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## NBER COMPUTER RESEARCH CENTER NOTES

*The NBER Computer Research Center for Economics and Management Science has been engaged, since its formation in 1971, in developing new software systems for quantitative social science research. Prototype systems for exploratory data analysis, mathematical programming, and econometrics are now in various stages of design and implementation. Notes on research in progress, as well as abstracts of working papers, are a regular feature in the Annals. Following are abstracts of 13 recent working papers. The complete papers are available at \$1.00 per copy from the NBER Computer Research Center, 575 Technology Square, Cambridge, Massachusetts 02139 (Attention: Support Staff).*

Becker, R., N. Kaden, and V. C. Klema, "The Singular Value Analysis in Matrix Computation", NBER Working Paper 46 (July 1974).

This paper discusses the robustness and the computational stability of the singular value decomposition algorithm used at the NBER Computer Research Center. The effect of perturbations on input data is explored. Suggestions are made for using the algorithm to get information about the rank of a real square or rectangular matrix. The algorithm can also be used to compute the best approximate solution of linear systems of equations with equality constraints, and to determine dependencies or near dependencies among the rows or columns of a matrix. A copy of the subroutine that is used and some examples on which it has been tested are included.

Belsley, D. A., and V. C. Klema, "Detecting and Assessing the Effects of Multicollinearity: A Use of the Singular Value Decomposition", NBER Working Paper 66 (December 1974).

This paper presents a means for detecting the presence of multicollinearity and for assessing the damage that such collinearity may cause estimated coefficients in the standard linear regression model. The means of analysis is the singular value decomposition, a numerical analytic device that directly exposes both the conditioning of the data matrix  $X$  and the linear dependencies that may exist among its columns. The same information is employed in the second part of the paper to determine the extent to which each regression coefficient is being adversely affected by each linear relation among the columns of  $X$  that lead to its ill conditioning.

Cooley, T. F., "A Comparison of Robust and Varying Parameter Estimates of a Macro-Econometric Model", NBER Working Paper 56 (September 1974).

Four estimators of econometric models are compared for predictive accuracy. Two estimators assume that the parameters of the equations are subject to variation over time. The first of these, the adaptive regression technique (ADR), assumes that the intercept varies over time; while the other, a varying-parameter regression technique (VPR), assumes that all parameters may be subject to variation. The other two estimators are ordinary least squares (OLS) and a robust estimator that gives less weight to large residuals. The vehicle for these experiments is the econometric model developed by Ray Fair. The main conclusion is that varying parameter techniques appear promising for the estimation of econometric models. They are clearly superior in the present context for short term

forecasts. Of the two varying parameter techniques considered, ADR is superior over longer prediction intervals.

— and S. J. DeCanio, "Varying-Parameter Supply Functions and The Sources of Economic Distress in American Agriculture, 1866-1914", NBER Working Paper 57 (September 1974)

The agrarian unrest in the United States at the end of the nineteenth century is examined. This unrest is often viewed as stemming from the inability of farmers to adapt to changing conditions in world agriculture. This hypothesis is tested in the context of a distributed lag supply function. Varying parameter estimation methods are used to trace the history of the parameters in the supply function and to decompose observed prices into permanent and transitory components over time. The patterns of variation are tested for conformity with a model of rational price-expectation formation. The conclusion is that farmers behaved as economic theory would predict, but that neither theory nor practice gave them relief from the troubles which plagued them.

Hill, R. W., and P. W. Holland, "A Monte Carlo Study of Two Robust Alternatives to Least Squares Regression Estimation", NBER Working Paper 58 (September 1974).

We give some Monte Carlo results on the performance of two robust alternatives to least squares regression estimation—least absolute residuals and the one-step "sine" estimator. We show how to scale the residuals for the sine estimator to achieve constant efficiency at the Gaussian across various choices of X-matrix and give some results for the contaminated Gaussian distribution.

Maddala, G. S., "Ridge Estimators for Distributed Lag Models", NBER Working Paper 69 (October 1974).

The paper explains how the Almon polynomial lag specification can be made stochastic in two different ways—one suggested by Shiller and another following the lines of Lindley and Smith. It is shown that both the estimators can be considered as modified ridge estimators. The paper then compares these modified ridge estimators with the ridge estimator suggested by Hoerl and Kennard. It is shown that for the estimation of distributed lag models the ridge estimator suggested by Hoerl and Kennard is not useful but that the modified ridge estimators corresponding to the stochastic versions of the Almon lag are promising. The paper has two empirical illustrations.

Maddala, G. S., and F. D. Nelson, "Analysis of Qualitative Variables", NBER Working Paper 70 (October 1974).

A variety of qualitative dependent variable models are surveyed with attention focused on the computational aspects of their analysis. The models covered include single equation dichotomous models; single equation polychotomous models with unordered, ordered, and sequential variables; and simultaneous equation models. Care is taken to elucidate the nature of the suggested "full information" and "limited information" approaches to the simultaneous equation models and the formulation of recursive and casual chain models.

Nelson, F. D., "Censored Regression Models with Unobserved Stochastic Censoring Thresholds", NBER Working Paper 63 (December 1974).

The "Tobit" model is a useful tool for estimation of regression models with a truncated or limited dependent variable, but it requires a threshold which is either a known constant or an observable and independent variable. The model presented here extends the Tobit model to the censored case where the threshold is an unobserved and not necessarily independent random variable. Maximum likelihood procedures can be employed for joint estimation of both the primary regression equation and the parameters of the distribution of that random threshold. The appropriate likelihood function is derived, the conditions necessary for identification are revealed, and the particular estimation difficulties are discussed. The model is illustrated by an application to the determination of a housewife's value of time.

Nelson, F. D., "On a General Computer Algorithm for the Analysis of Models with Limited Dependent Variables", NBER Working Paper 68 (October 1974).

Several econometric models for the analysis of relationships with limited dependent variables have been proposed including the probit, Tobit, two-limit probit, ordered discrete, and friction models. Widespread application of these methods has been hampered by the lack of suitable computer programs. This paper provides a concise survey of the various models; suggests a general functional model under which they may be formulated and analyzed; reviews the analytic problems and the similarities and dissimilarities of the models; and outlines the appropriate and necessary methods of analysis including, but not limited to, estimation. It is thus intended to serve as a guide for users of the various models for the preparation of suitable computer programs; for the users of those programs; and, more specifically, for the users of the program package utilizing the functional model as implemented on the NBER TROLL system.

Orchard-Hays, W., "Factoring LP Block-Angular Bases", NBER Working Paper 61 (November 1974).

A factorization of the basis for any block-angular LP model is presented, and its inverse is shown to be readily maintainable as piecemeal product-forms plus possible additional columns. Straightforward rules for piecemeal transformation of full rows and columns are given.

Wall, K. D., "The Rational Distributed Lag Structural Form—A General Econometric Model", NBER Working Paper 65 (December 1974).

The Rational Distributed Lag Structural Form of an econometric model is introduced, and its relationship to several traditional forms of representation is discussed. The traditional forms are viewed as special cases of the Rational Structural Form. Thus, the latter provides a unified framework for any treatment of the linear, time-invariant modeling problem. In particular, a solution of the estimation problem for the Rational Structure Form leads to the solution of the estimation problem for all traditional forms.

Welsch, R. E., "Data Analysis, Communication, and Control", NBER Working Paper 64 (December 1974).

The role of data analysis in communication, persuasion, and decision-making is discussed. Some problems with current data-analysis practice are presented, including communication, complex models, large data bases, one-pass processing, rigid assumptions, resistance, validity, prior information, access to new methods, and the responsiveness of data-analysis researchers to real-world needs. Recent progress in these areas is then outlined, with emphasis on graphics, Bayesian regression, robust estimation, jackknife, and interactive computing systems. Some remaining challenges for data analysts and others who are trying to integrate data into decision-making processes are discussed.

— and E. Kuh, "The Variances of Regression Coefficient Estimates Using Aggregate Data", NBER Working Paper 60 (October 1974).

This paper considers the effect of aggregation on the variance of parameter estimates for a linear regression model with random coefficients and an additive error term. Aggregate and micro variances are compared and measures of relative efficiency are introduced. Necessary conditions for efficient aggregation procedures are obtained from the Theil aggregation weights and from measures of synchronization related to the work of Grunfeld and Griliches.