Metadata Systems for the U.S. Statistical Agencies, in Plain Language

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Views presented by the authors do not necessarily represent the views of their agencies.

Outline

Goals: harmonization, interoperability, machine readability.

- Our agencies can do better at this, cooperatively. This is a primer.
- Basics of metadata – what you need to interpret a statistic: 11.3
- Metadata systems -- libraries, museums, data.gov, classification
- Guidance from US and international institutions
- Example projects
- Recommendations and takeaways

Metadata for tangible objects

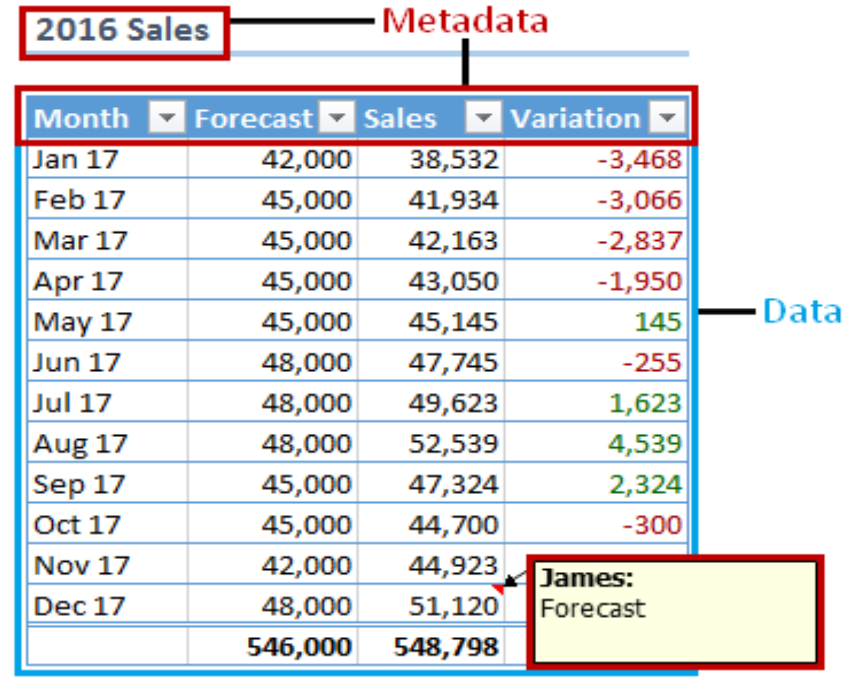
- Metadata has a long history notably for libraries
- Library catalog systems
  - Authors, titles, when and where published, length, type, topics
  - Recent standards track separately books as concept/content and as physical items
- Museum catalog
  - For each item in the collection
  - Name, maker, where it was made, provenance, type, materials, size, dimensions, conditions, legal restrictions, location, and photos
- A smartphone's components meet many metadata standards
- "Since metadata are data, then metadata can be stored in a database…" (ISO/IEC 11179).

Definitions

- Metadata associated with a data set helps use, describe, interpret, and organize it

- *Statistical metadata* are data used to describe *statistical objects*
- Information used in this *role* are metadata
- Metadata may include:
  - data description: variable names, units, frequency
  - definitions, methodology
  - microlevel detail on collection or processing or paradata

A spreadsheet



Spreadsheets contain a few metadata fields:

- tab names,
- table names,
- column names,
- user comments.

Statistical metadata

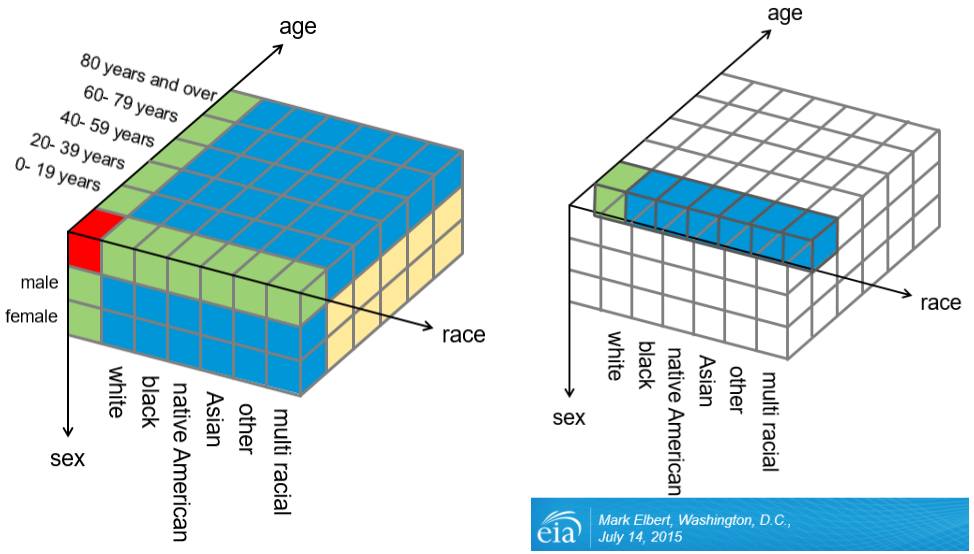
Typical statistical objects

- Concepts (especially their definitions)
- Variables
- Value domains (allowed values) for variables
- Classifications systems, code lists, and individual categories
- Questionnaires and forms
- Data collection questions
  - Wording, Response choices, Flows (skip pattern)
- Instruments (implemented questionnaires)
- Sampling plans
- Estimators
- Processing
  - Editing, Coding, Allocation
- Data sets
- Tables and N-cubes

Statistics are conceptual not tangible

Statistics and data are related to **concepts**.
Statistics have semantic relations to other values, e.g. percentages of something.

One aspect: Statistics and datasets have **dimensions.** e.g. unemployment rate for young Hispanic males in PA



Data sets and data.gov

- Documentation of a dataset is metadata
  - *Descriptive metadata* includes the methodology and year of data collection
- Data.gov lists Federal data sets
  - It shows information agencies share in a standard format on their own web sites
  - Data.gov's Open Metadata Schema is in JSON format

Dataset Fields

See the *Further Metadata Field Guidance* section to learn more about the use of each element, including the range of valid entries where appropriate. Consult the field mappings to find the equivalent v1.0, DCAT, Schema.org, and CKAN fields.

Field	Label	Definition	Required
@type	Metadata Type	IRI for the JSON-LD data type. This should be `dcat:Dataset` for each Dataset.	No
title	Title	Human-readable name of the asset. Should be in plain English and include sufficient detail to facilitate search and discovery.	Always
description	Description	Human-readable description (e.g., an abstract) with sufficient detail to enable a user to quickly understand whether the asset is of interest.	Always

Data dictionaries for variables

- Attributes typically included when describing variables include:
  - The concept a variable represents (say, marital status)
  - Value domain (<s, single>, <m, married>, <sp, separated>, <d, divorced>, <w, widowed>)
  - Datatype
  - Universe (say, adults in the US).
- Data dictionaries, variables, and variable attributes can be reused
- Goals: usability, interoperability, machine readability
  - A variable definition or data dictionary can be reused by URL/URI
  - Interoperability: Linked open data and RDF
  - Helps interoperability, inference, and prediction

Classifications and their metadata

- Our data sets use classifications for discrete, qualitatively distinct groups
- Example: Occupations
  - Population Censuses 1850-2010 had detailed 3-digit occupation lists
  - Many occupation category systems across time/place
    - SOC, O*NET, ISCO, HISCO, each of many countries, many versions and variants

- A data observation can say: occupation 55.
  - To interpret it, one needs to know which classification system it's from.
  - Want to compare it to observations across time, data sets
  - Those are **metadata issues.**
  - Crosswalks or concordances match categories
    - These are tables or decision trees; Machine learning can help
    - Classification management systems software can help track

- There are too many other classification systems to name: Industries: Census/ACS/CPS, SIC, NAICS, ISIC ; geographies; jurisdictions; illnesses and injuries; medical procedures; crops; types of schools, components of GDP, technologies in patents, . . .

Detailed Census of Population occupation categories	
1950	243
1960	296
1970	441
1980	504
1990	504
2000	543
2010	540
2018	569

Computer scientists and system analysts have no category in 1960, one in 1980, and five in 2000

Metadata for surveys

- What question was asked to produce the variable in the final data set?

- Our **unemployment rate** comes from survey data
  - It's a function of specific questions the respondent was asked
  - Are you in the civilian US population? Are you working? Hours? If not working: are you searching for work?

- To interpret income or earnings, after-tax, year, bonuses, stock options
  - DDI Life Cycle standards address these issues
- NCHS's Q-Bank

Storage and transmission of metadata

- Same formats can be used to store and transmit metadata
- For sharing data, machine-readable metadata should be sent along with it.
  - A Web API may send back data and metadata in this kind of XML. This one is from BEA.
  - The first 3 lines here have metadata so the client computer can interpret the rest as a table.

http://www.bea.gov/api/data?&UserID=Your-36Character-Key&method=GETDATASETLIST&ResultFormat=XML&

Example Return:

```
<BEAAPI>
<Request>
<RequestParam ParameterValue="GETDATASETLIST" ParameterName="METHOD"/>
<RequestParam ParameterValue="Your-36Character-Key" ParameterName="USERID"/>
<RequestParam ParameterValue="XML" ParameterName="RESULTFORMAT"/>
</Request>
<Results>
<Dataset DatasetDescription="Standard NIPA tables" DatasetName="NIPA"/>
<Dataset DatasetDescription="Standard NI underlying detail tables" DatasetName="NIUnderlyingDetail"/>
<Dataset DatasetDescription="Multinational Enterprises" DatasetName="MNE"/>
<Dataset DatasetDescription="Standard Fixed Assets tables" DatasetName="FixedAssets"/>
<Dataset DatasetDescription="International Transactions Accounts" DatasetName="ITA"/>
<Dataset DatasetDescription="International Investment Position" DatasetName="IIP"/>
<Dataset DatasetDescription="GDP by Industry" DatasetName="GDPbyIndustry"/>
<Dataset DatasetDescription="Detailed Regional Income data sets" DatasetName="RegionalIncome"/>
<Dataset DatasetDescription="Detailed Regional Product data sets" DatasetName="RegionalProduct"/>
<Dataset DatasetDescription="Retrieves various Regional datasets" DatasetName="RegionalData"/>
</Results>
</BEAAPI>
```

External guidance and constraints

- Metadata is in U.S. laws and regulations
- The UNECE family of metadata standards (GSBPM, GSIM)
  - Statistical business process model
  - Information models
- FAIR principles for scientific data
  - Findable, Accessible, Interoperable, and Reusable

➔ It's helpful not to rebuild from scratch; adopt standards implementation that meet guidance already

US laws specify metadata

- National Archives and Records Act of 1934
- Freedom of Information Act of 1967
- Privacy Act of 1974
- Paperwork Reduction Act (PRA) of 1995
- Open Data Policy – Managing Information as an Asset M-13-13 (2013)
- Digital Accountability and Transparency Act (DATA) of 2014
- Geospatial Data Act of 2018
- Information Quality Act
- Executive Order 13859 on Maintaining American Leadership in Artificial Intelligence (2019)
- Financial Transparency Act of 2019
- Grant Reporting Efficiency and Agreements Transparency (GREAT) Act of 2019

More on next slide

Recent U.S. laws and regulations

- OMB Directive M-13-13
  - Defines data.gov and its standards
- Federal Data Strategy
  - Guiding principles that encourage harmonizing federal data
  - Notably: reuse
- Evidence-Based Policymaking Act
  - Make harmonization of data easier for policy conclusions
  - Open government, open machine-readable formats
  - Encourages Web APIs
  - Codifies CIPSEA law

Example systems, dictionaries, projects

- FGDC – Program effort to develop geographic data standards
- NIEM – For interoperable data used for security, defense, public safety, justice, intelligence, and emergency management
- GIDS – Software to generate diverse Census questionnaires for the Economic Census, which differ for each industry

Non-Federal:

- ICPSR's DDI codebook and thesaurus
- Wikidata, Schema.org, SDMX, JSON-stat, . . . many more

Return on investment for metadata systems

ROI on metadata systems is not all in terms of money.

Costs include:

- Coordination of subject, survey, and IT specialists
- within and across agencies

Benefits: Metadata helps

- Facilitate use of our data directly
  - Help integrate and interoperate from other sources/agencies
  - Simplify questions users pose to us
- Retain organizational knowledge
  - Help address risks and costs of obsolescence of code & data ; transparency
- Develop future systems
  - To reuse survey questions, definitions of variables and classifications (DDI Codebook)
- Conduct research – ours and others
  - Statistical agency staff need to be involved

Recommendations and takeaways (1)

- **Reuse** established terminology, classifications, metadata schemes
  - Plan and share with other statistical agencies
  - Saves time and achieves interoperability and comparability
  - Meet standards and FAIR principles

- **Build** small; think big
  - Implementations help shape standards and vice versa
  - Identify opportunities and stakeholders for metadata systems
  - Try tools from other subject matter
  - Partner with external services working with Federal data
    - E.g. Google, Statistics USA, IPUMS

Recommendations and takeaways (2)

- **Learn** metadata tools
  - Engage with experts; attend conferences
  - Connect to professional groups and international institutions
  - Know the lingo – our glossary may help
  - Be aware of metadata standards for relevant subjects
    - DDI, FGDC/NGDA, NIEM, SDMX, GSIM, GSBPM
    - See tools and guidance at Data.Gov and Federal Data Strategy Action Plan
  - Take training; we can develop training together

- **Participate** in and advocate machine-readable metadata
  - Statistical agencies can enhance data.gov's Open Metadata Scheme
    - Standardized data dictionaries, seasonal adjustment tag, classification management
  - Use other metadata standards relevant to statistics

Contact

Any questions?

What else should we know about metadata issues?

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