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UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF CALIFORNIA
SAN JOSE DIVISION

NATIONAL URBAN LEAGUE; LEAGUE OF WOMEN VOTERS; BLACK ALLIANCE FOR JUST IMMIGRATION; HARRIS COUNTY, TEXAS; KING COUNTY, WASHINGTON; CITY OF LOS ANGELES, CALIFORNIA; CITY OF SALINAS, CALIFORNIA; CITY OF SAN JOSE, CALIFORNIA; RODNEY ELLIS; and ADRIAN GARCIA,

Plaintiffs,

v.

WILBUR L. ROSS, JR., in his official capacity as Secretary of Commerce; U.S. DEPARTMENT OF COMMERCE; STEVEN DILLINGHAM, in his official capacity as Director of the U.S. Census Bureau; and U.S. CENSUS BUREAU,

Defendants.

CASE NO. 20-cv-5799-LHK

DECLARATION OF DR. THOMAS A. LOUIS, PHD IN SUPPORT OF PLAINTIFFS' MOTION FOR STAY AND PRELIMINARY INJUNCTION

EXPERT DECLARATION OF DR. THOMAS LOUIS, PHD

I. Introduction

1. On August 3, 2020, the Census Bureau and Commerce Department announced that the Bureau will stop collecting census data on September 30, 2020 and to report the population totals used for congressional apportionment to the President by December 31, 2020. These revised deadlines will severely compromise the quality, accuracy, reliability, and indeed the legitimacy of the 2020 Census numbers used for apportionment, redistricting, and the many other important data products based on them.

2. The importance of a high-quality census goes well beyond apportionment. Quoting the Census Bureau's website, "The 2020 Census will determine congressional representation, inform hundreds of billions in federal funding every year, and provide data that will impact communities for the next decade."1

3. I have reviewed the Census Bureau's operational plans for the 2020 Census, the documentation that the Bureau issued describing the actions it is taking in response to the COVID-19 pandemic, its August 3, 2020 press statement announcing its intention to truncate the 2020 Census, its recently issued "2020 Operational Schedule Review," and a variety of other materials that the Bureau has posted to its website. I conclude that the administration's decision to shorten the timelines for data-collection and data-processing in the face of COVID-19 are very likely to negatively affect the accuracy, reliability, and legitimacy of this decade's census count.

II. Qualifications and Retainer Information

4. I briefly describe specific aspects of my qualifications and work experience that establish my credentials as an accomplished statistician and an expert on the Census Bureau and the Decennial Census. I have also attached a copy of my CV to this declaration.

5. I have been retained to provide this declaration for a $1,000 flat fee.

6. From 2013 to 2015, I served as Associate Director for Research and Methodology and Chief Scientist at the Census Bureau, working under an Interagency Personnel Agreement between the Bureau and Johns Hopkins University. I have held professorships in Biostatistics

[1] https://2020census.gov/en/census-data.html.

and Mathematics, employment at the Rand Corporation, and have been an active participant in professional organization activities concerning both the census and statistical research and methodology more generally. As a result of these roles, I have a deep understanding of the skills and processes that are necessary to achieve a complete and accurate Decennial Census.

7. The Research and Methodology Directorate at the Census Bureau is charged with conducting research and technology transfer related to survey design, disclosure avoidance, use of administrative records, statistical methods, economics, and survey measurement. The Directorate's staff collaborates broadly within and outside the Bureau. In my role as Associate Director for Research and Methodology and Chief Scientist at the Census Bureau, I gained deep familiarity with many of the statistical processes and standards necessary to generate a high quality census. During my tenure, I participated in the weekly management committee meetings where policy for the 2020 Decennial Census was set, as well as in advisory committees, including the advisory committee for the 2020 Decennial Census. I chaired the Census Bureau's data quality standards committee. I also advised and mentored staff in my directorate. Additionally, I occasionally represented the Bureau externally. In 2016, though no longer associate director, I continued to advise the Bureau on statistical analyses it uses to produce the data necessary for making alternative language determinations under Section 203 of the Voting Rights Act.

8. Since 1973, I have held tenure-track and tenured professorships in biostatistics or mathematics. Since 2002, I have been a Full Professor in the Department of Biostatistics, Johns Hopkins Bloomberg School of Public Health. In 2018, I became Professor Emeritus in the same department.

9. In addition to the work experience described above, I am an elected member of the International Statistical Institute and a Fellow of the American Statistical Association, the American Association for the Advancement of Science (AAAS), and the Institute of Mathematical Statistics. I am a National Associate of the National Research Council, an Honorary Life Member of the International Biometric Society, and hold an Honorary Doctorate from Hasselt University, Belgium. I have served as coordinating editor of the *Journal of the*

American Statistical Association, co-editor of *Biometrics*, and president of the International Biometric Society. I chaired the American Statistical Association's Section on Bayesian Statistical Science, and the Statistics Section of the American Association for the Advancement of Science. I have served on the National Academy of Science's Committee on National Statistics and on a variety of panels including the Panel on Estimates of Poverty for Small Geographic Areas. I also chaired the Panel on Formula Allocation of Federal and State Program Funds. In 2020, I chaired the committee that reviewed the Joint Program in Survey Methodology, a graduate-degree program offered jointly by the University of Maryland and the University of Michigan.

10. I have been asked by counsel for the Plaintiffs to comment on the effects on data quality of the federal government's August 3 decision to end data-collection for the Decennial Census on Sept. 30, 2020, and report apportionment data to the President of the United States by Dec. 31, 2020. Specifically, I have been asked to address:

- The Census Bureau's data-processing operations for the Decennial Census.
- The importance of the Census Bureau's data-processing operations for the quality of data products based on the Decennial Census, with specific focus on the state population totals used for apportionment and the population counts used for redistricting.
- Any effects that the decision to halt Decennial Census data-collection on Sept. 30 and truncate data-processing operations will have on the quality of data products based on the Decennial Census.

11. My opinions and judgments in this declaration are based on the knowledge I have gained through my education and experience. They are my own and do not necessarily represent those of Johns Hopkins University.

12. My declaration will first provide some general background for understanding the census operations that are endangered by the new truncated timelines. Then, it will explain how the Census Bureau's various data-collection and data-processing operations work together to produce a fair, accurate, and legitimate count. From there, the declaration will describe the

general consequences that substandard data collection has for census accuracy and how the Bureau's new, shortened timeline will have serious negative effects on the adequacy of its data collection. Then, I will describe the major components of the census's data-curation and-processing operations, explaining along the way how each will be negatively affected by the Bureau's new, truncated timelines. Finally, I will describe how inaccuracies in census data will affect two of the Bureau's most significant data products: the population totals used to apportion the U.S. House of Representatives and the data files that states use to draw electoral districts.

III. Background

13. A successful decennial census requires over ten years of advance planning, testing, evaluating, innovating, revising, and stress-testing, as well as substantial time developing questionnaires, webpages, and hand-held devices.[2] The Census Bureau had to resolve management challenges, such as renting and equipping field offices, as well as vetting, hiring, and training hundreds of thousands staff, including the enumerators who will travel to housing units all around the country to collect their occupants' responses.

14. Then, the Bureau must conduct the actual census, first by attempting to encourage people to self-respond via the internet, hard copy questionnaires, or telephone hotlines. If every household were to respond in one of these ways, the Bureau would have no need for Non-Response Follow-Up (NRFU)—the process by which the Bureau, as the term suggests, follows up directly with housing units that do not provide their answers to the census questionnaire early in the census-taking process. But, at present, only approximately 64% of households have self-responded. That leaves about 56 million addresses that hundreds of thousands of census takers must visit to collect the required information.

15. During and after data collection, the Bureau evaluates the information in its databases, replaces missing values with best estimates, corrects anomalies, assesses the quality of the resulting data, and improves that data (to the degree possible). Finally, the Bureau judges each of its data products to determine whether they are "fit for purpose" and releases only that

[2] *See* U.S. Census Bureau, *2020 Census Operational Plan*, Version 4.0 (2018), https://www2.census.gov/programs-surveys/decennial/2020/program-management/planning-docs/2020-oper-plan4.pdf.

data that the Bureau concludes is fit. The first bodies of information that the Bureau releases are the state population totals that support congressional apportionment, then the population files used for redistricting. These two major data releases are followed by a wide variety of data products based at least in part on the Decennial Census.[3]

16. All the foregoing is very challenging. But the advent of COVID-19 has considerably amplified these challenges, and, consequently, the risks to achieving the Census Bureau's mission of "counting every person, counting them once, and counting them in the right place." For example, as a result of COVID-19, NRFU operations were delayed, the difficulty of hiring and training enumerators increased, and the willingness of households to interact with enumerators decreased. In this context, truncating or otherwise altering census processes to meet the revised deadline of September 30, 2020 to complete NRFU data collection, the December 31, 2020 deadline for delivering the population counts to be used for apportionment, and the March 30, 2021 deadline for delivering the population counts to be used for redistricting, will degrade the actual and perceived quality of the Decennial Census data, as compared to the data that the Bureau would be able to produce if it could continue collecting data until October 31, 2020, deliver the apportionment counts in April 2021, and transfer the redistricting data to the states in July 2021. These circumstances will also degrade trust in the Decennial Census data.

17. The Census Bureau is staffed by skilled and dedicated civil servants, and I believe that they will do everything in their power to meet the revised deadlines. But for the Bureau's staff to do so, some key operations will need to be eliminated or abridged. In so doing, there will be a considerable degradation in census quality and its validity to support policy.

18. For more than ten years, the Bureau has been planning, experimenting, and lab- and field-testing for the 2020 Census. Along the way, the Bureau has been challenged by funding shortfalls and, now, COVID-19. The new deadlines will compromise the quality of collected data and considerably increase the need for error correction, imputation, and other "cures" that are

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[3] *See* U.S. Census Bureau, *2020 Census Detailed Operational Plan for: 19. Response Processing Operation (RPO)*, Version 2.0 (2019), https://www2.census.gov/programs-surveys/decennial/2020/program-management/planning-docs/RPO_detailed_operational_plan-v2.pdf.

only, at best, partial fixes. Once NRFU is terminated, it will be impossible to go back into the field because field offices will be closed and field staff terminated. Additional time for NRFU would considerably improve the completeness and quality of collected data by helping the Census Bureau avoid lost opportunities.

IV. Complex, Integrated Systems

19. Successfully planning, implementing, and completing the 2020 Census is a complex task. This is true for the Decennial Census as a whole, as well as its many component operations and sub-operations, including the operations the Bureau uses to collect the data it receives from well over one-hundred million households and then process it into usable forms. This complexity is well documented in the Bureau's own reports.[4] Figures 1, 2, and 3—which are included at the end of this declaration and which are drawn from the Bureau's own publicly available operational plans—graphically illustrate some of the many operations that must be successful for the census's results to be accurate and reliable. Some of these operations proceed in parallel, others sequentially, many recursively.

20. The Bureau's data-collection and data-curation/processing operations have benefitted from considerable automation, but clerical and expert attention is still needed for many components. The need for personnel time is most obvious for NRFU operations, for which very large numbers of vetted and trained field staff are key. But many components of the post-collection phase also require considerable personnel time and expertise. Importantly, substandard performance on some tasks challenges subsequent tasks and can degrade the overall quality of the census data. This is true both within the data-collection and data-processing operations, as well as between those two operations. Under these circumstances, the federal government's decision to shorten the Bureau's remaining time to complete the 2020 Census will create a cascading chain of consequences. First, shortening the NRFU timeline will result in substandard data collection. Then, such substandard collection will increase the scope of the work that the Bureau will have to perform in the data processing phase. At the same time, degraded data,

[4] *See 2020 Census Detailed Operational Plan for: 19. Response Processing Operation (RPO)*, version 2.0, 2019); *2020 Census Operational Plan*, version 4.0 (2018).

truncated timelines, and labor shortages will significantly constrain the Bureau's ability to correct for any data collection errors it encounters. Together, these conditions will lead to a substantially less accurate, lower quality 2020 Census.

V. Consequences of Substandard Data Collection

21. The quality, or lack thereof, of the data collection operation, including Non-Response Follow-Up (NRFU), is the most obvious, and likely the most important, example of the cascading consequences of substandard census performance that the Bureau's new timelines will produce. The quality of the data that the Census Bureau collects (a) directly increases with the number of households for which the Bureau has complete data, (b) is aided by the number of households for which the Bureau has partial data, and (c) is degraded by the number of households with no directly-collected information.[5] Information is directly collected if it is obtained by self-response (internet, telephone, or hard-copy) or obtained by field staff during NRFU.

22. There are data quality assessments and enhancements required for all data that the Bureau collects. But, the challenges of assessing and enhancing data are greatest for households that require all or most of their information to be "imputed"—that is, derived from administrative records and other sources because the people whom the data concerns have not responded directly to the census. The Bureau uses modeling to develop imputation models over the pre-census period, but these models always require additional expert inputs in the face of the realities the Bureau encounters in the field when the census begins. Crucially, the less data the Bureau has about housing units in a given geography, the more difficult it becomes for the Bureau to correctly impute households. I discuss this problem at greater length in Section XI below. Ultimately, failure to collect high-quality data during NRFU will seriously impact the Bureau's processing operations. By constraining data collection, the Bureau's new timelines will create significant obstacles for data processing.

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[5] *See* Joseph J. Salvo, *The Importance of Self-Response in the 2020 Census,* https://www1.nyc.gov/assets/planning/download/pdf/planning-level/nyc-population/census2020/importance-self-response.pdf (last visited Aug. 23, 2020); Joseph J. Salvo et al., *Census 2020 Why Increasing Self-Response is Key to a Good Count*, Significance (Jan. 29, 2020), https://rss.onlinelibrary.wiley.com/doi/10.1111/j.1740-9713.2020.01356.x.

VI. Consequences of Substandard Data Collection for Hard-To-Enumerate Populations

23. In addition to the inherent challenge of imputing a large amount of data, the challenge is considerably increased for "hard to count" geographic and demographic groups. The Bureau makes special efforts to obtain self-reported information from these groups, because the quality of administrative records and other information used in imputation models is lower for them.[6] Therefore, NRFU is central to the Bureau's operational plans to maximize directly-collected information. NRFU must be as high-quality and complete as possible, so that directly collected data can be used with relatively little need for quality enhancement (*see* Section VIII). A shortened NRFU time reduces the amount and quality of information collected directly from the homeless, minority groups, group quarters (facilities such as nursing homes, prisons, colleges), and other groups. And, because of the relatively poor quality of the data available to impute the members of such hard-to-count groups that the Bureau misses during NRFU, a shortened NRFU period imperils the Bureau's ability to provide trustworthy data for these groups.

VII. Additional Impact of Substandard Data Collection

24. Though a principal role of NRFU is to obtain data from households and individuals who have not self-responded, its role is far greater. NRFU can resolve issues that cannot be resolved as well (or at all) in the data processing phase. One example of a problem that NRFU can resolve more easily than later operations is "non-ID response," that is, census responses that people have submitted through the Bureau's website without providing a census-issued ID number. Non-ID response may produce an address that is not in the Bureau's Master Address File (MAF), which the Bureau uses to contact and track every housing unit in the country. When that happens, the Bureau's field staff must go to the presumed location during NRFU, check the response for validity against the housing unit they locate at that address, and possibly correct the information earlier submitted through the website. Also, many duplications

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[6] *See* Dave McClure et al., *Administrative Records in the 2020 US Census: Civil Rights Considerations and Opportunities*, Urban Institute (2017), https://www.urban.org/sites/default/files/publication/90446/census_ar_report.pdf; Z.H. Seeskin et al., *Constructing a Toolkit to Evaluate Quality of State and Local Administrative Data*, Int'l J. Population Data Sci. (Jan. 2019), https://ijpds.org/article/view/937/1031.

and vacancies can be resolved in the field. But these problems can only be resolved while field operations are active. As these examples reinforce, shortening the time for NRFU, as the Administration has declared and the Bureau has implemented, will cause the quality of the data that the Bureau will collect to be substantially worse.

VIII. Data Processing and Curation

25. As a baseline matter, even if all households, group quarters, and individuals self-responded to the census, the Bureau would still have to invest considerable work and time to make the data fit for use. Among the many tasks that the Bureau has to perform include:

- transforming written responses into code that computers can read;
- checking (and ideally fixing) illogical relations among data items, for example a parent who is younger than their child;
- checking the accuracy of geocoding (location), for example an address in one state that is geocoded to another;
- detecting and remediating over- or under-counts in various domains (such as different geographic areas or demographic groups);
- conducting the census count review; and,
- generally assessing and upgrading data quality and reliability.

26. Some processes are substantially sequential, requiring data to be collected before being processed. But many components of data curation are recursive. This means that a reviewer must take an initial pass through the data to identify issues, ideally resolve those issues, and then revisit the resulting data looking for new or additional issues. Additionally, staff, time, and other resources are needed to check that all aspects of the computer programming are correct, and some issues only emerge when the actual data are being processed.

27. Though many processes are automated, many require expert input, and therefore require time. For example, the Bureau has to a large degree automated outlier detection and identification. The goal of detection is to identify data items, individuals, or households that have values that appear anomalous relative to previously collected information or the predictions of the Bureau's statistical models. Examples include the age structure of a housing unit occupied

by a family with the same name as in the previous census, that is incompatible with the ten-year interval; or a number of dependent-aged children that is incompatible with tax records.

28. When the Bureau identifies outliers, it must then search for additional information to correct them. Many of these activities require expert input. As is the case in all data curation contexts, a computer algorithm cannot do it all. A person reviewing suspected outliers must ask whether the problematic value is idiosyncratic, or if it is a marker of a more general problem. If the former, can it be fixed? If the latter, can the more general problem be identified and the data adjusted? In the census context, an example of a general problem is that an enumerator has reported a large amount of inaccurate data. If NRFU is still active, some can be corrected in the field. Another example, one that operates in all contexts, is outliers induced by computer programming errors. Generally, these can be fixed in the data curation phase. In general, some error remediation can occur while NRFU is active, some once NRFU is closed, some will be difficult to resolve completely.

29. These are all time-consuming operations that will be made harder by a truncated NRFU period, both because it will reduce the time available to conduct field corrections of anomalies, and will also increase the amount of missing data that must be addressed by data curation, time that hasn't been made available.

IX. Impact of Revised Timelines

30. Based on my knowledge and experience, it is my opinion that the Bureau's revised timelines have forced it to cut corners to meet the December 31, 2020 and March 30, 2021 deadlines. For example, in the Bureau's August 17, 2020 Review of 2020 Operational Plan Schedule, the Census Count Review Operation is not mentioned.[7] The omission of the Count Review Operation is a point of significant concern, to the extent that omission reflects the Bureau's decision either not to conduct it, or to conduct it in a less complete or robust manner. The Count Review is an important quality control operation. The Count Review Operation helps

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[7] *See* Albert E. Fontenot & Timothy P. Olson, *Review of 2020 Operational Plan Schedule* (Aug. 17, 2020), https://www.census.gov/content/dam/Census/newsroom/press-kits/2020/2020-operational-plan-schedule-review.pdf.

enhance the accuracy of the 2020 Census by, among other things, "[e]valuating census responses and subsequent data files at multiple levels of geography for reasonableness and verifying that edits have been properly applied."[8]

31. This is a very time-consuming and important operation, which the Census Bureau has previously concluded is essential to an accurate count. Eliminating it will help the Bureau achieve the December 31, 2020 deadline for delivery of apportionment data, but will do so at a considerable cost in the quality and credibility of that data.

32. The Bureau's latest schedule highlights additional concerns. For example, the last item on slide 9 of the August 17, 2020 Review of 2020 Operational Plan Schedule reports, "Streamlining backend processing to deliver apportionment counts by the statutory deadline of December 31, 2020." Inevitably, streamlining will degrade quality, because the systems and procedures that have been developed and tested over the decade are designed to be both necessary and sufficient. So, alteration will necessarily depart from these best practices.

33. Additionally, slide 17 reports that, "Professional career staffers at the Census Bureau are evaluating the processes and procedures and incorporating technological developments, such as the improvements in the quality of the Master Address File, to determine how to effectively and accurately deliver apportionment counts by the statutory deadline of December 31, 2020." The slide contains no information to suggest that the evaluation will reveal shortcuts that will produce high-quality counts by the deadline. In any event, any shortcut that the Bureau would identify through this evaluation would require extensive assessment to determine that it is fit to purpose. The timeframe that the Bureau has now imposed on the process is unlikely to support that robust and necessary assessment.

34. Finally, all of the Bureau's post-data collection activities are compromised by the requirement that Bureau personnel dedicate resources to developing population files on the citizen voting-age population of each state, to comply with an executive order from President Trump. Even under appropriate timelines for other activities, diversion of resources to this task

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[8] U.S. Census Bureau, *2020 Census Detailed Operational Plan for: 23. Count Review Operation (CRO),* Version 1.0 (2019), https://www2.census.gov/programs-surveys/decennial/2020/program-management/planning-docs/CRO-detailed-operational-plan.pdf.

would be damaging. But under the shortened deadlines, this diversion of resources will be especially damaging.

X. Administrative Records

35. Several of the processes outlined above can—under certain circumstances—be aided by information in administrative records, even in cases where no data are missing for a household. Incomplete or substandard data collection adds the need to impute missing values, as well as increases the Bureau's workloads for error-checking and -adjudication. Figures 2 and 3 —both of which are drawn from the Bureau's detailed operational plans—display the complexities and dependencies of these processes. In 2020 Census Supporting Statement Part A, the Census Bureau indicates that 2020 Census operations and assessments would substantially rely on federal administrative records (SSA, IRS, CMMS, HUD, USPS, etc.), state records (SNAP, WIC, etc.) and local records (AdRecs), as well as third-party data from commercial operations and preexisting Census Bureau information (such as data from previous decennial censuses and the American Community Survey). Under the Bureau's original plans for the 2020 Census, this information would be used to enumerate or help enumerate or validate (i.e., check to see if collected data are compatible with information from other sources) several millions of households. It would also be used to reduce the NRFU workload. Decades of researching, collecting, and harmonizing this data undergird this integral component of census operations.

36. But, while administrative records can increase efficiency and accuracy, their use is by no means push-button. For example, state and local records vary in quality, and relations amongst data items from different sources can vary by geography.[9] These and other features require considerable time and expertise in the data-processing stages to implement correctly.

37. Cutting the census timelines short will reduce the quality of the data—that is, increase the distance between delivered and actual values.

XI. Imputation

38. Along with administrative records, imputation is used to fill in incomplete

[9] *See* Nat'l Acads. of Sci., Engineering, & Med., *Innovations in Federal Statistics, Combining Data Sources While Protecting Privacy* (2017), https://www.nap.edu/catalog/24652/innovations-in-federal-statistics-combining-data-sources-while-protecting-privacy.

response records using data from "similar" households. The validity of any imputation depends on sophisticated matching algorithms to identify "similar" units and relevant administrative records. Imputed values can, if arrived at carefully and based on high-quality data, have good validity. But, of course, the Bureau would very much prefer to have directly collected information as a starting point, because directly collected information is higher quality data.[10]

39. The need for massive imputation taxes staff time and can tax the pool of donor households—that is, households with attributes similar to the one with missing information—used to fill in missing information because it may lead to that pool running out of good matches. What this means, concretely: A large portion of imputation depends on "borrowing" information from other, "similar" households. As the need to impute increases, the relative number of good matches decreases. This is especially true for populations such as a small minority group in a census block or block group. As for many other data-processing operations, high quality imputation takes time. If the time devoted to it is reduced, there will likely be housing units with only partially resolved issues, but the Bureau will need to treat them as resolved, resulting in poor quality. For example, administrative records or paradata (context information collected by field staff) may show that a housing unit is occupied. But, the Bureau might not succeed in collecting any data from the unit. Because the unit is occupied, the Bureau will have to use imputation to produce a count of the residents. Due to the lower quality of administrative records for hard-to-count populations, the imputed values are likely to be less accurate for hard -to- count groups than for the relatively easy to count.[11] A situation such as this lays the foundation for differential undercounts, including racial and ethnic differential undercounts, and a generally less accurate and fair census. Foreshortened NRFU will create many such situations.

XII. Undercount and Overcount

40. Under- and over- counting in general biases counts, as do under- and over-

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[10] *See* Joseph J. Salvo, *The Importance of Self-Response in the 2020 Census,* https://www1.nyc.gov/assets/planning/download/pdf/planning-level/nyc-population/census2020/importance-self-response.pdf (last visited Aug. 23, 2020)

[11] *See* Dave McClure et al., *Administrative Records in the 2020 US Census: Civil Rights Considerations and Opportunities*, Urban Institute (2017), https://www.urban.org/sites/default/files/publication/90446/census_ar_report.pdf.

counting for specific geographic or demographic groups. The bias can influence apportionment, redistricting, and a variety of other uses of census products. As for most Census operations, the situation is complex. The Bureau's ability to identify and remediate problems with the data depends on previous Decennial Census data and other information, including administrative records. Pre-release record-matching of addresses and names is used to identify and reduce over-counts.

XIII. Apportionment

41. A great deal of curation is necessary before 2020 Census data are fit for use. The challenges depend to a degree on the intended use, and while it is the case that producing accurate state-wide total counts is less challenging that providing counts for smaller geographic or demographic domains, most of the issues and procedures identified in Section VIII must be addressed or deployed before apportionment figures should be delivered to the President and Congress. For example, it is well known that children under 5 years old are under-counted. Because of this systemic undercounting problem, a state's total population count will be lower than the true, underlying value.

42. One aspect of this systemic undercounting issue is key for apportionment. The percentage of children under 5 years old varies by state, as does the age-specific under-count. Consequently, when this undercount manifests, state-specific computed "shares" (percents) of total U. S. population will be different from their true, underlying shares, and congressional apportionment may be different from what would be produced by accurate data. This small example communicates the general idea. But the challenge is by no means small because there are a large number of domains (including, age, race, urban/rural, and citizenship status) where inaccuracy could generate inappropriate apportionment. Whatever the causes, if the deviations from the true, underlying state populations are large enough and spread unequally across states, state-specific shares of the U. S. population will differ from their true, underlying values. To achieve this accuracy goal, curation must be effective, and effectiveness requires considerable time and expertise. Meeting the current December 31, 2020 deadline will severely compromise the effectiveness of these processes and thereby will compromise the success of the

apportionment count.

XIV. Redistricting

43. By March 30, 2021, the Bureau plans to send redistricting counts to the states. This information is used to redraw legislative districts based on population changes. All of the challenges so far identified operate with additional force in developing high-quality, redistricting information. Accuracy is required at fine geographic and relatively fine demographic scales. Truncating field collection and data curation will severely compromise the quality of the redistricting data.

XV. Coda

44. In summary, truncation of the time for field operations and data curation, especially in the midst of the COVID-19 pandemic, will severely compromise the quality of the census data to be used for apportionment, redistricting, for policy and economic development, and for research. All these uses and more are key pillars of our democratic society, and every effort should be made to "get it right." The Bureau will most likely release numbers at the end of the census process. But if the quality of those numbers is low, fair apportionment and redistricting will be compromised. Widespread perceptions of inaccuracy, for example generated by post-release corrections will degrade trust in these numbers specifically, in 2020 decennial data more generally, and, likely, in all other Census Bureau produced information. Restoring the Spring and Summer 2021 deadlines to deliver curated and processed data will provide the Bureau time to substantially improve all of its products.

Tables and Figures

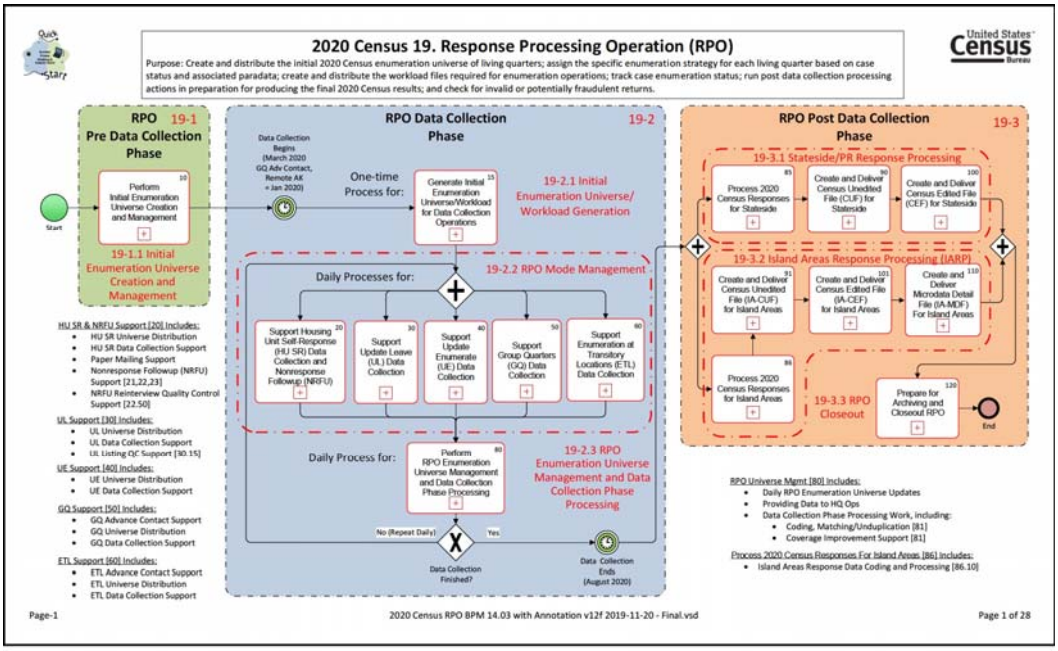

Figure 1: RPO Operational Context Model

Figure 1: Top-level business process model, Figure 01 in 2020 Census Detailed Operational Plan for: 19. Response Processing Operation (RPO), version 2.0, 2019.

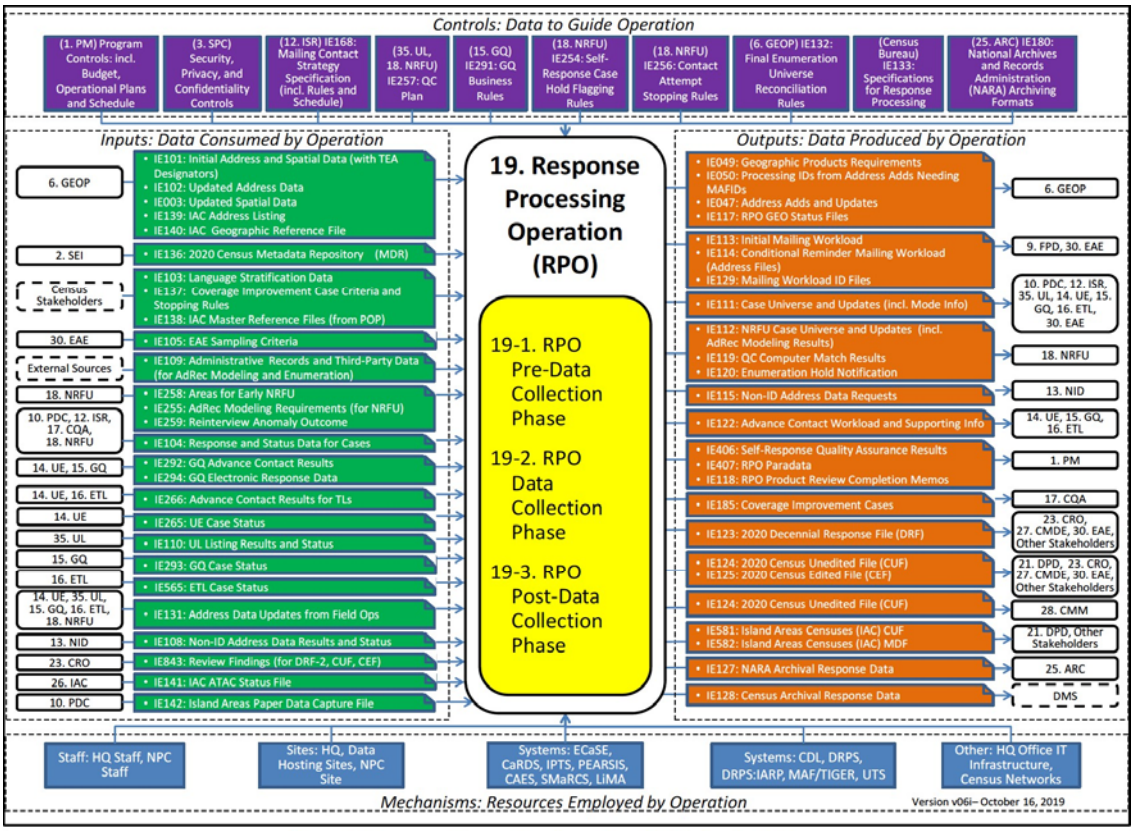

Figure 3: Response Processing Operation (RPO) Context Diagram

Figure 2: Context Diagram, Figure 03 in 2020 Census Detailed Operational Plan for: 19. Response Processing Operation (RPO), version 2.0, 2019.

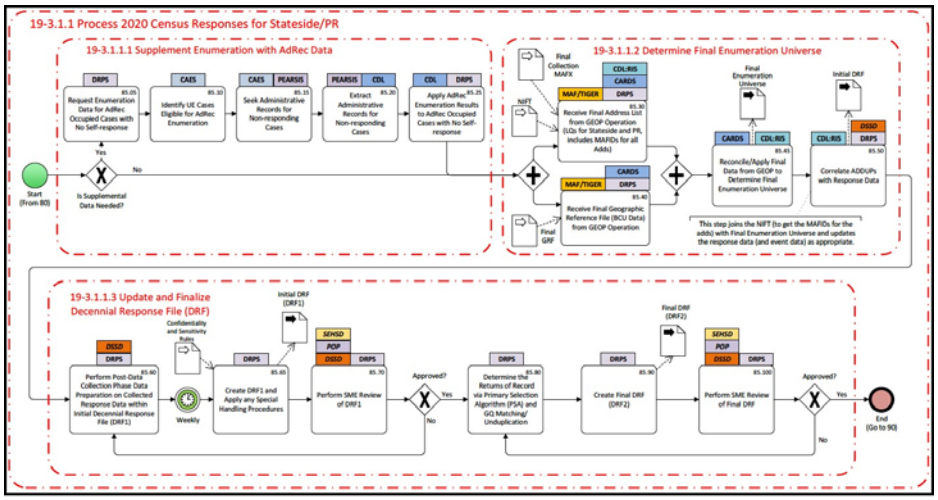

Figure 58: Process 2020 Census Responses for Stateside/PR

Figure 3: Constituent activities for processing Stateside and Puerto Rico, Figure 58 in 2020 Census Detailed Operational Plan for: 19. Response Processing Operation (RPO), version 2.0, 2019.

Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjury that the foregoing is true and correct.

Executed on August 24, 2020 at St. Michaels, Maryland.

Dr. Thomas A. Louis

Dr. Thomas A. Louis, Ph.D.

August 15, 2020

CURRICULUM VITAE

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Work Address

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Education

1966 BA Dartmouth College, with honors in Mathematics
1972 PhD Columbia University, Mathematical Statistics

Principal Professional Appointments

2018–	Professor Emeritus of Biostatistics, Johns Hopkins Bloomberg School of Public Health
2002–2017	Professor of Biostatistics, Johns Hopkins Bloomberg School of Public Health
2013–2015	Associate Director for Research & Methodology and Chief Scientist, U. S. Census Bureau
2000–2002	Senior Statistical Scientist, The RAND Corporation
1987–2000	Professor of Biostatistics, U of Minnesota School of Public Health
1987–1999	Head of Biostatistics, U of Minnesota School of Public Health
1987–2000	Professor, U of Minnesota School of Statistics
1979–1987	Associate Professor of Biostatistics, Harvard School of Public Health
1973–1979	Assistant Professor of Mathematics, Boston University
1972–1973	NIH Postdoctoral Fellow, Mathematics, Imperial College, London
1971–1972	Lecturer, Department of Mathematical Statistics, Columbia U
1970–1971	Consultant, IBM Thomas J. Watson Research Lab., Yorktown Heights, NY
1966–1967	Actuarial Trainee, Chubb and Son, New York

Other Professional Appointments

2018–2020	Expert Statistical Consultant, Center for Drug Evaluation & Research, Food & Drug Administration
2018–	Affiliate Professor of Statistics, George Mason University
2016–	Affiliated member, The Johns Hopkins Spatial Science for Public Health Center
2016	Distinguished Senior Research Fellow, U. S. Census Bureau
2012–2016	Core faculty member, Johns Hopkins Armstrong Institute for Patient Safety and Quality
2011	"Summer at Census" Scholar
2001–2003	Adjunct Professor, Epidemiology & Biostatistics, George Washington U
2000–2002	Adjunct Professor, Biostatistics, Johns Hopkins Bloomberg SPH
1999	Visiting Scholar, Committee on National Statistics, National Academy of Sciences
1995–1996	Visiting Professor, Afdeling Medische Statistiek, U of Leiden, NL
1994–2000	Member, U of Minnesota Cancer Center
1991–1998	Adjunct Associate, Hubert H. Humphrey Inst. of Public Affairs, U of Minnesota
1991–1996	Adjunct Professor, Biostatistics, Emory University School of Public Health
1988	Visiting Professor, Tongji Medical U, Wuhan People's Republic of China
1986	Visiting Scientist, Center for Mathematics and Computer Science, Amsterdam NL
1984	Visiting Professor, Biostatistics, U of North Carolina, Summer Term
1979–1981	Director, Biostatistics Consulting Laboratory, Harvard School of Public Health
1974–1979	Consultant, Boston University Medical School

Other Professional Appointments (continued)

1974–1979	Member, Boston University Cancer Center
1969–1970	Summer Employee, IBM T. J. Watson Research Lab., Yorktown Heights, NY

HONORS AND AWARDS

1967–1971	Fellow of the Faculty, Columbia University
1985	Elected member, International Statistical Institute
1988	Fellow of the American Statistical Association (ASA)
1988	Delta Omega Honorary Public Health Society
1991–1993	President-elect, president, past; Intl. Biometric Soc., Eastern North American Region (ENAR)
1996	Fellow of the American Association for the Advancement of Science (AAAS)
2003	ENAR President's Invited Address, "Aids to Statistical Navigation"
2005-2008	President-elect, President, Past-president; International Biometric Society
2010-2013	Chair-elect, Chair, Retiring Chair, AAAS Statistics Section (U)
2014	Charles L. Odoroff Memorial Lectureship, University of Rochester
2016	Honorary Life Member, International Biometric Society
2016	National Associate of the National Research Council
2017	Fellow of the Institute of Mathematical Statistics
2018	Doctor Honoris Causa, Hasselt University, Belgium

PROFESSIONAL ACTIVITIES

Memberships

American Association for the Advancement of Science
American Association of Public Opinion Research
American Statistical Association, PStat®
Institute of Mathematical Statistics
International Biometric Society
International Society for Bayesian Analysis
International Statistical Institute
Royal Statistical Society

Editorial

2018	Associate Editor, special issue of *The American Statistician* on statistical inference
2017–	Associate Editor, *Annual Review of Statistics and Its Application*
2011–2016	Editorial Committee, *Annual Review of Statistics and Its Application*
2009-2011	Co-editor, *Biometrics*
2006–2008	Coordinator, IBS Prose Editing Project
2004–2008	Editorial Board, *Biostatistics*
2003–2008	Editorial Board, *Clinical Trials*
2002–2002	Co-editor, Formula Funds Allocation special issue, *Journal of Official Statistics*
2001–2003	Editor & coordinating editor, *J. Am. Statist. Assoc., Applications and Case Studies*
1999–2002	Editorial Board, *Applied Stochastic Models in Business and Industry*
1999–2000	Associate Editor, *Controlled Clinical Trials*
1998–2000	Associate Editor, *Statistical Science*
1997–2018	Editorial Board, Chapman&Hall Series on Statistics and Applied Probability
1996–1999	Associate Editor, *statistica neerlandica*
1992–1998	Co-Editor, *Chance*
1993–1995	Editorial Board, *ASA-SIAM Series on Statistics and Applied Probability*
1989–1994	Editorial Board, *Statistics in Medicine*
1988–1991	Associate Editor, *JASA Theory and Methods*
1972–	Refereeing for statistical, biomedical, epidemiologic and environmental journals

Professional Organization Administration

2016-2017	Search Committee, *Biometrics* Executive Editor
2011-2013	Chair-elect, chair, past chair, AAAS Section-U, Statistics
2010-2012	Local Organizing Committee, IBS International Biometric Conference, Kobe Japan, 2012
2009–2015	IBS Editorial Advisory Committee
2009-2010	Chair, International Biometric Society, Council of Presidents
2009-2010	IBS/ENAR Nominations Committee
2008	Outgoing vice-President, International Biometric Society
2007	Organizing & Scientific Programme Committee, East Asia Regional Biometric Conference, Tokyo
2006-2007	President, International Biometric Society
2005-2006	IBS/ENAR Nominations Committee
2005	Incoming vice-President, International Biometric Society
2004	Executive Committee, ASA Section on Bayesian Statistical Science
2002–2003	Chair-elect/chair, ASA Section on Bayesian Statistical Science
2002	Member, ENAR Educational Advisory Committee
2002	Associate Director, Search Committee, National Institute of Statistical Sciences
2002	Chair, Nomination Committee, National Institute of Statistical Sciences
2000–2001	Program Committee, Year 2001 International Statistical Institute Conference
2001–2002	Program Committee, Year 2002 Intl. Epidemiologic Association Conference
2001	ASA-IMS Task Force to select statistical reviewers for Science
2001	ENAR management review
2000–2001	ENAR Nominating Committee
2000–2005	Member, ASA Scientific and Public Affairs Advisory Committee
2000–2002	Executive Committee, National Institute of Statistical Sciences
1999–2000	Program Committee, Year 2000 International Biometric Conference
1998–2000	ENAR Liaison to the ASA
1998	ENAR management review
1997–2002	Trustee, National Institute of Statistical Sciences (NISS)
1997–1989	Chair, Fellow Selection Committee, International Biometric Society
1997	ASA search Committee for new *Chance* editor
1994–1997	Council, International Biometric Society
1993–1996	IMS, Committee on Scientific Policy
1993–1996	AAAS Electorate Nominating Committee
1993	Chair, ASA Editor search Committee, *JASA Applications and Case Studies*
1993	Chair, ASA Sub-committee to Evaluate Health Science Journal Options
1993	Steering Committee, Research Synthesis: Social Science Informing Public Policy
1992	Nominating Committee, JASA book review editor
1992	President, Biometric Society, ENAR
1991–1993	Executive Committee, Biometric Society ENAR
1991–1992	Committee of Presidents of Statistical Societies
1991	Advisory Board, NISS
1988	Program Chair, Intl. Biometrics Society-ENAR Spring Meeting, Boston MA
1988	Regional Committee, Biometric Society ENAR
1978–1978	Co-program chair, Intl. Biometrics Society-ENAR Spring Meeting, Chapel Hill, NC
1976–1976	Local arrangements Committee 9th Intl. Biometric Conference, Boston, MA
1976–1986	Program Committee, Boston Chapter, ASA

Advisory

2020	Chair, Visiting Panel, Joint Program in Survey Methodology, U Maryland & Michigan
2019	Review coordinator, NAS workshop: Using Models to Estimate Hog and Pig Inventories
2019	Review of the Biostatistics Department, University of Miami
2018	Member of the tri-society (American Statistical Assn., American Sociological Assn., Population Assn. of America) group that prepared amicus briefs supporting the lawsuits in, New York, California, and the Supreme Court to block including a citizenship question on the 2020 census
2018	National Academies; National Investment Modeling expert Panel
2017–	Advisory Committee, U of Michigan Institute for Social Research, Educational Program on Responsive Survey Design for Efficient Survey Data Collection
2017–	Chair, NIDDK DSMB for the ARMMS-T2D study (Alliance of Randomized Trials of Medicine vs Metabolic Surgery in Type 2 Diabetes)
2017–2020	DSMB, NHLBI; Junctional AV Ablation for Permanent Atrial Fibrillation in Patients Undergoing Cardiac Resynchronization Therapy
2016–	DSMB, Bristol-Myers Squibb; gastric, lung, and renal cancer trials
2016–	DSMB, Minnesota Hearth Health Program–Aspirin Study
2016	Panelist, FDA workshop on, Facilitating Antibacterial Drug Development for Patients with Unmet Need and Developing Antibacterial Drugs That Target a Single Species
2016–	International Advisory Board, Interuniversity Institute of Biostatistics and Statistical Bioinformatics Universities of Hasselt &Leuven, Belgium
2016	Chair, external advisory board of the Department of Public Health and Primary Care, Leuven, Belgium
2016	NAS/CNSTAT Expert meetings on Improving the Relevance of Federal Statistics
2016	NIDDK Expert Evaluation Committee of the Alliance of Randomized Trials of Medicine versus Metabolic Surgery in Type 2 Diabetes (ARMMS-T2D) study
2015–	Technical Advisory Group, Developing Excellence in Leadership Training and Science Training, Sub-Saharan Africa Consortium for Advanced Biostatistics Training
2015–2016	Advisory Board, Center for Survey Statistics and Methodology, Iowa State U
2015–2016	PCORI/CTAP Post–Award Expert Advisory Subcommittee
2015–2018	CMS Technical Expert Panel: Hospital Inpatient and Outpatient Process and Structural Measure Development and Maintenance
2012–	External Evaluation Committee, Type 1 Diabetes TrialNet
2011–	Scientific Advisory Board, NIEHS Gulf Long-term Follow-Up (GuLF) Study
1985–	Report Review, The National Academies
1975–	Proposal review, NSF, NIH and other funding agencies
2015	Health Effects Institute (HEI) ad hoc Review Panel
2015	Clinical Trial Review Panel, NIH/NIDCD, Deafness and Communication Disorders for trial design and analysis in anti-bacterial drug development
2014–2015	DSMB, Flexibility in Duty Hour Requirements for Surgical Training (FIRST) trial
2014	PCORI Methodology Consultation ReviewPanel
2014–2015	NIA-sponsored NAS meetings on observational studies and causal inference
2013–2014	Panel on Hospital Performance Measure Testing, Mathematica
2012–2014	DSMB, Bangladesh Complementary Food Supplementation Trial
2012	Review of the University of Wisconsin, Biostatistics Training Grant Program
2011–2013	DSMB, Triple re-uptake inhibitor for the treatment of major depressive disorder (BMS)
2009–2013	External Expert Panel for the Hemodialysis Fistula Maturation Cohort Study
2007–2012	Board of Scientific Counselors, NIH-National Institute of Environmental Health Sciences
2006–2011	Scientific Advisory Committee, EPA/Harvard Center on Ambient Particle Health Effects
2004–2012	DSMB, Right Ventricular Pacing Study (Medtronic)

Advisory (continued)

2011	Chair, Committee of Presidents of Statistical Societies, Committee on Methods for Hospital-specific estimates of quality of care
2011	Census Bureau, "Summer at Census" visiting scholar
2011	*Ad hoc*, Tenure Review Committee, Columbia University
2010–2011	ASA/NISS Panel on ranking graduate programs
2010–2011	EPA Science Advisory Board Panel to review draft lead dust technical analyses
2010	Nat. Inst. Statist. Sci., Workshop on Assessing the Quality of Graduate Programs
2010	Chair, Steering Committee, National Academies workshop on Facilitating Innovation in the Federal Statistical System
2006–2010	DSMB, MK-0518 HIV Integrase Phase III Program (Merck)
2009	Working Group, the role of the NIH Biostatistical Methods and Research Design study section
2009	Proposal review, International Science and Technology Center in the Ukraine
2008	NAS Review Coordinator, "Phthalates and Cumulative Risk Assessment: The Tasks Ahead"
2008	Consultant, U of Wisconsin chair search, Dept. of Biostatistics and Medical Informatics
2007–2009	DSMB, VA Trial of Long-Acting Injectable Risperidone in the Treatment of Schizophrenia
2007	Review Panel, Ixabepilone for treatment of metastatic breast cancer (Bristol, Myers, Squibb)
2006–2009	NAS Standing Committee on Risk Analysis Issues and Reviews
2006–2008	DSMB, Preventing Pregnancy Malaria: Mother Infant outcomes study (NIH-NIAID)
2005–2008	NAS Committee on Applied and Theoretical Statistics
2005	Selection Committee, JASA Applications and Coordinating Editor for 2007-9
2004–2006	NAS Committee to Review the Effects of Changes in EPA's New Source Review Programs for Stationary Sources of Air Pollutants
2004	*Ad hoc* consultant, Board of Scientific Councilors review of the NIEHS Biostatistics Branch
2004	NIH Clinical Infectious Diseases and Microbiology, Research & Field Studies Special Study Section
2003–2004	Advisor, masters program in Biometrics, UMDNJ
2003–2004	Drinking Water Committee, EPA Science Advisory Board
2003	Input to IOM report, "Measuring What Matters: Allocation, Planning, and Quality Assessment for the Ryan White CARE Act"
2003	Review of the MS in Biostatistics, U of Medicine & Dentistry of NJ, SPH
2003	Committee to review Biostatistics at the U of Washington
2002–2004	NAS, Committee on use of third party toxicity research with human participants
2002–2003	Panel to review guidelines for thrombolysis treatment of acute ischemic stroke
2002	Chair, Committee to review Biostatistics at Emory U
2001–2008	DSMB, Dialysis Access Consortium (NIH-NIDDK)
2001–2002	NIH ad hoc group to promote increased funding for training in Biostatistics
2001	Committee to propose a statistics editor for Science magazine
2001	Advisory Committee, Program in Environmental Statistics, Biostatistics, Harvard SPH
2001	Proposal reviewer, VA studies on Persian Gulf Illness
2000–2005	Health Effects Institute, Report Review Committee
2000–2004	Advisory Committee, Harvard Cardiac Vulnerability Related to Particulate Matter Project
2000–2004	Scientific Advisory Committee, EPA/Harvard Center on Ambient Particle Health Effects
2000–2003	Advisory Board, Center for Innovation in Clinical Research, M.D. Anderson CC
2000–2003	Steering Committee, United States Renal Data System
2000–2003	Diesel Emissions Project Committee, Health Effects Institute
2000–2002	Chair, NAS panel on Formula Allocation of Federal and State Program Funds
2000	Panelist, NIH Consensus Conference on Adjuvant Therapy for Breast Cancer
1999	Chair, Review Committee, Dept. of Social and Preventive Medicine, SUNY Buffalo

Advisory (continued)

1998–2004	Chair, DSMB, Chemoprevention of Skin Cancers with DFMO Clinical Trial
1998	NIH Special Emphasis Panel Proposal Review
1997–1999	Oversight Committee, HEI, National Morbidity and Mortality Air Pollution Study
1997	Chair, NIAID proposal review panel, Statistical Center for the Women's Interagency Health Study
1997	Advisory panel, U Chicago Dept. OB/GYN, issues in stopping a clinical trial
1997–2003	NAS, Committee on National Statistics
1996–2003	Advisory Board, Institute of Medicine (IOM), Medical Follow-up Agency
1996–1999	NAS, Panel on Estimates of Poverty for Small Geographic Areas
1996	Organizational Review, U of Chicago, Department of Health Studies
1995	NCI site visit, Fred Hutchinson Cancer Research Center, Seattle Washington
1995	UCLA Visiting Committee on reorganizing statistics at the university
1995	Visiting Committee, Cleveland Clinic Dept. of Epidemiology and Biostatistics
1994–1996	IOM/MFUA Committee to Review the Health Consequences of Service during the Persian Gulf War
1994-1995	Reviewer, EPA Particulate Matter and Mortality Criterion Document
1993–1997	DSMB, Long-term outcome of Obesity Treatment in Minority Women Study
1991	Reviewer, NIAID/DAIDS, ACTG re-competition
1988–1990	AHCPR Health Care Technology Study Section
1987–1993	Advisory Committee for Research Synthesis, The Russell Sage Foundation
1984–1988	EPA Health Effects Scientific Review Panel
1981–1983	Advisory Committee, Kidney Transplant and Histocompatibility Study
1975–1983	Site visitor, National Cancer Institute

UNIVERSITY SERVICE

Johns Hopkins University (Bloomberg School of Public Health unless otherwise indicated)

2019–2020	Proposal review, Support for Creative Integrated Basic and Applied Research
2019–2020	Biostatistics Faculty Search Committee
2015–2016	Biostatistics Faculty Search Committee
2014–	Committee member, Ross/Royall Fund for Population Inference in Public Health
2011–2012	Chair, Biostatistics Faculty Search Committee
2010–2011	Search Committee for Chair of Environmental Health Sciences
2009–2010	Committee to review the Department of Environmental Health Sciences
2008–2012	SPH Committee on Academic Standards
2008–2009	HopkinsOne, University-wide Faculty Advisory Committee
2008–2009	Medical School Investigative Committee
2008–2009	Chair, Biostatistics Faculty Search Committee
2007–2008	Strategic Planning Steering Committee
2006–2011	Advisory Committee, Environmental Health Sciences, NIEHS Training Program
2005-2008	SPH Advisory Board
2005–2008	Faculty Senate: President-elect, President, past President
2004–2006	Sommer Scholar selection Committee
2004–2005	Chair, Faculty Grievance Committee
2003–2008	Committee on Appointments and Promotions

2003–2005	Faculty Senator
2003–2004	Planning Committee, FDA/Johns Hopkins workshop, "Can Bayesian approaches to studying new treatments improve regulatory decision-making?"
2002–2012	Steering Committee, Malaria Research Institute
2002–2004	FDA/Hopkins Liaison Development
2002–2004	Biostatistics Faculty Search Screening Committee
2002–2003	Co-chair, Biostatistics seminar Committee

University of Minnesota School of Public Health

2000	Dean Search Committee, School of Public Health
1999–2000	Ethics Advisory Committee
1998–1999	President's Distinguished Faculty Mentors Program
1997–1998	Academic Health Center faculty research development grants review Committee
1996–1997	Search Committee, Health Sciences Chief Information Officer
1994–1998	SPH Diversity Committee
1994–1995	SPH Diversity Committee, Co-chair
1994–1995	Chair, MPH Major in Biostatistics
1994	Search Committee, Director, Cancer Center Registry
1994	Ad Hoc Committee to investigate misconduct
1993–1996	Faculty Advisor, Sailing Club
1992–1994	Chair, Search Committee, Head, Center for Environmental Health Policy, SPH
1992	Chair, Biostatistician Search Committee, General Clinical Research Center
1991	Search Committee, Population Sciences faculty, Humphrey Institute
1990–1999	SPH Space Committee
1990–1990	Search Committee, SPH Dean
1989–1990	Chair, Search Committee, Head of Epidemiology, SPH
1988–1993	Academic Advisory Committee, Center for Biomedical Ethics (chair, 1988-1990)
1987–2000	Advisory Committee, General Clinical Research Center
1987–1999	SPH Policy Council

Harvard School of Public Health

1980–1984	Qualifying examination Committee
1980–1981	Institutional Review Board

COMMUNITY SERVICE

2018–	Docent, Chesapeake Bay Maritime Museum
2017–	Martingham Architecture Review Committee
1999–2000	Treasurer, L Harriet Yacht Club
1995	Faculty Member, National Breast Cancer Coalition, Project LEAD
1992–1995	Institutional Review Board, Allina Health System, Minneapolis, MN
1984	Co-chair, School Enrollment Projection & Reorganization Committe, Lexington MA
1975–1978	Faculty, Norfolk Prison Education Program, Norfolk MA

EDUCATIONAL ACTIVITIES

Courses: Probability theory, Statistical theory, Sequential analysis, Analysis of longitudinal data, Hierarchical models, Bayesian methods, Survey methods, Multivariate analysis, Discrete data, Robust methods, Screening and bioassay, Exploratory data analysis.

Research Advising: Principal or co-advisor for Biostatistics doctoral and masters students. Member of doctoral and masters Committees in Statistics, Biostatistics, Epidemiology, Environmental Health, Health Services, and Microbiology.

PUBLICATIONS

(Peer reviewed journal articles & books, Software, Peer reviewed journal discussions, Monographs, Book chapters, Proceedings, Book reviews, Letters & Columns)

Peer reviewed journal articles & books

1. Flehinger BJ, Louis TA (1971). Sequential treatment allocation in clinical trials. *Biometrika*, 58: 419–426.
2. Flehinger BJ, Louis TA (1972). Sequential medical trials with data-dependent treatment allocation. *Proc. Sixth Berkeley Symposium*, 4: 43–52.
3. Flehinger BJ, Louis TA, Robbins H, Singer B (1972). Reducing the number of inferior treatments in clinical trials. *Proc. Nat. Acad. of Sci. US*, 69: 2993–94.
4. Hsi BP, Louis TA (1975). A modified play-the-winner rule for sequential trials. *J. Am. Statist. Assoc.*, 70: 644–647.
5. Louis TA (1975). Optimal allocation in sequential tests comparing the means of two Gaussian populations. *Biometrika*, 62: 359–369.
6. Louis TA (1977). Sequential allocation in clinical trials comparing two exponential survival curves. *Biometrics*, 33: 627–634.
7. Albert A, Gertman P, Louis TA (1978). Screening for the early detection of cancer I: The temporal natural history of a progressive disease state. *Mathematical Biosciences*, 40: 1-59.
8. Albert A, German P, Louis TA, Liu S (1978). Screening for the early detection of cancer II: The impact of screening on the natural history of disease. *Mathematical Biosciences*, 40: 61–109.
9. Louis TA, Albert A, Heghinian S (1978). Screening for the early detection of cancer III: Estimation of disease natural history. *Mathematical Biosciences*, 40: 111–144.
10. Louis TA (1981). Confidence intervals for a binomial parameter after observing no successes. *The American Statistician*, 35: 154.
11. Louis TA (1981). Nonparametric analysis of an accelerated failure time model. *Biometrika*, 68: 381–390.
12. Russell R et al. (1981). Unstable angina pectoris national cooperative study group to compare medical and surgical therapy IV: Results in patients with left anterior descending disease. *Am. J. Cardiology*, 48: 517–524.
13. Laird NM, Louis TA (1982). Approximate posterior distributions for incomplete data problems. *J. Roy. Statist. Soc. Ser. B*, 44: 190–200.
14. Louis TA (1982). Finding the observed information using the EM algorithm. *J. Roy. Statist. Soc. Ser. B,* 44: 226–233.
15. Louis TA, Mosteller FM, McPeek B (1982). Timely topics in statistical methods for clinical trials. *Ann. Rev. Biophys. & Bioeng.*, 11: 81–104.
16. Shapiro SH and Louis TA, eds. (1983). *Clinical Trials: Issues and Approaches.* Marcel Dekker, New York.
17. Louis TA, Shapiro SH (1983). Critical issues in the conduct and interpretation of clinical trials. *Ann. Rev. Public Health*, 4: 25–46.
18. Eisen EA, Wegman DE, Louis TA (1983). Effects of selection in a prospective study of forced expiratory volume in Vermont granite workers. *Am. Rev. Respir. Disease*, 128: 587–591.
19. Lavori P, Louis TA, Bailar JC, Polansky M (1983). Designs for clinical experiments: Parallel comparisons of treatment. *N. Engl. J. Med.,* 309: 1291–1298.
20. Louis TA (1983). Statistics in laboratory studies. *Lab Animal*, 12: 17–25.
21. Ware JH, Louis TA (1983). Statistical problems in environmental research. *Can. J. Statist.*, 11: 51–70.
22. Bailar JC, Louis TA, Lavori P, Polansky M (1984). Designs for clinical experiments: Studies without internal controls. *N. Engl. J. Med.,* 311: 156–162.

23. Eisen EA, Smith TA, Wegman DE, Louis TA, Froines J (1984). Estimation of long-term dust exposures in the Vermont granite sheds. *J. Am. Indust. Hygiene Assoc.*, 45: 89–94.
24. Louis TA (1984). Estimating a population of parameter values using Bayes and empirical Bayes methods. *J. Am. Statist. Assoc.,* 78: 393–398.
25. Louis TA, Lavori P, Bailar JC, Polansky M (1984). Crossover and self-controlled designs in clinical research. *N. Engl. J. Med.*, 310: 24–31.
26. Moses L, Louis TA (1984). Statistical consulting in clinical research: The two-way street. *Statist. in Med.*, 3: 1–5.
27. Bailar JC, Louis TA, Lavori P, Polansky M (1984). A classification for biomedical research reports. *N. Engl. J. Med.,* 311: 1482–1487.
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32. Laird NM, Louis TA (1987). Empirical Bayes confidence intervals based on bootstrap samples (with discussion). *J. Am. Statist. Assoc.*, 82: 739–757.
33. Louis TA (1988). General methods for analyzing repeated measures. *Statistics in Medicine*, 7: 29–45.
34. DeGruttola V, Ware JH, Louis TA (1987). Influence analysis on generalized least squares estimators. *J. Am. Statist. Assoc.*, 82: 911–917.
35. Knuiman MW, Laird NM, Louis TA (1987). Inter-laboratory variability in Ames assay results. *Mutation Research*, 180: 171–182.
36. Dockery DW, Speizer FF, Ferris BG Jr., Ware JH, Louis TA, Spiro A III (1988). Cumulative and reversible effects of lifetime smoking on simple tests of lung function in adults. *Am. Rev. Respir. Disease,* 137: 286–292.
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38. Manu P, Louis TA, Lane TJ, Gottlieb L, Engel P, Rippey RM (1988). Unfavuorable outcomes of drug therapy: Subjective probability versus confidence intervals. *J. Clin. Pharm. and Therapeutics*, 13: 213–217.
39. Louis TA (1989). Analysis of a random sample of two-year carcinogen bioassays from the NCI data-base. *Fund. and Appl. Toxicology,* 12: 222–231.
40. Laird NM, Louis TA (1989). Bayes and empirical Bayes ranking methods. *J. Educational Statistics,*14: 29–46.
41. Laird NM, Louis TA (1989). Empirical Bayes confidence intervals for a series of related experiments. *Biometrics*, 45: 481–495.
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