# International Statistical Institute: Mission and Role in Global Development of Statistics


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# Themes

- ***What is striking is how ISI over 135 years has grown and reflected statistical growth, to be pivotal in connecting, developing and reaching out across***
  - ***World***
  - ***Areas of statistics***
  - ***Disciplines***
- ***The strength and challenge of Statistics are diversity, problem-solving and reach across***
  - ***Disciplines and workplaces***
  - ***Government, business and industry***
  - ***Whole society***
- ***Statistics education is the business of all statisticians***
  - ***all about communication and developing understanding***
  - ***users, producers, collaborators, innovators, future statisticians***

# Outline

- ***Overview of 135 years of vital ongoing ISI roles in global statistics***
- ***Brief look at how ISI developed some areas, including***
  - ***Mathematical Statistics - Bernoulli Society***
  - ***Business and Industrial Statistics - ISBIS***
  - ***Technology - IASC***
- ***Statistics education and development of IASE***
  - ***Associated activities including ISLP, GIST***
- ***Challenges and opportunities in statistics education..***
  - ***The good, the bad and the ugly***
  - ***Data science***
  - ***How these link with the whole statistical community***
- ***Importance of ISI, its Associations, Special Interest Groups and Outreach Committees***

# Early History

- Series of congresses initiated by Adolphe Quetelet, starting in 1853 in Brussels

**1853-1885**

- Emphasis on centralisation and uniformity of official statistics
- Every state should have a Central Statistical Commission
- The International Statistical Congress and its Permanent Commission

**ISI officially founded in 1885 at London Statistical Society's 50th celebration**

- 81 members and 80 associates
- across different countries
- Biennial sessions (congresses)

Original members:
81 top statisticians from government and academia

**1913: Permanent Office**

- Statistical yearbooks, archives
- Director ISI secretary-general
- Finances separate to Institute
- ISI treasurer an RSS officer

# League of Nations, United Nations

- One of the first League tasks was to convene a conference on International Cooperation in Statistics in London
  - International Statistical Commission set up
  - ISI major player and collaborated with organisations such as International Labour Office & Economic C'tee
- In 1940, ISI members of 4 American countries set up the Inter American Statistical Institute
- In 1948
  - ISI, under President Stuart Rice, and UN agreed on responsibilities, with the UN Statistical Commission (UNSC) taking over the collection and publishing of international statistical data and "the exertion of influence of governmental statistical practices".
  - Rice set up ISI Education Committee in 1948, and persuaded UNSC to advance proposals to UNESCO for a shared responsibility for the development of statistical education. (Continued later)
- [Ref: *https://www.isi-web.org/images/publ/J.W.Nixon.pdf* ]

# Connecting, developing, reaching out

- **Mission of ISI modified in 1947**
  - **"*..must become more comprehensive in its scope…affiliations with...national, regional and specialised international statistical organisations...to the benefit of statistical science as a whole*…"**
  - **New aims visionary, far-reaching and foundation for today's ISI's mission and objectives**
- **ISI adapted itself to become a truly professional society relevant for the global and whole statistical community**
- **Examples of foresight and innovation**
  - **Organisational membership with representative ex-officio member**
    - **Institutional – including many national statistical offices**
    - **Corporate – including many central banks,**
  - **Affiliate members with representative ex-officio member**
  - **Associations, initially called "sections", having their own organizational structure, but with objectives, statutes and by-laws approved by ISI, and in harmony with those of the ISI.**
    - **Reach out to cover a wide spectrum of global statistical interests**

# Connecting, developing, reaching out: some Associations

- International Association of Municipal Statistics, 1957
- Sciences of probability & mathematical statistics
  - Committee of Statistics in Physical Sciences, 1958, became International Association, IASPS, 1961
  - "Adopted" European Regional C'tee (ERC) of IMS and C'tee for Conferences in Stochastic Processes (CCSP) to form Bernoulli Society (BS), 1975
- Statistics in industry and business
  - Committee on Statistics in Industry and Technology 1951
  - Working Group in Industrial Statistics 1989
  - Committee on Statistics in Industry (CSI) 1992; CSBI, 1999
  - International Society Business and Industrial Statistics (ISBIS) 2005
- The International Environmetrics Society, TIES, 1989
  - Became an ISI Association 2008

# Currently ISI + Associations

- 1973: International Association of Survey Statisticians
- 1975: Bernoulli Society for Mathematical Statistics & Probability
- 1977: International Association for Statistical Computing
- 1985: International Association for Official Statistics
- 1991: International Association for Statistical Education
- 2005: International Society for Business and Industrial Statistics
- 2008: The International Environmetrics Society

- **Biennial ISI World Statistics Congresses**
  - **highpoint of connecting, developing, reaching out: vibrant, varied program; meetings, satellites, workshops, symposia, short courses, awards, prizes, International Prize in Statistics, culture**
- **Regional Statistics Conferences (RSC); Special Interest groups; Outreach Committees**

# Currently ISI+Associations

- Over 4,000 individual members (elected, regular, Association-only)
  - 60% of ISI elected members and 20% of ISI regular members are also members of at least one Association
- Close to 250 organisational members (Institutional, Corporate)
- Over 30 Affiliate members
- Observer status UNSC; President inaugural chair of UN GIST (Global Network of Institutions for Statistical Training)
- 10 Memoranda of Understanding (MoU's) with international organisations
- 11 websites linked by main ISI https://www.isi-web.org/
- 16 publications
- Over 15 different conferences, as well as WSC + satellites
- Over 20 awards and prizes
- Statistical Capacity Building
- Professional Ethics

# Statistics Education: ISI & IASE

- **In 1948, IS1 President Stuart Rice set up ISI Education Committee, increasing ISI's mandate to undertake educational activities and collaborate with UNESCO and other UN agencies.**

- **UNESCO grant to ISI for govt statistical training: ISEC set up in India, 1950, by P.C. Mahalanobis, has trained > 1500 from >80 countries.**

- **In 1970's, ISI increased attention to promoting statistics education in schools and universities. ISI Education Committee established task forces.**

- **Task Force on International Conferences in Statistical Education (ICOTS). ISI Committee's Roundtable conferences commenced in 1976. ICOTS commenced in 1982.**

- **Task Force on Teaching Statistics at School Level (TOTSAS), led initially by Vic Barnett**

# Statistics Education: ISI & IASE

- **TOTSAS group established regular newsletter (International Statistical Education newsletter). This lead to Vic and Joe Gani setting up the Teaching Statistics Trust to establish the journal *Teaching Statistics* (TS) in 1979**
  - ***Teaching Statistics* planning special issue on Data Science and Statistics for 2020**
  - **Name change in 2020 to *Teaching Statistics and Data Science* (TSDS)**

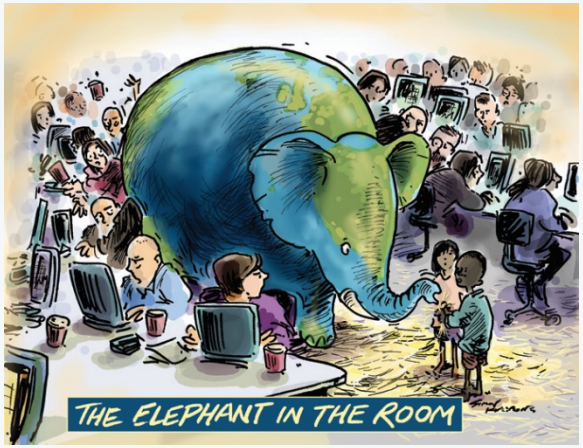
- **International Association for Statistics Education (IASE) established 1992 (Vere-Jones, 1994).**

- **In 1994, ISI committee to stimulate spread of quantitative skills around the world. In 2000 IASE invited to oversee it; called International Statistical literacy Project (ISLP) from 2002. In 2009, current structure of ISLP set up, including IAOS involvement. http://iase-web.org/islp/**
- **ISLP poster competition for two age groups of school students:**
  - **In 2017 more than 12 000 students participated, from 23 countries**
  - **Extended to university students for 2019**

# Statistics Education

**The learning and teaching of statistics is relevant to every statistician**

- **Data literacy**
- **Data science**
- **Big data**




**or**

**Recent comments from leading data scientists**

***Data science is everywhere and not new***

> ***What's changed is recognition of what analysts + technology can do and bringing this out of the back room***

***Data Science is not a person – it's a team. Diversity essential***

> ***But all members need some statistical foundation***

***Data science gives what, statistics gives why/understanding***

> ***Data scientists are statisticians who make meaning from data***

# What is statistics?

- **Statistics: science of variation, data, uncertainty, questioning of models, assumptions and interpretations**
- **Importance and power lie in:**
  - **pervasiveness**
  - **universality of concepts and thinking**
  - **power in specific contexts – across disciplines, business, industry, government and society**
  - **can be a driver, partner or servant, but from the most theoretical to the most applied, its roots lie always in real problems.**
- **Statistics is a thinking science**
  - ***…critically evaluate statistical information and data-based arguments…. Gal (2000)***

# "Data science" "Data literacy" "Big data"

## *Statistics and its teaching even MORE important*

- ***Data science is everywhere: brings together statistics, computer science, engineering, context knowledge***
  - **Need ownership, problem-solving, curiosity, thinking, critiquing**
- **Descriptions of 'data literacy' same as 'statistical literacy'**
- **'Big data' – complex and rich**
  - **Multivariate, variable diversity, and/or many cases**
  - **Data quality, high level technological data management**
- **More than two decades ago, I set up double degree in maths/stats and IT.**
  - **Those graduates went everywhere**
  - **Feedback included:**
    - **IT needs to be enabler to tackle anything in IT**
    - **Value of statistical learning which reflects the *practice* of statistics**
    - **Foundations for further learning**

# Sources for my comments

**1972- :**

- **University: all sizes, levels, disciplines, curricula, texts, mentoring …..**
- **Schools: teachers, schools, enrichment, curricula, resources, texts…….**
- **Learning support……..**
- **International, national:**
  - **Research and teaching centres**
  - **University reviews**
  - **IASE, SSA, RSS**
  - **WSC, ICOTS, OZCOTS**
- **National Senior Fellow**

**Organising computing labs for introductory "service" statistics 1980's**



**Principal Fellow, Higher Education Academy (HEA)**

***Teaching Statistics***
**Co-Editor, 2014-2016**
**Editor, 2017-**

- **UN World Data Forum: 2017, 2018**
- **UN Global Network of Institutions for Statistical Training (GIST)**

# Developments over past few decades

- During 1980's and 1990's, many statisticians and statistics educators worldwide initiated & implemented variety of changes

- Advocacy of
  - Data-driven concepts and statistical thinking
  - Real, 'large' contexts and data: simple within complex
  - Statistical learning which reflects the ***practice*** of statistics
  - Statistics in its own right (maths is servant)
  - Technological and data systems know-how
  - Student ownership and constructivism

- Much work and research accomplished by statistics educators in many countries, but much more needed
  - Penetration of advocacy not sufficient
  - There's good, bad and ugly

# Long-time advocacy from statisticians

- **Box (1976) – Joiner (2005)**
- **Vic Barnett (1986)**
  - **“we see, tied up together, the role of the statistician as consultant, consultancy as the stimulus for research in statistics, and consultancy as the basis for teaching statistics”.**

- **Authentic experience of full statistical investigation process**
  - **Cameron (2009) builds on Chambers’ (1993) ‘greater statistics’***
  - **comments that “*such training is an appropriate foundation for most statisticians wherever they may be employed*.”**
- **All descriptions of full statistical investigation process**
  - **emphasize importance of everything before analysis and everything after**
  - **emphasize cycle: *building solutions to improve understanding of issues/problems***
  - **Need to teach communication of assumptions and findings**
  - **“Solution” ≠ the answer**

# Long-time advocacy from statisticians

- **Authentic experience of full statistical investigation process**
  - **Kenett & Thyregod (2005) 5 steps in statistical practice**
    - ***"important to take part in collection of data, or at least have the opportunity to watch data being collected or generated."***
    - ***"encourage academic courses to cover the full 1–5 cycle....especially steps 1, 2 and 5."***
    - **1. Problem elicitation & preparation for tackling statistically**
    - **2. Preparing data (including planning, collecting, sourcing, identifying, organizing, validating…….)**
    - **5. Presentation of findings**

**Identical to advocacy for data science**

# Authentic learning of data investigations

- **1994-2011: I implemented semester-long free-choice full data investigation embedded in large introductory statistics courses in engineering, all sciences, IT and mainstream statistics programs**
  - **Given data and contexts, no matter how real, can't provide experience of *setting up, investigating, reporting***
  - ***Motivation to find tools***
  - ***Ownership* of data and context ⟹ engagement**

**Student "wow!"**

*** ownership**
*** visualisation + exploration**
*** tool empowerment within complex (>5 variables)**
*** student judgement + communication**

**Entice**
**Excite**
**Empower**

**Grab**
**Keep**
**Maintain**

**Identical to advocacy from data science**

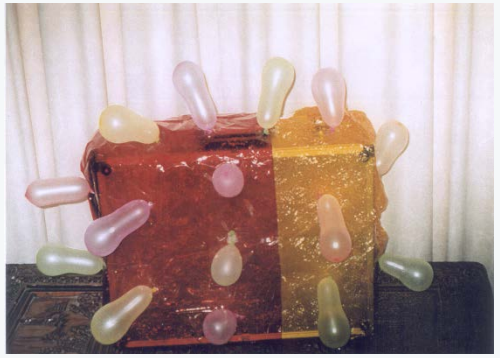
# Student choices: > 5000 projects!

Just a few!

- The three minute pop song
- Length of corporate employee phone calls
- 24 hours in a service station
- Lift or stairs?
- Aircraft noise levels
- Go go go!
- Human curiosity
- Death by statistics
- Holding breath
- Where are all the single people?

Crash testing stubbies

Egg strengths



Human curiosity

# Many effects on learning and teaching

- Choices of topics illustrate types of examples in which students **want** to see how statistical thinking and techniques can help
- Improved overall results
- Past students remember their projects - as do staff
- Discovered what students **need**
- Discovered what engages students.... *"get students to the sexiest, most useful techniques faster & more effectively…" Wild, 2006*
- Significant curriculum re-development to better reflect
  - learning needs
  - real statistical problems
  - modern statistics and statistical practice

**Lessons learnt plus investigations and data embedded in *Mind on Statistics*, MacGillivray, Utts & Heckard, 2nd edn (2014), Cengage**

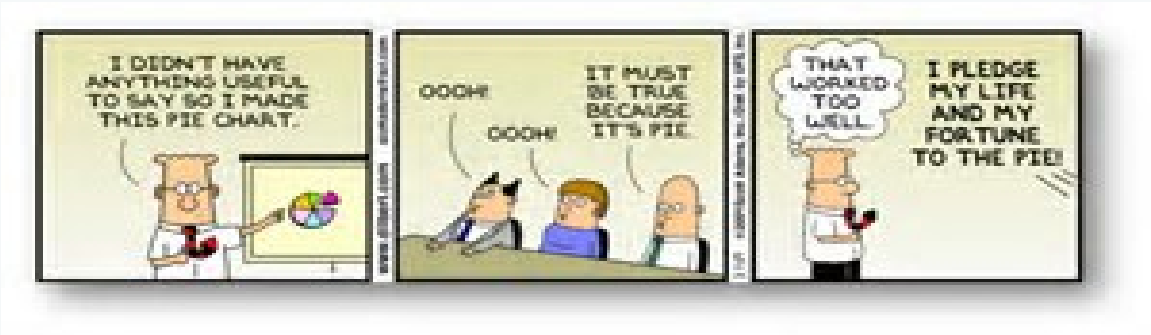
# Challenges in statistics education

**Penetration insufficient within and across disciplines and levels.**
**Important to reflect on the why …..**

- Nature, size, pervasiveness of Statistics
- Technology: resources, use & how much to learn
- Need real, complex, many-variable datasets
- Clinging and regression to old ways
- Non-authentic experience of statistical investigation process
- Rigid, discipline-embedded approaches, top-down case studies
- Assessment fears
  - Workload
  - Open-ended
  - Students “won’t do it right”

# Some challenges

- Too much focus on new ways of learning old content & old sequencing
- Domination of 1 and 2 variables
- Not enough understanding/emphasis assumptions and models
- Leftovers past their use-by-date
- What tools can & can't do




- Lack of coherent development
- Can't build on shaky foundations: perpetuation of norms
- Reclaim and reform learning of probabilistic thinking

# Some challenges

- ‘The’ question & ‘the’ answer


- Not enough of the initial exploration/framing of issues, what data and what variables
- Too much rush to force into ‘desired’ form or get to ‘desired end’
- Simulating the boring

# Some ways forward

- **Authentic experience**
  - **"What goes on in head?"**
  - **Students have to experience it.**
  - **"Empathy" - cultivate by role model: "let's see what we've got"**
- **Too much training for research self-interest and norms: statistics and other disciplines**
- **Real data and real contexts but**
  - **Contexts must not dominate statistical learning**
  - **Contexts must be familiar/readily accessible to students**
  - **Staff research interests must be controlled**
  - **Beware teacher-centred, top-down or context-complex case studies**
- **Must use technology as used in practice of statistics**
- **Authentic learning and assessment**

**All now advocated for data science!**

# Some statistical challenges in other disciplines

- **Foundational understanding and content pedagogy knowledge insufficient across disciplines and educational levels**
  - **Can't build on shaky foundations**
  - **Problems with probabilities**
    - **Inappropriate data for estimates**
    - **Misunderstanding of conditional probabilities**
    - **Incorrect multiplication of probabilities**
  - **Incorrect use of types of data**
  - **Essentials of hypothesis testing are natural**
  - **Multiple procedures and forcing into norms**
    - **overuse of t**
  - **Lack of identification, questioning and visualisation of assumptions**

- **Introductory across disciplines**
  - **Get to multivariable & real empowerment as soon as possible**

# Reclaim & reform probability learning

- Language & visualisation paramount
  - Use probability diagrams with probabilities represented by areas or lengths
  - Extensive student experience of conditioning language
- Conditional probability BEFORE independence
  - All probabilities are conditional
  - Use data, estimates, beliefs…….
  - P(A and B) = P(A|B)P(B). Ban term ‘multiplication rule’
- There are different ways of assigning probabilities, NOT different types of probabilities
  - Estimate
  - Model
  - Belief

  } Combination of any of these

  - Part of cycle of data investigation and models

# Assessment design - for learning

## Reflect what is of value

- **Workload fears**
  - Can balance open-ended + multiple choice
- **“Doing it right” fears**
  - Need authentic student experience
- **“Must be useful”**
  - Students learn best in contexts that matter to them

- **Multiple choice questions**
  - naturally course-specific
  - tend to be highly dependent on local culture/conditions

- **Criteria and standards for investigations**
  - tend to be more universal
  - need exemplars

# Opportunities: the how and collaboration

## Observe, listen, communicate, reflect, collaborate

- **Data science gives opportunities to renew push for authentic learning that reflects practice of 'greater statistics' and 'greater data science'**
  - **Parallels and commonalities must be constantly and strongly emphasized**

- **Enable coherent development**
- **Authentic working with other disciplines**
- **ASSESSMENT is key**
  - **Authentic and balance for efficient effectiveness**
  - **Real contexts, real data, complex data**
  - **Technology resources for learning and assessment**
- **Authentic collaboration & sharing**

# ISI + Associations

## The global statistics community needs ISI

## What does ISI need?

- More members for international effectiveness, impact and representation
- How to best turn liaisons into collaborative action
- Active special interest groups and committees
- The fuel of any professional organisation is its members
  - Challenge of international coordination of volunteer work

- What does the global community of statistics need?
- Advocacy and representation of
  - ‘greater statistics’, diversity and breadth
  - Nature of statistical thinking
  - Statistics and data science

Thank you and here's to statistics and data science!