Practical modern statistics **(M249)** content listing

Introductory unit	Revises statistical prerequisites, and introduces the software used for data analysis in the first three of the main books Introduces the four separate topics
Book 1: Medical Statistics	
Cohort studies and case-control studies	Cohort studies, measures of association, models for cohort studies, case-control studies, effect and interval estimation Testing for no association.
Bias, confounding and causation	Selection and information bias, confounding and Simpson's paradox, Mantel-Haenszel stratified analyses, 1-1 matched case-control studies, criteria for causation, dose-response analysis.
Randomised controlled trials and the medical literature	Randomization, concealment, intention-to-treat and per-protocol analyses, clinical trials, sample size estimation, systematic reviews and meta-analysis, reading and working through a published article
Book 2: Time Series	
Decomposition models	Presenting time series data, trend and seasonality, additive and multiplicative models, transforming time series, moving averages, estimating the trend, seasonal and irregular components
Forecasting	Simple, Holt and Holt-Winters exponential smoothing, autocorrelation and prediction, the correlogram, tests for zero autocorrelation, prediction errors
ARIMA models	Stationarity and differencing, autoregressive models, the partial autocorrelation function, moving average models, the ARIMA modelling framework, selecting an ARIMA model, fitting and checking ARIMA models, forecasting with ARIMA models
Book 3: Multivariate Analysis	
Describing and displaying multivariate data	What are multivariate data, scatterplots, matrix scatterplots and profile plots, mean vectors and the covariance matrix, standardisation and the correlation matrix
Reducing dimension	Motivation in two dimensions, linear combinations, principal components, percentage variance explained, when to standardize, higher-dimensional approximations, choosing the number of components
Discrimination	Representing groups in multivariate data, measuring the separation, between and within-groups covariance matrices, canonical discrimination, group standardization, multiple discriminant functions, allocation rules, choosing cut-off points, misclassification and confusion matrices
Book 4: Bayesian Statistics	
The Bayesian approach	Objective and subjective probability, Bayes' theorem. Prior distributions, the likelihood, posterior distributions
Prior to posterior analyses	Basics of Bayesian inference using conjugate analyses, gamma and beta distributions, specifying prior distributions, estimates and credible intervals. Some teaching software developed in-house aids the teaching of this part
Bayesian inference via simulation	Non-conjugate analyses, simulation-based inference, sampling variability, credible intervals, stochastic simulation in practice. Teaching supported by the use of WinBUGS
Markov chain Monte Carlo	Markov chain simulation, burn-in and convergence, interpreting MCMC output, Practical Bayesian data analysis with MCMC. Teaching supported by the use of WinBUGS
Review unit	Issues relating to global climate change are addressed using the methods from the earlier units, and there is a brief description of some further developments within the topics covered