ESF EXPLORATORY WORKSHOP (REF. # 04-171)

Specification Testing

<u>SCIENTIFIC REPORT</u>

Web Page: http://www.icane.es/Cursos/EWST/home.html

Palacio de la Magdalena, Santander (Spain) 16-18 December 2005

Convened by:

Miguel A. Delgado[1], Stefan Sperlich[1], and Juan Rodríguez-Poo[2]

---

[1] Universidad Carlos III de Madrid, Spain

[2] ICANE and Universidad de Cantabria

Table of Contents

1. <u>EXECUTIVE SUMMARY</u>

The ESF Workshop on Specification Testing has been hold in Santander (Spain) since 16th till 18th of December 2005. The workshop's site has been "Palacio de la Magdalena" (http://www.palaciomagdalena.com/), which hosts many international conferences and scientific events during the whole year.

The meeting has been sponsored by the ESF (45%), Spanish Ministerio de Educación y Ciencia (20%) and Instituto Cántabro de Estadística (ICANE) (35%).

The organizers of the events have been Miguel A. Delgado and Stefan Sperlich (Universidad Carlos III de Madrid) and Juan Rodríguez-Poo (ICANE and Universidad de Cantabria).

The practice of statistical testing plays several roles in empirical research. These range from the careful assessment of the evidence against specific scientific hypotheses to the judgement of whether an estimated model has decent goodness-of-fit, what is known by specification testing. Specification testing is an everyday research tool in any discipline, and contribution to the area can be found in a variety of fields. The workshop was intended to bring together some of the main researchers working on topics related to specification testing of probabilistic models useful for statistical inference purposes.

The meeting consisted of 10 Sessions during the three days, where 25 top specialists in specification testing, with quite different interests and applying alternative methodologies, presented and discussed their work. On Friday 16th and Saturday 17th the sessions were since 9:30 to till 18:45, and on Sunday since 9:30 till 13:30. In the Opening Session (Sunday 9:00-9:30), Miguel A. Delgado presented the aims of the workshop, Juan Rodriguez-Poo (Director of ICANE) introduced the Cantabria's Minister of Economy (A. Agudo), who welcome the participants to the city of Santander, and Stefan Sperlich explained, in the name of the ESF, the ESF activities. We had sessions of 25 minutes, on average, with 10 minutes for floor discussion.

The 25 papers presented in the workshop are in the verge of the state of the arts, and cover almost all the hot topics in the Specification testing literature. The contributions can be classified as follows:

1. Contributions on Goodness-of-fit testing based on empirical processes.
2. Contributions to Goodness-of-fit testing based on smoothers.
3. Specification and validation of Econometric Models.
4. Other methodological contributions related to Specification Testing.

Next Section will provide a more detailed account of the contributions in each part.

The meeting has been successful in bringing together top researches, which have done benchmark contributions in the Specification Testing literature. There have been a lot of discussions in each presentation. It is worth mentioning the many interesting discussions on the relative advantages of specification tests based on smoothers versus those based on empirical processes.

The Board of Editors of the *Journal of Econometrics* has agreed to edit an *Annals of the Journal of Econometrics* issue on "Specification Testing" based mainly on the contributions presented in the Exploratory Workshop after passing a referee process.

2. **SCIENTIFIC CONTENT OF THE EVENT**

All the articles presented in this meeting are available in the web page of the workshop: http://www.icane.es/Cursos/EWST/home.html.

The 25 contributions can be classified as follows:

(i)   Contributions on Goodness-of-fit testing based on empirical processes:

a.   Regression models:

-Tests based on transformed empirical processes.
 (A. Cabana, Univ. de Valladolid).
- Tests in models with measurement errors
(H. Koul, Michigan State University).
- Tests for structural breaks
(M. Huscova, Charles University, Czech Republic)

b. Time series data

- Specification testing of Markovian Models
(M. Newman, Technische Universität Braunschweig)
- Tests of conditional symmetry
 (Miguel A. Delgado, Universidad Carlos III)

c.   Lifetime data

-    Testing using survival/sacrifice experiments
(Winfried Stute, Gissen University)

d.   Spatial data

-    Specification tests for spatial statistical models
(Wenceslao Gonzalez-Manteiga, Univ. Santiago Compostela)

e.   Functional data

-    Specification tests for functional data
(J.A. Cuesta-Albertos, Univ. De Cantabria)

(ii)   Contributions to Goodness-of-fit testing based on smoothers.

    a. Regression models

    - Tests for additivity using smooth backfitting (S. Sperlich, Universidad Carlos III)
    - Specification tests using empirical likelihood.(I. van Keilegon, Univ. Luvain-la-Neuve)
    - Specification testing of the conditional variance (Holger Dette, Univ. Bochum)
    - Tests for structural breaks in mean and variance (Irene Gijbels, University of Leuven)
    - Data driven optimal Score tests in the direction of semiparametric alternatives (Teresa Ledwina, Polish Academy of Sciences).

    b. Time series models

    - Data driven tests for dynamic models(Emmanuel Guerre, Universite Pierre et Marie Curie)
    - Uniform confidence bands in non-parametric regression using kernels.(Javier Hidalgo, London School of Economics)

    c. Probability density: Tests based on kernels using the *L₁-distance*. (Ricardo Cao, Universidad de la Coruna)

(iii)   Specification and validation of Econometric Models

    a. Nonlinear Cointegration (Dag Tjostheim, University of Bergen)
    b. Fractional Cointegration (Peter M. Robinson, London School of Economics)
    c. Panel smooth transition regression (Timo Terasvirta, Stokholm School of Economics)
    d. Volatility models (Wolfgang Härdle, Humbolt Universitat)

(iv)   Other methodological contributions related to Specification Testing.

    a. Differentiation of sets (E.V. Khmaladze, Georgian Academy of Sciences).
    b. Reducing the course of dimensionality in nonparametric testing (Pascal Lavergne, INRA-Toulouse and Simon Fraser University).
    c. Spatially adaptive estimation via multiple testing (V. Spokoiny, Weierstrass Institute for Applied Analysis and Stochastics)
    d. Multiple testing and data smoothing (Michael Wolf, University of Zurich)

3. **ASSESSMENT OF THE RESULTS, CONTRIBUTION TO THE FUTURE DIRECTION OF THE FIELD, OUTCOME.**

All the participants agree that the meeting has been an excellent opportunity for discussing the alternative approaches to specification testing in the verge of the state of the arts. It will take long to discuss each of the contributions in the meeting, and it is rather unnecessary since all the articles presented in the meeting are in the web page of the workshop (http://www.icane.es/Cursos/EWST/home.html) and are attached to this document.

The participants have made benchmark contributions in the Specification Testing literature. They are coming from different fields, with alternative motivations and applied interests. A majority of participants come from Statistics Departments with interests in engineering, environmental science, medicine, biology and finance. We had also people working in Mathematics Departments mainly interested in the probabilistic approach to Specification Testing. A substantial proportion of participants come from Economics and Business Departments. The interests are very broad, and many participants did not know personally each other, though they are well known scholars in the field. The interaction of all these researchers has produced very interesting discussions in the different sessions and has suggested new avenues of joint research.

In the proposal, we address the issue of the lack of interaction between the two leading methodologies for specification testing: Those comparing, using a particular distance, accumulated curves and their sample counterparts, which apply empirical process theory.

(i)   Those using smoothing techniques, comparing curves estimated by smooth methods.
(ii) Those using empirical processes, comparing accumulated curves.

Many of the discussions in the sessions were about the relative advantages of the two methodologies. Tests based on the methodology (i) have non-negligible asymptotic power in every direction converging to the null hypothesis at the rate $n^{-1/2}$, and tests based on (ii) have trivial power in every of these directions. However, tests based on (ii) have the interesting feature that they have approximately equal power in all directions. As a consequence, they can enjoy minimax properties over suitable nonparametric families of alternatives. They pay for this by not having power $n^{-1/2}$ in any particular direction. Test based on (ii) has the weakness that they concentrate the power at the $n^{-1/2}$ scale in a very explicit direction, dictated mainly by the distance function used.

It is worth mentioning the many discussions on methodological aspects concerning each type of test. In particular, it has been interesting the proposal of dimension reduction techniques in tests based on smoothers, which arrive to important improvements in terms of power, detecting alternatives converging to the null infinitely faster as the sample size increases. The same dimension reduction techniques can be applied when using empirical process, with evident power gains in

practice, though a justification based on first order asymptotics seems hard to justify. It is also worth mentioning the discussions on data snooping, when the size of the test is jeopardized when different tests are applied one after other.

The main results presented in the workshop will be published in a volume of the *Annals of the Journal of Econometrics* after a selection procedure, which will follow a referee process.

We attach below some of the e-mails received after the meeting:

Peter Robinson wrote:

Dear Miguel, Juan and Stefan,

Warmest thanks and congratulations for the outstanding workshop. The conference site was unrivalled, the scientific standard was very high, the hotel was excellent, and the post-conference tour, with the characterful lunch and spectacular cave, was unforgettable. I cannot remember a more enjoyable conference. I know that an immense amount of work must have gone into making such a success of this, and I am extremely grateful to you and the colleagues who helped you.

Best regards and season's greetings

Peter

Ingrid Van Keilegom wrote:

Dear Stefan, Juan and Miguel,

Many thanks for the fantastic workshop you organized! I enjoyed it a lot, especially
the many discussions which were sometimes very fruitful and interesting, and contributed to the big success of the workshop !
The palace was wonderful, as well as the whole environment.   Many thanks for inviting me to be part of this selected group of very good researchers. And last but not least, thanks for your hospitality.

Best, Ingrid

From: Marie Huskova <huskova@karlin.mff.cuni.cz>
To: stefan.sperlic@uc3m.es, delgado@est-econ.uc3m.es,rodrigjm@unizar.es
Subject: thanks
Send reply to: huskova@karlin.mff.cuni.cz
Date sent: Wed, 21 Dec 2005 12:46:26 +0100

Dear colleagues,

 I would like to express my sincere thanks for organizing such a nice ,
enjoyable, friendly and   high level meeting!!!! Your affort to make the
meeting successful was really enormous.

   I have really enjoyed it both from the professional as well as social
point of view. The trip on Sunday gave   me an expression on nature
of the Cantabria.

   If either of you will be just by chance closed to my country, please,
let me know and I will try to arrange something for you.

  I wish Merry Christmas and Happy and Prosperous year 2006.

 Yours, Marie

 Dag Tjostheim wrote:

 Thanks very much, Stefan. And thanks so much for a well organized,
inspiring and Useful meeting. Very glad I went.

Happy Christmas,

Best regards,
dag

Irene Gijbels wrote:

Dear Miguel/Dear Stefan,

Thanks a lot to Juan, Miguel and Stefan for the wonderful workshop!
It was an extremely nice and warm event.
Thanks!

Best wished for 2006,
Irene.

----

4. **FINAL PROGRAM**

Time	Friday	Saturday	Sunday
09:00	Opening Session		
09:30 - 11:30	A.Cabaña *The use of Transformed Accumulated Residuals in Linear Models* Winfried Stute *Statistical Analysis of Lifetime Data in Survival/Sacrifice Experiments* E.V.Khmaladze *Differentiation of sets in measure and some application to probability and statistics.* Chair: M.Delgado	H.L.Koul *Minimum Distance Regression Model Checking with Berkson Measurement Errors* W.Gonzalez-Manteiga *Goodness-of-fit test for spatial statistical models* P.Lavergne *Breaking the curse of dimensionality in nonparametric testing* Chair: H.Dette	P.Vieu *Recent advances in nonparametric statistics for functional data* J.A.Cuesta-Albertos *Goodness of fit tests for functional data* H.Dette *Some new tests for the parametric form of the variance function* Chair: H.L.Koul
11:30 - 12:00	Coffee Break	Coffee Break	Coffee Break
12:00 – 13:30	12:00-13:00 E.Mammen / S.Sperlich *Tests for additivity in nonparametric regression based on smooth backfitting* W.Härdle *VAR Modeling of Factor Loading Series from a Dynamic Semiparametric Model for Implied Volatility String Dynamics* Chair: C. Velasco	P.M. Robinson *Diagnostic Testing for Cointegration* J.Hidalgo *Uniform confidence bands for kernel regression estimates with dependent data* M.A.Delgado *Nonparametric tests for conditional symmetry in dynamic models .* Chair: D.Tjøstheim	M.Neumann *Goodness-of-fit Tests for Markovian Time Series Models* I.Gijbels *Nonparametric testing for structural breaks in mean and variance* Chair: W.Gonzalez-Manteiga
13:30 – 15:15	13:00 – 15:15 Lunch Break / Castle Visit	Lunch Break	
15:15 – 17:15	D.Tjøstheim *Some goodness-of-fit problems for nonstationary processes* T. Terasvirta *Panel smooth transition regression models* M.Wolf *Stepwise multiple testing as formalized data snooping* Chair: J. Hidalgo	E.Guerre *A data-driven nonparametric specification test for dynamic regression models* T.Ledwina *Data Driven Score Tests of Fit for a Semiparametroc Homoscedastic Linear Regression Model* V.Spokoiny *Spatially adaptive estimation via multiple testing* Chair: W.Stute	Excursion with lunch
17:15 - 17:45	Coffee Break	Coffee Break	
17:45 – 18:45	I.Van Keilegom *Empirical Likelihood Test for a Class of Regression Models* R.Cao *Goodness-of-fit tests based on the kernel density estimator* Chair: W.Härdle	M.Huskova *Monitoring changes in linear models* Chair: V.Spokoiny	

5. <u>FINAL LIST OF PARTICIPANTS</u>

1. **A. Cabaña Nigro,** tenure professor, Universidad de Valladolid, , Dpto. de Estadística e Investigación Operativa, Universidad de Valladolid , C/ Prado de la Magdalena s/n , E - 47005 Valladolid*,* acnigro@eio.uva.es.

2. **Ricardo Cao**, full professor, Department of Mathematics, Universidade da Coruña, Campus de Elviña, s/n 15071 A Coruña, Spain
Phone: (+34) 981 167 000 ext. 1225, Email : rcao@udc.es.

3. **Juan Cuesta,** full professor, Departamento de Matemáticas, Facultad de Ciencias, Universidad de Cantabria, 39071 Santander. Spain. Research interest: Probability, Mathematical Statistics, Goodness-of-fit tests, Empirical Processes. E-mail: cuestaj@unican.es.

4. **Miguel A. Delgado,** full professor, Departamento de Economía, Universidad Carlos III de Madrid, C./ Madrid 126-128, Getafe, Madrid, Spain, e-mail: miguelangel.delgado@uc3m.es.

5. **Holger Dette,** full professor, Mathematik III, Universität Bochum, Universitätsstraße 150, NA 3/72, D - 44780 Bochum Research interest: Optimal designing, Empirical Processes, Nonparametric specification tests, Applications in engineering. E-Mail: Holger.Dette@ruhr-uni-bochum.de.

6. **Irene Gijbels,** full professor, Department of Mathematics, University of Leuven W. de Croylaan 54, B-3001 Heverlee, Belgium, Tel: +32 16 322018, E-mail: irene.gijbels@wis.kuleuven.ac.be Research interest: Mathematical statistics, Non- and semiparametric estimation, multivariate regression models, estimation of change points, survival analysis. E-mail: Irene.Gijbels@wis.kuleuven.be.

7. **Wenceslao Gonzalez-Manteiga,** full professor, Departamento de Estatística e I.O. Facultad de Matemáticas, Universidad de Santiago de Compostela, Campus Sur, E - 15706 Santiago de Compostela. Research interest: Curve estimation, Time series, Neural Networks, Bootstrap, Spatial data analysis, Survival data analysis, Applications in environment and medicine. E-mail: wences@zmat.usc.es.

8. **Emmanuel Guerre,** professor, Université Pierre et Marie Curie. Laboratoire de Statistique Théorique et Appliquée. Boite 158, Tour 45-55, E3, 4, place jussieu, 75252 Paris Cedex 05, France,   Research interest: (Adaptive) Goodness-of-fit testing; Non- /Semiparametric parametric econometrics, Time Series Analysis. E-mail: eguerre@ccr.jussieu.fr.

9. **Wolfgang Härdle**, full professor, Humboldt-Universität zu Berlin, Faculty of Economics, Institut für Statistik   und Ökonometrie, Spandauer Str.1, D-10178 Berlin. Research interest: Goodness-of-fit testing; Non- and Semiparametric estimation, Financial Statistics, Computational Statistics. E-mail: stat@wiwi.hu-berlin.de.

10. **Javier Hidalgo,** full professor, Department of Economics, London School of Economics, Houghton Street, London WC2A 2AE Research interest: Time series analysis, Semiparametric estimation, Specification testing, Econometric theory. E-mail: f.j.hidalgo@lse.ac.uk.

11. **Maria Huskova**, full professor, Department of Statistics, Charles University, Sokolovská 83, 186 00 Prague, Czech Republic, Phone n. 420 2 21913277 , Fax: 420 2 2323316. Research interest: Sequential methods, Asymptotic statistics, Change-point problems. E-mail: huskova@karlin.mff.cuni.cz.

12. **Estate Khmaladze,** A.Razmadze Mathematical Institute of the Georgian Academy of Sciences 1 M.Alexidze st., Tbilisi, 0193, Georgia Research interest: Probability; Empirical process; Martingale theory; Goodness-of-fit testing; Contour estimation. E-Mail: Estate.Khmaladze@mcs.vuw.ac.nz

13. **Hira L. Koul,** full professor, Michigan State University, Department of Statistics, East Lansing, MI 48824-1027, USA. Research interest: Non- and Semiparametric Statistics, Survival Analysis, Long-range dependence. E-mail: koul@stt.msu.edu.

14. **Pascal Lavergne**, professor, Simon Fraser University. Dept. of Economics, 8888 University Drive Burnaby BC, V5A 1S6 Canada. Research interests: Econometrics, Specification testing, Nonparametric modelling, Smoothing. E-mail: pascal_lavergne@sfu.ca

15. **Teresa Ledwina**, full professor, Institute of Mathematics , Polish Academy of Sciences, ul. Kopernika 18 , 51-617 Wroclaw , Poland , fax: +48-71-3481098, Research interest: mathematical statistics, adaptive testing, nonparametric statistics. E-mail: ledwina@impan.pan.wroc.pl

16. **Michael Neumann,** full professor, Institut für Mathematische Stochastik, Technische Universität Braunschweig, Pockelsstr. 14, D - 38106 Braunschweig Research interest: Mathematical statistics, Bootstrap, Time series, Nonparametric inference. E-mail: mi.neumann@tu-bs.de.

17. **Benedikt M. Poetscher,** full professor, Department of Statistics**,** University of Vienna**,** Universitaetsstrasse 5**,** A-1010 Vienna**,** Austria Research interests: Econometrics, Model selection, Nonlinear Time Series. *[Did not Arrive]*

18. **Juan Rodríguez-Poo,** full professor, INCANE and Universidad de Cantábria, Instituto Cántabro de Estadística, Pasaje de Peña Nº1, 3º izq., 39008, Santander, e-mail: juan.rodriguez@unican.es

19. **Peter Robinson,** full professor, Department of Economics, London School of Economics, Houghton Street, London WC2A 2AE Research interest: Econometrics, Time series analysis, Non- and semiparametric inference. E-mail: p.m.robinson@lse.ac.uk.

20. **Vladimir Spokoiny**, full professor, Weierstrass Institute for Applied Analysis and Stochastics Mohrenstr. 39, D-10117 Berlin, Germany. Research interest: Probability; (Adaptive) Goodness-of-fit testing; Non- and Semiparametric estimation, Image recognition. E-mail: spokoiny@wias-berlin.de.

21. **Winfried Stute,** full professor, Mathematisches Institut, Universität Giessen, Arndtstraße 2, D - 35392 Giessen. Research interest: Probability, Empirical processes, Nonparametric inference (especially based on U-processes), Applications in Finance. E-Mail: Winfried.Stute@math.uni-giessen.de.

22. **Ingrid van Keilegom**, Asociate Professor c/o Institut de Statistique, UCL, Voie du Roman Pays 20, B - 1348 Louvain-la-Neuve Research interest: Mathematical statistics, Survival analysis, Nonparametric regression, Bootstrap, Empirical likelihood methods. E-mail: vankeilegom@stat.ucl.ac.be.

23. **Stefan Sperlich,** profesor titular, Departamento de Economía, Universidad Carlos III de Madrid, C./ Madrid 126-128, Getafe, Madrid, Spain, e-mail: stefan.sperlich@uc3m.es.

24. **Dag Tjøstheim,** full professor**,** Department of Mathematics, University of Bergen, Johannes Bruns gate 12, N-5008 Bergen Norway, tel: (+47) 55 58 28 85. Research interest: Time series, Econometrics, Nonparametrics, Nonlinear models, Fishery research. E-Mail: dagt@mi.uib.no.

25. **Timo Terasvirta**, full professor, Stockholm School of Economics - Department of Economic Statistics, P.O. Box 6501, S-113 83 Stockholm, Sweden. Research interest: Econometrics (model building and microeconometric applications); time series analysis with economic applications. E-mail: Timo.Terasvirta@hhs.se

26. **Carlos Velasco**, associate professor, Departamento de Economía, Universidad Carlos III de Madrid, C/ Madrid 126, E – 28903 Getafe. Research interest: Time series (especially nonstationarity and long memory), Non- and semiparametric inference, Specification testing. Email: Carlos.Velasco@uc3m.es.

27. **Philippe Vieu,** full professor, Laboratoire de Statistique et Probabilités, Université Paul Sabatier, 118 route de Narbonne, F - 31062 Toulouse. Research interest: Models with functional data, Functional estimation and testing, Time series. E-mail: vieu@cict.fr.

28. **Michael Wolf,** full professor, Institute for Empirical Research in Economics University of Zurich, Blümlisalpstrasse 10, CH-8006 Zürich, Faculty of Economics. Phone: +41 (0)44 634 50 96. Email: mwolf@iew.unizh.ch

6. STATISTICAL INFORMATION OF PARTICIPANTS

Countries:

Belgium: 2
Czech Republic: 1
France: 3
Georgia: 1
Germany: 5
Norway: 1
Poland: 1
Spain: 5
Switzerland: 1
Sweden: 1
United Kingdom: 2
USA: 1

+3 organizers (Spain)