PENNSTATE

The Methodology Center

advancing methods, improving health

Annual Report




PENN STATE | 2014-15

Our mission

is to advance public health by improving experimental design and data analysis in the social, behavioral, and health sciences.

We draw upon and integrate methodological perspectives from a variety of disciplines, including statistics, engineering, psychology, and human development, to develop new quantitative methods for research focusing on vital public health issues, especially drug abuse and HIV.

Welcome!

We have just entered the final year of our current National Institute on Drug Abuse P50 Center of Excellence. As we wrap up the projects listed in this report, we are writing proposals to fund new methodological projects. All of us are excited about the new directions our research is heading during this dynamic period for our Center and for public health research.

Recently, the analysis of intensive, massive, and otherwise complex data sets has changed our daily lives in myriad ways, from the results of our Internet searches to widespread use of "smart" thermostats to conserve energy. Importantly, it is also changing the science of behavioral interventions, thanks, for example, to the collection of behavioral and psychological data using smartphones. The Methodology Center is positioned to help guide research that will harness the power of these data to improve public health.

With that in mind, we are shifting our research emphasis to focus more on developing the next generation of research methods for complex data. This report is a great opportunity for us to reflect on the past as we plan for the future.

Enjoy!

Linda M. Collins
Director, The Methodology Center
Distinguished Professor of Human Development and Family Studies and Professor of Statistics

To learn more about The Methodology Center, visit methodology.psu.edu.

4 Years of Growth: Outreach and Productivity

The Methodology Center's most powerful tools for disseminating new methods to other public health researchers are scientific publications, free software, and our website. Over the past four years, all of these areas have seen substantial growth, resulting in greater use of our methods around the world.

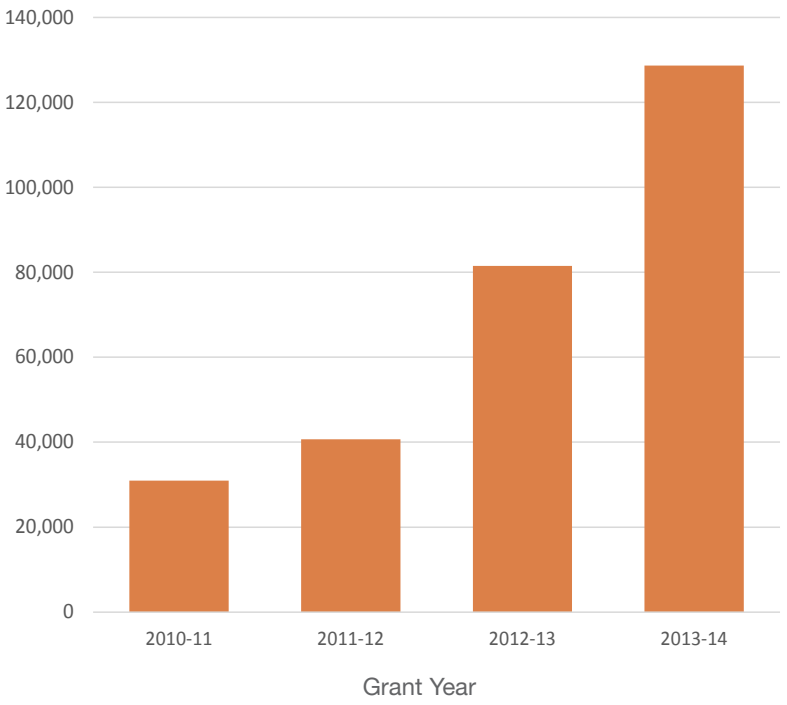
Free Software in 2013-14

8,000+ downloads

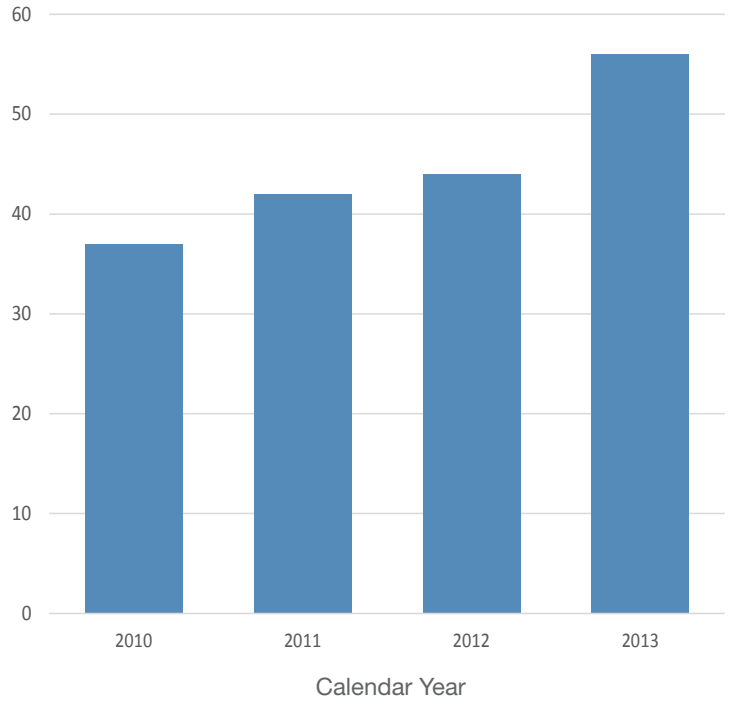
5 new releases in SAS, R, and Stata

methodology.psu.edu/downloads

Website Visits



Scientific Productivity: Articles, Books, Chapters



4 Years of Growth: HIV Research

New Methods for HIV-Prevention Research

Over the past four years, we have initiated collaborations with some of the top experts in HIV research. Here are a few highlights of our first steps in this field.

Conference on Methods for HIV Research

In September 2013, the NIH Office of AIDS Research, National Institute on Drug Abuse (NIDA), and Office of Behavioral and Social Sciences Research (OBSSR) supported a meeting hosted by The Methodology Center that gathered over 50 of the nation's top HIV researchers and methodologists to discuss integrating cutting-edge methods and HIV-prevention research. More than a dozen emerging leaders in HIV research received early career awards to attend.

This was an important moment for our center. It clarified our understanding of the needs of HIV researchers and helped them understand the value of our new methods for designing experiments. As a result of this meeting, we are in the process of submitting multiple grants related to HIV. For example, we are working on a proposal that will use the multiphase optimization strategy (MOST) to develop an optimized HIV-care continuum intervention for highly vulnerable populations. (See page 7 for information about MOST.)

Seth Kalichman, professor of psychology at University of Connecticut and Fredrick Altice, professor of medicine and epidemiology at Yale School of Medicine gave keynote addresses. Jacques Normand of NIDA made closing remarks.

Our HIV Publications

Visit methodology.psu.edu/annualreport2014 for videos of talks from the conference and a full list of our HIV-related publications, including applications of

>> latent class analysis (see page 8),

>> modern causal analysis techniques (see page 8), and

>> time-varying effect models (see page 9).

4 Years of Growth: Recognition of Scientists

Over the last four years, all five Methodology Center principal investigators have been recognized for their achievements and scientific contributions. Here are some of the highlights.

Susan Murphy

- **MacArthur Fellow, 2013**
- Institute of Medicine of the National Academies Member, 2014
- College on Problems of Drug Dependence Fellow, 2014
- University Distinguished Professor, 2014
- International Statistical Institute Member, 2011

Runze Li

- ***Annals of Statistics* Co-Editor, 2013-15**
- Distinguished Professor, 2012
- United Nations World Meteorological Organization Gerbier-Mumm Award, 2012
- American Statistical Association Fellow, 2011

Linda Collins

- **Society for Prevention Research President 2009-11**
- Distinguished Professor, 2014
- Society of Behavioral Medicine Fellow, 2014
- Penn State Patishall Research Award, 2011

Donna Coffman

- **Society for Prevention Research Early Career Award, 2014**
- Research Associate Professor, 2013

Stephanie Lanza

- ***Prevention Science* Associate Editor, 2012-16**
- Society for Prevention Research Friend of ECPN Mentoring Award, 2014
- Research Associate Professor, 2011

Current Research Projects

Building the Tools Researchers Need

The Methodology Center comprises six highly collaborative research projects. Each project analyzes newly available complex data sets to address a critical problem in experimental design or data analysis. Together, these projects provide the tools needed for scientists to design the best possible behavioral interventions to reduce the damage caused by drug use, smoking, alcohol abuse, risky sex, and other dangerous behaviors.

Multiphase Optimization Strategy (MOST)

What is MOST?

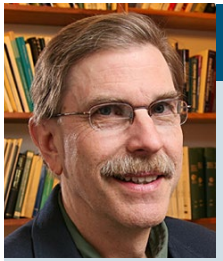
MOST is a framework for engineering effective and efficient behavioral interventions while carefully managing research resources to maximize scientific knowledge.

How does MOST help prevent drug abuse?

Interventions designed to treat behavior typically include many components. For example, a smoking intervention may include pre-quit counseling, nicotine replacement therapy, and post-quit counseling. MOST enables researchers to test each intervention component in a way that, regardless of the results of the experiment, facilitates scientific progress.

What has The Center contributed to MOST?

Linda Collins and her collaborators conceptualized and created MOST. Along with methodological work, Methodology Center scientists have created tutorials and software to enable scientists to use MOST. Currently, large-scale projects are using MOST to build interventions that address smoking, drug and alcohol abuse, obesity, and more.



New Methods to Fight Smoking

When my group started using MOST, my strong belief was that different intervention components would yield only additive effects. We have found, however, multiple cases where one intervention component negates the benefit of another component. This means that one really cannot go about building an optimal treatment package without data from factorial experiments. The MOST approach reveals this, and then guides experimental analysis of the study.

– *Timothy Baker, University of Wisconsin*

Principal Investigator of P50 CA143188, a project using MOST to develop an optimized smoking intervention

Current Research Projects

Latent Class Analysis (LCA)

What is LCA?

LCA is a data analytic technique that enables researchers to identify hidden subgroups within a population.

How does LCA help prevent drug abuse?

LCA has been applied extensively in studies of drug use and human development to identify subgroups of people who would benefit most from an intervention. The widespread use of LCA means that innovations in this area quickly reach a broad audience of researchers.

Hackathon researchers analyzing a common dataset

What has The Center contributed to LCA?

Center researchers have been developing and extending LCA models for many years, including the development of latent transition analysis, a longitudinal extension of LCA. Center researchers Linda Collins and Stephanie Lanza wrote the book, *Latent class and latent transition analysis: With applications in the social, behavioral, and health sciences.* We develop and distribute PROC LCA the LCA Stata plugin, which have enabled thousands of researchers around the world to apply LCA to their data. Recently, we have been developing models to enable researchers to understand how class membership can impact outcomes later in life.

Methods for Causal Inference

What are causal inference methods?

Causal inference methods allow researchers to identify the impact of exposure to a particular treatment or condition.

How does this research help prevent drug abuse?

In the study of health behaviors, randomization is often impossible. For example, if we want to understand how beliefs about substance use norms contribute to later substance use, it is impossible to randomize people to levels of belief. In order to develop effective behavioral interventions, new analytic methods are needed to determine the true impact of these nonrandomized factors. Center researchers are developing these methods.

What has The Center contributed to these methods?

Methodology Center researchers, led by Donna Coffman, have developed new methods to examine the effects of interventions (including an HIV-prevention intervention for women recently released from prison), the causal antecedents of negative health outcomes (including alcohol abuse and obesity), and the effects of sequences of health services among adolescent substance abusers.

Current Research Projects

Time-Varying Effect Model (TVEM)

What is TVEM?

TVEM is a method for modeling dynamic behavior and associations using intensive longitudinal data (ILD), such as data collected with a smartphone.

How does TVEM help prevent drug abuse?

When a person quits smoking, that person's mood, craving, and other factors contribute to the likelihood he or she will relapse. Using TVEM, researchers have been able to model these highly dynamic variables to identify times to intervene. TVEM allows researchers to understand dynamic associations that previously could not be modeled and potentially prevent smoking relapse.

What has The Center contributed to TVEM?

Center work on this topic extends back to Walls and Schafer's 2006 book, *Models for intensive longitudinal data*. As ILD become increasingly common, methods for ILD are allowing public health researchers to take advantage of the massive potential in these data. Methodology Center scientists, led by Runze Li, developed software to conduct TVEM.

We also held a preconference workshop at the 2012 Society for Research on Nicotine and Tobacco Annual Meeting and co-edited a 2014 special issue of the society's journal, *Nicotine and Tobacco Research*, titled "New Methods for Advancing Research on Tobacco Dependence Using Ecological Momentary Assessments."

The Prevention and Methodology Training Program

PAMT is a NIDA-funded collaboration with Penn State's Bennett Pierce Prevention Research Center, trains graduate students and postdoctoral researchers for careers that merge prevention research and cutting-edge methods.

Current PAMT postdoctoral trainees

Michael Russell (Ph.D., University of California, Irvine; Psychology and Social Behavior) researches ILD analysis for preventing substance abuse and aggression.

Megan Schuler (Ph.D., Johns Hopkins University; Mental Health) researches latent variable models and causal inference for drug abuse.

Angela Henneberger (Ph.D., University of Virginia; Educational Psychology: Applied Developmental Science) researches causal inference of peer influence to inform prevention programs.

Melissa Boone Brown (Ph.D., Columbia University; Sociomedical Sciences and Psychology) researches ILD to understand the connections between stress, HIV risk, and substance use in African Americans.

Rebecca Evans Polce (Ph.D., Johns Hopkins University; Health, Behavior, and Society) researches ILD for studying alcohol and other substance use across the life course.

Current Research Projects

Sequential, Multiple Assignment, Randomized Trial (SMART)

What is SMART?

SMART is a novel experimental design that allows scientists to develop interventions that include decisions about when and how to adapt for each individual.

How does SMART help prevent drug abuse?

Interventions designed using SMART are personalized using baseline characteristics, prior treatments, and prior response to treatment. SMARTs are being conducted around the world to develop adaptive interventions that address cocaine use, alcohol abuse, language deficits among children with autism spectrum disorder, childhood obesity, adolescent depression, and other urgent health problems.

What has The Center contributed to SMART?

SMART was conceived and developed by Susan Murphy and her collaborators. It was born out of the same conversations between Susan Murphy and Linda Collins that led to the development of MOST (see page 7). In 2013, Susan was named a fellow by the John D. and Catherine T. MacArthur Foundation for her groundbreaking work on SMART. Methodology Center investigators Daniel Almirall and Inbal Nahum-Shani have led the extension of SMART for use in helping health centers implement efficacious interventions. Center scientists have conducted dozens of trainings and created free software to disseminate SMART.

Creating Software

Our software team is anchored by John Dziak, a statistician, and Liying Huang, an applied mathematician. Together, they develop the technical tools that allow thousands of researchers around the world to put our methods to work.

Just-in-Time, Adaptive Interventions (JITAIs)

What are JITAIs?

New methods for constructing just-in-time, adaptive interventions (JITAIs) are our latest initiative to advance the construction of more effective behavioral interventions. JITAIs (pronounced like “Jedis” from Star Wars) are real-time interventions that are delivered via smartphone or other mobile device whenever need is indicated.

How will JITAIs help prevent drug abuse?

The JITAI project was born out of the SMART project when Susan Murphy saw the need for learning algorithms, statistical analyses, and clinical trial designs that enable the best use of mobile technologies, including smartphones, to deliver individualized behavioral interventions. In JITAIs, real-time ILD are passively or actively collected (e.g., ecological momentary assessments) and used to inform the real-time delivery of intervention options (e.g., recommendations, information, and prompts).

New Research Directions

Leveraging Data to Improve Health Through Behavior

Cancer, HIV, heart failure, and respiratory disease: some of the greatest threats to our health stem from risky behaviors that people engage in every day. By helping people avoid drug use, engage in healthy sexual behavior, use alcohol responsibly, increase physical activity, and eat healthy food, our society can prevent illness and save millions of dollars.

Behavior is driven by a complex set of factors that can differ greatly between people, and the consequences of dynamic behavior can be difficult to determine. It is critical that we understand the antecedents and causes of behavior in order to improve public health.

Recent technological advances are generating vast amounts of data, and these data hold enormous promise. To unlock that scientific knowledge, however, we need a combination of quality data; tailor-made, new statistical models; and carefully selected experimental design methods. The Methodology Center is uniquely positioned to provide scientists the tools to develop the next generation of behavioral interventions.

Building Skills for Research

I attended five of the Methodology Center's accessible and exceptional Summer Institutes on Innovative Methods. I applied the skills I learned there to describe and understand important trends and mediating mechanisms of LGBT youth substance use and mental health disparities. I will be forever grateful for these training opportunities.

– Michael P. Marshal, University of Pittsburgh
Associate Professor of Psychiatry and Pediatrics

Learn More

methodology.psu.edu/annualreport2014

Visit the online version of our Annual Report for enhanced content, including video and in-depth content on our research projects.

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Our Objective

The Methodology Center is a National Institute on Drug Abuse P50 Center of Excellence. We serve as a national resource on cutting-edge applied statistical methods for the behavioral, social, and health sciences. Our overall objective is to improve public health by improving public health research worldwide. We identify important emerging methodological issues based on our knowledge of the field and our collaborations with behavioral scientists.

Our Funding

Research at The Methodology Center is funded by grants from the National Institutes of Health, primarily the National Institute on Drug Abuse and the National Cancer Institute.

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