Engaging, Inspiring, and Training the Next Generation: Past Successes, Future Challenges and Opportunities

Marie Davidian
Department of Statistics
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Topics

🌟 Statistics is “hot!”
🌟 The biostatistics challenge
🌟 The SIBS experience
🌟 The future
“I keep saying that the sexy job in the next 10 years will be statisticians,” said Hal Varian, chief economist at Google. “And I’m not kidding.”
“Now they’re all excited to meet me.”
“Statistical expertise has become more valuable than ever”
The Age of Big Data

By STEVE LOHR

GOOD with numbers? Fascinated by data? The sound you hear is opportunity knocking.

Mo Zhou was snapped up by I.B.M. last summer, as a freshly minted Yale M.B.A., to join the technology company’s fast-growing ranks of data consultants. They help businesses make sense of an explosion of data — Web traffic and social network comments, as well as software and sensors that monitor shipments, suppliers and customers — to guide decisions, trim costs and lift sales. “I’ve always had a love of numbers,” says Ms. Zhou, whose job as a data analyst suits her skills.

To exploit the data flood, America will need many more like her. A report last year by the McKinsey Global Institute, the research arm of the consulting firm, projected that the United States needs 140,000 to 190,000 more workers with “deep analytical” expertise and 1.5 million more data-literate managers, whether retrained or hired.

The impact of data abundance extends well beyond business. Justin Grimmer, for example, is one of the new breed of political scientists. A 26-year-old assistant professor at Stanford, he combined math with political science in his undergraduate and graduate studies, seeing “an opportunity because the discipline is becoming increasingly data-intensive.” His research involves the computer-automated analysis of blog postings, Congressional speeches and press releases, and news articles, looking for insights into how political ideas spread.

“Statistics are interesting and fun. It’s cool now.”
Big need

FOR IMMEDIATE RELEASE
March 29, 2012

Contact: Rick Weiss 202 456-6037 rweiss@ostp.eop.gov
Lisa-Joy Zgorski 703 292-8311 lisajoy@nsf.gov

OBAMA ADMINISTRATION UNVEILS “BIG DATA” INITIATIVE:
ANNOUNCES $200 MILLION IN NEW R&D INVESTMENTS

Aiming to make the most of the fast-growing volume of digital data, the Obama Administration today announced a “Big Data Research and Development Initiative.” By improving our ability to extract knowledge and insights from large and complex collections of digital data, the initiative promises to help solve some the Nation’s most pressing challenges.
AP Statistics enrollment
(Source: Wikipedia)
Demand

🌟 2011 McKinsey Global Institute report:

Big data: The next frontier for innovation, competition, and productivity

“A significant constraint...will be a shortage of...people with deep expertise in statistics and data mining...a talent gap of 140K-190K positions in 2018”

http://www.mckinsey.com/Insights/MGI/Research/Technology_and_Innovation/Big_data_The_next_frontier_for_innovation
So why aren’t more US students going to grad school in Statistics?
(and in Biostatistics in particular?)

- Competition from other Science, Technology, Engineering, and Mathematics (STEM) disciplines
- Mathematics, Applied Mathematics, Computer Science,…
- Biomedical Engineering,…
So why aren’t more US students going to grad school in Statistics? (and in Biostatistics in particular?)

- Lack of interest (bad AP/undergraduate experience with statistics)
- Lack of knowledge of background required
- Lack of knowledge of career opportunities (especially in the biological/health sciences...)
Missing data

*Science*, February 11, 2011

“?”
A long-standing issue...

- The looming shortage of biostatisticians to meet the needs of the US health sciences research enterprise was highlighted well over a decade ago.
- Two NIH workshops in 2001 and 2003 to “examine the need to train more biostatisticians in the U.S. to meet the increasing opportunities” (and needs) in biomedical research.
Training of the next generation of biostatisticians: A call to action in the U.S.

David L. DeMets¹,*, †, Gary Stormo², Michael Boehnke³, Thomas A. Louis⁴, Jeremy Taylor³ and Dennis Dixon⁵

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⁵National Institute of Allergy and Infectious Diseases, National Institutes of Health, Bethesda, MD 20892, U.S.A.
Main points

- Health sciences research (omics, new technologies, “personalized medicine,”...)
- Cohort of current senior biostatisticians is approaching retirement...
- ...but PhD production has been flat
- Proportion of US PhD students low
- International students have opportunities in home countries (China, India,...)
Main points

- Interdisciplinary team approach is the new model for research; focus on collaboration
- Next generation will need both traditional theory/methods training and facility with emerging methodological areas, massive data, computation, biology, communication/leadership skills,...
- Government, private sector must reinvest in training of biostatisticians
Some recommendations

- Stimulate undergraduate awareness/interest
- Establish a general biostatistics training grant program (NIGMS + other Institutes)
- Improve peer review of biostatistics training grants
- Increase industry participation
The issue persists...

- The gap between supply of and demand for both Master’s and PhD biostatisticians is of great concern to biostatistics core directors for the Clinical and Translational Science Award sites (CTSAs)
- CTSA success hinges on adequate biostatistical collaborative resources
- Big Data will require Big workforce!
Action

✦ January 2003: RFA-HL-03-010 released by the National Heart, Lung, and Blood Institute (NHLBI) to support a “Summer Institute for Training in Biostatistics (SIBS)”

✦ July 2004: PAR-04-132 released by the National Institute of General Medical Sciences (NIGMS) to support a new predoctoral institutional training grant program in biostatistics
Summer Institute for Training in Biostatistics (SIBS)

- “Develop, conduct, and evaluate a summer course in the basic principles and methods of biostatistics”
- “…(attract) new students into the field as a response to the dwindling national pool of trained biostatisticians”
- “...advanced undergraduate students majoring in mathematics or another quantitative area”
Summer Institute for Training in Biostatistics (SIBS)

- 1 grant, summers of 2004, 2005, 2006
- T15 mechanism (short-term training)
- ~ 20-40 US citizens/Permanent Residents (PR)
- 5-6 weeks, emphasis on data analysis, essential role of biostatistics in biomedical research, career opportunities
- Effectiveness: participants going on to graduate school in biostatistics/statistics
Instrumental individuals

Dave DeMets

Nancy Geller
SIBS Applications

🌟 18 applications from departments of biostatistics and statistics
🌟 Only 1 SIBS grant to be awarded...

3 applications selected for funding!
Original SIBS programs

- Boston University Department of Biostatistics (PI: Lisa Sullivan)
- University of Wisconsin – Madison Department of Biostatistics and Medical Informatics (PI: Dave DeMets)
- North Carolina State University Department of Statistics – Duke Clinical Research Institute (Co-PIs: Dennis Boos, Marie Davidian)
SIBS PIs

Lisa Sullivan

Dennis Boos
Coordination from the start

- Meeting of PIs at NHLBI in Bethesda in Fall 2003; regular conference calls
- Coordination of dates, advertising/recruiting
- Posters/brochures mailed/emailed to > 1000 departments of statistics, math, engineering, computer science, biology,...
- Personal contacts, flyers at ENAR
- Individual websites, NHLBI website

http://www.nhlbi.nih.gov/funding/training/redbook/sibsweb.htm
Features

- 6 weeks, tuition for 4-6 hours course credit
- Room, board, transportation
- Common and unique elements
- Lectures by biostatisticians, clinicians, epidemiologists, statistical geneticists, ...
- Field trips (e.g., Framingham Heart Study site)
- Statistical software (SAS/R/etc), data analysis projects
The demand for biostatisticians TODAY is greater than ever before, and it is expected to INCREASE in the near future.

What is Biostatistics?

Biostatistics is a fundamental scientific component of all biomedical and public health research. It is based on mathematical, statistical, and biological principles. Biostatisticians work closely with experts from other fields in research teams. Together they seek to answer serious and important questions that affect human health and well-being.

Job Outlook

The demand for biostatisticians TODAY is greater than ever before, and it is expected to INCREASE in the near future.

Application Information

The application requires:

1. Completion of the on-line application form
2. A brief personal statement of interest
3. A copy of official current college transcripts
4. Two letters of recommendation

The application deadline is March 1, 2004.

For more information, contact:

Lisa Sullivan at Boston University lsull@bu.edu, www.bumc.bu.edu/biostats/sibs

Dennis Boos at North Carolina State University boos@stat.ncsu.edu, www.stat.ncsu.edu/sibs

David DeMets at the University of Wisconsin kalish@biostat.wisc.edu, www.biostat.wisc.edu/training/sibs

Sponsored by the National Heart, Lung, and Blood Institute.
SIBS 2004-2006

- 60-80 applications for 20-25 slots at each program in each year
- Math majors about 50% of applicants
- 202 participants over the three years
- ~60% went on to graduate school in biostatistics/statistics!
Notice of Limited Competition Request for Competing Applications: NHLBI Programs of Summer Institute for Training in Biostatistics

**Notice Number:** NOT-HL-05-118

**Key Dates**
- Release Date: June 7, 2005
- Application Receipt Date: January 24, 2006

**Issued by**

The NHLBI is requesting competing renewal applications from the three NHLBI Programs of Summer Institute for Training in Biostatistics (SIBS) [http://www.nhlbi.nih.gov/funding/training/medbooks/bioweb.htm](http://www.nhlbi.nih.gov/funding/training/medbooks/bioweb.htm). These programs were awarded as a result of a Request for Applications (RFA) HL-03-010, Programs of Summer Institute for Training in Biostatistics (SIBS) [http://grants.nih.gov/grants/guide/announcements/RFA-HL-03-010.html](http://grants.nih.gov/grants/guide/announcements/RFA-HL-03-010.html). This re-competition will continue to facilitate undergraduate training in biostatistics and to provide unique ongoing resources to the NHLBI investigators for a one-time renewal cycle.

**Mechanism of Support**

The limited competition for SIBS uses the NIH Continuing Education Training Grant award mechanisms (T15). Details of the responsibilities, relationships, and governance of a program funded under this Notice will be the same as in the current terms and conditions of the award. Organization, Operation, and Oversight, as well as Terms and Conditions of award remain unchanged from the original RFA [http://grants.nih.gov/grants/guide/announcements/RFA-HL-03-010.html](http://grants.nih.gov/grants/guide/announcements/RFA-HL-03-010.html).

The total project period for an application submitted in response to this Notice may not exceed three (3) years. This program will end as of May 31, 2010. No renewal of the program will occur. The anticipated award date is June 1, 2007.

**Funds Available**

The NHLBI intends to commit approximately $1 million total costs per year to support 3 Programs of Summer Institute for Training in Biostatistics (SIBS). An applicant may request a project period of up to 3 years and a budget for total costs of up to $250,000 per year. Although the financial plans of the NHLBI provide support for this program, awards pursuant to this Notice are contingent upon the availability of funds.

**Submitting an Application**

Applications must be prepared using the PHS 398 research grant application instructions and forms. Applications must have a DUN and Bradstreet (D&B) Data Universal Numbering System (DUNS) number as the Universal Identifier when applying for federal grants or cooperative agreements. The DUNS number can be obtained by calling (866) 705-5711 or through the web site at [http://www.dnb.com/](http://www.dnb.com/). The DUNS number should be entered on line 11 of the face page of the PHS 398 form. The PHS 398 document is available at [http://grants.nih.gov/grants/funding/phs398/phs398.html](http://grants.nih.gov/grants/funding/phs398/phs398.html) in an interactive format. For further assistance contact GrantsInfo, Telephone: (301) 480-2655, Email: GrantsInfo@nih.gov.

Supplemental Instructions: Only competing renewal applications, which were funded as part of RFA HL-03-010, Programs of Summer Institute for Training in Biostatistics, will be considered.

For every application, Item 2 on the Face Page should be checked “Yes”, after “Number” enter “NOT-HL-05-118” and after “Title” enter “Competing Applications for SIBS.”

*Signatures on Application to the NHLBI: Submit a signednowledgment page of the application, including the Checklist, to indicate signatory responsible in accordance with...*
SIBS 2007-2009

- **numbers of applications (> 100)**
- Continued coordination, joint advertising and recruitment
- Word of mouth, “Friends of SIBS,” inclusion in lists of internships, summer programs, *Amstat News* articles, sessions at JSM,…
- **409** participants 2004-2009, > 65% went on to graduate school in biostatistics/statistics!
SIBS II, 2010-2012

- Success of “SIBS I” led to “SIBS II”
- Applications for 7 programs for 2010-2012
- NHLBI and National Center for Research Resources (NCRR, now defunct)
Part I Overview Information

Department of Health and Human Services

Participating Organizations
National Institutes of Health (NIH) (http://www.nih.gov)

Components of Participating Organizations
National Heart, Lung, and Blood Institute (NHLBI) (http://www.nhlbi.nih.gov)
National Center for Research Resources (NCRR) (http://www.ncrr.nih.gov)

Title: Summer Institute for Training in Biostatistics II (T15)

Announcement Type
New

Update: The following update relating to this announcement has been issued:
- January 19, 2012 - This RFA has been reissued as RFA-HL-13-015.

Request For Applications (RFA) Number: RFA-HL-09-009

Catalog of Federal Domestic Assistance Number(s)
93.837, 93.838, 93.839, 93.233

Key Dates
Release Date: September 3, 2008
Letters of Intent Receipt Date: December 5, 2008
Application Receipt Date: January 6, 2009
Peer Review Date(s): April/May 2009
Council Date: May 2009
Earliest Anticipated Start Date: July 1, 2009
Additional Information to Be Available Date (Url Activation Date): Not Applicable
Expiration Date: January 7, 2009
SIBS II, 2010-2012

> 20 applications, 8 SIBS II grants awarded!

Original 3 programs + 5 more

Emory University (PI: Lance Waller)

University of Iowa (PI: Kathryn Chaloner)

University of Pittsburgh (PI: Roslyn Stone)

University of South Florida (PI: Yiliang Zhu)

Washington University in St. Louis (PI: G. Charles Gu)
SIBS II, 2010-2012

- 6-7 weeks, 15-25 participants, course credit
- Continued joint advertising and recruitment
- 607 unique applicants in 2010, 163 participants
- 518 unique applicants in 2011, 166 participants
- On track for similar turnout in 2012
- Of those eligible, ~60% went on to graduate school in biostatistics/statistics
The Summer Institutes for Training in Biostatistics are sponsored by the National Heart, Lung, and Blood Institute (http://www.nhlbi.nih.gov/funding/training/redbook/sibsweb.htm) and the National Center for Research Resources.

### What is Biostatistics?
- A summer program that explores how to apply quantitative methods to investigate important health issues.
- The opportunity to learn the principles of applied biostatistics from recognized experts in the field and meet practicing biostatisticians, epidemiologists, and statistical geneticists.
- The chance to gain real-world experience working with data from internationally recognized studies funded by the NHLBI.
- The chance to learn about opportunities for graduate study, additional training, and career opportunities.

### What is SIBS?
- Undergraduates majoring in mathematics, statistics, biology, or other science who have an interest in quantitative methods.
- Those with a baccalaureate degree are eligible to apply but priority is given to undergraduates at the time of application.
- Applicants must be American citizens or permanent residents of the United States.

### Eligibility
- No fees or tuition costs (housing, meals, and many extracurricular activities covered).
- Earn college credits.
- Hands-on training with top researchers.
- Access to top universities' facilities.

### Educational and Financial Benefits

### Additional Program Information
Eight SIBS programs will be held in the summer of 2012. Links to information on the programs including program dates, application procedures, and deadlines, will be available by Fall 2011 at the host department websites.

- **Boston University**
  http://osp.sph.bu.edu/sibs
- **Emory University**
  http://www.osp.emory.edu/cms/departments_centers/bios/bios_training/sibs.html
- **University of Iowa**
  http://obh.uiowa.edu/biostat/sibs/overview.html
- **University of North Carolina –– Duke Clinical Research Institute**
  http://www.stat.ncsu.edu/sibs/
- **University of Pittsburgh**
  http://www.biostat.pitt.edu/sibs
- **University of South Florida**
  http://health.usf.edu/sibs/
- **University of Wisconsin**
  http://www.biostat.wisc.edu/Educational_Resources/SIBS/
- **Washington University in St. Louis**
  http://www.biostat.wustl.edu/sibs/

The Summer Institutes for Training in Biostatistics are sponsored by the National Heart, Lung, and Blood Institute and the National Center for Research Resources.
SIBS II, continued, 2013-2015

Department of Health and Human Services

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Key Dates

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Anatomy of a SIBS program

✦ SIBS @ NCSU-DCRI
✦ Department of Statistics, NCSU: One of the largest departments of statistics in the world
✦ Duke Clinical Research Institute (DCRI): World’s largest academic research organization, with major emphasis on cardiovascular disease research
✦ 25 miles apart in Research Triangle region of NC
Anatomy of a SIBS program

- Not a traditional statistics course
- Broad view of biostatistics as an exciting discipline that is fundamental to health sciences research and offers myriad career options
- Overview of fundamental statistical principles and methodology
- Hands-on data analysis experience using data from DCRI studies and SAS/R
- Field trips showcasing “biostatistics in action”
Goal

Through these and other elements, pique the interest of participants and inspire them to pursue graduate training in biostatistics/statistics.
Schedule, M-F

10:00 am – noon  Lecture
Noon – 1:30 pm  Lunch
1:30 – 3:30 pm  Computer lab

🌟 Once or twice a week – field trips
🌟 Nights and Saturdays – social events
🌟 Four NCSU graduate students as teaching assistants and “mentors”
Mentors, 2004

Graduate Student Mentors
Opening dinner
Introduction to SIBS
First week

- Descriptive statistics
- Probability, distributions, sampling distributions
- Randomized vs observational studies
- Estimation, confidence intervals, hypothesis testing
- Labs: Introductions to SAS and R
- Special lecture by DCRI Director
- Field trip to DCRI
First week
First week
First week
First week
First Saturday
Lectures and labs

- Sample size calculation
- Introduction to clinical trials (statistical issues)
- Design a clinical trial!
- Linear and logistic regression analysis
- Survival analysis (K-M, log rank, Cox model)
- Issues with missing data
- Observational studies and confounding
- Early stopping and monitoring of clinical trials
Lectures and labs

- Statistics in drug development
- Statistics and genetics
- Linkage analysis, association studies
- Everything you ever wanted to know about graduate school – preparing for a career in biostatistics
- Responsible conduct of research, human subjects protections
- Case studies from DCRI projects
Field trips

- DCRI, Duke campus
- GlaxoSmithKline headquarters, RTP
- SAS Institute, Cary
- Duke University Medical Center “Cath lab”
- Duke University Center for Human Genetics
DUMC field trip

Treatment for Coronary Artery Disease: CABG, PCI or Medicine

Robert A. Harrington, MD, FACC
Professor of Medicine
Duke Clinical Research Institute
Duke University Medical Center
Capstone projects

- Data analysis challenges based on data from DCRI studies
- Teams of 3-4 participants
- Formulate hypotheses, conceive and carry out analyses, formal inferences and subject matter interpretation
- 20 minute team presentations on last Thursday
Capstone projects
Farewell dinner
Survey and evaluations

- First and last days – common survey of knowledge of and attitudes toward biostatistics (anonymous)
- Last day – evaluation of program (anonymous), exit interviews
Entertainment!
Dancing!
Mischief!
Romance!
Offspring!
Participant comments

“I wasn’t sure of my future plans before this program, and now I definitely want to go to grad school in biostatistics”

“Before coming to this program, I had no idea what biostatistics was. Now, I’m definitely thinking of going to grad school in biostatistics”

“After participating in SIBS, I am undoubtedly going to pursue a PhD in biostatistics”

“I would highly recommend this program to anyone not sure of what to do with a math degree”

“Overall, this program was fabulous and I’ll recommend it to other students in the future!”
Participant comments

“I loved the exposure to a TON of opportunities and career options in biostatistics. I’m leaving the program with a whole new appreciation for statistics. It sounds silly, but I never realized there was so much out there! I’m very grateful to have been given the opportunity to learn and experience so much this summer.”

“The field trips were my favorite part!”

“I loved the course content. It gave me a feel for what opportunities are out there”

“The instructors were all FANTASTIC!”
Past participant comments

“I attribute the SIBS program to finalizing my decision in pursuing the field as a career”

“Without the introduction ... that SIBS has provided me, I certainly would not be on the path I am now”

“The SIBS program (was) instrumental not only to the development of my interest in biostatistics but also to my preparation for graduate training in the field.”
SIBS impact

☆ Participants leave with great interest!
☆ SIBS participants are in graduate programs all over the US (Master’s and PhD)
☆ > 10 from “SIBS I” have received PhDs
☆ I write ~ 10 letters of reference for former participants each year
The future

The SIBS programs have been a phenomenal, transformative success!

But what’s next?
Challenges

- Four more years (this summer + 2013-2015) but then what happens?
- What if NHLBI and/or another NIH Institute(s) does not continue to fund the programs?
- In fact, additional such programs to inspire interest in biostatistics and statistics more generally are warranted now
Challenges

- SIBS is outstanding at inspiring interest – but how do we sustain it?
- Few follow-up opportunities exist for SIBS alumni who have a few more summers before grad school to get further experience
- Summer programs in competing fields could siphon them away.....
Challenges

*SIBS alumni who attend graduate school (and for that matter *all* of our graduate students) need training while they are in school to prepare them to be effective members of interdisciplinary research teams*

*We must adapt our *curricula* – more and more material, Big Data and computing, communication/leadership skills,*...
Challenges

» Opportunities for interdisciplinary experience come mainly through NIH T32 training grants

» But there has been no increase in the number of NIH biostatistics training grants over the last decade (~ 40)

» And only 9 are through NIGMS; the rest are through disease-specific Institutes

» There is no NIH-wide strategy for training of biostatisticians, despite our broad relevance
1. Programs to replace/supplement SIBS to continue to attract US students to biostatistics/statistics
2. Follow-up “booster shot” programs to sustain and heighten interest
3. Graduate school training experiences to prepare biostatistics students to be interdisciplinary scientists
How?

- We must take the lead as a profession
- We cannot assume that NIH, NSF, and other agencies can or will fund such programs alone
- All of the academic, government, and industry sectors are beneficiaries and hence are stakeholders
- As are professional societies and agencies
- Professional societies can partner, advocate, promote, facilitate
How?

- Lobby NIH for new agency-wide strategy for biostatistics training support at both Master’s and PhD levels, perhaps coordinated through the new National Center for Advancing Translational Sciences (NCATS)
- And for true peer review of all biostatistics training grants, disease-specific or not
- Enlist the aid of clinician/biologist colleagues, CTSA Directors
How?

- Lobby for CTSA support of undergrad “booster” and grad experiential training
- Form consortia (academic-industry-government-professional society) stakeholders to promote and spearhead
- Adapt successful models where possible; e.g., NCSU Graduate Industrial Traineeships

www.connectcanadainternships.ca,
www.masslifesciences.com/grants/challenge.html
WH Big Data initiative

- “Expand the workforce need to develop and use Big Data technologies.”
- “NIH is particularly interested in imaging, molecular, cellular, electrophysiological, chemical, behavioral, epidemiological, clinical, and other data sets related to health and disease.”
- “NSF is .... Encouraging research universities to develop interdisciplinary graduate programs to prepare the next generation of data scientists...”

http://www.whitehouse.gov/administration/eop/ostp.
Call to action

2013 is the International Year of Statistics – and Big Data are upon us. There’s no better time to come together and conceive of and fight for bold new strategies to engage, inspire, and train the next generation!