1 Introduction

1.1 Our books

Nearly all statistical techniques implemented in Brodgar are explained in:

- *Analysing Ecological Data*. (2007). Zuur, AF, Ieno, EN and Smith, GM, Springer. 680p.
- *Mixed effects models and extensions in ecology with R.* (2009). Zuur, AF, Ieno, EN, Walker, N, Saveliev, AA, and Smith, GM. Springer.

In Zuur et al. (2007), a large number of statistical techniques are discussed, e.g. data exploration techniques, linear regression, partial linear regression, generalised linear modelling, generalised additive modelling, tree models, mixed effects modelling, additive mixedeffects modelling, multivariate analysis (PCA, CA, CCA, RDA, MDS, DA, variance partitioning, etc.), time series analysis (common trends, sudden changes, etc.) and spatial statistics. The book also contains 17 case study chapters, which provide the reader with a blueprint for their own data analysis. Most of the analyses were carried out with Brodgar.

In Zuur et al (2009), statistical techniques to deal with heterogeneity, nested data, temporal correlation, spatial correlation, count data, zero inflated count data, etc. Analyses were carried out in the software R, but Brodgar can be used to deal with heterogeneity, nested data, temporal or spatial correlation with Gaussian distributions (Chapters 4 – 7, and various case studies).

1.2 The software

The software package Brodgar has been written in such a way that the statistical techniques can be carried out in an easy click-and-go way. Although we focus on biological and environmental data, Brodgar can be used to analyse data of any type. There are Brodgar users who analyse seismic data, fisheries data, marine benthic data, economical and econometrical data, forensic data, oceanographical data, chemical data, sensory data, and data from fields such as eco-toxicology and paleolimnology, among others.

Installation of Brodgar and R, and other technical information regarding Brodgar is explained in Chapter 2. The structure of the software package Brodgar is simple. There are five main steps:

- Import data
- Data exploration
- Univariate analysis
- Multivariate analysis
- Time series

Chapters 3-7 of the manual are organised in the same way. Importing data is explained in Chapter 3. The next chapters deal with data exploration (Chapter 4), univariate analysis (Chapter 5), multivariate analysis (Chapter 6) and time series techniques (Chapter 7). In these chapters, we also show how to do some of the analyses presented in the case studies in Zuur et al. (2007; 2009). Note that we will not repeat the underlying statistical theory in this manual; the reader is referred to Zuur et al (2007; 2009). It is not that we want the reader to buy these books; but there is no point in writing again 1200 pages of statistical text.

A list of some of the statistical techniques available in Brodgar is given in Table 1.1.

Table 1.1. A summary of the statistical techniques available in Brodgar.

Methods	Aim
Data exploration	
Histograms and density curves, index functions, boxplots, conditional boxplots and conditional histograms, dotplots, pair plots, lattice graphs, coplots, scatter plots. Calculate variance inflation factors. Violin plots. Time series specific methods: Plot data. Change colour of variable by mouse clicking. Auto-correlations and cross-correlations. Apply MDS on cross-correlations. Present the maximum (over time lags) cross-correlations. Enumerate all variables with high cross-correlation.	Detect outliers Do we need a transformation? Are relationships linear? Is there collinearity?
Univariate techniques	
Linear regression, partial linear regression, additive modelling (including semi-parametric), generalised additive modelling, generalised linear modelling, regression and classification trees, multinomial logistic regression, mixed modelling.	Analyse the relationship between 1 response variable and multiple explanatory variables.
Multivariate methods	
Principal component analysis (PCA), redundancy analysis, correspondence analysis, canonical correspondence analysis, partial redundancy analysis, partial canonical correspondence analysis, variance partitioning, factor analysis, canonical correlation analysis, discriminant analysis, multidimensional scaling (MDS), Generalised Procrustes analysis, clustering, Bray-Curtis ordination, measures of association, multivariate regression trees, ANOSIM, Mantel test.	Analyse multivariate data. Some of the techniques are designed to analyse one set of data, whereas other methods can cope with explanatory variables as well.
Time series methods	
Structural time series models, seemingly unrelated time series models, DFA, MAFA, ARIMAX, spectral analysis, sudden shift analysis, detect discontinuities (Webster curves), chronological clustering, Loess smoothing, seasonal decomposition, month plots.	Analyse time series data