IASE matters

Autumn, 1999

NEW EXECUTIVE OFFICERS FOR 1999-2001

The newly elected IASE Executive Committee is as follows:

President:	Brian Phillips	(Australia)
President Elect:	Carmen Batanero	(Spain)
Vice Presidents:	Dani Ben-Zvi	(Israel)
	Joan B. Garfield	(USA)
	Lionel Pereira Mendoza	(Singapore)
	Gilberte Schuyten	(Belgium)

We would all like to thank the outgoing Executive members, M. Gabriella Ottaviani and Michael Glencross, for all their work on behalf of IASE, as well as for their help and support over the past years.

STATISTICS EDUCATION IN SOUTH AFRICA

Michael Glencross, Director, Research Resource Centre, University of Transkei, Private Bag X1, Unitra, UMTATA, South Africa 5117. Email: glencross@getafix.utr.ac.za

Statistics Education at School: an Outcomes-Based Curriculum

The government's 1995 "White Paper" on Education and Training proposed sweeping changes in order to normalise and transform teaching and learning. The Department of Education also embarked on a review of the curriculum and, with effect from 1998, began phasing in a new curriculum that is based on the ideal of lifelong learning for all South Africans. In essence, the new curriculum introduces a paradigm shift, from a curriculum that has been content-based to one that is based on outcomes. The aim is to equip all students, now called learners, with the knowledge, competencies and orientations needed for success after they leave school or have completed their training. Its guiding vision is that of a thinking, competent future citizen. This new ambitious curriculum will integrate education and training by incorporating a view of learning that rejects rigid divisions between academic and applied knowledge, between theory and practice, and between knowledge and skills. It will also foster learning that encompasses a culture of human rights, multi-lingualism and multi-culturalism and sensitivity to the values of reconciliation and nation building.

In the past, statistics, with some probability, was taught in a number of South African schools, although it did not appear as a separate subject at either the primary or the secondary levels because it formed part of the mathematics curriculum. The transformation to an outcomes-based approach to teaching and learning brings with it significant changes to the entire school curriculum. The first noticeable change is that the whole curriculum from Grade 1 to Grade 12 will be structured around eight learning areas, one of which is Mathematical Literacy, Mathematics and Mathematical Sciences. It is in this learning area that statistics and probability are located. Another difference in the outcomes-based curriculum is the articulation of different kinds of outcomes. First are critical outcomes that are broad, generic and cross-curricular in nature and apply to all eight learning areas. For example, being able to collect, analyse, organise and critically evaluate information is a critical outcome for all learners at all levels in the educational system. Central to each learning area are learning area outcomes, i.e., general skills, abilities, attitudes and values that a learner will be expected to demonstrate.

In addition, each learning area has a number of specific outcomes, which relate to knowledge, understanding and attitudes that should be displayed in a particular context. For the learning area "Mathematical Literacy, Mathematics and Mathematical Sciences", a specific outcome that is central for statistics education is the one that requires learners to "use data from various contexts to make informed judgements." In this technological age of rapid information expansion, the ability to manage data and information is considered an indispensable skill for every citizen. An ever-increasing need exists to understand how information is processed and translated into useful knowledge. In the new South African curriculum, learners are expected to learn how to make informed decisions based on their encounters with data and information.

The new curriculum is being phased in over a number of years, beginning with Grade 1 in 1998, so full details of the curriculum framework, with its expected outcomes, assessment criteria, performance indicators and so on, are not yet available for all levels in the education system. However, information for the General Education and Training band (Grades 1 to 9) is well detailed and will be of interest to statistics educators. First, it should be noted that the General Education and Training band comprises a Foundation Phase (up to Grade 3), an Intermediate Phase (Grades 4-6) and a Senior Phase (Grades 7-9). Nine common assessment criteria are proposed for Grades 1-9:

1. Identification of situations for investigation.
2. Collection of data.
3. Organisation of data.
4. Application of statistical tools.
5. Display of data.
6. Communication of findings.
7. Critical evaluation of findings.
8. Evidence of knowledge of ways of counting.
9. Understanding of the concept of probability.

The particular skills that learners should acquire have been expressed in the form of 'Performance Indicators'. These indicators increase in sophistication from Foundation Phase, through Intermediate Phase to Senior Phase. For example, in the Foundation Phase the following Performance Indicators have been identified. Learners will:

- Identify situations and their characteristics for data collection.
- Ask the appropriate questions to gather data or formulate questionnaires to collect data and show logical sequence in questions asked. Name sources and media where information can be kept.
- Record data correctly on paper. Read relevant information from a variety of sources. Interpret and extract relevant information from simple tables. Arrange data in a particular order.

- Identify the most common element (mode). Calculate averages of a small number of measurements. Calculate deviation from the mean for at least one of the elements.
- Comment on how often we have such an occurrence. Present the data in a simple table and in simple graphical form.
- Give clear and labelled charts about data. Give clear verbal and written descriptions of data. Use different instruments and constructions to display data.
- Identify trends or most/least popular groupings in the data. Discuss the possible reasons for the trends and discuss whether these trends may change in time.
- Identify misconceptions from the use of phrases like 'statistics show that..."
- Solve simple problems involving chance, probability and predictions.

By the time the Senior Phase is reached, the Performance Indicators show greater sophistication and increasing familiarity with the concepts reflected in this part of the curriculum. Now learners are expected to:

- Recognise and identify different trends in fashion, advertising, music, food, etc., that are worth investigating.
- Recognise different issues in their environment that are of value to investigate, e.g., political, economic, cultural, social, and spiritual and plan data collection to enable the comparison of two groups on the same variables.
- Plan and carry out simple experiments and surveys to estimate proportions, e.g., number of red cars in the parking lot, number of trees in the school playground.
- Critically identify different methods of data collection for a specific area of investigation and use various methods of data collection.
- Explain what a simulation is in relation to an actual experiment.
- Decide when a sample is adequate and when a census is needed, e.g., selecting a Student Representative Council, and select types of samples, such as convenience, random, self-selection, stratified random.
- Draw up and/or refine data collection sheets involving lists, tables or scales. Compare different ways of organising data; sort, sequence and classify data; organise data in tables and/or nested tables.
- Identify variables that help answer questions. Design tables to represent data.
- Enter and manipulate data in a spreadsheet with a template already set up, e.g., amount of various organic matter in a soil sample.
- Develop a reasonably sized database, identifying variables that will provide information about the questions and fields to be used.
- Interpret statements about mean, median and mode of suitable data; understand different ways in hich average, variance and frequency

2

are used and the advantages/disadvantages of the mean, median or mode.

- Calculate, formulate, explain and state problems to a given set of data; draw conclusions from a given set of data. Use fractions/percentages to compare data and describe the variability of results.
- Display one, two and/or more variables of data in line plots with various scales multiples and decimal fractions. Represent grouped univariate data in histograms. Represent bivariate data in scatter plots.
- Label correctly; use a variety of available resources for display; describe findings using various representations.
- Report in written or verbal form the process used for data collection, planning of process and conclusions.
- Comment on improvements of existing data; make recommendations for the improvement of own data projects.
- Present a convincing argument on the advantages and/ or disadvantages of certain types of summary statistics and displays for representing particular data; summarise accurately the information displayed in a range of tables and graphs.
- Draw inferences from time series data and predictions from trends.
- Recognise techniques that create distortion; design unbiased questions or rephrase questions to eliminate bias.
- Distinguish plausible, possible and impossible interpretations of data, including when criticising the claims of others, as in media articles and when dealing with emotive issues.
- Identify aspects that are selected to highlight the construction of a particular argument to support a conclusion drawn. Analyse the manipulation of data to different ends. Demonstrate the effect of assumptions on conclusions.
- Use graphs/ equations for predictions; identify everyday situations where projections are used.
- Compare various methods of choosing a random sample; use randomness and explain why it is important in sampling; recognise the element of chance in data collection caused through natural variability and measurement errors. Design games or experiments using concepts of chance.
- Verify why certainty and impossibility exist and that some events are more likely to occur than others are; make predictions about situations based on personal experiences. Predict the probability that a particular event will occur and then provide reasonable data to support the prediction.
- Calculate theoretical probabilities by using tree-diagrams, Venn-diagrams and counting.
- Carry out simple probability experiments for which instructions are given, record the data and draw conclusions. Design and carry out their own probability experiments and/or

simulations. Recognise and explain the differences between experimental and theoretical outcomes.

- Interpret 'and', 'or' and 'not' when used to describe events, e.g., probability of achieving 1st and 2nd place is less than that of achieving a 1st place.

While few statistics educators will want to disagree with this list of laudable outcomes it is a matter of great concern that there are many teachers in South African schools who will have considerable difficulty in teaching this section of the curriculum. Unless a coherent and well-coordinated in service education and training programme is put in place, such a new curriculum will be nothing more than an impressive looking paper curriculum. The successful implementation of any curriculum depends on the classroom teachers and it is likely to take several years before the desired outcomes of this new curriculum become achievable by a majority of teachers.

Statistics Education at University

The recent "White Paper" on Higher Education has outlined a comprehensive set of initiatives for the transformation of higher education in South Africa through the development of a single coordinated system with new planning, governing and funding arrangements. This, coupled with the concurrent development of the South African Qualifications Authority and a National Qualifications Framework, has resulted in universities and polytechnics re-examining their internal structures, courses and syllabuses. There is now a clear move towards describing institutional qualifications in an outcomes-based format, as well as stipulating programmes of learning, their associated assessment criteria and the recognition of prior learning, together with a diversification of entry modes.

It was not surprising then, to see that at the South African Statistical Association's 1998 Annual Conference there were several papers that focused on matters of statistics education. For example, A. V. Boyd, University of the Witwatersrand, noted that falling standards in school mathematics and demographic changes in enrolment were forcing universities to re-examine syllabuses. He outlined teaching problems experienced in recent years, discussed the country's needs for statisticians engaged in research and in general statistical practice, and outlined a plan for the development of what he termed 'statistical technicians'.

In a paper titled 'Students doing it for themselves', P. Clarke, University of Natal, reported on a process of facilitation and group projects in a research design and data analysis class of psychology honours students. The outcomes of these projects proved to be useful and creative learning aids that could be made available to other students. Concern about

3

teaching methods resulted in *L. van der Merwe, University of Stellenbosch*, discussing the use of the PC in teaching statistics. Describing the structure and development of courses over a period of six years, van der Merwe outlined the advantages and disadvantages of using spreadsheets rather than 'canned' statistics packages.

Also concerned about psychology students who take a course in statistics "only because they have to", *M. Taljaard, University of Port Elizabeth*, examined the relationship between students' performance in statistics and variables such as home language, degree registered for, and previous mathematical experience. It was observed that students generally expressed feelings of fear and dislike about the subject. In an examination of 'Transformation of the teaching of statistics in South Africa: threat or challenge?', *J. I. de Wet, Vista University*, highlighted the fact that the teaching of statistics at South African universities would have to undergo major changes in the near future. The reason for this was that all universities had to comply with the provisions of the South African Qualifications Authority with regard to the National Qualifications Framework, as well as other requirements related to the transformation of Higher Education.

'The changing face of tertiary education in South Africa' was the title of a paper presented by *D. North, University of Durban-Westville*. Although not exclusively on statistics education, the paper drew attention to the development of a university 'three-year rolling plan'. This plan, which will affect the future funding of the institution, gives an indication of how the university intends implementing necessary changes to bring it into line with government higher education policies.

In conclusion, it may be seen that statistics education at all levels in South Africa is undergoing transformation. Although this is a difficult time for statistics educators, it is also an exciting period in our history and we look forward to statistics, probability and data handling becoming an appropriate and important part of everyone's education.

FORTHCOMING CONFERENCES
ICME 9, Tokyo/Makuhari, Japan
July 31st - 6th August 2000

IASE will have a strong presence at ICME 9. A plenary paper will be given by Mike Shaughnessy, USA, *From research to teaching: What research suggests about teaching data and chance.*

Susan Starkings, England, Tae Rim Lee, Korea, Theodore Chadjipadelis, Greece, and Professor Kobayashi, Japan, are organising the Topic Study Group TSG4: *The Teaching and Learning of Statistics*, with the theme "Statistics and Statistical Education for the year 2000 plus". Those interested in submitting a paper can contact Susan Starkings (starkisa@vax.sbu.ac.uk).

A Working Group for Action (WGA11) on *The use of technology in mathematics education* will be organised by Rolf Biehler, Germany (rolf.biehler@uni-bielefeld.de) and Barry Kissane, Australia (kissane@central.murdoch.edu.au)

More information is available from the conference website:
http://www.ma.kagu.sut.ac.jp/~icme-9/index.html

ICOTS-6 Durban, South Africa, 2002

Plans for ICOTS 6 in the summer of 2002 are already under way. The venue is Durban, in South Africa, during mid July. The proposed theme of the Conference is: *"Developing a statistically literate society"*. We will make a concerted effort to attract participation from African developing nations, in part offering funds to delegates as was the case at ICOTS 5.

The International Programme Committee (IPC) is being formed at present by:
- Maria-Gabriella Ottaviani (Italy), Chair;
- Brian Phillips (Australia), International Organiser;
- Dani Ben-Zvi (Israel), IPC Secretary;
- Linda Haines (South Africa), President, South African Statistical Association;
- Delia North, (South Africa), Chair of the Local Organising Committee.

Proposed Topics and Conveners
- School level: Lionel Pereira-Mendoza, Singapore (lpereira@nie.edu.sg);
- Post secondary: Gilberte Schuyten, Belgium (Gilberte.Schuyten@rug.ac.be);
- Workplace: Carol Joyce Blumberg, USA (wncarolj@vax2.winona.msus.edu) and René H. M. Smulders, The Netherlands (RSLS@cbs.nl);
- Wider society: Helen MacGillivray, Australia (h.macgillivray@fsc.qut.edu.au);
- International perspective: Vitalis Muba, Tanzania (eastc@ud.co.tz);
- Research: Carmen Batanero, Spain (batanero@goliat.ugr.es) and Joan B, Garfield, USA (jbg@maroon.tc.umn.edu);
- Technology: Lawrence Weldon, Canada (weldon@sfu.ca);
- Other determinants: Philip J. Boland, Ireland (Philip.J.Boland@ucd.ie);
- Local teachers: Tyna Lamprecht, South Africa (ajl4@icon.co.za).

A temporary web site has been set-up at http://www.swin.edu.au/maths/icots6/ by Brian Phillips with all the news from ICOTS6, its venue and information about South Africa. If you are interested in being Session Organisers, please contact the Topic Conveners. For further details, please contact M. Gabriella Ottaviani, (ottavian@pow2.sta.uniroma1.it) or Brian Phillips (bphillips@swin.edu.au).