Topic 7: Statistical literacy in the wider society
Convenors: Robert C delMas (United States), Sebastian Kuntze (Germany), Michiko Watanabe (Japan)
Abstract: A perennial ICOTS theme is our special responsibility to develop sustainable initiatives which enable citizens to lead and extend debates, in the media and elsewhere, on issues of inequality, crime, effects of smoking, use of alcohol, and support for societal preferences. This democratic imperative leads us to questions such as: How can we encourage people to want to engage in statistical learning? How can we contribute to subject-specific learning of relevant statistical knowledge? How do we enrich our under-standing of statistical literacy and methods by which it can be attained and sustained? These invited sessions seek to explore and enrich a variety of effective practices and interventions.

Session 7A: Statistical literacy beyond the classroom
Organizer: Carl Lee (United States)
Abstract: How do we engage people in the learning of statistical literacy beyond a typical classroom setting? What are innovative methods by which the knowledge and concepts learned will be sustained and [??] as an integral part of lifelong learning? This section welcomes papers addressing innovative methods and research work on teaching/learning statistical literacy beyond classroom. Some examples are methods for engaging adult learners, projects beyond classroom, serving learning involving communities, use of technology to engage students learning and using statistical literacy in global world and about the global world.

7A1: Statistical literacy for all
Presenter: Milo Schield (Augsburg College, United States)
Abstract: If statistical literacy is for all students, then we must teach them things they will use often in life. Students encounter statistics every day in graphs, tables and stories. They must read and interpret these statistics to make better personal decisions. They need to know whether a given statistic is weak or strong. How a statistically-unlikely event (winning two lotteries) can also be an expected event. They need to know what can influence a statistic or a statistically-significant result. Can they be influenced by bias, by context (what was taken into account), by confounding (what was not taken into account) or by the study assumptions (how groups are defined; how quantities are measured)? This paper presents the W. M. Keck Statistical Literacy course that focuses on statistics for life. This course has been taught online and includes a significant writing component. Student feedback is included.

7A2: Teaching Statistics for Critical Engagement Beyond Classroom Walls
Presenter: Lawrence Lesser (University of Texas at El Paso, United States)
Abstract: In today's age of "flipped" classrooms, it is all the more important to leverage opportunities to connect statistical concepts to the world beyond classroom walls. This can be done in many ways, such as service learning (e.g., my 2008 JSM paper), data collection, and engaging games/videos/podcasts that students can experience outside of a scheduled time and room. Examples range from elementary educa-tion (e.g., my featured lesson on a PBS-TV children's educational show) to adult education (e.g., my outreach work on lottery literacy includes papers, a lesson, song, and video). Also, social justice examples (e.g., my 2007 JSE paper) and cultural/diversity explorations (e.g., my 2010 ICOTS paper) offer students personally meaningful and potentially transformative opportunities to learn the importance and power of statistics for assessing, understanding, and changing inequities still persisting in society at large. Informed by literature on informal science education, we offer framework and recommendations for statistics education.

7A3: Taking statistical literacy to the masses with YouTube, blogging, Facebook and Twitter
Presenter: Nicola Ward Petty (Statistics Learning Centre, Christchurch, New Zealand)
Abstract: Social media enables us to connect with the world, but YouTube, Twitter, Blogging and Face-book remain a mystery to many. Statistics Learning Centre YouTube channel has short friendly videos

about statistics and receives about 1000 views a day from all over the world. The blog, Learn and Teach Statistics and Operations Research, receives 2000 hits per week, which has grown through email lists, Twitter, Facebook and judicious choice of topics, keywords and tags. In this session I will describe the growth of each of these endeavours, explaining how to get started and providing pointers for reaching out with the message of statistical literacy to a wider society.

Session 7B: Statistical literacy requirements for teachers

Organizers: Sebastian Kuntze (Germany) and Ute Sproesser (Germany)

This session aims at casting light on studies about requirements for teachers related to statistical literacy. To foster statistical literacy in their students, teachers need specific content knowledge and pedagogical content knowledge. Moreover, other variables such as epistemological beliefs, convictions and instruction-related views may play a role when teachers design or frame learning opportunities to develop statistical literacy. As emphasized also in the joint ICMI/IASE study, there is a substantial need for empirical research into such requirements for teachers. To this end, several research interests will be in the scope of this invited session, such as research looking at the impact of teacher variables on the learning process and learning outcomes of students; theoretical approaches that specify requirements for teachers related to statistical literacy; research into the design and evaluation of in-service and pre-service teacher professional development activities.

7B1: Statistical literacy requirements for teachers

Presenter: Brian Beaudrie (Northern Arizona University, United States)

Abstract: This paper examines the relationship between statistical literacy in a broad sense and international teacher preparation and student learning standards pertaining to statistics. This paper will begin with a discussion of why statistical literacy is essential in today's society and the consequences, on an individual and societal level, of not being statistically literate. Since teachers should play a primary role in developing statistical literacy, the authors present an examination of teacher preparation and student learning guidelines from multiple countries in the area of statistics. The authors present conclusions regarding the alignment between societal statistical literacy requirements and teaching and learning guidelines. Recommendations for statistical literacy requirements for generalist and subject-specific teachers are offered based in this analysis.

7B2: Improving statistical knowledge for teaching of variability through professional development

Presenter: Helena Wessels (University of Stellenbosch, South Africa)

Abstract: This paper reports on a professional development programme focusing on statistical literacy, more specifically the development of in-service teachers' awareness of and reasoning about variability in multiple trials under uncertainty, and their ability to transfer their understandings to related tasks. The research formed part of a larger project in which the profiling of ninety grade 8-12 teachers was followed by professional development intervention in which fourteen volunteering teachers participated. Variability and uncertainty are key concepts in statistics, but are under-emphasised in many school curricula. These topics formed part of the focus of the intervention. Analysis of post intervention tasks revealed substantial increases in teachers' levels of reasoning about variability and their ability to transfer these competencies to related tasks. The results emphasise the value of well-designed learning experiences and rich discussions in teacher professional development programmes in statistical literacy.

7B3: Teachers' views related to goals of the statistics classroom – from global to content-specific

Presenter: Sebastian Kuntze (Ludwigsburg University of Education, Germany)

Abstract: When teachers design learning opportunities in the statistics classroom, they should be aware of specific goals related to statistical literacy – and they should be able to refer to these goals when evaluating the learning potential of tasks. Consequently, possessing corresponding professional knowledge can be seen as a key requirement for teachers. However, as empirical research into these professional knowl-

edge components is still scarce, this study focuses on this area and aims at identifying needs for professional development. The results suggest that many teachers did not see fostering the students' understanding of statistical variation as a prominent goal and that they did hardly acknowledge the specific learning potential of corresponding tasks.

Session 7C: Assessment of statistical literacy

Organizer: Rosemary Callingham (Australia)

The concept of statistical literacy is becoming well accepted as a critical component needed for intelligent and involved citizenship throughout the world. The increase in demand for "evidence-based" approaches has focused attention on statistical literacy for adults. The knowledge and understanding of statistics and its application in a variety of contexts starts, however, in the school setting, and continues to develop throughout adulthood, as greater experience is brought to bear on considering the statistical information. Statistically literate people should be able to move beyond the data presented and ask critical questions about the data itself, and the interpretation. This requires active involvement in thinking about data and questioning claims made. Such an involvement demands more of assessment than simply considering the capacity to undertake the relevant calculations. Critical approaches require higher-order thinking, such as the capacity to analyse a situation going beyond the immediately obvious information, synthesise an argument, and evaluate the claims made. The focus of this session will be on ways in which the statistics education community has moved to develop tools and instruments for assessing statistical literacy, and the outcomes of using such tools in a variety of settings. The session will include perspectives from those involved with school education as well as professional settings.

7C1: Towards statistical literacy - relating assessment to the real world

Presenter: Penelope Bidgood (Kingston University, United Kingdom)

Abstract: Students have different strengths and different approaches to learning so the assessment process should give opportunities for them to demonstrate their abilities and achieve the relevant learning outcomes. Reforms in statistical education at all levels place increasing emphasis on students' abilities to think and reason statistically using real data in appropriate contexts. The huge expansion in technology has given access to various data sources and advances in statistical software have greatly expanded the range of analyses that can be conducted almost instantaneously. Hence there are varied assessment strategies in statistics, whether in specialist or service courses, in which students can be set realistic problems to solve. This talk will discuss some issues in the assessment of statistics, drawing upon the author's experience in various projects over the years.

7C2: Validity of the LOCUS Assessments

Presenter: Catherine Case (University of Florida, United States)

Abstract: This session will present the systematic process utilized by the Levels of Conceptual Understanding in Statistics (LOCUS) project to establish content validity for assessments measuring students' statistical understanding in grades 6-12. This NSF-funded assessment project utilized a modified Evidence Centered Design approach (ECD) (Mislevy & Risconscente, 2006) to develop assessments aligned with the Common Core State Standards in Mathematics as well as the Guidelines for Assessment and Instruction in Statistics Education (Franklin et al., 2007). The ECD process began with a domain analysis based on CCSSM, GAISE, and learning trajectories from statistics education research and subsequently added layers articulating the claims to be made about student proficiency and the observable evidence to support those claims. This session will describe how the ECD approach formalized the evidentiary reasoning by which performance on the LOCUS assessment tasks can be used to support valid inferences about the larger domain of statistical understanding.

7C3: Assessing teachers' statistical literacy

Presenter: Helen Chick (University of Tasmania, Australia)

Co-authors: Roger Wander (, Australia) and Robyn Pierce (University of Melbourne, Australia)
Abstract: Teachers are inundated with data, including reports from mandated testing. Interpreting such reports requires professional statistical literacy, involving technical statistical knowledge and the capacity to interpret data meaningfully. For a study investigating teachers' data use, the authors designed instruments for assessing statistical literacy. They examined typical reports, identified the key knowledge and skills required to understand this data, and then constructed items that focused on critical components of statistical literacy. Designing the instrument involved constraints like ensuring that items assessed workplace-relevant statistical knowledge, and that the instrument did not take too long to complete. An online version of this statistical literacy instrument was developed from the results of an initial pen-and-paper design, with further constraints associated with screen space requirements and designing items for automated marking. This paper will examine some of these design issues and their impact on assessing teachers' statistical literacy prior to providing appropriate professional learning.

Session 7D: Developing statistical literacy: Case studies and lessons learned

Organizer: Iddo Gal (Israel)

Abstract: Statistical literacy is a complex, multi-dimensional construct whose meaning and implementation evolves or changes with the characteristics of different functional contexts in which people have to function. This session examines several case studies involving efforts and educational practices aiming to develop statistical literacy of different populations of learners, both in formal education contexts as well as in informal, applied contexts involving adults. The case studies offer an opportunity to reflect on the conceptualization of statistical literacy and identify factors associated with its development.

Papers for this session are currently being arranged.

Session 7E: Factors that affect statistical literacy

Organizers: Einav Aizikovitsh-Udi (Israel), David Clarke (Australia), Sebastian Kuntze (Germany)

Abstract: The development of Statistical Literacy can be affected in a variety of ways. For example, it might that particular reasoning skills or the capacity for critical thinking, essential to statistical literacy, require specific development. Even general cognitive skills such as reading competency could act to facilitate or impede the development of statistical literacy. In addition, student conceptions of key constructs such as variability can be seen as central to statistical literacy. The papers in this session will report research into these different factors.

7E1: A multilevel perspective on factors influencing students' statistical literacy

Presenter: Ute Sproesser (Ludwigsburg University of Education, Germany). Co-authors: Sebastian Kuntze (Ludwigsburg University of Education, Germany), Joachim Engel (Ludwigsburg University of Education, Germany)
Abstract: Over the last two decades statistics has been recognized as an important part of the school curriculum worldwide. As a result, questions related to impact factors on statistical literacy merit focused attention in empirical research. For instance, interdependencies with individual factors such as general cognitive abilities, reading comprehension or specific elements of mathematical content knowledge is still scarce. Consequently, this paper addresses this research need. We report empirical results from two studies on relationships between statistical literacy and potential influencing factors. The findings provide insight into the role of such covariates and support the validity of the competency measure we used to assess a key aspect of statistical literacy. The evidence further suggests that statistical literacy also depends on class variables beyond individual dispositions.

7E2: Critical thinking as an impact factor on statistical literacy – theoretical frameworks and results from an interview study
Presenter: Einav Aizikovitsh-Udi (Beit Berl Academic College, Israel)
Co-author: Sebastian Kuntze (Ludwigsburg University of Education, Germany)
Abstract: The theoretical frameworks of Critical Thinking (CT) and Statistical Thinking (ST) suggest an overlap – however, the quality of the connectedness of CT and ST has still not been described empirically in a satisfactory way. As elements of ST are a key prerequisite of statistical literacy, CT impacts on statistical literacy as well. This study hence focuses on the role of CT in the process of solving problems which require statistical literacy. A case analysis based on interview data provides insight into thinking processes and affords focusing such connections between CT and ST. The results support the hypothesis that thinking skills in both areas are interdependent and help to describe key intersection areas from a theoretical point of view: For instance, the interviewees' use of strategies of evaluating claims has a high explanatory power and provides a combined framework from the CT and ST perspectives.

7E3: Pre-service mathematics teachers' critical thinking through statistical and probabilistic information in the media context
Presenter:
Abstract: This study investigated pre-service mathematics teachers' critical thinking regarding statistical and probabilistic information in the media texts. In particular, the study examined what critical thinking skills pre-service middle school mathematics teachers utilize on the basis of their statistical and probabilistic knowledge while reading media texts. Participants of the study consisted of four senior pre-service middle school mathematics teachers enrolled in a public university. Data were collected through in-depth interviews with the participants. The results of the study highlighted that pre-service middle school mathematics teachers reflected different critical thinking skills and to what extent they made use of critical thinking skills was differentiated on the basis of their statistical and probabilistic knowledge. The results of the study could enlighten research domains to develop teachers' critical thinking and statistical literacy.

Source: http://icots.net/9/topic.php?t=7