Main Topics

Topic 1

Key issues in the What, Who, When, How of statistics and data science education

Topic team: Jennifer Noll (Chair, US), Darren Macey (UK), Susanne Schnell (Germany)

Asking questions is at the heart of all statistical and data science endeavours. Carefully interrogating and researching contexts are the seeds of statistical and data investigations. Such questioning and probing may involve other disciplines, clients or colleagues, but always leads to identifying issues and questions to be investigated. The querying of data, in all the meanings of querying, is now more important than ever. No matter what the stated provenance, nor how simple, complex, rich or large the data, the questions of how, where, when, who and why are essential for the procurement of any meaningful interpretation. And no progress towards interpretation and information is possible without understanding what the data are. Whether theoretical or applied, analysis requires identifying and querying assumptions and results, with interpretation in context including critiquing and proffering ideas for further issues and questions. Similarly, critiquing of reports, data, investigations also encompasses the above questioning and querying.

Such questioning is acknowledged and established as being core to the statistical and data sciences thinking, and thus integral within the learning and teaching of their thinking and skills across educational levels, all disciplines and for citizenship. We must also apply such questioning to statistical and data science education – to curricula, pedagogies, strategies, resources, training, research, and institutional, national and international structures. Such questioning will permeate all the topics of ICOTS 12.

Papers for Topic 1 should aim to provide leading or seminal discussion on the conference theme, identifying and addressing key issues and questions for statistical and data science education in today's world.

- What should be taught, when, to whom, by whom and how?
- What are key developments and key ongoing challenges?
- What is happening worldwide and how can the international statistical community help?
- Who should be involved in the international statistical community?
- How do we make our voices heard and who should we target, support, and collaborate with for best impact?
- What and when should today's and tomorrow's teachers learn and who should teach them?

- How do we disseminate best practice in teaching statistical and data science?
- What constitutes evidence of best practice at different educational levels and in different teaching contexts?
- What are the key impediments to embedding best practice?
- How do we help build the broad tent of the statistical and data sciences for best educational benefit for all?

Topic 2

Statistics and data education at the school level

Topic team: Michel Dvir (Chair, Israel), Katie Makar (Australia), TBA

In our modern, data-centric world, the importance of statistics and probability is growing significantly and vibrant democracies need well-informed citizens who can reason about data and probability critically when discussing relevant social issues and engaging in public decision-making processes. To achieve this, there must be a spiral curriculum of education in statistical and probabilistic reasoning and thinking that begins at the elementary and pre-school level and continues throughout the school years. Papers in Topic 2 will explore the latest developments and approaches to teaching and learning of statistics, probability and data science for students from the elementary through secondary level (approximately ages 3-18). In addition to studies of experiences in school contexts, this topic is interested in out-of-school learning opportunities for learners in this age range. Papers may report on students' engagement with data in a variety of contexts, including mathematics/statistics/data science courses, but also in subject matter courses (e.g. STEAM or social science) that integrate data or probability.

Papers in Topic 2 may address any of the following (or related) topics:

- theories of how statistical and probabilistic reasoning and thinking develops;
- pedagogical techniques to support the development of such reasoning and thinking;
- design of learning environments for statistical and probabilistic reasoning and thinking;
- the design and use of digital resources to enhance data exploration and statistical modelling, including simulations;
- policy issues regarding early statistical and probabilistic learning;
- issues of equity and diversity and inclusive education as they relate to the learning of statistics and probability;
- considerations of how the growth of data science, digital resources and the increasing availability of large data sets will impact education in statistics and probability at the school level.

Papers can identify current best practices, place them within the overall context of current trends in statistics and data science education research and practice, and consider the implications for both teaching and learning.

Topic 3

Statistics and data education at the post-secondary level

Topic team: Mitchum Bock (Chair, UK), Leandro Souza (Brazil), Shunya Koga (Japan)

In a world where data skills are in demand by employers it is now desirable that all tertiary students are provided with suitable statistical training as part of their studies, regardless of their main discipline. With such diversity in skills and attitude toward statistics in tertiary education, what should we teach and how do we engage and empower our learners? Topic 3 explores the strategies and challenges in preparing tertiary students for a data-driven world, and includes but is not limited to:

- Upskilling tertiary students in data and statistical literacy
    - How do we deliver data literacy for all students, in an accessible and inclusive way?
    - Teaching critical thinking, evaluation, ethical considerations, and problem-solving skills in the age of AI.
    - Curricular reform to meet employer needs.

- Innovative modes of learning and assessing statistics
    - How do innovative learning strategies impact student engagement and achievement?
    - Collaborative and interdisciplinary approaches to learning statistics and data science by engaging students with real-world problems.
    - Authentic assessment at scale: how do we embed learning in assessment with ever-growing student cohorts?

- Technology for learning, and learning the technology
    - Innovative technologies for classroom use, and teaching our students to use relevant technology/software responsibly and ethically.
    - How should we use AI to enhance teaching and learning of statistics and data science?
    - Harnessing learning analytics for personalised learning and student early warning systems.

Topic 4

New technologies and paradigms in assessment

Topic team: Brenna Curley (Chair, US), Ana Luisa Blancarte (Mexico), Bruce Dunham (Canada)

Assessment plays a vital role in the teaching and learning process in statistics education, and its methods have considerable influence on both learners and teachers. Such assessment needs to mirror changing instructional goals which involve understanding of context- and data-based arguments, statistical reasoning, and communication skills, while requiring students to integrate abstract ideas and linked conceptual networks with procedural and technical skills. However, our learners are increasingly diverse, possessing a wide range of ages, backgrounds, and preconceptions in data analysis, coding, mathematics and probability, as well as diverse goals and perceptions regarding how they will apply statistical knowledge, so the question of equity in assessment is ever-relevant.

Sessions in Topic 4 will explore:

- innovations in assessment, both methodologically and philosophically;
- critical looks at current and recommended practices;
- results and improvements for increasing the reliability, equality, and validity of assessment procedures in statistics and data science.

Topic 5

Improving teaching and teaching capacity in statistics

Topic team: David Stern (Chair, UK), Yap Von Bing (Singapore), Maria Tackett (US)

The growing importance of statistics education in today's data-driven world highlights the need to continuously improve teaching practices and build educator capacity. This topic focuses on addressing the challenges faced by statistics teachers at all levels, from schools to universities, in an era of rapidly evolving curricula, technology, and data literacy demands. Ensuring that educators are well-prepared to teach a diverse range of students and integrate innovative pedagogical methods is key to fostering statistical literacy across society.

We invite submissions to Topic 5 that explore:

- evidence-based strategies to enhance teacher preparation,
- innovative teaching approaches that engage students, and
- models for expanding teaching capacity in various educational settings.

Relevant topics include the development of professional training for teachers, methods for increasing access to statistics education, and research on effective assessment practices. Papers addressing curricular reforms, the use of technology in teaching, and strategies for engaging non-traditional or large cohorts of students are also encouraged. Through these contributions, we aim to advance global efforts in improving statistics education and empowering educators to meet modern challenges.

Topic 6

Statistics education across and into disciplines

Topic team: Matt Beckman (Chair, US), Charlotte Jones-Todd (NZ), Linda Chaba (Kenya)

The topic session "Statistics education across and into disciplines" aims to bring together statistics educators within and across disciplines. We hope to facilitate discussions with statistical educators as well as institutional data providers to explore ways in which effective statistical education and training can help improve statistical practice in any given subject area. Our goal is to learn from each other to better prepare current students to work with the broad context of applications that statisticians encounter.

Proposals to Topic 6 may include, but are not limited to:

- discussions of interdisciplinary statistical education approaches;
- activities / datasets which introduce students to interdisciplinary context;
- teaching approaches to navigating ethical challenges that arise when statistical methods are applied in real world settings;
- discussion of professional development.

Topic 7

Teaching probability and stochastic thinking within statistics

Topic team: Karin Binder (Chair, Germany), Per Nilsson (Sweden), Saleha Habibullah (Pakistan)

Probability is the very guide of life – Cicero (106BC – 43BC)

The pervasiveness of chance, randomness and data in our everyday world means that the ability to reason probabilistically is essential. Given the constant barrage of data-derived information we face daily, statistical, probabilistic and risk reasoning are key educational outcomes for every 21st century citizen in order to navigate the complexities of the modern world.

Sessions within Topic 7 will explore the latest developments and approaches to the teaching and learning of probability and stochastic thinking across all educational levels.

Papers in Topic 7 may address any of the following (or related) topics:

- Challenges in teaching probability and stochastic thinking
- Opportunities to support students' probabilistic and risk reasoning
- Approaches to promoting probability and risk literacy at the school level, post-school level, and beyond
- Design and implementation of innovative technological resources to facilitate teaching and learning of probability and stochastic thinking across all educational level
- Future directions for the teaching and learning of probability and stochastic thinking

Topic 8

Training in statistics, data science and emerging technologies for and in workplaces

Topic team: TBA

Today's workplaces are undergoing rapid transformation with an ever-increasing use of big data and a range of technologies, including AI. Statistical and data literacy competencies are acknowledged as essential skills for all workplaces in a world where decision-making and policy development are data-driven enterprises. An agile, statistically literate and statistically aware workforce is now crucial. The implications for teaching have both challenges and opportunities at all levels of education, across disciplines and for preparing statistical and data science graduates and postgraduates. Partnerships between educational institutions and industries (through internships, data hackathons and other initiatives), can offer hands-on experiences and real-world problem-solving opportunities. Such training and educational experiences can enhance the ability of all workers and workplaces to make informed decisions, adapt to technological advancements, and address challenges in an increasingly data-driven world. Topic 8 considers the opportunities, strategies and challenges of balancing and integrating education in statistics, data science and emerging technologies for and in diverse workplaces.

Papers in Topic 8 may address any of the following (or related) topics:

- Statistical and data literacy competencies in workplaces
- Embedding statistical and data science thinking in technological education
- What role does artificial intelligence play in the teaching and learning of statistics? Is it important to teach machine learning at senior school or post-secondary level?
- How much knowledge of databases and data technology work is fundamental to statistical foundations for workplaces in any discipline?
- What is different in preparing future statisticians and data scientists?
- What are the effects of open-source software, vast open resources and reproducible data analyses?
- Roles of hackathons and internships
- Professional development in an ever-changing landscape
- Support and professional development for statistical and data scientists
- Roles of national and international statistical and data science communities
- Data issues, including quality, privacy and security
- Ethical data practices
- Interdisciplinary professional and educational collaboration

Topic 9

New directions and developments in statistics education research

Topic team: Lonneke Boels (Chair, Netherlands), Tim Erickson (US), TBA

Rapid technological advances in today's world requires fresh perspectives on the teaching and learning of statistics and data science. As the role of data in society continues to grow, new challenges and opportunities are emerging in the statistics and data science research field. Current and future statistics and data science education research needs to consider the rise of big data, machine learning, and artificial intelligence, and how these technologies are reshaping the landscape for teachers and students in an increasingly diverse and ethically complex world.

Sessions within Topic 9 will explore contemporary issues in the field, such as the integration of new technologies, equity and inclusion, cultural responsiveness, the importance of ethical considerations, and growing concerns around academic integrity.

Papers in Topic 9 may address any of the following (or related) topics:

- The role of ethics and data privacy in statistics education research
- Inter and cross-disciplinary approaches in statistics education research
- Reducing barriers to participation in statistics and data science education
- The role of technology and digital learning environments in reducing barriers to statistics and data science education
- Assessment challenges and opportunities in statistics education research
- The role of recent and non-traditional types of data in statistics education research
- Future directions for the teaching and learning of statistics and data science

Topic 10

Growing society-wide statistical, data science and data technological literacy

Topic team: *Joachim Engel* (Chair, Germany), TBA, TBA

Literacy, especially quantitative literacy, has taken on enormous importance these days. The need to understand numbers, decipher them and use them in everyday contexts and for citizenship makes it important to promote the teaching of statistics and data science.
It is essential to integrate statistical, data and technological literacy into education systems at all levels—from early schooling to higher education—and extending into professional development. But beyond formal education, raising public awareness and ensuring continuous professional growth are vital. Workshops, media campaigns, democratizing the access to data, poster competitions, data clubs, data literacy resources, and partnerships between educational institutions, government, business and international organisations provide opportunities for hands-on experience in exploring and critiquing data in all its forms in society: sources, reports and information.

Papers in Topic 10 may address any of the following (or related) issues:

- What partnerships can best leverage data literacy?
- How to promote social good through statistics and data analysis and data science?
- the distinct roles of statistics, data science, and data technologies to promote a more conscious, and integrated society;
- the impact of data technologies on sustainable development;
- Is knowing how databases and data technology work fundamental to the development of statistical concepts?
- Is it important to provide tools for young children to learn to programme and develop code (in R or Python) to analyse data?
- the roles of poster competitions and data clubs;
- Educating for citizenship and withstanding misinformation;
- the roles of the United Nations, Offices of National Statistics and professional societies;
- the role of privacy, ethics, and data in an open data world;
- Cross-disciplinary approaches to data science education;
- Integrating data literacy into K-12 education;
- Democratizing data: the role of citizen, social and open data initiatives in education