Applied Statistics for Food- and Biotechnology

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Reviewers suggested by the editors:
• Prof. Todeschini (University Bicocca of Milan), roberto.todeschini@unimib.it

Target groups: students, graduates, industry staff in the area of food and biotechnology

Objectives: The idea is to have a book, which explains the use of statistical methods which are mostly used in food and biotechnology and the corresponding basics in form of case studies. The focus should be on understanding how and when to use the appropriate statistical techniques. Emphasis has to be placed on prerequisites (statistical reasoning and planning of experiments) and the appropriate use of parametric statistical methods.

Contents and Structure

In line with previous ISEKI-Books, each chapter should have the following sections:

• introduction
• objectives and learning outcomes
• problem to solve
• procedure
• appendices

One objective of this book should be to advice and demonstrate good practice of the use of statistical methodologies in form of case studies that provide real data and information on statistical planning and experimental designs. It would also be important in some of the case studies to show a complete analysis in an appendix using one or more computer programs.

Additionally to the full case studies, shorter exercises/or short case studies (for statistical reasoning and experimental planning) should be given at the end of each chapter. All authors writing chapters on case studies should provide data to be used in the book. Other datasets taken from other sources should also be used.

Statistical Advice

It is extremely important and statistical advice is very often omitted in books. Essentially this could be reminders of assumptions made using models (e.g. normality), warnings to check assumptions (e.g. residual analysis), general advance validating or invalidating the use of these methodologies, advice on alternative procedures.

One way of doing this is to have one margin that kept for comments. Comments can be short explanations, some giving references to books that describe these concepts in more detail, cross-reference to other
material in book or further explanation in the Appendix, cross-reference to case studies, examples with references of its use in publications (journals and books).

References
These should reference more than one text that explains the theory in more detail, gives additional exercises, references to examples of using different software (many books use at least one program). Could be divided into references used in chapter and further reading.

Content suggested

1. **INTRODUCTION**
   1.1. Using this book
   1.2. Good statistical practice
   1.3. Statistical methods for analysing data in food studies

2. **COLLECTING DATA AND DATA HANDLING**
   2.1. Introduction to collecting and handling data (Victoria A Jideani, Department of Food Technology, Cape Peninsula University of Technology, Cape Town, South Africa, Israel Afam, National Food Technology Research Centre, Botswana)
   2.2. Sampling (Israel Afam Jideani, National Food Technology Research Centre, Botswana)
   2.3. Errors in data treatment (Saverio Mannino, University of Milan, Italy)
   2.4. Calibration and measurement issues (Maciej Wojtczak, Technical University of Lodz, Poland)
   2.5. Accuracy, bias, precision of measurements (Maciej Wojtczak, Technical University of Lodz, Poland)
   2.6. Quantification of the variability (by analysis, by sampling, etc.) of results (Variance components analysis) (Gerhard Schleining, BOKU - Department of Food Science and Technology, Austria)

3. **ANALYSING AND REPRESENTING DATA**
   3.1. Introduction to reporting data and interpreting results (Todor Todorov and Ivanka Zheleva, Angel Kanchev University of Rousse, Bulgaria)
   3.2. Graphical methods for data representation and analysis (Fahrettin GÖGÜS and Huseyin Bozkurt Food Engineering Department, Gaziantep, Turkey)
   3.3. Testing of Hypothesis (Zsuzsa H. Horváth and Cecília Hodúr, University of Szeged, Hungary)
   3.4. Fitting Data to Models (Ivanka Zheleva, Angel Kanchev University of Rousse, Bulgaria)
   3.5. Non-Parametric Methods (Beata Stehlikova and Jan Brindza, Slovak Agricultural University in Nitra, Slovakia)

4. **HANDLING OF MULTIVARIATE DATA**
   4.1. Finding correlations, relationships and underlying structures of multivariate data (Prisana Suwannaporn, Kasetsart University, Department of Food Science and Technology, Bangkok, Thailand)
   4.2. Multiresponse/multivariate modelling (Teresa Brandão and Mafalda Quintas, Universidade Católica Portuguesa, Porto, Portugal)
   4.3. Discriminant analysis (Prisana Suwannaporn, Kasetsart University, Department of Food Science and Technology, Bangkok, Thailand)
   4.4. PCA related to food authentification (Edward Muntean, Department of Analytical Chemistry and Instrumental Analysis, Cluj Napoca, Romania)
   4.5. Model validation (Saverio Mannino, University of Milan, Italy)

5. **STATISTICAL PROCESS CONTROL**
   5.1. Introduction to Statistical Process Control (Lester Wilson, Iowa State University and Daniela Borda, Dunarea de Jos University, Bioengineering Department, Romania)
   5.2. Application of process control charts (Daniela Borda, Iulia Bleonaca and Iuliana Banu, Dunarea de Jos University, Bioengineering Department, Romania)
   5.3. Analyzing process capability (Daniela Borda, Iulia Bleonaca and Iuliana Banu, Dunarea de Jos University, Bioengineering Department, Romania)
6. EXPERIMENTAL DESIGN
6.1. Introduction to experimental design and statistical modelling (Peter Ho, Viana do Castelo Polytechnic Institute, Portugal, Jesus Frias, Dublin Institute of Technology, Ireland)
6.2. Mixture experiments using ratios of components and factorial designs (Helmut Zenz, BOKU - Department of Food Science and Technology, Austria)
6.3. Experimental Design and Response Surface Methodology (RSM) applied for Biotechnology processes (Eliana Setsuko Kamimura, Depto de Engenharia de Alimentos, Pirassunung-Sp, Brasil)
6.4. Response surface designs (Socrates Quispe Condori, Universidad Peruana Unión, Lima, Peru)

7. CASE STUDIES IN CHEMISTRY
7.1. Validation of an Analytical Method (Ulrike Zitz, BOKU - Department of Food Science and Technology, Austria)
7.2. High performance liquid chromatography as a tool in establishing food authenticity (Edward Muntean, Department of Analytical Chemistry and Instrumental Analysis, Cluj Napoca, Romania)
7.3. Presentation and determination of hop cultivars by a model on composition of hop essential oil (Milica Kauc, Department. for Food Science and Nutrition, Ljubljana)
7.4. Determination of atrazine residues in vegetable samples by elisa, validation by GC-MS (José Antonio Gabaldón and A. Martínez, Centro Tecnológico Nacional de la Conserva (CTC), C/ Concordia s/n, 30500 Molina de Segura, Murcia, Spain, A. Maquieira and R. Puchades, Departamento de Química, Universidad Politécnica de Valencia, Camino de Vera s/n, 46071-Valencia, Spain)
7.5. Optimization of Signal/Noise Ratio of Some Pesticide Residues Depending on the Measurements of LC-MS/MS by Using Response Surface Methodology (Semih Otles, Hasan Savas Sazak and Ebru Evcil Pelvan, Ege University, Izmir, Turkey)

8. CASE STUDIES IN MICROBIOLOGY
8.1. Standardisation and Characterisation of a method for determination of microbial count (Ulrike Zitz, BOKU - Department of Food Science and Technology, Austria)
8.2. Statistical treatment of results from plate counts (Graham McBride, National Institute of Water and Atmospheric Research (NIWA), Hamilton, New Zealand, Andrew Ball and Lynn McIntyre, Institute of Environmental Science and Research (ESR) Ltd., Christchurch, New Zealand)

9. CASE STUDIES IN SENSORY ANALYSIS
9.1. Applications in Sensory Analysis (Eugenios Akis Katsanidis, Aristotle University of Thessaloniki, Greece)
9.2. Selecting sensory assessors and monitoring the performance of untrained and trained assessors (Peter Ho and Manual Rui Alves, Viana do Castelo Polytechnic Institute, Portugal)
9.3. Consumer preferences mapping (Klaus Dürrschmid, BOKU - Department of Food Science and Technology, Austria)

10. CASE STUDIES ON THE USE OF SOFTWARE
10.1. Comparing Basic – Excel – Statgraphics for regression analysis (Gerhard Schleining, BOKU - Department of Food Science and Technology, Austria)
10.2. Mathcad (Edward Muntean, Department of Analytical Chemistry and Instrumental Analysis, Cluj Napoca, Romania)
10.3. Using R for statistical analysis of sensory data (Peter Ho and Manual Rui Alves, Viana do Castelo Polytechnic Institute, Portugal)
10.4. Using R for statistical analysis (Peter Ho, Viana do Castelo Polytechnic Institute, Portugal, Jesus Frias, Dublin Institute of Technology, Ireland)
10.5. Design Expert (Margarida Viera, College of Technology of University of Algarve, Portugal)
10.6. Variance component Analysis with Statgraphics (Gerhard Schleining, BOKU - Department of Food Science and Technology, Austria)
10.7. Unscrambler and Senstools (Klaus Dürrschmid, BOKU - Department of Food Science and Technology, Austria)
10.8. Multivariate Analysis in MATLAB (Saverio Mannino, University of Milan, Italy)
1. INTRODUCTION

Written for non-statisticians, this book is aimed at students, graduates, industry staff in the area of food and biotechnology. The book provides an extensive list of case studies with step-by-step instructions for performing analyses and interpreting the results accompanied with simple, easy-to-understand explanations of statistical concepts behind.

1.1. Using this book

Essentially used to outline how a reader should use this book, why we use case studies, explanations into the use of software (alternatives).

1.2. Good statistical practice

Discuss basics of why we use statistical methods, introduces methodologies used and how they link to assumptions we make about our experiments, inappropriate use of statistics, failure to check statistical assumptions, etc.

1.3. Statistical methods for analysing data in food studies

shows how to tackle problems in food studies, with examples and introduces the reader to the methods explained in the book with relevant examples (no calculations only figures or tables), ...

2. COLLECTING DATA AND DATA HANDLING

2.1. Introduction to collecting and handling data (Victoria A Jideani, Department of Food Technology, Cape Peninsula University of Technology, Cape Town, South Africa, Israel Afam, National Food Technology Research Centre, Botswana)

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This section details the methods for collecting data while ensuring consistency and quality of the data. Numerous questions can be asked about measurement procedures and this is the subject of metrology discussed in this section. Data pre-treatment (Data cleaning, data integration, data transformation and data reduction) is discussed as a tool to increase the accuracy of the information obtained from the collected data. Data cleaning comprises of handling missing values using multiple imputation; identifying outliers using robust parameter estimate and correcting data for inconsistency. Data integration involves combining data from multiple sources to form a coherent data store. Data transformation includes min-max, z-score and scaling. Data reduction will discuss principal component analysis. Methods for organizing and summarizing data and for drawing conclusions based on information contained in the data are discussed. Often an investigator will want to obtain or convey information about particular characteristics of data. In this section we introduce several numerical summary measures that describe where a sample or distribution is centered; we develop the most useful measures of variability; consider more detailed data summaries and how they can be combined to yield concise yet informative data descriptions. This section is limited to analysis of univariate data consisting of observations on a single variable.

2.2. Sampling (Israel Afam Jideani, National Food Technology Research Centre, Botswana)

Sampling plans provide methods for controlling or eliminating the effects of external factors and assessing the magnitude of their combined effect on measured data. Sampling also addresses the problem of how far we can generalize the conclusions that we draw from data. Types of sampling including acceptance sampling, sampling plans and sample size and sampling distribution are discussed.
2.3. **Errors in data treatment** (Saverio Mannino, University of Milan, Italy)

(Sample Preparation Errors, Instrumental Noise, Sources of Errors, error propagation)

2.4. **Calibration and measurement issues** (Maciej Wojtczak, Technical University of Lodz, Poland)

introduces the issues relating to the use of statistics and experimental design for univariate and multivariate calibrations of analytical instrumentation of different levels of precision, detection limits, precision of calculated/estimated values.

2.5. **Accuracy, bias, precision of measurements** (Maciej Wojtczak, Technical University of Lodz, Poland)

estimating accuracy, bias, experimental error, precision, repeatability, reproducibility, inter-laboratory studies

2.6. **Quantification of the variability** (by analysis, by sampling, etc.) of results (Variance components analysis) (Gerhard Schleining, BOKU - Department of Food Science and Technology, Austria)

data presentation, outliers, homogeneity of variance, normality

3. **ANALYSING AND REPRESENTING DATA**

3.1. **Introduction to reporting data and interpreting results** (Todor Todorov and Ivanka Zheleva, Angel Kanchev University of Rousse, Bulgaria)

descriptive analysis (mean, variance, standard deviation, range, normal distribution), calculating confidence intervals and the interpretation of significance levels, exploratory data analysis

Frequency distributions, Averages and measures of central tendency, Standard deviation and other measures of dispersion.

3.2. **Graphical methods for data representation and analysis** (Fahrettin GÖGÜS and Huseyin Bozkurt Food Engineering Department, Gaziantep, Turkey)

Fourfold analysis, Box-whisker, ...

3.3. **Testing of Hypothesis** (Zsuzsa H. Horváth and Cecília Hodúr, University of Szeged, Hungary)

Basic outline on Hypothesis Tests (H0, H1 critical region, significance levels)

Comparison of Variances:

- Two samples tests (F-test)
- Tests for homogeneity of variances: Cochran-test, Bartlett-test, Levene-test

Comparison of means:

- One sample tests (u-test, t-test)
- Two samples tests (u-test, t-test, Welch-test)

Tests for three or more samples (one-way ANOVA, Bonferroni’s method, Tukey for all pairwise, Dunnet’s method, Scheffé’s method))

3.4. **Fitting Data to Models** (Ivanka Zheleva, Angel Kanchev University of Rousse, Bulgaria)

introduction to linear and non-linear regression, relationships with ANOVA, correlation analysis, model building and selection criteria (F test, AIC, BIC), Cross validation. Practical examples of using models (linear, polynomial, logistic) in analysing food data, what to do when original model does not meet assumptions

3.5. **Non-Parametric Methods** (Beata Stehlikova and Jan Brindza, Slovak Agricultural University in Nitra, Slovakia)

practical introduction to the use of non-parametric methods for analysis count and categorical data, non-parametric ANOVA (Friedman), ANOVA of contingency tables. Graphical methods for analysing count and categorical data
4. HANDLING OF MULTIVARIATE DATA

4.1. Finding correlations, relationships and underlying structures of multivariate data (Prisana Suwannaporn, Kasetsart University, Department of Food Science and Technology, Bangkok, Thailand)
Introduction to multivariate Analysis and Modelling, multidimensional scaling

4.2. Multiresponse/multivariate modelling (Teresa Brandão and Mafalda Quintas, Universidade Católica Portuguesa, Porto, Portugal)
Exploratory analysis of multivariate data, data-preprocessing (outliers, missing data), selecting an appropriate statistical methodology, introduction to different methods. Introduction to the use of Bayesian methods (Quintas et al 2007.pdf)

4.3. Discriminant analysis (Prisana Suwannaporn, Kasetsart University, Department of Food Science and Technology, Bangkok, Thailand)

4.4. PCA related to food authentification (Edward Muntean, Department of Analytical Chemistry and Instrumental Analysis, Cluj Napoca, Romania)
Principal component analysis, factor analysis (exploratory and confirmatory), discriminant analysis

5. STATISTICAL PROCESS CONTROL

5.1. Introduction to Statistical Process Control (Lester Wilson, Iowa State University and Daniela Borda, Dunarea de Jos University, Bioengineering Department, Romania)
General considerations on statistical process control. Applications of the SPC. Interpretation of abnormal variations in and out control charts. Possible causes of the variations. Statistical stability.

5.2. Application of process control charts (Daniela Borda, Iulia Bleonaca and Iuliana Banu, Dunarea de Jos University, Bioengineering Department, Romania)
Control charts: Shewhart charts: (x, R), (x,S), control charts for fraction rejected p, np, charts for nonconformities c/u, CuSum charts. Practical examples of using charts in analysing food data. Interpretation of different variation registered in the charts.

5.3. Analyzing process capability (Daniela Borda, Iulia Bleonaca and Iuliana Banu, Dunarea de Jos University, Bioengineering Department, Romania)
Statistical performance, Calculation of the process potential index-Cp and process capability index - Cpk. Examples.

6. EXPERIMENTAL DESIGN

6.1. Introduction to experimental design and statistical modelling (Peter Ho, Viana do Castelo Polytechnic Institute, Portugal, Jesus Frias, Dublin Institute of Technology, Ireland)
Introduction to basic experimental design issues, replication, blocking, randomization, selecting an appropriate experimental design, using DOE for factor Screening, determining the size of the experiment.
Introduction to experimental design models (factorial designs, block designs, incomplete blocks, Split-plots, response surface designs) and their analysis (Univariate or multivariate, parametric or non-parametric), application of designs in different areas of food research, Estimation of factor effects (location and dispersion models), Choice of factor models and their analysis (fixed, random and mixed effects, variance components).
6.2. Mixture experiments using ratios of components and factorial designs (Helmut Zenz, BOKU - Department of Food Science and Technology, Austria)

6.3. Experimental Design and Response Surface Methodology (RSM) applied for Biotechnology processes (Eliaza Setsuko Kamimura, Depto de Engenharia de Alimentos, Pirassununga-SP, Brasil)

Introduction (Screening Design, Central Composite Rotatable Design) Cases

6.4. Response surface designs (Sócrates Quispe Condori, Universidad Peruana Unión, Lima, Peru)

Central Composite Design (CCD-Circumscribed, -Inscribed, -Face-Centered), Box-Behnken Design, Uniform Shell Design (Doehlert Design), Simplicial Shell Design. A general strategy for the construction of response surface designs will be presented and a flow chart of the strategy of experimenting will be depicted. The state of the art about the application of Response Surface Designs in food research will be done. This review corresponds to the period 2000-2008. A chart will be constructed in order to classify the several references and their response surface designs applied. Considering that the Central Composite and Box-Behnken Designs are the most commonly used designs in food research, an example of each design will be presented. Statistical analysis will be conducted using the software STATISTICA version 7.1 (StatSoft, Inc. 2005).

7. CASE STUDIES IN CHEMISTRY

7.1. Validation of an Analytical Method (Ulrike Zitz, BOKU - Department of Food Science and Technology, Austria)

7.2. High performance liquid chromatography as a tool in establishing food authenticity (Edward Muntean, Department of Analytical Chemistry and Instrumental Analysis, Cluj Napoca, Romania)

7.3. Presentation and determination of hop cultivars by a model on composition of hop essential oil (Milica Kač, Department. for Food Science and Nutrition, Ljubljana)

Data Collection for Experiments and Exploratory analysis and graphical Display
- preparing and presenting large database(s) on GC analyses of hop essential oil,
- choosing the necessary parameters by classical PCA methods,
- creating and using a Min-Max model (Mmin-Mmax matrix) to visualize (dis)similarities between various (genetically (non)related) cultivars, comparing growing areas, analytical methods,....
- relations to the content(s) of bitter substances (brewing value)
- relations to other statistical methods (PCA, HCA, RDA).

7.4. Determination of atrazine residues in vegetable samples by elisa, validation by GC-MS (José Antonio Gabaldón and A. Martinez, Centro Tecnológico Nacional de la Conserva (CTC), C/ Concordia s/n, 30500 Molina de Segura, Murcia, Spain, A. Maquieira and R. Puchades, Departamento de Quimica, Universidad Politécnica de Valencia, Camino de Vera s/n, 46071-Valencia, Spain)

The development and application of an analytical method -based on IA principles- for the highly sensitive, accurate and rapid analysis of the herbicide atrazine is presented. The IA based on antibody-immobilised ELISA format show a detection limit of 0.2 ng/L, and the dynamic range of the assay extended from 9.6 to 345.0 ng/L with a precision -variation coefficients- lower than 6.5% for all atrazine concentration tested. Cross-reactivity studies showed that R10 serum was free of interferences -CR values were lower than 17%-except from propazine. Since immunoreagents tolerate well up to 5% of MeOH concentrations without significant losses in the assay sensitivity, vegetable samples were extracted by blending 5 g in 10 ml of MeOH for 10 min, followed by a vacuum filtration through 0.45 µm nylon filters. Working with a 1/200 dilution of the extracts in PBS, atrazine concentration was determined by ELISA. Comparison studies between GC-MS and ELISA carried out by an analysis of variance (ANOVA), using Startgraphics Plus 5.0 statistical software package, showed and acceptable concordance at two atrazine levels tested (50 and 120 µg/kg). In all cases, a multiple comparison of mean values was done using LSD test.
7.5. Optimization of Signal/Noise Ratio of Some Pesticide Residues Depending on the Measurements of LC-MS/MS by Using Response Surface Methodology (Semih Otles, Hasan Savas Sazak and Ebru Evcil Pelvan, Ege University, Izmir, Turkey)

**Aim:** The aim of the study is to find the optimum signal/noise ratio of some pesticide residues for several factors which are known to be effective on these residues. These factors are gas temperature, gas flow, nebulizer pressure, capillary voltage, fragmentor voltage and collision energy.

**Tool:** To find the optimum parameter values, we use Response Surface Methodology which involves using several design values of the factors and obtaining response values in the first place. Then, a quadratic regression model will be fitted and the maximum signal/noise ratio of pesticide residue will be investigated using the fitted regression line and the response surface plots.

8. CASE STUDIES IN MICROBIOLOGY

8.1. Standardisation and Characterisation of a method for determination of microbial count (Ulrike Zitz, BOKU - Department of Food Science and Technology, Austria)

8.2. Statistical treatment of results from plate counts (Graham McBride, National Institute of Water and Atmospheric Research (NIWA), Hamilton, New Zealand, Andrew Ball and Lynn McIntyre, Institute of Environmental Science and Research (ESR) Ltd., Christchurch, New Zealand)

Microbiological enumeration data for food and water quality and/or safety evaluations can be achieved using a variety of plate count techniques such as pour plating, spread plating, spiral plating, membrane filtration and Petrifilm. However, depending on the method selected and the food sample in question, numerous factors can influence the quality of the data obtained. These include for example the size of the plate, the temperature of agar, methods to homogenise samples and distribute cells, incubation times and conditions, cellular injury and the growth of spreader colonies and competing microflora. In addition, questions regarding valid counting range, the use of replicates (the more the better? what to do about the odd one out?), uncertainty and data calculation (geometric mean vs. arithmetic mean?) require careful consideration. To this end, this book chapter will consider the statistical treatment of results obtained from the various plate count methods mentioned using a case study approach.

9. CASE STUDIES IN SENSORY ANALYSIS

9.1. Applications in Sensory Analysis (Eugenios Akis Katsanidis, Aristotle University of Thessaloniki, Greece)

Often used tests, such as the paired comparison test, the duo-trio test, the triangle test and ranking tests are discussed and compared in terms of statistical power. The statistical procedures for the analysis of the sensory evaluation data derived from these tests include non-parametric and binomial-based methods. Binomial-based tests on proportions and rank order tests (such as the $\chi^2$ test and the Friedman test) are described. Three cases studies on the triangle test, paired-preference and the ranking test are presented.

9.2. Selecting sensory assessors and monitoring the performance of untrained and trained assessors (Peter Ho and Manual Rui Alves, Viana do Castelo Polytechnic Institute, Portugal)

Introduction to univariate and multivariate approaches for the selection of sensory assessors (ANOVA and chemometric methods). Procedures for determining assessors discriminatory and repeatability capabilities, techniques to identify differences in use of scales and monitoring assessor variability, determining when an assessor is sufficiently trained.

9.3. Consumer preferences mapping (Klaus Dürrschmid, BOKU - Department of Food Science and Technology, Austria)

10. CASE STUDIES ON THE USE OF SOFTWARE

Each contribution should use data from this book and demonstrate how to use a particular software for a specific method.
10.1. Comparing Basic – Excel – Statgraphics for regression analysis (Gerhard Schleining, BOKU - Department of Food Science and Technology, Austria)

10.2. Mathcad (Edward Muntean, Department of Analytical Chemistry and Instrumental Analysis, Cluj Napoca, Romania)

10.3. Using R for statistical analysis of sensory data (Peter Ho and Manual Rui Alves, Viana do Castelo Polytechnic Institute, Portugal)
Overview of existing R libraries for analysing sensory data. Detailed explanation of techniques used for chapter on “Statistical techniques for selecting sensory assessors and monitoring the performance of untrained and trained assessors”.

10.4. Using R for statistical analysis (Peter Ho, Viana do Castelo Polytechnic Institute, Portugal, Jesus Frias, Dublin Institute of Technology, Ireland)
This chapter will give examples of using R functions and statistical libraries for analysing data from this book. A complete set of datasets and R functions will be developed, including the use of a GUI.
(I have talked to Jesus about this and he suggested that we compile a complete library with all functions to analyse all data (probably with a GUI) for the whole book. We will introduce the GUI and its functions.)

10.5. Design Expert (Margarida Viera, College of Technology of University of Algarve, Portugal)

10.6. Variance component Analysis with Statgraphics (Gerhard Schleining, BOKU - Department of Food Science and Technology, Austria)

10.7. Unscrambler and Senstools (Klaus Dürrschmid, BOKU - Department of Food Science and Technology, Austria)

10.8. Multivariate Analysis in MATLAB (Saverio Mannino, University of Milan, Italy)