GAISE II Preface

In 2020 as the *Pre-K–12 Guidelines for Assessment and Instruction in Statistics Education II: A Framework for Statistics and Data Science Education report (GAISE II)* is published, never have data and statistical literacy been more important. The public is being called upon to synthesize information from many global issues, including the COVID-19 global pandemic, a changing planet with extreme weather conditions, economic upturns and downturns, and important social issues such as the Black Lives Matter movement. Data are encountered through visualizations (sometimes interactive and sometimes not), reports from scientific studies (such as medical studies), journalists' articles and websites.

The demands for statistical literacy have never been greater. Statistically literate high-school graduate need to be able to evaluate the conclusions and legitimacy of reported results as well as formulate their own analyses. Steve Levitt, co-author of *Freakonomics*, addressed the need for statistical and data literacy with this quote from an October 2, 2019 podcast:

> *I believe that we owe it to our children to prepare them for the world that they will encounter—a world driven by data. Basic data fluency is a requirement not just for most good jobs, but also for navigating life more generally, whether it is in terms of financial literacy, making good choices about our own health, or knowing who and what to believe.*

Driven by the digital revolution, data are now readily accessible to statistical methods and technological tools so that students can gain insights and make recommendations to manage pressing world issues. Data can be extremely valuable, but only if they are used judiciously and in a proper context.

Today, many sectors of the economy and most jobs rely on data skills. Good data sense is needed to easily read the news and to participate in society as a well-informed member. Because of this, it is essential that all students leave secondary school prepared to live and work in a data-driven world. The Pre-K–12 GAISE II report presents a set of recommendations for school-level statistical literacy.

Overview and Goals of GAISE II

Guidelines for Assessment and Instruction in Statistics Education: A Pre-K–12 Curriculum Framework (hereafter referred to as Pre-K–12 GAISE I) was first released in 2005 with slight revisions in 2007 (https://www.amstat.org/asa/files/pdfs/GAISE/GAISEPreK-12_Full.pdf) along with the *Guidelines for Assessment and Instruction in Statistics Education College Report*. The *GAISE College Report* outlined recommendations for the post-secondary introductory statistics course and was updated in 2016 (https://www.amstat.org/asa/files/pdfs/GAISE/GaiseCollege_Full.pdf).

The Pre-K–12 GAISE I report was written to enhance the statistics standards in the National Council for Teachers of Mathematics (NCTM) 2000 *Principles and Standards of School Mathematics* and as a follow-up document to the Conference Board of Mathematical Sciences (CBMS) *Mathematical Education for Teachers (MET)* document. The Pre-K–12 GAISE I was a seminal and visionary document that championed the necessity of data and statistical literacy starting in the early school grades. It provided a framework of recommendations for developing students' foundational skills in statistical reasoning in three levels across

the school years, described as levels A, B, and C. These levels are maintained in GAISE II and are roughly equivalent to elementary, middle, and high school. The progression through the sequential levels in the Pre-K–12 GAISE (both I and II) is intended for any individual who is striving to achieve statistical literacy, regardless of age.

Since its initial publication, GAISE I has significantly impacted the inclusion of statistics standards at the state and national level in the United States and across the world. The report has been used internationally as a reference point for statistics education at the school level. There is a Spanish translation of GAISE I (https://www.amstat.org/asa/files/pdfs/GAISE/Spanish.pdf). At the time of this writing, Google scholar shows over 790 citations for GAISE I in scholarly works. The report has been referenced in numerous National Science Foundation grant projects and other professional STEM educational organizations' reports. GAISE I also influenced the development of state standards across the United States and the writing of the ASA *Statistical Education of Teachers* (SET) document (https://www.amstat.org/asa/files/pdfs/EDU-SET.pdf) that makes recommendations for the preparation of school level teachers in statistics.

GAISE I primarily focused on traditional data types of quantitative and categorical variables and on study designs using small data sets of samples from a population. Fifteen years later, data types have expanded beyond being classified as quantitative and categorical thus necessitating the acquisition of different and often state-of-the-art statistical skills. Today, for example, data include text posted on social media or highly structured (or unstructured) collections of pictures, sounds, or videos. Data are immense and readily available. Data are multidimensional. Data representations and visualizations are also often multidimensional and interactive displaying many variables simultaneously.

GAISE II incorporates the new skills needed for making sense of data today while maintaining the spirit of GAISE I. GAISE II highlights:

1. The importance of asking questions throughout the statistical problem-solving process (formulating a statistical investigative question, collecting or considering data, analyzing data, and interpreting results), and how this process remains at the forefront of statistical reasoning for all studies involving data

2. The consideration of different data and variable types, the importance of carefully planning how to collect data or how to consider data to help answer statistical investigative questions, and the process of collecting, cleaning, interrogating, and analyzing the data

3. The inclusion of multivariate thinking throughout all Pre-K–12 educational levels

4. The role of probabilistic thinking in quantifying randomness throughout all levels

5. The recognition that modern statistical practice is intertwined with technology, and the importance of incorporating technology as feasible

6. The enhanced importance of clearly and accurately communicating statistical information

7. The role of assessment at the school level, especially items that measure conceptual understanding and require statistical reasoning involving the statistical problem-solving process

A Future Driven by Data

As stated in GAISE II,

> *Data are used to tell a story. Statisticians see the world through data – data serve as models of reality. Statistical thinking and the statistical problem-solving process are foundational to exploring all data.*

GAISE II presents a vision where every individual is confident in reasoning statistically, making sense of data, and knowing how and when to bring a healthy skepticism to information gleaned from data. Presented here is a framework of essential concepts and 22 examples across the three levels of skills development. This framework supports all students as they learn to appreciate the vital role of statistical reasoning and data science and acquire the essential life skill of data literacy.

We, the writers, are appreciative of the opportunity, support, and endorsement from the Board of Directors of both the American Statistical Association (ASA) and the National Council for the Teachers of Mathematics (NCTM) for the enhancement of the Pre-K–12 GAISE I document. Our hope is that the Pre-K–12 GAISE II document will enrich your work in fostering the ultimate goal: statistical literacy for all.

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