Lecture 13: Decision-Making and Decision Support Systems

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BIS4410

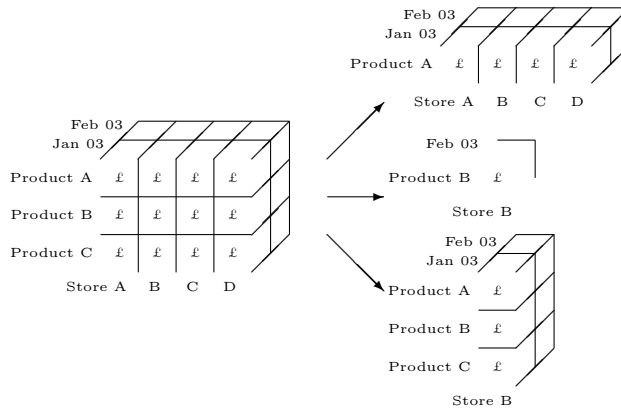## Contents

1 Decision Support Systems

Decision Support Systems

Definition 1 (Decision Support Systems (DSS))**.** Information systems designed to support mangers and organisations in making-decisions

- Typical components:

  1. Database (local, shared, internal, external)
  2. Knowledge base (e.g. ontology, mathematical or statistical model)
  3. User interface

- DSS can be classified by levels: Operational, tactical, strategic (executive)

Remark 1. *Closely related to DSS are the Management Support Systems (MSS)*

Multivariate Data and Databases

Feb 03
Jan 03
Product A £ £ £ £
Store A B C D

Feb 03
Jan 03
Product A £ £ £ £
Product B £ £ £ £
Product C £ £ £ £
Store A B C D

Feb 03
Product B £
Store B

Feb 03
Jan 03
Product A £
Product B £
Product C £
Store B

Data-driven models
Data is used as input to data-driven models

2 Motivation for data-driven modelling

Hidden relations in data

- Suppose you observe the following data:

x	y
0	1
1	2
2	4
3	8

- Can you suggest what should be the next value of y?

x	y
4	?

- You may have concluded that x and y are related by

$$y = 2^x$$

- Would it be useful to know y for each x?

Hidden relations in data

- Suppose you observe the following GBP/EUR rates:

Today	Tomorrow
0.89513	0.89966
0.89966	0.89934
0.89934	0.89963
0.89963	0.89771

- Can you suggest what should be the next value of y?

Today	Tomorrow
0.89771	?

- Is there a relationship between x (today) and y (tomorrow) rates of GBP/EUR?

- Would it be useful to know y for each x?

- Hint: Consider buy or sell decisions.

3 Techniques and applications for data-driven modelling

Data-Mining

Definition 2 (Data-mining)**.** is the process of analysing large datasets to discover new patterns and knowledge about the underlying phenomena.

- Data is analysed and used to

  - Make predictions
  - Provide explanations

- This helps to make informed and better decisions

Remark 2 (Structured and unstructured of data)**.** *Data can be*

Structured *: numerical, ordinal, nominal*

Unstructured *: text, audio, video*

Techniques used for structured DM

- Statistical modelling of relationships in data:

  - logistic regression
  - linear regression
  - non-linear regression
  - neural networks

Table 1: GBP/EUR rates 4–8 Jan, 2010

| Date	Today	Tomorrow
2010/01/04	0.89513	0.89966
2010/01/05	0.89966	0.89934
2010/01/06	0.89934	0.89963
2010/01/07	0.89963	0.89771
2010/01/08	0.89771	?

- Clustering and classification
  - hierarchical clustering
  - k-means clustering
  - self-organising maps
- Factor analysis and complexity reduction
  - principle component analysis
  - independent component analysis
  - blind source separation

Linear regression: Detecting trends

If there are just two variables x (e.g. 'Today') and y (e.g. 'Tomorrow'), then we can use a function $f(x)$ of one variable to model y:

$$\text{Tomorrow} \approx f(\text{Today})$$
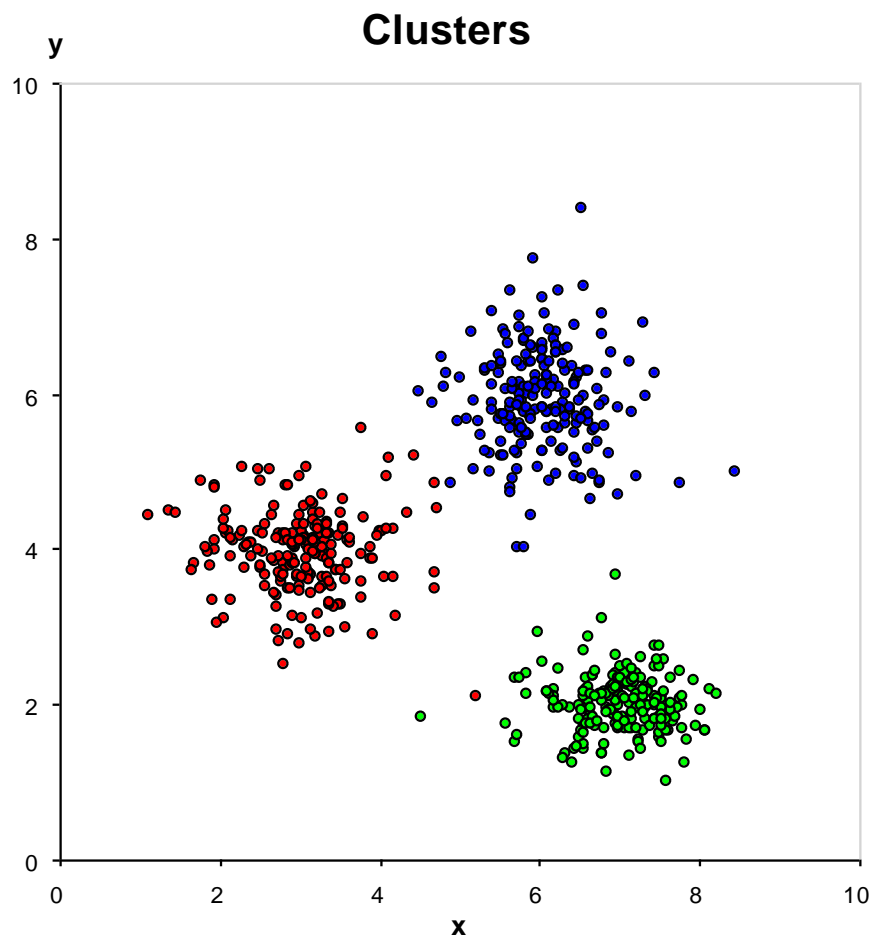
GBP / EUR Exchange rates

$$y = a + bx$$
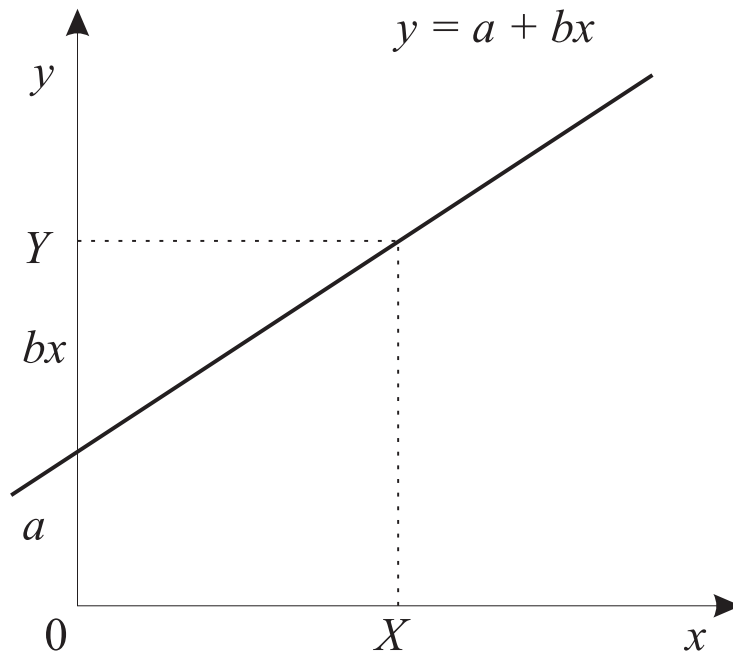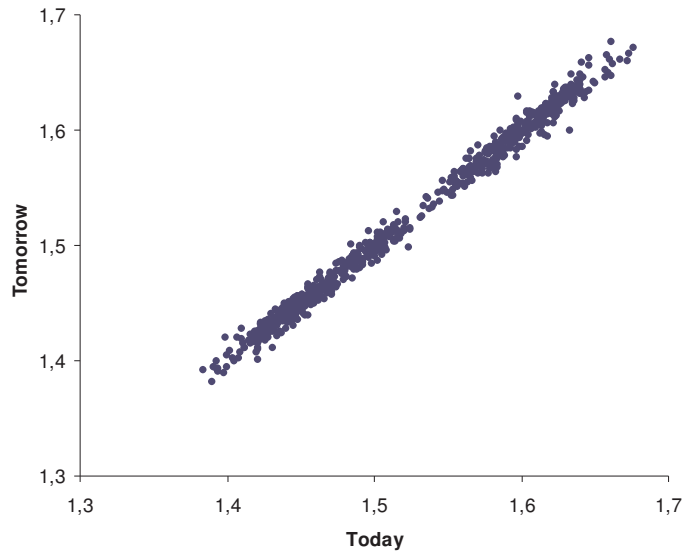
For example, we can use linear model with parameters a (intercept) and b (slope):

$$y \approx f(x) = a + b\,x$$

Clustering and classification

Case:	Age	Gender	M. Income (£ K)	M. Expenses (£ K)	Home owner	Credit score
1	21	0	2	1	0	3
2	18	1	1	2	0	1
3	50	1	6	2	1	5
4	23	0	3	1	1	4
5	40	1	3	2	0	2

- **Clusters** are groups of points close to each other.

- One of the main goals of **multivariate analysis** is to find clusters of points.

- 'Similar' customers would have small distance between them and would belong to the same group (cluster).

Main DM applications

Free :

- R Statistics and programming language
- Orange
- RapidMiner
- Weka

Commercial :

- SAS Enterprise Miner
- SPSS
- IBM InfoSphere
- Oracle DM
- Microsoft Analysis Services

Some other modelling techniques

- Numerical optimisation (linear programming, convex programming)
- Combinatorial optimisation (genetic algorithms, particle swarm filters)
- Stochastic simulation (Monte-Carlo models)
- Text-mining

Additional Reading

1. Metaxiotis and Psarras (2004):

   The contribution of neural networks and genetic algorithms to business decision support: Academic myth or practical solution?

References

Metaxiotis, K., & Psarras, J. (2004). The contribution of neural networks and genetic algorithms to business decision support: Academic myth or practical solution? *Management Decision*, *42*(2).