ASA Response to NSF Request for Information on the Development of a 2025 National Artificial Intelligence Research and Development Strategic Plan

May 29, 2025

The American Statistical Association (ASA) respectfully submits this response to the National Science Foundation's Request for Information on the 2025 National AI Research and Development Strategic Plan. We emphasize the critical and often overlooked role of statistical expertise in ensuring AI systems are rigorous, trustworthy, and responsibly developed across sectors—from science and education to national security, economics, and public policy.

Models are only as good as the data they use for training, and statisticians specialize in designing efficient and accurate data collection systems and, critically, mitigating bias that comes from not having comprehensive or fully representative input data. Further, even the most sophisticated model will be uncertain about some predictions and just plain wrong about others. As the science of learning from data and studying uncertainty, statistics provides essential methods for quantifying, propagating, and communicating uncertainty, as well as detecting and correcting miscalibration in AI models—which is crucial for informed decision-making, especially in regulated environments. Statistical methods and study design also play a crucial role in the evaluation of AI models: the processes of assessing whether they work in practice and the iterative process of improving relevance and impact. One of the keys to making AI models work optimally is for the developers of the system to include individuals that understand the underlying application that drives the deployment of the models as well as their technical characteristics. The training provided by Statistics and Biostatistics programs excels at

preparing individuals that can work at this interface. Hence, supporting the training of the next generation of statistical scientists is fundamental to advance America's AI leadership.

Key Recommendations

1. Comprehensive Approach to AI Development

The current AI landscape disproportionately focuses on model engineering and algorithmic sophistication, overlooking crucial statistical considerations that are fundamental to meaningful AI innovation and the use of AI tools in practice. Statistical innovations tend to take place either *before* (e.g. focusing on the nature and process of data being collected and used) or *after* (quantifying uncertainty and correcting for miscalibration, or evaluating the use of the tool in practice) the model engineering and algorithm development stage. Critically, many statistical innovations are *model agnostic,* meaning they will be just as salient with tomorrow's AI as they are with today's. We urge the NSF to:

- Explicitly integrate statistical expertise at every stage of AI research and development
- Explicitly integrate statistical leadership in federally funded AI projects, in fields ranging from agriculture, energy, and national security to health, medicine, and regulatory science.
- Establish dedicated committees and solicitations that prioritize statistical perspectives.
- Recognize that AI's true potential lies not just in model complexity, but in data quality, interpretation, and responsible application.

2. Emphasize the fundamental role of data and research design in AI development

When AI models fail, we tend to blame the algorithm. The term "algorithmic bias," for example implies that the AI model has been engineered in a way that systematically prioritizes one group over another. In many cases, though, the algorithm is just replicating patterns that exist in data. ASA emphasizes the role of data collection, research design, and other considerations in mitigating algorithmic bias and related pitfalls. For example, sample size determination and hypothesis testing remain critical in the era of AI. In a landscape where benchmarks dominate, what are appropriate metrics, how much data are required for sufficient power, and determining if a statistically significant difference is observed between models will be critical. Our recommendations include:

- Prioritizing research on:
    - Selection bias identification and mitigation
    - Robust evaluation design, including experimental and non-experimental when needed
    - Comprehensive data quality assessment

    - System reliability: quantifying the uncertainty and reliability of both subcomponents and entire AI systems, as AI models interact with tools and each other
- Developing an infrastructure for model evaluation, perhaps under the umbrella of the National Artificial Intelligence Research Resource (NAIRR).
- Developing frameworks to
    - enable data autonomy for individuals and institutions, especially in lower-resource settings
    - ensure unbiased data representation, usage, and algorithmic accountability
    - facilitate data autonomy in under-resourced settings and transparency in data provenance and preprocessing

3. Beyond Prediction: The Importance of Statistical Inference

While predictive capabilities are crucial, scientific advancement requires robust inference methodologies that take into account the uncertainties in AI model outputs. We advocate for:

- Assessment of the uncertainty in AI models and the resulting output
- Assessment of the uncertainty in AI systems, where models will interact with each other and/or tools
- Supporting research that integrates predictions with traditional scientific inference
- Developing methodological innovations that leverage both predictive models and statistical reasoning
- Recognizing the long-standing statistical traditions of combining diverse data sources

4. Uncertainty and Decision-Making

As AI becomes increasingly prevalent, understanding and managing uncertainty becomes paramount. This becomes more critical as AI models communicate with one another and error can propagate through the system. The ASA recommends investing in research on:

- Decision-theory approaches in the presence of statistical, model, and data uncertainty
- Methodologies for assessing prediction accuracy, including on AI agency and systems
- Frameworks for reasoning with AI-generated predictions

5. Supporting statistical training

As pointed out before, researchers trained in statistics and biostatistics excel at preparing individuals who understand both the underlying application domain and the technical challenges associated with the deployment of AI models. The ASA recommends providing support for statistical training at the undergraduate, graduate, and postgraduate levels

- Expanding programs that support undergraduate education such as the NSF Data Science Corps (perhaps reformulated as an “AI core\ps” program) and the NSF Scholarships in Science, Technology, Engineering, and Mathematics Program (SSTEM) with subprograms targeting Statistics and Biostatistics.
- An increase in funding for the NSF Graduate Research Fellowship Program (GRFP), the NSF Research Traineeship Program (NRT) and the Research Training Groups in the Mathematical Sciences (RTG), with a particular emphasis in the areas of Statistics and Biostatistics.
- The development of novel programs to fund postgraduate work at the interface of AI and statistics/biostatistics methods.
- The development and expansion of similar programs at other federal agencies like the Department of Defense and the Department of Energy, among others.

6. Interdisciplinary Collaboration and Infrastructure

To truly advance AI capabilities, we propose:

- Creating research initiatives that bring together statisticians, AI developers, AI practitioners, policymakers, and domain experts
- Establishing collaborative platforms across government, academia, and industry. The government collaboration should include the Department of Energy, the Department of Defense, and NASA. The DOE and the national lab complex, for example, have extensive infrastructure designed for large computing challenges like AI and have invested heavily in its research. Partnerships with AI developers like OpenAI and Anthropic are also essential to the nation's success.
- Supporting continued collaboration between the National Artificial Intelligence Research Resource (NAIRR) Pilot and the National Secure Data Service Demonstration (NSDS)

7. Validation, Reproducibility, and Model Governance

As AI influences decisions across government, industry, and civil society, systematic model validation and governance protocols are urgently needed. We recommend:

- Developing standards for reproducibility, benchmarking, and cross-validation across environments and populations
- Promoting regulatory-grade evaluation frameworks for use in public service delivery, risk assessment, and economic and infrastructure forecasting
- Establishing national guidelines for documentation, versioning, and explainability of AI systems

8. Strategic Data Collaboration Opportunities

The ASA strongly endorses leveraging existing infrastructure to advance AI research. The NAIRR and NSDS initiatives represent a critical pathway for responsible AI development:

- NAIRR offers a promising framework for harnessing government and public data for AI methodological and substantive research, with a statutory focus on leveraging publicly available government data
- NSDS complements federal statistical agencies by providing access to restricted government data through robust data governance
- Current collaborative efforts, including technical projects to create safe versions of restricted data for AI research, demonstrate the potential for innovative data access methodologies

These initiatives build on decades of statistical system data governance, providing strong ethical, methodological, and legal frameworks for AI research. We recommend expanding joint methodological and data governance projects to:

- Advance safe and appropriate access to government data
- Drive cutting-edge AI research
- Ensure rigorous statistical oversight and accountability

Conclusion

The United States can only secure its position as a global AI leader by embracing a holistic, statistically informed approach to AI research and development. Statisticians offer critical expertise in data collection, research design, model evaluation, uncertainty quantification, and ethical considerations—elements essential to responsible AI innovation. Statistics has been, and will continue to be, the foundation of AI technologies. Without the support and advancement of statistics, the progress of AI would be severely limited.

The ASA stands ready to collaborate with the NSF in realizing a comprehensive, rigorous, and innovative national AI strategy.

Questions or comments may be directed to ASA Director of Science Policy Steve Pierson: spierson@amstat.org.