CANTER

9301✓

Department of Economics
UNIVERSITY OF CANTERBURY
CHRISTCHURCH, NEW ZEALAND

ISSN 1171-0705

ASSESSING STARMER'S EVIDENCE FOR NEW THEORIES OF CHOICE: A SUBJECTIVIST'S COMMENT

John Fountain

Discussion Paper

No. 9301

Department of Economics, University of Canterbury
Christchurch, New Zealand

Discussion Paper No. 9301

January 1993

ASSESSING STARMER'S EVIDENCE FOR NEW THEORIES OF CHOICE: A SUBJECTIVIST'S COMMENT

John Fountain

Assessing Starmer's Evidence for New Theories of Choice: A Subjectivist's Comment

John Fountain
Senior Lecturer in Economics
University of Canterbury
Christchurch
New Zealand

January 1993

Abstract

Inferences derived from Starmer's (1992) experimental evidence concerning Expected Utility (EUT), Fanning Out (FO), and Fanning In (FI) theories are both incomplete and incorrect. A subjectivist Bayesian approach based on calculating posterior probability distributions for experimental outcomes is used to quantify the degree of support for each theory and to make coherent inferences about the relative performance of FO and FI theories in explaining violations of EUT.

JEL Classifications C11,C91

Keywords Expected Utility, Fanning Out, Bayesian Inference

Starmer's (1992) interesting paper on new theories of choice under uncertainty has two aims:

1• "to assess the extent to which EUT [*Expected Utility Theory*] fails predictively and whether new theories make a significant contribution to the explanation of individual behaviour under uncertainty" (p. 813), and

2• "to assess the relative performance of alternatives to EUT by examining whether there is any systematic bias apparent in the residual from EUT"(p.822)

Curiously, in addressing these aims, Starmer dismisses the evidence about violations of EUT relevant to (1), leaves the prediction issues in (1) and (2) untouched, and fails to take systematic account of prior evidence in his assessment of alternatives to EUT, Fanning Out (FO) and Fanning In (FI). This note remedies these problems.

The answer to scientific prediction questions involves calculating posterior probabilities of outcomes (de Finetti (1975) Ch. 11). To predict the outcome on the next trial of experiments, Starmer's experimental evidence and methods are used in conjunction with de Finetti's representation theorem (Lad(1992)), a theorem that specifies the general form of a coherent joint probability distribution for quantities of the sort reported in Starmer's experiments (see the Appendix for details). Two types of prior beliefs are used for comparison purposes, designated *Symmetric EUT* and *Asymmetric FO.* The *Symmetric EUT* prior characterizes one who assumes "subjects choose according to EUT but make random mistakes" (Starmer, p.822). The *Asymmetric FO* prior characterizes one who is reluctant to "predict universal fanning in...[*because of*]...the evidence of fanning out which has been detected in earlier experiments"(Starmer, p.823). It is difficult to generalise from the literature on experimental tests of EUT[1] because experiments differ in prizes, locations of prospects in the unit probability triangle, and incentive systems, but the *Asymmetric FO* concept captures the essential features of this evidence: in appropriately chosen and framed choice situations one can probably get at least a majority of people exhibiting the common consequence effect with most of the rest choosing in accord with EUT (hence asymmetric violations of EUT in favour of FO). Prior probability assertions for an experimental outcome consistent with the relevant theories are shown below (for details see the Appendix):

	EUT	**FO**	**FI**
Symmetric EUT	90%	5%	5%
Asymmetric FO	48%	50%	2%

Questions in Starmer's experiments provide a choice between "riskier" *R* and "safer" *S* prospects (p. 813). For a specific *pair* of questions {*m* vs *n*} the reported data X_i from each subject i, i=1,...124, can take on one of four possible values from the set {(*R*,*R*), (*S*,*S*), (*R*,*S*), (*S*,*R*)}. The raw data and results of Starmer's hypothesis tests from his Table 3 are reproduced in Table 1 below along with the coherent posterior probabilities of the experimental outcomes[2] for each of the 13 pairs of choice situations analysed by Starmer.

Consider aim (1) for inferences based on a *Symmetric EUT*. From Table 1, prior beliefs on EUT being satisfied are revised downwards from 90% to between 71% and 82% in all 13 question pairs. Starmer claims that the data is "damaging evidence"(p.821) against EUT but also "not very meaningful"[3](p 821). No reasonable coherent inferences based on the data can support these claims. To be sure, predcitions based on EUT are not 100% accurate, but successful prediction in the 70-80% range are not to be scoffed at. Inaccuracies in predictions should be judged *relative to* competing theories[4]. On this comparison EUT wins hands down: Table 1's posterior probabilities for FI or FO being correct range from 6% to 21% compared to 71% to 82% for EUT.

The second of Starmer's aims, assessing the relative performance of alternatives to EUT, FO and FI, should make use of posterior conditional probabilities of the sort reported in the last two columns of Table 1. Consider first the case of symmetric priors. The posterior conditional probabilities of a violation of EUT being in the direction predicted by FO range from 22% to almost 60% . Figure 1 plots these posterior conditional probabilities in ascending order from lowest to highest to facilitate a comparison with the 50% prior conditional assessment on FO. In only 3 of the 13 cases in Table 1 does the probability of FO increase above 50%; in 10 out of the 13 decision situations the posterior probability of FO drops below 50%, but relatively gradually.

Starmer doesn not take this approach to his inferences. Instead, after performing classical hypothesis tests on the symmetry of biases in EUT violations, he simply claims that there is "no support...[*for theories*] ...which predict universal fanning out " in the violations of EUT, since in 10 cases "the majority of violations are consistent with FI and 8 of these are significant...[*while*] there are only three cases where the majority violation is consistent with FO but none are significant"(p. 822). This summary inference is incorrect. Whether or not Starmer's hypothesis tests are significant in a classical statistical sense[5], the evidence supports an increase in the posterior conditional probability of FO in some cases and a decrease in others. But Fig. 1 and the fact that the average posterior conditional probability of FO from Table 1 has decreased to 38.6% (relative to the prior of 50%) show clearly that the decrease is not uniformly strong enough to warrant a claim "no support" for FO. Generally, calculating coherent conditional posteriors for FO or FI on a case by case basis and presenting summary information on the distribution of these probabilities is a much superior way of assessing the relative predictive power of these two theories than relying on case by case binary (all/none) measures of support and reporting binary (all/none) summary information.

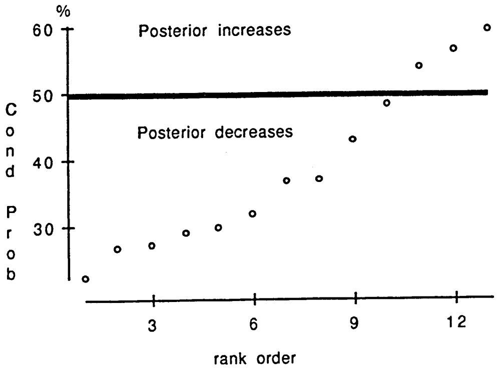
Starmer makes another inference relevant to aim (2), that if any generalisation is warranted from this data "it would have to be for universal fanning-in"(p.823), but he does not think universal fanning in is a "sustainable hypothesis" because of past prior evidence concerning FO in other experiments. Again, the question relevant to Starmer's second aim is not how sustainable FI is in a binary all/none sense, but how much one can learn from his experimental evidence. For symmetric prior beliefs Fig. 1 and the fact that the average posterior conditional probability of FO has fallen to 38.6% is telling: there is some support for FO but on average more support for FI. For asymmetric priors in favour of FO a stronger assertion is warranted. The posterior probabilities in the last column of Table 1 show that someone with an asymmetric prior asserting a conditional 96.4% chance that violations of EUT on these experiments will be consistent with FO will revise his/her beliefs downward to between 58% and 80% in all 13 cases, and 69% on average.That is, the prior conditional probability asserted for FI is only 3.4% and the posterior conditional probability on FI is increased almost tenfold to 31% on average. The evidence does not support "universal" FI in the face of strong prior beliefs about FO in the sense of a 100% prediction rate, but it certainly does offer a *uniform* and *sizeable* (approx. 27% for this prior) increase in support for FI theories.

In summary, there is much more to learn from the evidence collected by Starmer than revealled by the hypothesis tests and inferences in Starmer's paper. Considering aim (1), his evidence is strongly supportive of EUT *relative to FO and FI* as alternative explanatory theories. EUT simply performs better than FO or FI using posterior probability assessments for a wide range of priors to predict outcomes in choice situations involving the range of parameters (prizes, probabilities, incentive mechanisms) selected in Starmer's experiment. The evidence concerning the ability of alternative theories to account for violations of EUT is mixed. For someone with symmetric prior beliefs about violations of EUT, both FO and FI receive some support with FI receiving more support than FO on average. But for someone with highly asymmetric prior beliefs favouring FO explanations of EUT violations, Starmer's evidence provides no support. Moreover, such beliefs should be revised downwards in the face of the evidence produced in Starmer's experiments, in some cases substantially.

Table 1: Posterior Probabilities

Set	Cases	Observed Histogram (raw count)				Null[6] (5%)	Posterior Probability of Relevant Column Category (values in %)						Posterior Probability of FO <u>given an EUT Violation</u>	
							Symmetric EUT			Asymmetric FO			Symmet-ric EUT	Asymmetric FO
		RR	SS	RS	SR		EUT[7]	FO[8]	FI[9]	EUT	FO	FI		
Horizontal Comparisons							*prior* 90%	*prior* 5%	*prior* 5%	*prior* 48%	*prior* 50%	*prior* 2%	*prior* 50%	*prior* 96.2%
1	1 vs 2	40	47	27	10	Reject	79.0	6.7	14.3	60.3	26.8	12.9	31.9	67.4
1	2 vs	26	62	24	12	Reject	79.5	7.6	12.9	60.7	27.7	11.6	37.0	70.5
1	3 vs 4	23	65	15	21	Accept	79.5	11.6	8.9	60.7	31.7	7.6	56.5	80.7
1	1 vs 4	33	46	34	11	Reject	75.4	7.1	17.4	56.7	27.2	16.1	29.1	62.9
2	8 vs 9	47	35	16	26	Accept	76.8	13.8	9.4	58.0	33.9	8.0	59.6	80.9
Vertical Comparisons														
1	3 vs 5	30	46	8	40	Reject	74.1	5.8	20.1	55.4	25.9	18.8	22.4	58.0
1	2 vs 7	42	44	8	30	Reject	78.6	5.8	15.6	59.8	25.9	14.3	27.1	64.4
2	8 vs 10	50	42	13	19	Accept	81.3	8.0	10.7	62.5	28.1	9.4	42.9	75.0
Northwest Comparisons														
1	4 vs 5	30	40	14	40	Reject	71.4	8.5	20.1	52.7	28.6	18.8	29.7	60.4
1	4 vs 7	33	41	11	39	Reject	73.2	7.1	19.6	54.5	27.2	18.3	26.7	59.8
1	5 vs 7	49	31	21	23	Accept	75.9	11.6	12.5	57.1	31.7	11.2	48.1	74.0
1	2 vs 6	33	41	17	33	Reject	73.2	9.8	17.0	54.5	29.9	15.6	36.7	65.7
2	9 vs 10	50	32	23	19	Accept	76.8	12.5	10.7	58.0	32.6	9.4	53.8	77.7

Figure 1: Posterior conditional probabilities of FO given an EUT violation[10]: Symmetric EUT



Notes

[1]See Sugden (1987) Appleby and Starmer(1987) Kahneman and Tversky(1988) for general overviews.

[2]EUT predicts subjects will choose either two "riskier" or two "safer" prospects, (*R*,*R*) or (*S*,*S*) , FO theories predict (*R*,*S*) (or (*S*,*R*)) and FI theories predict (*S*,*R*) (or (*R*,*S*)) depending on the particular location of the prospects being compared in the unit probability triangle.

[3]not meaningful allegedly because some other experiment could be constructed to ensure almost a 100% success rate for EUT.

[4]Starmer does not test mixed fan type hypotheses as in Nielson (1992), although his data is very relevant to such theories.

[5]Starmer is unwilling to use the null hypothesis as a basis for prediction when it is accepted, and makes no suggestion about how to predict in cases where the null is rejectd.

[6]Starmer's test statistic is based on the normal approximation to a binomial distribution B(p,n) with p=1/2.

[7]sum of probabilities for categories RR and SS

[8]corresponds to category SR for horizontal comparisons and to category RS for other comparisons

[9]corresponds to category RS for horizontal comparisons and to category SR for other comparisons

[10]data from Table 1

Appendix

The notation $X_N = \{X_1, X_{2,,}...X_N\}$ is used to describe a possible sequence of results of an experiment involving N subjects for a specific *pair* of questions {m,n}. The reported data X_i from each subject i, i=1,...124, can take on one of four possible values from the set {(*R*,*R*), (*S*,*S*), (*R*,*S*), (*S*,*R*)}. The histogram, $s_j(X_N)$, j in {(*R*,*R*), (*S*,*S*), (*R*,*S*), (*S*,*R*)}, corresponding to any observed sequence $X_N = \{X_1, X_2, ...X_N\}$ is defined in the natural way as the sum or count of the number of observations X_i in the sequence which are in category j. The notation $S^*_{RR}, S^*_{SS}, S^*_{RS}, S^*_{SR}$ denotes the histograms derived from a sequence of actual observations $X_m = \{X_1, X_{2,}...X_m\}$ in an experiment with m observations, and S_{RR}, S_{SS}, S_{RS}, S_{SR} to denote category sums for yet to be observed sequences of observations $X_{N-m} = \{X_1, X_{2,}...X_{N-m}\}$.

The issue of scientific prediction boils down to making inferences, coherent conditional probability assessments, about yet to be observed sequences of observations $X_{N-m} = \{X_1, X_{2,}...X_{N-m}\}$, or the histograms $s_j(X_{N-m})$ derived from them, having observed other sequences $X_m = \{X_1, X_{2,}...X_m\}$ of observations. The inferences in this note are based on the theory of operational subjective statistical procedures (Lad (1992)), particularly on a fundamental representation theorem of de Finetti, a brief explanation of which follows.

Whatever one thinks about the credibility of expected EUT, FI, FO, etc., we presume that almost everyone would regard the sequence of observations from an experiment like Starmer's involving N subjects, $X_N = \{X_1, X_{2,}...X_N\}$, *exchangeably.* Exchangeability is a restriction on one's personal probability assessment of sequences of possible experimental results $X_N = \{X_1, X_{2,}...X_N\}$. It means that, if a particular sequence of experimental results $X'_N = \{X'_1, X'_2, ...X'_N\}$ yields a histogram $s_j(X'_N)$, j in {(*R*,*R*), (*S*,*S*), (*R*,*S*), (*S*,*R*)}, one would assert equal probabilities to any other individual sequence of experimental results $X''_N = \{X_1, X_{2,}...X_N\}$ yielding the same histogram. If X''_N yields the same histogram as X'_N the sequence of observations X''_N is simply a permutation of the sequence of observations X'_N . You regard the sequence of possible observations X_N exchangeably as long as you are prepared to assert that any two observation sequences X''_N and X'_N yielding the same histogram have equal probability. Exchangeability seems eminently sensible in the context of Starmer's experiment.

Exchangeability has a very powerful implications for coherent personal probability assessments for possible data sequences $X_N = \{X_1, X_{2,}...X_N\}$. According to de Finetti's representation theorem, Lad (1992, Ch 5, pp 62-64), if we regard the sequence $X_1, X_{2,}...X_N$ as exchangeable and if our subjective probability distribution is infinitely exchangeably extendible then :

A• The histogram $S^*_{RR}, S^*_{SS}, S^*_{RS}, S^*_{SR}$ for the observed sequence $X_1, X_{2,}...X_m$ is a sufficient statistic for any coherent inference about the remaining N-m quantities in the sequence $X_1, X_2, ...X_N$.

B• One's personal probability distribution for an observable sequence $X_n = \{X_1, X_2, \ldots X_n\}$, for any choice of n observations from N, can be written as

$$\text{(1)} \quad P[X_1, X_2, \ldots X_n] = \int_0^1 \cdots \int_0^1 \prod_{\text{all } j} \theta_j^{s_j(X_n)} d_{RR} d_{SS} d_{RS} d_{SR} M(\theta_{RR}, \theta_{SS}, \theta_{RS}, \theta_{SR})$$

where $s_j(X_n)$ is the histogram for X_n, $(\theta_{RR}, \theta_{SS}, \theta_{RS}, \theta_{SR})$ is a vector of parameters and $M((\theta_{RR}, \theta_{SS}, \theta_{RS}, \theta_{SR}))$ is a mixing distribution The parameters θ_j in equation (1) are the imagined "long run" proportions of observations that fall in category j in an infinitely extended sequence of observations X_N.

C• Using the natural conjugate form of mixing function for (1), a Dirichlet distribution with parameters (α_{RR}, α_{SS}, α_{RS}, α_{SR}), the <u>conditional</u> distribution of the category sums S_{RR}, S_{SS},S_{RS}, S_{SR} for the remaining N-m observations from X_N, given a histogram S^*_{RR},S^*_{SS},S^*_{RS},S^*_{SR} of observations on m of them, is distributed **Polya**(N-m, $\alpha_{RR} + S^*_{RR}$, $\alpha_{SS} + S^*_{SS}$,...$\alpha_{SR} + S^*_{SR}$) ; i.e.

$$\text{(2)} \quad P[s_{RR}s_{SS}s_{RS}s_{SR} \mid s^*_{RR}s^*_{SS}s^*_{RS}s^*_{SR}] = \frac{(N-m)!}{s_{RR}!s_{SS}!s_{RS}!s_{SR}!} \frac{\Gamma[\sum_{\text{all } j} \alpha_j + s^*_j] \cdot \prod_{\text{all } j} \Gamma[\alpha_j + s_j]}{\Gamma[(N-m) + \sum_{\text{all } j} \alpha_j] \cdot \prod_{\text{all } j} \Gamma[\alpha_j]}$$

Equations (1) and (2) permit us to distinguish between theoretical views that assess the probability of histograms of data differently through a choice of the mixing distribution M . Prior evidence or beliefs can be incorporated systematically into the prediction question through judicious choices of the mixing distribution M.

Equation (2) offers a useful way to think about the choice of parameters (α_{RR}, α_{SS}, α_{RS}, α_{SR}) for the Dirichlet mixing distribution. Notice that in equation (2) posterior beliefs change at a rate determined by the sums $\alpha_j + s_j^*$. Changes in parameters α_j have precisely the same impact on conditional probability assessments as do changes in observational data s_j^*. The choice of parameters (α_{RR}, α_{SS}, α_{RS}, α_{SR}) can thus be calibrated in terms of "observational" equivalents. The larger the size of your α_j, the stronger you hold your prior beliefs about EUT being satisfied in the sense that prior belief is regarded as equivalent to or "worth" a larger amount of evidence.

Our choice of parameters for the Dirichlet mixing distribution covers two representative possibilities:

•*Symmetric EUT* Prior beliefs are equivalent to 90 out of a total of 100 observations in support of EUT, equally distributed between the RR and SS categories; the 10 "violations" of EUT are equally distributed between RS and RR
(α_{RR}, α_{SS}, α_{RS}, α_{SR})=(45,45,5,5)

•*Asymmetric FO* Prior beliefs are equivalent to 50 out of a total of 100 observations in support of FO, with 48 equally distributed between the EUT categories RR and SS categories; the remaining 2 observations are for FI; (α_{RR}, α_{SS}, α_{RS}, α_{SR})=(24,24,50,2) when FO implies RS.and (24,24,2,50) otherwise.

Bibliography

Appleby, L. and C. Starmer (1987) "Individual Choice Under Uncertainty: A Review of Experimental Evidence, Past and Present" in Hey and Lambert (1987) 25-45

Bell, David E., Howard Raiffa, and Amos Tversky editors (1988), *Decision Making : Descriptive, Normative and Prescriptive Interactions,* Cambridge: Cambridge University Press

de Finetti, B (1975) *Theory of Probability* Vol. 2 London: John Wiley

Hey, J.D. and P.J. Lambert, ed. (1987) *Surveys in the Economics of Uncertainty* Oxford: Basil Blackwell

Lad, F (1992) *Operational Subjective Statistical Methods*, Christchurch: University of Canterbury Statistics Department, (mimeo)

Neilson, W. F. (1992) " A Mixed Fan Hypothesis and its Implications for Behaviour towards Risk" *Journal of Economic Behaviour and Organization* 19, 197-211

Starmer, C. (1992) Testing New Theories of Choice Under Uncertainty Using the Common Consequence Effect *Review of Economic Studies* 59, 813-830

Sugden, R (1987) "New Developments in the Theory of Choice Under Uncertainty" in Hey and Lambert (1987) 1-24

Tversky, Amos and Daniel Kahneman (1988) "Rational Choice and the Framing of Decisions" in Bell, Raiffa, and Tversky (1988) 167-192

LIST OF DISCUSSION PAPERS*

No. 8801	Workers' Compensation Rates and the Demand for Apprentices and Non-Apprentices in Victoria, by Pasquale M. Sgro and David E. A. Giles.
No. 8802	The Adventures of Sherlock Holmes, the 48% Solution, by Michael Carter.
No. 8803	The Exact Distribution of a Simple Pre-Test Estimator, by David E. A. Giles.
No. 8804	Pre-testing for Linear Restrictions in a Regression Model With Student-t Errors, by Judith A. Clarke.
No. 8805	Divisia Monetary Aggregates and the Real User Cost of Money, by Ewen McCann and David Giles.
No. 8806	The Management of New Zealand's Lobster Fishery, by Alan Woodfield and Pim Borren.
No. 8807	Poverty Measurement: A Generalization of Sen's Result, by Prasanta K. Pattanaik and Manimay Sen.
No. 8808	A Note on Sen's Normalization Axiom for a Poverty Measure, by Prasanta K. Pattanaik and Manimay Sen.
No. 8809	Budget Deficits and Asset Sales, by Ewen McCann.
No. 8810	Unorganized Money Markets and 'Unproductive' Assets in the New Structuralist Critique of Financial Liberalization, by P. Dorian Owen and Otton Solis-Fallas.
No. 8901	Testing for Financial Buffer Stocks in Sectoral Portfolio Models, by P. Dorian Owen.
No. 8902	Provisional Data and Unbiased Prediction of Economic Time Series by Karen Browning and David Giles.
No. 8903	Coefficient Sign Changes When Restricting Regression Models Under Instrumental Variables Estimation, by David E. A. Giles.
No. 8904	Economies of Scale in the New Zealand Electricity Distribution Industry, by David E. A. Giles and Nicolas S. Wyatt.
No. 8905	Some Recent Developments in Econometrics: Lessons for Applied Economists, by David E. A. Giles.
No. 8906	Asymptotic Properties of the Ordinary Least Squares Estimator in Simultaneous Equations Models, by V. K. Srivastava and D. E. A. Giles.
No. 8907	Unbiased Estimation of the Mean Squared Error of the Feasible Generalised Ridge Regression Estimator, by V. K. Srivasatva and D. E. A. Giles.
No. 8908	An Unbiased Estimator of the Covariance Matrix of the Mixed Regression Estimator, by D. E. A. Giles and V. K. Srivastava.
No. 8909	Pre-testing for Linear Restrictions in a Regression Model with Spherically Symmetric Disturbances, by Judith A. Giles.
No. 9001	The Durbin-Watson Test for Autocorrelation in Nonlinear Models, by Kenneth J. White.
No. 9002	Determinants of Aggregate Demand for Cigarettes in New Zealand, by Robin Harrison and Jane Chetwyd.
No. 9003	Unemployment Duration and the Measurement of Unemployment, by Manimay Sengupta.
No. 9004	Estimation of the Error Variance After a Preliminary-Test of Homogeneity in a Regression Model with Spherically Symmetric Disturbances, by Judith A. Giles.
No. 9005	An Expository Note on the Composite Commodity Theorem, by Michael Carter.
No. 9006	The Optimal Size of a Preliminary Test of Linear Restrictions in a Mis-specified Regression Model, by David E. A. Giles, Offer Lieberman, and Judith A. Giles.
No. 9007	Inflation, Unemployment and Macroeconomic Policy in New Zealand: A Public Choice Analysis, by David J. Smyth and Alan E. Woodfield.
No. 9008	Inflation — Unemployment Choices in New Zealand and the Median Voter Theorem, by David J. Smyth and Alan E. Woodfield.
No. 9009	The Power of the Durbin-Watson Test when the Errors are Heteroscedastic, by David E. A. Giles and John P. Small.
No. 9010	The Exact Distribution of a Least Squares Regression Coefficient Estimator After a Preliminary t-Test, by David E. A. Giles and Virendra K. Srivastava.
No. 9011	Testing Linear Restrictions on Coefficients in a Linear Regression Model with Proxy variables and Spherically Symmetric Disturbances, by Kazuhiro Ohtani and Judith A. Giles.

(Continued on next page)

No. 9012 Some Consequences of Applying the Goldfeld-Quandt Test to Mis-Specified Regression Models, by David E. A. Giles and Guy N. Saxton.

No. 9013 Pre-testing in a Mis-specified Regression Model, by Judith A. Giles.

No. 9014 Two Results in Balanced-Growth Educational Policy, by Alan E. Woodfield.

No. 9101 Bounds on the Effect of Heteroscedasticity on the Chow Test for Structural Change, by David Giles and Offer Lieberman.

No. 9102 The Optimal Size of a Preliminary Test for Linear Restrictions when Estimating the Regression Scale Parameter, by Judith A. Giles and Offer Lieberman.

No. 9103 Some Properties of the Durbin-Watson Test After a Preliminary t-Test, by David Giles and Offer Lieberman.

No. 9104 Preliminary-Test Estimation of the Regression Scale Parameter when the Loss Function is Asymmetric, by Judith A. Giles and David E. A. Giles.

No. 9105 On an Index of Poverty, by Manimay Sengupta and Prasanta K. Pattanaik.

No. 9106 Cartels May Be Good For You, by Michael Carter and Julian Wright.

No. 9107 Lp-Norm Consistencies of Nonparametric Estimates of Regression, Heteroskedasticity and Variance of Regression Estimate when Distribution of Regression is Known, by Radhey S. Singh.

No. 9108 Optimal Telecommunications Tariffs and the CCITT, by Michael Carter and Julian Wright.

No. 9109 Price Indices : Systems Estimation and Tests, by David Giles and Ewen McCann.

No. 9110 The Limiting Power of Point Optimal Autocorrelation Tests, by John P. Small.

No. 9111 The Exact Power of Some Autocorrelation Tests When the Disturbances are Heteroscedastic, by John P. Small.

No. 9112 Some Consequences of Using the Chow Test in the Context of Autocorrelated Disturbances, by David Giles and Murray Scott.

No. 9113 The Exact Distribution of R^2 when the Disturbances are Autocorrelated, by Mark L. Carrodus and David E. A. Giles.

No. 9114 Optimal Critical Values of a Preliminary Test for Linear Restrictions in a Regression Model with Multivariate Student-t Disturbances, by Jason K. Wong and Judith A. Giles.

No. 9115 Pre-Test Estimation in a Regression Model with a Misspecified Error Covariance Matrix, by K. V. Albertson.

No. 9116 Estimation of the Scale Parameter After a Pre-test for Homogeneity in a Mis-specified Regression Model, by Judith A. Giles.

No. 9201 Testing for Arch-Garch Errors in a Mis-specified Regression, by David E. A. Giles, Judith A. Giles, and Jason K. Wong.

No. 9202 Quasi Rational Consumer Demand — Some Positive and Normative Surprises, by John Fountain.

No. 9203 Pre-test Estimation and Testing in Econometrics: Recent Developments, by Judith A. Giles and David E. A. Giles.

No. 9204 Optimal Immigration in a Model of Education and Growth, by K-L. Shea and A. E. Woodfield.

No. 9205 Optimal Capital Requirements for Admission of Business Immigrants in the Long Run, by K-L. Shea and A. E. Woodfield.

No. 9206 Causality, Unit Roots and Export-Led Growth: The New Zealand Experience, by David E. A. Giles, Judith A. Giles and Ewen McCann.

No. 9207 The Sampling Performance of Inequality Restricted and Pre-Test Estimators in a Mis-specified Linear Model, by Alan T. K. Wan.

No. 9208 Testing and Estimation with Seasonal Autoregressive Mis-specification, by John P. Small.

No. 9209 A Bargaining Experiment, by Michael Carter and Mark Sunderland.

No. 9210 Pre-Test Estimation in Regression Under Absolute Error Loss, by David E. A. Giles.

No. 9211 Estimation of the Regression Scale After a Pre-Test for Homoscedasticity Under Linex Loss, by Judith A. Giles and David E. A. Giles.

No. 9301 Assessing Starmer's Evidence for New Theories of Choice: A Subjectivist's Comment, by John Fountain.

* Copies of these Discussion Papers may be obtained for $4 (including postage, price changes occasionally) each by writing to the Secretary, Department of Economics, University of Canterbury, Christchurch, New Zealand. A list of the Discussion Papers prior to 1988 is available on request.