

2006 ABSTRACTS

STATISTICS AT LA TROBE

No. 2006-1

The Relative Efficiency of Prediction Intervals

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Abstract

There is an extensive literature on the measurement of the relative efficiencies of estimators, hypothesis tests and confidence intervals. However, the important topic of the measurement of the relative efficiencies of prediction intervals has hitherto not been properly explored. Following Hodges and Lehmann (1970), we require that a measure of the relative efficiency of two prediction intervals be stable in large samples. We examine the consequences of this requirement when these prediction intervals have coverage probability (a) equal to nominal and (b) asymptotically equal to nominal. Illustrations for independent and identically distributed data and time series data are provided.

Key words Prediction interval; Relative efficiency.

No. 2006-2

The Coverage Probability of Confidence Intervals in 2^r Factorial Experiments after Preliminary Hypothesis Testing

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Abstract

We consider a 2^r factorial experiment with m replicates, where $m \geq 2$. We suppose that the parameter of interest θ is a specified linear combination of the regression parameters. Our aim is to find a confidence interval for θ . We suppose that preliminary hypothesis tests are carried out sequentially beginning with the r th order interaction. After these preliminary hypothesis tests, a confidence interval for θ with nominal coverage $1 - \alpha$ is constructed using the following procedure on the same data. Both the estimator of θ and the formula for its standard deviation are based on the assumption that the selected model had been given to us *a priori*. We describe a new efficient Monte Carlo method, which employs conditioning for variance reduction, for estimating the

minimum coverage probability of the resulting confidence interval. The application of this method is demonstrated in the context of a 2^3 factorial experiment with 2 replicates and a particular contrast θ of interest. The preliminary hypothesis tests consist of the following two step procedure. In the first step we test the null hypothesis that the third order interaction is zero against the alternative hypothesis that it is non-zero. If this null hypothesis is accepted then we assume that this interaction is zero and proceed to the second step; otherwise we stop. In the second step, for each of the second order interactions we The resulting confidence interval, with nominal coverage probability 0.95, has minimum coverage probability that is, to a good approximation, 0.464. This shows that this confidence interval is completely inadequate.

Key words: coverage probability; factorial experiment; naive confidence interval; preliminary hypothesis tests.

No. 2006-3

Measures of Evidence and Inference

Invited Paper Presented to the 55th Meeting of the
International Statistical Institute, Sydney, 2005

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Abstract

Statistical inference can be divided into testing hypotheses regarding model parameters and estimation of model parameters, with notions of ‘evidence’ for and against hypotheses found within testing. These notions differ in the three main structures within which one carries out inference, each requiring more assumptions. After reviewing these ideas and relating some of them to the theory of fuzzy sets, we discuss new measures of evidence which extend the p-value evidence to a calibration scale where interpretation is possible under alternative hypotheses, and where combinations of evidence from different studies are simple. An alternative approach to evidence based on the Law of Likelihood proposed by Royall (1997) is not discussed here.

No. 2006-4

Confidence intervals for the standardized effect arising in comparisons of two normal populations

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Abstract

Confidence intervals for a standardized effect are derived after stabilizing the variance of the Welch t -statistic. Simulation studies demonstrate the viability of the resulting intervals for a wide range of parameter values and sample sizes as small as five. The methodology is extended to the combination of results from several studies, so as to obtain a confidence interval for a representative standardized effect for all the studies. The methods are illustrated on a recent meta-analytic study of systolic blood pressure reduction during a weight reducing regime, as well as the classical Mumford data on psychological intervention and hospital length of stay.

Key words: meta-analysis, variance stabilizing transformation, Welch t -test.

No. 2006-5

Implications of influence function analysis for SIR, SIRII and SAVE

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Abstract

Sliced Inverse Regression (SIR), SIRII and Sliced Average Variance Estimates (SAVE) are three related dimension reduction methods that require relatively mild model assumptions. Although for some model types the advantages of SAVE and SIRII over SIR have been well documented, there has so far been little insight into comparisons of the procedures when they are seen as competing estimators. As an approximation for the relative influence of single observations from large samples, the influence function is used to compare the sensitivity of the three methods to particular observational types. The analysis carried out here explains why there is a lack of agreement concerning the preferability of these dimension reduction procedures in general.

The usefulness of the influence function also extends to the sample level for the detection of influential observations. The efficiently computed empirical influence function derived from the theoretical influence function is compared with the true relative sample influence values via both a large and small data set. The empirical influence values for SAVE and SIRII offer poor approximations to the true sample equivalent and seem to require prohibitively large samples. We introduce an efficient influence measure based on deleted observation expansions that provides an excellent approximation, even for the small sample example, whilst retaining the ability to understand why an observation may or may not be influential.

Key words: meta-analysis, variance stabilizing transformation, Welch t -test, Sliced Inverse Regression, Sliced Average Variance Estimates, dimension reduction, influential observations.

No. 2006-6

Detecting influential observations in Sliced Inverse Regression analysis

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Abstract

We consider the detection of influential observations on the estimation of the dimension reduction subspace returned by Sliced Inverse Regression (SIR). Although there are many measures to detect influential observations in related methods such as multiple linear regression, there has been little development in this area with respect to dimension reduction. We look at one particular influence measure for a version of SIR and show, via simulation and example, how it may be used to detect influential observations in practice.

Key words: dimension reduction; influence function; influential observations; sliced inverse regression.

No. 2006-7

Improved Prediction Limits for AR(p) and ARCH(p) Processes

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Abstract

A new simulation-based prediction limit that improves on any given estimative d -step-ahead prediction limit for a Markov process is described. This improved prediction limit can be found with almost no algebraic manipulations. Nonetheless, it has the same asymptotic coverage properties as the Barndorff-Nielsen and Cox (1994) and Vidoni (2004) improved prediction limits. The new prediction limit is ideally suited to those Markov process models for which the algebraic manipulations required for the latter improved prediction limits are very complicated. We illustrate the new method by applying it in the context of one-step-ahead prediction for a zero-mean Gaussian AR(2) process and an ARCH(2) process.

Keywords. Estimative prediction limit, improved prediction limit.

Diagnostics and influence measures for ordinary least squares in the single-index model

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Abstract

Ordinary least squares (OLS) regression can be shown to be useful under a wide range of assumed models that are more general than the often assumed Multiple Linear Regression (MLR) model. For example, when certain distributional conditions for the predictor are fulfilled, OLS can be used to estimate the index vector in the Single Index Model (SIM). However, under the SIM it is the direction of this vector that is important rather than the magnitude of its individual components. As such, different diagnostics are required when estimation is carried out under the SIM than those that are available for an assumed MLR model. In this paper we derive influence measures that can be used to understand the sensitivity of the direction of the OLS index estimate with respect to small perturbations. An influence diagnostic is also introduced that can be used to detect influential observations in practice. It is also shown, via both real-life and simulated examples, how this diagnostic can assist in improving OLS index estimates.

Keywords. Single-index model, influence function, influence diagnostics, robustness.