Data Analysis

Determination of mean foot length
Woodcut from Jacob Köbel's "Geometrei" published 1575 in Frankfurt

Siegmund Brandt

Data Analysis

Statistical and Computational Methods for Scientists and Engineers

Fourth Edition

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Preface to the Fourth English Edition

For the present edition, the book has undergone two major changes: Its appearance was tightened significantly and the programs are now written in the modern programming language Java.

Tightening was possible without giving up essential contents by expedient use of the Internet. Since practically all users can connect to the net, it is no longer necessary to reproduce program listings in the printed text. In this way, the physical size of the book was reduced considerably.

The Java language offers a number of advantages over the older programming languages used in earlier editions. It is object-oriented and hence also more readable. It includes access to libraries of user-friendly auxiliary routines, allowing for instance the easy creation of windows for input, output, or graphics. For most popular computers, Java is either preinstalled or can be downloaded from the Internet free of charge. (See Sect. 1.3 for details.) Since by now Java is often taught at school, many students are already somewhat familiar with the language.

Our Java programs for data analysis and for the production of graphics, including many example programs and solutions to programming problems, can be downloaded from the page extras.springer.com.

I am grateful to Dr. Tilo Stroh for numerous stimulating discussions and technical help. The graphics programs are based on previous common work.

Siegen, Germany — Siegmund Brandt

Contents

List of Examples

Frequently Used Symbols and Notation

$x, y, \xi, \eta, \ldots$	(ordinary) variable
$\mathbf{x}, \mathbf{y}, \boldsymbol{\xi}, \boldsymbol{\eta}, \ldots$	vector variable
$\mathsf{x}, \mathsf{y}, \ldots$	random variable
$\boldsymbol{\mathsf{x}}, \boldsymbol{\mathsf{y}}, \ldots$	vector of random variables
$A, B, C, \ldots$	matrices
B	bias
$\mathrm{cov}(\mathsf{x}, \mathsf{y})$	covariance
F	variance ratio
$f(x)$	probability density
$F(x)$	distribution function
$E(\mathsf{x}) = \hat{x}$	mean value, expectation value
H	hypothesis
H_0	null hypothesis
L, ℓ	likelihood functions
$L(S_c, \lambda)$	operating characteristic function
$M(S_c, \lambda)$	power (of a test)
M	minimum function, target function
$P(A)$	probability of the event A
Q	sum of squares
$\mathsf{s}^2, \mathsf{s}_x^2$	sample variance
S	estimator
S_c	critical region
t	variable of Student's distribution
T	Testfunktion
x_{m}	most probable value (mode)
$x_{0.5}$	median
x_q	quantile
$\bar{\mathsf{x}}$	sample mean
$\widetilde{x}$	estimator from maximum likelihood or least squares
α	level of significance
$1 - \alpha$	level of confidence
λ	parameter of a distribution
$\varphi(t)$	characteristic function

$\phi(x)$, $\psi(x)$	probability density and distribution function of the normal distribution
$\phi_0(x)$, $\psi_0(x)$	probability density and distribution function of the standard normal distribution
$\sigma(\mathsf{x}) = \Delta(\mathsf{x})$	standard deviation
$\sigma^2(\mathsf{x})$	variance
χ^2	variable of the χ^2 distribution
$\Omega(P)$	inverse function of the normal distribution