

Nurturing Minds
A Weekly Seminar Series to give impetus to development discourse and stimulate intellectual thought

**PAKISTAN INSTITUTE OF DEVELOPMENT
ECONOMICS**



Topic: "Metafrontier Frameworks for the Study of Firm-Level Efficiencies and Technology Ratios"

DR GEORGE E BATTESE

The seminar will be based on the Metfrontier frameworks paper co-authored by Dr George Battese. The paper uses the concept of a metafrontier to compare the technical efficiencies of firms that may be classified into different groups. The paper presents the basic analytical framework necessary for the definition of a metafrontier, shows how a metafrontier can be estimated using non-parametric and parametric methods, and presents an empirical application using cross-country agricultural sector data. The paper also explores the issues of technological change, time-varying technical inefficiency, multiple outputs, different efficiency orientations, and firm heterogeneity.

Date: November 22, 2006
Wednesday

Time: 11:00 am

Location Details

**Seminar Hall
Pakistan Institute of
Development Economics
Quaid-e-Azam University
Campus
Islamabad.**

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About the Speaker...

Dr George Battese is a name well-known to economists around the world. He has been working at the University of New England since 1964. With Doctor in Philosophy and Doctor in Economics, Dr Battese has numerous publications, chapter in books, over 55 published articles, 34 conference papers and other manuscripts to his credit. He has, during his professional career, supervised over 30 research students; been a referee for countless journals; and, been a member of various scholarly societies.

Your active participation will make this effort a turning point in the importance of intellectual contribution to our development processes!

CURRICULUM VITAE for GEORGE EDWARD BATTESE

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ACADEMIC QUALIFICATIONS

| | |
|------|---|
| 1964 | Bachelor of Agricultural Economics, University of New England. |
| 1968 | Master of Agricultural Economics, University of New England. |
| 1973 | Doctor of Philosophy (Major: Statistics), Iowa State University. |
| 2005 | Doctor of Economics University of New England |

HONOURS

| | |
|---------------|---|
| 1960-1963 | Australian Commonwealth Scholarship. |
| 1960-1963 | Australian Agricultural Council Scholarship. |
| 1960 | UNE Union Scholarship for Agricultural Economics. |
| 1970 | Mu Sigma Rho (Statistical Honour Fraternity). |
| 1974 | Sigma Xi (Scientific Research Society of North America). |
| 1977 | Australian Journal of Agricultural Economics Prize for Best Paper. |
| 1994- present | Justice of the Peace in the State of New South Wales |

POSITIONS HELD

Department of Economic Statistics, UNE

Tutor, 20/1/1964 - 12/9/1965
Temporary Lecturer, 13/9/1965 - 25/8/1967

Department of Econometrics, UNE

Lecturer, 1/6/1974 - 31/12/1977
Senior Lecturer, 1/1/1978 - 31/12/1992
Associate Professor, 1/1/1993 - 31/12/1998

School of Economics, UNE

Associate Professor (Econometrics), 1/1/1999 – 2/8/2002
Honorary Fellow, 3/8/2002-present

Department of Statistics, Iowa State University

Graduate Assistant, 1/9/1967 - 31/8/1970
Instructor/Associate, 1/9/1970 - 30/6/1971
Associate, 1/7/1971 - 30/6/1973
Visiting Assistant Professor, 1/7/1973 - 1/6/1974
Visiting Associate Professor, 1/7/1980 - 30/6/1981
Visiting Professor, 12/1/1987 - 30/11/1987

Department of Economics, Göteborg University
Visiting Professor, 2/12/1996 - 27/6/1997

**SERVICE IN THE FACULTY OF ECONOMICS, BUSINESS AND LAW
(UNE)**

Sub-Dean for Postgraduate Studies, November 1981 to April 1986

Sub-Dean for Undergraduate Studies, December 1990 to December 1994

Member of Standing Committee, February –August 1999

Faculty Representative on the UNE Promotion Committee in 2000 (for Level D).

TEACHING AREAS

Introductory Statistics for Economics and Business
Statistical Theory for Econometrics
Econometric Theory
Survey Sampling
Applied Econometrics
Demography

PUBLICATIONS

Books

1. Battese, G.E. (1986), *Introductory Statistics for Economic Studies*, Teaching Monograph Series 4, University of New England, Armidale, xiii + 539 pp.
2. Coelli, T., D.S.P. Rao and G.E. Battese (1998), *An Introduction to Efficiency and Productivity Analysis*, Kluwer Academic Publishers, Boston, xvi + 275 pp.
3. Coelli, T.J., D.S.P. Rao, C.J. O'Donnell and G.E. Battese (2005), *An Introduction to Efficiency and Productivity Analysis*, 2nd Edition, Springer, New York, 349 pp.

Edited Journal Issue

Battese, G.E. and T.J. Coelli, (1997), Guest Editors of Special Issue: Papers Presented at the New England Conference on Efficiency and Productivity, *Journal of Productivity Analysis*, 8, (4), November, 1997.

Chapters in Books

1. Fuller, W.A. and G.E. Battese (1981), "Regression Estimation for Small Areas", in Gilford, D.M., G L. Nelson and L. Ingram (eds.), *Rural America in Passage: Statistics for Policy*, National Academy Press, Washington, D.C., 572-586.
2. Battese G.E. and Coelli, T.J. (1992), "Frontier Production Functions, Technical Efficiency and Panel Data: With Application to Paddy Farmers in India", in

- Gulledge, T.R. and C.A.K. Lovell (eds), *International Applications of Productivity and Efficiency Analysis*, Kluwer, Boston.
3. Fuller, W.A., and G.E. Battese (1993), "Estimation of Linear Models with Crossed-Error Structure", in Maddala, G.S. (Ed.), *The Econometrics of Panel Data, Volume I*, Edward Elgar Publishing Limited, Aldershot, England, 81-92.
 4. Ajibefun, I.A, R. Kada and G.E. Battese (2002), "Technical Efficiency and Technological Change in Japanese Rice Industry: A Stochastic Frontier Analysis", in Acharya, S.S., S. Singh and V. Sagar (Eds.), *Sustainable Agriculture, Poverty and Food Security: Agenda for Asian Economies*, Rawat Publications, Jaipur and New Delhi, 214-225.

Published Articles

1. Duloy, J.H. and G.E. Battese (1967), "Time and Recursiveness in Livestock Feeding Trials", *Australian Journal of Agricultural Economics*, 11, 184-191.
2. Battese, G.E., J.H. Duloy, J.M. Holder and B.R. Wilson (1968), "The Determination of Optimal Rations for Pigs Fed Separated Milk and Grain", *Journal of Agricultural Economics*, 19, 355-364.
3. Battese, G.E. (1969), "Optimal Rations for Pigs Fed Separated Milk and Grain: A Rejoinder", *Journal of Agricultural Economics*, 20, 359.
4. Battese, G.E., W.A. Fuller and W.D. Shrader (1972), "Analysis of Crop Rotation Experiments, With Application to the Iowa Carrington-Clyde Rotation- Fertility Experiments", *Iowa Agricultural and Home Economics Experiment Station, Research Bulletin*, 574, 20 pp.
5. Battese, G.E., and W.A. Fuller (1972), "Determination of Economic Optima from Crop-Rotation Experiments", *Biometrics*, 28, 781-792.
6. Fuller, W.A. and G.E. Battese (1973), "Transformations for Estimation of Linear Models with Nested-Error Structure", *Journal of the American Statistical Association*, 68, 626-632.
7. Battese, G.E. and W.A. Fuller (1973), "An Unbiased Response Model for Analysis of Categorical Data", *Proceedings of the Social Statistics Section of the American Statistical Association 1973*, 202-207.
8. Fuller, W.A. and G.E. Battese (1974), "Estimation of the Linear Model with Crossed-Error Structure", *Journal of Econometrics*, 2, 67-78. (Also Erratum in *Journal of Econometrics*, 3, 203.)
9. Garcia, P.A., G.E. Battese and W.D. Brewer (1975), "Longitudinal Study of Age and Cohort Influences on Dietary Patterns", *Journal of Gerontology*, 30, 349-356.
10. Battese, G.E., W.A. Fuller and R.D. Hickman (1976), "Estimation of Response Variances from Interview-Re-interview Surveys", *Journal of the Indian Society of Agricultural Statistics*, 28 (2), 1-14.
11. Battese, G.E. and E.M. Francisco (1977), "Distributions of Indemnities for Crop-Insurance Plans: With Application to Grain Crops in N.S.W.", *Australian Journal of Agricultural Economics*, 21 (2), 67-79.
12. Farrell, D.J., J.B. Hardaker, G.E. Battese and R.B. Cumming (1977), "Effects of Variation in Dietary Energy Concentration of Starter and Finisher Diets on Broiler Production", *Australian Journal of Experimental Agriculture and Animal Husbandry*, 17 (88), 755-760.
13. Battese, G.E. (1977), "Agricultural Economists, Response Functions and Lack-of-Fit Tests", *Review of Marketing and Agricultural Economics*, 45 (3), 85-94.

14. Battese, G.E. and G.S. Corra (1977), "Estimation of a Production Frontier Model: With Application to the Pastoral Zone of Eastern Australia", *Australian Journal of Agricultural Economics*, 21 (3), 169-179.
15. Battese, G.E. and E.M. Francisco (1977), "Distribuciones De Indemnizaciones Para Programas De Seguro Agrícola Con Referencia A Los Cereales En New South Wales", *Revista Ciencia E. Investigacion Agraria*, 6 (3), 219-229.
16. Battese, G.E. (1978), "On the Modelling of Fertiliser Response", *Journal of the Australian Institute of Agricultural Science*, 44 (2), 89-90.
17. Battese, G.E. and W.E. Griffiths (1980), "On R-Squared Statistics for the General Linear Model with Nonscalar Covariance Matrix", *Australian Economic Papers*, 19, 343-348.
18. Battese, G.E. and B.P. Bonyhady (1981), "Estimation of Household Expenditure Functions: An Application of a Class of Heteroscedastic Regression Models", *Economic Record*, 57, 80-85.
19. Battese, G.E. and W.A. Fuller (1981), "Prediction of County Crop Areas Using Survey and Satellite Data", *Proceedings of the Section on Survey Research Methods of the American Statistical Association 1981*, 500-505.
20. Garcia, P.A., G.E. Battese, K.B. Morrison and W.D. Brewer (1982), "Analysis of Cohort and Aging Effects on Anthropometric Measurements of Women in a Longitudinal Study", *Nutrition Research*, 2, 371-384.
21. Battese, G.E. and S.J. Malik (1987), "Estimation of Elasticities of Substitution for CES Production Functions Using Data on Selected Manufacturing Industries in Pakistan", *Pakistan Development Review*, XXVI (2), 161-177.
22. Battese, G.E. (1987), "Book Review of Harrison, S.R. and H.V. Tamaschke, *Applied Statistical Analysis*, Prentice-Hall, Sydney, 1984 ", *Australian Journal of Agricultural Economics*, 31, 91-94.
23. Battese, G.E. and S.J. Malik (1988), "Estimation of Elasticities of Substitution for CES and VES Production Functions Using Firm-Level Data for Food-Processing Industries in Pakistan", *Pakistan Development Review*, XXVI (3), 59-71.
24. Battese, G.E., R.M. Harter and W.A. Fuller (1988), "An Error Components Model for Prediction of County Crop Areas Using Survey and Satellite Data", *Journal of the American Statistical Association*, 83, 28-36.
25. Battese, G.E. and T.J. Coelli (1988), "Prediction of Firm-Level Technical Efficiencies with a Generalised Frontier Production Function and Panel Data", *Journal of Econometrics*, 38, 387-399.
26. Battese, G.E., N.A. Hasabelnaby and W.A. Fuller (1989), "Estimation of Livestock Inventories Using Several Area- and Multiple-Frame Estimators", *Survey Methodology*, 15, 13-27.
27. Battese, G.E., T.J. Coelli and T.C. Colby (1989), "Estimation of Frontier Production Functions and the Efficiencies of Indian Farms Using Panel Data from ICRISAT's Village Level Studies", *Journal of Quantitative Economics*, 5, 327-348.
28. Battese, G.E. (1992), "Frontier Production Functions and Technical Efficiency: A Survey of Empirical Applications in Agricultural Economics", *Agricultural Economics*, 7, 185-208.
29. Battese, G.E. and T.J. Coelli (1992), "Frontier Production Functions, Technical Efficiency and Panel Data: With Application to Paddy Farmers in India", *Journal of Productivity Analysis*, 3, 153-169.

30. Battese, G.E. and G.A. Tsesema (1993), "Estimation of Stochastic Frontier Production Functions with Time-varying Parameters and Technical Efficiencies Using Panel Data from Indian Villages", *Agricultural Economics*, 9, 313-333.
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36. Coelli, T.J. and G.E. Battese (1996), "Identification of Factors which Influence the Technical Inefficiency of Indian Farmers", *Australian Journal of Agricultural Economics*, 40, 103-128.
37. Battese, G.E. (1997), "A Note on the Estimation of Cobb-Douglas Production Functions When Some Explanatory Variables Have Zero Values", *Journal of Agricultural Economics*, 48, 250-252.
38. Battese, G.E., A.N. Rambaldi and G.H. Wan (1997), "A Stochastic Frontier Production Function with Flexible Risk Properties", *Journal of Productivity Analysis*, 8, 269-280.
39. Battese, G.E., and S.S. Broca (1997), "Functional Forms of Stochastic Frontier Production Functions and Models for Technical Inefficiency Effects: A Comparative Study for Wheat Farmers in Pakistan", *Journal of Productivity Analysis*, 8, 395-414.
40. Ngwenya, S.A., G.E. Battese and E.M. Fleming (1997), "The Relationship Between Farm Size and the Technical Inefficiency of Production of Wheat Farmers in Eastern Free State, Province of South Africa", *Agrekon*, 36, 283-301.
41. Ahmad, M., and G.E. Battese (1997), "A Probit Analysis of the Incidence of the Cotton Leaf Curl Virus in Punjab, Pakistan", *Pakistan Development Review*, 36 (2), 155-165.
42. Battese, G.E. and T.J. Coelli (1997), "Guest Editors' Introduction", *Journal of Productivity Analysis*, 8 (4), 323-324.
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44. Seyoum, E.T., G.E. Battese and E.M. Fleming (1998), "Technical Efficiency and Productivity of Maize Producers in Eastern Ethiopia: A Study of Farmers Within and Outside the Sasakawa-Global 2000 Agricultural Project", *Agricultural Economics*, 19, 341-348.

45. Battese, G.E. (1998), "A Methodological Note On A Stochastic Frontier Model For The Analysis Of The Effects Of Quality Of Irrigation Water On Crop Yields", *Pakistan Development Review*, 37, 293-298.
46. Battese, G.E., and S. Hassan, (1999), "Technical Efficiency of Cotton Farmers in Vehari District of Punjab, Pakistan", *Pakistan Journal of Applied Economics*, 15 (1 & 2), 41-53.
47. Lundvall, K., and G.E. Battese (2000), "Firm Size, Age and Efficiency: Evidence from Kenyan Manufacturing Firms", *Journal of Development Studies*, 36 (3), 146-163.
48. Battese, G.E., A. Heshmati and L. Hjalmarsson (2000), "Efficiency of Labour Use in the Swedish Banking Industry: A Stochastic Frontier Approach", *Empirical Economics*, 25, 623-640.
49. Battese, G.E. and D.S.P. Rao (2002), "Technology Gap, Efficiency and a Stochastic Metafrontier Function", *International Journal of Business and Economics*, 1 (2), 1-7.
50. Ajibefun, I.A., G.E. Battese, and R. Kada (2002), "Technical Efficiency, Technological Change and Productivity of Hired and Family Labour in the Japanese Rice Industry", *Empirical Economics Letters*, 1 (1), 21-31.
51. Ajibefun, I.A., G.E. Battese and A.G. Daramola (2002), "Determinants of Technical Efficiency in Smallholder Food Crop Farming: Application of Stochastic Frontier Production Function", *Quarterly Journal of International Agriculture*, 41 (3), 225-240.
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53. Khairo, S.A., and G.E. Battese (2005), "A Study of Technical Inefficiencies of Maize Farmers Within and Outside the New Agricultural Extension Program in the Harari Region of Ethiopia", *South African Journal of Agricultural Extension*, 34, 1-15.
54. Khairo, S.A., G.E. Battese and J.D. Mullen (2005), "Agriculture, food security and agricultural policy in Ethiopia", *Outlook in Agriculture*, 34 (2), 77-82.
55. Tveterås, R., and G.E. Battese (2006), "Agglomeration Externalities, Productivity and Technical Inefficiency", *Journal of Regional Science*, (to appear).
56. O'Donnell, C.J., D.S.P. Rao and G.E. Battese (2007), "Metafrontier Frameworks for the Study of Firm-Level Efficiencies and Technology Ratios", *Empirical Economics*, (to appear).

Theses

1. Battese, G.E. (1967), *A Theoretical Study of Spatial Equilibrium Models*, Unpublished M.Ag.Ec. Thesis, University of New England, Armidale, July 1967, 133 pp.
2. Battese, G.E. (1973), *Parametric Models for Response Errors in Survey Sampling*, Unpublished Ph.D. Dissertation, Department of Statistics, Iowa State University, Ames, August 1973, 127 pp.
3. Battese, G.E. (2004), *25 Years of Research on Modelling and Estimation of Stochastic Frontier Models*, Unpublished D.Ec. Dissertation, University of New England, April 2004, 625 pp.

Other Manuscripts

1. Battese, G.E., W.A. Fuller and R.D. Hickman (1972), "Interview Effects and Response Errors in a Replicated Survey of Farm Operators in Selected Iowa Counties", *Report to the Statistical Reporting Service, United States Department of Agriculture*, Statistical Laboratory, Iowa State University, Ames, July 1972, 35p.
2. Battese, G.E. (1976), *Lecture Notes for Theory of Statistics A and B*, Printed Lecture Notes for External Students in Economic Statistics 205-1 and 310-1, University of New England, Armidale, 282p.
3. Battese, G.E., W.A. Fuller and R.D. Hickman (1978), "A Study of Farm Operator Attitudes Toward Surveys", *Report to the Statistical Reporting Service, United States Department of Agriculture*, Iowa State University, Ames, March 1978, 41p.
4. Garcia, P.A., G.E. Battese and W.D. Brewer (1981), "Anthropometric Measurements, Basal Metabolism and Urinary Creatinine of Aging Women", Unpublished Paper, Department of Human Nutrition, Iowa State University, 24p.
5. Malik, S.J. and G.E. Battese (1986), "Choice of Techniques: A Cautionary Tale from Pakistan", Unpublished Paper, Pakistan Institute of Development Economics, Islamabad, 46p.
6. Coelli, T.J. and G.E. Battese (1986), "A Frontier Production Function for Panel Data: With Application to the Australian Dairy Industry", *Working Papers in Econometrics and Applied Statistics*, No. 24, Department of Econometrics, University of New England, Armidale, 21p.
7. Battese, G.E. (1986), "On the Prediction of Technical Efficiencies, Given the Specifications of a Generalised Frontier Production Function and Panel Data on Sample Firms", *Working Papers in Econometrics and Applied Statistics*, No. 28, Department of Econometrics, University of New England, Armidale, 11p.
8. Battese, G.E. and S. J. Malik (1986), "Identification and Estimation of Elasticities of Substitution for Firm-Level Production Functions Using Aggregative Data", *Working Papers in Econometrics and Applied Statistics*, No. 25, Department of Econometrics, University of New England, Armidale, 21p.
9. Battese, G.E. (1986), "Continuous Random Variables, Frequency Polygons and Density Functions", Unpublished Paper, Department of Econometrics, University of New England, Armidale, 7p.
10. Battese, G.E., S.M. Nusser and W.A. Fuller (1988), "Estimation of the Distribution of Usual Intakes for Selected Dietary Components", *Technical Report 88-TR5, Center for Agricultural and Rural Development*, Iowa State University, Ames, 71p.
11. Battese, G.E. and S.J. Malik (1988), "Identification and Estimation of Elasticities of Substitution for Firm-Level Production Functions Using Aggregative Data: With Application to the Food-Processing Industry in Pakistan", Unpublished Paper, Department of Econometrics, University of New England, Armidale, 30p.
12. Battese, G.E., S.J. Malik and I. Babar (1988), "The Possibilities of Employment Generation in the Large-Scale, Food-Processing Industry in Pakistan", *Unpublished Paper, Department of Econometrics*, University of New England, Armidale, 15p.

13. Battese, G.E. (1988), "Frontier Production Functions and Technical Efficiencies of Farms: With Application to Panel Data from ICRISAT's Village Level Studies", *Report to the International Crops Research Institute for the Semi-Arid Tropics*, Department of Econometrics, University of New England, Armidale, 22p.
14. Nusser, S.M., G.E. Battese and W.A. Fuller (1990), "Method of Moments Estimation of Usual Intake Distributions", *Working Paper 90-WP52, Center for Agricultural and Rural Development*, Iowa State University, Ames, 27p.
15. Battese, G.E. (1992), *Study Guides for Econometrics 270-1/370-1: Survey Design and Analysis*, Department of Econometrics, University of New England, Armidale, 186p.
16. Wan, G.H. and G.E. Battese (1992), "A Stochastic Frontier Production Function Incorporating Flexible Risk Properties", *Working Papers in Econometrics and Applied Statistics*, No. 66, Department of Econometrics, University of New England, Armidale, 12p.
17. Battese, G.E. and T.J. Coelli (1993), "A Stochastic Frontier Production Function Incorporating a Model for Technical Inefficiency Effects", *Working Papers in Econometrics and Applied Statistics*, No. 69, Department of Econometrics, University of New England, 22p.
18. Battese, G.E., and M. Bernabe (1993), "An Investigation of Stochastic Frontier Production Functions Involving Farmer Characteristics Using ICRISAT Data from Three Indian Villages", *Working Papers in Econometrics and Applied Statistics*, No. 72, Department of Econometrics, University of New England, 38pp.
19. Battese, G.E. (1996), "On the Estimation of Production Functions Involving Explanatory Variables Which Have Zero Values", *Working Papers in Econometrics and Applied Statistics*, No. 86, Department of Econometrics, University of New England, Armidale, 6pp.
20. Nsanzugwanko, M.D., G.E. Battese and E.M. Fleming (1996), "The Technical Efficiency of Small Agricultural Producers in Central Ethiopia", *CEPA Working Papers*, No. 5/96, Centre for Efficiency and Productivity Analysis, University of New England, Armidale, 16pp.
21. Ajibefun, I.A., Battese, G.E. and Kada, R. (1996), "Technical Efficiency and Technological Change in the Japanese Rice Industry: A Stochastic Frontier Analysis", *CEPA Working Papers*, No. 9/96, ISBN 1 86389 4997, Department of Econometrics, University of New England, Armidale, pp. 22.
22. Ajibefun, I.A., G.E. Battese and A.G. Daramola (1996), "Investigation of Factors Influencing the Technical Efficiencies of Smallholder Croppers in Nigeria", *CEPA Working Papers*, 9/96, Centre for Efficiency and Productivity Analysis, University of New England, Armidale, 19pp.
23. Battese, G.E. (1997), *Topics in Statistics and Econometrics*, Lecture Notes for a Short Course at the University of Agriculture, Faisalabad, Pakistan, 140pp.
24. Bayarsaihan, T., G.E. Battese, and T.J. Coelli, (1998), "Productivity of Mongolian Grain Farming: 1976-89", *CEPA Working Papers*, No. 2/98, Department of Econometrics, University of New England, Armidale, pp. 26.
25. Lundvall, K., and G.E. Battese (1998), "Firm Size, Age and Efficiency: Evidence from Kenyan Manufacturing Firms", *CEPA Working Papers*, No. 7/98, Centre for Efficiency and Productivity Analysis, University of New England, Armidale, pp. 40.

26. Battese, G.E., A. Heshmati and L. Hjalmarsson (1998), "Efficiency of Labour Use in the Swedish Banking Industry: A Stochastic Frontier Approach", *CEPA Working Papers*, No. 6/98, Centre for Efficiency and Productivity Analysis, University of New England, Armidale, pp. 29.
27. Battese, G.E. (1998), "A Stochastic Frontier Model for the Analysis of the Effects of Quality of Irrigation Water on Crop Yields", *CEPA Working Papers*, No. 9/98, Centre for Efficiency and Productivity Analysis, University of New England, Armidale, pp. 10.
28. Battese, G.E., and S. Hassan (1998), "Technical Efficiency of Cotton Farmers in a Region of the Punjab, Pakistan", *CEPA Working Papers*, No. 8/98, Centre for Efficiency and Productivity Analysis, University of New England, Armidale, pp. 20.
29. Tveterås, R., and G.E. Battese (2001), "The Influence of Regional Agglomeration Externalities on Efficiency in Norwegian Salmon Aquaculture", *CEPA Working Papers*, No. 1/2001, ISBN 1 86389 7399, School of Economics, University of New England, Armidale, pp. 27.
30. Battese, G.E. and D.S.P. Rao (2001), "Productivity Potential and Technical Efficiency Levels of Firms in Different Regions Using a Stochastic Frontier Metaproduction Function Model", *CEPA Working Papers*, No. 6/2001, Centre for Efficiency and Productivity Analysis, School of Economics, University of New England, Armidale, pp. 10.
31. Battese, G.E., D.S.P. Rao and D. Walujadi (2001), "Technical Efficiency and Productivity of Garment Firms in Different Regions in Indonesia: A Stochastic Frontier Analysis Using a Time-varying Inefficiency Model and a Metaproduction Function", *CEPA Working Papers*, No. 7/2001, Centre for Efficiency and Productivity Analysis, School of Economics, University of New England, Armidale, pp. 26.
32. Battese, G.E., D.S.P. Rao and D. Walujadi (2001), "Technical Efficiency and Productivity of Firms Using a Stochastic Metaproduction Frontier", Efficiency Series Paper 8/2001, Permanent Seminar on Efficiency and Productivity, Departamento de Economía, Universidad de Oviedo, Oviedo, Spain, pp. 20.
33. Daryanto, H.K.S., G.E. Battese and E.M. Fleming (2002), "Technical Efficiencies of Rice Farmers Using Different Irrigation Systems in Different Cropping Seasons in West Java, Indonesia", *CEPA Working Papers*, No. 1/2002, School of Economics, University of New England, Armidale, NSW, pp. 27.
34. Battese, G.E., D.S.P. Rao, and C.J. O'Donnell (2002), "A Metafrontier Production Function for Estimation of Technical Efficiencies and Technology Gaps for Firms Operating Under Different Technologies", *CEPA Working Papers*, No. 2/2002, School of Economics, University of New England, Armidale, NSW, pp. 20.
35. Aijebefun, I.A. and G.E. Battese (2002), "Analysis of Technical Efficiency and Policy Options in Small-scale Food Crop Production in South-western Nigeria", (in preparation)
36. Rao, D.S.P., C.J. O'Donnell, and G.E. Battese (2003), "Metafrontier Functions for the Study of Inter-regional Productivity Differences", *CEPA Working Paper Series*, **WP01/2003**, University of Queensland, 34 pp.
37. Wiboonpongse, A., S. Sriboonchitta and G.E. Battese (2005), The Effects of Production Inputs, Technical Inefficiency and Biological Risk on Jasmine and

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CONFERENCE PAPERS

1. "Transformations for Correlated Error Models" (with W. A. Fuller), *Joint Statistical Meeting of the American Statistical Association and the Biometric Society (E.N.A.R.)*, Iowa State University, 26th-28th April, 1972.
2. "An Unbiased Response Model for Analysis of Categorical Data" (with W. A. Fuller), *Annual Meetings of the American Statistical Association*, New York, 27th-30th December 1973.
3. "Linear Models with Error Variances that are Proportional to a Power of the Expectations of the Dependent Variable" (with B.P. Bonyhady), *Third Australian Statistical Conference*, La Trobe University, Melbourne, 18th-20th February 1976.
4. "Estimation of a Production Frontier Model: With Application to the Pastoral Zone of Eastern Australia" (with G.S. Corra), *21st Annual Conference of the Australian Agricultural Economics Society*, University of Queensland, Brisbane, 8th-10th February 1977.
5. "Insurance Plans for Crops with Normal or Non-normal Yield: With Application to Grain Crops in N.S.W." (with E.M. Francisco), *21st Annual Conference of the Australian Agricultural Economics Society*, University of Queensland, Brisbane, 8th-10th February 1977.
6. "Prediction of County Crop Areas Using Survey and Satellite Data" (with W.A. Fuller), *Annual Meetings of the American Statistical Association*, Detroit, 10th-13th August 1981.
7. "An Error Components Model for Prediction of County Crop Areas Using Survey and Satellite Data" (with W.A. Fuller), *6th Australian Statistical Conference*, University of Melbourne, 23rd-27th August 1982.
8. "A Frontier Production Function for Panel Data: With Application to the Australian Dairy Industry" (with T.J. Coelli), *30th Annual Conference of the Australian Agricultural Economics Society*, Australian National University, Canberra, 3rd-5th February 1986.
9. "Identification and Estimation of Elasticities of Substitution for Firm-Level Production Functions Using Aggregative Data" (with S.J. Malik), *Australasian Meeting of the Econometric Society*, University of Melbourne, 28th-30th August 1986.
10. "Prediction of Technical Efficiencies, Given a Frontier Production Function and Panel Data", *Australasian Meeting of the Econometric Society*, University of Melbourne, 28th-30th August 1986.
11. "The Possibilities of Employment Generation in the Large-Scale, Food-Processing Industry in Pakistan" (with S.J. Malik and I. Babar), *Australian Economics Congress*, Australian National University, Canberra, 28th August-2nd September 1988.
12. "Estimation of Frontier Production Functions and Technical Efficiencies for Indian Farms Using Panel Data from ICRISAT's Village Level Studies" (with T. J. Coelli and T. C. Colby), *33rd Annual Conference of the Australian Agricultural Economics Society*, Lincoln University, Christchurch, 7th-9th

- February 1989. (Also at the *Australasian Meeting of the Econometric Society*, University of New England, Armidale, 13th-15th July 1989).
13. "Production Frontiers, Technical Efficiency and Time", *Conference on Modelling Production With Multiple Outputs*, La Trobe University, 7th-9th September 1989.
 14. "Frontier Production Functions, Technical Efficiency and Panel Data", Invited Paper in the Productivity and Efficiency Analysis Sessions, *30th Joint National Meeting of the Operations Research Society of America and the Institute of Management Science*, Philadelphia, 29th-31st October 1990.
 15. "Frontier Production Functions and Technical Efficiency: A Survey of Empirical Applications in Agricultural Economics", *35th Annual Conference of the Australian Agricultural Economics Society*, University of New England, Armidale, 5th-7th February 1991.
 16. "Frontier Production Functions, Technical Efficiency and Panel Data: With Application to Paddy Farmers in India (with T.J. Coelli), *Australasian Meeting of the Econometric Society*, University of New South Wales, Sydney, 10th-13th July 1991. (Also at the *Conference on Current Issues in Productivity Analysis*, State University of New Jersey-Rutgers, Newark, 16th-18th December 1991.)
 17. "Estimation of Stochastic Frontier Production Functions with Time-Varying Parameters and Technical Efficiencies Using Panel Data from Indian Villages" (with G.A. Tessema), *36th Annual Conference of the Australian Agricultural Economics Society*, Australian National University, Canberra, 10th-12th February 1992.
 18. "A Stochastic Frontier Production Function Incorporating Flexible Risk Properties" (with G.H. Wan), *Australasian Meeting of the Econometric Society*, Monash University, Melbourne, 6th-8th July 1992.
 19. "A Generalised Stochastic Frontier Production Function Incorporating a Model for Inefficiency Effects" (with T.J. Coelli), *Australasian Meeting of the Econometric Society*, University of Sydney, 7th-9th July 1993.
 20. "Identification of Factors which Influence the Technical Inefficiency of Indian Farmers" (with T.J. Coelli), *38th Annual Conference of the Australian Agricultural Economics Society*, Victoria University, Wellington, 8th-10th February 1994.
 21. "Technical Efficiencies of Smallholder Cocoa Producers in Papua New Guinea" (with K.C. Gimbol and E.M. Fleming), *38th Annual Conference of the Australian Agricultural Economics Society*, Victoria University, Wellington, 8th-10th February 1994.
 22. "A Stochastic Frontier Production Function with Flexible Risk Properties" (with A.N. Rambaldi and G.H. Wan). *Georgia Productivity Workshop*, University of Georgia, Athens, 21st-23rd October 1994 (Also at the *39th Annual Conference of the Australian Agricultural Economics Society*, University of Western Australia, Perth, 13th - 15th February 1995.)
 23. "A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data" (with T.J. Coelli), *Fourth European Workshop on Efficiency and Productivity Analysis*, Center for Operations Research and Econometrics, Universite Catholique de Louvain, Louvain-La-Neuve, Belgium, 26-28 October 1995.
 24. "Functional Forms of Stochastic Frontier Production Functions and Models for Technical Inefficiency Effects: A Comparative Study for Wheat Farmers in

- Pakistan” (with S.S. Broca), *New England Conference on Efficiency and Productivity*, University of New England, Armidale, 23-24 November 1995.
25. "The Technical Efficiency of Small Agricultural Producers in Central Ethiopia" (with M.D. Nsanzugwanko and E.M. Fleming), *40th Annual Conference of the Australian Agricultural & Resource Economics Society*, University of Melbourne, 13-15 February 1996.
 26. "Functional Forms of Stochastic Frontier Production Functions and Models for Technical Inefficiency Effects: A Comparative Study for Wheat Farmers in Pakistan", *Georgia Productivity Workshop II*, University of Georgia, Athens, 1-3 November 1996.
 27. "Productivity of Mongolian Grain Farming, 1975-1989" (with T. Bayarsaihan and T.J. Coelli), Paper presented at the *41st Annual Conference of the Australian Agricultural & Resource Economics Society*, Gold Coast, 20-25 January 1997.
 28. "Stochastic Frontier Production Functions and Models for Technical Inefficiency Effects", *Invited Paper* presented at *The Taipei International Conference on Efficiency and Productivity Growth*, Academia Sinica, Taipei, 20-21 June 1997.
 29. "Efficiency of Labour Use in the Swedish Banking Industry: A Stochastic Frontier Approach", Paper presented at the *Georgia Productivity Workshop III*, University of Georgia, Athens, 29-30 October, 1998.
 30. "Firm Size, Age and Efficiency: Evidence from Kenyan Manufacturing Firms", Paper (with K. Lundvall) presented at the *Sixth European Workshop on Efficiency and Productivity Analysis*, The Royal Agricultural University, Copenhagen, 29-31 October, 1999.
 31. "Stochastic Frontier Analysis and Metaproduction Functions", *Invited Paper* at the *Seventh European Workshop on Efficiency and Productivity Analysis*, University of Oviedo, Spain, 25-29 September, 2001.
 32. "Technical Efficiencies of Rice Farmers Using Different Irrigation Systems in Different Cropping Seasons in West Java, Indonesia", *Asia Conference on Efficiency and Productivity Growth*, Taipei, 19-20 July, 2002.
 33. "Technology Gap, Efficiency and a Stochastic Metafrontier Function", *Economic Measurement Group*, University of New South Wales, 6 September, 2002.
 34. "Metafrontier Functions for the Study of Inter-regional Productivity Differences", *Eighth European Workshop on Efficiency and Productivity Analysis*, University of Oviedo, Spain, 24-27 September, 2003.

PROFESSIONAL SEMINARS

1. *Statistical Laboratory, Iowa State University, Ames*, 5 January 1972: "Transformations for Regression Analyses of Correlated Observations"
2. *Faculty of Economic Studies, University of New England, Armidale*, 27 May 1976: "Heteroscedastic Linear Models with Application in Economics"
3. *Statistics Colloquium, University of New England, Armidale*, 8 August 1977: "Heteroscedasticity and the Estimation of Household Expenditure Functions for Australia"
4. *N.S.W. Department of Agriculture Research Station, Grafton*, 19 August 1977: "Experimental Data and Lack-of-Fit Tests"

5. *Department of Econometrics, University of New South Wales*, 14 October 1977: "Heteroscedasticity and the Estimation of Household Expenditure Functions for Australia"
6. *Statistical Laboratory, Iowa State University, Ames*, 15 October 1980: "Heteroscedastic Regression Models and the Estimation of Expenditure Functions"
7. *Remote Sensing Section, U.S. Dept. of Agriculture, Washington*, 20 April 1981: "Prediction of County Crop Areas Using Survey and Satellite Data"
8. *Department of Statistics, Australian National University*, 14 October 1983: "An Error Components Model for Prediction of County Crop Areas Using Survey and Satellite Data"
9. *Statistical Laboratory, Iowa State University, Ames*, 18 March 1987: "Frontier Production Functions and Technical Efficiency of Firms"
10. *Department of Economics, Vanderbilt University, Nashville*, 12 June 1987: "Frontier Production Functions and Technical Efficiency of Firms"
11. *Econometrics Workshop, Department of Economics, Michigan State University, East Lansing*, 8 October 1987: "Prediction of Firm-Level Technical Efficiencies, Given a Generalised Frontier Production Function and Panel Data"
12. *Department of Statistics, Iowa State University, Ames*, 16 November 1987: "On Teaching the Concept of a Density Function of a Continuous Random Variable in an Elementary Statistics Course"
13. *Human Nutrition Information Service, U.S. Dept. of Agriculture, Washington*, 20 April 1988: "Estimation of the Distribution of Usual Intakes for Selected Dietary Components Using Data from the 1985-86 Continuing Survey of Food Intakes by Individuals"
14. *International Crops Research Institute for the Semi-Arid Tropics, Patancheru, India*, 30 September 1988: "Frontier Production Functions and Technical Efficiencies of Farms: With Application to Panel Data from ICRISAT's Village Level Studies"
15. *Department of Economics, Research School of Pacific Studies, Australian National University, Canberra*, 29 November 1988: "Frontier Production Functions and Technical Efficiencies of Firms: With Application to Panel Data from ICRISAT's Village Level Studies"
16. *Department of Economics, Iowa State University, Ames*, 8 November 1990: "Frontier Production Functions, Technical Efficiency and Panel Data"
17. *Department of Economics, University of Michigan, Ann Arbor*, 16 November 1990: "Frontier Production Functions, Technical Efficiency and Panel Data"
18. *Department of Economics, University of Texas at Austin*, 2 December 1991: "Frontier Production Functions, Technical Efficiency and Panel Data: With Application to Paddy Farmers in India"
19. *Department of Economics, Southern Methodist University, Dallas*, 4 December 1991: "Frontier Production Functions, Technical Efficiency and Panel Data: With Application to Paddy Farmers in India"
20. *International Food Policy Research Institute, Washington*, 12 December 1991: "Frontier Production Functions, Technical Efficiency and Panel Data: With Application to Paddy Farmers in India"
21. *Department of Agricultural Economics, University of Sydney*, 25 June 1992: "Frontier Production Functions and Technical Efficiency and Panel Data: Concepts, Models and Applications"

22. *Joint Seminar of the Department of Economics and the Department of Agricultural Economics, Louisiana State University, Baton Rouge, 9 November 1992: "Frontier Production Functions and Technical Efficiency and Panel Data: Concepts, Models and Applications"*
23. *Department of Economics, Vanderbilt University, Nashville, 10 November 1992: "Estimation of Stochastic Frontier Production Functions with Time-Varying Parameters and Technical Efficiencies Using Panel Data from Indian Villages"*
24. *Department of Economics, University of Connecticut, Storrs, 17 November 1992: "Frontier Production Functions and Technical Efficiency: With Application to Panel Data from Selected Indian Villages"*
25. *Department of Economics, Union College, Schenectady, 18 November 1992: "Estimation of Stochastic Frontier Production Functions with Time-Varying Parameters and Technical Efficiencies Using Panel Data from Indian Villages"*
26. *Department of Agricultural Economics, University of Kentucky, 20 November 1992: "Frontier Production Functions and Technical Efficiency: With Application to Panel Data from Selected Indian Villages"*
27. *Department of Economics and Associated Research Program Seminar, University of Wollongong, 12 May 1993: "A Generalised Stochastic Frontier Production Function Incorporating a Model for Technical Inefficiency Effects"*
28. *International Food Policy Research Institute, Washington, 2 July 1993: "An Investigation of Technical Inefficiencies of Production of Wheat Farmers in Four Districts of Pakistan"*
29. *Joint Department of Economics and Department of Statistics Colloquium, Texas A & M University, College Station, 12 November 1993: "A Generalised Stochastic Frontier Production Function Incorporating a Model for Technical Inefficiency Effects"*
30. *Department of Economics, Rice University, Houston, 13 November 1993: "A Generalised Stochastic Frontier Production Function Incorporating a Model for Technical Inefficiency Effects"*
31. *Department of Agricultural Economics, University of Kentucky, 19 November 1993: "A Generalised Stochastic Frontier Production Function Incorporating a Model for Technical Inefficiency Effects"*
32. *Department of Economics, University of Otago, Dunedin, 11 February 1994: "A Generalised Stochastic Frontier Production Function Incorporating a Model for Technical Inefficiency Effects"*
33. *Dept. of Statistics, Australian National University, Canberra, 15 April 1994: "A Generalised Stochastic Frontier Production Function Incorporating a Model for Technical Inefficiency Effects"*
34. *Econometrics and Statistics Colloquium, University of Chicago, 2 November 1994: "A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data"*
35. *Department of Agricultural Economics and Food Marketing, University of Newcastle Upon Tyne, 25 October 1995: "Frontier Production Functions and Technical Efficiency: Concepts, Models and Applications"*
36. *Department of Economics, University of Queensland, Brisbane, 15 March 1996: "Functional Forms of Stochastic Frontier Production Functions and Models for Technical Inefficiency Effects"*
37. *Joint Seminar to the Departments of Agricultural Economics and Policy, Development Economics, and General Economics, Wageningen Agricultural*

- University*, 10 June 1996: “Functional Forms of Stochastic Frontier Production Functions and Models for Technical Inefficiency Effects”
38. *Department of Agricultural Economics and Management, University of Reading*, 13 June 1996: “Frontier Production Functions: An Application to Indian Paddy Farmers”
 39. *Economic & Social Research Council, Development Studies Group, London School of Economics*, 14 June 1996: “Functional Forms of Stochastic Frontier Production Functions and Models for Technical Inefficiency Effects”
 40. *Econometrics Workshop, Department of Applied Economics, University of Cambridge*, 19 June 1996: “Functional Forms of Stochastic Frontier Production Functions and Models for Technical Inefficiency Effects”
 41. *School of Economic Studies, University of Manchester*, 21 June 1996: “Functional Forms of Stochastic Frontier Production Functions and Models for Technical Inefficiency Effects”
 42. *Department of Economics, Göteborg University, Gothenburg*, 24 January 1997: “The Relationship Between Farm Size and the Technical Inefficiency of Production of Wheat Farmers in Eastern Orange Free State, South Africa”
 43. *Department of Economic Statistics, Stockholm School of Economics*, 13 March 1997: “Stochastic Frontier Production Functions and Models for Technical Inefficiency Effects”
 44. *School of Economics and Commercial Law, Göteborg University, Gothenburg*, Special Lecture to Economics Students from Tilburg University, 3 April 1997: “Econometrics and Production Functions”
 45. *Department of Economics, Royal Veterinary and Agricultural University, Copenhagen*, 11 March 1997: “Stochastic Frontier Production Functions and Models for Technical Inefficiency Effects”
 46. *Department of Management, Odense University, Denmark*, 14 March 1997: “Stochastic Frontier Production Functions and Models for Technical Inefficiency Effects”
 47. *Department of Economics, University of Oslo, Oslo*, 7 May 1997: “Stochastic Frontier Production Functions and Models for Technical Inefficiency Effects”
 48. *Department of Economics, Institute for Advanced Studies, Vienna*, 30 June 1997: “Stochastic Frontier Production Functions and Models for Technical Inefficiency Effects”
 49. *Applied Economics Research Centre, University of Karachi*, 13 February 1998: “Functional Forms of Stochastic Frontier Production Functions and Technical Inefficiency Effects: A Comparative Study of Wheat Farmers in Pakistan”
 50. *Department of Econometrics, University of New England*, 3 July 1998: “A Stochastic Frontier Model for the Analysis of the Effects of Quality of Irrigation Water on Crop Yields”
 51. *Department of Economics, Michigan State University*, 4 November 1998: “Efficiency of Labour Use in the Swedish Banking Industry: A Stochastic Frontier Approach”
 52. *The Anderson Graduate School of Management, University of California at Los Angeles*, 6 November 1998: “Introduction to Frontier Models” and “Efficiency of Labour Use in the Swedish Banking Industry: A Stochastic Frontier Approach”
 53. *Department of Economics, Hong Kong Baptist University*, 13-17 September 1999: *Invited Lectures* on “Stochastic Frontiers: Concepts, Models and Applications”.

54. The Mansholt Institute, Wageningen University, 26 October 1999: "Firm Size, Age and Efficiency: Evidence from Kenyan Manufacturing Firms".
55. Department of Economics, University of Melbourne, 19 July 2001: "Stochastic Frontier Analysis and Metaproduction Functions".
56. Department of Agricultural and Resource Economics, University of California at Davis, 14 February 2005, "Metafrontier Functions for the Study of Inter-regional Productivity Differences".
57. Department of Economics, University of Hawaii at Manoa, 25 February 2005, "Metafrontier Functions for the Study of Inter-regional Productivity Differences".

SUPERVISION OF RESEARCH STUDENTS

1. Bruce Bonyhady, (1975) "Estimation of Linear Models with Variances a Power of the Expectations: With Application to a Consumer Expenditure Relation", B.Ec.(Hons.) Dissertation.
2. Greg Corra (1976), "Statistical Models for Production Frontiers: With Application to the Pastoral Zone of Eastern Australia", B.Ag.Ec. Dissertation.
3. Rachel Harter (1981), "Small Area Estimation Using the Nested Error Model", M.S. dissertation at Iowa State University.
4. Vo Van Anh, (1983), "'Statistical Inference for a Class of Heteroscedastic Regression Models", M.Ec. Dissertation.
5. Sohail Malik (1985), "Choice of Techniques, Elasticities of Substitution and Manufacturing Industries in Pakistan", Ph.D. Dissertation.
6. Jim Baldwin (1985), Graduate Diploma of Statistics Dissertation.
7. Tim Coelli (1985), "A Generalized Frontier Production Function for Cross-Sectional, Time-Series Data", B.App.Ec. Dissertation.
8. Glenn Barry (1986), "Prediction of Individual Firm Technical Efficiency for a Generalized Frontier Model Using Panel Data", B.Ec.(Hons.) Dissertation.
9. Thomas Colby (1988), "Estimation of a Frontier Production Function Model Using Panel Data on Firms with Unequal Numbers of Observations", B.Ec.(Hons.) Dissertation.
10. Charles Umberger (1988), Trends in Aboriginal Health in Australia, Dip Stats Dissertation
11. Stephen Thollar (1989), "Robust Estimation Versus Estimation Under Misspecification in a Heteroscedastic Error Model", M.Ec. Dissertation (jointly supervised by Bill Griffiths).
12. Paul Segal (1990), "A Production Frontier Incorporating a Flexible Functional Form, Time-Varying Firm Effects and Unbalanced Panel Data", Diploma in Economic Statistics.
13. Getachew Tessema (1991), "Estimation of a Stochastic Frontier Production Function with Time-Varying Technical Efficiency Using Indian Farm-Level Data", M.Ec. Dissertation.
14. Calasewaka (1991), "Supply Response of Pepper in Indonesia", M.Ec. Dissertation (jointly supervised by Kevin Parton).
15. Matt Balogh (1992), "Quantitative Political Analysis in Australia : Introducing the Psephograph". Master of Arts thesis (jointly supervised by John Warhurst).
16. Manolito Bernabe (1993), "Investigation on Some Farmer Characteristics in Stochastic Frontier Production Functions Using Panel Data from Indian Villages", M.Ec. Dissertation.

17. Chris Gimbol (1993), "An Analysis of Technical Efficiency of Smallholder Cocoa Producers in Papua New Guinea", M.Ec. Dissertation (jointly supervised by Euan Fleming).
18. Midlaster Nsanzugwanko (1994), "Analysis of Technical Efficiency of Agricultural Production in Ethiopia", M.Ec. Dissertation (jointly supervised by Euan Fleming).
19. Carl Yeomans (1994), "A Flexible Risk Stochastic Frontier Production Function: With Application to Cross-Sectional Data from Central Ethiopian Farms", B.Ec.(Hons.) Dissertation.
20. Tim Coelli (1996), "Specification and Estimation of Stochastic Frontier Production Functions", Ph.D. Dissertation.
21. Emayenesh Seyoum (1996), "Technical Efficiency and Productivity of Maize Producers in Eastern Ethiopia: A Comparison of Traditional Farmers and Those Within the Sasakawa-Global 2000 Agricultural Project", M.Ec. Dissertation (jointly supervised by Euan Fleming).
22. Siphon Ngwenya (1996), "Analysis of Technical Inefficiencies of Production of Wheat Farmers in Eastern Orange Free State, South Africa", B.Ag.Ec. Dissertation (jointly supervised by Euan Fleming).
23. Santhi Wicks (1996), "Impact of Organic Fertiliser on Rice Production in Matinkis, the Philippines: A Stochastic Frontier Analysis", B.Ag.Ec. Dissertation (jointly supervised by Euan Fleming).
24. Salahadin Khairo (1998), "A Study of Technical Inefficiency of Production of Maize Farmers Within and Outside the Extension Program in the Harari Region, Ethiopia", M.Ec. Dissertation (jointly supervised by Phil Simmons).
25. Satbir Singh (2000), "Performance of Dairy Cooperatives and Private Dairies at the Milk Plant Level in India", PhD Thesis (jointly supervised by Euan Fleming, after Tim Coelli went on study leave).
26. Alan Aku (2000), "An Analysis of Technical Efficiency of Cocoa Estate Producers in Papua New Guinea", M.Ec Dissertation (joint with Euan Fleming)
27. Dedi Walujadi (2000), "The Measurement of Efficiency of Production in the Indonesian Garment Industry: Evidence from Firm-level Data", PhD thesis, (jointly supervised by Abul Shamsuddin and Prasada Rao)
28. Heny Daryanto (2000), "Analysis of the Technical Efficiency of Rice Production in West Java Province, Indonesia: A Stochastic Frontier Production Function Approach", PhD thesis, (jointly supervised by Euan Fleming).
29. Lizbeth Gabutin (2001), "Technical Efficiency of Tomato Producers in the CAMATIS Project, Bukidnon, Philippines" MEc dissertation (jointly supervised by Euan Fleming).
30. Elizabeth Siebert (2002), "Market-Based Incentive Mechanisms and Management of Salinity in the Mallee Region of South Australia", MEc dissertation (jointly supervised by Jack Sinden).
31. Filadelfo de Mateo (2003), "Incorporation of Adjustment Costs in DEA Models: Selection of Optimal Paths" PhD thesis (jointly supervised by Chris O'Donnell).
32. Renato Villano (2004), "The Measurement of Technical Efficiency, Production Risk and Risk Preferences: Evidence from Rain-fed Lowland Rice Environment in the Philippines" PhD thesis (jointly supervised by Chris O'Donnell and Euan Fleming), submitted in March 2004.

33. Yaovarate Chaovanapoonphol (2006), “The Impact of Financial Services on the Performance of Rice Farmers in the Upper North of Thailand” (jointly supervised by Christy Chiang and Roley Piggott), commenced in February 2003.

PROFESSIONAL SERVICES

Referee for Journals

Agricultural Economics
American Journal of Agricultural Economics
American Statistician
Aquaculture Economics and Management
Australian Journal of Agricultural and Resource Economics
Biometrics
Bulletin of Economic Research
Business and Economics Letters
CAHIERS d'Economie et Sociologie Rurales
Canadian Journal of Agricultural Economics
Econometric Reviews
Economic Systems
Economics of Education Review
European Journal of Operational Research
European Review of Agricultural Economics
Empirical Economics
International Journal of Business and Economics
Iran Agricultural Research
Journal of African Economies
Journal of Agricultural Economics
Journal of Agricultural & Resource Economics
Journal of Agricultural Science and Technology
Journal of Applied Econometrics
Journal of Development Economics
Journal of Development Studies
Journal of Economics and Finance
Journal of Environmental Economics and Management
Journal of Environmental Management
Journal of the American Statistical Association
Journal of the Australian Chiropractors' Association
Journal of the Australian Institute of Agricultural Science
Journal of Economics and Finance
Journal of Econometrics
Journal of Environmental Management
Journal of Productivity Analysis
Journal of Regional Science
Managerial and Decision Economics
Political Methodology
Review of Urban & Regional Development Studies
Review of Marketing and Agricultural Economics
Resource & Energy Economics

Sankya
Scandinavian Journal of Economics
Survey Methodology
The Journal of International Trade and Economic Development
The Review of Economic Studies
The Review of Economics and Statistics
World Bank Economic Review

Australasian Region of the Econometric Society

Chair, Contributed Papers Session, Australasian Meeting of the Econometric Society, University of Sydney, August 1984.

Member of the Standing Committee, 1988 - 1991.

Chair, Programme Committee, Australasian Meeting of the Econometric Society, University of New England, Armidale, 13th - 15th July, 1989.

Member, Programme Committee, Australasian Meeting of the Econometric Society, University of New England, Armidale, 13th - 15th July, 1994.

Chair, Invited Paper Session, Australasian Meeting of the Econometric Society, University of New England, Armidale, 13th - 15th July, 1994.

Australian Agricultural Economics Society

Chair, Invited Papers Session on Econometrics, 36th Annual Conference, Australian National University, Canberra 10th-12th February, 1992.

Chair, Contributed Papers Session, 38th Annual Conference, Victoria University, Wellington, 8th-10th February, 1994.

Productivity Conferences

Chair, Contributed Papers Session, Georgia Productivity Workshop, University of Georgia, Athens, 21-23 October, 1994.

Conference Committee, New England Conference on Efficiency and Productivity, University of New England, Armidale, 22-23 November, 1995.

Chair, Invited Papers Session, New England Conference on Efficiency and Productivity, University of New England, Armidale, 22-23 November, 1995.

Chair, Contributed Papers Session, New England Conference on Efficiency and Productivity, University of New England, Armidale, 23-24 November, 1995.

Chair, Contributed Papers Session, Georgia Productivity Workshop II, University of Georgia, Athens, 1-3 November, 1996.

Chair, Contributed Papers Session, Taipei International Conference on Efficiency and Productivity Growth, Academia Sinica, Taipei, 20-21 June, 1997.

Discussant, Contributed Papers Session, Taipei International Conference on Efficiency and Productivity Growth, Academia Sinica, Taipei, 20-21 June, 1997.

Chair, Contributed Papers Session, Georgia Productivity Workshop III, University of Georgia, Athens, 29-30 October, 1998.

Chair, Contributed Papers Session, Sixth European Workshop on Efficiency and Productivity Analysis, Royal Agricultural and Veterinary University, Copenhagen, 29-31 October, 1999.

Keynote Speaker, Seventh European Workshop on Efficiency and Productivity Analysis, University of Oviedo, Spain, 25-27 September, 2001.

Chair, Contributed Papers Session, Seventh European Workshop on Efficiency and Productivity Analysis, University of Oviedo, Spain, 25-27 September, 2001.

Chair, Contributed Papers Session, Eighth European Workshop on Efficiency and Productivity Analysis, University of Oviedo, Spain, 24-27 September, 2003.

Other Editorial Work

*Suggested revisions for Chapter 21 on "Sample Surveys" in Snedecor, G.W. and W.G. Cochran, *Statistical Methods*, Iowa State University Press, 8th Edition. (The 8th Edition was prepared by the Statistical Laboratory, Iowa State University.)*

*Wrote Section 5.3.3 on "Frontier Functions" in Dillon, J.L. and J.R. Anderson, *The Analysis of Response in Crop and Livestock Production*, Pergamon Press, 3rd Edition, pp. 76-77.*

*Associate Editor, *International Journal of Business and Economics**

*Board of Editors, *Empirical Economics Letters**

MEMBERSHIP OF SCHOLARLY SOCIETIES

American Statistical Association

Australian Agricultural and Resource Economics Society

Econometric Society

Productivity Analysis Network

CONSULTANCIES

1. *The International Crops Research Institute for the Semi-Arid Tropics, Hyderabad, India (one week, October 1988)*
2. *The International Food Policy Research Institute, Washington, D.C. (6 weeks, June-July 1993)*
3. *University of Agriculture, Faisalabad, Pakistan (3 months, November 1997 to February 1998)*
4. *Hong Kong Baptist University, Hong Kong (1 week, September 1999)*
5. *Innovative Development Strategies, Islamabad, Pakistan (3 weeks, November 2006)*