Manuele Leonelli

School of Science and Technology, IE University
Paseo de la Castellana, 259, 28029 Madrid – Spain
+34 636588831 • manuele.leonelli@ie.edu
manueleleonelli.github.io • DOB: 12/08/1988

Research Interests

Data Science, Machine Learning, Statistics, and Applications

Work Experience

Assistant Professor **Madrid**
School of Science and Technology - IE University *2019-*

Visiting Professor **Montreal**
Faculty of Medicine - McGill University *2019*

Lecturer **Glasgow**
School of Mathematics and Statistics - University of Glasgow *2017-2019*

Universidade Federal do Rio de Janeiro **Rio De Janeiro**
CAPES Postdoctoral Fellow *2015-2016*

Education

University of Glasgow **Glasgow**
PostGraduate Certificate in Academic Practice *2017-2019*

University of Warwick **Coventry**
PhD in Statistics *2011-2015*
- Dissertation: Bayesian decision support in complex modular systems: an algebraic and graphical approach
- Supervisor: Jim Q. Smith

University of Warwick **Coventry**
MSc in Statistics, Distinction *2010–2011*
- Dissertation: The phase transition of random graphs
- Supervisor: Christina Goldschmidt

Universitá degli Studi di Genova **Genova**
BSc in Mathematical Statistics and Data Management, 110/110 cum laude *2007–2010*
- Dissertation: Rough paths integration of standard and fractional Brownian motion
- Supervisor: Eva Riccomagno

Publications

1. **Leonelli, M.** and Varando, G. (2024). Robust learning of staged tree models: A case study in evaluating transport services, *Socio-Economic Planning Sciences* (to appear).
2. Carter, J. S., **Leonelli, M.**, Riccomagno, E. and Varando, G. (2024). Learning staged trees from incomplete data. In *International Conference on Probabilistic Graphical Models*. PMLR (to

appear).

3. **Leonelli, M.** and Varando, G. (2024). Context-specific refinements of Bayesian network classifiers. In *International Conference on Probabilistic Graphical Models*. PMLR (to appear).
4. Varando, G., Carli, F. and **Leonelli, M.** (2024). Staged trees and asymmetry-labeled DAGs, *Metrika* (to appear).
5. **Leonelli, M.** and Varando, G. (2024). Structural learning of simple staged trees, *Data Mining and Knowledge Discovery* 54(2), 1734–1750.
6. **Leonelli, M.** and Varando, G. (2024). Learning and interpreting asymmetry-labeled DAGs: a case study on COVID-19 fear. *Applied Intelligence*, 38(3), 1520–1544.
7. Filigheddu, M.T., **Leonelli, M.**, Varando, G., Gómez-Bermejo, M.Á., Ventura-Díaz, S., Gorospe, L. and Fortún, J. (2024). Using staged tree models for health data: Investigating invasive fungal infections by Aspergillus and other filamentous fungi. *Computational and Structural Biotechnology Journal*, 24: 12–22.
8. **Leonelli, M.**, Ramanathan, R. and Wilkerson, R.L. (2023). Sensitivity and robustness analysis in Bayesian networks with the bnmonitor R package. *Knowledge-Based Systems*, 278: 110882.
9. Ballester-Ripoll, R. and **Leonelli, M.** (2023). The YODO algorithm: An efficient computational framework for sensitivity analysis in Bayesian networks. *International Journal of Approximate Reasoning*, 108929.
10. Carli, F., **Leonelli, M.**, Varando, G (2023). A new class of generative classifiers based on staged tree models. *Knowledge-Based Systems*, 268: 110488.
11. **Leonelli, M.** and Varando, G (2023). Context-specific causal discovery for categorical data using staged trees. In: *International Conference on Artificial Intelligence and Statistics*, 8871–8888.
12. **Leonelli, M.** and Riccomagno, E. (2022). A geometric characterization of sensitivity analysis in monomial models. *International Journal of Approximate Reasoning*, 151, 64-84.
13. Ballester-Ripoll, R. and **Leonelli, M.** (2022). You Only Derive Once (YODO): Automatic Differentiation for Efficient Sensitivity Analysis in Bayesian Networks. In *International Conference on Probabilistic Graphical Models* (pp. 169-180). PMLR.
14. **Leonelli, M.** and Varando, G. (2022). Highly Efficient Structural Learning of Sparse Staged Trees. In *International Conference on Probabilistic Graphical Models* (pp. 193-204). PMLR.
15. Ballester-Ripoll, R. and **Leonelli, M.** (2022) Computing Sobol indices in probabilistic graphical models. *Reliability Engineering & System Safety*, 225: 108573
16. Görgen, C., **Leonelli, M.** and Marigliano, O. (2022) The curved exponential family of a staged tree. *Electronic Journal of Statistics*, 16(1): 2607–2620.
17. Carli, F., **Leonelli, M.**, Riccomagno, E. and Varando, G. (2022) The R package stagedtrees for structural learning of stratified staged trees. *Journal of Statistical Software*, 102(6): 1–30.
18. Lattanzi, C. and **Leonelli, M.** (2021) A changepoint approach for the identification of financial extreme regimes. *Brazilian Journal of Probability and Statistics* 35(4):811–837.
19. **Leonelli, M.** and Riccomagno, E. and Smith, J.Q. (2020) Coherent combination of probabilistic outputs for group decision making: an algebraic approach. *OR Spectrum*, 42: 499-528.
20. Görgen, C. and **Leonelli, M.** (2020) Model-preserving sensitivity analysis for families of Gaussian distributions. *Journal of Machine Learning Research*, 21: 1-32.
21. **Leonelli, M.** and Gamerman, D. (2020) Semiparametric bivariate modelling with flexible extremal dependence. *Statistics and Computing*, 30(2): 221-236.
22. **Leonelli, M.** (2019) Sensitivity analysis beyond linearity. *International Journal of Approximate Reasoning*, 113: 106-118.
23. **Leonelli, M.** and Smith, J.Q. (2017) Discussion of "Beyond subjective and objective in statistics"

by A. Gelman and C. Hennig. *Journal of the Royal Statistical Society Series A*, 180(4): 1012.

24. **Leonelli, M.**, Riccomagno, E. and Smith, J.Q. (2017) A symbolic algebra for the computation of expected utilities in multiplicative influence diagrams. *Annals of Mathematics and Artificial Intelligence*, 81(3-4): 273-313.
25. **Leonelli, M.**, Görgen, C. and Smith, J.Q. (2017) Sensitivity analysis in multilinear probabilistic models. *Information Sciences*, 411: 84-97.
26. **Leonelli, M.** and Smith, J.Q. (2017) Directed expected utility networks. *Decision Analysis*, 14(2): 108-125.
27. **Leonelli, M.** and Smith, J.Q. (2015) Bayesian decision support for complex systems with many distributed experts. *Annals of Operations Research*, 235(1): 517-542.
28. Görgen, C., **Leonelli M.** and Smith J.Q. (2015) A Differential Approach for Staged Trees. In: Destercke S., Denoeux T. (eds) *Symbolic and Quantitative Approaches to Reasoning with Uncertainty*, pp. 346-355.
29. **Leonelli, M.** and Smith, J.Q. (2013) Using graphical models and multi-attribute utility theory for probabilistic uncertainty handling in large systems, with application to nuclear emergency management. In: *IEEE 29th International Conference on Data Engineering Workshops (ICDEW)*, Brisbane, pp. 181-192.

Preprints

1. **Leonelli, M.**, Smith, J.Q. and Wright, S.K. (2024) The diameter of a stochastic matrix: new measure for sensitivity analysis in Bayesian networks. *arXiv:2407.04667*.
2. Ballester-Ripoll, R. and **Leonelli, M.** (2024). Global sensitivity analysis of uncertain parameters in Bayesian networks. *arXiv:2406.05764*.
3. Gonzalez Soffner, C.R. and **Leonelli, M.** (2024). An analysis of factors impacting team strengths in the Australian Football League using time-variant Bradley-Terry models. arXiv preprint *arXiv:2405.12588*.
4. Carter, J.S., **Leonelli, M.**, Riccomagno, E. and Ugolini, A. (2024). Staged trees for discrete longitudinal data, *arXiv:2401.04297*.
5. de Carvalho, M., Leonelli, M. and Rossi, A. Tracking change-points in multivariate extremes, *arXiv:2011:05067*.

Software

1. `bnmonitor`: An Implementation of Sensitivity Analysis in Bayesian Networks (R package).
2. `stagedtrees`: Staged Event Trees (R package).
3. `extrememix`: Bayesian estimation of extreme value mixture models (R package).

Award Generation

- Co-Investigator of a ESRC/EPSRC JOINT Impact Acceleration Account Project with title *Assessing the feasibility and usefulness of complex systems methods for the work of the new public health body in Scotland*. (28k)
- Principal's Early Career Mobility Scheme to visit McGill University (3k).
- Celebrating New Appointment grant from the London Mathematical Society (0.6k).
- CAPES Postdoctoral Fellowship.

Student Awards

- 06/16: John Copas PhD Thesis Prize for the best Statistics PhD thesis at Warwick University.
- 06/12: Travel grant to the conference: Algebraic Statistics in the Alleghenies.
- 10/11: Departmental PhD Bursary - PhD Statistics - University of Warwick.
- 10/10: Departmental MSc Bursary - MSc Statistics - University of Warwick.

Service to Profession

- External Examiner of the PhD thesis *Multivariate time-series modelling and forecasting with high-order dynamic Bayesian networks applied in industrial settings* by David Quesada López at the Universidad Politecnica de Madrid (2023).
- External Examiner of the PhD thesis *Conditional preference networks: efficient dominance testing and learning* by Kathryn Laing at the University of Leeds (2020).
- Instructor of "Data Visualisation and Advanced Data Analysis" at AIMS Ghana (African Institute of Mathematical Sciences) (2019)
- Editor of Bernoulli News (2019-2023).
- Organizer of the *1st UK Workshop on Probabilistic Modelling using Chain Event Graphs* at the University of Glasgow (2019).
- Invited instructor at the First LARS-IASC School on Computational Statistics and Data Science - Statistics of extremes: Modelling, inferences, and applications - in Salvador, Brazil (2018) (jointly with Dani Gamerman and Miguel Carvalho).
- External examiner of the PhD thesis *Theoretical Studies on Bayesian Network Classifiers* by Gherardo Varando at the Universidad Politecnica de Madrid (2018).
- Organizer of the Statistics Seminar at the University of Glasgow (2018-19).
- MSc Statistics Projects Coordinator at the University of Glasgow (2018-19).
- Internal examiner of the PhD thesis *Hierarchical Hidden Markov Models with Applications to BiSulfite-Sequencing Data* by Tusharkanti Ghosh at the University of Glasgow (2018).
- Referee for Annals of Applied Statistics, Bayesian Analysis, Brazilian Journal of Probability and Statistics, Communications in Statistics - Theory and Methods, Computational Statistics & Data Analysis, Environmental and Ecological Statistics, Environmetrics, Journal of the American Statistical Association, Information Sciences, International Journal of Approximate Reasoning, Statistical Methods & Applications, Test.

Selected Presentations

- Invited speaker at University of Glasgow, Universidad Politecnica de Madrid, University of Leeds, University of Edinburgh, Queen Mary University, Universitá degli Studi di Genova, Universitat Pompeu Fabra, University of Venice and KTH Royal Institute of Technology.
- Asymmetry-Labeled DAGs: Representation, Learning and Causal Reasoning. *Learning on Graphs, Local Meeting*. Madrid, Spain (11/23)
- A global sensitivity analysis approach in Bayesian networks. *7th Workshop on Games and Decisions in Risk and Reliability*. Madrid, Spain (05/23)
- Highly efficient structural learning of sparse staged trees. *11th International Conference on Probabilistic Graphical Models*. Almeria, Spain (09/22)
- Staged Trees and Asymmetry-Labeled DAGs. *IMS Annual Meeting*. London, UK (06/22)
- A conditional independence framework for coherent modularized inference. *7th Bayesian, Fiducial*

and Frequentist Conference. Toronto, Canada (05/22)
- Semiparametric bivariate modelling with flexible extremal dependence. *CM Statistics*. London, UK (12/20).
- Modeling dependence with diagonal distributions. *Incontro di Statistica Matematica*. Sestri Levante, Italy (01/20).
- Sensitivity analysis in graphical models: a polynomial approach. *1st Italian Meeting on Probability and Mathematical Statistics*. Turin, Italy (06/17)
- Directed expected utility networks. *5th Workshop on Games and Decisions in Risk and Reliability*. Madrid, Spain (06/17)
- Semiparametric Bayesian multivariate models for extreme exceedances. *22nd Simpósio Nacional de Probabilidade e Estatística*. Porto Alegre, Brazil (07/16)
- Integrating probabilistic outputs for coherent group decision making. *13th Encontro Brasileiro de Estatística Bayesiana*. Belo Horizonte, Brazil (02/16)
- A differential approach for staged trees. *13th European Conference on Symbolic and Quantitative Approaches to Reasoning with Uncertainty*. Compienge, France (07/15)
- The algebra of integrated partial belief systems. *Algebraic Statistics 2015*, Genoa, Italy (06/15)
- Uncertainty handling in integrating decision support systems. *Calculating and Communicating Uncertainty*, London, UK (01/15)
- Dynamic uncertainty handling for coherent decision making in nuclear emergency response. *American Nuclear Society Winter Meeting*, Washington, DC (10/14)
- Using graphical models and multiattribute utility theory for probabilistic uncertainty handling. *29th IEEE International Conference on Data Engineering*, Brisbane, Australia (04/13)

Teaching

- **IE University, 2024/25:**
  - Mathematics Fundamentals (MSc), Discrete Mathematics for Computing (MSc), Customer Analytics (Bachelor), Financial Analytics (Bachelor), Probability for Computer Science (Bachelor)
- **IE University, 2023/24:**
  - Mathematics Fundamentals (MSc), Discrete Mathematics for Computing (MSc), Statistics for Data Science (MSc), Machine Learning I (MSc), Bayesian Statistics (Bachelor), Applied Machine Learning using Graphs (Bachelor), Probability for Computer Science (Bachelor)
- **IE University, 2022/23:**
  - Mathemathics Fundamentals (MSc), Discrete Mathematics for Computing (MSc), Simulation and Modelling to Understand Change (Bachelor), Bayesian Statistics (Bachelor), Probability for Computer Science (Bachelor).
- **IE University, 2021/22:**
  - Maths for Computing (MSc), Math Lab (MSc), Statistics and Probability (MSc), Simulation and Modelling to Understand Change (Bachelor), Bayesian Statistics (Bachelor), Probability for Computer Science (Bachelor).
- **IE University, 2020/21:**
  - Maths for Computing (MSc), Math Lab (MSc), Statistics and Probability (MSc), Simulation and Modelling to Understand Change (Bachelor), Bayesian Statistics (Bachelor).
- **IE University, 2019/20:**
  - Maths for Computing (MSc), Math Lab (MSc), Fundamentals of Probability and Statistics

(Bachelor), Simulation and Modelling to Understand Change (Bachelor).

- **University of Glasgow, 2018/19:**
  - Introduction to R programming (Bachelor and MSc), Design of Experiments (Bachelor and MSc).
- **University of Glasgow, 2017/18:**
  - Introduction to R programming (Bachelor), Data Analysis (MSc), Design of Experiments (Bachelor and MSc), Introduction to Probability and Statistics (PhD).
- **University of Glasgow, 2016/17:**
  - Data Analysis (MSc), Design of Experiments (Bachelor and MSc), Introduction to Probability and Statistics (PhD).

Supervision

- **MSc students:** Tsan-Mu Lin (2018), Barbara Maria Mena Velasquez (2018), Ioannis Setzis (2018), David Quinlan (2018), Yusen Yao (2017), Zhipeng Kuang (2017).
- **Undergraduate students:** Anthony Yacouub (2024), Carlos Rafael González (2024), Joaquín Casasús (2024), Tomás Vintimilla (2024), Manuel Concepción (2024), Alex Rossi (2019), Ramsiya Ramanathan (2019), Cameron Miller (2019), Lanxin Li (2019), Matteo Perillo (2019), Haoyu Liu (2019), Chiara Lattanzi (2018), Emily Griffiths (2018).

Languages

Italian: Mother tongue

English: Fluent

Portuguese: Intermediate

Spanish: Fluent

Other Skills and Interests

- Computing: C++, Latex, Maple, Matlab, OX, R
- Sports: Volleyball (Warwick University 1st Team Captain, Official Referee), Crossfit, Alpine Ski
- Volunteer at the European University Volleyball Championship - Camerino, 07/2009
- Sports Activator at Warwick University and SHEVO (Senior Higher Education Volleyball Officer) for Volleyball England
- Sports scholarship holder for volleyball at Warwick University
- Driving licenses: A3, B