ICOTS-6. DEVELOPPING A STATISTICAL LITERATE SOCIETY[1]

Cape Town, 7th to 12th July 2002

1. REPORT FROM THE IPC EXECUTIVE

IPC Executive in Cape Town

ICOTS–6 held in Cape Town (South Africa) from 7 to 12 July 2002, was undoubtedly a great success, both from the organisational and the scientific point of view. The 472 attendants, in fact a large majority of the IASE membership, met for six days, during which they presented their papers. The superb accommodation of the Holiday Inn Cape Town, gave the delegates the possibility to exchange views and to dwell upon their past, present and future projects and activities in a pleasant place. All of this allowed participants the opportunity to strengthen old friendships and to start new ones.

The atmosphere was of an active, scientific community open to new fellow members, happy to share their experiences, to receive information and input coming from different sources and suggesting new ideas and projects for the future. Preparing for this Conference has been a challenge, and has required a long period of work.

The success of ICOTS–6 is based on well organised team work. In September 1998, the IASE Executive Committee began the process by choosing the Conference theme "*Developing a Statistically Literate Society*" and appointing a team of people to act as the Executive Committee of the International Programme Committee (IPC): M. Gabriella Ottaviani (Chair), Brian Phillips (International Organiser and Editor) and Dani Ben-Zvi (Scientific Secretary). After this a group of people were coopted as members of the International Programme Committee (IPC). Within the IPC, 11 topics were proposed with one, or sometimes two people appointed as Topic Convenors as indicated later in this report. In addition Linda Haines (South Africa) was included on the IPC as the Local Organising Committee (LOC) representative.

After presenting an abstract of their topic, each convenor(s) proposed a number of session organisers, each of whom, in turn, presented an abstract of the session and put forward at least three invited paper authors. The International Programme Committee members have co-operated worldwide to gradually construct an interesting and useful program showing the best of the activities, studies and research in Statistics Education, in order to work towards "Developing a statistically literate society". Through the interest of their proposals and the quality of the authors they invited, they ensured the standard of ICOTS–6 to be very high. This activity required a continual effort for about four years, particularly of the Executive Committee, that had to plan and supervise all the process and to maintain contacts with the Local Organising Committee. Communications were kept and maintained by e-mail.

Of enormous assistance were the IPC and the LOC Websites. A very special thanks goes to Dani and Dagan Ben-Zvi, for the wonderful IPC website at http://www.beeri.org.il/icots6 which they designed and maintained in very trying circumstances. It constantly showed where the Conference preparations were at, what the next steps were and the corresponding deadlines. This site has unfortunately been terminated but post-conference information will be available at the IASE homepage: http://www.cbs.nl/isi/iase.htm. The LOC Website, designed and maintained by the University of Natal Public Section at the address: http://icots.itikzn.co.za/ gave all important logistic local information and it proved to be most important in providing information in the unforeseeable relocation of the venue from Durban to Cape Town. We recommend a visit to the ICOTS6 IPC website now available at http://icots6.haifa.ac.il/icots6.html.

ICOTS–6 is the first ICOTS where a refereeing system has been proposed to the authors. This was due not

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[1] *Statistics Education Research Journal 1(2),54-74, http:/fehps.une.edu.au/serj*
International Association for Statistical Education

only to the request coming from some colleagues who needed their papers refereed for funding purposes, but also from a scientific desire of the Exec and IPC who thought that the time had come to improve the quality of the papers presented at the ICOTS Conferences. This, no doubt increased the task of the Exec, particularly of Brian Phillips who had to follow the refereeing process, but as Brian Phillips noticed, "The larger than expected response for authors to have their paper refereed was also most heartening". All papers whether refereed or not, underwent an editing process to ensure a quality product. The papers presented at this Conference were numerous, nearly 300 papers form the Proceedings of ICOTS–6. In fact the IPC Executive Committee decision to produce a CD of the ICOTS–6 Proceedings, rather than hard copy, was very well received, and the work done by Brian Phillips and his Editorial Board to edit the CD has been epic. In addition some 25 posters were on display throughout the conference.

There were several other scientific products of the Conference: the ICOTS–6 Abstract Book is a useful printed guide to the CD. It contains titles and authors of the plenary sessions as well as sessions, titles and authors of the invited and contributed topics. Besides this, it contains the abstracts of all papers listed and an e-mail list of ICOTS–6 authors and organisers. The ICOTS–6 Papers for School Teachers is a peculiarity of ICOTS–6 that put in evidence a further achievement of this successful Conference. In fact, following the suggestions of the IPC Executive Committee, the Local Organising Committee and in particular Jacky Galpin, Delia North and Jacky Scheiber, succeeded in organising a series of events to reach out to local school teachers (see report from local organisers). ICOTS–6 Papers for School Teachers contains a collection of papers which were selected from all papers presented at the Conference by the ICOTS–6 Local Organising Committee as of special interest to South African Teachers. The 232 pages of the booklet contain the plenary sessions papers, the Statistics Literacy papers and 31 papers selected from the other sessions.

Many persons have committed themselves to design and organise this conference during the last four years, but no doubt all of this has been worthwhile. A conference like ICOTS only happens because of the commitment of a large number of people from around the world who are prepared to freely give much time and effort. We would like to pay tribute to the great support we received from so many people who helped in the making the conference such a success. This includes three IASE Executives from 1997 to 2002, an International Program Committee of 18 people, many who also worked as Topic Convenors, a Local Organising committee of 11 people, 76 session organisers and a professional events organiser and staff, Sue Bumpsteed Conferences (Pty) Ltd, Lynn Selby, the AV Coordinator for her commitment to ensuring the audio visual aspects of the conference worked to perfection and Lynne du Toit of Safari Tours for making sure everyone got there safely and had a great social program. We greatly appreciated the excellent co-operation of well over 300 authors and give special thanks to more than 70 referees who so generously gave of their time and expertise to do such a professional job. We certainly could not have finished with such a quality product without the work of the sub-editors and the CD designers. Furthermore, we wish to thank the Local Organising Committee, especially Jacky Galpin, who were extremely helpful in getting the program together as well as the many other aspects of hosting the conference. We also express sincere thanks to the 18 sponsors for easing the financial and logistic problems of running such a conference. In closing, we are very happy to say that the many dramatic events which have occurred during the planning of this conference did not deter this brilliant and devoted group of statistics educators from providing all the valuable material and getting to Cape Town for this wonderful occasion. Any statistics educator who did not attend really missed out on a very special occasion.

We think that the IASE should be proud of this event that has contributed to better understand its task and its potentialities in divulging statistics, its teaching/learning, and its usefulness in everyday life. We will be willing to assist those who are now starting the long task of planning for ICOTS-7 in Brazil in 2006.

Acknowledgements

The IASE greatly appreciates the support given by many funding and academic institutions as well as individuals who have helped make ICOTS-6 possible and contributed to the conference works and funding:

- **ICOTS International Programme Committee**: Maria Gabriella Ottaviani (Chair, Italy), Brian Phillips (International Organiser and editor of Proceedings, Australia), Dani Ben-Zvi (Scientific Secretary, Israel, also developed the IPC web page http://www.beeri.org.il/icots6), Carmen Batanero, Philip J. Boland, Carol Joyce Blumberg, Andrew I. Dale, Iddo Gal, Joan Garfield, Helen MacGillivray, Vitalis Muba, Rene H.M. Smulders, Gilberte Schuyten, Allan J. Rossman, Susan Starkings, Jane Watson, and Lawrence Weldon.
- **ICOTS Local Organising Committee**: Delia North (Chair), Jacky Galpin (Treasurer), Linda Haines (IPC representative), Sue Bumpsteed, Andrew Dale, Riaan de Jongh, Iain McDonald, Vishnu Naidoo, Mbulaheni Nthangeni, Jackie Scheiber, and Gwen Williams.

- **Funding and Academic Institutions**: ISI Teaching Statistics Trust Fund, Standard Bank of South Africa, South African Statistical Association, South African Department of Education, American Statistical Association, Education Section of the American Statistical Association, Teaching Statistics in the Health Sciences Section and Statistics in Epidemiology Section of the American Statistical Association, Vredestein Rubber Resources, Victorian Branch of Australian Statistical Association, Kibbutz Be'eri, Israel, Instituto Balear de Estadística, Instituto Catalan de Estadística, The Augsburg College, W. M. Keck Statistical Literacy Project, USA and the School of Mathematical Sciences, Swinburne University of Technology, Australia. We are also very grateful to the International Statistical Institute and its officers, in particular Marcel Van den Broecke and Daniel Berze, for its professional and technical support, as well as for providing assistance to some delegates to attend the conference through the ISI Development Fund Programme.

Finally we thank those who helped in the refereeing process and contributed to increase the quality of the papers presented in these proceedings.

2. REPORT FROM THE LOCAL ORGANISERS

ICOTS-6 LOC

A total of 472 delegates from 54 countries attended the sixth international conference on teaching statistics, held in Cape Town (South Africa) from 7 to 12 July 2002. The conference was a great success despite the relocation of the host city which was necessitated just four months prior to the event! The many months (actually years!) of hard work by both the LOC and IPC paid rich dividends as all indications are that delegates found the conference organization to be excellent - accommodation, transport, speakers audio-visual requirements, tours and social functions were of the highest standard.

The conference was supported by the City of Cape Town and the SA government, evident from the fact that, at the Mayoral reception on the Sunday night, the guest speaker was Tami Mseleku, Director General of Education, while the Master of Ceremonies was Pali Lehohla, the Statistician General of SA. In addition, the conference was opened by the Trevor Manuel, Minister of Finance of South Africa, after the flags of the countries of the participants were carried in, and the national anthem sung by a group of children, led by the famous Cape Minstrels.

Most of the delegates had accommodation in the Holiday Inn Cape Town, Strand Street, the conference venue. This cut down on transport time and gave delegates more time to network and socialize. The delegates were well catered for on the social front - a mayoral reception on the Sunday night, a “happy hour” around the posters on Monday night, wine tasting around the posters on Tuesday night, local tours on Wednesday afternoon and the conference banquet on Thursday night ensured that delegates relaxed after the academic demands of the day. Delegates booked many pre- and post-conference tours at the conference tour desk which was available throughout the conference. Visits to the various game parks in South Africa (particularly Kruger National Park) were the most popular choice, while a tour to a local township was a very popular choice for the Wednesday afternoon local tour.

A total of 25 posters were on show during the conference - amongst them three posters by South African school children. The children presented their posters on the Tuesday and thoroughly enjoyed the excitement of discussing their posters with the many interested delegates. The posters presented by the children were the winning entries in local statistics poster competitions run at a few schools.

A major local thrust for ICOTS6 was a series of events put in place to reach out to local school teachers. The South African Statistics Association (SASA), Association of Mathematics Educators of South Africa (AMESA), Statistics South Africa and the Department of Education united to present a wonderful program for local school teachers to become acquainted with basic statistics concepts (many local school teachers have had no previous statistics training) which will soon be part of the new school syllabus in South Africa.

On the Saturday a 1-day CensusAtSchool workshop was held in Durban (following on from the national mathematics school teachers conference which had just ended on the previous day). This workshop was attended by disadvantaged teachers selected from all the provinces in South Africa and focussed on the data collection process in the recent CensusAtSchool project in South Africa, as well as demonstrating how to use CensusAtSchool materials in the classroom. This workshop was repeated in Cape Town on Sunday. The attendees of this CensusAtSchool workshop consisted of a some international ICOTS delegates, local school teachers from the Cape Town area and most significantly, a group of teachers, from each province in South Africa, selected by the Department of Education. These teachers include key mathematics co-ordinators from the 9 provinces of South Africa. Aspects of CensusAtSchool from other countries were also presented at both workshops, giving an international perspective to the data sets, which will be made available to all schools in South Africa.

A local teacher session, running for the full duration of the conference, was organised by SASA and AMESA, and ensured that the teachers got sufficient training in statistics to be able to meet the demands of the statistics section of their new school syllabus (to be fully implemented in 2005). The local teacher session was split into two strands, Primary (grades 4,5,6) and Senior (grades 7,8,9). A workshop approach prevailed throughout and this ensured that the teachers would have adequate materials to use in the classroom. Each teacher received a die, plastic cups and various coloured poker chips and in no time groups were merrily simulating their data and arguing the finer points of probability theory! Other sessions focussed on using details of histograms, charts, plots and other aspects of the school syllabus, as well as interpretation of newspaper articles and other material incorporating statistical concepts. The teachers were very excited to discover the relevance of statistics to all aspects of teaching at school, and in fact to all aspects of life. The local teacher session and the CensusAtSchool workshop was captured on video camera in order to be used in follow-up workshops to be held in the various provinces in South Africa. Presentation of these workshops was a requirement for funding received by many of the teachers who attended ICOTS6. Support from SASA and AMESA will assist these teachers in spreading knowledge gained at ICOTS6.

ICOTS6 certainly gave local teachers the training to assist in creating a statistically literate society in South Africa!

3. OPENING ADDRESS

THE HONOURABLE TREVOR MANUEL (MP)
Minister of Finance
South Africa

The Opening Address at ICOTS6 was delivered by South Africa's Minister of Finance, The Honourable Trevor Manuel. It is exceedingly rare that we get the perspective of a government policy maker at the most senior cabinet level on statistics and its role in policy making, and on statistics education. So we are publishing the text of this excellent speech in full in the pages that follow.

3.1. SIXTH INTERNATIONAL CONFERENCE ON TEACHING OF STATISTICS OPENING ADDRESS

I would like to commend ICOTS and the organising committee for the work done in preparation for this conference. In looking at the programme my particular favourite is Session 4H "Educating Managers, Executives, Lawyers, Politicians, Government officials and other Decision Makers". Numeracy for Lawyers? For Politicians? What next – elementary numeracy for Auditors?

My enthusiasm for the work of ICOTS arises from my responsibilities as a policy maker in South Africa. Our young democracy is but 8 years old and was built to improve on the quality of life of all its citizens. This task is undertaken against the history of huge inequalities; not just in material circumstance, but also in access to knowledge and understanding. I believe fundamentally that democracy works when citizens participate, because citizens know, because they've been empowered through education.

Dr. Helmut F. Spinner (1999) (German obviously), at the conference on policies and statistics in the European Union: Challenges and responses, defines a Knowledge Society: as a well informed society in fact, that should become increasingly better informed and he argues that in a complete knowledge society, all the knowledge of the world will be available to everyone, available everywhere, available simultaneously and

available freely. This is what we are striving to achieve here in South Africa. Dr. Spinner poses the five preconditions for this to happen as:

- The non-technological infrastructure should first be upgraded
- Literacy should be achieved
- There should be promotion of use
- There should be promotion of access
- Basic freedoms should be guaranteed.

The question to yourselves is what knowledge do we impart in the teaching of statistics? I will hazard it is knowledge as understanding and knowledge as insight. The latter being more important in that we do not see people in our offices churned out of universities performing at this third level of knowledge. That is knowledge as insight.

Larry Gonick and Woollcott Smith (1993), authors of the cartoon guide to statistics say "*we muddle through life making choices based on incomplete information*." In order to make informed decisions in the face of incomplete data we often use statistics and…."*what makes statistics unique is its ability to quantify uncertainty, to make it precise. This allows statisticians to make categorical statements, with complete assurance about their level of uncertainty.*" By quantifying this uncertainty, one begins to know what to do about risk, and what resources to allocate to it. On a daily basis my political portfolio has to deal with uncertainties about the markets, currency behaviour, prices of the bullion, the all share index, inflation rate, GDP growth, savings and investment, sectoral performance, employment, investor confidence, likely direct foreign investment, asset security, their growth, adequacy of their deployment and ultimately derivation and appropriation of value for society. In examining this array of information, the risk is that I may confuse the noise of so much information with reliable statistics.

I do not wish to replace the statisticians in Stats SA, they must be consummate professionals, nor do I wish to undermine the valuable work that the Statistics Council does in providing an external quality assurance to the work of Stats SA. I seek, as policy maker to define the terms for engagement between the statistical agency and Cabinet.

From the list of matters outlined above that concern government and my portfolio, you can realise that I have to deal with statistics matter, that is, measurement of inputs, outputs, outcomes and impact. While the first of the four measures might be a matter of arithmetic and largely financial accounting, the latter three are the subject of statistical collection, collation and derivation of indices for measurement, evaluation and decision making for determining:

- What types and levels of inputs should be made?
- Why these inputs should be made?
- For whom these inputs should be made?
- When these inputs should be made?
- Where these inputs should be made?
- How these inputs should be made to have maximum effect?
- How will I know that the inputs are working for me? Am I measuring what I need to measure? How will I recognise success? How will I recognise failure?

"*Three fourths of the mistakes a man makes are made because he does not really know what he thinks he knows*" (James Bryce 1838-1922). Am I measuring what I need to measure? Do I have confidence in the indicators I am using? And what is my confidence level?

My responsibility as a Minister of Finance is to firstly ensure that the country has sufficient high quality statistics produced by our statistical agency and secondly to ensure that the populace can receive the statistics. This is where educators come in. Thirdly, Government has to intermediate between the generation and the use of statistics.

Indeed *"when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind. It may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science*". (William Thomson, Lord Kelvin 1824-1907).

"Before Census@Schools I did not know how tall I was", remarked a young girl of 15 years of age from a remote school. This was in September 2001 when StatsSA conducted Census at Schools. "The census says we are not as many as we are" was exclaimed a resident from the Western Cape Province when the census results of Western Cape were released in October 1998. "How can we be classified as not being poor" was the question raised by a resident of the Province of Mpumalanga when the report on poverty measurement was released in 2000.

Statistics are a matter of life and death too. Where they are applied to amplify knowledge they can save lives and where they are ignored losses can be incurred.

Larry Gonick notes that in 1986, the space shuttle challenger exploded, killing seven astronauts, including a lady teacher. The decision to launch at a temperature of 29 degrees had been made without doing a simple analysis of performance data at low temperature. On the other hand the trials of salk polio vaccine performed in 1954 on a sufficiently large sample of children, 400,000 in number eliminated bias in the results. Robust statistical analysis of the data firmly established the vaccine's effectiveness, and today polio is a thing of the past.

Why should a young girl of fifteen at school fail to know about herself? She says I did not know how tall I was. A UN Statistics Division Handbook on the Operation and Organization of a Statistical Agency (December 2001) notes that, encouraging schools and high schools in the learning of statistics constitutes best practice. In fact they note that in Poland, there is an active high school competition for the best essay in which extensive use is made of official statistics. I have also realized that Canada recently has introduced the teaching of statistics for teachers and as I surfed the Web I came across a website on statistics in primary schools for Japan.

It will be desirable that statistical institutions avail their stacks of data to schools for use as teaching material. The United Kingdom in outlining their management model for statistical office opine that there has to be a critical mass of key skills. So you are potentially producers of these skills for that reason you have to seek relevance.

I have looked at the programme and I have been struck by a few topics that will be handled, and allow me to reference them without influencing you on which ones you should attend. I am pleased to see that a political angle is brought to the fore through a presentation titled looking at the behaviour of the electorate by Theodore Chadjipaledis. Larry Gonick in his book "a cartoon guide to statistics" argues that all this probability stuff is only good before an election. Your poll star statistician will tell you that I am 95% or 99% confident that you will win the election. This is so because of several things, such as response bias because voters can lie to the interviewer, secondly, the actual voters is what counts although the potential voters constitutes an unbiased sample and thirdly voters may not be home to answer the poll. After the election, the senator is either 100% in or 100% out.

Let me digress by drawing attention to a matter of fundamental importance to policy makers all over, but especially in the developing world, namely HIV and Aids. There is no dispute about the severity of the disease but it is exceedingly hard to deal with this in an environment where there is no reliable statistics available. In South Africa we have results from ante-natal clinics and we have available actuarial models constructed for appreciating risk in the life assurance companies and not for public policy making. In addition the disease remains stigmatised in communities and doctors do not always capture Aids as a cause of death raising concerns about the veracity of parts of a huge mortality study presently underway. Simultaneously, there are a range of interests on this matter who all claim infallible statistics. In an environment of the absence of a cure, policy makers face a huge dilemma on resource allocation. Would money be best spent on research into a cure or a vaccine, on preventive education, on drug therapies, on care for people living with the disease or welfare on those left behind? Each of these choices is relative and dependent both on the reliability of statistics and on the ability to engage with the populace. In many respects the results will be shaped by the extent of exposure of ordinary people to the basic natural sciences; physiology, nutrition and efficacy of drugs which all influence lifestyle choices. None of this is assisted by statistical noise be this on infection rates or life expectancy. Part of my appeal to this conference is to give attention to the interconnectedness between the teaching of numeracy and the links to that which would empower people.

I am pleased that Professor John Volmink is presenting on the issues of statistical literacy for South Africa. My appeal to Stats SA is to engage with these matters and to bring results which would allow other parts of government to take forward the work of Census@Schools. I want to welcome the entry into the discussion of community based learning and wish to express appreciation to Trisha Thorne and Rob Root for their paper. I am encouraged by the paper by Madden and Choi on the duties of statistical agencies to their clients. I am happy that Koffi N'Guesson is advancing discussion on the training of African statisticians – our heads of state gathered in Durban to launch the African Union and take forward the New Partnership for Africa's development will depend for their efforts on good quality statistics to advance these programmes.

My challenge to all of you is to help us help the 15-year-old who did not know how tall she was. My challenge to all of you is to help us to understand what we should focus on to build an empowered society. My challenge to this conference is to help us to meet Spinner's definition of a knowledge society.

I wish you fruitful deliberations.

THE HONOURABLE TREVOR MANUEL
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3.2 REFERENCES IN TREVOR MANUEL'S ADDRESS

Chadjipaledis, T. (2002). Using statistics as a tool in political research. The case of electoral behaviour. Proceedings, ICOTS6. (See section 5.4)

Gonick, L. and Smith, W. (1994). The cartoon guide to statistics. Harper Collins.

N'Guessan, K. (2002). Training of African statisticians: the experience of the National School for Statistics and Applied Economics (ENSEA) in Abidjan. Proceedings, ICOTS6. (See section 5.4)

Madden, R. (2002). Statistical agencies' duties to their clients: who teaches, who learns? (Presented by Ching Choi) Proceedings, ICOTS6. (See section 5.5)

Thorme, P. and Root, R. (2002). Community-based learning: motivating encounters with real-world statistics. Proceedings, ICOTS6. (See section 5.5)

Volmink, J. (2002). The importance of numeracy and in particular of statistical literacy for South Africa. Proceedings, ICOTS6. (See section 4)

3.3. MINI-BIOGRAPHY OF THE HONOURABLE TREVOR MANUEL

(from the South African National Treasury website http://www.finance.gov.za/people.htm)

Trevor Andrew Manuel was born on 31 January 1956 and grew up in Kensington, Cape Town where his mother Philma still lives. He attended Windermere Primary School and matriculated from Harold Cressy High School in Cape Town.

Mr. Manuel completed a National Diploma in Civil and Structure Engineering at the Peninsula Technicon and studied Law during his many periods of detention. He practised as a technician until 1981, whereupon he entered public life. From 1981 he was the General Secretary of the Cape Areas Housing Action Committee. In 1983 he was elected Regional Secretary and a National Executive Member of the United Democratic Front (UDF), a broad anti-apartheid coalition.

For these activities, he was repeatedly detained without trial or placed under house arrest between 1985 and February 1990, spending a total of thirty-five months in detention.

He was elected to both the National Executive Committee and the National Working Committee of the ANC in 1991 and appointed head of the ANC's Department of Economic Planning. In this capacity, he was responsible for the shaping of ANC Economic Policy.

At the time of the historic elections of 27 April 1994 he was elected as an ANC Member of Parliament and in May 1994 he was appointed Minister of Trade and Industry. On 4 April 1996, he was appointed Minister of Finance, a position he currently holds.

Mr. Manuel was selected by the World Economic Forum as a "Global Leader for Tomorrow" in January 1994, he was appointed to the Advisory Committee of the UN Initiative for Trade Efficiency. In September 1994, he was awarded the Africa Prize by the German Africa Foundation, jointly with Derek Keys, who was the Minister of Finance in South Africa at that time. In March 1996 he was awarded the Rotary International Paul Harris Award for Outstanding Achievement by the Rotary Club of Isipingo-Prospection.

4. SUMMARY OF PLENARY SESSIONS

John Volmink, South Africa. *The importance of numeracy and in particular of statistical literacy for South Africa.*

The development of a Revised National Curriculum Statement is seen as a key project in the transformation of South African Society. The thrust of the project is towards achieving "a prosperous, truly united, democratic and internationally competitive country with literate, creative and critical citizens leading productive, self-fulfilled lives in a country free of violence, discrimination and prejudice." (Curriculum 2005, Learning for the 21st Century 1997, Department of Education, Pretoria.). Curriculum reform in South Africa thus faces a two-fold challenge. The first is the post-apartheid challenge which requires developing the knowledge, values and skills base for South Africa's citizens necessary for greater social justice and development. Secondly, there is the challenge of participating in a global economy. This raises questions about the knowledge, values, skills and competences for innovation and economic growth for the 21st Century. The view taken by the curriculum designers is that the best route to greater social justice and development is through a high-knowledge and high skills curriculum. This paper will explore the meaning and importance of numeracy and in particular of statistical literacy, within this context. The paper will focus largely on the relationship between values and mathematical/statistical literacy within the South African context.

Scott Murray, Canada and Iddo Gal, Israel. *Preparing for diversity in statistics literacy: institutional and educational implications.*

Improving the public's understanding of statistical information requires that producers or reporters of statistical messages are aware of: The nature of people's statistics literacy, The factors that affect the difficulty of statistics-related messages, The existence of individual or group differences in statistics literacy; and The information needs of different target audiences. Implications are discussed regarding the need to prepare different types of communicative products and formulate strategies for dissemination and public education.

Jane M. Watson, Australia. *Doing research in statistics education: more than just data.*

As teachers of statistics we know the fundamental components of statistical enquiry, be it classical or exploratory. When we turn the focus on ourselves as statistics educators, we run the risk of forgetting some of the fundamental principles of good research – principles that are broader than carrying out statistical significance tests. In this talk I want to present some examples of research in statistics education to illustrate the stages and outcomes that contribute to results that have a scholarly impact on the statistics education community. As a single teacher with a good idea on how to teach "confidence intervals," I do not expect anyone to pay much attention to me. If I can, however, place my ideas in the context of others' ideas or research on teaching confidence intervals; conduct a study – maybe a case study or a controlled experimental design – that is valid for considering the issue I want to promote in teaching about confidence intervals; and have my results refereed by peers in the field; then I can expect people to pay attention to me.

Peter Holmes, UK. *Teaching, learning and assessment: complementary or conflicting categories for school statistics.*

Over many years I have been attempting to improve statistical literacy in the population by changing the school curriculum. All such attempts have to be put in the general context of teaching, learning and assessing the subject. Ideally these should complement and reinforce each other. In practice they often conflict - in particular assessment can distort the learning process. In this talk I consider the nature of these conflicts and how they might be overcome in practice, giving examples from a lifetime's experience.

Maria Gabriella Ottaviani, Italy. *1982-2002: From the past towards the future.*

This paper, after considering the reasons and aims that gave origin to the International Conference on Teaching Statistics (ICOTS), traces the line of thought along which the Conference developed from 1982 to 2002. This is done by applying textual data analysis to the titles of the papers published in the Proceedings of the first five Conferences, and to the titles that were on the International Programme Committee Web site on October 27, 2001. Knowing past and present enables one to present suggestions about possible future Conference scientific developments.

George W. Cobb, USA. *What can cheap computing offer statistics literacy?*

For statistics at the research level, cheap computing has pushed aside the old order and ushered in a new one based on algorithmic thinking. This is a much deeper change than just teaching an old dog faster ways to do the standard tricks. The old dog now lies content in the sun; computers have brought us an energetic young puppy who is eagerly exploring the whole field anew. What does all this mean, if anything, for statistical thinking at the introductory level? Is it time for the standard curriculum to lie down in a sunny spot and give some new puppies a chance? My view on this is still evolving, in response to what I read, what I hear from colleagues, and what I learn from my students in the classroom. Thus I can't say for certain where my thinking will be in July 2002, but my general theme will be the opportunities that algorithmic thinking offers us to revisit basic ideas of statistics.

International Forum on Statistics Literacy: Statistical Literacy, Statistical Numeracy and Developing Society's Statistical Health and Richness. Chair: Helen McGillivray, Australia. *Panel Members:* Luigi Biggeri, Italy, Lisbeth Cordani, Brazil, Pali Lehohla, South Africa, Jessica Utts, USA.

During the past decade, many statisticians and statistical educators have discussed or been involved in matters ranging from the accreditation of statisticians to education for statistical thinking to the interaction of statistics and information technology to the problems of society numeracy and mathematics education. Even the ICOTS6 theme itself has produced considerable discussion amongst statisticians as to whether we should talk about statistical literacy or statistical numeracy. What is common in all these topics of discussion, debate and involvement, is the understanding that statistics is integral to an extensive range of functions of society and to many disciplines, and that society's statistical health depends on facilitating development of, and access to, a full and diverse range of statistical capabilities. That is, as with mathematics, the totality of society's statistical health and strength depends on its ongoing development of the continuum of statistical understanding, abilities and skills, from universal basic statistical literacy through the full spectrum to highly sophisticated scientific and management capabilities. With the addition of a suitable description of some form of universal basic statistical literacy, the definitions of types of statistical ability and skills discussed in Bartholomew's Royal Statistical Society's Presidential address (1995), illustrate this continuum. Facilitating the development, resourcing and ongoing nurturing of this continuum is an enormous challenge. The forum speakers, together with other contributers and questions, will comment on just some aspects of this challenge from both international and personal perspectives.

5. SUMMARIES OF TOPIC SESSIONS

Note: Complete data of authors, organisers and presenters as well as full papers, including those not presented orally, can be found in the **ICOTS-6 Proceedings CD**, which are available from the International Statistical Institute Permanent Office, P.O. Box 950, 2270 AZ Voorburg The Netherlands, Fax 31-70-3860025, E-mail: isi@cbs.nl.

5.1. TOPIC 1. STATISTICAL LITERACY. Convenors: Iddo Gal and Brian Phillips

There are many questions involving statistical thinking which confront people when they are at work, handling household affairs, reading a newspaper or watching TV, or in leisure. Some examples are: How does investing on the stock market compare with gambling? How should we interpret news stories about the latest health research findings? Is it wise to bet on the underdog? How can we interpret reports involving tables and graphs? How can we know when statistics are being misused or abused in the media or in advertisements? Such and related questions face people from all walks of life, whether or not they have had any formal education in statistics.

Under this topic many questions were discussed involving statistical thinking which confront people when they are at work, handling household affairs, reading a newspaper or watching TV, or in leisure. The term "statistical literacy" does not have a single accepted meaning, but in general refers to people's ability and propensity to interpret, critically evaluate, and communicate about statistical information, data-related claims, or chance-related phenomena which they may encounter in diverse life contexts. In many societies or communities citizens are increasingly being expected (or declare their right) to be informed and act as critical consumers of statistical and probabilistic information. To that effect, presentations suggested some level of statistics literacy

that may be desirable not only from all school or university graduates, but also of all adults, regardless of their educational and personal backgrounds.

Presentations at Session 1A: *Frameworks and Studies in Statistics Literacy*, organised by Iddo Gal (Israel) dealt with 'Three kinds of statistical literacy: what should we teach?', Milo Schield, 'Analysis of data from a nationwide psychological project involving coin-tossing predictions', David Green and 'Profile for statistical understanding', Chris Reading.

Topics for presentations in Session 1B: *Statistics for the Citizen*, organised by Brian Phillips (Australia) run in two sessions, were 'What educated citizens should know about statistics and probability', Jessica Utts, 'Promoting statistics thinking amongst secondary school students in the national context', Philip J. Boland, 'Toward a statistically literate citizenry: what statistics everyone should know', Jerry L. Moreno, 'Experience of dealing with the media on congenital anomaly research', Beverley Botting, 'Dna "fingerprints" and their statistical analysis in human populations', A.Marie Phillips and 'Probability and game shows', Mike Fletcher. All the speakers gave very good presentations and these sessions proved very popular. Presenters also described some research-based findings or concerns based on classroom experiences regarding statistics literacy levels of learners or people in general, and suggested various courses of action that educators can follow, either in terms of specific classroom activities or regarding the needed general approach to instruction and skill development.

5.2. TOPIC 2. STATISTICS EDUCATION AT THE SCHOOL LEVEL. Convenor: Jane Watson

Topic 2 focused on statistics education at the school level and it was encouraging to observe that the response at ICOTS6 was the largest at any ICOTS thus far. Twenty-one papers were presented at the conference under five subgroupings reflecting innovative ideas at the elementary level (organized by Dave Pratt), innovative ideas at the secondary level (organized by Gail Burrill), research (organized by Pat Thompson), curriculum development (organized by Dani Ben-Zvi) and sociocultural aspects of learning (organized by Paul Cobb). Although there was some overlap of interest with other topic groupings within ICOTS6, particularly related to Research (Topic 6) and Technology (Topic 7), the focus in Topic 2 was intended to reflect the context of what occurs in relation to the teaching and learning of statistics at the school level.

Papers in Session 2A, *Statistics in Elementary School*, organised by Dave Pratt (UK), considered three different aspects of statistics learning by young children: variation, the arithmetic mean, and randomness. Grade 3 students were the recipients of 10 lessons on chance and data with an emphasis on variation in the report presented by Jane Watson. Pre and post tests indicated a significant gain in basic understanding of both chance and data, and the part variation plays in relation to the fundamental concepts. José Luis Cortina discussed three different ways that 12-year-old students make sense of the arithmetic mean as a ratio. These were based on in-depth interviews using problems from the initial phases of the curriculum and provided a basis for suggestions for designing instruction. Efthymia Paparistodemou discussed a case study of 6-8-year-old children working in a game-like environment to construct spatial representations of a sample space. With the ability to inspect and reconstruct the rules of the game, children displayed their understanding of random events within a novel medium.

Papers in Session 2B, *Innovative Ideas for Teaching Statistics in Secondary School*, organised by Gail Burrill (USA) reflected perspectives from four different countries: the United Kingdom, the United States, the United Arab Emirates, and Australia. James Nicholson outlined the pedagogical basis for a range of materials, including the use of technology, in particular to allow the exploration of larger data sets and of the effects of random variation. Based on a project in Northern Ireland, examples of materials focusing on some key statistical concepts were presented. The relationship of statistics to the rest of the mathematics curriculum was the feature of Jeffery Witmer's presentation based on the Data Driven Mathematics curriculum. He suggested that many mathematical topics, such as formulas, linearity, centers, inequalities, and matrices can be used to motivate and lay the foundation for the relevance of statistics both to mathematics itself and to the real world. The perspective taken by Hanan Innabi reflected the importance of critical thinking throughout the school curriculum. Examples were given from secondary school statistics to show how statistics provides a practical, interesting, and different way to facilitate critical thinking. Using his experience as an Australian secondary teacher, Anthony Harradine, suggested ways of moving beyond the traditional methods of teaching the Normal Distribution and the Central Limit Theorem. These focused on conceptual understanding, meaningful calculation of probabilities, and using the outcomes in an integrated fashion.

Papers in Session 2C, *Research on Teaching Statistics at the School Level*, organised by Pat Thompson (USA), reflected many diverse approaches to research in statistics education at the school level: research related

to students, research related to teachers, research involving both teachers and students, and the overall relationship of research to the classroom. Dani Ben-Zvi described grade 7 students' cooperative work on a data assessment task in a computer-assisted environment following a carefully designed Exploratory Data Analysis course. Of interest were their formulations of research questions and hypotheses, and use and interpretation of data representations. One presentation that focused on research only on teachers' understanding was that by Jinfa Cai. He compared and contrasted twelve inexperienced and eleven experienced teachers' constructions of pedagogical representations for teaching the arithmetic average. Although the experienced teachers were better able to predict representations and errors common for middle school students, these were not more evident in their generation of lesson plans. Two studies reported on projects involving both teachers and their students. Silio Rigatti Luchini presented the results of a study involving 145 teachers and over 2000 students aged 6-10 in five Italian provences, with teachers attending a preliminary training course. Concept maps were used as a method of comparing student understanding before and after the teaching occurred. In the other presentation James Nicholson reported on a project where a number of teachers and students worked iteratively with materials being developed in areas such as Correlation and Regression, Sampling Methods, and Estimation. The aim was to produce materials to address conceptual difficulties occurring at the A-level (in the U.K.). Finally, Gail Burrill looked at the overall picture of the relationship of research to teaching at the school level, in particular in relation to the production of curriculum materials. Although indicating that progress has been made in some areas, she raised several questions that would help build a more coherent story for future use of research outcomes in the classroom.

Of the papers in Session 2D, *Innovative Statistics Curriculum Development and Research Projects at the School Level,* organised by Dani Ben-Zvi (Israel) three focused on the curriculum itself, one on the implementation of a new curriculum, and two on instructional issues. The CensusAtSchool project for students aged 7 to 16 was discussed by Doreen Conner. Based on a website in the UK, the project offers the opportunity for students to gather information about themselves and then become part of national and international (including Australia and South Africa) data bases. Annie Morin addressed the curriculum issues associated with statistics becoming a part of the mathematics curriculum at the school level, interdisciplinary projects being developed, and the increasing availability of computers. She felt the movement of topics downward from the tertiary level required a more precise definition of objectives and the ways to, and limits on, achieving them. Peter Holmes, on the other hand, reviewed the past 40 years of curriculum change with respect to school statistics. Mainly using experiences from the United Kingdom and the United States, he discussed the successes and the lessons to be learned for the future. One paper dealt with curriculum implementation. South Africa is about to introduce a new curriculum, which will include statistics education for the first time, and Delia North presented a plan to assist teachers who have little or no training in statistics. A pivotal aspect of the plan is that statistical training be developed according to the age of the learners, bearing in mind the mathematical tools at their disposal. One of the instructional presentations, by Gianfranco Galmacci and Anna Maria Milito, described the results of an Italian study of 6000 students at every school level and 338 teachers, comparing how different teaching approaches influenced the students' learning processes. The other paper on instruction, by Koeno Gravemeijer, presented an instructional design heuristic called "emergent modeling", with a sequence on data analysis as an example. Emergent modeling focuses on modeling as "organizing" and has a dual meaning, related both to the process by which models emerge, and to the process by which these models support the emergence of more formal knowledge.

The three papers in Session 2E, *Sociocultural Aspects of the Learning of Statistics at the School Level,* organised by Paul Cobb (USA), presented very different aspects of the sociocultural influences on statistical learning and understanding. Paul Cobb reported on a classroom design experiment where 12-year-old students developed identities as those who chose to engage in, saw value in, and viewed themselves as competent at developing data-based arguments. He also discussed the aspects of the design that supported this transition. Collaborative work was the focus of the report by Carolina Carvalho, which considered the encouragement of peer interaction during class. Analysis of excerpts of interactions was the methodology employed. Celia Hoyles and Richard Noss described the findings of a study of the ways paediatric nurses think about the notions of average and variation. Conclusions were drawn about ways that more general mathematical meanings are constructed and "transferred", taking into account both cognitive and sociocultural perspectives.

Overall the 21 papers provided a wide range of views and insights into the teaching and learning of statistics at the school level. The discussions following the presentations were often lively and many contacts were made for the future exchange of outcomes and ideas. Finally I would like to thank Lionel Pereira-Mendoza who began the organization of Topic 2 but had to withdraw part way through the process.

5.3. TOPIC 3. STATISTICS EDUCATION AT THE POST-SECONDARY LEVEL. Convenors: Gilberte Schuyten and Allan J. Rossman

Statistics is a crucial part of the education of students in many disciplines and is used by an ever increasingly number of people in the workplace. Statistics is studied maybe by more students at post secondary level than any other subject is. A wide variety of statistical contents and student audiences is covered at this level. The presentations at ICOTS-6 provided a representative sample of ways statistical contents and skills can be taught taking into account different backgrounds of students. Sessions were categorized by type of course, student audience, pedagogical approach, and statistical topic.

Session 3A, *Statistics as a Service Subject in First Level Courses* was organised by Beth Chance (USA). The last decade has seen a renewed focus on the introductory statistics course for non-statistics majors at the tertiary level. This "service course" has been infused with recommendations for active learning, conceptual understanding, real data, and effective use of technology. Instructors have aimed to make the course more interesting and accessible to students by connecting the material to their own majors and non academic experiences. Speakers in this session discussed recent innovations in statistics instruction aimed at making the course more relevant to a general audience. Particular attention was paid to experiences that allow students to apply their knowledge in a social or humanitarian context, and to how these experiences have impacted students' perception of the utility of statistics.

Session 3B, *Statistics as a Service Subject in Second Level Courses*: Teaching Regression Models was organised by Joachim Engel (Germany). Modeling functional relationships between two or more variables is a central topic of applied statistics. In this session various approaches were discussed to teach regression models. The focus was on teaching understanding and concepts of various regression models, not on mathematical details. The technological aspect of using modern software as a tool to promote understanding (e.g. through simulation) was also covered. Presentations dealt with 'Interpretation of regression output: diagnostics, graphs and the bottom line', 'Understanding regression', 'Accessible methodologies for estimating density functions' and 'Advanced topics for a first service course in statistics'.

Session 3C, *Statistics for Future Statisticians* was organised by Ann Cannon (USA). A major effort has been undertaken recently in the United States to identify what should constitute a major (first degree) and minor in Statistics. Participants in the discussion have included industrial statisticians (end-users) as well as faculty from a broad range of post-secondary institutions. The first speaker discussed the results of the Undergraduate Statistics Education Initiative (USEI) in the United States. The second and third speakers reported on the status of majors (first degrees) and minors on other continents.

Session 3D, *Statistics and Research Designs: An Integrated Approach*, organised by Glenys Bishop (Australia). Much current statistical education at the post-secondary level focuses on methods of data analysis and the use of statistical packages. Subject matter experts often teach research methods to upper undergraduates and beginning postgraduate students but their emphasis is less on the statistical validity of study designs as on their practicalities. The papers showed how the integrated approach can be used in teaching undergraduates or postgraduates, for experimental or survey or observational study designs. Presentations dealt with 'Experimental research in a statistical concepts course', 'Teaching statistics and research methods in a virtual learning environment', 'Improvement of teaching and use of statistics in Africa's Sub-Saharan countries: the example of Benin' and 'Statistics made alive'.

Session 3E, *Statistics Learning with Cases/Projects*, was oganised by Roxy Peck (USA). Speakers in this session described how case studies and/or projects have been integrated into statistics instruction at the post secondary level in innovative ways, and addressed the resulting impact on student motivation and learning. Presentations dealt with 'Case studies in the mathematical statistics course', 'Statistical investigations – Drawing it all together', 'Survey sampling: learning by doing. A twenty years graduate level teaching experience' and 'Projects for advanced undergraduates – Leaving the script behind'.

Session 3F, *Bayesian Statistics* was organised by Dalene Stangl (USA). Due to advances in numerical methods and computation, use of Bayesian methods is rapidly increasing both within the statistics profession as well as in substantive research areas. This is evidenced by a rise in publication of Bayesian-based statistics textbooks and a rise in publication of substantive research articles using Bayesian methods. Teaching of Bayesian methods in undergraduate courses must follow. Speakers discussed the ease and difficulty of teaching the Bayesian perspective and shared teaching resources with those interested in bringing Bayesian methods into their own courses.

Session 3G, *Nonparametric Methods,* was organised by Noel Veraverbeke (Belgium). The so-called nonparametric methods began some fifty years ago. Initially they aimed at distribution-free procedures, not requiring the restriction of a parametric model for the data. These methods are typically based on the ranks of the observations and turn out to be less computational and conceptually simpler than their parametric counterparts. In later years further important classes of nonparametric methods developed. It is also important to note that the ever more powerful computer packages greatly influenced the whole area of nonparametric statistics. Advantages and disadvantages were discussed and attention was given to the way the methods fit in the teaching of our statistics courses. Presentations dealt with 'The teaching and practical implementation of the nonparametric bootstrap', 'A short introduction to nonparametric curve estimation', 'Visual basic applications and spreadsheet for teaching estimation of nonparametric density and regression functions' and 'Tests for interaction in a two-way layout: Should they be included in a nonparametrics course?'

Session 3H, *Teaching Consultancy Skills to Statisticians* was organised by Gabriella M. Belli (USA). Some ways that consultancy skills may be acquired is via formal coursework, mentorships, job training programs, by working jointly with faculty consultants, by informal training or observation, or simply through one's own experience. The papers in this session focused on various aspects of preparing students for statistical consultancy.

Session 3I, *Statistics for Future Teachers* was organised by Graham Jones (USA) and Zakayo Msokwa (Tanzania). In response to the critical role that information and data play in our technological society, there have been international calls for reform in statistics education at all grade levels of the school mathematics curriculum. If this reform is to be successful, prospective teachers of elementary, middle, and high school grades need to be equipped with the content and pedagogical knowledge to teach data handling effectively.. Speakers in this session presented and discussed innovative programs in statistics education for prospective teachers of elementary, middle and secondary school.

Session 3J, *Statistics for Future Health Care Professionals*, was organised by Tom Short (USA). Health care professionals must balance competing demands in addition to their primary concern of patient care. This session brought leading educators from a variety of health care education contexts together to share their views on training future health care professionals. Presentations dealt with 'Making statistics relevant for undergraduate nurses', 'From testing to decision-making: changing how we teach statistics to health care professionals', 'Usage of medical journal articles in biostatistical training for residents' and 'Intensive short-courses in biostatistics for fellows and physicians'.

Session 3K, *Sampling for Surveys*, was organised by Alan H. Welsh (Australia).The image of sampling conveyed by many books and courses is of a dry, turgid subject beloved by pedants. The content often seems like an unconnected set of topics characterised by clever but apparently ad hoc methods. In fact, sample surveys are an exciting, important area of statistics in which all the statistical issues appear – how to collect data, how to analyse data, how to interpret data, appropriate frameworks for inference, conflicting paradigms etc. So how can we teach basic sampling with verve and style? The talks in this session explored different approaches to answering this question. Presentations dealt with 'Training professionals in survey sampling', 'Use of mini-projects in the teaching of survey sampling', and 'Survey training for official statisticians in Brazil'.

Session 3L, *Multivariate Statistics,* was organised by John Harraway (New Zealand). As well as discussing some of the more recently developed multivariate techniques, this session included series of papers highlighting the breadth of application by covering methodology and data from such diverse areas as epidemiology, ecology, environmental science, marketing research and the social sciences. For each of these subjects, interesting recent data sets were presented. Presentations dealt with 'Multivariate methods for ecology and environmental science', 'Hierarchical linear models for the analysis of longitudinal data with applications from HIV/AIDS program evaluation' and 'Making multivariate interesting and fun for students'.

Session 3M, *Hypothesis testing* was organised by Alan McLean (Australia). The title of papers were: 'Hypothesis testing in psychology: throwing the baby out with the bath water?', 'Statistacy: vocabulary and hypothesis testing', 'Hypothesis tests, confidence intervals, and common sense' and 'How significance tests should be presented to avoid the typical misinterpretations'.

Session 3N, *Teaching Categorical Data Analysis* was organised by Michael Campbell (UK). Categorical data are traditionally analysed by the chi-squared test, one of the first statistical tests to be developed in the history of statistics. Since then there has been considerable work on other models to describe categorical data, including ordinal, polytomous, continuation ratio, stereotypical and Row and Column models. However understanding the consequences and usefulness of these models has still some way to go. The following papers were presented:

'Teaching categorical data analysis', 'Teaching statisticians and applied researchers statistical methods for analysis of data from rating scales' and 'Teaching statistics on-line: our experiences and thoughts'.

Session 3O, *Statistics for the Actuarial Syllabus*, organised by Jacky Galpin (South Africa). Much of the content of the actuarial syllabus is made up of statistical materials, and is generally taught by statisticians and not actuaries. Recent changes to the actuarial syllabus have required the teaching, at undergraduate level, of material normally taught at postgraduate level. This session presented some aspects of these issues. Presentations dealt with 'Plan member risk and the defined contribution pension plan', 'Net value and ruin theory by spreadsheet', 'Teaching stochastic calculus to the 3rd year students' and 'Teaching statistics to the modern actuary'.

5.4. TOPIC 4. STATISTICS EDUCATION/TRAINING AND THE WORKPLACE. Convenors: Carol Joyce Blumberg and René H.M. Smulders.

Session 4A, *Making Statistical Consulting and Technical Co-operation More Effective was* organised by Jean-Louis Bodin and chaired by Bart Meganck. Koffi N'Guessan described the various training programs that ENSEA carries out for individuals mainly from French-speaking countries in Sub-Saharan Africa. Carmen Arribas discussed the training courses, seminars, workshops, etc. in Spanish, held both in Spain and in Latin American countries, for professionals working at National Statistical Offices, Central Banks, Ministries of Planning and the other institutions producing the official statistics of the countries in the region.

Session 4B*, The Role of National and International Statistics Organisations in Improving Statistical Knowledge in the Workplace* was organised and chaired by Marcel Van den Broecke. Bart Meganck focused on the learning of statistics in the context of Eurostat's role in developing statistical programmes and the transfer of statistical knowledge for the implementation of monetary union in Europe. The paper by Madge Haven and Madhuri Mulekar presented by Carol Joyce Blumberg described the ASA's publications in the area of statistics education, its activities at the primary and secondary school levels, its role in statistics education at the post-secondary level, and its varied continuing education activities. Daniel Berze gave a historical overview from 1945 until the 1991 creation of the IASE, with particular reference to the ISECs in Calcutta and Beirut and the activities of the ISI Statistical Education Committee.

Session 4C, *Training of Official Statisticians* was organised and chaired by Denis Farrell. Bradley Payne, Peter Holmes and Neville Davies described the development and implementation in Malawi of a course in Key Statistical Skills for clerks parallel to the Ordinary Certificate in Statistics of the UK's Royal Statistical Society. Pilar Martín-Guzmán commented on how the de-centralisation of a country's statistical system, the globalisation and worldwide need of harmonisation of statistical systems, and the increasing number and variety of users influence the training of official statisticians. Ruslan Motoryn described how his University trains students in both the international and national standards of national accounts needed for a market economy.

Session 4D, *Distance Learning* was co-organised by Lea Bregar and Irena Ograjenšek (Slovenia) and chaired by Irena Ograjenšek. The first paper was 'Statistical Education and the Workplace: Present State of Affairs and Future Challenges' by Lea Bregar, Irena Ograjenšek and Mojca Bavdaž Kveder. The paper focused on the question how modern information and telecommunication technology, including distance learning, can increase the quality and efficiency of statistical training at the workplace from the learners' point of view. The second paper was 'Experiencing Statistics at a Distance' by W. Robert Stephenson (Iowa State University, USA). He discussed how a two-semester sequence of distance education courses in Applied Statistics for Industry for managers and engineers in the workplace incorporates the use of videotapes, practical experiences and other activities. The third paper was 'Just-in-Time Network-Based Statistical Learning: Tools Development and Implementation' by Lea Vermeire, An Carbonez, Paul Darius (Katholieke Universiteit Leuven, Belgium) and Jill Fresen (University of Pretoria, South Africa). The paper reported on their work in short-course and in-company training in statistics, with special attention given to a self-study course for a government department and a system of highly interactive applets for visualisation of statistical concepts related to the linear model. The paper 'From Online Learner to Online Teacher' by Sharon Copeland-Smith (Swinburne University of Technology and Multimedia, Australia) was not presented orally, but is in the Proceedings.

Session 4E-1, *The Use of Census Material in Statistics Teaching* and Session 4E-2, *The Interface Between Official Statistics and University Teaching* were organised and chaired by Sharleen Forbes (Statistics New Zealand, New Zealand). Session 4E-1 began with the presentation by Maria-Gabriella Ottaviani (University of Rome "La Sapienza", Italy) of the paper 'The Italian Census at School' by Cristiana Conti (Italian National Statistical Institute (ISTAT), Italy) and Enzo Lombardo (University of Rome "La Sapienza", Italy) and the

presentation by Lesley Hooper (Statistics New Zealand, New Zealand) of her paper 'Making Census Count in the Classroom'. Both papers briefly discussed the history and mechanics of the Censuses of school children carried out in their respective countries. They also described the various materials and websites that the national statistics offices developed for use by teachers and students relating to Censuses. The Session continued by having the audience ask questions of a panel chaired by Lesley Hooper and consisting of Maria-Gabriella Ottaviani, Sharleen Forbes, Reinie Cordier (Statistics South Africa, South Africa) and Doreen Connor (The Nottingham Trent University, England), who have all been involved in Censuses involving children.

The first paper in Session 4E-2 was 'The Use of Official Statistics in Teaching University Geography Students in Italy' by Enrica Aureli and Riccardo Russo (University of Rome "La Sapienza", Italy). This paper discussed the statistical methods and tools taught at the upper level in the geographical disciplines at Italian universities and described some selected postgraduate courses. The second paper was 'Teaching Official Statistics in an Irish University Statistics Department' by Patrick Murphy (University College Dublin, Ireland). His paper outlined the development of a new course in Official Statistics for undergraduate students at his University that can easily be adapted for use elsewhere. The final paper in this session was 'Development of Customer Oriented Learning Environment at Statistics Finland' by Reija Helenius (Statistics Finland, Finland). This paper described how training in the use of statistical information for users from various governmental and non-profit agencies is continuously being developed by Statistics Finland and discussed, as an example, Statistics Finland's web-based-learning project.

Session 4F, *Statistical Training and Education of Lawyers, Judges, Doctors, Researchers, and Other Professionals* was organised by Elisabeth Svensson (Örebro University, Sweden). The only paper presented orally from this session was 'Cramming for Court: Teaching Statistics to Litigators' by Mary Gray (American University, USA), whose actual presentation was combined with those in Session 4H. The paper gave guidelines for statisticians, who are preparing lawyers to effectively present and to cross-examine witnesses presenting statistical evidence during court trials, based on her experiences as a lawyer and as a statistician. The papers 'Statistical Training for Doctors in the UK' by Michael Campbell (University of Sheffield, UK) and 'Teaching Statistics to Medical Doctors through Research Methods: A Case of Medical Education Research in Iran' by Abbas Bazargan (University of Tehran, Iran) are available on the Proceedings CD.

Session 4G, *Preparation and Training of Workers in the 21st Century* was organised and chaired by Albert Shulte (recently retired from Oakland County (Michigan) Schools, USA). The first paper was 'Statistical Education and Training for Workers of the Public Administrations: Objectives, Issues, Strategies' by Luigi Biggeri (Italian National Statistical Institute (ISTAT), Italy) and Alberto Zuliani (University of Rome "La Sapienza", Italy). The paper focused on (i) the need for quantitative skills for public administration management and personnel; (ii) how to define the objectives of the education and a plan of training; and (iii) the strategies, issues and evaluation of some specific experiences. The second paper was 'Preparing Workers for the 21st Century: The Importance of Statistical Competencies' by Beverley Carlson (United Nations Economic Commission for Latin America and the Caribbean (ECLAC), Chile). This paper discussed the need to generate more meaningful statistics about the workings of the rapidly changing labour market and the interplay between the supply of skilled manpower and the statistical competencies required by employers, and how to use of this information to improve the teaching of statistics at all levels. The third paper was 'Statistics – Driving Success or Blocking the Road?' by Stephen A. Zayac (Ford Motor Company, USA) and a summary of it was given by Albert Shulte. This paper discussed statistical training needs from the viewpoint of someone in industry. The final paper in this session was 'Would you Allow Your Accountant to Perform Surgery? Implications for Education of Primary Teachers' by Lionel Pereira-Mendoza (National Institute of Education, Singapore). This paper discussed the issues related to statistical knowledge as it applies to primary teachers, since most teacher education programmes for primary teachers include mathematics education courses, but do not specifically address statistical education.

Session 4H, *Educating Managers, Executives, Politicians, Government Officials and Other Decision Makers* was organised by Theodore Chadjipadelis (Aristotle University, Greece) and chaired by Elisabeth Svensson (Örebro University, Sweden). The first paper was 'Using Statistics as a Tool in Political Research: The Case of Electoral Behavior' by Theodore Chadjipadelis (Aristotle University, Greece). This paper discussed the problems of using statistical techniques in the political sciences by following and commenting on the phases of observation of electoral behaviour. The second paper was 'Statistics Education for Future Managers: Needs, Obstacles, Possible Solutions' by Corinne Hahn (ESCP-EAP and NEGOCIA, France) and Patrick Dassonville (ESCP-EAP, France). This paper gave examples of the types of on-the-job problems future managers are likely to meet and discussed the difficulties and some possible solutions when teaching statistics in management schools. The third paper was 'International Statistics for Public and Private Decision Makers: New Tools to Improve the OECD

Communication Policy' by Enrico Giovannini (Organisation for Economic Co-operation and Development (OECD), France). This presentation discussed OECD's "new vision" for its statistical activities, including the development of a new statistical information system and the system's implications for the training of private and public decision makers.

Session 4I, *Statistical Training and Education in Environmental Settings* was co-organised by María Virginia López and María del Carmen Fabrizio (University of Buenos Aires, Argentina) and chaired by María del Carmen Fabrizio. The first paper was 'Factors Affecting Performance in a University Service Course on Biostatistics: An Update' by John A. Harraway (University of Otago, New Zealand). His paper reported that there were no differences in marks received in university level Biostatistics between those students who had mathematics with calculus and those who had mathematics with statistics in secondary school, nor were differences found by gender. The second paper was 'Role of Statistics in the Education of Agricultural Science Students' by Katarina Cobanovic (University of Novi Sad, FR Yugoslavia). This paper described the author's experiences of teaching statistics in the Agricultural Faculty at her University with discussion of problems and dilemmas encountered and some solutions. The third paper was 'The Status of Statistics in Agricultural Studies: An Epistemological Approach' by María Virginia López, María del Carmen Fabrizio, María Cristina Plencovich, and Hernán Giorgini (University of Buenos Aires, Argentina). This paper described the results of a survey of 23 Argentine universities with agriculture programs that obtained information, using various indicators, about the insertion of Statistics into the university programs and explored the epistemological ideas underlying in the teaching of Statistics in agricultural schools. This paper was a replacement at the co-convenors' request for a withdrawn paper. It is not in the *Proceedings* and can be obtained from María Virginia López at mvlopez@mail.agro.uba.ar.

Session 4J, *Practical Training in the Workplace for Tertiary and Postgraduate Students* was organised by Katherine Taylor Halvorsen (Smith College, USA) and chaired by John McKenzie (Babson College, USA). The first presentation was 'Internships for Undergraduate Statistics Majors: The BYU Experience' by Lara Wolfson (Brigham Young University, USA). She discussed how BYU has prepared students for internship experiences, how BYU has created an academic tie-in with students' internship experiences and various partnerships with employers (Note: This paper is not in the *Proceedings;* a copy of the PowerPoint presentation is available from ljwolfson@byu.edu). The second presentation was 'Statistics Education and Bulgarian Management Training Institutions Development Project' by Nadezhda Tsankova (University of Veliko Turnovo 'St. Cyril and St. Methodius', Bulgaria). In the paper she introduced the general aims and objectives, methodology, and specific outcomes of an investigation of students' opinions of the Project, with a focus on the "Statistics in Internet" distance-learning module. The third presentation was 'An Internship Program at a Liberal Arts College' by Katherine Taylor Halvorsen (Smith College, USA). She described the new internship program at Smith College, how students find internships, and how the College prepares students for internships (Note: This paper does not appear in the Proceedings; a copy of the PowerPoint presentation is available from khalvors@email.smith.edu).

Session 4K, *Training of Institutional Research Professionals* was organised and chaired by Amanda Lourens (Technikon Pretoria, South Africa) as President of the South African Statistical Association (SASA) and as Vice-Chairperson of the South African Association of Institutional Research (SAAIR). The first paper was 'Training Institutional Research Professionals' by Gerald W. McLaughlin (DePaul University, USA) and Josetta S. McLaughlin (Roosevelt University, USA). Their paper focussed on training, with specific attention to the various roles of an institutional research professional, the statistical and analytical tools used to perform tasks, and the need to teach others to use and interpret statistical results. The second paper was 'Promoting Statistics Literacy: New Opportunities for the Training of Institutional Research Professionals' by Linda Hewitt (Centre for Interdisciplinary Research and Development, Trinidad and Tobago). This paper examined the existing functions and areas of operations with respect to institutional research, as well as the challenges surrounding the new and emerging demands for statistics and indicators in the 15 member states of the Caribbean Community (CARICOM) region. The third paper was 'Training Institutional Research Professionals: Teaching a Statistics Course in Six Hours or Fewer, The Art of Teaching' by Mary Ann Coughlin (Springfield College, USA). This paper focussed on the difficulties that are associated with teaching statistical content and skills in professional development settings and discussed various pedagogical approaches designed to increase statistical understanding. The final paper was 'Intriguing Facets of Institution Research' by Pieter J. Vermeulen (University of Pretoria, South Africa). This paper described how the strategies and solutions to problems encountered in institutional research differ substantially from those of the past, mainly due to the advancement of technology.

Session 4L, *Statistics Education and the Workplace: A Challenge for All (A Discussion and Informal Gathering)* was co-organised by Carol Joyce Blumberg (Winona State University, USA), Daniel Berze (ISI Permanent Office, The Netherlands), and René Smulders (Statistics Netherlands, The Netherlands) and chaired

by Carol Blumberg. The session began with 15 minutes of informal gathering. Sharleen Forbes (Statistics New Zealand, New Zealand) and Enrico Giovannini (OECD, France) then gave brief introductory remarks about the types of relationships needed in the future between statisticians in academic institutions, official statisticians, and statisticians in the private sector. Copies of their power-point presentations are available from Carol Blumberg at cblumberg@winona.edu. The remaining 40 minutes of the session were spent in audience discussion, with many ideas generated for as to how individuals, as well IASE and ISI, can help foster interaction between statisticians in academic institutions and those in the public and private sectors. One suggestion is already being implemented by IASE as part of the International Statistical Literacy Project.

5.5. TOPIC 5. STATISTICS EDUCATION AND THE WIDER SOCIETY. Convenor: Helen MacGillivray

It is reported that H.G. Wells once said that "Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write." The statistical sciences provide the underpinning for the analysis and communication of quantitative information involving variation, across all areas of society. Possibly more than for any other discipline the interaction between statistical developers, users and recipients needs to closely influence and be influenced by, statistical education at all levels, recognising that life-long learning is not just a cliché in statistics and that statistical understanding is a key enabler across modern society.

The sessions in this topic aimed to explore the multi-faceted interactions between statistical education and the roles of statistics in key aspects of society. It is both a strength and weakness of the statistical profession that statisticians work in highly diverse and dispersed areas and workplaces, working with professionals in many and varied other fields. The challenges of this for the professional societies, continuing professional development, statistics education and accreditation, formed the theme of session 5D, organised by Neville Davies. Derek Pike's cogently argued and persuasive paper on the importance and relevance of the continuing professional development process to ensure maintenance of professional standards, also sought to foster ongoing constructive debate between academic and commercial statisticians. Brian Phillips' paper on the roles of the IASE was complemented by the paper (Neville Hunt, Flavia Jolliffe, Neville Davies) on the role of the Royal Statistical Society in shaping statistics education in the UK and beyond, while Pali Lehohla's paper on a South African perspective on promoting statistical literacy illustrated society's need for broad-based statistics awareness raising programs.

The impact of information technology on statistics and statistics education has already been enormous, continues to grow, and takes many forms. Software and visualisation are integral to both the practice of, and education in, statistics. Mike Fuller's paper in Session 5F, organised by Gianfranco Galmacci, moved from this to considering the extent to which statistics curricula can adapt to changing opportunities generated by ICT, and the potential for use of statistical ideas in computer science education. Ewan Crawford and Adrian Bowman's paper (presented by Ewan) gave valuable insights to the extent to which ICT can support resources, networking and information sharing in statistics education, discussing the range of associated organisational challenges and opportunities.

The world of health and life sciences (Session 5G, organised by Petter Laake) also has many challenges and opportunities for statisticians and statistics education, in both traditional and emerging fields. This was reflected by the variety of papers in this session, and their emphasis on close interaction with user areas. Bradley Payne, Nick Merryfield and David Griffiths reported on the first ever survey of the UK medical sales field force, demonstrating a new interrogation tool to facilitate analysis. Nibia Aires considered the advantages and disadvantages of teaching classic methods in the post-genomic era. Ivar Heuch discussed the balances required in statistics training that are taken into the practical challenges of epidemiological data, and Penelope Pekow reviewed experiences in teaching biostatistics within an exchange program between the Medical University of South Africa and the University of Massachusetts.

Like mathematics, statistics has the qualities and duties of transferability and enablement. And mathematics itself across all its levels, is an enabler for statistical understanding, development and hence education. In session 5A, organised by Brian Greer, Jeff Evans discussed how tracing the development of concepts of affect and emotion in mathematics education research is informative for research on teaching statistics. The other three papers considered the interaction between aspects of mathematics and statistics education. Michael Bulmer discussed the development of a computer-based version of concept maps in teaching statistics, giving an interactive concept map with a narrative. Joachim Engel considered activities incorporating statistical concepts and mathematical foundations, and Jerry Moreno presented some insight into the NSF-funded project Data-Driven Mathematics which motivates mathematics topics from a data point of view.

The papers in Session 5B, organised by David Griffiths, illustrated the question of whether statistics education is a discipline in itself or in association with the contexts of user areas. Nye John and David Johnson's paper on teaching managers to think statistically, Dennis Pearl's paper on using health science examples to create statistical understanding for a diverse group of students in a variety of majors, and Brian Greer's paper on teaching the essential rationale of statistical methods in psychology, led to a brief but lively discussion of experiences across the areas.

In the wide worlds of business, government and engineering, statistical education at all levels is not only increasingly important but also benefits greatly and often unexpectedly from constant interaction with statistical usage and real problems. Session 5C, organised by Eric Sowey, considered just some aspects of the business and government sectors. Richard Madden's paper (presented by Ching Choi) used topical examples from official statistical agencies to draw some important messages for teaching statistics in practical and ethical issues. Jonathan Cryer reviewed the effects of the 17 annual US Conferences to date on Making Statistics More Effective in Schools and Business, and Gerald Goodall and Derek Pike focussed on defining relevant continuing professional development objectives and materials in the diverse areas of business and government.

All speakers in Session 5D, organised by Helen MacGillivray, emphasized the importance of statistics in the engineering world and the challenges of both engaging the students and facilitating their development of both statistical literacy and specific statistical skills under the pressures of an engineering course. Richard Wilson's and Stephen Vardeman's papers both focussed on the need to connect with engineering environments and thinking whether in a first or second course. The student perspective from James Moody, Australia's Young Engineer of the Year, emphasized the dual needs of general and specific statistical underpinning for engineering students, and Neil Diamond discussed how to distil valuable teaching tools from real and sometimes complex consulting problems.

Session 5H, organised by Jacky Galpin, after hearing from Eric Sowey on educating statisticians to enhance their future clients' statistical understanding, from Jacky on the integrating social issues such as HIV/AIDS, and from Swapna Mukhopadhyay on connecting with socially sensitive and important issues such as gun violence, incorporated a most interesting and lively audience and panel discussion on social issues and statistics education. In many ways, this discussion epitomised the theme of Topic 5, with all speakers contributing to a rich variety of aspects of the challenges, opportunities and needs in the interaction of statistics education with the wide areas of society it underpins, serves, and is enriched by.

5.6. TOPIC 6. RESEARCH IN STATISTICS EDUCATION. Convenors: *Joan B. Garfield and Carmen Batanero*

Research in statistics education is a priority area for IASE, since a well-developed research literature and research agenda are essential for promoting the field of statistics education. In this particular ICOTS meeting we paid particular attention to the development of statistics education research, examining current research problems, directions for future areas of inquiry, and the use of theoretical models on which our research might be based. In addition to including sessions on teaching and learning statistics and probability we focused sessions on research related to assessing student outcomes, the role of technology in learning statistics as well as in conducting research on student learning, and on the conceptions and beliefs of statistics teachers.

Session 6A, *Developing Statistics Education Research* was organised by Mike Shaughnessy (USA). Presentations dealt with 'Creating cognitive conflict in a controlled research setting: sampling' (Jane Watson), 'Students' individual and collective statistical thinking' (Edward Mooney and Cynthia Langrall), 'Assessing and tracing the development of Basotho elementary students' growth in probabilistic thinking' (Victor Polaki), 'Framework for teacher knowledge and understanding about probability' (Tova Kvatinsky), and 'Students' understanding of variability in a probability environment' (Mike Shaughnessy).

Session 6B, *Theoretical Models of Statistical Knowledge, Thinking, Reasoning and Learning* was organised by Maxine Pfannkuch (NZ) and Chris Wild (NZ) and included the following presentations: 'Studying the median: a framework to analyse instructional processes in statistics education' (Juan Godino), 'The development of a framework characterizing middle school students' statistical thinking' (Cynthia Langrall and Edward S. Mooney), 'How students experience learning statistics and teaching' (Peter Petocz, Anna Reid) and 'Statistical thinking models' (Chris Wild).

Session 6C, *Technology and Research in Teaching and Learning Statistics* was organised by Erica Morris (UK) and chaired by Juan Godino (Spain). Presentations dealt with 'The role of computer based technology in developing understanding of the concept of sampling distribution' (Kay Lipson), 'The statistical re-education of Psychology' (Geoff Cumming), and 'Comparison of multimedia educational materials used in an introductory

statistical methods course' (Richard Alldredge).

Session 6E, *Teachers' Training, Conceptions and Beliefs,* was organised by Lisbeth Cordani (Brazil). Papers on 'Probability and statistics in elementary school: a research of teachers' training', (Celi Espansadin), 'Teacher's training in a statistics teaching experiment' (Linda Gattuso) and 'Investigating the 'data sense' of preservice teachers' (Tim Burgess) were presented.

Session 6F, *Research into Teaching and Learning Statistics at Tertiary Levels* was organised by Flavia Jolliffe (UK) Presentations dealt with 'Modelling students' learning of introductory statistics' (Dirk Tempelaar), 'Choosing to study independently - when is it a bad idea?' (Glenda Francis), 'Evaluating the impact of multimedia lectures on student learning and attitudes' (Sterling C. Hilton), and 'Investigating patterns of interview conversations among lecturers in the Malaysian institutes of higher learning on the teaching of statistics at the introductory level' (Zamalia Mahmud).

Session 6G, *Research into Teaching and Learning Probability* was organised by Antonio Estepa (Spain). Presentations dealt with 'Teaching probability and statistics to 10 years old children' (Marie Berrondo), 'On the use of paradoxes in the teaching of probability' (Talma Leviatan) and 'Misconceptions in probability' (Lin Ju and Lionel Pereira-Mendoza).

Session 6H, *Round Table Discussion: Major Problems and Directions in Statistics Education* was organised Joan Garfield (USA) and Carmen Batanero (Spain) and chaired by Lisbeth Cordani (Brazil). Different graduate training programs for statistics education research were presented by Mike Shaughnessy and Carmen Batanero and debated by Gabriella Ottaviani.

5.7. TOPIC 7. TECHNOLOGY IN STATISTICS EDUCATION. Convenor: *Laurence Weldon*

This topic explored the way in which teaching and learning of statistics has changed as a result of modern technologies. In particular, animations based on Internet browsers which operate an many platforms have brought some unity to a field that has been quite disorganized. Moreover, the ease of distributing these animations to students for their interactive use has added interest and effectiveness to online education. Some products that were originally designed for distance education are now being used in the classroom - the effort needed to prepare these is great but widespread use makes them feasible. The sessions of this topic focused on these Internet technologies but will include other computer-based technologies as well.

Session 7A, *Java-Based Instructional Packages* was organised by Doug Stirling (New Zealand). Presentations dealt with 'Java applets and multimedia catalogues for statistics education', 'Applets for experimenting with statistical concepts' and ´Interactive content in web pages to teach statistics'.

Session 7B, *Computer-Based Demonstrations of Statistical Phenomena*, was organised by Andrej Blejec (Slovenia). Presentations were: 'Computer modules for teaching statistical concepts', 'Teaching statistical concepts with simulated data' and 'Hands-on survey research in a virtual environment'.

Sessions 7C, *Using Technology for Statistics Education in Engineering*, was organised by David Bacon (Canada) and there were discussions about 'Learning statistics in an engineering curriculum', 'Technology, statistical thinking and engineering students and 'Teaching experimental design to engineers: some experiences and advice'.

Session 7D, *Using Graphics Calculators in Statistics Education,* was organised by Kay Lipson (Australia) and included the following papers: 'Simulation as a tool to develop statistical understanding', 'Simulating experiments with the graphic calculator TI 83plus' and 'Teaching statistics with TI 83'.

Session 7E, *Statistics Education and the Internet*, was organised by Joe Wisenbaker (USA). Presentations dealt with 'St@tnet, an internet based software for teaching introductory statistics', 'News - groups and teaching statistics. Are they useful?' and 'A personal journey toward a virtual introductory statistics course: not (quite) ready for prime time'.

Sesion 7F, *Research-Based Design and Use of Software for Teaching Statistical Concepts* was organised by Cliff Konold (USA) and Bill Finzer (USA). Papers were 'Route-type and landscape-type software for learning statistical data analysis', 'Technology, statistics, and subtleties of measurement: bridging the gap between science and mathematics' and 'The Fathom experience—is research-based development of a commercial statistics learning environment possible?

Session 7G, *Software Tools Designed for Statistics Education* was organised by Rodney Carr (Australia). Presentations were: 'Using Excel to teach statistics in New Zealand secondary schools', 'A data analysis tool that organizes analysis by variable types', 'Using Fathom to promote interactive explorations of statistical concepts' and 'Live figures: interactive diagrams for statistical understanding'.

5.8. TOPIC 8. OTHER DETERMINANTS AND DEVELOPMENTS IN STATISTICS EDUCATION. Convenor: *Philip J. Boland*

Statistics is a very broad discipline encompassing so many areas of practical application. Don't we know that everyone needs to learn (and be taught) Statistics? The purpose of a topic on Other Determinants and Developments in Statistics Education at the ICOTS meetings is to include sessions which address special aspects of teaching statistics, but which do not necessarily fall under one of the main conference themes. Generally this topic is open to novel and sometimes-controversial sessions, and at ICOTS-6 there were five such sessions of a very high calibre.

Robert Delmas organised a session (8A) on *Learning Factors in Statistics Education*, although he was not able to actually attend the conference himself. In the session, Carl Lee made an interesting presentation on the issue of motivation and expectations in introductory statistics courses, while Verena Nolan discussed the influence of attitude, knowledge of English and mathematical ability in a course on quantitative techniques.

Kay McClain organised and spoke in a very interesting session (8B) on *Data Analysis and Statistical Learning*. Kay provided an analysis of a teacher development experiment, in which she concluded that the learning trajectory for the teacher's activity paralleled that of the students. Cliff Konold made an excellent presentation on how students use a "modal clump" in trying to express both the average and spread of a set of data. Katie Makar discussed the statistical thinking of teachers in analysing their own students' data.

Jerry Moreno chaired and organised a very interesting session (8E) on *Projects and Poster Competitions in Statistics Education.* A most interesting selection of posters from the American Statistical Association's annual poster competition was given by Linda Quinn. Loi Soh Loi discussed the impact of final year projects in a Singapore university business school. Saleha Naghmi Habibulluh spoke on her experience over many years in organising (national and international) statistical competitions and exhibitions in Pakistan. Susan Starkings gave a very nice presentation on the use of statistical projects as part of the secondary school curriculum in the UK.

Given the need to convey the importance of statistics to the general public, it was very appropriate to have Shen Shir Ming organise a session (8F) at this ICOTS-6 on *The Mass Media and Statistics*. Martin Podehl gave a fascinating presentation on the efforts of the National Statistical Office of Canada to co-ordinate with the news media on informing the public about social and economic issues. Yuen Ying Chan spoke on the role of statistics in journalism education.

Mbulaheni Nthangeni organised a session (8G) on *Teaching Statistics to Second-Language Students*, where Renette Blignaut and I. M. Vente gave a paper on Statistics Teaching Enhanced by Teamwork.

5.9. TOPIC 9. AN INTERNATIONAL PERSPECTIVE FOR STATISTICS EDUCATION. Convenor: *Vitalis Muba*

Session 9A, *Statistics Education in African Countries*, was organised by Fayez Mina (Egypt). Reda Mosad El-Said Asar presented 'An experimental approach for teaching statistics in the Egyptian schools', John W. Odhiambo spoke about the 'Teaching of statistics in Kenya'. Jules J.S. de Tibeiro presented the paper: 'Is it reasonable to teach statistics without probability or probability without statistics?' and Fayez M. Mina discussed 'Some features of future statistics education'.

In Session 9B, *Statistics Education in Spanish-speaking Countries*, organised by Teresita Teran (Argentina), Antonio Estepa summarised the state of stochastic education in the Ibero-American countries.

The following papers were presented in Session 9C, *Statistics Education in Asia*, organised by Ann-Lee Wang (Malaysia). Louisa Lam talked about the changes in the statistics syllabus and the way it is taught in schools in Hong Kong. She also discussed the implication of the way statistics is taught in schools. R. P. Suresh explained the academic background of students taking the Post-Graduate Diploma in Management in the Indian Institute of Management Kozhikode. He gave an illustration of how case studies may be used to teach probability concepts to these students. Y. Zhang gave a review of the development of statistical education at the tertiary level in China. The number of students taking the various types of statistics courses were touched on. He concluded by saying that statistical education is expanding in China.

5.10. CONTRIBUTED PAPERS AND POSTERS. Convenor: *Susan Starkings*

Over 50 interesting papers were submitted to the contributed paper section of the ICOTS 6 conference held in South Africa. The papers were grouped under the following headings:

- Teaching and Learning Statistics Using Electronic Media
- Concepts in Teaching Statistics
- Assessment in Statistics
- Statistics Education for Teachers
- Teaching Statistics at University
- Research into Teaching and Learning Statistics
- Teaching School Children Statistics

It is evident from the contributed sessions that authors have a great deal of knowledge and expertise in the area of statistical education. The diversification, of the papers presented, and the imaginative ways in which the authors have constructed these papers is commendable. Some interesting discussions should emerge as result of the papers presented.

The papers submitted advocated the teaching of statistics as a practical application that linked statistics to a student's everyday life. This entailed students collecting and generating data relevant to their daily interests and experiences and then using these data to construct and test hypothesis. Several authors provided research evidence to support new methods of teaching the subject. The use of technology now plays a prominent role, in the papers submitted, with interesting and novel ways of using this technology to enhance learning being demonstrated. Numerous practical examples were elucidated for every level of statistics being taught in educational establishments.

The common themes that emerged, from these papers, were the use of topical and relevant examples; that technology should be used as a tool for data analysis, and that the use of various instructional techniques is beneficial to both teachers and students alike. To sum up, contributors agreed that the learning of statistics should be achieved through doing real life practical problems that bring theory into practice.

POSTERS. Convenor: Andrew Dale

A total of 25 posters were on show during the conference – amongst them three posters by South African school children. The children presented their posters on the Tuesday and thoroughly enjoyed the excitement of discussing their posters with the many interested delegates. The posters presented by the children were the winning entries in local statistics poster competitions run at a few schools.