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PROCEEDINGS

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PLENARY SESSIONS

- (A) E. Baldacci [Financial Crises and their Impacts: Data Gaps and Innovation in Statistical Production.](#)
- (B) D. Dunson [Probabilistic inference from big and complex data.](#)
- (C) S. Strozza [Foreign immigration in Italy: a forty-year-old history.](#)

SPECIALIZED SESSION (SPE)

(SPE-01) Inference, sampling and survey design

- P. Conti [Resampling from finite populations under complex designs: the pseudo-population approach.](#) (Co-author(s): F. Andreis, D. Marella, F. Mecatti)
- P. Righi [A joint use of model based and design based frameworks for defining optimal sampling designs.](#) (Co-author(s): P. D. Falorsi)
- A. Ruiz-Gazen [A unified approach for robustness in survey sampling.](#) (Co-author(s): J. Beaumont, D. Haziza)

(SPE-02) Multivariate models for risk assessment

- M. Billio [A Bayesian nonparametric approach to macroeconomic risk.](#) (Co-author(s): R. Casarin, M. Costola, M Guindani)
- P. Cerchiello [Bank risk contagion:an analysis through big data.](#) (Co-author(s): P. Giudici, G. Nicola)
- L. De Angelis [A Markov-switching regression model with non-Gaussian innovations for systemic risk measurement.](#) (Co-author(s): C. Viroli)

(SPE-03) Bayesian nonparametrics

- D. Durante [Bayesian Nonparametric Modeling of Dynamic International Relations.](#) (Co-author(s): D. Dunson)
- A. Guglielmi [Bayesian autoregressive semiparametric models for gap times of recurrent events.](#) (Co-author(s): G. Paulon, M. De Iorio)
- A. Rodriguez [Restricted Nonparametric Mixtures models for Disease Clustering.](#) (Co-author(s): T. Xifara)

(SPE-04) Statistical methods for the analysis of gene-environment interaction in the study of complex pathologies

- C. Angelini** [An introduction to next generation sequencing for studying omic-environment interactions.](#)
- L. Calciano** [Statistical approaches for the evaluation of genetic associations in complex diseases: the heterogeneity of asthma phenotypes.](#) (Co-author(s): L. Portas, S. Accordini)
- Y. Pankaj** [Improved case-only approach to study genome-wide gene-environment interaction.](#) (Co-author(s): S. Freitag-Wolf, A. Dempfle, W. Lieb, M. Krawczak)

(SPE-05) Nonlinear time series

- M. Niglio** [Probabilistic properties of Self Exciting Threshold Autoregressive processes.](#) (Co-author(s): F. Giordano, C. D. Vitale)
- T. Proietti** [Optimal prediction of stochastic trends.](#) (Co-author(s): A. Giovannelli)
- H. Tong** [On model selection from a finite family of possibly misspecified models.](#) (Co-author(s): H. Hsu, C. Ing)

(SPE-06) Spatial analyses in demography

- F. Heins** [Measuring residential segregation with spatial indices: an appraisal and applications for the metropolitan area of Rome.](#) (Co-author(s): F. Benassi, F. Lipizzi, E. Paluzzi)
- A. Mazza** [Immigrants' settlement patterns in the city of Naples.](#) (Co-author(s): G. Gabrielli, S. Strozza)
- L. Natale** [Native Immigration and Pull Factor Evolution in Italy: a Spatial Approach.](#) (Co-author(s): A. Santacroce, F. G. Truglia)

(SPE-07) Recent developments in Volatility modeling

- R. Casarin** [Dynamic Model Averaging for Quantile Regression.](#) (Co-author(s): M. Bernardi, B. Mailet, L. Petrella)
- A. Rahbek** [Testing volatility: consistency of bootstrap testing for a parameter on the boundary of the parameter space.](#)
- E. Ruiz** [Asymmetric Stochastic Volatility Models: Properties and Estimation.](#) (Co-author(s): V. Czellar, X. Mao, H. Veiga)

(SPE-08) Advances in ordinal contingency table analysis

- L. D'Ambra** [Dimensionality reduction methods for contingency tables with ordinal variables.](#) (Co-author(s): P. Amenta, A. D'Ambra)
- R. Lombardo** [Modelling Trends in Ordered Three-Way Non-Symmetrical Correspondence Analysis.](#) (Co-author(s): P. Kroonenberg, E. Beh)
- M. Riani** [Using Collapsing and Multiple Comparisons to Detect Association in Two Way Contingency Tables.](#) (Co-author(s): S. Arsenis)

(SPE-09) Statistical models for directional and circular data

- C. Ley** [The WeiSSVM: a tractable, parsimonious and flexible model for cylindrical data.](#)
- G. Mastrantonio** [The multivariate projected-skew normal distribution: Bayesian estimation and a hidden Markov model application.](#)
- A. Panzera** [Circular density estimation via matching local trigonometric moments.](#) (Co-author(s): M. Di Marzio, S. Fensore, C. C. Taylor)

(SPE-10) The interplay between frequentist and bayesian inference

- C. Grazian** [Classical inference for intractable likelihoods.](#)
- J. Hannig** [Fusion learning for Interlaboratory Comparison.](#) (Co-author(s): Q. Feng, H. Iyer, C. Wang, X. Liu)
- F. Pauli** [p-value in science: a review of issues and proposed solutions.](#)

(SPE-11) Société Française de Statistique

- B.H. Avner** [Stochastic Block Model for Multiplex network: an application to a multilevel network of researchers..](#)
- Y. Bennani** [Nonnegative Matrix Factorization for Transfer Learning.](#) (Co-author(s): I. Redko)
- T. Laloe** [Detection of dependence patterns with delay.](#)
- J. Poggi** [Disaggregated Electricity Forecasting using Wavelet-Based Clustering of Individual Consumers.](#) (Co-author(s): J. Cugliari, Y. Goude)

(SPE-12) National accounts

- A. Coli** [The European Welfare State in times of crisis according to macroeconomic official statistics.](#) (Co-author(s): E. Micheletti, B. Pacini)
- C. Martelli** [National Account and Open Data: a new semantic approach.](#)
- G. Oneto** [New information contents of the National Accounts for the monitoring of the economic situation.](#)

(SPE-13) Statistical tools for monitoring the educational system and assessing students' performances

- L. Grilli** [Evaluation of university students' performance through a multidimensional finite mixture IRT model.](#) (Co-author(s): S. Bacci, F. Bartolucci, C. Rampichini)
- G. Leckie** [Monitoring school performance using value-added and value-table models: Lessons from the UK.](#)
- P. Sarnacchiaro** [A statistical model to assess teacher performance.](#) (Co-author(s): I. Camminatiello, R. Palma)

(SPE-14) Robust inference by bounded estimating functions

- A.C. Monti** [M Estimation based Inference for Ordinal Response Model.](#)
- E. Ruli** [Approximate Robust Bayesian Inference with an Application to Linear Mixed Models.](#) (Co-author(s): N. Sartori, L. Ventura)
- J. Valeinis** [Some robust methods using empirical likelihood for two samples.](#) (Co-author(s): M. Velina, E. Cers, G. Luta)

SOLICITED SESSION (SOL)

(SOL-01) Subjective wellbeing and demographic events over the life course

- G. Fuochi** [Cultural and institutional drivers of basic psychological needs satisfaction.](#) (Co-author(s): P. Conzo, A. Aassve, L. Mencarini)
- L. Mencarini** [Five reasons to be happy about childbearing.](#) (Co-author(s): A. Aassve, F. Luppi)
- B. Nowok** [Migration motivations and migrants' satisfaction in the life course: A sequence analysis of geographical mobility trajectories in the United Kingdom.](#)
- A. Pirralha** [Does becoming a parent change the meaning of happiness and life satisfaction? Evidence from the European Social Survey.](#) (Co-author(s): H. Dobewall)

(SOL-02) Statistics for equitable and sustainable development

- E. di Bella** [Wellbeing and sustainable development: a multi-indicator approach to evaluate urban waste management systems.](#) (Co-author(s): B. Cavalletti, M. Corsi)
- C. Giusti** [Small Area Estimation for Local Welfare Indicators in Italy.](#) (Co-author(s): S. Marchetti, L. Faustini, L. Porciani)
- T. Laureti** [Does socio-economic variables influence the Italians' adherence towards a sustainable diet?.](#) (Co-author(s): L. Secondi)
- F. Riccardini** [Sustainability of wellbeing: an analysis of resilience and vulnerability through subjective indicators.](#) (Co-author(s): M. Bachelet, F. Maggino)

(SOL-03) New approaches to treat undercoverage and nonresponse

- F. Andreis** [Methodological perspectives for surveying rare and clustered population: towards a sequentially adaptive approach.](#)
- E. Furfaro** [Dealing with under-coverage bias via Dual/Multiple Frame designs: a simulation study for telephone surveys.](#)

D. Haziza [Weight adjustment procedures for the treatment of unit nonresponse in surveys.](#) (Co-author(s): É. Lesage)

E. Kabzinska [Empirical likelihood multiplicity adjusted estimator for multiple frame surveys.](#) (Co-author(s): Y. G. Berger)

(SOL-04) Statistical models and methods for network data

M. Cugmas [Measuring stability of co-authorship structures in time.](#) (Co-author(s): A. Ferligoj)

J. Koskinen [A dynamic discrete-choice model for movement flows.](#) (Co-author(s): T. Mueller, T. Grund)

G. Ragozini [Prototyping and Comparing Networks through Archetypal Analysis.](#) (Co-author(s): D. De Stefano, M.R. D'Esposito)

S. Zaccarin [Modeling network dynamics: evidence from policy-driven innovation networks.](#) (Co-author(s): A. Caloffi, D. De Stefano, F. Rossi, M. Russo)

(SOL-05) Recent developments in computational statistics

R. Argiento [A conditional algorithm for Bayesian finite mixture models via normalized point process.](#)

S. Favaro [Thompson sampling for species discovery.](#) (Co-author(s): M. Battiston, Y. Teh)

A. Mira [An application of Reinforced Urn Process to advice network data.](#) (Co-author(s): S. Peluso, P. Muliere, F. Pallotti, A. Loni)

N. Sartori [Bootstrap prepivoting in the presence of many nuisance parameters.](#) (Co-author(s): R. Bellio, I. Kosmidis, A. Salvan)

(SOL-06) Statisticians meet naturalists: issues on ecological and environmental statistics

F. Ferretti [Estimating the abundance of wildlife ungulate populations in Mediterranean areas: methods, problems and findings.](#) (Co-author(s): A. Sforzi)

M. Ferretti [The monitoring of forests in Europe: methods, problems and proposals.](#)

D. Rocchini [The power of generalized entropy for biodiversity assessment by remote sensing: an open source approach.](#) (Co-author(s): L. Delucchi, G. Bacaro)

(SOL-07) From survey data to new data sources and big data in official statistics

G. Barcaroli [Machine learning and statistical inference: the case of Istat survey on ICT.](#) (Co-author(s): G. Bianchi, R. Bruni, A. Nurra, S. Salamone, M. Scarnò)

S. Falorsi [Forecasting Italian Youth Unemployment Rate Using Online Search Data.](#) (Co-author(s): S. Loriga, A. Naccarato, A. Pierini)

B. Liseo [Bayesian nonparametric methods for record linkage.](#) (Co-author(s): A. Tancredi)

T. Tuoto [Exploring solutions for linking Big Data in Official Statistics.](#) (Co-author(s): L. Di Consiglio, D. Fusco)

(SOL-08) Symbolic data analysis methods and applications

E. Diday [Explanatory and discriminatory power of variables in Symbolic Data Analysis.](#)

M.B. Ferraro [Fuzzy and possibilistic approach to clustering of imprecise data.](#) (Co-author(s): P. Giordani)

L. Grassini [Symbolic data analysis approach for monitoring the stability of monuments..](#) (Co-author(s): B. Bertaccini, G. Biagi, A. Giusti)

M. Ichino [Similarity and Dissimilarity Measures for Mixed Feature-type Symbolic Data.](#) (Co-author(s): K. Umbleja)

(SOL-09) Compositional analysis

L. Crosato [Forecasting CPI weights through compositional VARIMA: an application to Italian data..](#) (Co-author(s): F. Lovisolo, B. Zavanella)

J. A. Martín-Fernández [Understanding association rules from a compositional data approach.](#) (Co-author(s): M. Vives-Mestres, R. Kenett)

A. Menafoglio [Object Oriented Geostatistical Simulation of Functional Compositions via Dimensionality Reduction in Bayes spaces.](#) (Co-author(s): A. Guadagnini, P. Secchi)

V. Simonacci [Fitting CANDECOMP-PARAFAC model for compositional data: a combined SWATLD-ALS algorithm.](#) (Co-author(s): M. Di Palma, V. Todorov)

(SOL-10) Sustainable development: theory, measures and applications

F. Riccardini [Measuring sustainable development goals from now to 2030.](#)

F. Riccardini [How the nexus of food/water/energy can be seen with the perspective on well-being of people and the Italian BES framework.](#) (Co-author(s): D. De Rosa)

T. Rondinella [An innovative methodology for the analysis of sustainability, inclusion and smartness of growth through Europe2020 indicators..](#) (Co-author(s): E. Grimaccia)

P. Ungaro [The Italian population behaviours toward environmental sustainability: a study from Istat surveys.](#) (Co-author(s): I. Mingo, V. Talucci)

(SOL-11) Detecting heterogeneity in ordinal data surveys

E. Di Nardo [CUB models: a preliminary Fuzzy approach to heterogeneity.](#) (Co-author(s): R. Simone)

S. Giordano [Modelling uncertainty in bivariate models for ordinal responses.](#) (Co-author(s): R. Colombi, A. Gottard, M. Iannario)

M. Manisera Treatment of “don’t know” responses in rating data: effects on the heterogeneity of the CUB distribution. (Co-author(s): P. Zuccolotto)

F. Pennoni Modelling a multivariate hidden Markov process on survey data.

(SOL-12) Active ageing: age management and lifelong learning strategies

P. E. Cardone Age management in Italian companies. Findings of two Isfol surveys. (Co-author(s): M. Aversa, L. D’Agostino)

A. Lorenti Working after Retirement in Europe.

C. Polli Older low-skilled workers and economic crisis in Italy. (Co-author(s): R. Angotti)

G. Rivellini Population ageing and human resources management. A chance for Applied Demography. (Co-author(s): F. Marcaletti, F. Racioppi)

(SOL-13) Statistical models for evaluating policy impact

M. Bia Evaluation of Training Programs by exploiting secondary outcomes in Principal Stratification frameworks: the case of Luxembourg. (Co-author(s): F. Li, A. Mercatanti)

G. Cerulli Testing Stability of Regression Discontinuity Models. (Co-author(s): Y. Dongz, A. Lewbel, A. Poulsen)

R. P. Mamede Counterfactual Impact Evaluation of Vocational Education in Portugal. (Co-author(s): D. Cruz, T. Fernandes)

G. Pellegrini Italian public guarantees to SME: the impact on regional growth. (Co-author(s): M. De Castris)

(SOL-14) Usage of geocoded micro data in the economic analysis

M. Dickson Spatial sampling methods with locational errors. (Co-author(s): D. Filipponi)

D. Giuliani Spatial Micro-Econometrics Models with Locational Errors. (Co-author(s): S. Cozzi, G. Espa)

F. Santi Three-Year Survival Probability of Italian Start-up Businesses in Health-care Industry: an Empirical Investigation through Logistic Multilevel Modelling. (Co-author(s): M. M. Dickson, D. Giuliani, D. Piacentino)

(SOL-15) Statistical models in functional data analysis

G. Adelfio Space-time FPCA Algorithm for clustering of multidimensional curves. (Co-author(s): F. Di Salvo, M. Chiodi)

C. Miller Functional data analysis approaches for satellite remote sensing applications. (Co-author(s): R. O’Donnell, M. Gong, M. Scott)

E. Romano Order statistics for spatially dependent functional data. (Co-author(s): A. Balzanella, R. Verde)

L. M. Sangalli [A penalized regression model for functional data with spatial dependence.](#) (Co-author(s): M. S. Bernardi, G. Mazza, J. O. Ramsay)

(SOL-16) Forecasting economic and financial time series

G. Goracci [Asymptotics and power of entropy based tests of dependence for categorical data.](#) (Co-author(s): S. Giannerini)

M. M. Pelagatti [Forecasting electricity load and price: a comparison of different approaches.](#) (Co-author(s): F. Lisi)

G. Storti [Flexible Realized GARCH Models.](#) (Co-author(s): R. Gerlach)

(SOL-17) Immigrations and integration in Italy

O. Casacchia [Minorities internal migration in Italy: an analysis based on gravity models.](#) (Co-author(s): C. Reynaud, S. Strozza, E. Tucci)

C. Conti [Growing generations and new models of integration.](#)

N. Tedesco [Measurement of segregation in the labour market. An alternative approach.](#) (Co-author(s): L. Salaris)

L. Terzera [Family behaviours among first generation migrants.](#) (Co-author(s): E. Barbiano di Belgiojoso)

(SOL-18) Open data, linked data and big data in public administration and official statistics

G. Di Bella [Linked Administrative Data in Official Statistics: a Positive Feedback for the Quality?.](#) (Co-author(s): G. Garofalo)

C. Martelli [Generating high quality administrative data: new technologies in a national statistical reuse perspective.](#) (Co-author(s): M. Calzaroni, A. Samaritani)

V. Santarcangelo [An innovative approach about the analysis of quality and efficiency in Italian law.](#) (Co-author(s): A. Buondonno, A. Romano, M. Giacalone, C. Cusatelli)

B. Squitieri [Prato municipality experience towards a high integration between administrative and statistical data.](#)

(SOL-19) Evaluation of prognostic biomarkers

F. Ambrogi [Combining Clinical and Omics data: hope or illusion?.](#) (Co-author(s): P. Boracchi)

L. Antolini [Graphical representations and summary indicators to assess the performance of risk predictors.](#) (Co-author(s): D. Bernasconi)

P. Chiodini [Multivariable prognostic model: external validation and model recalibration with application to non-metastatic renal cell carcinoma.](#) (Co-author(s): L. Cindolo)

(SOL-20) Models for studying the mobility of students

- S. Balia** [Modelling inter-regional patient mobility: evidence from the Italian NHS.](#) (Co-author(s): R. Brau, E. Marrocu)
- A. D'Agostino** [University mobility at enrollment: geographical disparities in Italy.](#) (Co-author(s): G. Ghellini, S. Longobardi)
- M. Enea** [From South to North? Mobility of Southern Italian students at the transition from the first to the second level university degree.](#)
- F. Giambona** [Measuring territory student-attractiveness in Italy. Longitudinal evidence.](#)

CONTRIBUTED SESSION (CON)

(CON-01) Bayesian statistics (1)

- F. Giummolè** [Reference priors based on composite likelihoods.](#) (Co-author(s): V. Mameli, L. Ventura)
- B. Nipoti** [On Bayesian nonparametric inference for discovery probabilities.](#) (Co-author(s): J. Arbel, S. Favaro, Y. W. Teh)
- R. Pappadà** [Relabelling in Bayesian mixture models by pivotal units.](#) (Co-author(s): L. Egidi, F. Pauli, N. Torelli)
- C. Scricciolo** [On Deconvolution of Dirichlet-Laplace Mixtures.](#)

(CON-02) Statistical modeling

- P. Faroughi** [A New Bivariate Regression Model for Count Data with Excess Zeros.](#) (Co-author(s): N. Ismail)
- B. Francis** [Dynamic latent class profiles in cross-sectional surveys: some preliminary results.](#) (Co-author(s): V. Hoti)
- P. M. Kroonenberg** [The use of deviance plots for non-nested model selection in loglinear models, structural equations, three-mode analysis.](#)
- A. Lucadamo** [Variable selection through Multinomial LASSO for PCMR.](#) (Co-author(s): L. Greco)
- O. Paccagnella** [Integrating CUB Models and Vignette Approaches.](#) (Co-author(s): S. Pavan, M. Iannario)

(CON-03) Demographics and social statistics (1)

- D. Bellani** [Gender egalitarianism, education and life-long singlehood: A multilevel analysis.](#) (Co-author(s): G. Esping-Andersen, L. Nedoluzhko)
- L. Colangelo** [Fear of Crime and Victimization among Sexual Harassed Women: Evidence from Italy.](#) (Co-author(s): P. Mancini)

- S. De Cantis** [A survival approach for the analysis of cruise passengers' behavior at the destination.](#) (Co-author(s): M. Ferrante, A. Parroco, N. Shoval)
- A. Di Pino** [Retirement of the Male Partner and the Housework Division in the Italian Couples: Estimation of the Causal Effects.](#) (Co-author(s): M. Campolo)
- F. Laricca** [Many women start, but few continue: determinants of breastfeeding in Italy.](#) (Co-author(s): A. Pinnelli)

(CON-04) Environmental statistics

- F. Bono** [Measuring sustainable economic development through a multidimensional Gini index.](#) (Co-author(s): M. Giacomarra, R. Giaimo)
- C. Calculli** [Modeling multi-site individual corals growth.](#) (Co-author(s): B. Cafarelli, D. Cocchi, E. Pignotti)
- F. Di Salvo** [GAMs and functional kriging for air quality data.](#) (Co-author(s): A. Plaia, M. Ruggieri)
- F. Durante** [The Kendall distribution and multivariate risks.](#)

(CON-05) Health statistics

- E. di Bella** [Dental care systems across Europe: the case of Switzerland.](#) (Co-author(s): L. Leporatti, I. Krejci, S. Ardu)
- F. Gasperoni** [Multi-state models for hospitalizations of heart failure patients in Trieste.](#) (Co-author(s): F. Ieva, G. Barbati)
- F. Grossetti** [Multi-state Approach to Administrative Data on Patients affected by Chronic Heart Failure.](#) (Co-author(s): F. Ieva, S. Scalvini, A. M. Paganoni)
- G. Montanari** [Evaluation of health care services through a latent Markov model with covariates.](#) (Co-author(s): S. Pandolfi)

(CON-06) Labor market statistics

- A. Bianchi** [Multifactor Partitioning: an analysis of employment and firm size.](#) (Co-author(s): S. Biffignandi)
- G. Busetta** [Ugly Betty looks for a job. Will she ever find it in Italy?.](#) (Co-author(s): F. Fiorillo)
- G. Busetta** [No country for foreigners: an analysis of hiring process in Italian labor market.](#) (Co-author(s): M. Campolo, D. Panarello)
- F. Crippa** [Know your audience. Towards a partnership between employers and university.](#) (Co-author(s): M. Zenga)
- I. Vannini** [Online Job Vacancies: a big data analysis.](#) (Co-author(s): D. Rotalone, C. Di Stefano, A. P. Paliotta, D. F. Iezzi)

(CON-07) Robust statistics

- F. Greselin** [Robust estimation of mixtures of skew-normal distributions.](#) (Co-author(s): L. García-Escudero, A. Mayo-Isacar, G. McLachlan)
- M. Musio** [Renyi's Scoring Rules.](#) (Co-author(s): A. F. Dawid)
- A. Paganoni** [Robust classification of multivariate functional data.](#) (Co-author(s): F. Ieva)
- G. C. Porzio** [A robust estimator for the mean direction of the von Mises-Fisher distribution.](#) (Co-author(s): T. Kirschstein, S. Liebscher, G. Pandolfo, G. Ragozini)
- F. Palumbo** [Robust Partial Possibilistic Regression Path Modeling.](#) (Co-author(s): R. Romano)

(CON-08) Sampling methods

- A. Ghiglietti** [Adaptive Randomly Reinforced Urn design and its asymptotic properties.](#)
- D. Marella** [PC algorithm from complex sample data.](#) (Co-author(s): P. Vicard)
- S. Missiroli** [Optimal Adaptive Group Sequential Procedure for Finite Populations in the Presence of a Cost Function.](#) (Co-author(s): E. Carfagna)
- E. Pelle** [The Rao regression-type estimator in ranked set sampling.](#) (Co-author(s): P. Perri)
- M. Ruggiero** [Modelling stationary varying-size populations via Polya sampling.](#) (Co-author(s): P. De Blasi, S. Walker)

(CON-09) Economic data analysis

- M. Brunetti** [Getting older and riskier: the effect of Medicare on household portfolio choices.](#) (Co-author(s): M. Angrisani, V. Atella)
- E. Ciavolino** [Modelling the Public Opinion on the European Economy with the HO-MIMIC Model.](#) (Co-author(s): M. Carpita)
- G. D'Epifanio** [Indexing the Worthiness of Social Agents. To norm index on conventional specifications.](#)
- G. Guagnano** [An econometric model for undeclared work.](#) (Co-author(s): M. Arezzo)
- M. Mussini** [A spatial shift-share decomposition of energy consumption variation.](#) (Co-author(s): L. Grossi)

(CON-10) Quantile methods

- M. Bernardi** [Bayesian inference for \$L_p\$ -quantile regression models.](#) (Co-author(s): V. Bignozzi, L. Petrella)
- V. Bignozzi** [On the \$L_p\$ -quantiles and the Student \$t\$ distribution.](#) (Co-author(s): M. Bernardi, L. Petrella)
- M. Marino** [M-quantile regression for multivariate longitudinal data.](#) (Co-author(s): M. Alfò, M. Ranalli, N. Salvati)

D. Vistocco [Comparing Prediction Intervals in Quantile and OLS Regression.](#) (Co-author(s): C. Davino)

(CON-11) Statistical algorithms

N. Loperfido [An Algorithm for Finding Projections with Extreme Kurtosis.](#) (Co-author(s): C. Franceschini)

L. Scrucca [Poisson change-point models estimated by Genetic Algorithms.](#)

A. Stamm [Maximum Likelihood Estimators of Brain White Matter Microstructure.](#) (Co-author(s): O. Commowick, S. Vantini, S. K. Warfield)

(CON-12) Statistics for medicine

G. Barbati [Competing risks between mortality and heart failure hospital re-admissions: a community-based investigation from the Trieste area.](#) (Co-author(s): F. Ieva, A. Scagnetto, G. Sinagra, A. Di Lenarda)

C. Brombin [Evaluating association between emotion recognition and Heart Rate Variability indices.](#) (Co-author(s): F. Cugnata, R. M. Martoni, M. Ferrario, C. Di Serio)

M. Ferrante [Socio-economic deprivation, territorial inequalities and mortality for cardiovascular diseases in Sicily.](#) (Co-author(s): A. Millito, A. Parroco)

M. Giacalone [The use of Permutation Tests on Large-Sized Datasets.](#) (Co-author(s): A. Alibrandi, A. Zirilli)

(CON-13) Statistics for the education system

G. Boscaino [Further considerations on a new indicator for higher education student performance.](#) (Co-author(s): G. Adelfio, V. Capursi)

C. Masci [Analysis of pupils' INVALSI achievements by means of bivariate multi-level models.](#) (Co-author(s): A. Paganoni, F. Ieva, T. Agasisti)

A. Valentini [Promoting statistical literacy to university students: a new approach adopted by Istat.](#) (Co-author(s): G. De Candia, M. Carbonara)

(CON-14) Testing procedures

E. Cascini [A Reliability Problem: Censored Tests.](#)

G. De Santis [Testing the Gamma-Gompertz-Makeham model.](#) (Co-author(s): G. Salinari)

M. M. Pelagatti [A nonparametric test of independence.](#)

A. Pini [Functional Data Analysis of Tongue Profiles.](#) (Co-author(s): L. Spreafico, S. Vantini, A. Vietti)

A. Vagheggini [On the asymptotic power of the statistical test under Response-Adaptive randomization.](#) (Co-author(s): A. Baldi Antognini, M. Zagoraiou)

(CON-15) Time series analysis

- C. Cappelli** [Robust Atheoretical Regression Tree to detect structural breaks in financial time series.](#) (Co-author(s): P. D'Urso, F. Di Iorio)
- P. Chirico** [Prediction intervals for heteroscedastic series by Holt-Winters methods.](#)
- M. Costa** [Inequality decomposition for financial variables evaluation.](#)
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Measuring territory student-attractiveness in Italy. Longitudinal evidence

Misurare l'attrattività dei territori italiani per gli studenti universitari. Evidenze longitudinali

Francesca Giambona

Abstract The aim of this paper is to investigate the factors affecting university student mobility in Italy in a longitudinal perspective, by considering the flows across competing territorial areas supplying tertiary education programs. The Bradley-Terry modelling approach based on pair comparisons has been adopted to define the attractiveness of competing territories and a range of determinants related to the socio-economic characteristics of the areas as well as universities' resources. Data released by the Italian Ministry of Education (MiUR) are analysed for the academic years 2010/2011-2014/2015. The modelling approach considers score values for each territory and year, allowing to evaluate whether attractiveness improves or deteriorates over time, and to rank areas according to their attractiveness. To this end, an index based on ranking changes, appropriately weighed with the differences in score values, is proposed. Empirical findings highlight that attractiveness depends not only on the educational programs, but also on territories' socio-economic factors, reflecting the well-known North-South divide that persists in time.

Abstract *Lo scopo di questo contributo è quello di indagare i fattori che influenzano la mobilità degli studenti universitari in Italia in una prospettiva longitudinale, considerando i flussi in entrata ed in uscita tra aree territoriali che offrono formazione universitaria. A tal fine è stato specificato un modello statistico noto in letteratura come Bradley-Terry model. Tale modello, attraverso confronti a coppie tra territori, permette di misurare la loro attrattività considerando un insieme di fattori relativi alle caratteristiche socio-economiche delle aree e alle risorse universitarie. I dati diffusi dal MIUR per gli anni accademici 2010/2011-2014/2015 hanno permesso l'analisi della mobilità degli studenti in prospettiva longitudinale. Il modello statistico utilizzato fornisce un valore (score) per ogni territorio e per ogni anno, permettendo di costruire una graduatoria dei territori. Al fine di considerare il miglioramento (peggioramento) di attrattività sia in termini di valore (score) che di rango è stato proposto un indice basato su cambiamenti nel posizionamento nella graduatoria, opportunamente pesato con le differenze dei valori di punteggio. I risultati ottenuti evidenziano che l'attrattività dipende non solo dall'offerta formativa dei territori, ma anche da fattori socio-economici, riflettendo il noto divario Nord-Sud, divario che permane nel tempo: negli anni considerati circa la metà dei territori che perdono attrattività è nel Sud.*

Key words: university attractiveness, longitudinal, Bradley-Terry Model.

¹

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1 Introduction

The Italian university system is mostly public and is organised on a national basis. Universities are largely funded by central government authorities and student fees are relatively low. Since the early 1990s, universities have become autonomous institutions that decide how to spend their budgets to pursue institutional tasks, such as research, teaching, and services in the area where they are located (primarily in the health sectors with university hospitals). Central authorities assign each institution a yearly monetary provision that is mainly allocated based on the university's size (i.e., the number of the students enrolled). After more than twenty years of self-government, a number of Italian universities now suffer from the financial crisis, a high rate of dropouts, high unemployment or underemployed graduate rates and a low power to attract students from other territories. For these reasons, private and public stakeholders demand greater accountability from the system, and the central government assigns a portion of the yearly financial provision to each university based on certain indicators of performance. Among these indicators, particular attention is paid to features related to the student mobility and university attractiveness, both of which are monitored by tracking the number of incoming students from other areas. A debate has arisen on the factors that actually indicate the quality of universities and on the influence that public policies to finance universities have on the local economies. Focusing on the ability of universities to attract students in a territory, these debates have rarely investigated the determinants behind the flows of incoming students with respect to the characteristics of the territory.

The issue of student mobility primarily refers to studies of the immigration phenomenon, which is currently considered to comprise a number of push-and-pull factors. A number of authors have paid attention to its determinants emphasising the influence of the educational, political, social, cultural and economic conditions of the origins and destinations places on their mobility (Caruso and de Wit, 2013; Beine et al, 2012; Kahanec and Kralikova, 2011; Kratz, 2011; Agarwal et al., 2008; Baryla and Dotterweich, 2001). Empirical studies on student mobility can be divided into two main strands: studies on international student mobility, which focus on mobility across countries (e.g., Van Bouwel and Veugelers, 2009; de Wit, 2010; Kahanec and Kralikova, 2011; Caruso and de Wit, 2013), and studies on domestic student mobility, which focus on flows among territories within the same country (Dal Bianco et al., 2009; Ordine and Rose, 2007; Agasisti et al., 2007). From another point of view, student mobility can be analysed on a micro or macro perspective based on the variety of subjective or objective reasons.

With respect to the macro level of analysis, the emphasis falls on the attractiveness of places of destination considering some key "origin" and "destination" factors (Dal Bianco, 2009; Agasisti and Dal Bianco, 2007) or on the phenomenon of brain drain (Fratesi and Percoco, 2014; Ciriaci, 2012; Ordine and Rose, 2007; Makovec, 2006; Lupi and Ordine, 2006; Brunello and Cappellari, 2005). Indeed, student mobility has several implications in terms of socio-economic development (i.e., the net loss of human capital) and on the rate of innovation and economic growth of the origin regions (Fratesi and Riggi, 2007; Viesti, 2005) and in

terms of monetary resources transferred by the central government authorities to the universities based on their attractiveness (measured in terms of student mobility).

From a macro perspective, the existing empirical studies have mainly analysed student mobility in terms of the flows of incoming students (Dal Bianco, 2009; Agasisti and Dal Bianco, 2007), distinguishing the forced moving students (who migrate from a territorial area that does not have a university) and the free moving students (who migrate from a territory with tertiary education supply) (Giambona et al., forthcoming). In these approaches the use of macro-covariates, which vary across territories, helps to account for differences among alternative destinations (Dotti et al, 2013; Agasisti and Dal Bianco, 2007). The first group of covariates includes the socio-economic conditions of territories, whereas a second group of covariates refers to resources that the universities in the territory are able to receive for their academic supply (in terms of educational and research activities).

Recent empirical evidence has analysed the Italian South-North student mobility divide, indicating that returns to education depend on the specific institution attended and on the characteristics of territory where the university is located (Makovec, 2006; Brunello and Cappellari, 2005). These factors underlie that the labour mobility from Southern to Northern areas is reflected by student mobility and contributes to increase in the magnitude of the regional disparities (Fratesi and Percoco, 2014; Ordine and Rose, 2007). Indeed, Southern students who attend Northern universities show very little inclination to return to the South (Svimez, 2009), furthering the brain drain phenomenon.

In this framework, starting from the main recent empirical evidences for the academic year 2011/2012 (Giambona et al., forthcoming), this paper analyses student mobility across competing territories supplying tertiary educational programs in Italy, namely TETA (Tertiary Education Territorial Areas), over the academic years 2010/11, 2012/13 and 2014/15. The aim is to analyse the changes in attractiveness of TETAs occurred within this time span, in particular with respect to the North-South divide. The improvement/deterioration in attractiveness is evaluated by means of a specific index developed in Giambona and Vassallo (2013).

2 The Bradley-Terry Model

The analysis of TETAs' attractiveness is focused on modelling student flows and uses an approach based on pairwise comparisons across competing territorial areas in Italy. Specifically, we distinguish between two typologies of migrant students: those who migrate from a territorial area that does not host a university, called "forced" migrant students (if they want to attend a university, they must migrate), and students who migrate from an area that has a tertiary education institution, named "free" migrant students (they have the opportunity to attend a university where they live, but they choose to move). In this contribution we model free students flows, whilst forced mover students have been considered to define a measure of the initial advantage of TETAs.

The standard Bradley-Terry model (Agresti, 2002; Bradley and Terry, 1952) considers the territories to be players (e.g., i and j) with different abilities. If the ability of i (for $i = 1, \dots, M$) is higher than the ability of j (for all $j \neq i$), the number of times that i beats j is expected to be higher than the number of times j “beats” i .

In a competition across territories for attracting students, this concept can be translated as the number of students who prefer the area i coming from the area j . The model specifies the probability that in a pairwise comparison between i and j (for j that range from 1 to $M-1$), at time t students prefer the area i to j , as follows:

$$\text{pr}(i \text{ beats } j)_t = \frac{\alpha_{it}}{\alpha_{it} + \alpha_{jt}} \quad (1)$$

where α_i and α_j are the ability parameters that measure the intensity of an unobservable (latent) trait in the two players. In the analysis of students’ mobility the ability parameters are the attractiveness parameter of the competing TETAs.

By expressing the model in the logit form, equation (1) becomes

$$\text{logit}[\text{pr}(i \text{ beats } j)_t] = \lambda_{it} - \lambda_{jt} \quad (2)$$

where $\lambda_{it} = \log \alpha_{it}$ and λ_{jt} may be fixed or random parameter. Based on the results of comparisons that share a common TETA, the attractiveness parameters of TETAs at each time t are estimated.

The basic model allows to make generalisations in several directions (Turner and Firth, 2013), for example, to specify ability as a function of covariates. If player covariates ($r = 1 \dots p$) are used to explain differences in players’ abilities, the parameters λ_{it} and λ_{jt} are related to the covariates by a linear predictor:

$$\lambda_{it} = \sum_{r=1}^p \beta_r x_{irt} + U_{it} \quad (3)$$

and equation (2) becomes

$$\text{logit}[\text{pr}(i \text{ beats } j)_t] = \sum_{r=1}^p (x_{irt} - x_{jrt}) \beta_r + U_{it} - U_{jt} \quad (4)$$

where U_{it} and U_{jt} are normally distributed random terms. Missing observations among covariates are handled by considering the individual parameters of the players containing missing predictor values as fixed effects (Turner and Firth, 2013). In the framework of the Bradley-Terry models, differences in attractiveness parameters (as measured by a fixed or random parameter shared by all pairs in which the same territory is involved) are the factors that lead students to prefer one TETA over another.

Finally, for each TETA, the change over time in attractiveness has been evaluated through the index I_i based on the annual changes in rank (ΔR) appropriately weighed with the annual differences of the score (ΔS) (Giambona and Vassallo, 2013):

$$I_i = \sum_{t=2013}^{2015} (-\Delta R_{t,i}) \cdot \frac{|\Delta S_{t,i}|}{\sum_{i=1}^m |\Delta S_{t,i}|} \quad (5)$$

3 Empirical findings

Student mobility is defined in terms of the number of *free* students who move from their place of residence to attend a university degree program in another territory. The data were provided for the academic years 2010/2011, 2012/2013 and 2014/2015 by the Italian central government department for the university (ANS, MiUR). On the basis of the location of traditional universities in the country, the Italian territory has been divided into 50 TETAs supplying educational programs and thus in competition to attract students.

To describe the socio-economic characteristics we considered the findings of the survey carried out by the daily newspaper *Il Sole 24 Ore* on 36 factors related to the main domains of living conditions in the Italian provinces. These factors refer to standard of living, business and work, health and environmental services, population, public order, and leisure, and the overall quality of life index summarizing these domains (QUALITYOFLIFE).

To describe the effect of the characteristics strictly related to the tertiary education supply in TETAs we considered: (a) TETAs' capability to attract yearly financial provisions from the central government (BENEFIT); (b) a measure of the overall quality of universities located in a TETA with respect to services provided to students (CENSISQUALITY). Specifically, the BENEFIT indicator was calculated by considering the share of "benefit" over the total amount of central government provisions for each university. For TETAs hosting different university institutions, we considered the average values of each indicator.

Further, we added two measures to account for the capability of each TETA to attract students from territories without universities in terms of amount of the flow (INCIDENCE) and heterogeneity (HETEROGENEITY) of the territories from which they come from (Giambona et al., forthcoming). The combination of these two measures measures the *initial advantage* of each TETA with respect to the others in attracting students. Specifically, the *incidence* index (INCIDENCE) measures the percentage of forced movers in each TETA on the total forced movers, whilst the *heterogeneity* index (HETEROGENEITY) stands for the capability of each TETA to attract students from few or many Italian provinces without universities. To this aim, the Gini index of heterogeneity (Leti, 2001) is used to describe for each TETA the variability of the distribution of forced mover students by province of residence. The two indexes aim to control for any initial advantage of a TETA in measuring its relative ability to attract students. As a further measure of initial advantage, we include an indicator which counts the number of adjacent provinces without universities (PROVADWITHOUT).

The physical distance between TETAs was not considered because in Italy there is no clear correspondence between physical distances and time and moving costs. For example, the widespread presence of low-cost airlines make it sometimes cheaper and faster to move from South or Centre to North than to reach adjacent TETAs. In this perspective, to account for transportation facilities, we included the number of railway stations (STATIONS) and the presence of airports (AIRPORTAVAILABILITY).

The results of the analysis using the Bradley-Terry model (Table 1) indicate that the QUALITYOFLIFE has a positive and significant effect on attractiveness as well as the indicators related to the university domains (BENEFIT and CENSISQUALITY). TETAs with higher values of initial advantage (HETEROGENEITY, INCIDENCE) are more attractive than the others, and if the TETA is located near provinces without universities (PROVADWITHOUT) it has more chance to attract students. Instead, the number of railway stations (STATIONS) and the availability of airport (AIRPORTAVAILABILITY) have no significant effect on attractiveness¹.

Table 1: results of the Bradley Terry Model

<i>Fixed Effects</i>			
	<i>Coeff.</i>	<i>Std. Error</i>	<i>p-value</i>
Quality of life	0,040	0,003	***
Benefit	3,812	1,038	***
CensisQuality	0,037	0,019	.
Heterogeneity	1,731	0,703	*
Incidence	0,360	0,080	***
ProvAdWithout	0,243	0,121	*
Airport availability	-0,411	0,320	
Stations	0,003	0,010	
<i>Random Effects</i>			
	<i>Sd</i>	<i>SE</i>	<i>p.value</i>
	1,598	0,103	***

Signif. codes: p<0.000 '***' p<0.001 '**' p<0.010 '*' p<0.050 '.' not sig. ' '

Table 2 shows the ability scores and rankings for each TETA and academic year, and the improvement index I_i . To ease comparability, each score is normalized by its range; therefore, the score varies now between 0 (the lowest level of attractiveness) and 1 (the maximum level of attractiveness).

In the time span considered, eight TETAs do not change ranking (for example Bologna, Cosenza and Catania); some strongly improve their position (for example Bolzano, Aosta and Reggio Calabria) while others strongly worsen it (as l'Aquila, Como-Varese and Enna).

Table 3 shows the number of TETAs, the score and the ranking mean (for each academic year) for each macro-area, and the percentage of TETAs that

¹ If considered in this model, as the effect is caught by the other covariate.

improve/worsen their attractiveness according to TETAs macro-areas. In the time span, in Centre-North macro-area the ranking mean is higher than South and the score mean in South is lower than Centre-North. Considering improvement in time, the share of TETAs improving their attractiveness in the Centre and North is 46% and 47%, respectively, whereas only 36-37% worsen their position. Instead, among the Southern TETAs those worsening their position prevail (50%).

Table 2: ability scores and rankings, improvement index

TETA	Ability Scores			Ability Rankings			Improvement INDEX	
	2010-2011	2012-2013	2014-2015	2010-2011	2012-2013	2014-2015		
AQ	AQUILA	0,6275	0,5964	0,5473	18	19	27	-2,402
COVA	COMO-VARESE	0,5711	0,5607	0,5079	22	24	29	-1,599
EN	ENNA	0,1357	0,0079	0,1357	44	49	47	-1,277
BG	BERGAMO	0,6288	0,5873	0,5730	17	21	25	-0,997
CZ	CATANZARO	0,1685	0,1662	0,1944	43	43	45	-0,338
SA	SALERNO	0,0633	0,0626	0,1219	47	47	49	-0,188
FG	FOGGIA	0,0409	0,0000	0,0000	48	50	50	-0,180
MORE	MODENA-REGGIO EMILIA	0,8139	0,7782	0,7983	6	7	8	-0,081
MC	MACERATA	0,6528	0,6514	0,6587	15	15	16	-0,071
PR	PARMA	0,8354	0,8097	0,8120	3	5	5	-0,066
BA	BARI	0,1928	0,1907	0,2580	36	38	39	-0,044
ISCB	MOLISE	0,1811	0,1841	0,2588	38	40	38	-0,040
UD	UDINE	0,7822	0,7777	0,7930	7	8	10	-0,027
BS	BRESCIA	0,6129	0,5840	0,6074	20	22	20	-0,020
SS	SASSARI	0,4195	0,4171	0,4672	32	33	33	-0,017
TN	TRENTO	0,7763	0,7669	0,7826	8	10	11	-0,016
FR	FROSINONE	0,2200	0,2184	0,2938	35	36	36	-0,014
RM	ROMA	0,7666	0,7530	0,7804	11	12	12	-0,004
VT	VITERBO	0,4475	0,4369	0,4851	29	30	30	-0,003
CA	CAGLIARI	0,4371	0,4292	0,4775	31	32	32	-0,003
CHPE	CHIETI-PESCARA	0,4434	0,4354	0,4807	30	31	31	-0,003
BO	BOLOGNA	1,0000	1,0000	1,0000	1	1	1	0,000
CS	COSENZA	0,1753	0,1776	0,2550	41	41	41	0,000
CT	CATANIA	0,1686	0,1694	0,2430	42	42	42	0,000
FI	FIRENZE	0,8480	0,8347	0,8518	2	2	2	0,000
PD	PADOVA	0,8216	0,8267	0,8326	4	4	4	0,000
PI	PISA	0,7713	0,7726	0,7957	9	9	9	0,000
TE	TERAMO	0,4096	0,4007	0,4425	34	34	34	0,000
TS	TRIESTE	0,7303	0,7229	0,7739	14	14	14	0,000
PA	PALERMO	0,1343	0,1346	0,2121	45	45	44	0,003
PV	PAVIA	0,5303	0,5217	0,5623	27	27	26	0,003
PU	PESARO-URBINO	0,6507	0,6469	0,6720	16	16	15	0,008
FE	FERRARA	0,5995	0,5927	0,6253	21	20	18	0,010
GE	GENOVA	0,5548	0,5463	0,5851	24	26	22	0,013
ME	MESSINA	0,0365	0,0379	0,1356	49	48	48	0,018
AN	ANCONA	0,5070	0,4936	0,5449	28	29	28	0,023
NA	NAPOLI	0,1798	0,1869	0,2578	40	39	40	0,028
VR	VERONA	0,7568	0,7654	0,7788	12	11	13	0,037
VE	VENEZIA	0,6135	0,6115	0,6370	19	17	17	0,045
VEATNO	PIEMONTE-ORIENTALE	0,5669	0,5577	0,5776	23	25	23	0,111
MTPZ	MATERA-POTENZA	0,1808	0,1986	0,2932	39	37	37	0,126
MI	MILANO	0,8154	0,8304	0,8423	5	3	3	0,140
LE	LECCE	0,1296	0,1561	0,2369	46	44	43	0,185
PG	PERUGIA	0,5504	0,5620	0,5884	26	23	21	0,233
TO	TORINO	0,7670	0,7806	0,8064	10	6	6	0,263
BN	BENEVENTO	0,1903	0,2450	0,3086	37	35	35	0,314
SI	SIENA	0,7558	0,7519	0,7993	13	13	7	0,662
RC	REGGIOLABRIA	0,0000	0,0757	0,1495	50	46	46	0,826
AO	AOSTA	0,5511	0,6063	0,6234	25	18	19	1,114
BZ	BOLZANO	0,4159	0,5197	0,5768	33	28	24	1,685

Table 3: descriptive statistics and improvement index by macro-area

	North	Centre	South
Number of TETA	19	11	20
Mean score 10/11	0,6943	0,6110	0,2157
Mean score 12/13	0,6916	0,6116	0,2136
Mean score 14/15	0,7091	0,6449	0,2738
Mean ranking 10/11	15	19	40
Mean ranking 12/13	15	18	40
Mean ranking 14/15	15	18	40
Improvement			
-	37%	36%	50%
=	16%	18%	15%
+	47%	46%	35%
<i>Total</i>	<i>100%</i>	<i>100%</i>	<i>100%</i>

4 Conclusions

The results of the Bradley-Terry model suggest that TETAs attractiveness does not depend only on the quality of the educational supply, but also on socio-economic factors reflecting the well-known divide between the less-advanced Southern and the more-advanced Northern regions. These economic factors affect the behaviour of individuals and the decisions of families, who tend to migrate toward the Northern regions for tertiary studies to look for better educational and job opportunities. Furthermore, TETAs that are able to attract students from adjacent provinces without universities and with higher initial advantage are more attractive than the others. Regarding the time span considered, some TETAs improve their attractiveness whereas other get worse (in a more or less considerable way), and eight TETAs do not change their capability to attract students. Among them, Bologna maintains its first position. According to the empirical findings, most of the Southern TETAs were the least attractive areas: the first Southern TETAs, at the beginning of the period, is in 18-th position whilst the last Northern TETA is in 33-th position in ranking. This is the notorious North-South divide that (with some exceptions) is confirmed in time: about half of Southern TETAs lost attractiveness, and, considering all TETAs, the 20% of TETAs that lose attractiveness is in the South, against the lowest 14% for the Northern TETAs and 8% for the Centre macro-area.

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