Expanding the Role of Synthetic Data at the U.S. Census Bureau

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Tension between Confidentiality and Information Content of Statistical Products

- NSOs use a wealth of information to fulfill their mandate to provide information about the economy and population including
 - Survey collections
 - Administrative records
- Individuals often are legally required to provide this information
 - → High response rates
 - → High quality data
 - → Structured data (representative of the underlying population)
- NSOs are entrusted to use this information only for statistical purposes, with the explicit understanding that the data are confidential and won't be disclosed
 - Disclosure protection often codified in statutes
- Necessarily limiting the types of data products that can be publically released

Increasing the variety and information in statistical products while maintaining confidentiality

- Statistical products are constructed via suitable aggregation of confidential survey, census or administrative microdata
 - Products cannot reveal data for individual persons, households or firms
- However, products constructed from microdata so that re-identification is sufficiently difficult can potentially reveal details and features that traditional aggregations must mask to maintain confidentiality
- One approach to avoid literal masking is to use multiple imputation to fully or partially synthesize key variables or entire datasets
- The resulting “Synthetic” data set can be used to construct safe data products

Public-Use Synthetic Microdata

- Some sophisticated users require access to detailed microdata
- The traditional solution was to provide access through
 - Anonymized micro data
 - Secure environments such as a Research Data Center
- Anonymized microdata is becoming more risky and so restricted access, even in RDCs
- Synthetic datasets can address both concerns, and Census has produced two experimental versions
 - SIPP-Synthetic Beta: household data augmented with administrative data
 - Synthetic Longitudinal Business Database (SynLBD): synthetic panel of business establishments

Synthetic Data

- Synthetic data is the result of a process of data anonymization
- Synthetic data are generated by modeling real data
 - Sampling from posterior predictive distribution
 - Sequential regression multivariate imputation
- The resulting data tries to preserve as many of the moments of the real data as well as summary aggregates
- Higher confidentiality protection since respondent information is modeled

Development of Synthetic data products at the Census Bureau

- Collaboration between academe and Census research staff
 - Cornell and Duke Universities, National Institute for Statistical Sciences
 - Center for Economic Studies, Center for Disclosure Avoidance Research and Social, Economic and Household Statistics Division
- Partial funding from the National Science Foundation
- Census staff benefit greatly from working with leading academics
- Collaborations resulted in two class of new data products employing synthetic or partially synthetic data
 - Synthetic Public Use Micro Datasets
 - Online tools

Synthetic Data to Support Online Tools and Apps

- Partially Synthetic data allow users to select custom geographies in “OnTheMap”
- Commuting patterns natural disasters

Future of synthetic data in official statistics

- Data users will access official statistics in apps developed outside of NSOs
 - The Census Bureau has an open data API that allows developers to call tabulated estimates from several surveys
 - Allowing an API to call from synthetic micro data would allow developers much more latitude in creating apps that give users maximum flexibility
- Synthetic data can play a prominent role in producing public-use micro datasets as it gets more difficult to release anonymized data that protects confidentiality

Challenges

- Synthetic data aren't valid for all analysis goals, and determining validity can be challenging
- Users may not accept or “trust” synthetic data
- On the other hand, users may put too much faith in estimates from synthetic data, taking the values as “truth”
 - Already observed for multi-year estimates from the American Community Survey
- Statistical inferences require additional computations, requiring a higher level of user sophistication or flexible algorithms
- NSOs may not have sufficient staff with the training and skills to develop, deploy and support synthetic data products

Next Steps

- Research and development of synthetic data products continues
 - SynLBD v3 will be expanded to include firm characteristics and full time coverage
- NSOs need to pay special attention to educating the public on correct use of synthetic data and to make sure they know when they are using it
 - This might require developing software code to facilitate correct computation of statistical inferences
- Partnerships with academe should be reinforced
 - Mutually beneficial and key to developing internal human capital
 - Universities can develop courses targeted at NSO staff
- More aggressively explore partnerships with private industry to develop easy to use, multi-platform synthetic data applications
- Resources are limited, but interest and potential are sufficiently high that public/private partnerships are possible