EDITORIAL NOTE

Opening Note: The Golden Jubilee of the Institute of Mathematics and Statistics of the University of São Paulo

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According to the Bible, *Jubilee* is the year of festivities immediately following the seven cycles of the Sabbatical year. The year of 2020 marked the fiftieth anniversary of the foundation of the Institute of Mathematics and Statistics (IME) of the University of São Paulo (USP). Indeed IME was created on January 15th, 1970, in the realm of the University Reform (Reforma Universitária) of 1969, to assemble in a single place the faculty of mathematics-related areas working in various units of the University.

IME succeeded the Mathematics sub-section of the Faculty of Philosophy (FFCL), with a glorious history dating back to the birth of the University in 1934. Its formation was mainly the work of the Italian professors Fantappiè and Albanese. However education at the graduate level mostly started in 1945, with the coming of Weil, and later, Dieudonné, Delsarte, Grothendieck and a number of other Bourbakists. New impetus to research in mathematics came in the early 1960s, with the creation of the (now defunct) Institute of Mathematical Researches (IPM—Instituto de Pesquisas Matemáticas), result of a partnership between the mathematicians working at FFCL and those at the Polytechnic School (EP). The teaching of classes in Numerical Analysis and Applied Mathematics at USP can be traced back to 1952, but research in those fields gained momentum in 1962, the year in which the department of Mathematics at EP acquired an IBM 1620 mainframe scientific computer.

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The teaching of Statistics at FFCL started under the leadership of the Italian professor Galvani in 1936. Later, the 1961 visit of Jerzy Neyman (from Berkeley) provided an important stimulus to the modernization of research in Statistics at USP.

Today IME comprises four main departments, namely, Mathematics, Statistics, Applied Mathematics and Computer Science. It congregates around 170 full time faculty members, who advance research in various fields of Pure and Applied Mathematics, Statistics and Computer Science; in addition, about 2600 students are enrolled in undergraduate and graduate courses in IME; and the institute is served by approximately 100 full time staff members.

Such are the vagaries of history, and 2020 was also the year in which the global COVID-19 pandemic arrived in São Paulo. Dramatically enough, the two-day festivities for IME's Jubilee, planned in advance for months, were cancelled just a few hours before their opening ceremony. Therefore it is a unique joy and pride for us to introduce this issue of the *São Paulo Journal of Mathematical Sciences*, containing selected research milestones by current and past researchers affiliated with IME. Unfortunately for various reasons it was not viable to receive contributions from all people, many important fields were left out, and we are sorry for those omissions. Nonetheless we hope this glimpse at the activities developed at IME will leave an imprint of the significance of the research carried out at this institute. We have ordered the contributions according to the *Mathematics Subject Classification* codes.

Notable professors at IME were the late Cândido Lima da Silva Dias, its first director, Chaim Samuel Hönig, co-founder of the Brazilian Colloquium of Mathematics, and Elza Furtado Gomide, a pioneering woman doing mathematics in Brazil. In addition, we would like to say a few words about the contributors to this volume and their contributions, as well as other notable professors affiliated with the institute who have sadly passed away.

Research in ALGEBRA at IME has always been very active and diverse. From a foundational point of view, in their article Ribeiro, Roberto and Mariano delve into abstract quadratic form theory and algebraic multivalued structures, carrying forward the successful partnership between Dickmann and Miraglia in the 1990s. Polcino Milies created a school around him in the field of ring theory. He writes a remarkable survey on some of the most important conjectures on the units of a group ring and the progress made towards their solution, together with historical background and motivation, which is sure to interest a wide range of readers with a penchant for algebra. Coelho has had many PhD students, and his masterful survey describes the work he has done with them since the early 1990s, with the general aim of organizing the module category of an associative algebra. The article by Murakami, Peresi and Shestakov is a comprehensive retrospect of the research of the group in non-associative algebras at IME (except Lie algebras, for which we refer to Futorny's article below), whose initiator was Roberto C. F. Costa in 1980. Shestakov was the co-recipient of the Moore Prize in 2007, given by the American Mathematical Society. Representation theory of Lie algebras is an active mainstream branch of Mathematics, which plays an increasingly important role in different areas of modern science. Futorny writes a clear and concise exposition of the results obtained by the research group in Lie algebras at IME in the last 20 years, in particular related

to Harish-Chandra modules, Gelfand-Tsetlin $\mathfrak{gl}(n)$-modules, Galois algebras, representations of *W*-algebras and representations of affine Lie algebras. In ANALYSIS, the mathematical work of the late Dan Henry is the theme of Pereira's article, in special the perturbation theory of domains in boundary value problems of PDEs. Henry's best known opus is his monograph about the geometric theory of semilinear parabolic equations, having been translated into many languages and having received thousands of citations. Pava's massive and very interesting article is a clear exposition of some of his most important results concerned with the analysis of qualitative properties of solutions to nonlinear dispersive models. Turning to DYNAMICAL SYSTEMS, the late Jorge Manuel Sotomayor Tello was one of the pioneers of the modern theory of bifurcation, and introduced the concept of structural stability in the study of lines of curvature, together with Carlos Gutierrez. Here he tells this story in an appealing way. The contributions of Waldyr Muniz Oliva range from geometrical mechanics to functional differential equations. Here his influential 1983 preprint on Morse-Smale maps in infinite dimensions is finally published. At the time, this work exerted an immediate effect on a group of mathematicians centered around Jack Hale (from Brown) who were trying to extend the successful global theory of finite dimensional dynamical systems to infinite dimensions; a preface by Ragazzo and Peixoto gives more details about the story. Salomão was co-recipient of the SBM Prize in 2015, and recipient of the Bessel Research Award in 2017 given by the Humboldt Foundation. Together with de Paulo, Salomão presents us with a survey on some important dynamical applications of the theory of pseudo-holomorphic curves in symplectizations to the study of Reeb flows in dimension three. De Faria and Guarino's survey includes new results concerning the dynamics of circle homeomorphisms that are differentiable with a finite number of flat spots with well controlled structure, bringing together techniques from all over mathematics, and it is destined to become the standard reference in the field. Moving to FUNCTIONAL ANALYSIS, in their survey Garcia, Juriaans, Oliveira and Rodrigues collect a number of highlights of the contribution by the late Jorge Aragona, together with his collaborators, to Colombeau theory, a nonlinear theory of generalized functions; Aragona wrote altogether six joint papers with Colombeau. Sánchez, Ferenczi and Randrianantoanina write an authoritative survey on Mazur's rotation problem, which appears in Banach's famous 1932 book, presenting unexpected connections of Mazur's problem with renorming theory and differentiability in functional analysis, with topological group theory and the theory of representations, with the area of amenability, with Fraïssé theory and Ramsey theory. Talking about DIFFERENTIAL GEOMETRY, the late Alexandre Augusto Martins Rodrigues was co-founder of IPM and a pioneer in research in that field at IME, having worked with Spencer, Kuranishi, Koszul and Ehresmann. His legacy is witnessed by the influence he exerted on the lines of research in Differential Geometry at IME. The late Carlos Edgard Harle was the first one to generalize Élie Cartan's theory of isoparametric hypersurfaces to higher codimension. Gudlaugur Thorbergsson (from Cologne) is a world leader in the field of isoparametric submanifolds and polar foliations, and visited IME in 1998 and 2002. His survey contains a tribute to Harle's work. An authorized translation of Harle's article, originally published in Portuguese, follows. Bettiol and Piccione's superb survey provides an introduction to the Crandall-Rabinowitz bifurcation

theory via the study of a certain ODE system which arises from the Yamabe problem. Piccione has been President of the Brazilian Mathematical Society since 2017. Research in ALGEBRAIC TOPOLOGY at IME can be seen as the heritage of the late Carlos Benjamin de Lyra. Borsari, Cardona and Gonçalves' clear and well-written survey brings us some of their works on Nielsen-Reidemeister numbers, equivariant fixed point theory and coincidence theory.

In STATISTICS, Morettin is internationally renowned for his research in wavelets and time series. Together with Porto, he contributes an excellent review of methods for the estimation of nonparametric regression models using wavelets, under different scenarios. Pereira and Stern's impressive survey provides an overview about the Full Bayesian Significance Test, an important novel test of statistical hypothesis, first published in 1999 by those authors, and anchored by a novel measure of statistical significance, known as the e-value. We also pay posthumous tribute to Heleno Bolfarine, a prominent leader in the investigation of statistical models, such as regression models, having published extensively on the subject and advised with great success; he was also the recipient of the 2021 Mahalanobis Prize, given by the Government of India.

Last but not least, in COMPUTER SCIENCE, Miyazawa and Wakabayashi's survey communicates their expertise in the design of approximation algorithms for geometric packing problems, a subject they have been contributing to for over a couple of decades. Their paper in this issue focuses on problems involving circle packings, and is aptly dedicated to the late Imre Simon, an eminent theoretical computer scientist, who was at IME since its early days and whose scientific work and vision shaped, among others, the development of our CS Department decisively. In 2009 Simon was awarded (post mortem) one of the only two Professor Emeritus titles ever granted at IME (the other one being awarded to Waldyr Muniz Oliva in 1994). Barrera is internationally renowned as a pioneer in the theoretical development of Mathematical Morphology, a mature area of image analysis. His paper with Hashimoto, Hirata, Hirata Jr. and Reis is a theoretical discussion of their contributions to that field, including the lattice-theoretic approach, automatic design of operators, and the construction of alternative representations of morphological operators.

We warmly acknowledge the outstanding contributions from all the authors. This remarkable collection of surveys stands out as a unique written testimony of the passage of IME's 50th, and a good omen for its prosperous next fifty years.