The Dataverse Network:
An Infrastructure for Data Sharing

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Institute for Quantitative Social Science
Harvard University

(8/14/08 talk at “UseR! 2008”, Technische Universität, Dortmund, Germany)

Papers

Papers


- More information: [http://TheData.org](http://TheData.org)
Accessibility:

Most large data sets: in public archives

Most data in published articles: not accessible, results not replicable without the original author

Problems even with professional archives:

Data in different archives have different identifiers

One major archive renumbered all its acquisitions

Changes to data are made; identifiers are reused or deaccessioned; old data are lost

Data sets are not like books

Static data files (even if on the web): unreadable after a few years

When storage methods change: some data sets are lost; others have altered content!

Connection to analysis software (like R) uncertain, time consuming, annoying, error prone

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What About a Centralized Data Access Solution?

Highly desirable when feasible
Works great in astronomy, etc., when data formats are universal, goals are common, and agreements are in place
Impossible when data are heterogeneous in format, origin, size, effort needed to collect or analyze, IRB access rules, etc.

Why don’t researchers put data in public archives?
The Archive gets the credit
Upon questioning: they want credit, control, and visibility
(So why don’t they worry about print publishers getting all the credit? Lack of data citations!)

We propose: technological solutions to these political problems

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Public Distribution: without permission from the author

Authorization: fulfill requirements the author originally met

Validation: check that data exists, without authorization

Persistence: Decades from now...

Verification: data remains unchanged, even if converted from SPSS to Stata to R, from a PC to a Mac to Linux, and from 8 inch magnetic tape to 5.25 inch floppies to a DVD.

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Legal Protection:
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First author (last name first)

Special formatting codes

Special indentation

Citations: rule-based, precise, redundant

Print Citations Work: authors don’t think publishers get all the credit; cited articles can be found; copyeditors don’t need to see the original to know it exists; the link from citation to print persists
A New Citation Standard for Numeric Data


1. Author
2. Year
3. Title
4. Unique Global Identifier: will work after URLs stop working
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Data to Universal Numeric Fingerprints

| 1 4 4 21 | ... | 1 2 2 91 | ... | 1 9 2 72 | ... | 0 2 2 2 | ... | 1 6 2 12 | ... | 1 9 4 52 | ... | 0 3 2 23 | ... | 0 2 5 91 | ... | 0 5 8 91 | ... | 1 9 1 72 | ... |
| 1 4 4 21 | ... | 1 2 2 91 | ... | 1 9 2 72 | ... | 0 2 2 2 | ... | 1 6 2 12 | ... | 1 9 4 52 | ... | 0 3 2 23 | ... | 0 2 5 91 | ... | 0 5 8 91 | ... | 1 9 1 72 | ... |

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1 & 4 & 4 & 21 \\
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1 & 9 & 2 & 72 \\
0 & 2 & 2 & 2 \\
1 & 6 & 2 & 12 \\
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0 & 5 & 8 & 91 \\
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\end{array} \]

\[ \Rightarrow \]

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Data to Universal Numeric Fingerprints

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1 & 6 & 2 & 12 & \cdots & 204 \\
1 & 9 & 4 & 52 & \cdots & 311 \\
0 & 3 & 2 & 23 & \cdots & 92 \\
0 & 2 & 5 & 91 & \cdots & 212 \\
0 & 5 & 8 & 91 & \cdots & 91 \\
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1 & 9 & 2 & 72 & \cdots & 104 \\
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1 & 6 & 2 & 12 & \cdots & 204 \\
1 & 9 & 4 & 52 & \cdots & 311 \\
0 & 3 & 2 & 23 & \cdots & 92 \\
0 & 2 & 5 & 91 & \cdots & 212 \\
0 & 5 & 8 & 91 & \cdots & 91 \\
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\vdots & \vdots & \vdots & \vdots & \ddots & \vdots \\
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\end{pmatrix}
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Advantages of UNFs

UNF is calculated from the content, not the file. It's the same UNF regardless of changes in computer hardware, storage medium, operating system, statistical software, database, or spreadsheet software.

Cryptographic technology: any change in data content changes the UNF. (cannot tinker after the fact!)

Noninvertible properties: UNFs convey no information about data content. OK to distribute for highly sensitive, confidential, or proprietary data. Copyeditor can validate data’s existence even without authorization.

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- UNF is calculated from the content not the file: It's the Same UNF regardless of changes in computer hardware, storage medium, operating system, statistical software, database, or spreadsheet software.

- Cryptographic technology: any change in data content changes the UNF. (cannot tinker after the fact!)

- Noninvertible properties
  - UNFs convey no information about data content
  - OK to distribute for highly sensitive, confidential, or proprietary data
  - Copyeditor can validate data’s existence even without authorization

- The citation refers to one specific data set that can’t ever be altered, even if journal doesn’t keep a copy

- Future researchers can quickly check that they have the same data as used by the author: merely recalculate the UNF
Web 2.0 Terminology

Software: find CD, install locally, hit next, hit next, hit next.

Web application software: no installation; load web browser and run (Dataverse Network Software)

Host: The computers where the web application software runs (universities, archives, libraries)

Virtual host: Where the web application software seems to run, but does not (web sites of: authors, journals, granting agencies, research centers, universities, scholarly organizations, etc.)
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http://www.peterson.com

http://dvn.iq.harvard.edu/peterson
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The Dataverse Network Project Homepage (http://TheData.org)

Dataverse Networks may harvest metadata from each other (dashed lines)

The IQSS Dataverse Network at Harvard University

- SMR Dataverse
- Gary King’s Dataverse
- PoliSci 101 Dataverse
- U.S. Census Dataverse
- APSA Legislative Section Dataverse
- NSF Dataverse
- Weatherhead Center Dataverse
- MacArthur Network on Inequality Dataverse
- Dept of Psychology Dataverse

Each Dataverse Network may serve numerous individual dataverses (arrows)

Most users come directly to a dataverse, which is a self-contained archive (with all services provided by a Dataverse Network)

Software is available at the project homepage and only needs to be installed to establish a Dataverse Network. Dataverses are virtual hosts.
Your Dataverse

Full service virtual archive, with numerous data services (citation, metadata, archiving, subsetting, conversion, translation, analysis, ...)

List of your data, or your view of the universe of data

Branded as yours: with the look and feel of your site

Easy to setup: give DVN your style, and include a link to your new dataverse

Easy to manage: no software or hardware installation, backups, worry about archiving standards, or data format translations; still exists if you move; easy to rebrand

High acceptability: experiments indicate >90% uptake for authors

Reuse: same data may appear on different dataverses

Results: Articles with data available have twice the impact factor! (with dataverse, it should be more)

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Journals, for replication data archives
Future Researchers: browse or search for a dataverse or dataset; forward citation search; verification via UNFs; subsetting; read metadata, abstract, & documentation; check for new versions; translate format; statistical analyses; download
Teachers, a list or for in depth analysis
Sections of scholarly organizations, to organize existing data
Granting agencies
Research centers
Major Research Projects
Academic departments, universities, data centers, libraries
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The Universe of Data meets the Universe of Methods
The Universe of Data meets the Universe of Methods

- **R Project for Statistical Computing**

- Zelig: Everyone’s Statistical Software
  - An ontology we developed of almost all statistical methods
  - Users incorporate original packages a simple model description language (and R bridge functions)
  - Result: Unified Syntax, the same 3 commands to use any method

- **R + Zelig + Dataverse Network**
  - Write Zelig bridge function
  - $\Rightarrow$ your method appears in the DVN GUI
  - Greatly reduced time from methods development to widespread use

- Easy for applied data analysts who use R
- Easy for applied researchers who don’t use R (GUI time not wasted: save R code for replication or further analysis)
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- Install DVN software & you can also give out dataverses

To increase use of your R package through Zelig and the DVN GUI:

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To join us:

DVN and Zelig are open source projects; contributions welcome!

For more information:

http://TheData.org

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Technology used in DVN Software

Language: Java Enterprise Edition 5 (with EJB3 and JSF) (team picked for JavaOne; Sun engineers regularly call for advice)
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- **Statistical computing:** R and Zelig