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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. Following are abstracts of five recent working papers. The complete texts are available at $1.00 per copy from the respective authors at: NBER Computer Research Center, 575 Technology Square, Cambridge, Massachusetts 02139.

Cooley, T. F., and K. D. Wall, "Identification Theory for Time-Varying Models," NBER Working Paper 127 (March 1976).

The identification of time-varying coefficient regression models is investigated using an analysis of the classical information matrix. The variable coefficients are characterized by autoregressive stochastic processes; this allows the entire model to be cast in state-space form. Thus, the unknown stochastic specification parameters and priors can be interpreted in terms of the coefficient matrices and initial state vector. Concentration of the likelihood function on these quantities allows the identification of each to be considered separately. Suitable restriction of the form of the state-space model, coupled with the concept of controllability, permits identification of the coefficient transition parameters. Partial identification of the variance-covariance matrix for the random disturbances on the coefficients is established in a like manner. Introducing the additional concept of observability then permits identification of the unknown priors. The results are analogous to those already established in the econometric literature—namely, that the coefficients of the reduced form are always identified subject to the absence of multicollinearity. Some consistency results derived from the above approach are also presented.

Cooley, T. F., and K. D. Wall, "A Note on Optimal Smoothing for Time-Varying Coefficient Problems," NBER Working Paper 128 (March 1976).

An algorithm completely solves the optimal estimation problem for time-varying parameters when no proper prior distribution is specified. The key ideas involve a combination of the information-form Kalman filter with the two-filter interpretation of the optimal smoother. The algorithm produces efficient estimates of the parameter trajectories over the entire sample, and is equally applicable when a proper prior distribution has been specified.

Gay, D. M., "Representing Symmetric Rank-2 Updates," NBER Working Paper 124 (February 1976).

Various quasi-Newton methods periodically add a symmetric "correction" matrix of rank at most 2 to a matrix approximating some quantity A of interest (such as the Hessian of an objective function). Several ways of expressing a symmetric rank-2 matrix Δ as the sum of rank-1 matrices are examined. It is easy to compute rank-1 matrices Δ_1 and Δ_2 such that $\Delta = \Delta_1 + \Delta_2$ and $\|\Delta_1\| + \|\Delta_2\|$ is minimized, where $\|\cdot\|$ is *any* inner product norm. Such a representation recommends itself for use in those computer programs that maintain A explicitly, since it

should reduce cancellation errors or improve efficiency over other representations. In the common case where Δ is indefinite, a choice of the form $\Delta_1 = \Delta_2^T = xy^T$ appears best. For rank-2 quasi-Newton updates Δ, this case occurs exactly when Δ may be obtained by symmetrizing some rank-1 update; such popular updates as the DFP, BFGS, PSB, and Davidon's new optimally conditioned update fall into this category.

Gay, D. M., "On Modifying Singular Values to Solve Possibly Singular Systems of Nonlinear Equations," NBER Working Paper 125 (March 1976).

If a certain nondegeneracy assumption holds, it is possible to guarantee the existence of a solution to a system of nonlinear equations $f(x) = 0$ whose Jacobian matrix $J(x)$ exists but may be singular. The main idea is to modify small singular values of $J(x)$ in such a way that the modified Jacobian matrix $\hat{J}(x)$ has a continuous pseudoinverse $\hat{J}^+(x)$ and that a solution x^* of $f(x) = 0$ may be found by determining an asymptote of the solution to the initial value problem $x(0) = x_0$, $x'(t) = -\hat{J}^+(x)f(x)$. Practical (algorithmic) implications of this result are briefly discussed. Although the nondegeneracy assumption may fail for many systems of interest (indeed, if the assumption holds and $J(x^*)$ is nonsingular, then x^* is unique), algorithms using $\hat{J}^+(x)$ may enjoy a larger region of convergence than those that require (an approximation to) $J^{-1}(x)$.

Wall, K. D., "Inter-Equation Constraints and the Specification of Dynamic Structure," NBER Working Paper 119 (January 1976).

The effect of a class of linear inter-equation constraints on the specification of the lag structure in econometric models is considered. In particular, attention is focused on the linear summing, or "adding up," constraints which arise between equations in factor-shares analysis. The consequences of such constraints on the specification of lag structures for models with dynamic adjustments and autoregressive or moving-average disturbances are presented in the form of linear restrictions that result in singular coefficient matrices. Thus, the structural (lag) specification of one equation depends on the structure of all other equations in the model.

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ANNOUNCEMENT

FIFTH CESR WORKSHOP ON STOCHASTIC CONTROL AND ECONOMICS

The NBER's Conference on the Computer in Economic and Social Research will hold its fifth workshop on Stochastic Control and Economics, May 26–28, 1976, in Palo Alto, California. As in years past the purpose of the workshop will be to bring together 60 engineers and economists to discuss problems of mutual interest, with special emphasis on control of econometric models, modeling, identification, prediction and stochastic control techniques. The organizers will be Professor David Kendrick of the University of Texas at Austin and Professor Edison Tse of Stanford University.

All CESR members are welcomed to attend the meeting. If you would like further information on this workshop or the CESR, please contact Ms. Kathy Klein, National Bureau of Economic Research, 261 Madison Avenue, New York, New York 10016 at (212) 682-3190.