CHAPTER 5

Practical Tools for Effective Measurement and Analytics

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SUMMARY

Increasingly important features of good data analysis are the transparency with which the analysis is undertaken and the reproducibility of its results. These features ensure the credibility of analytical outputs and policy guidance. The World Bank's Development Impact Evaluation (DIME) Department has developed freely available tools and processes to support the achievement of these best practices by analysts across the world. These resources include research-cycle frameworks, extensive training tools, detailed archives of process and technical guidance, and a collaborative approach to data and analytics. The DIME Analytics team continuously updates many of these resources and makes them available globally as a free knowledge product. This chapter describes the frameworks, the approach, and the products that are available to bring these best practices into any organization that relies on data analytics for decision-making. The chapter provides a discussion of how to apply these elements to public administration, thus ensuring that analytics of government accord with international best practices.

ANALYTICS IN PRACTICE

- For credibility, modern methods for data analysis rely on analysts undertaking their work in a transparent way that ensures their results can be replicated.
- Best practices for reproducibility and transparency assure the internal quality and organization of data work and provide a template for publishing materials externally when appropriate.
- Producing analysis that accords with best practices requires considering the full life cycle of data work, such that each stage of handling data can be designed to support the next stages.

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- Development Impact Evaluation (DIME) Analytics, a unit of the DIME Department at the World Bank, has developed extensive, publicly available tools and trainings to standardize and promulgate these best practices among analysts across the world.
- This chapter describes these resources and links to their locations online. It provides a discussion of how to apply these elements to public administration, thus ensuring government analytics accord with international best practices.

INTRODUCTION

The principles of good data analysis and empirical research have been refined over centuries. Today's analysts and researchers work in an environment in which adherence to modern standards of analysis is an essential part of the credibility of their results. As such standards become more abundant and layered, it can be a challenge to keep up to date on best practices. These considerations go beyond the internal analysis of government data and are of general concern to anyone attempting to undertake rigorous analysis.

To support analysts and researchers across the world in understanding and implementing modern approaches to data analysis, the World Bank's Development Impact Evaluation (DIME) Department has created a series of resources to support the adoption of best practices in data collection and analysis. The DIME Analytics unit aims to help data analysts identify inefficiencies and practices that compromise the quality of analysis and to develop a workflow that strengthens their work. DIME Analytics creates and tests tools that support these practices and provides the training and technical support necessary to sustain their adoption (illustrated in figure 5.1). This chapter aims to provide an introduction to the resources (typically free) DIME Analytics provides, which are in themselves an introduction to the global frontier of best practices in data analytics.

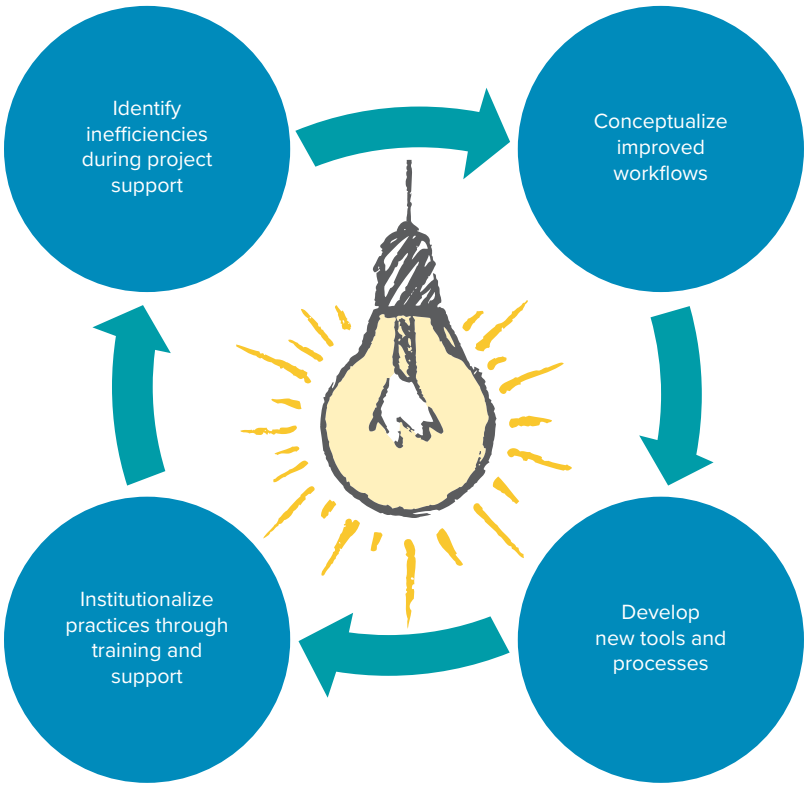
Creating high-quality data and research outputs is central to generating useful insights to inform public administration. DIME Analytics' resources are well suited to those interested in updating their administration's capacity to collect high-quality data and evaluate the impact of public administration reforms. This chapter therefore describes protocols for high-quality data collection relevant to all public administration data collection efforts and discusses how best practices for reproducible and transparent data collection and analysis can establish the credibility of public administration analysis and research.

ESTABLISHING THE CREDIBILITY OF PUBLIC ADMINISTRATION MEASUREMENT

The framework of reproducibility, transparency, and credibility has become the basis for empirical research and data analysis worldwide. There are several core reasons for the adoption of these principles in the academic world, and most of them apply equally to the sphere of policy analysis, design, and governance. In academic research, collaborators are often not employed in the same organization, or direct collaboration may never occur. These standards have been adopted so that disparate teams and individuals can access, reuse, assess, and build upon the work done by other researchers in the ecosystem, even when they do not have institutional or personal connections to one another. A similar argument can be made of the many distinct units of government administrations.

Reproducible data work is designed so that the materials and processes from a task can be easily reused and adapted within and across contexts. Such data work is done with the goals of collaboration and the handoff of materials in mind, even if the research materials are not intended for public consumption. When analytical processes are designed for collaboration and reuse, they become a form of knowledge

FIGURE 5.1 DIME Analytics Uses an Iterative Process to Expand Technical Capacity throughout the Research Cycle



Source: DIME (Development Impact Evaluation) Analytics, World Bank.

accumulation within an organization. By contrast, data processes that are completed as "one-off" tasks—nonreproducible processes that cannot be transferred to other people after completion—cannot transfer workflow improvements and efficiencies to other tasks. Reproducible data work also enables more people to work on a task because the tools can be handed off among individuals on the team; it also enables more people to conduct quality control over the work of others, which is a built-in feature of reusing others' work.

Transparent work is designed so the materials and processes from a task can be understood and used by individuals not involved in the original task. In research, this often means publishing or releasing code, data, and documentation to the general public (or under license to other researchers). However, publication is not the most important aspect of transparent work. The essential characteristic of transparent work is that the documentation of all steps is complete, the organization of subtasks is easily understood, and the complete materials are archived in a known location. In this way, a transparent process is one that can be accessed and replicated by a new team without contacting the original analysts. This approach allows knowledge transfer to happen rapidly both across an organization, from team to team, and within an organization as materials are reused and improved upon progressively over time.

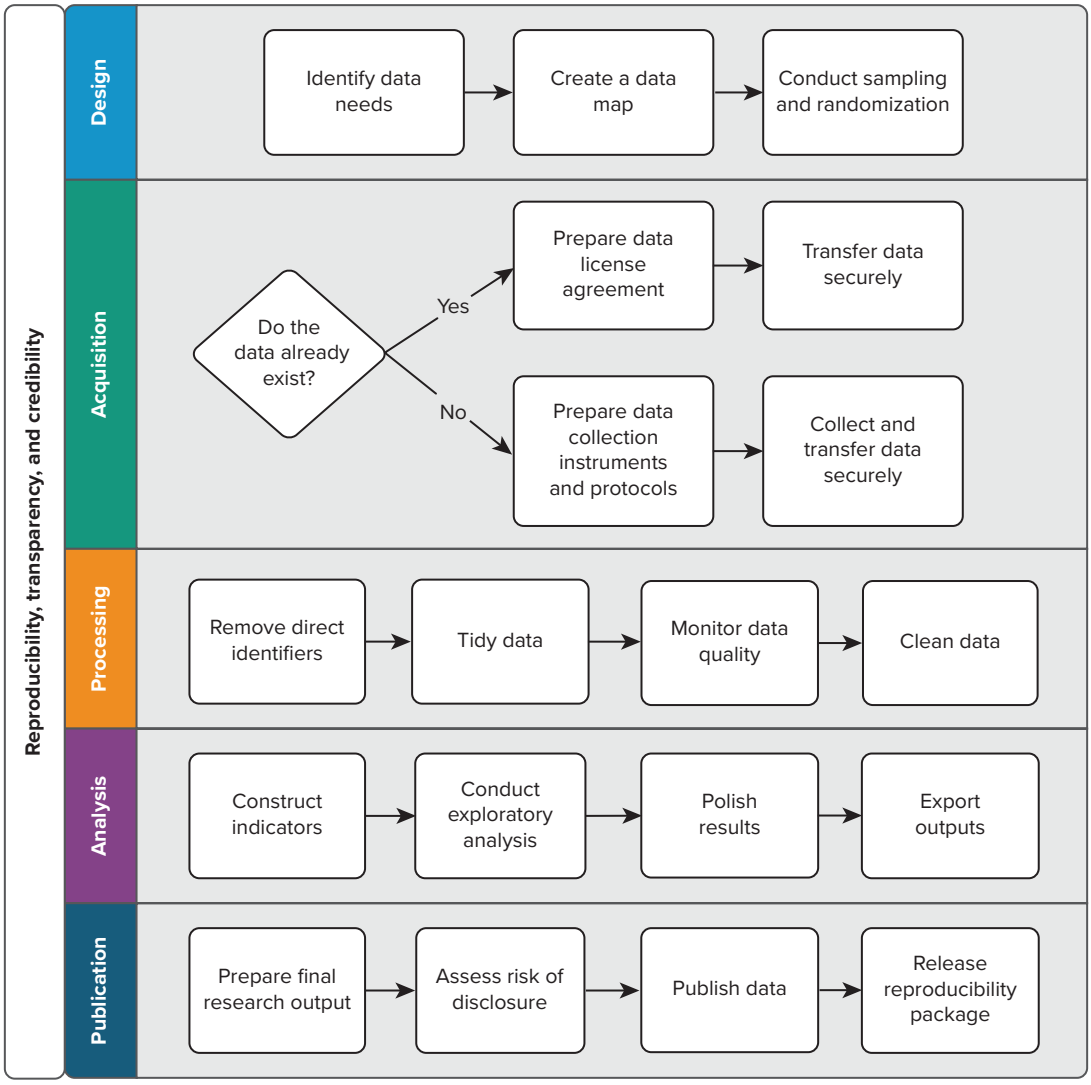
Together, these two approaches produce a foundation of credibility for conclusions and outputs within an organization. Reproducible work usually demands the adoption of standardized processes for subtasks. Processes that are reused frequently and by many people will attract higher levels of investment and quality assurance. Similarly, when data, code, and documentation are intended to be seen and reused by others, authors are incentivized to improve their own organization and description of materials, particularly if they or their own team will be the ones reusing them in the future. When these materials are archived and are visible to other members

of an organization, they can be quality-controlled, and, over time, the best work becomes widely improved and adopted, establishing the reputation of high-quality tools and processes. Whether or not analytical materials are ever released to the public is secondary to adopting a mindset of collaboration and reuse across a research organization.

PROTOCOLS FOR HIGH-QUALITY DATA COLLECTION

The conventions, standards, and best practices that are fast becoming a necessity for high-quality empirical research affect most elements of data collection and analysis. Figure 5.2 describes the standard workflow of analysis from design to reporting or publication. Some of these steps may be redundant, such as when using administrative data, but considering the full workflow allows analysts to imagine what the optimal process would have been if they had been in control of each stage of data collection and analysis.

FIGURE 5.2 Overview of the Tasks Involved in Development Research Data Work



Source: Bjärkefur et al. 2021.

DIME Analytics has described best practices at each of these stages in its published handbook, *Development Research in Practice: The DIME Analytics Data Handbook* (Bjärkefur et al. 2021). *The DIME Analytics Data Handbook* is intended to train users of data in effective, efficient, and ethical data handling. It covers the full data workflow for an empirical project, compiling all the lessons and tools developed by DIME Analytics into a single narrative of best practices. It provides a step-by-step guide to high-quality, reproducible data work at each stage of the data workflow, from design to publication, as visualized in figure 5.2. Each chapter contains boxes with examples of how the practices and workflows described in that chapter were applied in a real-life case. The handbook is available for free download through the World Bank's Open Knowledge Repository or for purchase from Amazon. The handbook and related resources will be updated over time as best practices evolve, and feedback can always be provided through the handbook's GitHub repository.[1]

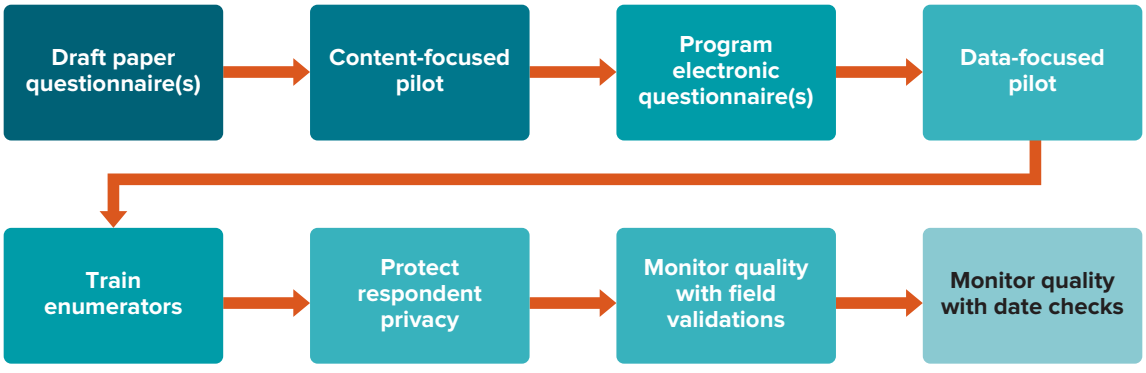
Let us take as an example the element "Prepare data collection instruments and protocols" in the "Acquisition" pillar in figure 5.2. This activity can be further broken down into constituent parts. The handbook provides narrative descriptions and best practices for each stage of the activity. It also provides links to corresponding entries on the DIME Wiki, which contain more specific technical details and are kept up to date as these details change and evolve.[2] Figure 5.3 illustrates the full workflow for an electronic survey.

Each of these stages can then be broken down further into constituent activities. Figure 5.4 summarizes the key protocols for ensuring data quality at every stage of the survey workflow. In this way, for each activity related to data collection, DIME Analytics has outlined the activities required to undertake rigorous data collection and analysis and has provided a knowledge network for analysts to obtain the appropriate level of specific detail about each task and subtask for their current needs. Adhering to such standardized and organized protocols, even when analysis is not intended to be made public, ensures that work is organized and internally consistent. In this way, the DIME Analytics knowledge products reflect the world's frontier knowledge about how to obtain credible empirical results.

As an example of the application of these principles in public administration, consider an assessment of the impact of in-service training. Much effort is made to keep the skills of public servants current with new procedures within government and innovations in wider society. However, there is frequently little evaluation of whether such training actually has an impact on the quality of government processes or productivity. An effective measurement framework might include an immediate assessment of public servants' skills upon entry to and exit from the training, as well as a follow-up with objective assessments of the quality of procedure and productivity.

To assess the broad impact of an in-service training intervention, we could imagine returning to the unit of the trainee after some time had passed and assessing the impact of the training through a survey

FIGURE 5.3 Workflow for High-Quality Survey Data Collection



Source: DIME (Development Impact Evaluation) Analytics, World Bank.

FIGURE 5.4 Summary Protocols for High-Quality Data Collection at Every Stage of the Survey Workflow

Prepare for a survey

- Design a well-powered sampling strategy
- Develop detailed terms of reference for data collection

Draft survey instrument

- Align with research questions or theory of change
- Draft on paper for electronic surveys

Content-focused pilot

- Qualitative data collection to inform survey design
- Assess the draft instrument, flow of interview questions, and survey protocols

Program electronic survey instrument

- Use technology to improve quality
- Embed survey logic, range checks, filtered response options, location checks, calculations, multimedia, etc.

Data-focused pilot

- Test survey programming
- Export and scrutinize data

Train enumerators

- Develop detailed enumerator manual, use as basis for training
- Review paper version to understand survey design and objectives, then practice on tablets
- Train more enumerators than needed, use quizzes and field testing to identify best candidates

Protect respondent privacy

- Include informed consent at beginning of every questionnaire
- Ensure data are protected when collected, and stored after encrypting
- Limit access to personal data

Monitor quality with field validations

- Revisit subset of respondents to verify data (back checks)
- Perform unannounced field visits (spot checks)
- Record portions of interview to check quality remotely (audio audits)

Monitor quality with data checks

- Prepare scripted set of data checks in advance
- Run high-frequency checks on every batch of data—typically every day
- Assess consistency and range of responses, check for missing values, test for enumerator-specific effects, monitor duplicates, and check for completeness vis-a-vis field logs

Source: DIME (Development Impact Evaluation) Analytics, World Bank.

of the unit's public servants. Working through the elements of figure 5.4, this would require the following steps:

- **Prepare for a survey:** Ensure that we have a sufficiently large sample of trainees to detect a quantitative increase in their knowledge. Determine which organizations or units we want to survey and any subgroups of respondents we want to focus on (managers vs. nonmanagers, contract workers vs. staff, etc.). Obtain organizational structure charts if necessary.
- **Draft survey instrument:** Develop questions sufficiently close to the concepts of interest to provide us with measures we can act on. We might ask the trainees questions about how they have used the new

procedures in their daily work, and we might ask their colleagues whether this has made them easier to work with on related tasks. Basing our survey on existing surveys of these trainees would allow us to track the impacts of training across time.

- **Pilot:** Test intended questions with the audience of interest so the trainees understand what we are asking about. Though we might be asking about the actual practice of using the new procedures, the wrong question will make trainees respond about the change in rules rather than whether they are actually being followed.
- **Train enumerators:** If data collection is managed by enumerators, ensure they understand the appropriate protocols of the public service and take a consistent approach to measurement. If trainees differ in seniority, how will an enumerator ensure a common approach to surveying across the hierarchy?
- **Protect respondents' privacy:** Create protocols to ensure the process protects respondents' privacy. Individual public servants' capability at aspects of their jobs is highly sensitive information. If officials believe that their data will not be completely private, they may refuse to cooperate with the data collection exercise.
- **Monitor quality with field validations and/or data checks:** Implement a system that monitors survey data as they come in, and monitor whether a specific enumerator, department, or agency is presenting unusual data.

For a more detailed explanation of the protocols associated with surveys, please refer to chapter 4 of *The DIME Analytics Data Handbook* (Bjärkefur et al. 2021) and the videos and lectures from the Manage Successful Impact Evaluation Surveys course (DIME Analytics 2020a, 2021b).[3] To learn how to implement high-quality surveys in practice, please refer to the DIME Wiki articles on Primary Data Collection, Field Surveys, Survey Protocols, and Remote Surveys.[4] For specific considerations regarding phone surveys, please refer to chapters 1 and 2 of *Mobile Phone Panel Surveys in Developing Countries: A Practical Guide for Microdata Collection* (Dabalen et al. 2016).

PUBLIC RESOURCES AND TOOLS

To support the implementation of a rigorous research process, DIME Analytics has made a range of resources, technical solutions, and research protocols available through open-access trainings and open-source tools. We have found that there is significant unmet demand for these public goods, demonstrated by fast-growing and widespread global interest in our offerings. This section describes DIME Analytics' flagship resources.

Development Research in Practice: The Course

The DIME Analytics Data Handbook is accompanied by the course Development Research in Practice.[5] This free and fully virtual course lasts 8 weeks, with seven lecture weeks each corresponding to one of the chapters from the handbook. This course provides attendees with a high-level overview of the entire process of empirical research so that they understand how each stage of the research workflow fits among the others and how the framework of transparency, reproducibility, and credibility informs the entire structure. Each week presents a motivational video with paired readings from the handbook and the DIME Wiki, a detailed lecture and Q&A session with DIME

Analytics team members on the topic of the week, and a knowledge assessment for attendees. The course will be offered annually, and all course materials are publicly available for self-study (DIME Analytics 2021a).

Manage Successful Impact Evaluation Surveys

Manage Successful Impact Evaluation Surveys is a free, virtual course in which participants learn and practice the workflows involved in primary data collection. It acts as a complement to the Development Research in Practice course, providing a deep dive into the processes that are described at a high level in chapter 4 of *The DIME Analytics Data Handbook*. The course covers best practices at all stages of the survey workflow, from planning to piloting instruments and monitoring data quality once fieldwork begins. There is a strong emphasis throughout on research ethics and reproducible workflows. During the global pandemic, a special module focused on adapting surveys to remote data collection. Participants learn to plan for and prepare successful surveys, design high-quality survey instruments, effectively train surveyors (including remote training), monitor survey implementation, ensure high-quality data, and handle confidential data securely, among other topics. The course uses a combination of virtual lectures, readings, and hands-on exercises. It is offered annually, and all course materials are available online for self-study (DIME Analytics 2020a, 2021b).

Measuring Development Conference

DIME Analytics annually invites a diverse group of attendees to become part of a community of analysts interested in innovations in measurement. Measuring Development is an annual conference organized jointly by DIME, the World Bank's Development Economics Data Group, and the Center for Effective Global Action at the University of California, Berkeley. The conference focuses on data and measurement innovations across different sectors and themes. It was held virtually and was open to the public in 2020 and 2021. The focus for 2021 was "Emerging Data and Methods in Global Health Research" (a summary blog can be found in Jones, Fishman, and Reschechko 2021). Previous topics have included "Data Integration and Data Fusion" (2020), "Crisis Preparedness and Response" (2019), and "Artificial Intelligence and Economic Development" (2018).[6]

DIME Wiki

The DIME Wiki is a one-stop shop for resources on the best practices and resources across all phases of an impact evaluation (IE): design, fieldwork, data, and analysis. It focuses on practical implementation guidelines rather than theory. With over 200 content pages, the DIME Wiki is open to the public, easily searchable, and suitable for users of varying levels of expertise. The DIME Wiki is closely linked to *The DIME Analytics Data Handbook*; the handbook links to the DIME Wiki for implementation details and specific examples of the best practices it outlines.[7]

Stata Packages

If you use Stata (a statistical package many researchers use for their analysis), you may be interested in the DIME Analytics Stata software packages, ietoolkit and iefieldkit. These packages are a direct result of DIME Analytics' efforts to identify inefficiencies and common sources of error in data workflows and to create tools that routinize best practices. The ietoolkit package includes standardized commands for data analysis tasks that are common in DIME work. The iefieldkit package includes commands related to primary data

collection that create rapid, standardized, and well-documented data acquisition workflows. These statistical packages can be installed through the Statistical Software Components (SSC) archive. The source code for ietoolkit and iefieldkit is available for public review and contribution via GitHub.[8] By using these standardized commands, users avoid repeating common mistakes and produce more efficient code as well as share common workflows for major tasks.

Data Visualization Libraries

If you are producing graphics from your data, you may be interested in the DIME Analytics visual libraries for Stata and R users (Andrade et al. 2020).[9] The libraries contain example code for model data visualizations in an easy-to-browse format. These libraries help researchers reduce the time they spend creating professional-quality, reproducible graphs and maps. Both the Stata library and the R library are open to contributions through GitHub.[10]

Technical Trainings

DIME Analytics provides regular technical trainings to World Bank staff and consultants. All training materials are shared with the public through the Open Science Framework platform; self-study is encouraged, and DIME Analytics provides support to independent learners by answering questions and responding to feedback in the relevant GitHub repositories. To access an index of these trainings and browse all materials, visit the DIME Analytics profile page on the Open Science Framework website.[11]

Research Assistant Onboarding Course

The Research Assistant Onboarding Course is designed to familiarize research assistants (or, in a public administration setting, junior analysts) with best practices for reproducible research.[12] By the end of the course's six sessions, participants have the tools and knowledge to implement these best practices and to set up a collaborative workflow for code, data sets, and research outputs. Most content is platform independent and software agnostic, though participants are expected to be familiar with statistical software. The course is offered twice yearly to World Bank staff and consultants; course materials are available to the public (DIME Analytics 2020b).

R for Advanced Stata Users

The R for Advanced Stata Users course provides an introduction to the R programming language, building on knowledge of Stata.[13] The course focuses on common tasks in development research related to descriptive analysis, data visualization, data processing, and geospatial data work. The course is offered twice yearly to World Bank staff and consultants; course materials are available to the public (DIME Analytics 2019).

Continuing Education Series

DIME Analytics offers a biweekly Continuing Education Series in the fall and spring semesters. The trainings are typically hands-on, and the topics are decided based on a review of common issues faced by DIME project teams. For example, in 2020, DIME Analytics delivered 11 Continuing Education sessions on topics including "Data Quality Monitoring," "Working with Spatial Data in Stata," "Optimizing Survey Length," "GitHub Pull Requests," and "Introduction to Python for Stata Users" (DIME Analytics 2020–2023).

CONCLUSION

The World Bank's DIME Analytics team has made a sustained, years-long effort to implement the principles of transparency, reproducibility, and credibility across the cycle of data work. It has taken an iterative approach. First, through direct engagement with analytical teams, DIME Analytics identifies processes that are both common and ad hoc, such that the whole organization would benefit from standardization. Then, the DIME Analytics team works to understand the essential needs of the analytics teams for the process or subtask, mapping each process as part of a research flowchart and defining the inputs and outputs that are desired for the process. Next, the team either identifies an external tool or process that can be utilized or develops its own tools or guidelines that are appropriate to data work. Finally, the materials are documented, archived, and disseminated into team workflows through the frequent training and support sessions the team organizes.

In this way, DIME as an organization has accumulated a knowledge base of high-quality analytical tools and standardized processes and best practices that are used across almost all its projects. For the DIME Department, these resources form a visible foundation that makes DIME research well known for its attention to quality and underscores the reliability of DIME research products. Additionally, an essential element of the mission of DIME and the World Bank is to produce global public resources for high-quality analytical evidence. In response to this mission, DIME Analytics makes its tools, processes, and trainings publicly available whenever possible and enables them to be self-paced and remote to the greatest practical extent. This chapter has summarized some of the key features and philosophies of the DIME Analytics approach and has offered these resources to readers so they may use and access whatever materials are helpful to them.

NOTES

We acknowledge the initiative of Arianna Legovini (alegovini@worldbank.org) and Florence Kondylis (fkondylis@worldbank.org) for their creation of and ongoing support for the DIME Analytics team, and Vincenzo di Maro (dimaro@worldbank.org) for his leadership and management. We especially acknowledge the work of Kristoffer Bjärkefur (kbjarkefur@worldbank.org), Luíza Cardoso de Andrade (lcardoso@worldbank.org), and Roshni Khincha (rkhincha@worldbank.org) as members of that team, as well as the support and assistance of Avnish Singh (asingh42@worldbank.org), Patricia Paskov (ppaskov@worldbank.org), Radhika Kaul (rkaul1@worldbank.org), Mizuhiro Suzuki (msuzuki1@worldbank.org), Yifan Powers (ypowers@worldbank.org), and Maria Arnal Canudo (marnalcanudo@worldbank.org). We further recognize all members of the DIME team, past and present, for their contributions to this portfolio and all the World Bank teams and external support we have graciously received. DIME Analytics has been financially supported by the United Kingdom Foreign, Commonwealth and Development Office (FCDO) through the DIME i2i Umbrella Facility for Impact Evaluation at the World Bank.

1. *The DIME Analytics Data Handbook* GitHub repository can be found at https://worldbank.github.io/dime-data-handbook/.
2. The DIME Wiki is maintained by DIME Analytics and can be found at https://dimewiki.worldbank.org/.
3. More information about the Manage Successful Impact Evaluation Surveys course is available on the World Bank website at https://www.worldbank.org/en/events/2021/05/24/manage-successful-impact-evaluation-surveys.
4. DIME Wiki, s.v. "Primary Data Collection," last modified May 6, 2022, 17:02, https://dimewiki.worldbank.org/Primary_Data_Collection; DIME Wiki, s.v. "Field Surveys," last modified May 6, 2021, 17:27, https://dimewiki.worldbank.org/Field_Surveys; DIME Wiki, s.v. "Survey Protocols," last modified July 11, 2022, 16:18, https://dimewiki.worldbank.org/Survey_Protocols; DIME Wiki, s.v. "Remote Surveys," last modified April 7, 2022, 17:35, https://dimewiki.worldbank.org/Remote_Surveys.
5. More information about the Development Research in Practice course is available on the World Bank website at https://www.worldbank.org/en/events/2021/07/12/development-research-in-practice.
6. More information about the 2018 and 2019 conferences can be found on the World Bank website at https://www.worldbank.org/en/events/2018/01/29/artificial-intelligence-for-economic-development and https://www.worldbank.org/en/events/2019/03/27/crisis-preparedness-and-response. More information about the 2020 and 2021 conferences can be found on the website of the Center for Effective Global Action at https://cega.berkeley.edu/event/annual-conference-on-measuring-development-vi-data-integration-and-data-fusion/ and https://cega.berkeley.edu/event/measuring-development-2021-emerging-data-and-methods-in-global-health-research/.

7. The DIME Wiki can be found at https://dimewiki.worldbank.org/.
8. The GitHub repository for ietoolkit is available in the World Bank's repository at https://github.com/worldbank/ietoolkit. The GitHub repository for iefieldkit is available in the World Bank's repository at https://github.com/worldbank/iefieldkit.
9. The Stata visual library is available at https://worldbank.github.io/stata-visual-library/. The R visual library is available at https://worldbank.github.io/r-econ-visual-library/.
10. The GitHub repository for the Stata visual library is available in the World Bank's repository at https://github.com/worldbank/stata-visual-library. The GitHub repository for the R visual library is available on the World Bank's repository at https://github.com/worldbank/r-econ-visual-library.
11. The DIME Analytics profile page on the Open Science Framework website can be found at https://osf.io/wzjtk.
12. More information about the Research Assistant Onboarding Course is available at https://www.worldbank.org/en/events/2020/01/30/ra-onboarding-course.
13. More information about the R for Advanced Stata Users course can be found on the World Bank website at https://www.worldbank.org/en/events/2019/04/16/R-for-advanced-stata-Users.

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