Bus 273:
Statistical Analysis For Business

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About These Slides

- The present slides are not self-contained; they need to be explained and discussed. This will be done in the lectures.

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- The slides were produced using LaTeX and R (the R project; www.R-project.org) on a GNU/Linux system.

- R files used for this course are available upon request.

PART I:

Introduction to Statistics;

Basic Concepts;

Descriptive Statistics

Chapter 1:

Introduction

1.1 Some Examples

1. Scratching down numbers.

Students in a first course of statistics were asked to enter their gender and body-height into a list. The result was:

(m,167)(m,181)(m,178)(m,180) (f,160) (f,174) (f,170) (f,173) (f,168)
(f,165) (m,195)(m,185)(m,183)(m,192)(m,195)(m,188) (f,168) (f,160)
(f,169) (f,175) (f,157) (f,162) (f,172) (f,160) (m,173) (f,157) (m,170)
(f,170) (f,168) (m,182)(m,175) (f,165) (m,185) (f,170) (m,182)(m,190)
(m,188) (f,160) (m,188)(m,182) (f,177) (f,165) (f,163) (f,160) (f,160)
(f,170) (m,175)(m,176)(m,183) (f,170) (f,170) (f,169) (m,181)(m,177)

Here, f=female and m=male, and the body-height is in centimeters. What can you tell from these data?

1.1 Some Examples

1. Scratching down numbers.

female:

15	77
16	0000002355588899
17	00000023457

male:

16	7
17	0355678
18	0112223355888
19	0255

Here, **15** | 7 = 157 cm. Such a diagram is called a **stem-and-leaf display**, or simply **stemplot**.

1.1 Some Examples

2. Averages.

Averages are very important. They beware us from getting lost in information. But we have to be careful with averages.

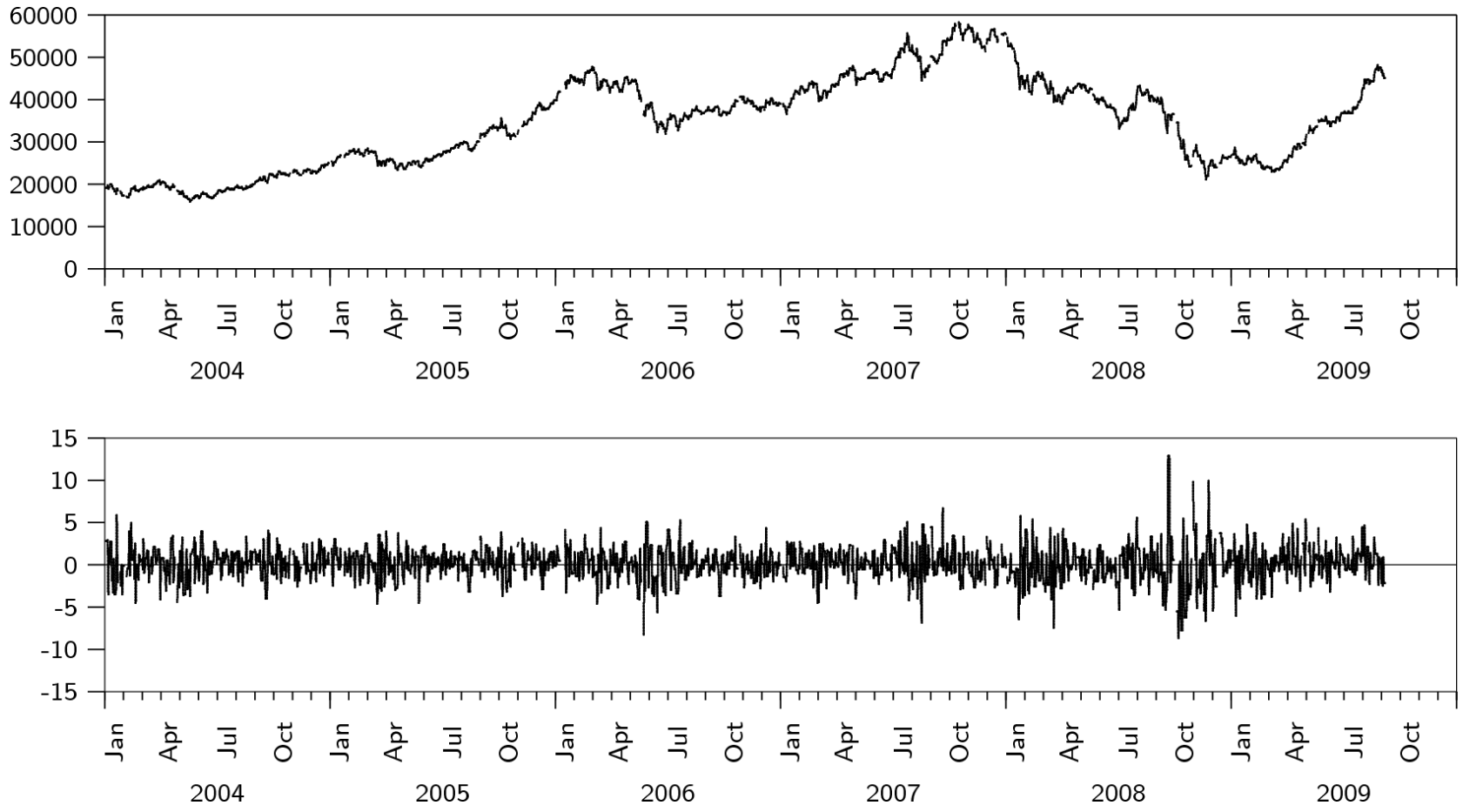
Consider a share of stock. Its price. . .

. . . 2 years ago:	\$ 100
. . . 1 year ago:	\$ 150
. . . today:	\$ 90

What is the average annual gain or loss of the stock in percent?

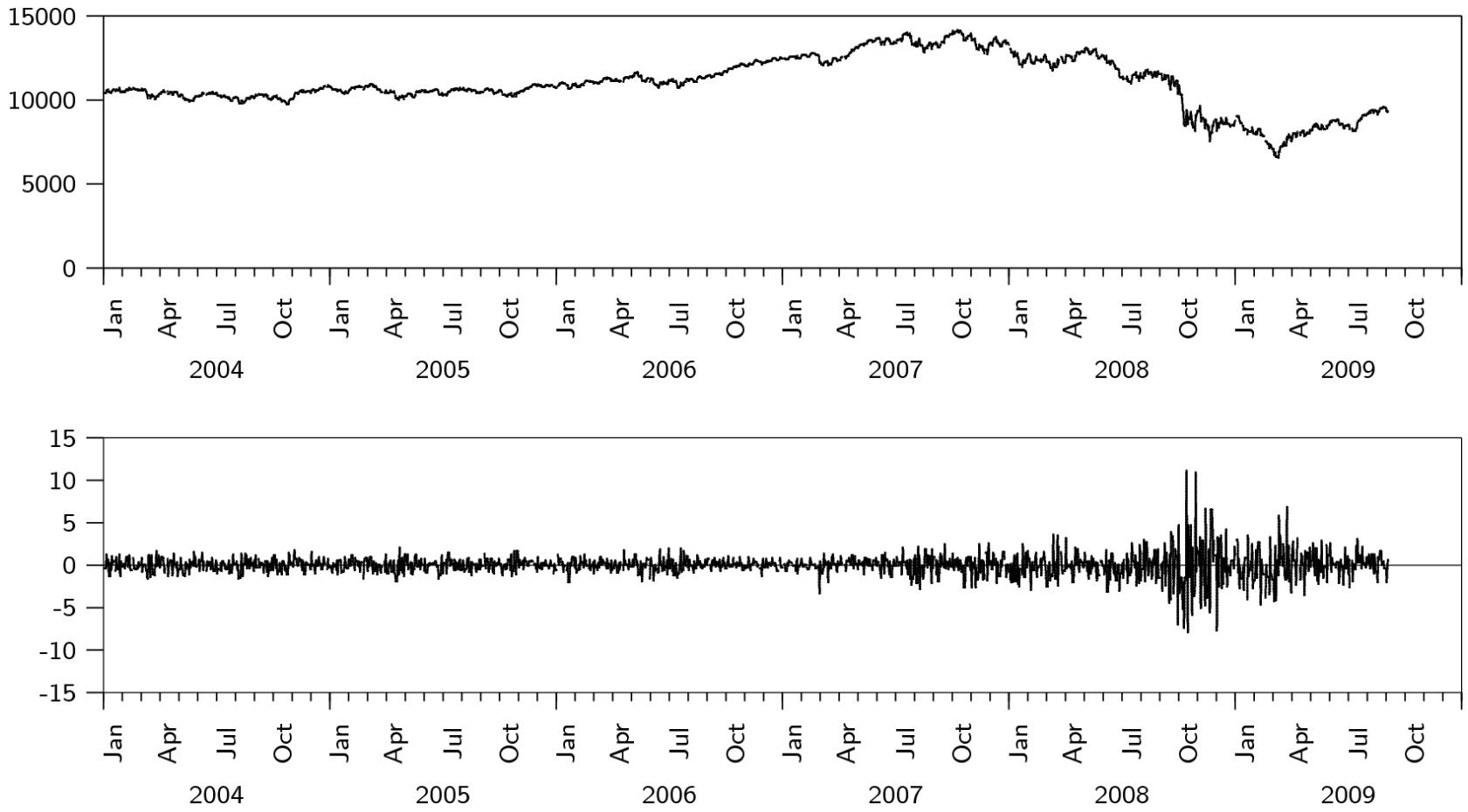
1.1 Some Examples

3. A stock index and its daily returns — İMKB 100.



1.1 Some Examples

3. A stock index and its daily returns — Dow-Jones.



1.1 Some Examples

4. Supermarket customer behaviour.

Effective management requires understanding your customers.
Buying pattern of supermarket customers:

- Total expenditure?
- Combinations of goods?
- Acceptance of special offers?
- Customers' expectations?

1.1 Some Examples

5. Credit card management: Is a person credit-worthy?

A bank cannot see the person in detail. . . But there are clues:

- age, education, professional environment
- previous payment behaviour
- stability of residential area
- number of cellular phone contracts

How can we exploit these clues? Data protection issues?!?

1.1 Some Examples

6. A quality of service problem.

- How long is the waiting time for customers phoning a call center until their call is answered?
- Can this service process be improved? How?
- A sample of waiting times of size $n = 10$ was:

  86, 21, 76, 20, 29, 198, 94, 17, 225, 78

  What can we do with this data set? Is a sample size of 10 enough?

1.1 Some Examples

7. A public opinion poll.

- After hurricane Katrina, are people in favour of rebuilding New Orleans?
- Result of a poll: 384 of 609 adults (that is, about 63%) polled by telephone September 5-6, 2005, said they believe New Orleans should be rebuilt.
- What can we do with this information? — What does it mean? — Can it answer our initial question?

1.1 Some Examples

8. Television audience rating.

- Ayşe hanım is the program manager of a television channel.
- Her goal is that, in the future, the rating of "Çiçek Taksi" should be at least 10%.
- One evening, 350 televisions in 4000 randomly selected households were tuned into this program.
- Can we conclude that Ayşe hanım has not reached her goal?

1.2 Statistics as a Science

The term "Statistics".

The word "statistics" can refer to:

- a science ("statistics" is singular)
- results of this science ("statistics" is plural)

1.2 Statistics as a Science

Statistics is the science of reasoning with numbers.

Statistics is concerned with

- detecting the structure in data sets.
- facilitating the communication between people.
- making well-founded decisions.
- forecasting the future.
- providing a link between theory and observations.
- determining what (numerical) information is needed to solve a given problem.

1.2 Statistics as a Science

On being misled by numbers.

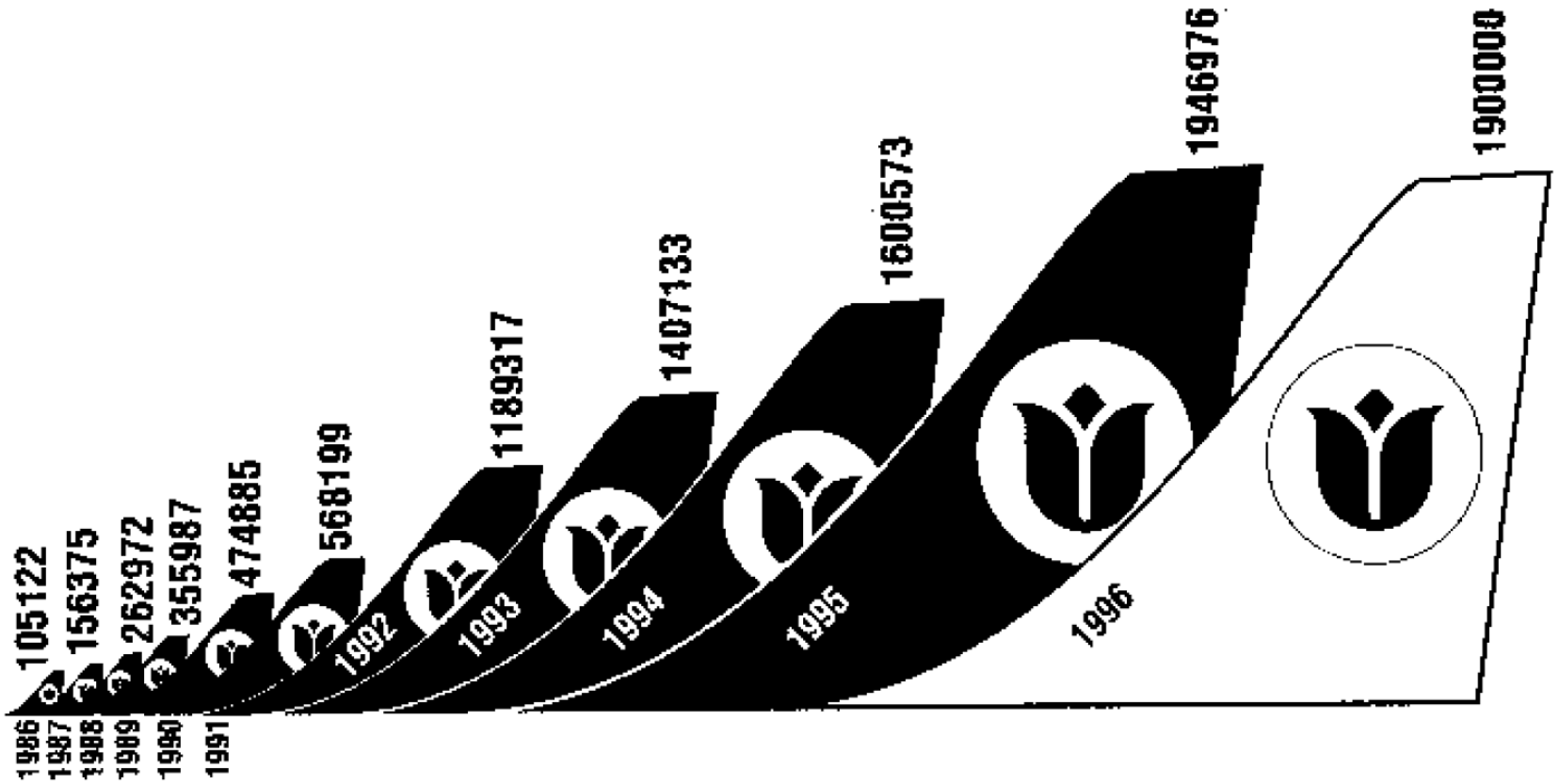
İstanbul'un nüfusu (2000):

$$\boxed{9\,822\,210}$$

(Source: Türkiye İstatistik Yıllığı 2005, TÜİK)

1.2 Statistics as a Science

Images can also be misleading:



1.2 Statistics as a Science

Statistics and the Computer.

- Although some techniques can be done using paper and pencil, statistics is a hi-tech science: It needs powerful software to be effective.
- The computer does the computation.
- You have to do the reasoning yourself.

1.2 Statistics as a Science

Statistics and the Computer.

- Some problems will be solved in the lab classes, using MS-Excel.
- Please keep in mind that MS-Excel is not the only spreadsheet program (others, which are open-source: Gnumeric, KSpread, OpenOffice.org Calc, . . .)
- We recommend (for advanced users): R. Please visit:

www.R-project.org

1.3 Descriptive and Inductive Statistics

The goals of descriptive and inductive statistics.

The goal of. . .

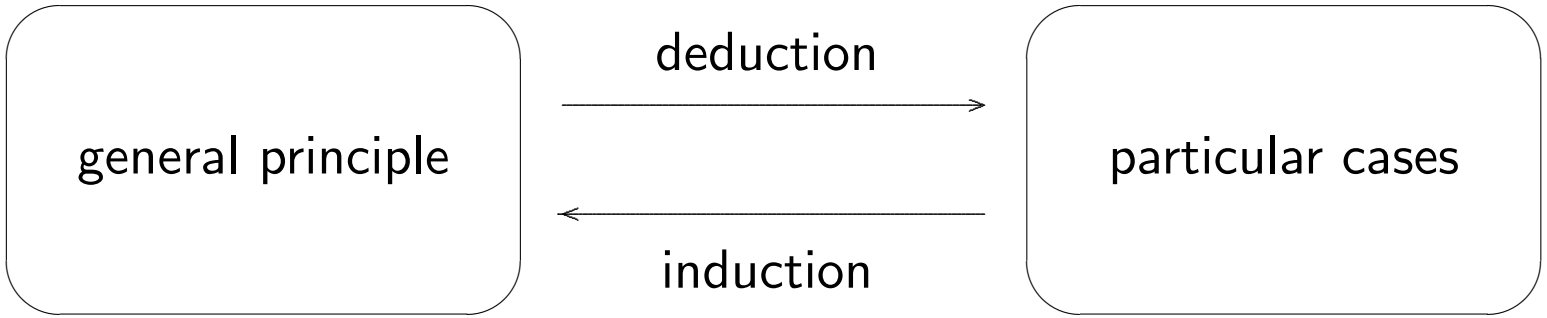
- . . . descriptive statistics is: Describe, summarize, display given data (data reduction!).

- . . . inductive statistics is: Draw conclusions from data (sample data, observations) to more general principles (the population).
  The process of drawing conclusions is called statistical inference.

1.3 Descriptive and Inductive Statistics

Conclusions.

There are two kinds of conclusions:



- In the context of inductive statistics, the "particular cases" are observed data (sample data).
- The "general principle" is a probability distribution, characterizing the entire population.

1.4 Some Historical Remarks

1. The Origins

- 2600 BC: construction of pyramids in Egypt; censuses to determine the power of the state
- population censuses for recruitment and taxation
- USA: population census to represent the states according to population (1787 Constitution)

1.4 Some Historical Remarks

2. "University Statistics"

- Hermann Conring (1606–1681): systematic description of state affairs

- Gottfried Achenwall (1719–1772):
  "Staatsmerkwürdigkeiten"
  ("phenomena of particular interest of a country or a people")
  $\longrightarrow$ "Statistik"

1.4 Some Historical Remarks

3. Political Arithmetics

- John Graunt (1620–1674):
  "Bills of Mortality of the City of London" (1662)

- William Petty (1623–1687):
  "Essays in Political Arithmetics" (1672)

- Thomas Robert Malthus (1766–1834): "An Essay on the Principle of Population, as it Affects the Future Improvement of Society" (1798)

1.4 Some Historical Remarks

4. Games of Chance

- Gerolamo Cardano (1501–1576):
  "De ludo aleae" (1560s; published 1663)
- Antoine Chevalier de Méré (1607–1685):
  questions concerning gambling
- Blaise Pascal (1623–1662)
- Pierre de Fermat (1601–1665)
- Christiaan Huygens (1629–1695)

1.4 Some Historical Remarks

5. Probability

- Jacob Bernoulli (1655–1705):
  "Ars Conjectandi" (published 1713)
- Abraham de Moivre (1667-1754):
  "The Doctrine of Chances" (1718)
- Pierre-Simon Laplace (1749–1827)
- Thomas Bayes (1702–1761): "Essay Towards Solving a Problem in the Doctrine of Chances" (1764)

1.4 Some Historical Remarks

6. Discovery of Statistical Regularity in Society

- Adolphe Quetelet (1796–1874):
  "l'homme moyen" (the average man) (1835)
- Henry Thomas Buckle (1821–1862)
- John Stuart Mill (1806–1873)
- Karl Marx (1818–1883)
- Émile Durkheim (1858–1917)

1.4 Some Historical Remarks

7. The "Statistical Revolution"

- Charles Darwin (1809–1882): "On the Origin of Species by Means of Natural Selection" (1859)
- Francis Galton (1822–1911)
- Karl Pearson (1857–1936)
- James Clerk Maxwell (1831–1879)
- Ludwig Boltzmann (1844–1906)
- Charles Sanders Peirce (1839–1914)

1.4 Some Historical Remarks

8. The Beginning of Statistical Inference

- Ronald Aylmer Fisher (1890–1961)
- Jerzy Neyman (1894–1981)
- Egon S. Pearson (1895–1980)