency	Percentage of the observed values belonging to a particular class
Relative Frequency Distribution	Tabulation of data showing percent frequency of items in each of several non-overlapping classes
Percent Frequency	$= \text{Relative Frequency} \times 100 = \frac{f_i}{n} \times 100$

where f_i = frequency of the i^{th} value of the variable

$n = \sum_{i=1}^{k} f_i$ = total no. of observations

k = the no. of different values for the variable

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation

No. of TVs	Frequency	Relative Frequency	Percent Frequency
0	1	1 ÷ 50 = 0.02	0.02 × 100 = 2
1	16	16 ÷ 50 = 0.32	0.32 × 100 = 32
2	14	14 ÷ 50 = 0. 28	0.28 × 100 = 28
3	12	12 ÷ 50 = 0.24	0.24 × 100 = 24
4	3	3 ÷ 50 = 0.06	0.06 × 100 = 6
5	2	2 ÷ 50 = 0.04	0.04 × 100 = 4
6	2	2 ÷ 50 = 0.04	0.04 × 100 = 4
Total	50	1.00	100

Days to Maturity	Frequency	Relative Frequency	Percent Frequency
30 – 39	3	3 ÷ 40 = 0.075	0.075 × 100 = 7.5
40 – 49	1	1 ÷ 40 = 0.025	0. 025 × 100 = 2.5
50 – 59	8	8 ÷ 40 = 0. 200	0.200 × 100 = 20.0
60 – 69	10	10 ÷ 40 = 0.250	0.250 × 100 = 25.0
70 – 79	7	7 ÷ 40 = 0.175	0.175 × 100 = 17.5
80 – 89	7	7 ÷ 40 = 0.175	0.175 × 100 = 17.5
90 – 99	4	4 ÷ 40 = 0.100	0.100 × 100 = 10.0
Total	40	1.00	100

Descriptive Statistics - Data Visualization

Quantitative Data

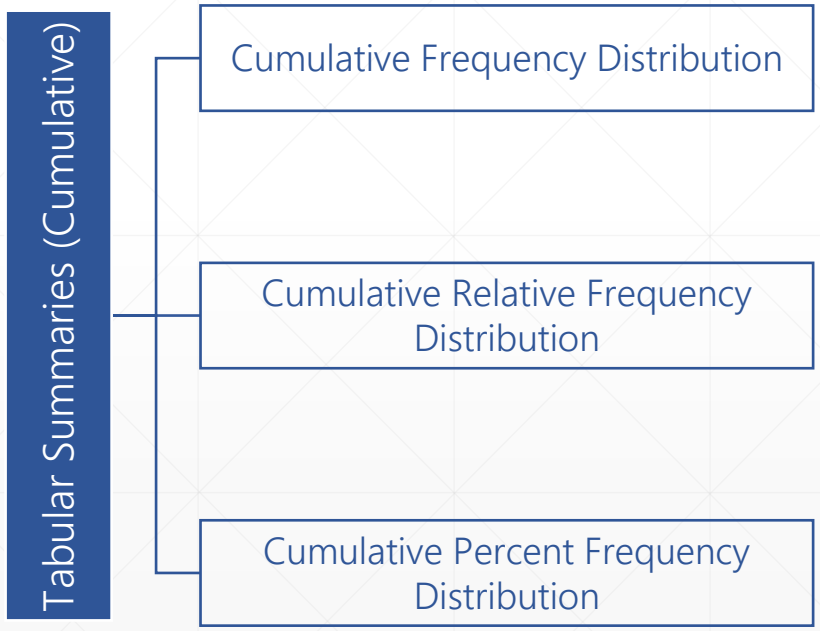
- Tabulation

Weight	Frequency	Relative Frequency	Percent Frequency
55 – less than 65	4	4 ÷ 37 ≈ 0.11	0.11 × 100 = 11
65 – less than 75	11	11 ÷ 37 ≈ 0.30	0.30 × 100 = 30
75 – less than 85	15	15 ÷ 37 ≈ 0. 41	0.41 × 100 = 41
85 – less than 95	4	4 ÷ 37 ≈ 0.11	0.11 × 100 = 11
95 – less than 105	2	2 ÷ 37 ≈ 0.05	0.05 × 100 = 5
105 – less than 115	0	0 ÷ 37 = 0.00	0.00 × 100 = 0
115 – less than 125	0	0 ÷ 37 = 0.00	0.00 × 100 = 0
125 – less than 135	1	1 ÷ 37 ≈ 0.02	0.02 × 100 = 2
Total	37	1.00	100

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation



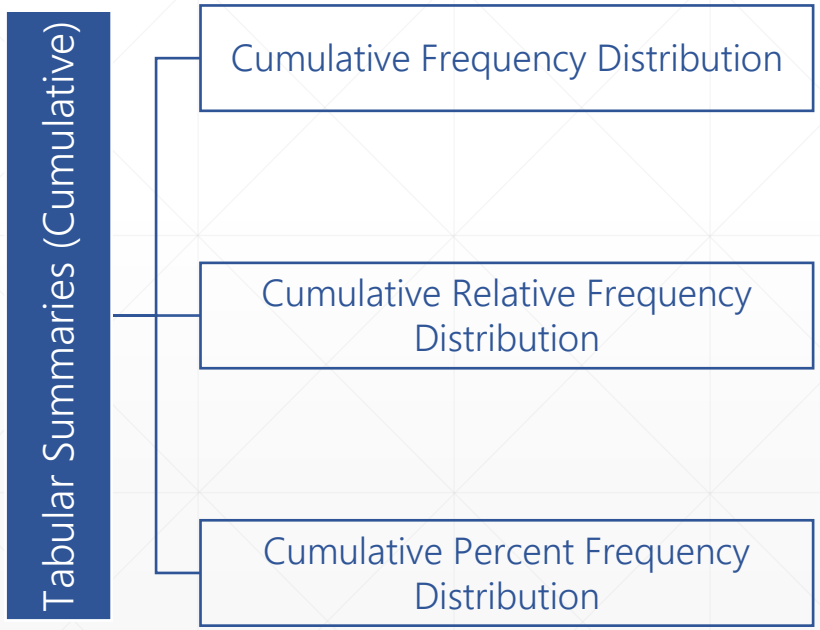
Cumulative Frequency Distribution	
Cumulative Frequency	Number of data items with values less than or equal to the upper class limit or upper class cut-point of each class
Cumulative Frequency Distribution	Tabulation of data showing the cumulative frequency of items in each of several non-overlapping classes

- Cumulative frequency distributions use the no. of classes, class widths, class limits developed for frequency distributions
- Cumulative frequency of the last class will always equal the total no. of observations

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation



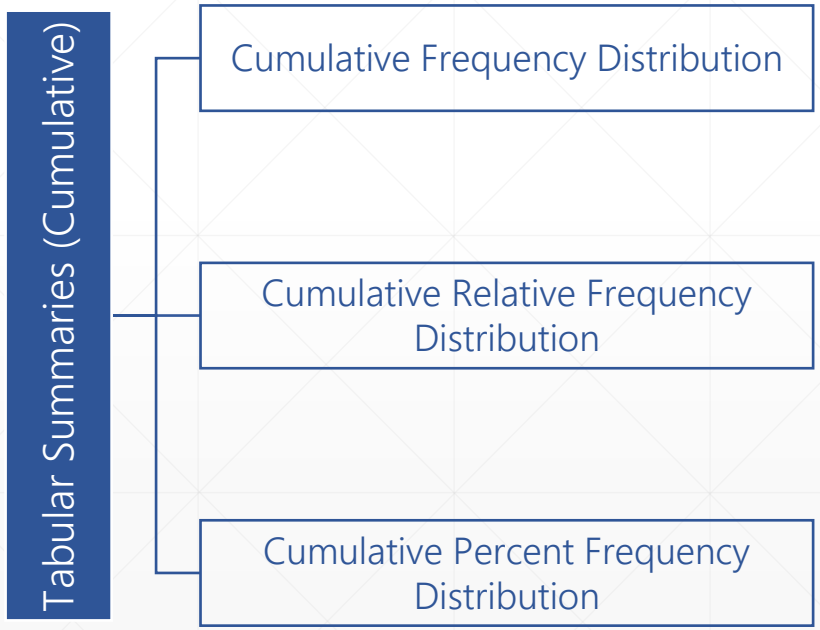
Cumulative Relative Frequency Distribution	
Cumulative Frequency	Fraction or proportion of observed values less than or equal to the upper class limit or upper class cut-point of each class
Cumulative Frequency Distribution	Tabulation of data showing the cumulative relative frequency of items in each of several non-overlapping classes

- Cumulative relative frequency of the last class will always equal 1

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation



Cumulative Percent Frequency Distribution	
Cumulative Frequency	Percentage of the observed values less than or equal to the upper class limit or upper class cut-point of each class
Cumulative Frequency Distribution	Tabulation of data showing the cumulative percent frequency of items in each of several non-overlapping classes

- Cumulative percent frequency of the last class will always equal 100

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation

No. of TVs	Frequency	Relative Frequency	Percent Frequency	No. of TVs	Cumulative Frequency	Cumulative Relative Frequency	Cumulative Percent Frequency
0	1	0.02	2	Less than or equal to 0	1	0.02	2
1	16	0.32	32	Less than or equal to 1	17	0.34	34
2	14	0. 28	28	Less than or equal to 2	31	0.62	62
3	12	0.24	24	Less than or equal to 3	43	0.86	86
4	3	0.06	6	Less than or equal to 4	46	0.92	92
5	2	0.04	4	Less than or equal to 5	48	0.96	96
6	2	0.04	4	Less than or equal to 6	50	1.00	100
Total	50	1.00	100				

Descriptive Statistics - Data Visualization

Quantitative Data

- Tabulation

Days to Maturity	Frequency	Relative Frequency	Percent Frequency	Days to Maturity	Cumulative Frequency	Cumulative Relative Frequency	Cumulative Percent Frequency
30 – 39	3	3 ÷ 40 = 0.075	0.075 × 100 = 7.5	Less than or equal to 39	3	0.075	7.5
40 – 49	1	1 ÷ 40 = 0.025	0. 025 × 100 = 2.5	Less than or equal to 49	4	0.100	10.0
50 – 59	8	8 ÷ 40 = 0. 200	0.200 × 100 = 20.0	Less than or equal to 59	12	0.300	30.0
60 – 69	10	10 ÷ 40 = 0.250	0.250 × 100 = 25.0	Less than or equal to 69	22	0.550	55.0
70 – 79	7	7 ÷ 40 = 0.175	0.175 × 100 = 17.5	Less than or equal to 79	29	0.725	72.5
80 – 89	7	7 ÷ 40 = 0.175	0.175 × 100 = 17.5	Less than or equal to 89	36	0.900	90.0
90 – 99	4	4 ÷ 40 = 0.100	0.100 × 100 = 10.0	Less than or equal to 99	40	1.000	100.0
Total	40	1.00	100				

Descriptive Statistics - Data Visualization

Quantitative Data

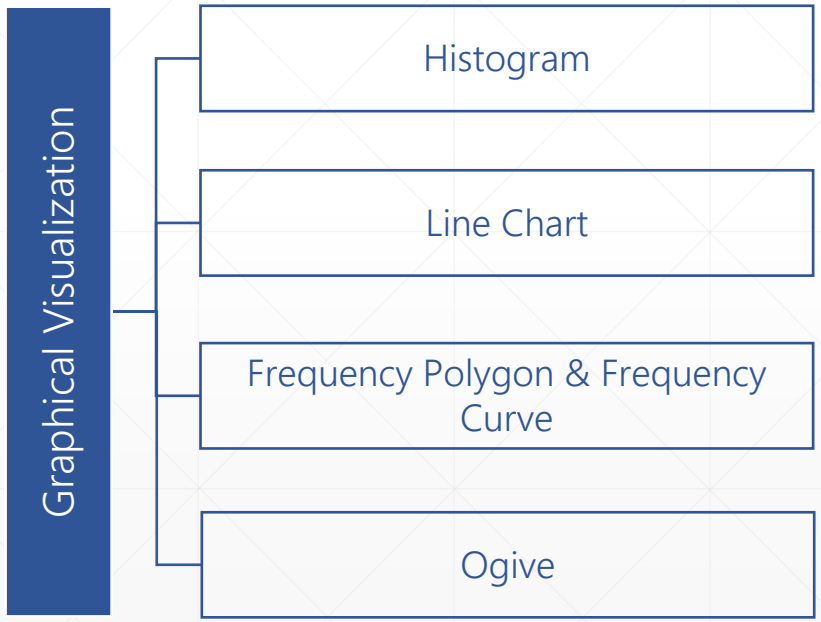
- Tabulation

Weight	Frequency	Relative Frequency	Percent Frequency	Weight	Cumulative Frequency	Cumulative Relative Frequency	Cumulative Percent Frequency
55 – less than 65	4	4 ÷ 37 ≈ 0.11	0.11 × 100 = 11	Less than 65	4	0.11	11
65 – less than 75	11	11 ÷ 37 ≈ 0.30	0.30 × 100 = 30	Less than 75	15	0.41	41
75 – less than 85	15	15 ÷ 37 ≈ 0. 41	0.41 × 100 = 41	Less than 85	30	0.82	82
85 – less than 95	4	4 ÷ 37 ≈ 0.11	0.11 × 100 = 11	Less than 95	34	0.93	93
95 – less than 105	2	2 ÷ 37 ≈ 0.05	0.05 × 100 = 5	Less than 105	36	0.98	98
105 – less than 115	0	0 ÷ 37 = 0.00	0.00 × 100 = 0	Less than 115	36	0.98	98
115 – less than 125	0	0 ÷ 37 = 0.00	0.00 × 100 = 0	Less than 125	36	0.98	98
125 – less than 135	1	1 ÷ 37 ≈ 0.02	0.02 × 100 = 2	Less than 135	37	1.00	100
Total	37	1.00	100				

Descriptive Statistics - Data Visualization

Quantitative Data

- Graphical Visualization



Histogram

- Analogous to bar chart for qualitative data
- A graphical representation that displays the classes or categories of quantitative data on a horizontal axis and the descriptive measure associated with those classes or categories as a bar above those classes or categories on a vertical axis
- The bars may be vertical or horizontal, and have the same width
- The length or height of each bar represents the frequency or percentage of observations or some other measure associated with the category
- The bars of different categories are positioned such that they touch each other
- The bars of different categories touch each other to emphasize the fact the there is no natural separation between the bars of adjacent classes or categories

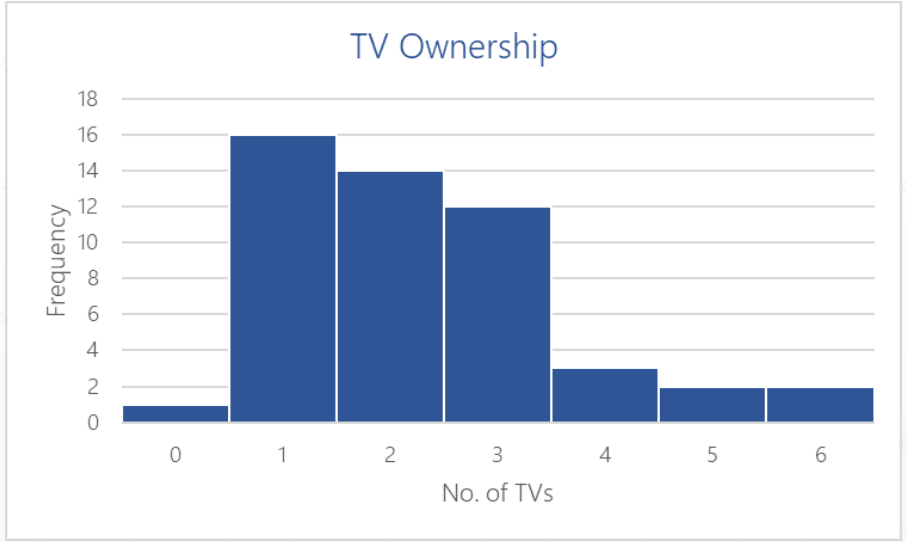
Descriptive Statistics - Data Visualization

Quantitative Data

- Graphical Visualization

Histogram

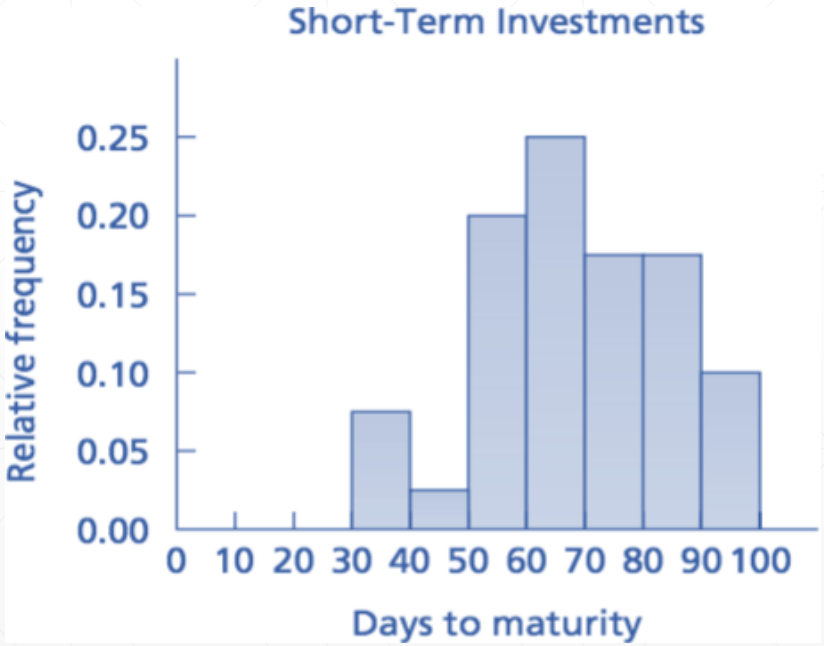
- Frequency Histogram - a histogram that uses frequencies on the vertical axis
- Relative Frequency Histogram - a histogram that uses relative frequencies on the vertical axis
- Percent Frequency Histogram - a histogram that uses percent frequencies on the vertical axis
- For single-value grouping, the distinct values of the observations are used to label the bars, with each such value centered under its bar
- For limit grouping or cut point grouping, the lower class limits or, equivalently, the lower class cut points, are used to label the bars, or alternately class marks or class midpoints centered under the bars can also be used to label the bars



Descriptive Statistics - Data Visualization

Quantitative Data

- Graphical Visualization
  - Histogram



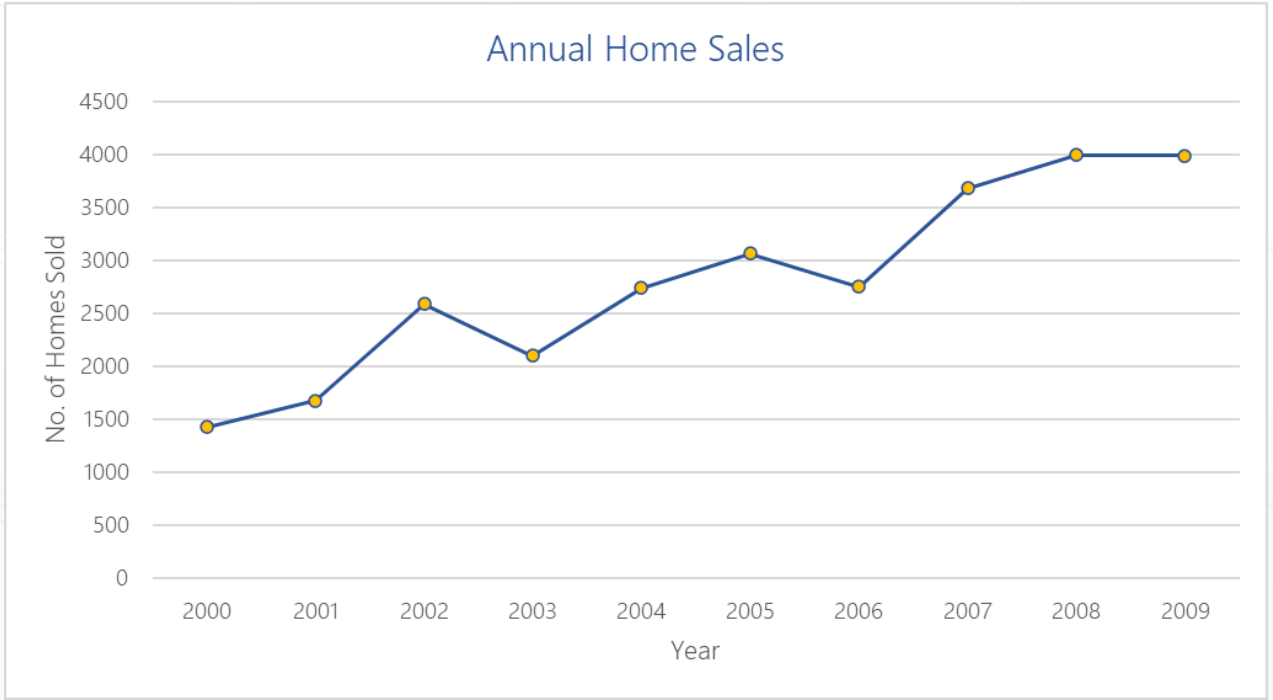
Descriptive Statistics - Data Visualization

Quantitative Data

- Graphical Visualization

Line Chart

- A graphical representation where data are plotted on a Cartesian coordinate grid with straight lines connecting each pair of successive points
- Used to display quantitative values over a continuous interval or time period
- Most frequently used to show trends and analyze how the data has changed over time
- Typically, the vertical axis has a quantitative value, while the horizontal axis is a timescale or a sequence of intervals



Descriptive Statistics - Data Visualization

Quantitative Data

- Graphical Visualization

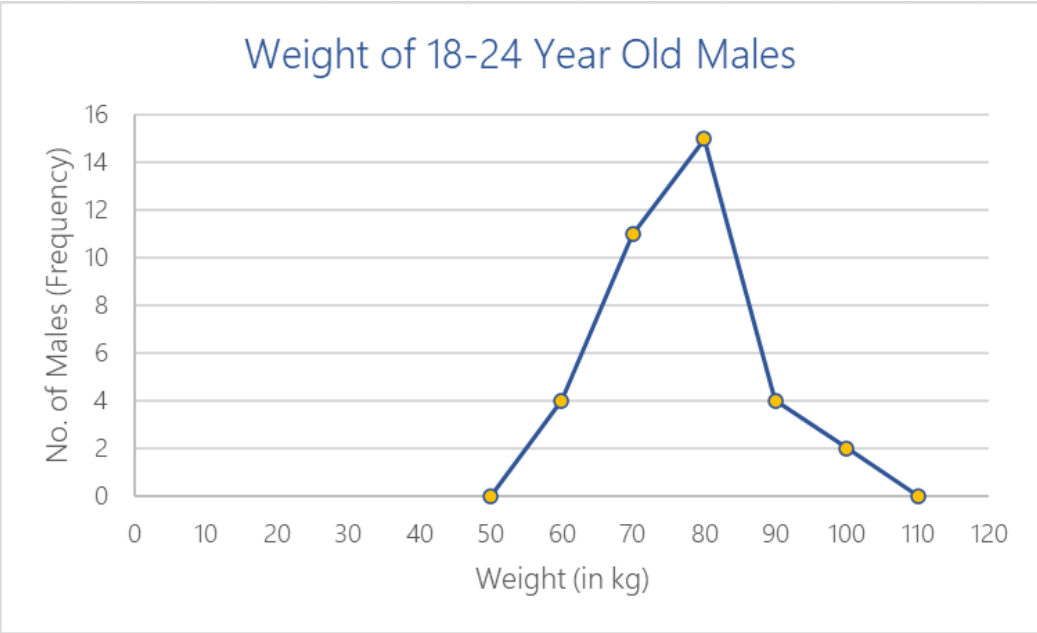
Frequency Polygon & Frequency Curve

- Frequency Polygon - a line chart created by joining all of the top points of a histogram with end points lying on the horizontal axis i.e., the rightmost & leftmost points are zero
- Frequency polygon looks like a line chart, making continuous data visually easy to interpret, and is used for understanding shape of distribution of data
- Line charts are used to show trends & to analyze how the data has changed over time
- A frequency polygon is similar to a histogram except that there are no rectangles, only a point at the midpoint of each class at a height proportional to the frequency of the class
- Frequency Curve - a frequency polygon with smooth curves connecting the points instead of straight lines
- Note: To draw frequency polygon or frequency curve, one class interval must be included below the lowest value in data and one class interval must be included above the highest value in data such that both these classes will have a frequency of 0
- Note: In frequency polygons & frequency curves, frequencies are marked against the class mark

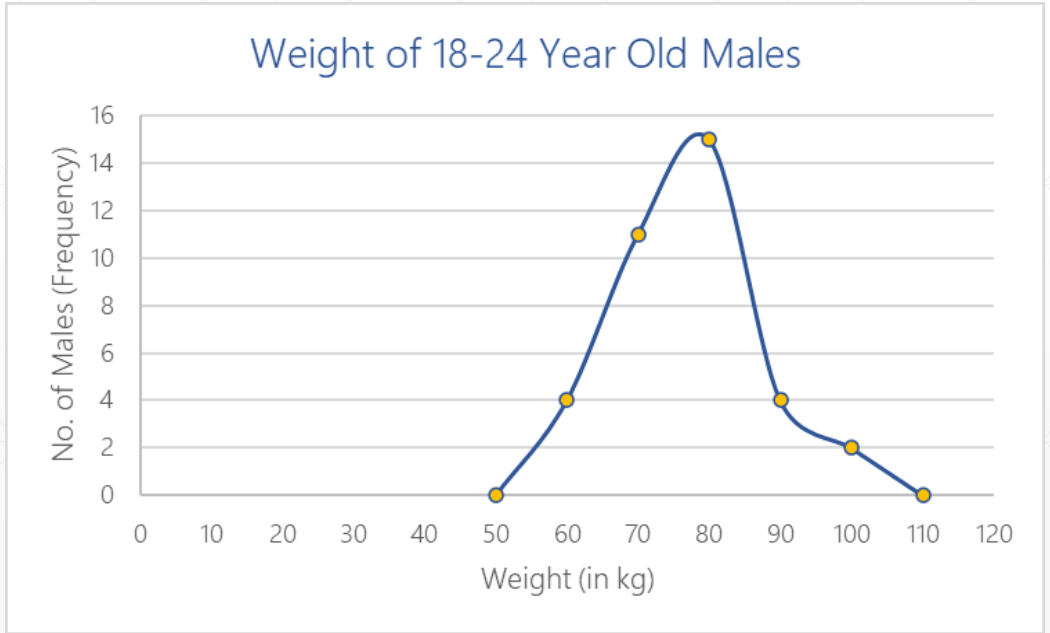
Descriptive Statistics - Data Visualization

Quantitative Data

- Graphical Visualization
  - Frequency Polygon



  - Frequency Curve



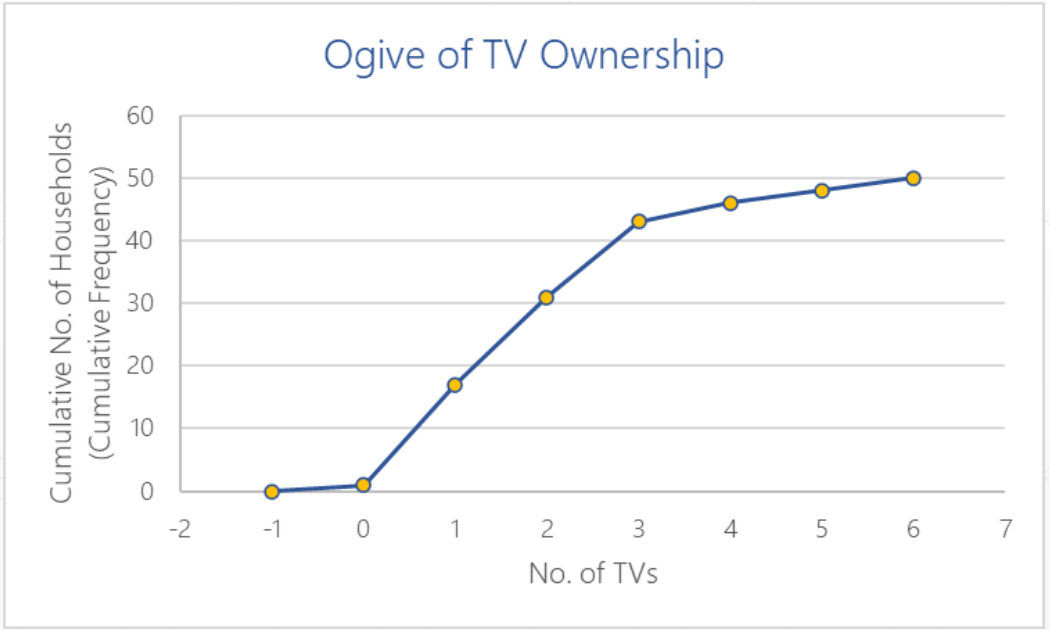
Descriptive Statistics - Data Visualization

Quantitative Data

- Graphical Visualization

Ogive

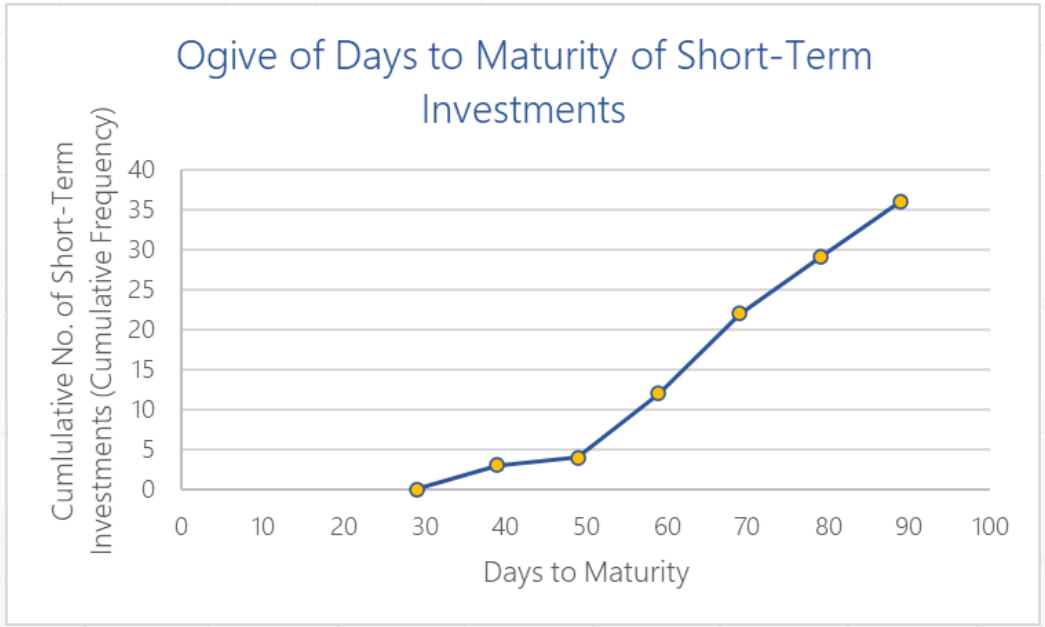
- Ogive - a graph of cumulative frequency distribution that represents the data values on the horizontal axis and the cumulative frequencies or cumulative relative frequencies or cumulative percent frequencies on the vertical axis
- Constructed like a line chart by plotting points corresponding to the cumulative frequency of each class and connecting each pair of successive points by straight lines
- On the horizontal axis, upper class limits or upper class cut-points are displayed for representing the classes or categories
- Note: To draw ogive, one class interval must be included below the lowest value in data such that this class will have a frequency of 0

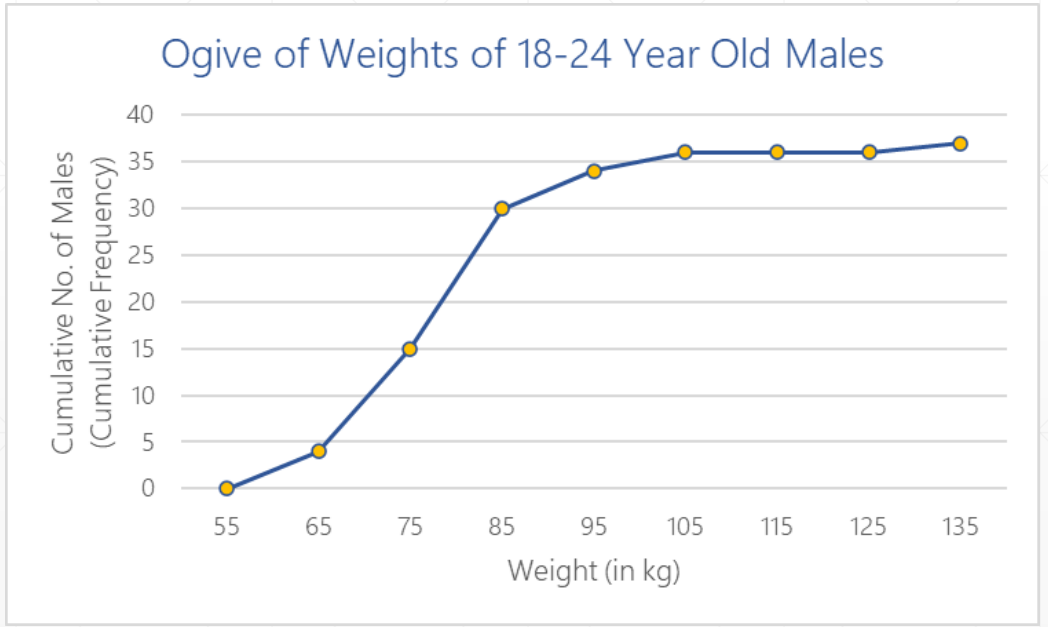


Descriptive Statistics - Data Visualization

Quantitative Data

- Graphical Visualization
  - Ogive





Thank You

Prof. Jigar M. Shah