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Foreword to the Special Issue on "Statistics, Statistical Engineering, and Innovation for Industry 4.0"

This special issue of *Applied Stochastic Models in Business and Industry* is dedicated to the advances in statistics and statistical engineering towards industry 4.0, following the workshop "Statistics and Innovation for Industry 4.0" which was held in Florence (Italy), February 20–21, 2020. The event was organized by the StEering Inter-university Research Centre: Design, Quality and Reliability, and by the Department of Statistics Computer Science Applications "G. Parenti", University of Florence (Italy), with the scientific support of the Beijing Institute of Technology, Renmin University of China, and the European Network for Business and Industrial Statistics (ENBIS).

International speakers shared their knowledge and innovative studies in order to improve research related to the field of statistics, engineering, management and technology *in and for* a global and sustainable world. Seven invited sessions, related to the main topics of Statistics and Engineering for Industry 4.0, were organized by considering: statistical for engineering, reliability, big data and classification, Bayesian methods, computer experiments, business and marketing studies.

Talks from industry (on successful applications) related to the illustration of particularly challenging technological issues provided the opportunity to discuss and suggest real solutions for innovation in an Industry 4.0 perspective.

The scientific programme confirmed the effective relationship between academic research and practical applications in business and industrial statistics, also expounding the usual topics aimed at a global conjunction between data science and the technological issues arising in a 4.0 world.

Following this line of reasoning, the aim of the special issue is to present recent developments in statistics that are relevant for successfully addressing the new challenges that could arise in a "4.0 ERA", for example, technological and engineering issues. The focus will be on the interface between statistics and engineering, also considering other related aspects, such as big data and other analytical projects, with emphasis on applications in line with the usual topics of the journal.

The special issue contains nine papers, among them some were presented by invited speakers at the conference.

All the papers show how statistics can be effectively applied to solve technological issues, and how empirical problems can stimulate the development of specific, carefully illustrated, theoretical aspects.

The nine papers can be divided considering the statistical methods involved, but also the field of application. To this end, most of them concern quality improvement, measurement uncertainty and methodological issues in manufacturing and/or industrial processes; others are related to healthcare and biostatistics.

Maculotti et al. present a practical study in Industry 4.0, namely, by applying Kriging modelling on the measurement errors in manufactured parts. The paper integrates stochastics, industry and geometry for solving the problem.

Facchinetti et al. consider estimation of dispersion effects in off-line quality control techniques by expounding the Taguchi parameter design method. They provide an interesting insight into the method and propose suitable solutions for better identifying the control parameters.

Borgoni et al. apply spatial analysis in order to investigate the occurrence of defects in the manufacturing of integrated circuits. More specifically, the authors use a concatenation of methods, involving control charts, clustering and graphical tools.

Zuanetti et al. study how the ultrasonic wave propagation behaviour may be a useful tool for the assessment of materials, for instance in civil engineering, by involving a new statistical modelling approach through the Bayesian semiparametric method and the Dirichlet process.

Quality assessment is also evaluated in Capezza et al. where resistance spot-welding is studied through the dynamic resistance curve observations by applying the functional data analysis.

Clustering selection procedure, lasso regression and permutation tests are jointly used in Arboretti et al. aimed at suggesting a new method for variable selection in the near-infrared spectroscopy, used in food and pharmaceutical industries for several purposes, such as quality control, product properties and component concentrations.

A multistep biochemical process is studied in Frieri et al. The authors, by considering the empirical problem, suggest a theoretical solution based on optimal experimental designs to encompass the problem of defining a design space, when a multi-step process is present together with the issue of interaction between two consecutive steps.

The topic of the paper by Barone et al. concerns healthcare and industry 4.0, where the authors study radiomics, used to extract information from biochemical images. A novel statistical approach is suggested and applied to a case-study on prostate-cancer analysis.

Stefanini and Magrini use a Bayesian structural causal model to estimate mediation effects in cell transformation assays providing an informative joint prior distribution helping to determine the sample size for lowering the expected uncertainty of estimates below a pre-assigned threshold.

We would like to thank the authors for their interesting contributions, and the reviewers for their appreciated comments and suggestions that improved the quality of the special issue.

We also would like to thank the Scientific and Organizing Committee members, especially the academic Chinese colleagues, colleagues of the StEring research centre and all attendees (onsite and in streaming), as well as all those who contributed to the success of the conference by presenting talks and posters and who took an active part in the discussions.

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