

Ethics for Undergraduates

Workgroup on Undergraduate Education

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This white paper (and other related resources) can be found at <http://www.amstat.org/education/curriculumguidelines.cfm>.

Introduction

Ethical behavior of statisticians is critical to ensuring our work is trusted and accepted. Ethical issues permeate statistical work. Some examples of ethical issues are---underpowered studies are misleading, P-value hacking (and more generally running many tests and reporting only the most significant) is misleading, monitoring outcomes of the analysis to decide what variables, data to include in the study and the obligation to employ adequate subject-matter expertise and guard against predisposition of results.

Undergraduate statistics programs should discuss ethical issues and provide further resources for BS graduates to access as references when needed when they are in the labor force. This may range from a required seminar, lectures in a capstone program or a full semester/quarter course devoted to ethics. Since many students' training ends with a bachelor's degree, failing to discuss ethical principles with undergraduates is a disservice to the profession. Given the heavy requirements a student carries, a practical method for ethics introduction to undergraduates might be lectures within appropriate courses or seminars. They need to know the issues and know when they need to seek guidance on moral dilemmas. Leaving ethical issues for the boss really is not effective when the bachelor statistician has been into the weeds, needs to make decisions somewhat independently at times and knows the issues.

Overview

The Board of Directors for the American Statistical in August 1999 approved Ethical Guidelines for Statistical Practice (Attachment 2). These guidelines cover eight general topics that specify important ethical considerations under each topic:

1. Professionalism
2. Responsibilities to clients
3. Responsibilities in Publications and Testimony

4. Responsibilities to Research subjects
5. Responsibilities to Research Team colleagues
6. Responsibilities to statistical Practitioners
7. Responsibilities regarding allegations of misconduct
8. Responsibilities of employers.

(See WWW.amstat.org/committees/ethics/index.html for more specifics)

Most statisticians' work involves following good ethical practices either directly or indirectly. For example, decisions involving types of tests performed on the data, variables actually collected and used for the analysis should be appropriate so as to not lead to erroneous analysis. Validity of the assumptions in the analysis, the appropriateness of the population studied, the representativeness of the data for the population studied should be appropriate for the goal of the research. Adding appropriate caveats to the results is critical so as not to mislead the reader. Intentionally misleading the reader about the conclusions drawn are a few examples of ethical issues that statisticians must be mindful about as they do their work.

Ethical issues that concern statisticians such as designing experiments involving human or animal subjects to handling confidential data sets are well documented. Statisticians involved with experiments involving human subjects or animal experiments know there are rigorous institutional reviews for efficacy due to ethical dilemmas associated with these studies. For clinical trials involving human subjects there can be intense scrutiny by institutional review boards (IRB) for privacy concerns, even for seemingly innocuous survey instruments. The Department of Health and Human Services' Office of Human Subjects Research website has extensive information on this type of research. When handling data involving human subjects, statisticians must follow ethical standards when deciding on appropriate statistical techniques to use and report on data. The statistician must ensure people's privacy is protected in presenting findings, particularly in today's world with the wealth of information on the Internet. Undergraduates should end up with recognition of when they need to consult experts on these ethical dilemmas or know when to do follow up research when confronted with these issues.

Good Ethical Practices

Each of the eight ASA ethical topic areas involve from five to a dozen responsibilities that should be followed. Some examples of ethical responsibilities include:

- remain current in dynamically evolving statistical methodologies,
- guard against predisposition of the results that might predetermine the analytical result,
- ensure adequate subject matter expertise is applied and planned for the study,

- don't imply protection of privacy and confidentiality from legal processes of discovery unless explicitly authorized to do so,
- provide only expert testimony you would be willing to have peer reviewed.

These 5 examples of ethical principles are important for bachelor statisticians to be exposed to as well as graduate students and senior seasoned statisticians. As bachelor graduates enter the labor force and get into the weeds of the analysis they are best positioned to protect against misuse and misinterpretation of data. For example, if a statistician who does analysis asks himself/herself if the analysis can withstand peer review at each stage, the work will be credible. Guarding against predisposition of the results ensures that statisticians are not saying what the boss or client desires but what the data actually says. Privacy and confidentiality concerns can be very subtle. It is probably unrealistic for undergraduates to gain significant insight into privacy but not unrealistic for them to be sensitized to the issues and know when they need to seek expert assistance.

Today's data world presents many more opportunities for data to be analyzed and potential new ethical dilemmas. People need to be assured that data in today's big data environment are used responsibly and ethically. This implies that analysis of data protects each person's privacy if they are included in the dataset, and acknowledges that analysis and conclusions involves honest judgments that must be clearly.

Jessica Utts in her text: *Seeing through Statistics*; 3rd edition has an excellent chapter on ethics in statistical studies (chapter 26) with many insightful examples of how a researcher can unintentionally go wrong. In addition to ethics involving human studies, the chapter describes principles that Federal statistical agencies follow in conducting surveys, gives examples where not following good principles can result in misleading results, discusses how an experimenter can inadvertently introduce personal bias into studies/analysis, and fair reporting of results including caveats so that a reader can properly interpret the researcher's conclusions,

Ethics in Research

Some organizations require researchers to take ethics training and follow ethical practices in their studies. For example, St Olaf College (<http://wp.stolaf.edu/irb/training>) requires training for researchers, both faculty and students. Federal agencies such as the National Science Foundation require its grantees to follow ethical principles. Instilling these ideas in statistics programs is a worthwhile objective as statisticians will be held to this standard.

Teaching Options

The concern in an undergraduate statistics program is the amount of depth one can give students given the demand for technical courses in statistical theory and applications and

other university requirements. However, ignoring ethics is not responsible. Ethics should be woven into an undergraduate curriculum in some consistent fashion.

Tractenburg and Fitzgerald (2013) propose a matrix of the eight ASA ethical areas crossed by six learnable, improvable knowledge, skills and abilities (KSAs) of ethical reasoning which ideally could be used to develop a one semester or quarter course on ethics for PStat (attachment 1). Some of these KSAs involving ethics could be addressed in a capstone, data analysis programs, case studies or internship program at some level as appropriate. Cases studies can be an excellent way to weave in ethical considerations. If consistently reinforced in these courses and programs, teaching ethics will not be burdensome, and consistent reinforcement will remind students of its relevancy to our profession.

Material that should be referenced and/or covered can be in an ethics program in statistics can be derived from:

- ASA ethical guideline for statisticians (attachment 2)
- ISI ethical guideline for statisticians (attachment 3)
- Common rule---Code of Federal Regulations Title 45 Part 46 (current version issued in 2009 currently being revised)
- Institutional Review Boards.

Teaching ethics should include a discussion on ethical issues on data handling, analytics and reporting results. For analytics:

- Formulate the question, don't just consider the significance level
- Look at the data using graphs, etc.
- Consider the environment of the data collection
- Analyze the data using appropriate techniques
- Draw conclusions based supported by the data and analysis independent of your perceived ideas or desired results
- After drawing conclusions, look at the data again and reevaluate conclusions.

For reporting:

- Clearly state the assumptions and caveats a reader should know about
- State conclusions within reason
- Don't confuse causation with association
- Fully report statistical significance, e.g. when multiple tests are performed, reporting only the most significant results is misleading

- Report practical significance
- Report any unresolved problems and possible consequences

Remember: “The problem isn’t that another sample may give a different answer, but that another statistician working with the same sample may give a different answer.”

Where a program wants to offer a more in depth program for ethics, a potential one-semester course could be developed from a course outline proposed by Rochelle Tractenburg and Kevin Fitzgerald at JSM 2014:

- Orientation meeting: introduction to the knowledge and skills case study approach for ethical decision making, and portfolio assessment.
- Discuss the utility of prerequisite knowledge and how/whether augmenting this with formal ethical reasoning can serve as a basis for adequate reasoning and case study discussions. Is it ever OK not to use the highest possible levels of competence, judgment, and diligence in the design and execution of an analysis?
- Definitions of unprofessional conduct, research misconduct, and policies for handling misconduct in the workplace.
- Discuss ethical and moral dilemmas in confidentiality and privacy, and the interface between confidentiality and intellectual property.
- Identify and articulate obligations to protect fundamental human rights and respect diversity in cultures.
- Describe decision-making frameworks and their applications in cases involving the design of ethical clinical or animal research, participant recruitment, and the concept of “informed” consent.
- Identify and evaluate alternative actions with respect to current developments in animal research/models such as using data previously collected or finding an alternative to traditional animal testing.
- Discuss responsibilities to funders, clients & employers: identifying and avoiding conflicts of interest – personal, professional, and financial.
- Discuss the use and interpretation of data analysis; responsibilities for making and justifying decisions with due consideration of the employer or funder and funding structure in data management, sharing, and ownership.
- Whether or not quantitative work will be published or shared, what are our responsibilities to our professional community?
- Discussion of the decision making processes every data scientist engages in, whether in research or applied settings; and sole and team science contexts.

- Reflecting on the quantitative scientist as a responsible member of society, and larger impacts of decisions made by the quantitative scientist throughout design and execution of analyses and simulations, and reporting of results.

See Rochelle Tractenberg and Kevin Fitzgerald August 2014 for more details.

Combining topics and covering them in less depth could result in a shorter course; topics can also be incorporated in other courses. For example, institutions that perform animal or human subject research have well established protocols while ethics on analytical studies are not usually addressed well if at all.

References and Acknowledgements:

Jessica Utts; *Seeing through Statistics*, 3rd edition; Chapter 26

Tractenberg, RE, *Ethical Reasoning for Quantitative Scientists: A Mastery Rubric for Developmental Trajectories, Professional Identity, and Portfolios that Document Both*, Proceedings of the 2013 Joint Statistical Meetings, Montreal, Quebec, Canada.

Tractenberg, RE & FitzGerald KT. (2014, August): *Responsibility in the conduct of Quantitative Sciences: Preparing future practitioners and certifying professionals*: Joint Statistical Meetings, Boston, MA. (Abstract # 313307), forthcoming in Proceedings of the 2014 Joint Statistical Meetings, Boston, MA.

Attachment 1

The Novice performance of ethical reasoning KSAs, expected to be achieved after a semester or quarter long course on ethical reasoning (compliant with NSF/NIH/DOD requirements) that also introduces the eight ASA Ethical Guideline Topical Areas.

Table 1. Eight ASA ethical professional areas (rows) crossed with six *learnable, improvable* KSAs of ethical reasoning

From: <http://www.amstat.org/committees/ethics/index.html> after Tractenberg & FitzGerald (2012, Table 1); Table 1 reproduced with permission from Tractenberg RE (2013). Ethical Reasoning for Quantitative Scientists: A Mastery Rubric for Developmental Trajectories, Professional Identity, and Portfolios that Document Both. Proceedings of the 2013 Joint Statistical Meetings, Montreal, Quebec, Canada.

	Knowledge, skills and abilities (KSAs) of Ethical Reasoning				
	<i>Prerequisite knowledge:</i>	<i>Recognize a Moral issue: what are the implicit and explicit options I am considering when I choose to act any given way? What are my responsibilities?</i>	<i>Identify decision-making frameworks: Focus on Stewardship, virtue ethics, “accepted practice”, and utilitarianism frameworks.</i>	<i>Identify and evaluate alternative actions:</i>	<i>Make & justify decision:</i>
<p>Ethical Reasoning KSAS:</p> <p>ASA Ethical Guideline Areas:</p>	<p>Instruction on NIH domain and its relevance to the ASA ethical area</p>	<p>What are my responsibilities with respect to peer review of my work, or reviewing others’ work?</p> <p>Should I submit my work to peer review? Should I provide a peer review? Can I justify not exercising every bit of my competence and judgment in my peer review?</p>	<p>How is “peer review” treated under each of these frameworks? Do the frameworks treat transparency, informativeness, precision, accuracy, and groundedness differently as objectives?</p>	<p>My actions must support both my profession and the scientific domain under study.</p> <p>Considering my time and effort as <i>resources</i>, and optimizing transparency, informativeness, precision, accuracy, and groundedness), what do my choices (moral issues) necessarily imply?</p>	<p>Articulating how a why my actions represent my professionalism a my competence.</p> <p>Is there a mechanism by which I can justify my decisions about peer review? If not, what other justifications can I come up with so, by what authorities does that justification apply to my situation?</p>
<p><u>Professionalism</u></p> <p>competence, judgment, diligence</p>	<p>peer review</p>	<p>Do my actions with respect</p>	<p>How are my</p>	<p>Considering my</p>	<p>Are there formal</p>
<p><u>Responsibilities to</u></p>	<p>data acquisition and laboratory tools;</p>	<p>Do my actions with respect</p>	<p>How are my</p>	<p>Considering my</p>	<p>Are there formal</p>

<p>funderson, clients & employers</p> <p>assuring that statistical work is suitable</p>	<p>management, sharing and ownership</p>	<p>to data (acquisition, management, sharing) treat one 'client' as more important than another? Can I justify prioritizing these responsibilities? Can I rationalize choices made by employers (e.g., to NOT share data) and still maintain professionalism and suitability of my work to the task at hand?</p>	<p>responsibilities to funderson, clients and employers with respect to data issues (transparency, informativeness, precision, accuracy, and groundedness), treated under each framework?</p>	<p>responsibilities to these entities (transparency, informativeness, precision, accuracy, and groundedness), what do my choices about data, its management and sharing necessarily imply?</p>	<p>mechanisms by which I can justify my decisions about its management and sharing? If not, what other justification come up with? If so, what authority does that justification apply to my situation?</p>
<p>Responsibilities in Publications and Testimony</p>	<p>responsible authorship and publication</p>	<p>Can I take full responsibility for what I have written, published, or testified? Is the entirety of my written or testified work fully professional? Have I done everything I can to ensure that my responsibilities to reviewers, readers/hearers, and decisionmakers have been met?</p> <p>Or,</p> <p>Are there situations I have seen/can imagine where these responsibilities might need to be prioritized?</p>	<p>How is "responsible authorship" treated under each of these frameworks? Do they differ in their requirements for transparency, informativeness, precision, accuracy, and groundedness?</p>	<p>Considering my responsibilities to reviewers and readers (or hearers) – and decisionmakers, (transparency, informativeness, precision, accuracy, and groundedness), what do my choices about publications and/or testimony necessarily imply?</p>	<p>Are there established mechanisms by which I can justify my decisions about publishing or testifying? If not, what other justification come up with? If so, what authority does that justification apply to my situation?</p>
<p>Responsibilities to Research Subjects</p>	<p>policies regarding human subjects, live vertebrate animal subjects in research, and safe laboratory practices</p>	<p>What is my role as a quantitative scientist in the alignment of the research with the governing policies? Is the sample size and proposed analytic plan the correct balance of risk and knowledge-value? Have I prioritized power over interpretability of results? Does the analysis plan support theory testing and/or knowledge building, or the NHST methodology?</p>	<p>How is/are the quantitative scientists' role(s) with respect to research subjects viewed under each of these frameworks?</p>	<p>Considering my responsibilities to the research participants, (professional competence and judgment), what do my choices about the analyses necessarily imply?</p>	<p>Is there a formal mechanism by which I can justify my decisions about sample size, experimental design and/or analytic method? If not, what other justification come up with? If so, what authority does that justification apply to my situation?</p>
<p>Responsibilities to Research Team Colleagues</p>	<p>conflict of interest – personal, professional, and financial collaborative research including collaborations with industry</p>	<p>What is a conflict of interest? Do my responsibilities change, or are they prioritized differently, when my colleagues are on an academic team vs. in or</p>	<p>How is/are the quantitative scientists' role(s) with respect to research colleagues and/or conflicts of interest viewed</p>	<p>Considering my responsibilities to the research colleagues (transparency, informativeness, precision, accuracy, and groundedness),</p>	<p>Is there a formal mechanism by which I can justify my decisions about conflicts of interest their declaration/mana</p>

		with industry? Are there different elements of professionalism that pertain when the research team colleagues are with me (in academia, in industry) or in another domain (industry/academia)? Are my responsibilities to government partners different or prioritized differently than those to industry/academic partners?	under each of these frameworks? Are different frameworks more applicable to academic, industry or government colleagues?	what do my choices about the conflicts of interest and their declaration/management necessarily imply?	nt? If not, what other justification can I come up with? If so, by what authority does the justification apply to my situation?
<u>Responsibilities to Other Statisticians or Statistical Practitioners</u>	the quantitative scientist as a responsible member of society, contemporary ethical issues in scientific &/or quantitative research, and the environmental and societal impacts of quantitative sciences in scientific research – whether this affects academic or lay consumers. Helping scientists be responsible;	Can I take full responsibility for what I have written, published, or taught? Is the entirety of my written or spoken work fully professional? Are my responsibilities generally primarily to reviewers, readers/hearers, and decisionmakers –or are they more to other statistical practitioners? Are their situations I have seen/can imagine where the responsibilities might need to be prioritized differently for “lay” vs. professional statistical consumption?	How is/are the quantitative scientists’ role(s) with respect to <i>other</i> quantitative scientists treated under each of these frameworks? Do the frameworks apply differently when other quantitative scientists are actually also research collaborators <or vice versa>?	Considering my responsibilities other statistical practitioners (professional judgment), what do my choices about publications and/or testimony, and how these publications or testimonies may be viewed by the public/society, necessarily imply?	Are there established mechanisms by which I can justify my decisions about work? If not, what other justification can I come up with? If so, by what authority does the justification apply to my situation? Are the justifications different if the “so” is a professional (quantitative or scientific) one vs. general (lay) one?
<u>Responsibilities Regarding Allegations of Misconduct</u>	Definitions of research misconduct and policies for handling misconduct	Do I rely on the letter of the definition to identify misconduct (or the spirit)? Do I prioritize definitions when there are different bodies/regulations to consider? Can I rely on government agency (e.g., NSF, NIH), institutional, or professional society definitions with greater confidence? Can I marginally avoid a label or charge of “misconduct” and maintain my professionalism?	How is/are the quantitative scientists’ role(s) with respect to misconduct by <i>non</i> quantitative scientist colleagues treated under each of these frameworks? Do the frameworks apply differently when I or my colleagues are quantitative scientists?	Considering definitions of, and policies for handling, misconduct, do these different frameworks lead to different decisions?	Is there a formal mechanism by which I can justify my decisions about misconduct? If not, what other justification can I come up with? If so, by what authority does that justification apply to my situation?

<p><u>Responsibilities of Employers,</u></p>	<p>mentor/mentee responsibilities and relationships</p>	<p>If your employer (client or funder) does not understand specifically what you do/how you do it, does that alter or affect their responsibilities with respect to your mentorship and professional development? Does the independent quantitative scientist have different responsibilities to mentor/be mentored than collaborative or "supportive" quantitative scientists?</p>	<p>How is mentorship for quantitative scientists specifically treated under each framework?</p>	<p>Do your responsibilities to have or provide mentorship vary throughout your career, across different contexts (academia, industry, government)? What distinguishes the different alternatives you identify? Is it primarily the extent of the obligation or some other aspect?</p>	<p>Are there established mechanisms by which I can justify my decisions about mentoring/seeking a mentor? If not, what other justifications come up with? If so, what authority does that justification apply to my situation?</p>
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Ethical Guidelines for Statistical Practice

Prepared by the Committee on Professional Ethics

Approved by the Board of Directors, August 7, 1999

Executive Summary

This document contains two parts: **I. Preamble** and **II. Ethical Guidelines**. The Preamble addresses **A. Purpose of the Guidelines**, **B. Statistics and Society**, and **C. Shared Values**. The purpose of the document is to encourage ethical and effective statistical work in morally conducive working environments. It is also intended to assist students in learning to perform statistical work responsibly. Statistics plays a vital role in many aspects of science, the economy, governance, and even entertainment. It is important that all statistical practitioners recognize their potential impact on the broader society and the attendant ethical obligations to perform their work responsibly. Furthermore, practitioners are encouraged to exercise "good professional citizenship" in order to improve the public climate for, understanding of, and respect for the use of statistics throughout its range of applications.

The **Ethical Guidelines** address eight general topic areas and specify important ethical considerations under each topic.

A. Professionalism points out the need for competence, judgment, diligence, self-respect, and worthiness of the respect of other people.

B. Responsibilities to Funders, Clients, and Employers discusses the practitioner's responsibility for assuring that statistical work is suitable to the needs and resources of those who are paying for it, that funders understand the capabilities and limitations of statistics in addressing their problem, and that the funder's confidential information is protected.

C. Responsibilities in Publications and Testimony addresses the need to report sufficient information to give readers, including other practitioners, a clear understanding of the intent of the work, how and by whom it was performed, and any limitations on its validity.

D. Responsibilities to Research Subjects describes requirements for protecting the interests of human and animal subjects of research-not only during data collection but also in the analysis, interpretation, and publication of the resulting findings.

E. Responsibilities to Research Team Colleagues addresses the mutual responsibilities of professionals participating in multidisciplinary research teams.

F. Responsibilities to Other Statisticians or Statistical Practitioners notes the interdependence of professionals doing similar work, whether in the same or different organizations. Basically, they must contribute to the strength of their professions overall by sharing nonproprietary data and methods, participating in peer review, and respecting differing professional opinions.

G. Responsibilities Regarding Allegations of Misconduct addresses the sometimes painful process of investigating potential ethical violations and treating those involved with both justice and respect.

H. Responsibilities of Employers, Including Organizations, Individuals, Attorneys, or Other Clients
Employing Statistical Practitioners encourages employers and clients to recognize the highly interdependent nature of statistical ethics and statistical validity. Employers and clients must not pressure practitioners to produce a particular "result," regardless of its statistical validity. They must avoid the potential social harm that can result from the dissemination of false or misleading statistical work.

I. PREAMBLE

A. Purpose of the Guidelines

The American Statistical Association's Ethical Guidelines for Statistical Practice are intended to help statistics practitioners make and communicate ethical decisions. Clients, employers, researchers, policymakers, journalists, and the public should be urged to expect statistical practice to be conducted in accordance with

these guidelines and to object when it is not. While learning how to apply statistical theory to problems, students should be encouraged to use these guidelines, regardless of whether their target professional specialty will be "statistician." Employers, attorneys, and other clients of statistics practitioners have a responsibility to provide a moral environment that fosters the use of these ethical guidelines.

Application of these or any other ethical guidelines generally requires good judgment and common sense. The guidelines may be partially conflicting in specific cases. The application of these guidelines in any given case can depend on issues of law and shared values; work-group politics; the status and power of the individuals involved; and the extent to which the ethical lapses pose a threat to the public, to one's profession, or to one's organization. The individuals and institutions responsible for making such ethical decisions can receive valuable assistance by discussion and consultation with others, particularly persons with divergent interests with respect to the ethical issues under consideration.

B. Statistics and Society

The professional performance of statistical analyses is essential to many aspects of society. The use of statistics in medical diagnoses and biomedical research may affect whether individuals live or die, whether their health is protected or jeopardized, and whether medical science advances or gets sidetracked. Life, death, and health, as well as efficiency, may be at stake in statistical analyses of occupational, environmental, or transportation safety. Early detection and control of new or recurrent infectious diseases depend on sound epidemiological statistics. Mental and social health may be at stake in psychological and sociological applications of statistical analysis.

Effective functioning of the economy depends on the availability of reliable, timely, and properly interpreted economic data. The profitability of individual firms depends in part on their quality control and market research, both of which should rely on statistical methods. Agricultural productivity benefits greatly from statistically sound applications to research and output reporting. Governmental policy decisions regarding public health, criminal justice, social equity, education, the environment, the siting of critical facilities, and other matters depend in part on sound statistics.

Scientific and engineering research in all disciplines requires the careful design and analysis of experiments and observations. To the extent that uncertainty and measurement error are involved—as they are in most

research-research design, data quality management, analysis, and interpretation are all crucially dependent on statistical concepts and methods. Even in theory, much of science and engineering involves natural variability. Variability, whether great or small, must be carefully examined for both random error and possible researcher bias or wishful thinking.

Statistical tools and methods, as with many other technologies, can be employed either for social good or evil. The professionalism encouraged by these guidelines is predicated on their use in socially responsible pursuits by morally responsible societies, governments, and employers. Where the end purpose of a statistical application is itself morally reprehensible, statistical professionalism ceases to have ethical worth.

C. Shared Values

Because society depends on sound statistical practice, all practitioners of statistics, whatever their training and occupation, have social obligations to perform their work in a professional, competent, and ethical manner. This document is directed to those whose primary occupation is statistics. Still, the principles expressed here should also guide the statistical work of professionals in all other disciplines that use statistical methods. All statistical practitioners are obliged to conduct their professional activities with responsible attention to the following:

1. The social value of their work and the consequences of how well or poorly it is performed. This includes respect for the life, liberty, dignity, and property of other people.
2. The avoidance of any tendency to slant statistical work toward predetermined outcomes. (It is acceptable to advocate a position; it is not acceptable to misapply statistical methods in doing so.)
3. Statistics as a science. (As in any science, understanding evolves. Statisticians have a body of established knowledge, but also many unresolved issues that deserve frank discussion.)
4. The maintenance and upgrading of competence in their work.
5. Adherence to all applicable laws and regulations, as well as applicable international covenants, while also seeking to change any of those that are ethically inappropriate.
6. Preservation of data archives in a manner consistent with responsible protection of the safety and confidentiality of any human being or organization involved.

In addition to ethical obligations, good professional citizenship encourages the following:

7. Collegiality and civility with fellow professionals.
8. Support for improved public understanding of and respect for statistics.
9. Support for sound statistical practice, especially when it is unfairly criticized.
10. Exposure of dishonest or incompetent uses of statistics.
11. Service to one's profession as a statistical editor, reviewer, or association official and service as an active participant in (formal or informal) ethical review panels.

II. ETHICAL GUIDELINES

A. Professionalism

1. Strive for relevance in statistical analyses. Typically, each study should be based on a competent understanding of the subject-matter issues, statistical protocols that are clearly defined for the stage (exploratory, intermediate, or final) of analysis before looking at those data that will be decisive for that stage, and technical criteria to justify both the practical relevance of the study and the amount of data to be used.
2. Guard against the possibility that a predisposition by investigators or data providers might predetermine the analytic result. Employ data selection or sampling methods and analytic approaches that are designed to ensure valid analyses in either frequentist or Bayesian approaches.
3. Remain current in dynamically evolving statistical methodology; yesterday's preferred methods may be barely acceptable today and totally obsolete tomorrow.
4. Ensure that adequate statistical and subject-matter expertise is both applied to any planned study. If this criterion is not met initially, it is important to add the missing expertise before completing the study design.
5. Use only statistical methodologies suitable to the data and to obtaining valid results. For example, address the multiple potentially confounding factors in observational studies and use due caution in drawing causal inferences.

6. Do not join a research project unless you can expect to achieve valid results and you are confident that your name will not be associated with the project or resulting publications without your explicit consent.
7. The fact that a procedure is automated does not ensure its correctness or appropriateness; it is also necessary to understand the theory, data, and methods used in each statistical study. This goal is served best when a competent statistical practitioner is included early in the research design, preferably in the planning stage.
8. Recognize that any frequentist statistical test has a random chance of indicating significance when it is not really present. Running multiple tests on the same data set at the same stage of an analysis increases the chance of obtaining at least one invalid result. Selecting the one "significant" result from a multiplicity of parallel tests poses a grave risk of an incorrect conclusion. Failure to disclose the full extent of tests and their results in such a case would be highly misleading.
9. Respect and acknowledge the contributions and intellectual property of others.
10. Disclose conflicts of interest, financial and otherwise, and resolve them. This may sometimes require divestiture of the conflicting personal interest or withdrawal from the professional activity. Examples where conflict of interest may be problematic include grant reviews, other peer reviews, and tensions between scholarship and personal or family financial interests.
11. Provide only such expert testimony as you would be willing to have peer reviewed.

B. Responsibilities to Funders, Clients, and Employers

1. Where appropriate, present a client or employer with choices among valid alternative statistical approaches that may vary in scope, cost, or precision.
2. Clearly state your statistical qualifications and experience relevant to your work.
3. Clarify the respective roles of different participants in studies to be undertaken.
4. Explain any expected adverse consequences of failure to follow through on an agreed-upon sampling or analytic plan.
5. Apply statistical sampling and analysis procedures scientifically, without predetermining the outcome.

6. Make new statistical knowledge widely available to provide benefits to society at large and beyond your own scope of applications. Statistical methods may be broadly applicable to many classes of problem or application. (Statistical innovators may well be entitled to monetary or other rewards for their writings, software, or research results.)
7. Guard privileged information of the employer, client, or funder.
8. Fulfill all commitments.
9. Accept full responsibility for your professional performance.

C. Responsibilities in Publications and Testimony

1. Maintain personal responsibility for all work bearing your name; avoid undertaking work or coauthoring publications for which you would not want to acknowledge responsibility. Conversely, accept (or insist upon) appropriate authorship or acknowledgment for professional statistical contributions to research and the resulting publications or testimony.
2. Report statistical and substantive assumptions made in the study.
3. In publications or testimony, identify who is responsible for the statistical work if it would not otherwise be apparent.
4. Make clear the basis for authorship order, if determined on grounds other than intellectual contribution. Preferably, authorship order in statistical publications should be by degree of intellectual contribution to the study and material to be published, to the extent that such ordering can feasibly be determined. When some other rule of authorship order is used in a statistical publication, the rule should be disclosed in a footnote or endnote. (Where authorship order by contribution is assumed by those making decisions about hiring, promotion, or tenure, for example, failure to disclose an alternative rule may improperly damage or advance careers.)
5. Account for all data considered in a study and explain the sample(s) actually used.
6. Report the sources and assessed adequacy of the data.
7. Report the data cleaning and screening procedures used, including any imputation.
8. Clearly and fully report the steps taken to guard validity. Address the suitability of the analytic methods and their inherent assumptions relative to the circumstances of the specific study. Identify the computer routines used to implement the analytic methods.

9. Where appropriate, address potential confounding variables not included in the study.
10. In publications or testimony, identify the ultimate financial sponsor of the study, the stated purpose, and the intended use of the study results.
11. When reporting analyses of volunteer data or other data not representative of a defined population, include appropriate disclaimers.
12. Report the limits of statistical inference of the study and possible sources of error. For example, disclose any significant failure to follow through fully on an agreed sampling or analytic plan and explain any resulting adverse consequences.
13. Share data used in published studies to aid peer review and replication, but exercise due caution to protect proprietary and confidential data, including all data that might inappropriately reveal respondent identities.
14. As appropriate, promptly and publicly correct any errors discovered after publication.
15. Write with consideration of the intended audience. (For the general public, convey the scope, relevance, and conclusions of a study without technical distractions. For the professional literature, strive to answer the questions likely to occur to your peers.)

D. Responsibilities to Research Subjects (including census or survey respondents and persons and organizations supplying data from administrative records, as well as subjects of physically or psychologically invasive research)

1. Know about and adhere to appropriate rules for the protection of human subjects, including particularly vulnerable or other special populations that may be subject to special risks or may not be fully able to protect their own interests. Ensure adequate planning to support the practical value of the research, validity of expected results, ability to provide the protection promised, and consideration of all other ethical issues involved.
2. Avoid the use of excessive or inadequate numbers of research subjects by making informed recommendations for study size. These recommendations may be based on prospective power analysis, the planned precision of the study endpoint(s), or other methods to ensure appropriate scope to either frequentist or Bayesian approaches. Study scope also should take into consideration the feasibility of obtaining research subjects and the value of the data elements to be collected.

3. Avoid excessive risk to research subjects and excessive imposition on their time and privacy.
4. Protect the privacy and confidentiality of research subjects and data concerning them, whether obtained directly from the subjects, other persons, or administrative records. Anticipate secondary and indirect uses of the data when obtaining approvals from research subjects; obtain approvals appropriate for peer review and independent replication of analyses.
5. Be aware of legal limitations on privacy and confidentiality assurances. Do not, for example, imply protection of privacy and confidentiality from legal processes of discovery unless explicitly authorized to do so.
6. Before participating in a study involving human beings or organizations, analyzing data from such a study, or accepting resulting manuscripts for review, consider whether appropriate research subject approvals were obtained. (This safeguard will lower your risk of learning only after the fact that you have collaborated on an unethical study.) Consider also what assurances of privacy and confidentiality were given and abide by those assurances.
7. Avoid or minimize the use of deception. Where it is necessary and provides significant knowledge-as in some psychological, sociological, and other research-ensure prior independent ethical review of the protocol and continued monitoring of the research.
8. Where full disclosure of study parameters to subjects or other investigators is not advisable, as in some randomized clinical trials, generally inform them of the nature of the information withheld and the reason for withholding it. As with deception, ensure independent ethical review of the protocol and continued monitoring of the research.
9. Know about and adhere to appropriate animal welfare guidelines in research involving animals. Ensure that a competent understanding of the subject matter is combined with credible statistical validity.

E. Responsibilities to Research Team Colleagues

1. Inform colleagues from other disciplines about relevant aspects of statistical ethics.
2. Promote effective and efficient use of statistics by the research team.
3. Respect the ethical obligations of members of other disciplines, as well as your own.
4. Ensure professional reporting of the statistical design and analysis.

5. Avoid compromising statistical validity for expediency, but use reasonable approximations as appropriate.

F. Responsibilities to Other Statisticians or Statistics Practitioners

1. Promote sharing of (nonproprietary) data and methods. As appropriate, make suitably documented data available for replicate analyses, metadata studies, and other suitable research by qualified investigators.
2. Be willing to help strengthen the work of others through appropriate peer review. When doing so, complete the review promptly and well.
3. Assess methods, not individuals.
4. Respect differences of opinion.
5. Instill in students an appreciation for the practical value of the concepts and methods they are learning.
6. Use professional qualifications and the contributions of the individual as an important basis for decisions regarding statistical practitioners' hiring, firing, promotion, work assignments, publications and presentations, candidacy for offices and awards, funding or approval of research, and other professional matters. Avoid as best you can harassment of or discrimination against statistical practitioners (or anyone else) on professionally irrelevant bases such as race, color, ethnicity, sex, sexual orientation, national origin, age, religion, nationality, or disability.

G. Responsibilities Regarding Allegations of Misconduct

1. Avoid condoning or appearing to condone careless, incompetent, or unethical practices in statistical studies conducted in your working environment or elsewhere.
2. Deplore all types of professional misconduct, not just plagiarism and data fabrication or falsification. Misconduct more broadly includes all professional dishonesty, by commission or omission, and, within the realm of professional activities and expression, all harmful disrespect for

people, unauthorized use of their intellectual and physical property, and unjustified detraction from their reputations.

3. Recognize that differences of opinion and honest error do not constitute misconduct; they warrant discussion, but not accusation. Questionable scientific practices may or may not constitute misconduct, depending on their nature and the definition of misconduct used.
4. If involved in a misconduct investigation, know and follow prescribed procedures. Maintain confidentiality during an investigation, but disclose the results honestly after the investigation has been completed.
5. Following a misconduct investigation, support the appropriate efforts of the accused, the witnesses, and those reporting the possible scientific error or misconduct to resume their careers in as normal a manner as possible.
6. Do not condone retaliation against or damage to the employability of those who responsibly call attention to possible scientific error or misconduct.

H. Responsibilities of Employers, Including Organizations, Individuals, Attorneys, or Other Clients Employing Statistical Practitioners

1. Recognize that the results of valid statistical studies cannot be guaranteed to conform to the expectations or desires of those commissioning the study or the statistical practitioner(s). Any measures taken to ensure a particular outcome will lessen the validity of the analysis.
2. Valid findings result from competent work in a moral environment. Pressure on a statistical practitioner to deviate from these guidelines is likely to damage both the validity of study results and the professional credibility of the practitioner.
3. Make new statistical knowledge widely available in order to benefit society at large. (Those who have funded the development of statistical innovations are entitled to monetary and other rewards for their resulting products, software, or research results.)
4. Support sound statistical analysis and expose incompetent or corrupt statistical practice. In cases of conflict, statistical practitioners and those employing them are encouraged to resolve issues of ethical practice privately. If private resolution is not possible, recognize that statistical practitioners

have an ethical obligation to expose incompetent or corrupt practice before it can cause harm to research subjects or society at large.

5. Recognize that within organizations and within professions using statistical methods generally, statistics practitioners with greater prestige, power, or status have a responsibility to protect the professional freedom and responsibility of more subordinate statistical practitioners who comply with these guidelines.
6. Do not include statistical practitioners in authorship or acknowledge their contributions to projects or publications without their explicit permission.

Key References:

1. U.S. federal regulations regarding human subjects protection are contained in **Title 45** of the Code of Federal Regulations, Chapter 46 (45 CFR 46).
4. ***The Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research*** is available through the Office of Human Research Protections.
5. Title 13, U.S. Code, Chapter 5 - Censuses, Subchapter II - Population, housing, and unemployment, Sec. 141 restricts uses of U.S. population census information. Similar restrictions may apply in other countries.
6. The International Statistical Institute's 1985 ***Declaration on Professional Ethics***
7. The United Nations Statistical Commission's 1994 ***Fundamental Principles of Official Statistics***

DECLARATION ON PROFESSIONAL ETHICS

ADOPTED BY THE ISI COUNCIL

22 & 23 July 2010

Reykjavik, Iceland

International Statistical Institute - Permanent Office

P.O. Box 24070

2490 AB The Hague

The Netherlands

PREAMBLE, VALUES, PRINCIPLES AND BACKGROUND

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Preamble

The ISI's Declaration on Professional Ethics consists of a statement of Shared Professional Values and a set of Ethical Principles that derive from these values.

For the purposes of this document, the definition of who is a statistician goes well beyond those with formal degrees in the field, to include a wide array of creators and users of statistical data and tools. Statisticians work within a variety of economic, cultural, legal and political settings, each of which influences the emphasis and focus of statistical inquiry. They also work within one of several different branches of their discipline, each involving its own techniques and procedures and, possibly, its own ethical approach.

Statisticians work in diverse fields such as economics, psychology, sociology, medicine, whose practitioners have ethical conventions that may influence their conduct. Even within the same setting and branch of statistics, individuals may face various situations and constraints in which ethical questions arise.

The aim of this declaration is to enable the statistician's individual ethical judgments and decisions to be informed by shared values and experience, rather than by rigid rules imposed by the profession. The declaration seeks to document widely held principles of the statistics profession and to identify the factors that obstruct their implementation. It recognizes that, the operation of one principle may impede the operation of another, that statisticians – in common with other occupational groups – have competing obligations not all of which can be fulfilled simultaneously. Thus, statisticians will sometimes have to make choices between principles. The declaration does not attempt to resolve these choices or to establish priorities among the principles. Instead it offers a framework within which the conscientious statistician should be able to work comfortably. It is urged that departures from the framework of principles be the result of deliberation rather than of ignorance.

The declaration's first intention is to be informative and descriptive rather than authoritarian or prescriptive. Second, it is designed to be applicable as far as possible to the wide and changing areas of statistical methodology and application. For this reason, its provisions are drawn quite broadly. Third, although the principles are framed so as to have wider application to decisions than to the issues it specifically mentions, the declaration is by no means exhaustive. It is designed in the knowledge that it will require periodic updating and amendment, reflecting on the one hand developments in the generation of information and technical tools utilized by statisticians and, on the other hand, in the uses (and, consequently, misuses) of statistical outputs. Fourth, the values, principles, and the commentaries which follow acknowledge with the general written or unwritten rules or norms, such as compliance with the law or the need for probity. However, the declaration restricts itself insofar as possible to matters of specific concern to statistical inquiry.

Although not explicitly stated, the Principles inherently reflect the obligations and responsibilities of – as well as the resulting conflicts faced by – statisticians to forces and pressures outside of their own performance, namely to and from:

- Society
- Employers, Clients, and Funders
- Colleagues
- Subjects

In carrying out his/her responsibilities, each statistician must be sensitive to the need to ensure that his/her actions are, first, consistent with the best interests of each group and, second, do not favor any group at the expense of any other, or conflict with any of the Principles.

The Principles are followed by short commentaries on the conflicts and difficulties inherent in their application. A link is provided for each ethical principle for those who wish to pursue the issues. Similarly, a limited annotated bibliography is provided after the commentaries for those who wish to pursue the issues or consult more detailed texts.

Shared Professional Values

Our shared professional values are respect, professionalism, truthfulness and integrity.

1. **Respect**

We respect the privacy of others and the promises of confidentiality given to them.

We respect the communities where data is collected and guard against harm coming to them by misuse of the results.

We should not suppress or improperly detract from the work of others.

2. **Professionalism**

The value Professionalism implies Responsibility, Competence and Expert Knowledge, and Informed Judgment.

We work to understand our users' needs.

We use our statistical knowledge, data, and analyses for the Common Good to serve the society.

We strive to collect and analyze data of the highest quality possible.

We are responsible for the fitness of data and of methods for the purpose at hand.

We discuss issues objectively and strive to contribute to the resolution of problems.

We obey the law and work to change laws we believe impede good statistical practice.

We are continuously learning both about our own field as well as those to which we apply our methods.

We develop new methods as appropriate.

We do not take assignments in which we have a clear conflict of interest.

We act responsibly with our employers.

3. **Truthfulness and Integrity**

By Truthfulness and Integrity, we mean Independence, Objectivity and Transparency.

We produce statistical results using our science and are not influenced by pressure from politicians or funders.

We are transparent about the statistical methodologies used and make these methodologies public.

We strive to produce results that reflect the observed phenomena in an impartial manner.

We present data and analyses honestly and openly.

We are accountable for our actions.

We have respect for intellectual property.

As scientists, we pursue promising new ideas and discard those demonstrated to be invalid.

We work towards the logical coherence and empirical adequacy of our data and conclusions.

We value well-established objective criteria of assessment.

Ethical Principles

1. **Pursuing Objectivity**

Statisticians should pursue objectivity without fear or favor, only selecting and using methods designed to produce the most accurate results. They should present all findings openly, completely, and in a transparent manner regardless of the outcomes. Statisticians should be particularly sensitive to the need to present findings when they challenge a preferred outcome. The statistician should guard against predictable misinterpretation or misuse. If such

misinterpretation or misuse occurs, steps should be taken to inform potential users. Findings should be communicated for the benefit of the widest possible community, yet attempt to ensure no harm to any population group.

2. Clarifying Obligations and Roles

The respective obligations of employer, client, or funder and statistician in regard to their roles and responsibility that might raise ethical issues should be spelled out and fully understood. In providing advice or guidance, statisticians should take care to stay within their area of competence, and seek advice, as appropriate, from others with the relevant expertise.

3. Assessing Alternatives Impartially

Available methods and procedures should be considered and an impartial assessment provided to the employer, client, or funder of the respective merits and limitations of alternatives, along with the proposed method.

4. Conflicting Interests

Statisticians avoid assignments where they have a financial or personal conflict of interest in the outcome of the work. The likely consequences of collecting and disseminating various types of data and the results of their analysis should be considered and explored.

5. Avoiding Preempted Outcomes

Any attempt to establish a predetermined outcome from a proposed statistical inquiry should be rejected, as should contractual conditions contingent upon such a requirement.

6. Guarding Privileged Information

Privileged information is to be kept confidential. This prohibition is not to be extended to statistical methods and procedures utilized to conduct the inquiry or produce published data.

7. Exhibiting Professional Competence

Statisticians shall seek to upgrade their professional knowledge and skills, and shall maintain awareness of technological developments, procedures, and standards which are relevant to their field, and shall encourage others to do the same.

8. Maintaining Confidence in Statistics

In order to promote and preserve the confidence of the public, statisticians should ensure that they accurately and correctly describe their results, including the explanatory power of their data. It is incumbent upon statisticians to alert potential users of the results to the limits of their reliability and applicability.

9. Exposing and Reviewing Methods and Findings

Adequate information should be provided to the public to permit the methods, procedures, techniques, and findings to be assessed independently.

10. Communicating Ethical Principles

In collaborating with colleagues and others in the same or other disciplines, it is necessary and important to ensure that the ethical principles of all participants are clear, understood, respected, and reflected in the undertaking.

11. Bearing Responsibility for the Integrity of the Discipline

Statisticians are subject to the general moral rules of scientific and scholarly conduct: they should not deceive or knowingly misrepresent or attempt to prevent reporting of misconduct or obstruct the scientific/scholarly research of others.

12. Protecting the Interests of Subjects

Statisticians are obligated to protect subjects, individually and collectively, insofar as possible, against potentially harmful effects of participating. This responsibility is not absolved by consent or by the legal requirement to participate. The intrusive potential of some forms of statistical inquiry requires that they be undertaken only with great care, full justification of need, and notification of those involved. These inquiries should be based, as far as practicable,

on the subjects' freely given, informed consent. The identities and records of all subjects or respondents should be kept confidential. Appropriate measures should be utilized to prevent data from being released in a form that would allow a subject's or respondent's identity to be disclosed or inferred.

Background Note

The involvement of the International Statistical Institute in establishing a declaration on professional ethics has extended over the past quarter century. The Bureau of the Institute, in response to representations by members and a proposal by the Institute's Committee on Future Directions, initially established a Committee on a Code of Ethics for Statisticians in 1979, during the 42nd ISI Session in Manila. That Committee^[1] prepared a 'code' that was accepted by the Institute during its Centenary Celebration in 1985, with the adoption of the following resolution by the General Assembly of the ISI on 21 August, 1985:

- recognizing that the aim of the Declaration on Professional Ethics for Statisticians is to document shared professional values and experience as a means of providing guidance rather than regulation;
- adopts the Declaration as an affirmation of the membership's concern with these matters and of its resolve to promote knowledge and interest in professional ethics among statisticians worldwide;
- determines to send the Declaration to all members of the ISI and its Associations and to disseminate it, as appropriate, within the statistical profession;
- commends the Committee responsible for developing the Declaration for its thorough, efficient and successful work during the last five years.

With the passage of time, the Institute found itself revisiting the question of the need for an updating of the Declaration. In July 2006, the Executive Committee specifically invited its standing Professional Ethics Committee^[2] to revisit the ISI Declaration and, "should the occasion arise, (propose) updates to the ISI Declaration". This the Committee has now done. A revised document, prepared for a meeting held in Paris, in March 2007, and hosted by INSEE, was followed by an open meeting at the ISI international meetings in Lisbon, in August 2007, at which the results of all these efforts were presented to the participants for their comments and reactions. Although agreement was evident on many points, a number of suggestions for further examination were proposed, which are reflected in the addition of a Section on Shared Professional Values and a reordering and combining of several of the Ethical Principles that derive from these Values. This document is the result of these recent efforts. In accordance with the spirit and letter of the original resolution, the International Statistical Institute presents this revised and updated Declaration on Professional Ethics, with the continued hope and belief that the new document will assist colleagues throughout the world in the pursuit of their professional goals and responsibilities.

[1] The Committee was chaired by Roger Jowell. Original members were W. Edwards Deming, Arno Donda, Helmut V. Muhsam and Edmund Rapaport, who subsequently were joined by Edmundo Berumen-Torres, Gilbert Motsemme and René Padiou.

[2] The current Committee is composed of David Morganstein (Chair), Margo Anderson, Edmundo Berumen, Stephen E. Fienberg, Fred Ho, Roger Jowell †, Denise Lievesley, Olav Ljones, Bill Seltzer, and Jan Robert Suesser. The Committee receives important support from an Ethics Advisory Group consisting of Jean-Louis Bodin, Oliver J.M. Chinganya, Howard Gabriels, Dan Levine, René Padiou, Hrachya Petrosyan, and Norbert Victor.