Center for Big Data Research and Applications (CBDRA)

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Measure and analyze myriad data types

Surveys
- Decennial
- ACS
- CPS
- Various others

Observational data
- Facebook
- Twitter
- TV viewing
- Mobile phone
- Internet search

Business Process
- Flight bookings
- Financial transactions
- Point of sale
- Credit cards

Sensors
- Traffic patterns
- Smart electricity meters
- Satellite images
- Weather information
Center for Big Data Research

- Use machine learning and Big Data tools and techniques to make current Census products “better, cheaper, faster”
- Research and produce new “products”
- Combine survey data, administrative records, transactions … to improve current products, and produce new ones
  - E.g. UMETRICS – current RDC release
The Vision
Using mobile phone data for national statistics

- Experiments in European statistics
  - Assessing the Quality of Mobile Phone Data as a Source of Statistics (Proximus Belgium, Statistics Belgium, Eurostat)

- Population distribution from mobile phone data

- Complement traditional statistics, capture real time phenomena
Mobile phone data - population

Census 2011

Mobile phones 2015
Using Google images to estimate ACS demographics

- Machine learning of vision
- Using Deep Learning and Google Street View to Estimate the Demographic Makeup of the US
  - Gebru, et al
  - arXiv:1702.06683
Big Data in Economic Impact of Internet Infrastructure

https://fiber.google.com/newcities/

Google Fiber locations
## Big Data in Operations

<table>
<thead>
<tr>
<th>Industry</th>
<th>Segment</th>
<th>Type of Savings</th>
<th>Estimated Value Over 15 Years (Billion nominal US dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aviation</td>
<td>Commercial</td>
<td>1% Fuel Savings</td>
<td>$30B</td>
</tr>
<tr>
<td>Power</td>
<td>Gas-fired Generation</td>
<td>1% Fuel Savings</td>
<td>$66B</td>
</tr>
<tr>
<td>Healthcare</td>
<td>System-wide</td>
<td>1% Reduction in System Inefficiency</td>
<td>$63B</td>
</tr>
<tr>
<td>Rail</td>
<td>Freight</td>
<td>1% Reduction in System Inefficiency</td>
<td>$27B</td>
</tr>
<tr>
<td>Oil &amp; Gas</td>
<td>Exploration &amp; Development</td>
<td>1% Reduction in Capital Expenditures</td>
<td>$90B</td>
</tr>
</tbody>
</table>

(Source: GE)
Big Data in Transportation

- Empty Trailer Backhaul Brokering: Enhancing Revenue and Environmental Sustainability
Big Data in Energy

- Interaction between renewables and traditional electricity generation
- BOTH demand and supply variations
- How to match demand with supply?
  - New market mechanisms
  - Automated agents
  - Smart meters
- Large scale experiments to elicit true preferences
- Causal inference possible
Big Data in Healthcare

- Medication adherence, opioid use
- Spatio-temporal analysis
  - e.g. distance to pharmacy
- Household composition
  - e.g. help from family members
- Income effects
- Work condition
- Social networks (phone, FB, etc.)
Several ongoing projects (open to innovative projects)

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IRIS Overview

• Intermediary organization to facilitate data sharing for research and reporting among universities, federal agencies, researchers
  • 60 committed university members -- ~$28.7 billion in 2015 expenditures
  • Broad engagement and support from research community/associations

• Platform for fundamental social science research of immediate practical import
  • >70 researchers from 14 institutions have accessed research data to date
  • Sloan support for research community building

• One of the first research/training infrastructures for computational social science
  • Training and courses with ICPSR, JSMP
MEMBERS: Universities contribute data, support infrastructure and receive campus-specific and aggregate reports

NODES: Approved nodes materially improve data, develop products, and expand user communities

USERS: Approved users securely access de-identified aggregate datasets

PARTNERS: Approved partners receive data from IRIS which they improve and make accessible through their own secure systems
First Research Data Release

• 19 universities
  • $11B in 2014 federal R&D (16% of total)

• Transaction level data
  • 162,694 federal and non-federal sponsored projects
  • 333,565 individuals
    • 28,641 Post-Docs
    • 76,295 Grad Students
    • 87,195 Undergrads
  • $18.1B in vendor spending to 441,796 establishments
  • $6B in subcontracts to other performers

• Links to abstracts etc for federal awards (NIH, NSF, USDA)

• Individual level links to dissertation information

• Title 13 crosswalks to LEHD, LBD, ACS, Decennial Census (available only through the FSRDC system)
Accessing data through the IRIS VDE

• No Census data available in any form, but IRIS data is mirrored in RDCs
• Windows virtual desktop environment, shuts down i/o on your machine.
• Data can be added to your scratch space by IRIS research support staff
• Only aggregate information and statistics such as regression coefficients can be removed
• Export occurs after a privacy disclosure process based on Census procedures
• Restricted access documentation in Wiki format allows user updates
• Online ticket system to report data and software bugs
• No fee now, but a modest fee for researchers who are not affiliated with IRIS member institutions is likely
Accessing data through the IRIS VDE

• Check out background materials and FAQ on IRIS Website (http://iris.isr.umich.edu/research-data/)
• Download and complete application and data use agreement
• All virtual machines are loaded with Windows 7 and the following software, packages, and libraries: Microsoft Office, Stata 14, SAS 9.4, R / RStudio, MATLAB, LaTeX, HeidiSQL, MS SQL Server Management Studio 2014, Gephi, Cytoscape, QGIS, GRASS GIS, Adobe Acrobat Pro,, Notepad++, Python, Anaconda, Jointpoint, PuTTY, WinSCP, and TightVNC Viewer. Researchers can contact IRIS for any questions concerning existing software or to request the installation of additional applications in the VDI.
Research Community Development

• More than **70 researchers** from **14 institutions** have accessed data through either VDE or FSRDC so far

• First research meeting this summer

• Sloan Foundation Support for research grants
  • $15 k Dissertation
  • $30 k early and mid-career grants
  • Call for proposals in Fall 2017

• Constituting a scientific advisory board this summer

• Next data release (target=30 universities) in Winter, 2018.
Sign up for updates on data improvements, funding and training opportunities as well as IRIS news and events via our website’s contact page http://iris.isr.umich.edu/contact/
Using Census Data at the Federal Statistical Research Data Centers

Barbara A. Downs
Director, FSRDC
Center for Economic Studies
U.S. Census Bureau
FSRDC Environment

Physical Security

• Secure Census facility within host institution
• Census employee on-site at all FSRDCs
• Authorized personnel only
• Researcher Special Sworn Status
  • Requires moderate level background check
  • Oath of confidentiality is for life
• Data accessed via secure connection from thin client device to Census data facility in Bowie, MD
• Printing strictly controlled
• No internet access
• All output reviewed for disclosure risk
FSRDC Environment
Collaboration

• Each project has “home” FSRDC
  • Researchers may collaborate across FSRDCs
  • Projects may move “homes” as researchers relocate

• FSRDC Administrator
  • Coordinates project access across FSRDCs
  • Coordinates review of output
Census Project Proposals

• Three stages of review
  • FSRDC Development and Review
    • Abstract
    • Proposal
    • Predominant Purpose Statement
  • Census Bureau Review
    • 5 concurrent reviews
  • Other Agency Review
    • SSA, BLS, IRS – any agency providing some of the project’s data
Census Project Proposals
Review Criteria

• Scientific merit
• Requires non-public data
• Provides benefit to Census Bureau programs
• Is feasible
• Poses no risk of disclosure of individual or business
Census Project Proposals
Benefits to Census Bureau

• Census-IRS Criteria Agreement
• Helps Census check data it collects, edits, and tabulates
  • Permits rigorous analysis of confidential data
  • Tests validity of data processing rules
  • Evaluates conceptual and processing assumptions
• Prepares new economic or population estimates
Census Project Proposals

Timing

- Census review
  - ~75 days
- Other Agency review
  - 3 to 6 months
- Special Sworn Status
  - Concurrent with Agency review
  - 3 to 5 months
Thank You!

• Links
  • Federal Statistical Research Data Centers
    www.census.gov/fsrdc

• Contact
  • Barbara A. Downs (barbara.a.downs@census.gov)