

# Statistics Education Research Journal

Volume 7 Number 1 May 2008

# **Editors**

Peter Petocz Tom Short

#### **Assistant Editor**

Beth Chance

# **Associate Editors**

Andrej Blejec Carol Joyce Blumberg Nick J. Broers Joan B. Garfield John Harraway Flavia Jolliffe M. Gabriella Ottaviani Lionel Pereira-Mendoza Peter Petocz Maxine Pfannkuch Dave Pratt Chris Reading Ernesto Sanchez Richard L. Scheaffer Gilberte Schuyten Jane Watson

International Association for Statistical Education http://www.stat.auckland.ac.nz/~iase

International Statistical Institute http://isi.cbs.nl/

#### STATISTICS EDUCATION RESEARCH JOURNAL

The Statistics Education Research Journal (SERJ) is a peer-reviewed electronic journal of the International Association for Statistical Education (IASE) and the International Statistical Institute (ISI). SERJ is published twice a year and is free.

SERJ aims to advance research-based knowledge that can help to improve the teaching, learning, and understanding of statistics or probability at all educational levels and in both formal (classroom-based) and informal (out-of-classroom) contexts. Such research may examine, for example, cognitive, motivational, attitudinal, curricular, teaching-related, technology-related, organizational, or societal factors and processes that are related to the development and understanding of stochastic knowledge. In addition, research may focus on how people use or apply statistical and probabilistic information and ideas, broadly viewed.

The *Journal* encourages the submission of quality papers related to the above goals, such as reports of original research (both quantitative and qualitative), integrative and critical reviews of research literature, analyses of research-based theoretical and methodological models, and other types of papers described in full in the Guidelines for Authors. All papers are reviewed internally by an Associate Editor or Editor, and are blind-reviewed by at least two external referees. Contributions in English are recommended. Contributions in French and Spanish will also be considered. A submitted paper must not have been published before or be under consideration for publication elsewhere.

Further information and guidelines for authors are available at: http://www.stat.auckland.ac.nz/serj

#### **Submissions**

Manuscripts must be submitted by email, as an attached Word document, to co-editor Tom Short <tshort@iup.edu>. Submitted manuscripts should be produced using the Template file and in accordance with details in the Guidelines for Authors on the Journal's Web page: http://www.stat.auckland.ac.nz/serj

© International Association for Statistical Education (IASE/ISI), May 2008

Publication: IASE/ISI, Voorburg, The Netherlands

Technical Production: California Polytechnic State University, San Luis Obispo, California, United

States of America

Web hosting and technical support: Department of Statistics, University of Auckland, New Zealand

ISSN: 1570-1824

### **International Association for Statistical Education**

President: Allan Rossman (United States of America)
President-Elect: Helen MacGillivray (Australia)
Past- President: Gilberte Schuyten (Belgium)

Vice-Presidents: Andrej Blejec (Slovenia), John Harraway (New Zealand), James Nicholson

(Ireland), Delia North (South Africa), Enriqueta Reston (Phillipines)

# SERJ EDITORIAL BOARD

#### **Editors**

- Peter Petocz, Macquarie University, Sydney, North Ryde, New South Wales 2109, Australia Email: peter.petocz@mq.edu.au
- Tom Short, Mathematics Department, Indiana University of Pennsylvania, 210 South 10th St., Indiana, Pennsylvania 15705, USA. Email: tshort@iup.edu

#### **Assistant Editor**

Beth Chance, Department of Statistics, California Polytechnic State University, San Luis Obispo, California, 93407, USA. Email: bchance@calpoly.edu

#### **Associate Editors**

- Andrej Blejec, National Institute of Biology, Vecna pot 111 POB 141, SI-1000 Ljubljana, Slovenia. Email: andrej.blejec@nib.si
- Carol Joyce Blumberg, Energy Information Administration, US Department of Energy, 1000 Independence Avenue SW, EI-42, Washington DC 20585, USA. Email: carol.blumberg@eia.doe.gov
- Nick J. Broers, Department of Methodology and Statistics, Maastricht University, P.O. Box 616, 6200 MD, Maastricht, The Netherlands. Email: nick.broers@stat.unimaas.nl
- Joan B. Garfield, Educational Psychology, University of Minnesota, 315 Burton Hall, 178 Pillsbury Drive, S.E., Minneapolis, MN 55455, USA. Email: jbg@umn.edu
- John Harraway, Department of Mathematics and Statistics, University of Otago, P.O.Box 56, Dunedin, New Zealand. Email: jharraway@maths.otago.ac.nz
- Flavia Jolliffe, Institute of Mathematics, Statistics and Actuarial Science, University of Kent, Canterbury, Kent, CT2 7NF, United Kingdom. Email: F.Jolliffe@kent.ac.uk
- M. Gabriella Ottaviani, Dipartimento di Statistica Probabilitá e Statistiche Applicate, Universitá degli Studi di Roma "La Sapienza", P.le Aldo Moro, 5, 00185, Rome, Italy. Email: Mariagabriella.ottaviani@uniroma1.it
- Lionel Pereira-Mendoza, 3366 Drew Henry Drive, Osgoode, Ottawa K0A 2W0 Ontario Canada K0A 2W0. Email: lionel@iammendoza.com
- Maxine Pfannkuch, Mathematics Education Unit, Department of Mathematics, The University of Auckland, Private Bag 92019, Auckland, New Zealand. Email: m.pfannkuch@auckland.ac.nz
- Dave Pratt, Institute of Education, University of London, 20 Bedford Way, London WC1H 0AL. d.pratt@ioe.ac.uk
- Christine Reading, SiMERR National Centre, Faculty of Education, Health and Professional Studies, University of New England, Armidale, NSW 2351, Australia. Email: creading@une.edu.au
- Ernesto Sánchez, Departamento de Matematica Educativa, CINVESTAV-IPN, Av. Instituto Politecnico Nacional 2508, Col. San Pedro Zacatenco, 07360, Mexico D. F., Mexico. Email: esanchez@cinvestav.mx
- Richard L. Scheaffer, Department of Statistics, University of Florida, 907 NW 21 Terrace, Gainesville, FL 32603, USA. Email: scheaffe@stat.ufl.edu
- Gilberte Schuyten, Faculty of Psychology and Educational Sciences, Ghent University, H. Dunantlaan 1, B-9000 Gent, Belgium. Email: Gilberte.Schuyten@UGent.be
- Jane Watson, University of Tasmania, Private Bag 66, Hobart, Tasmania 7001, Australia. Email: Jane.Watson@utas.edu.au

# TABLE OF CONTENTS

| Editorial   | 2  |
|---|----|
| Jared Keeley, Ryan Zayac, and Christopher Correia  Curvilinear Relationships Between Statistics Anxiety and Performance Among  Undergraduate Students: Evidence for Optimal Anxiety | 4  |
| Randall Groth  Assessing Teachers' Discourse about the Pre-K-12 Guidelines for Assessment and Instruction in Statistics Education (GAISE)   | 16 |
| Jackie Reid and Chris Reading  Measuring the Development of Students' Consideration of Variation  | 40 |
| Forthcoming IASE Conferences  | 60 |
| Other Forthcoming Conferences   | 66 |

# **EDITORIAL**

Welcome to *SERJ* Volume 7 Number 1! In this issue Jared Keeley, Ryan Zayac, and Christopher Correia conjecture that an optimal anxiety level exists in undergraduate students to maximize performance in statistics courses. Randy Groth assesses teacher awareness of, perceptions about, and preparation for the American Statistical Association-endorsed "Pre-K-12 Guidelines for Assessment and Instruction in Statistics Education" (GAISE) document. Jackie Reid and Chris Reading present research on "Measuring the Development of Students' Consideration of Variation," a sequel to their 2006 *SERJ* article.

Iddo Gal's term as *SERJ* Co-editor ended in December 2008. Iddo's energy, enthusiasm, and high standards will be missed. His influence on *SERJ* is so pervasive that it is only now, nearly six months after his term has ended, that we are catching all of the references to his name and contact information on the *SERJ* Web site and making appropriate revisions. Thank you, Iddo, for your inspiration.

Peter Petocz joins me as the new *SERJ* Co-editor, for a four-year term from 2008 through 2011. Peter is an Associate Professor of Statistics in the Department of Statistics at Macquarie University in Sydney, Australia. Peter's statistics education research experience emphasizes student conceptions of the importance of statistics in their future careers, and assessments of the importance of statistics and mathematics in the adult work force. He has also published collaborative articles in orthodontics and nutrition. Welcome, Peter!

Work for *SERJ* became less of a priority for Peter in early April 2008, when he had a brain tumor surgically removed. Thankfully, he seems to be experiencing a full recovery. Best wishes for future good health, Peter!

SERJ thanks Mokaeane Victor Polaki from the National University of Lesotho for service as an Associate Editor, and we welcome Nick Broers from the Department of Methodology and Statistics at Maastricht University in the Netherlands to the Editorial Board.

In November 2008 SERJ will publish a special issue on reasoning about informal statistical inference. Dave Pratt and Janet Ainley are serving as guest editors for the special issue, and they are working with Peter Petocz to guide manuscripts through the review and revision process. Beginning in 2009 we propose to publish two regular issues of SERJ in May and November, regardless of the publication schedule for special issues. Our manuscript load has enough to support two regular issues each year.

Happily, the statistics education research community as a whole is supporting more publication across a variety of forums. The "Teacher's Corner" in *The American Statistician* is now publishing regularly again, and the December 2007 issue of the *International Statistical Review* was entirely devoted to statistics education. *SERJ* continues to receive more manuscripts than can be easily handled, suggesting a profound increase in the awareness and scholarly activity associated with statistics education research.

Two other exciting initiatives are getting started in 2008. The "Variety in Statistics Assessment" (ViSA) project (http://www.rsscse.org.uk/activities/visa) is being hosted by the Royal Statistical Society Centre for Statistical Education and currently has a "Call for Contributions" posted on its Web site. In addition, Joan Garfield and Dennis Pearl received a small grant through the American Statistical Association's Member Initiative

Statistics Education Research Journal, 7(1), 2-3, http://www.stat.auckland.ac.nz/serj © International Association for Statistical Education (IASE/ISI), May, 2008

program to host a workshop on key components of graduate programs in statistics education.

Thank you for reading SERJ. We welcome manuscripts, suggestions, and feedback!

TOM SHORT, for PETER PETOCZ