



An Accredited Institution of the University of Westminster (UK)

- To foster in students confidence to cope with the processing and analyzing of quantitative information.
- To provide an appreciation of numerical and statistical concepts relevant to the business environment.

Learning outcomes:

- apply numerical skills to business and/or engineering problems
- present statistical data in a variety of formats, including electronic means
- apply basic rules of algebra and calculus
- using spreadsheets summarize numerical data into averages and deviations and apply them to a variety of business problems.

In brief, you will learn how ...:

- To appreciate benefit of numerical data for businesses
- To make decisions based on the numerical data
- To interpret and represent numerical data in a most appropriate way depending on your aims
- To solve statistics and calculus problems using various quantitative methods
- Note: You can find out more about module content in module syllabus and 12-week teaching schedule.

Teaching methods:

- 1-hour online lecture each week (online)
- 2-hour tutorial each week (offline)
- 1-hour workshop each week (offline)

You will learn the theory and its application

Two assessments (or components):

- In-class test (30%+10%).
 - 30% goes to an in-class test in Teaching Week 6
 - 10% goes to weekly online mini-quizzes
- Final exam (60%) in Final exam week
 - True/false
 - Theory description
 - Problem solving
 - Open ended questions
 - Multiple choice

LECTURE 1

DATA & DATA REPRESENTATION

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DATA

- the meaning and types of data
- sources of data
- the scales of measurements for data

DATA REPRESENTATION TECHNIQUES AND TOOLS

- analyze the quantitative and qualitative data;
- display data in the form of table;
- display data in the form of graph.

What is data? (1)

- **Data** –

- the facts and figures that are collected, analyzed and summarized.

Examples: data about people, countries, employees
nature, universities, number of products sold, costs, prices,
movies, cars, hospitals, registration numbers, tax codes etc

What is data? (2)

- Data may be obtained through **already existing-sources** or through **statistical studies**.
 1. *already existing-source*:
Salaries, sales, advertising costs, inventory levels can be disclosed from a company,
 2. *from a statistical study*:
an experiment, a questionnaire, a survey, etc

- **Primary data** – the data that are obtained as a result of conducting a questionnaire, a survey, an interview, an observation, etc.

Examples: _____

- **Secondary data** – the data that come from existing sources. Government institutions, healthcare facilities, Internet and others can provide a great deal of information in a ready-to-estimate format.

Examples: _____

Questions:

What data is more costly (expensive):
primary or secondary?

What data is more reliable (trustworthy):
primary or secondary?

Table 1 A data set for 8 US Colleges & Universities

College/ University	Enroll- ment	Type	Control	Tuition(\$)		Room & Board (\$)
				Resident	Nonres-t	
Univ. of Alabama	23,838	Coed	Public	5,278	15,294	5,380
Westminster College	953	Coed	Private	15,030	15,030	6,140
Univ. of Colorado	31,399	Coed	Public	5,643	23,539	8,300
Columbia College	1,446	Women	Private	20,302	20,302	6,022
Texas A&M Univ.	45,380	Coed	Public	6,966	15,216	7,660
St. John's Univ.	2,044	Men	Private	24,924	24,924	6,496
Yale Univ.	11,416	Coed	Private	33,030	33,030	10,020
Meredith College	2,139	Women	Private	21,200	21,200	5,940

Source: "Accredited US Senior Colleges and Universities" *The 2007 Information Please Almanac*.
<http://www.infoplease.com/edu/colleges>

Q: What are the components of the statistical table?

- **Element** – the entity or item on which data are collected.
Examples: Westminster College, Yale Univ., etc
- **Variable** – a characteristic of interest for an element.
Examples: Enrollment, type, etc
- **Observation** – a set of measurements collected for a particular element.
Examples: 953, coed, public, \$6,140, etc

Main types of data



- **Qualitative data** provide labels or names for variables. They can be nonnumeric descriptions or numeric codes.

Examples: Coed, Public, etc

- **Quantitative data** show an amount of variables. They indicate either “how much” or “how many” of something.

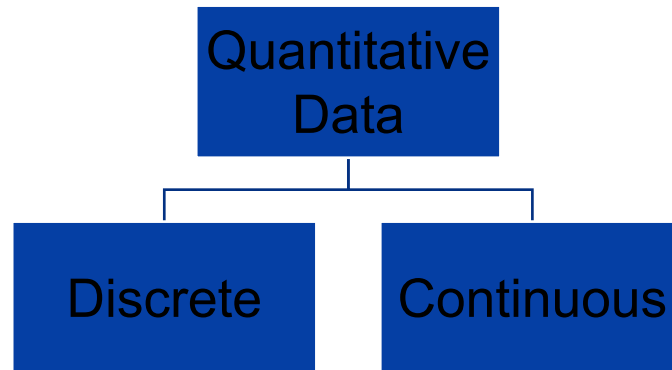
Examples: 953 students, \$6,140 for Room & Boarding, etc

Question:

- Consider **this room** as an element.

Are its variables such as,

Names of students	quantitative or qualitative?
Mode of students	quantitative or qualitative?
Number of students	quantitative or qualitative?



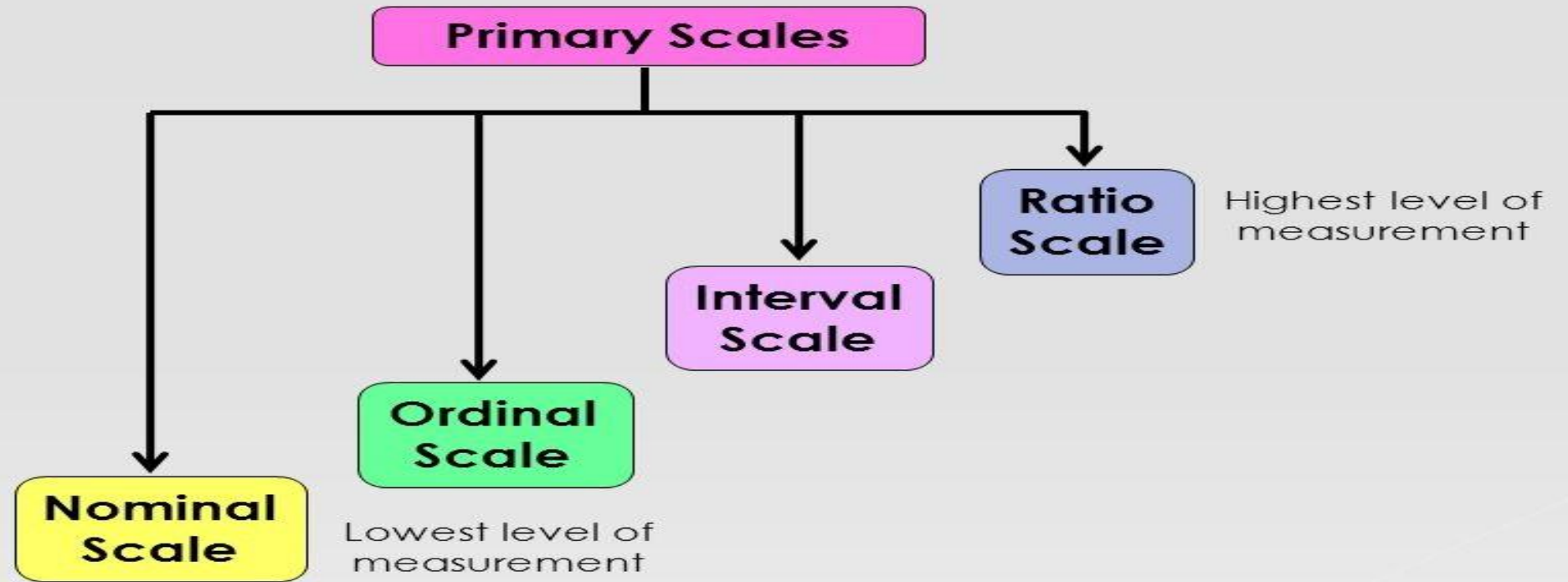
- **Discrete data** – the data obtained as a result of counting.

Examples: Number of enrolled students: 500, 1000, 2458, etc.

- **Continuous data** – the data that can take any value within a continuum, limited only by the precision of the measurement instrument.

Examples: Length or height of some object: 5 cm, 5.35 cm,

Scales of Measurement



SM for Qualitative Data (1)

- **Nominal scale** – a scale of measurement that uses name or label to define a characteristic of an element.



NOMINAL

****Nominal sounds like name****



Notes

- Lowest level of measurement
- Discrete categories
- No natural order
- Categorical or dichotomous
- May be referred to a qualitative or categorical

Examples

- Gender
 - ✘ 0 = Female
 - ✘ 1 = Male

Dichotomous
- Group Membership
 - ✘ 1 = Experimental
 - ✘ 2 = Placebo
 - ✘ 3 = Routine

Categorical
- Marital status, colour, religion, type of car ...

SM for Qualitative Data (2)

- **Ordinal scale** – a scale of measurement that is nominal and allows ranking or ordering the data according to some criteria.



ORDINAL

****Ordinal sounds like order****



Notes

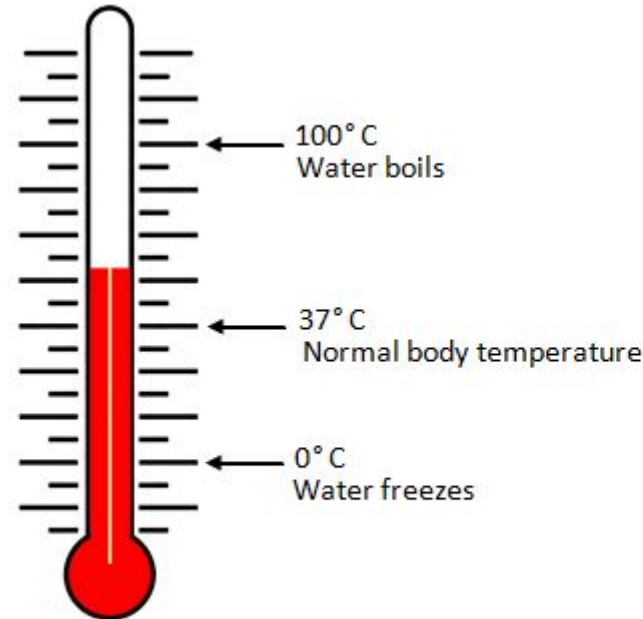
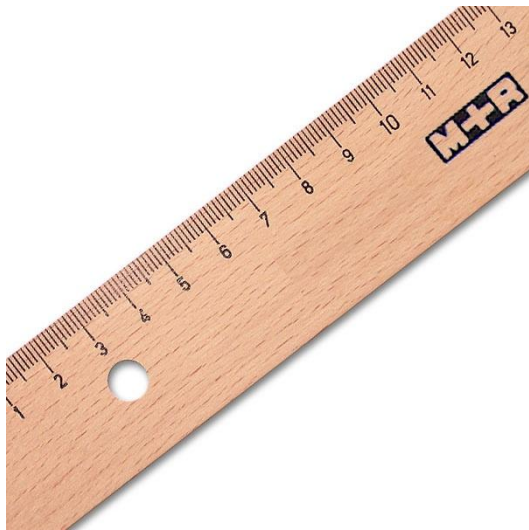
- **Ordered categories**
- Relative rankings
- Unknown distance between rankings
- Zero is arbitrary

Examples

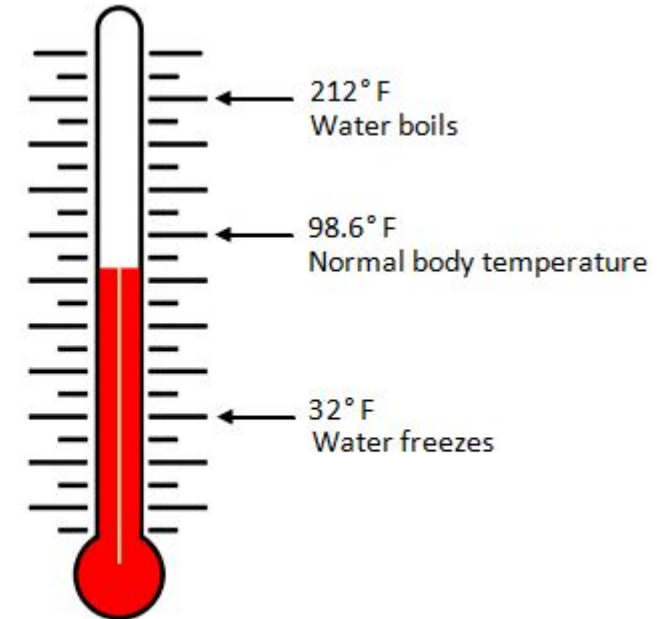
- Likert scales
- Socioeconomic status
 - × 1 = Low
 - × 2 = Middle
 - × 3 = High
- Size
 - × 1 = Small
 - × 2 = Medium
 - × 3 = Large
- Size, ranking of favorite sports, class rankings, wellness rankings

SM for Quantitative Data (1)

- **Interval scale** – a scale of measurement that is ordinal and intervals between data can be used to compare variable observations.



Celsius Thermometer



Fahrenheit Thermometer

INTERVAL



Notes

- Ordered categories
- Equal distance
 - Can measure differences
- **Zero is arbitrary**
 - Temperature
 - ✦ Celsius or Fahrenheit
 - Elevation
 - Time

Possible Measures

- All ordinal tests
- Mean
- Standard deviation
- Addition and subtraction
 - *Cannot multiply or divide*

SM for Quantitative Data (2)

- **Ratio scale** – a scale of measurement that is interval and allows considering the ratio of two data values.



RATIO



Notes

- Precise, Ordered, Exact
- Equal intervals
- **Natural zero**
 - ✦ Weight
 - ✦ Time
 - ✦ Degrees Kelvin

Possible Measures

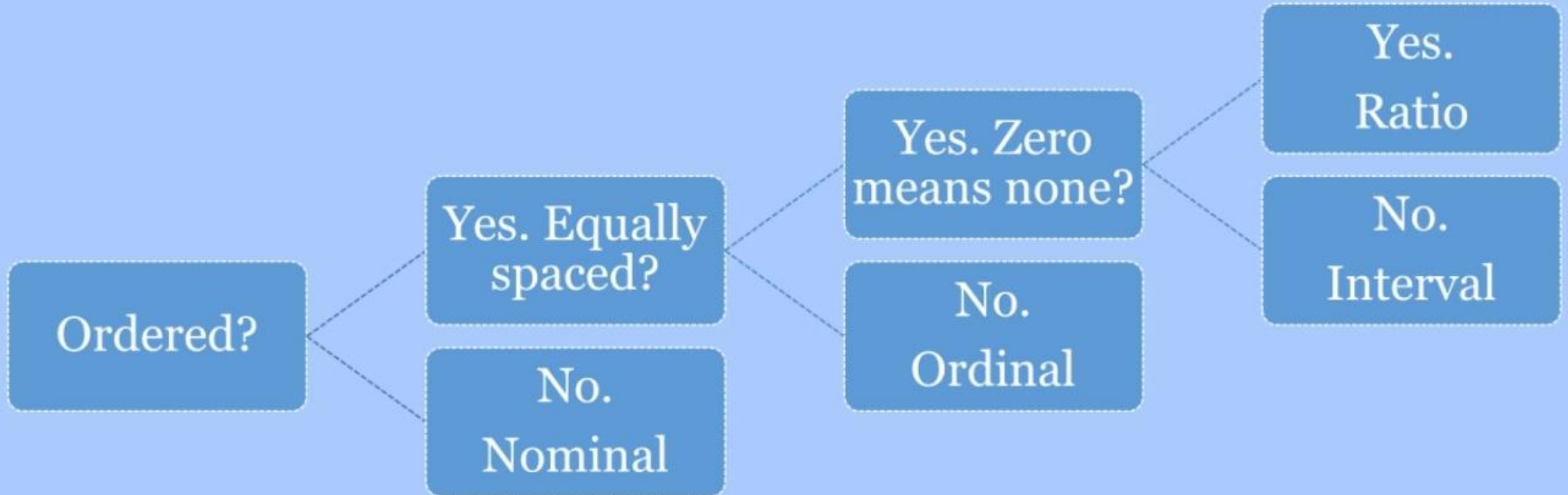
- **All** operations are possible
 - Descriptive and inferential statistics
- **Can** make comparisons
 - An 8 kg baby is twice as heavy as a 4 kg baby
- **Can** add, subtract, multiply, divide (ratios)

CHARACTERISTICS OF LEVELS OF MEASUREMENT



	Nominal	Ordinal	Interval	Ratio
Labeled	<input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> Yes
Ordered	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> Yes
Known difference	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> Yes
Zero is arbitrary	N/A	<input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Zero means none	N/A	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Yes

LEVEL OF MEASUREMENT DECISION TREE



- **Raw data** – the data that has not been processed (analyzed, categorized, put in a table) yet.

Example:

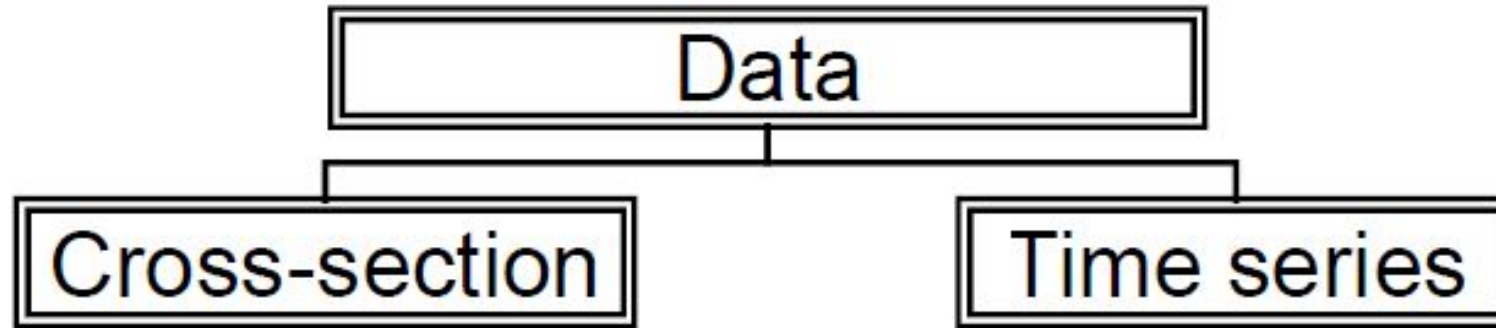
Number of students (total 100), who attended 12 lectures: 100, 98, 85, 76, 64, 55, 76, 87, 96, 98, 99 & 100

- **Aggregate data** – the data that has already been processed to serve one's goal.

Example:

On four lectures, the attendance of students was lower than 80 and on other eight lectures it was greater or equal to 80.

(the raw data above have been analyzed).



Cross-section data – data collected at the same point in time or based on the same period of time.

Example:

Numbers of different models of automobiles produced by GM Uzbekistan in 2020.

Time series data – data that consist of observations collected at regular intervals over time.

Example:

Number of automobiles produced by GM Uzbekistan during the period from 2010 to 2020.

- **Population** – a collection of all elements of interest in a particular study.
- **Sample** – a subset of the population

Example:

All University students vs CIFS students

CIFS students vs 3CIFS1 group

Note: Data about a large group of elements are difficult to collect due to various restrictions, therefore only a small part of the group is considered.

PART II. Data representation tools and techniques

Section I Qualitative data:

- **Case 1.** Research conducted on 50 individuals' choice on GM Uzbekistan automobiles.

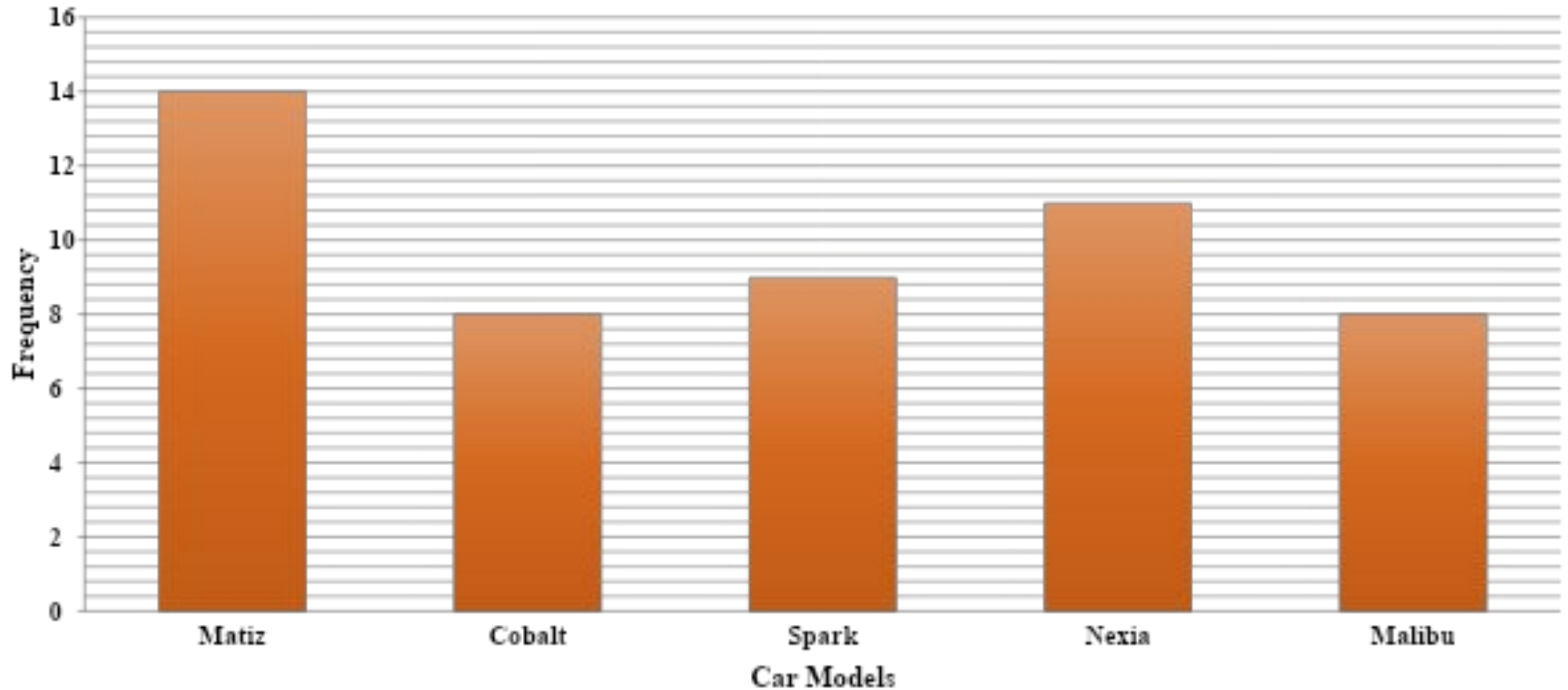
Table 1. Data from a sample of 50 new-car purchases

Nexia	Cobalt	Nexia	Nexia	Spark
Matiz	Spark	Nexia	Matiz	Cobalt
Nexia	Cobalt	Nexia	Matiz	Spark
Matiz	Spark	Malibu	Cobalt	Cobalt
Matiz	Matiz	Malibu	Matiz	Malibu
Cobalt	Malibu	Matiz	Cobalt	Matiz
Matiz	Nexia	Malibu	Malibu	Spark
Nexia	Spark	Malibu	Matiz	Matiz
Malibu	Matiz	Matiz	Nexia	Cobalt
Nexia	Spark	Nexia	Spark	Spark

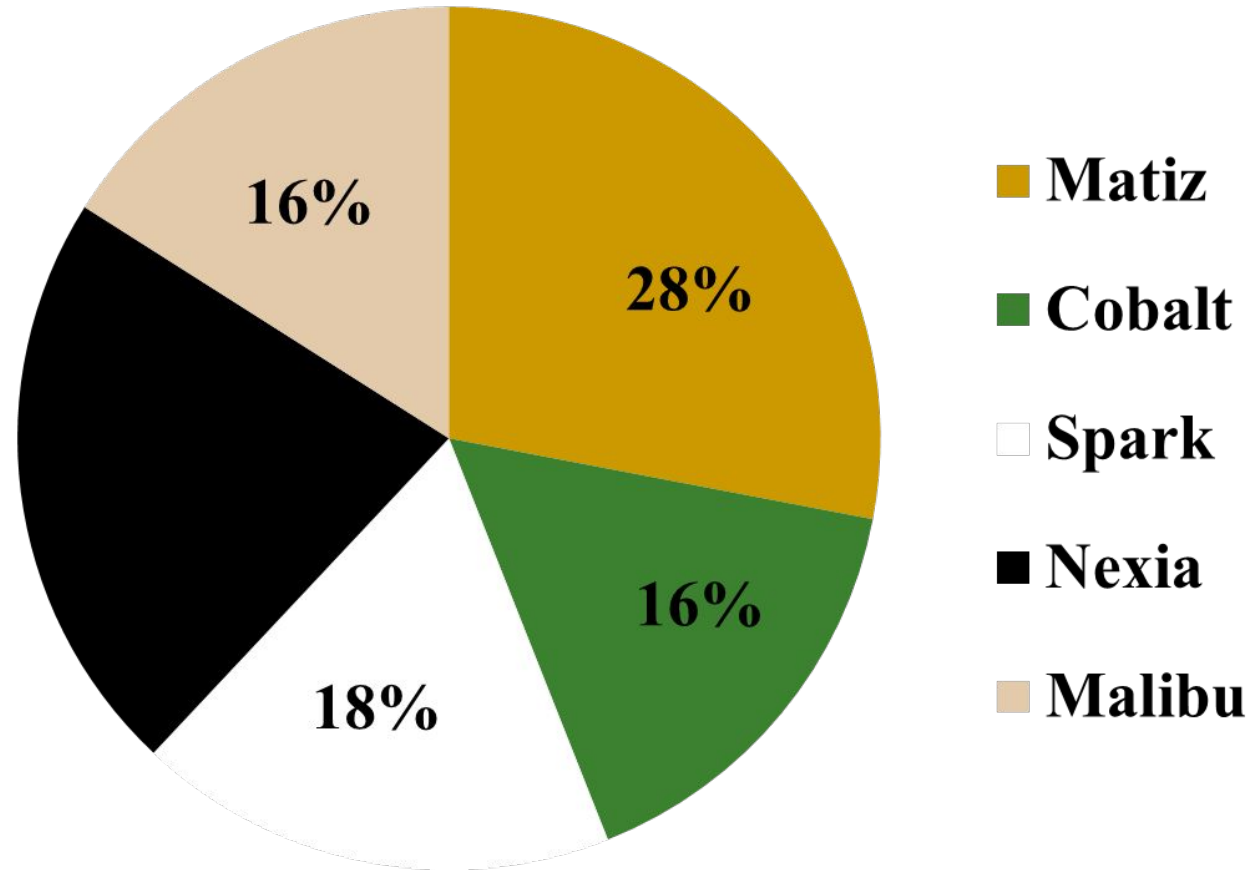
• Frequency and Relative frequency tables

Automobile purchased	Tally	Frequency	Relative frequency
Matiz		14	0.28
Cobalt		8	0.16
Spark		9	0.18
Nexia		11	0.22
Malibu		8	0.16
Total		50	1.00

Graphical Method: Bar graph



Graphical Method: Pie chart



- **Case 2.** The store sold the following numbers of refrigerators on 30 different days. Analyze and present the data in tabular and graphical forms.

5	0	15	1	23	6	5	18	8	10
2	10	6	0	0	11	2	13	6	3
19	7	12	1	5	16	0	14	4	8

Frequency, relative and cumulative frequency table

Range = $23 - 0 = 23$; Group width = $23:5 = 4.6 \approx 5$;

Thus, make the group width = 5 for convenience.

Number of car sold	Tally	Frequency	Cumulative frequency	Relative frequency
0-4		10	10	0.33
5-9		9	19	0.3
10-14		6	25	0.2
15-19		4	29	0.13
20-24		1	30	0.03
Total		30		1.00

Stem-and-Leaf diagram

A store sold the following numbers of refrigerators on 30 days:

5	0	15	1	23	6	5	18	8	10
2	10	6	0	0	11	2	13	6	3
19	7	12	1	5	16	0	14	4	8

1-Method

0		5016582600263715048
1		5800139264
2		3

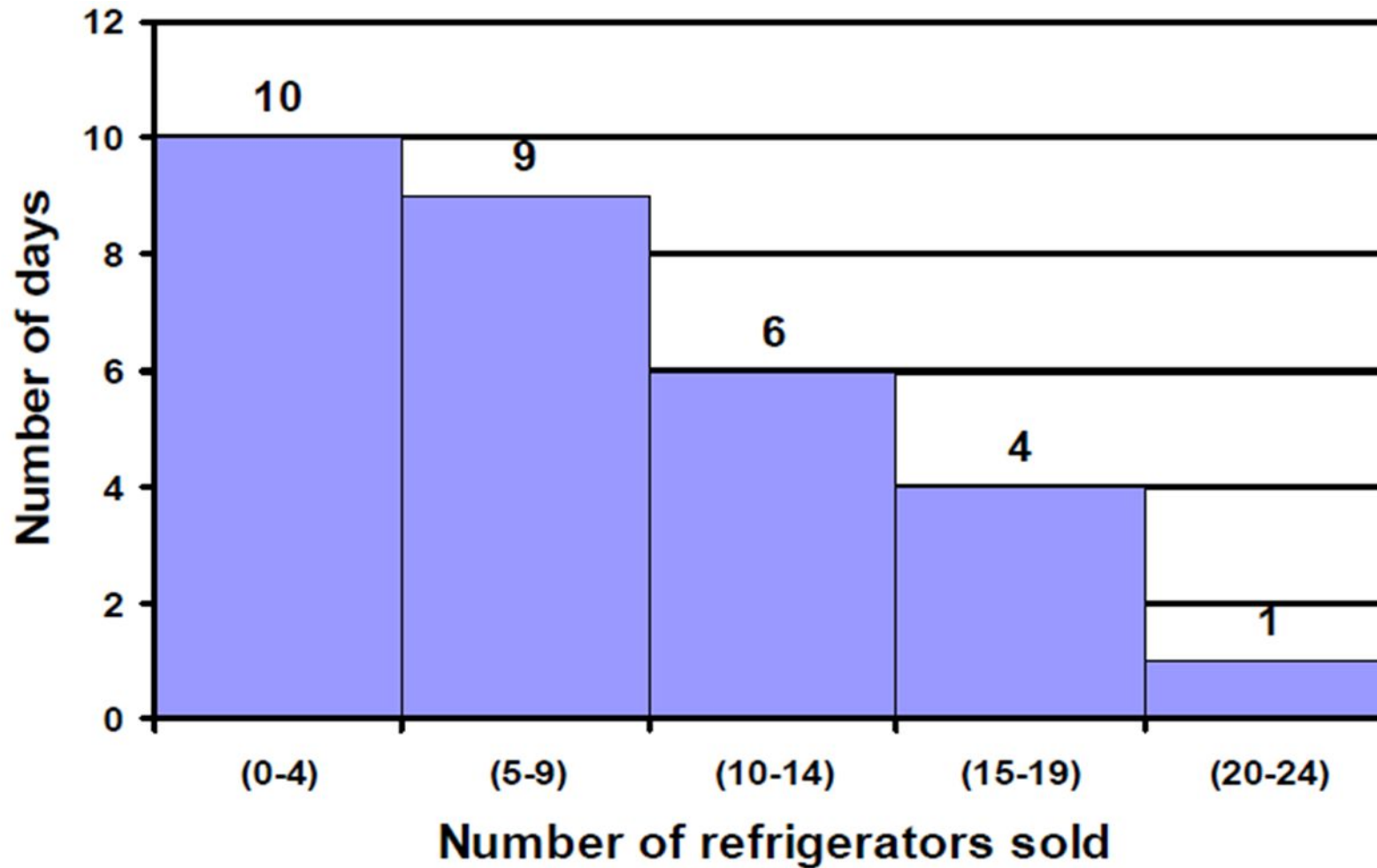
Stem = 10, Leaf = 1

2-Method

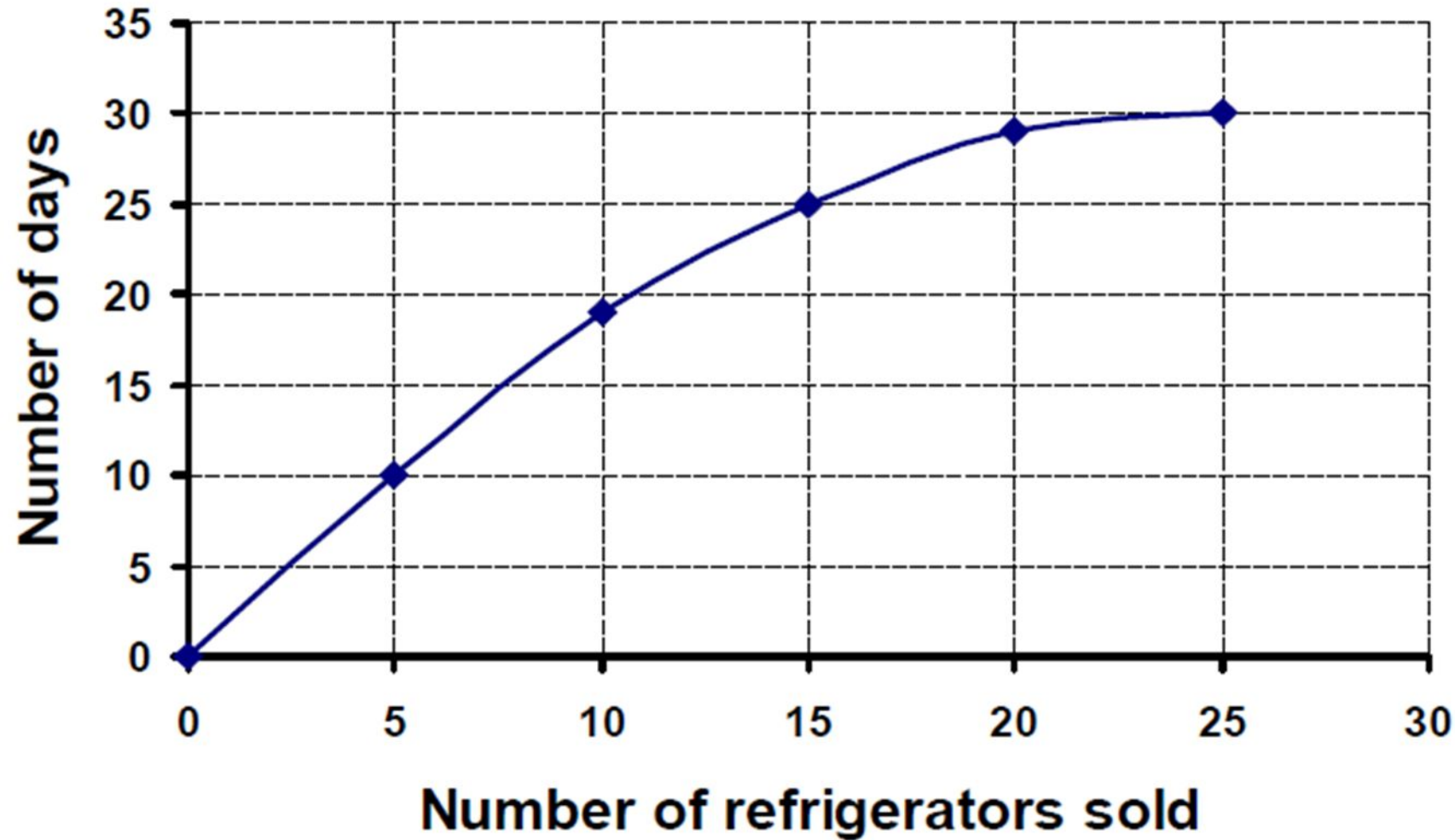
0		0120023104
0		56586758
1		001324
1		5896
2		3

Graphical Method: Histogram

Histogram



Cumulative frequency

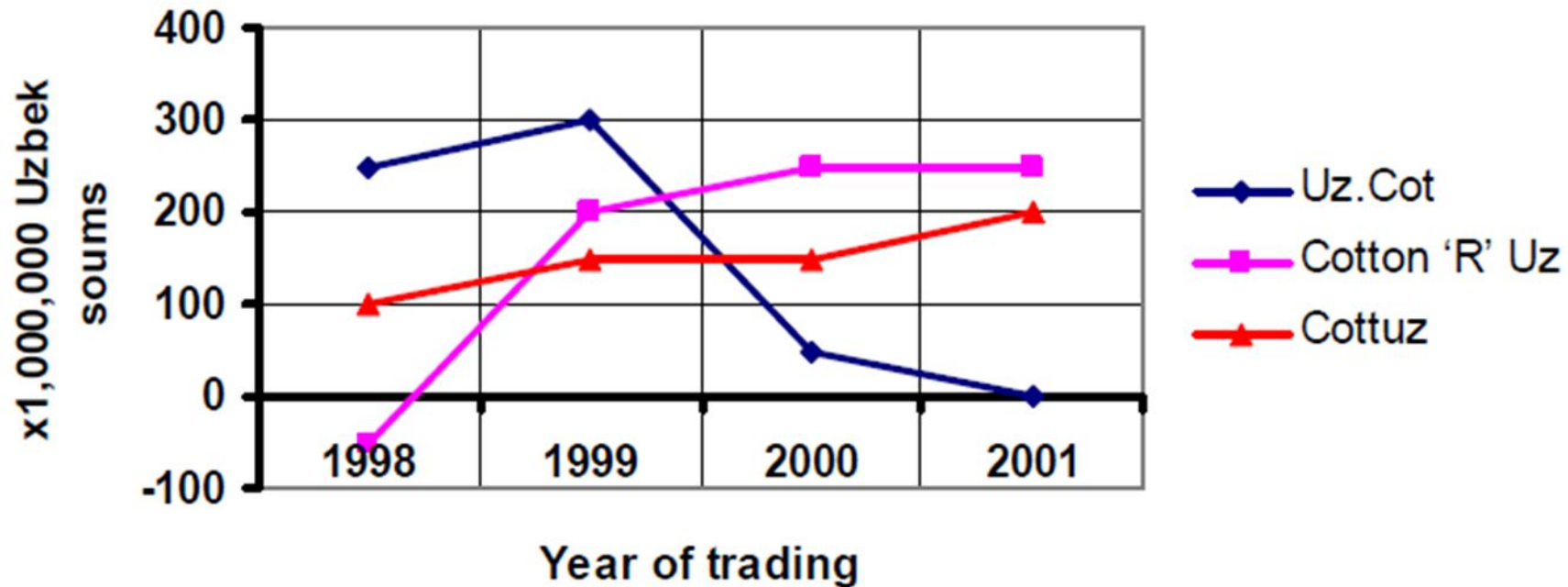


Case 3. the following table shows the profit made by three cotton companies over four years. Display this data graphically

Name/Year	1998	1999	2000	2001
Uz.Cot	250	300	50	0
Cotton 'R' Uz	- 50	200	250	250
Cottuz	100	150	150	200

Quantitative data: Time series

Times series graph (line graph)



Case 4:

The company XYZ produces three types of products (A, B, and C). The total sales of the Product A in 1999, 2000 and 2001 were £40,000, £45,000 and £50,000, of the Product B were £30,000, £40,000 and £50,000 and of the Product C were £50,000, £55,000 and £60,000 respectively. Construct a table for this data and illustrate it with a help of bar chart.

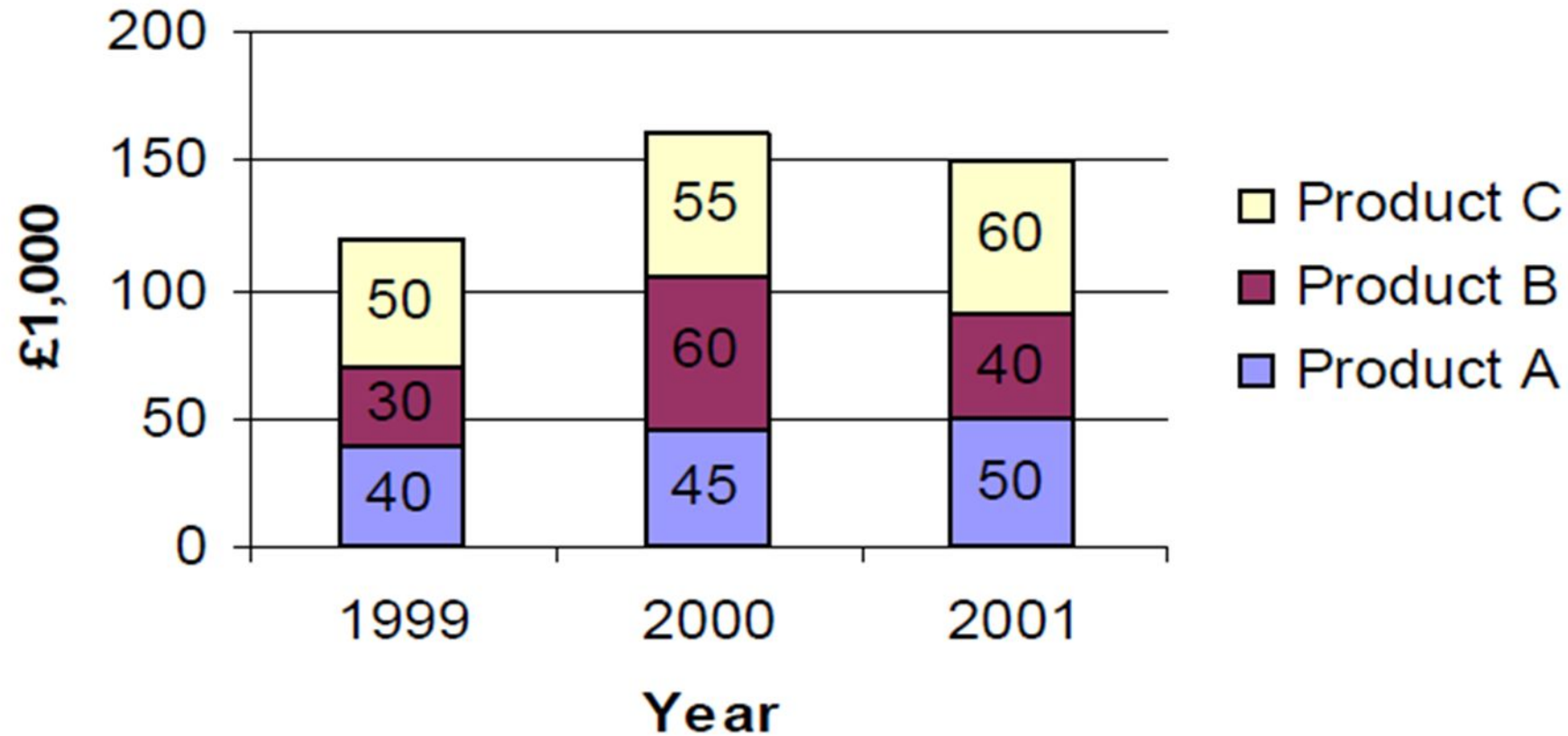
Tabular form

Product/Year	1999	2000	2001
A	40	45	50
B	30	60	40
C	50	55	60

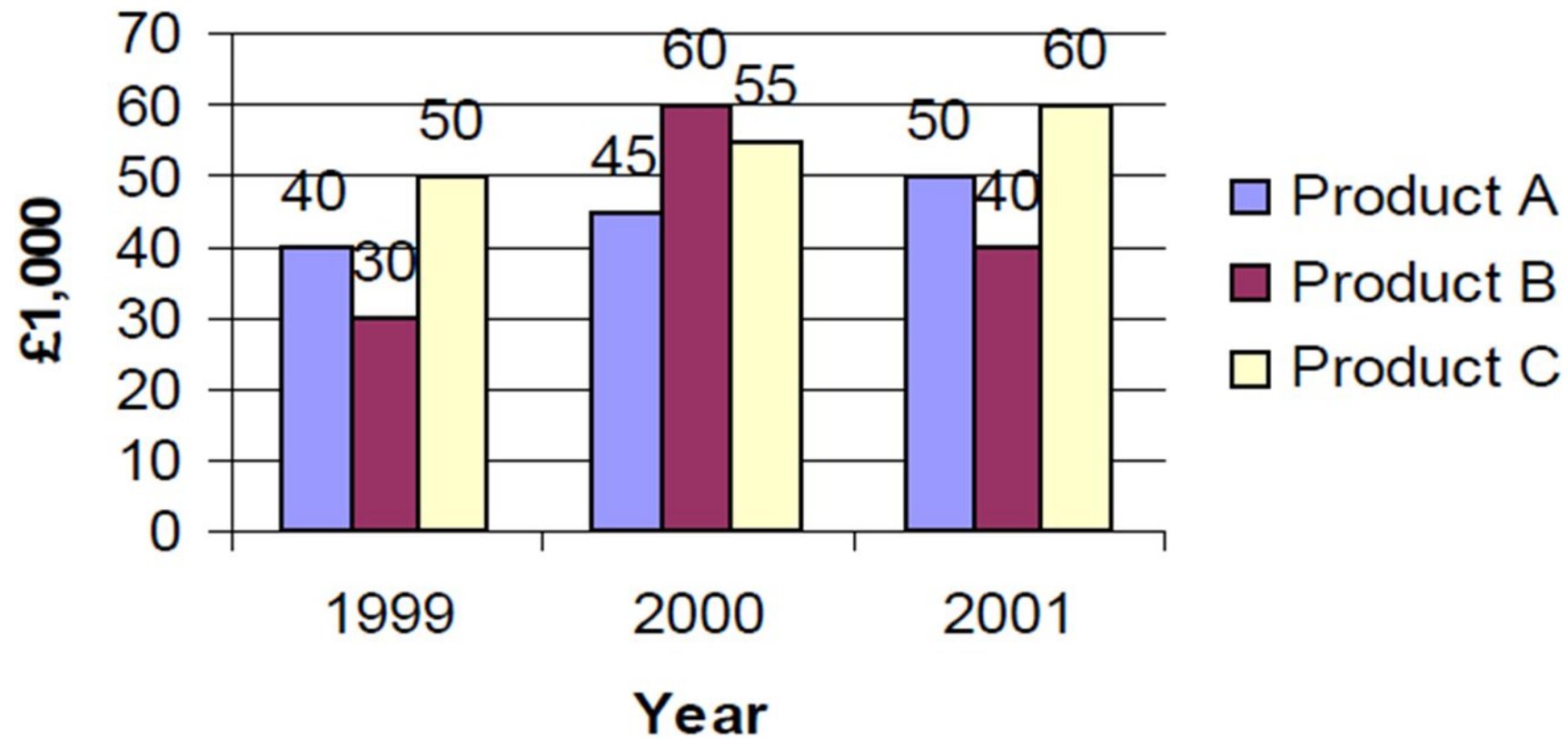
or

Year/Product	A	B	C
1999	40	30	50
2000	45	60	55
2001	50	40	60

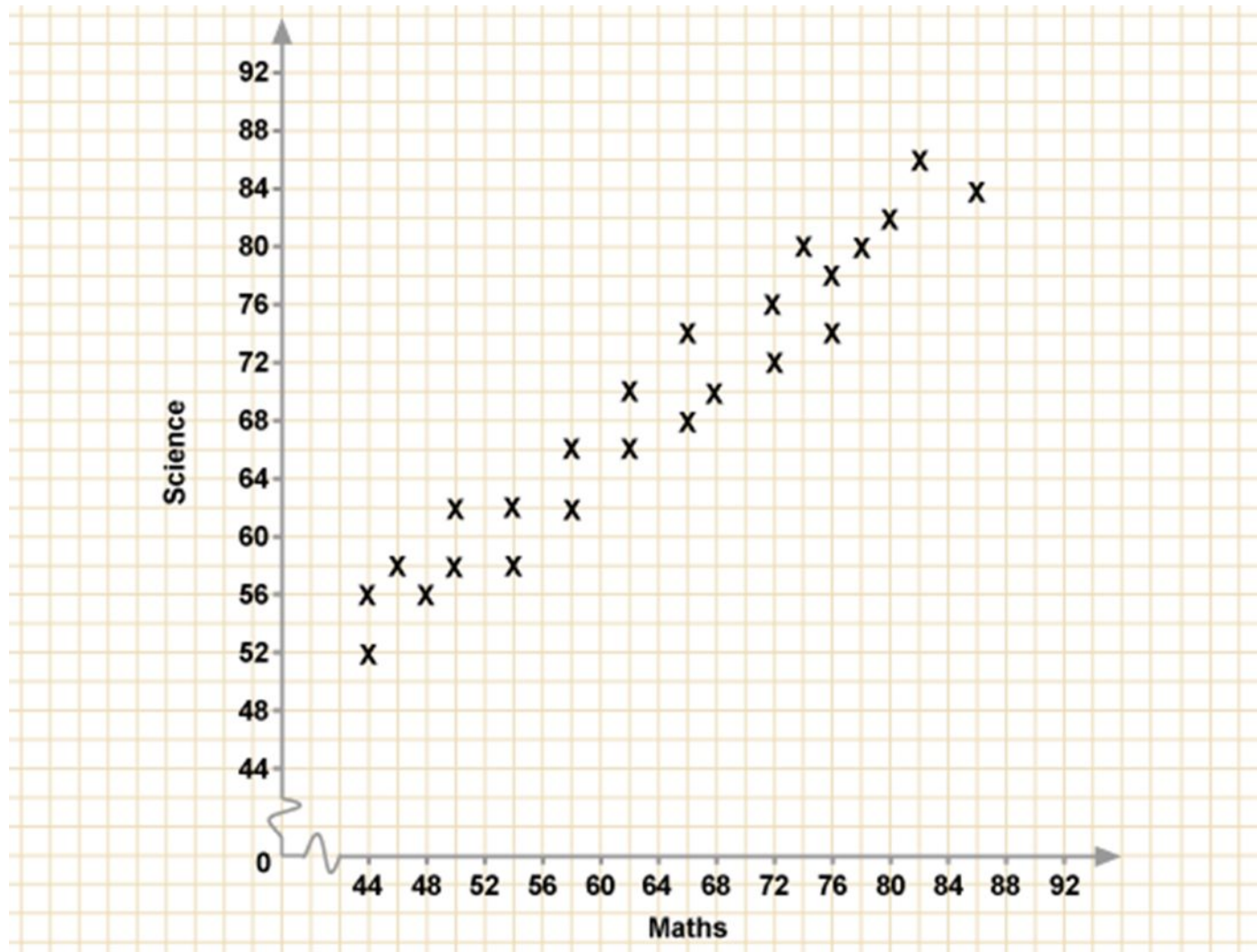
Component bar graph



Multiple bar graph



Scatter graph



Concluding remarks:

Today, you learnt:

- a) The components of statistical table;
- b) The main types of data;
- c) The scales of measurement of the data
- d) analyze statistical data;
- e) use tabular methods to display data
- f) use graphical methods to display data

- Jon Curwin..., “Quantitative Methods...”, Chapters 1-2
- Glyn Burton..., “Quantitative Methods...”, Chapter 1
- Richard Thomas, “Quantitative Methods...”, Chapter 1.1
- Mik Wisniewski..., “Foundation Quantitative...”, Chapter 3
- Clare Morris, “Quantitative Approaches...”, Chapter 3

Essential readings (Part 2):

- Jon Curwin..., “Quantitative methods...”, Chapter 4
- Glyn Burton..., “Quantitative methods...”, Chapter 1
- Richard Thomas, “Quantitative methods...”, Chapter 1.2-1.4
- Mik Wisniewski..., “Foundation Quantitative...”, Chapters 5-6
- Clare Morris, “Quantitative Approaches...”, Chapter 5
- Louise Swift “Quantitative methods...”, Chapter DD1.