

Emerging Topics in Statistics and Biostatistics

Hon Keung Tony Ng  
Daniel F. Heitjan *Editors*

# Recent Advances on Sampling Methods and Educational Statistics

In Honor of S. Lynne Stokes

 Springer

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S. Lynne Stokes

# Life and Works of S. Lynne Stokes

I was born on December 16, 1950, in Corsicana, the seat of Navarro County, Texas, where six generations of the Stokes family had lived. I was the second-born to a family of teachers. My dad taught mathematics and physics and coached the baseball team at Navarro Junior College, which had been established in 1946 as he and so many others were returning from WWII. My mother taught Spanish and agriculture, neither of which she had ever taken a course in, at the high school in her nearby hometown, Richland. In 1952, my parents decided to pull up roots and head to graduate school at Peabody College, now a part of Vanderbilt University, in Nashville, Tennessee. Their families were horrified that they would move so far away, and especially that a mom of two would take such an unconventional path. But the GI Bill had placed higher education within reach for many families who would now be called “first-generation,” including mine. My parents went on to earn doctorates and have careers as college professors, he in mathematics and she in psychology. Their last and longest stint was at Austin Peay State University, where my dad chaired the Math Department for more than 20 years and my mom helped train a generation of school counselors in Clarksville, Tennessee. From this exposure and the joy they had in their careers, I decided at a young age that being a professor was my goal.

I studied mathematics at the University of the South in Suwanee, Tennessee. One of the faculty members, Mac Priestley, agreed to supervise me in an independent study out of Kemeny and Snell’s book on Markov chains. From that experience, I decided that enrolling in a statistics PhD program was the right path for me, not realizing that it was actually probability I had been fascinated by. Luckily, I liked statistics even better, which I realized after joining the program at the University of North Carolina.

My years in Chapel Hill are among my fondest memories. My advisor, Norman Johnson, was endlessly encouraging and supportive. He asked me to read Dell and Clutter’s 1972 ranked set sampling paper, then recently published, to see if I had any ideas on extensions for my dissertation work. Since that time, I have had the pleasure of discussing and collaborating with many on this topic, including several contributors to this volume.

My first job after school was in the Department of Mathematics at Vanderbilt, which was near my family home. I was one of only two statisticians in a large department. I soon decided I preferred real data and the company of other statisticians, and moved on to the Patuxent Wildlife Research Center in Laurel, Maryland. Patuxent was then a part of the US Fish and Wildlife Service and located in a 16,000-acre refuge of beautiful forest and wetlands in the midst of the Washington DC/Baltimore urban sprawl. There I learned from scratch about birds, and how to model bird-banding and capture-recapture data from the talented biometricians there, including Jim Nichols, a mentor and co-author. This is a skill I transferred from birds to people (at Census) and back to fish and the people who catch them (for NOAA) over the course of my career.

Patuxent changed my life in another way as well. There I met Dan Moulton, a biologist in the bird-banding lab, where he worked between field seasons on Laysan Island in Hawaii, where he was studying and banding Laysan ducks. During his second 6-month field season, we corresponded by letter and audio tape. These could be transported only by military plane or ship as they patrolled the Hawaiian archipelago. Soon after Dan returned from Laysan, we married.

While he was away, I left Patuxent for the US Census Bureau, which was just a short trip around the Beltway. Mary Mulry and I were hired into the Statistical Methods Division by Paul Biemer, whom we had first met at age 20 when all three of us were participants in an undergraduate NSF summer mathematics program at Texas A&M. Mary, Paul, and I have been colleagues, friends, and collaborators for 50 years, and we have NSF to thank for that.

Paul had studied under H. O. Hartley, and he introduced me to sampling theory and measurement error methods. The Census Bureau provided an unlimited supply of real-life problems for non-sampling error research, which has remained a lifelong interest. Fortunately for my career, errors occur whenever data are collected. This allowed me to dabble in many fascinating application areas over the years. Two of these areas, fisheries and education surveys, are well represented in this volume (Brick, Andrews & Foster; Becker & Gozutok).

When Dan took a position at Texas Parks and Wildlife in Austin in 1983, I moved with him and worked remotely for Census, before that was common. This arrangement was facilitated with the help of Kent Marquis, my division chief at Census, and Carl Morris, then in the Mathematics Department at the University of Texas. Kent and Carl had known each other at Rand, proving once again that it helps to get lucky. Soon a faculty position opened for a statistician in the Management Science Department at UT's Business School, and I was again in the right place at the right time. In my 15 years at UT, I expanded the range of problems I worked on with colleagues in fields from finance to demography to operations research.

In 2001, I left UT for the Statistics Department at Southern Methodist University, after a convincing chat with my long-time acquaintance Bill Schucany. I had first met Bill at a Conference of Texas Statisticians meeting shortly after moving to Texas, and had received useful advice from him over the years. SMU was a perfect place for the last 20 years of my career, providing a helpful administration, supportive colleagues, and excellent graduate students. I chaired the department for

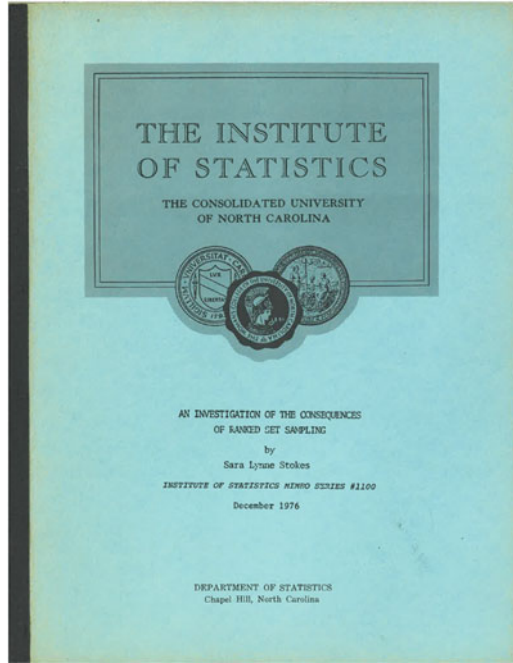
one term, and then became the inaugural director of SMU's Data Science Institute in my last 2 years there. Several of the contributors to this volume are cherished colleagues and former students from SMU.

My path likely would not have been so straight and well-marked if it had not been for the opportunities that began to open up for women at just the right time for me. I also benefited from introductions provided by supportive male mentors, colleagues, and classmates. I entered the University of the South the first year they accepted women (1969). My entering cohort in the Statistics Department at UNC in 1972 were half women and half men, marking the first year that women who were not wives of students were admitted in significant numbers. I was the fourth woman to receive a PhD in statistics at UNC, three of whom were supervised by Norman Johnson, who may have been influenced by his wife Regina from the UNC Biostatistics Department. At Vanderbilt, I was the first woman to fill a tenure-track position in the Mathematics Department, and at SMU, the first woman chair of the Statistics Department. My network-building began in the NSF program I attended as a 20 year old, which I believe illustrates the value of promoting diversity in such programs for young scholars.

Dallas, TX, USA  
May 2022

S. Lynne Stokes





S. Lynne Stokes's PhD thesis



Lynne enjoying the snow at Patuxent Wildlife Research Center, circa 1980



Mary Mulry, Paul Biemer, and Lynne at an NSF program reunion circa 1980



Lynne enjoying Friday morning teatime at SMU in 2007



Celebrating Betsy Becker's election to Fellow at 2008 JSM with an Educational Statistics mentor for both of us, Ingram Olkin



Helena Jia, Lynne, and Bingchen Liu in downtown Princeton during a meeting at ETS in 2017



From left to right: Jessica Wickersham, Raanju R. Sundararajan, Daniel F. Heitjan, Chul Moon, Hon Keung Tony Ng, Xinlei (Sherry) Wang, Mahesh Fernando, Monnie McGee, S. Lynne Stokes, Sheila Crain, Jing Cao, and Charles South in Dallas, Texas, during a department faculty gathering in May 2022

# Awards, Honors, and Publications of S. Lynne Stokes

## Awards and Honors

- Caren Prothro Faculty Service Award, Southern Methodist University (2019)
- Founders Award, American Statistical Association (2013)
- Dedman Family Distinguished Professor, Southern Methodist University (2013)
- United Methodist Church University Scholar/Teacher of the Year Award (2011)
- Don Owen Award, American Statistical Association, San Antonio Chapter (2005)
- Fellow of the American Statistical Association (1998)
- Phi Beta Kappa
- Sigma Pi Sigma

## Publications

### *Refereed Journals and Proceedings*

1. “Investigating Record Linkage for Combining Voluntary Catch Reports with a Probability Sample,” (B. Williams, L. Stokes, and J. Foster), *Fisheries Research*, 251, 106301 (2022).
2. “Predictive modeling of maximum injury severity and potential economic cost in a car accident based on the General estimates system data,” (G. Alkan, R. Farrow, H. Liu, C. Moore, H.K.T. Ng, S. L. Stokes, Y. Xu, Z. Xu, Y. Yan, and Y. Zhang), *Computational Statistics*, 36, 1561–1575 (2021).
3. “The Impact of non-sampling errors on estimators of catch from electronic reporting Systems,” (L. Stokes, B. Williams, R. McShane, and S. Zalsha), *Journal of Survey Statistics and Methodology*, 9, 159–184 (2021).

4. "Prevalence of Sexual Victimization among Female and Male College Students: A Methodological Note with Data," (Jouriles, E. N., Nguyen, J., Krauss, A., Stokes, S. L., and McDonald, R.), *Journal of Interpersonal Violence*, (2020).
5. "A method to correct for frame membership error in dual frame estimators," (D. Lin, Z. Liu, and L. Stokes), *Survey Methodology*, 45, 543–565 (2019).
6. "Accumulating Evidence of the Impact of Voter ID Laws: Student Engagement in the Political Process," (K. S. McConville, L. Stokes, and M. Gray), *Statistics and Public Policy*, 5, 1–8 (2018).
7. "Cross-Cultural Issues in Teaching Ethics in a Statistics Curriculum," (A. Elliott, L. Stokes, and J. Cao) *The American Statistician*, 72, 359–367 (2018).
8. "Comparison of Different Ranking Methods in Wine Tasting," (J. Cao and S.L. Stokes), *Journal of Wine Economics*, 12, 203–210 (2017).
9. "Estimation of total from a population of unknown size and application to estimating recreational red snapper catch in Texas," (B. Liu, S.L. Stokes, T. Topping, and G. Stunz), *Journal of Survey Statistics and Methodology*, 5, 350–371 (2017).
10. "Just in time teaching in Statistics Classrooms," (M. McGee, L. Stokes, and P. Nadolsky), *Journal of Statistics Education*, 24, 16–26 (2016).
11. "A power analysis for fidelity measurement sample size determination," (L. Stokes and J. Allor) *Psychological Methods*, 21, 35–46 (2016).
12. "Using Ranked Set Sampling with Cluster Randomized Designs for Improved Inference on Treatment Effects," (X. Wang, J. Lim, and L. Stokes), *Journal of the American Statistical Association*, 111, 1576–1590 (2016).
13. "Analyses of Wine Tasting Data: A Tutorial," (I. Olkin, Y. Lou, L. Stokes, and J. Cao), *Journal of Wine Economics*, 10, 4–30 (2015).
14. "The National Children's Study 2014: Commentary on a Recent National Research Council/Institute of Medicine Report Academic Pediatrics," *Academic Pediatrics*, 14, 545–546 (2014).
15. "Sample Size Calculation for a Hypothesis Test," (L. Stokes), *Journal of the American Medical Association*, 312, 180–181 (2014).
16. "Kernel Density Estimator from Ranked Set Samples," (X. Wang, J. Lim, M. Chen, and L. Stokes), *Communications in Statistics – Theory and Methods*, 43, 2156–2168 (2014).
17. "Methods for Improving Response Rates in Two-Phase Mail Surveys," (M. Brick, W. Andrews, P. Brick, H. King, N. Mathiowetz, and L. Stokes), *Survey Practice*, 5, 1–6. (2012).
18. "Stranger at the Gate: the Effect of the Plaintiff's use of an Interpreter on Juror Decision-Making," (D. Shuman, L. Stokes, and G. Martinez), *Behavioral Sciences and the Law*, 29, 499–512 (2011).
19. "Performance of Weighted Random Effects Model Estimators under Complex Sampling Designs," (Y. Jia, L. Stokes, I. Harris, and Y. Wang), *Journal of Educational and Behavioral Statistics*, 36, 6–32 (2011).
20. "Evaluation of Wine Judge Performance through Three Characteristics: Bias, Discrimination, and Variation," (J. Cao and L. Stokes), *Journal of Wine Economics*, 5, 1–11. (2010)

21. "A Bayesian Approach to Ranking and Rater Evaluation: an Application to Grant Reviews," (J. Cao, S. Zhang, and L. Stokes), *Journal of Educational and Behavioral Statistics*, 35, 194–215. (2010).
22. "Data Masking for Disclosure Limitation," (L. Stokes and G. Duncan), *Wiley Interdisciplinary Reviews: Computational Statistics*, 1, 1–10 (2009).
23. "Bayesian IRT guessing models for partial guessing behaviors," (J. Cao and L. Stokes), *Psychometrika*, 73, 209–230 (2008).
24. "A Nonparametric Mean Estimator for Judgment Post-Stratified Data," (X. Wang, J. Lim, and L. Stokes), *Biometrics*, 64, 355–363 (2008).
25. "Judgment Post-Stratification with Multiple Rankers," (L. Stokes, X. Wang, and M. Chen), *Journal of Statistical Theory and Applications*, 6, 344–359 (2007).
26. "Concomitants of multivariate order statistics with application to judgment post-stratification," (X. Wang, L. Stokes, J. Lim, and M. Chen), *Journal of the American Statistical Association*, 101, 1693–1704 (2006).
27. "Forming Post-Strata via Bayesian Treed Capture-Recapture Models," (X. Wang, J. Lim, and L. Stokes), *Biometrika*, 93, 861–876, (2006).
28. "An Estimator of Number of Species from Quadrat Sampling," (P. Haas, Y. Liu, and L. Stokes), *Biometrics*, 62, 135–141 (2006).
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32. "Using Auxiliary Information for Improving Estimation in the Number of Species Problem," *Statistica Sinica*, 13, 655–671 (2003).
33. "Comment on 'Can a Statistician Deliver?'" *Journal of Official Statistics*, 17, 103–106 (2001).
34. "Acceptance Sampling with Rectification when Classification Errors are Present," (M. Anderson, B. Greenberg, and L. Stokes), *Journal of Quality Technology*, 33, 493–505 (2001).
35. "Editorial: Special issue on Statistical Design and Analysis with Ranked Set Samples," (N. P. Ross and L. Stokes), *Environmental and Ecological Statistics*, 6, 1–6 (1999).
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38. "Do Product Warnings Increase Safe Behavior?: A Meta Analysis" (E. Cox, L. Stokes, E. Murff), *Journal of Public Policy and Marketing*, 25, 195–204 (1997).

39. "Estimation of the CDF of a Finite Population using a Calibration Sample" (M. Luo, L. Stokes, and T. Sager), *Environmental and Ecological Statistics*, 15, 346–352 (1997).
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43. "Parametric Ranked Set Sampling," (L. Stokes), *Annals of the Institute of Statistical Mathematics*, 47, 465–482 (1995).
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47. "Estimating the Size of a Subdomain: An Application in Auditing," (L. Stokes), *Journal of Business and Economic Statistics*, 8, 337–346 (1990).
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52. "Estimation of Interviewer Effects for Categorical Items in a Random Digit Dial Telephone Survey," (S. L. Stokes), *Journal of the American Statistical Association*, 83, 623–630 (1988).
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54. "Optimal Design of Interviewer Variance Estimates in Complex Surveys," (P. Biemer and L. Stokes), *Journal of the American Statistical Association*, 80, 158–166 (1985).



55. "The Jolly-Seber Method Applied to Age-Stratified Populations," (S. L. Stokes), *Journal of Wildlife Management*, 48, 1053–1059 (1984).
56. "Additional Comments on the Assumption of Homogeneous Survival Rates in Modern Bird Banding Estimation Models," (J. Nichols, L. Stokes, J. Hines, and M. Conroy), *Journal of Wildlife Management*, 46, 953–962 (1982).
57. "Remarks on the Use of Mark-recapture Methodology in Estimating Avian Population Size" (J. Nichols, B. Noon, L. Stokes, and J. Hines), *Studies in Avian Biology*, 6, 121–136 (1981).
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59. "Inferences on the Correlation Coefficient in Bivariate Normal Populations from Ranked Set Samples," (S. L. Stokes), *Journal of the American Statistical Association*, 75, 989–995 (1980).
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### ***Book Chapters***

1. "Measuring treatment fidelity with reliability and validity across a program of intervention research: Practical and theoretical considerations," (Allor, J. H. and Stokes, L.), In G. Roberts, S. Vaughn, S. N. Beretvas, and V. Wong (Eds.), *Measuring and Modeling Treatment Fidelity in Studies of Educational Intervention*, New York: Routledge Taylor & Francis Group (2017).
2. "Interviewer Effects," in *Encyclopedia of Research Methods for the Social Sciences*, M. Lewis-Beck, A. Brayman and T.F. Liao, Editors, Sage Publications (2003).
3. "Identifying and Adjusting for Recall Error with Application to Fertility Surveys," (T. Pullum and L. Stokes), Chapter 31 (pp. 711–732), *Survey Measurement and Process Quality*, John Wiley and Sons (1997).
4. "A Cost-Effective Approach for Regulating Insurance Company Solvency," (J. Lamm-Tennant, L. Starks, and L. Stokes), in *The Financial Dynamics of the Insurance Industry*, 153–167, E.I Altman and I.T. Vanderhoof, Editors, Irwin Professional Publishing, New York (1995).
5. "Some Recent Results on the Modeling and Estimation of Measurement Errors in Surveys," (with P. Biemer and L. Stokes), Chapter 24 (pp. 487–516) in *Measurement Errors in Surveys*, John Wiley & Sons (1991).
6. "A New Approach to Identifying Sources of Interviewer Effects in Telephone Surveys," (L. Stokes and M. Yeh), Chapter 22 (pp. 357–373) in *Telephone Survey Methodology*, Robert M. Groves, Editor, John Wiley and Sons, Inc. (1988).
7. "Ranked Set Sampling," in *Encyclopedia of Statistical Sciences*, N. Johnson and S. Kotz, Editors, John Wiley & Sons, 585–588 (1986).

# Preface

When our colleague Lynne Stokes announced her intention to transition to emerita status at the end of the 2022 academic year, our initial reactions were dismay—at losing a valued colleague—and surprise—that she would walk away while still at the top of her game. How can you retire, Lynne; what will you do? And what will our department do without you?

After reconciling ourselves to the coming new reality, we decided that we should do something special to commemorate Lynne’s remarkable career and recognize this momentous life change. A symposium, we thought—but Lynne said she did not want a symposium. Well then, a party hosting current and past colleagues and students. No, Lynne said, no party. Perhaps an intimate dinner with the faculty? No again. A Texas barbecue? A Lynne-themed Friday tea time? No and no. Well how about a *festschrift*?

And that is how this book came to be.

So we made the rounds of Lynne’s many students, co-authors, and past and current colleagues, who were universally eager to contribute papers in areas where she has worked over the years. We express our sincere gratitude to all of them for writing chapters of such high quality on a tight deadline. Special thanks are also due to the referees, many of them authors as well, for their constructive reviews. And we acknowledge the team from Springer Nature Group—Laura Aileen Briskman, Kirthika Selvaraju, Faith Su, and Amelie von Zumbusch—who have gently guided the project from inception to production.

Most importantly, we are grateful to our colleague and friend Lynne Stokes for blessing this work and for supporting our efforts with her characteristic energy, generosity, and humility. It is our great pleasure to present her with this book on the occasion of her transition to the next phase of a most interesting and well-lived life.

Waltham, MA, USA  
Dallas, TX, USA  
June 2022

Hon Keung Tony Ng  
Daniel F. Heitjan

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