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Ethical Aspects of Statistical Practice

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SUMMARY

This paper embodies a personal view of the ethical considerations that the author believes should be continuously in the mind of any applied statistician or biometrician whose work involves extensive collaboration with other persons and organizations. It looks particularly at the contribution of the International Statistical Institute to the codification of principles, the duties of the statistician in relation to data and the interests of his employer or client, his responsibilities to his professional colleagues and towards society as a whole, and, by no means least, the responsibility of the client towards the statistician who works with him.

1. Introduction

We who call ourselves statisticians range over a broad spectrum of types of interaction with other persons and with society as a whole. A few of us are essentially pure mathematicians who find fulfilment in advancing mathematical theory that has some statistical context; to them may be applied the general ethical standards of the scholar, intellectual truth and honesty allied to fair dealing with the work and reputations of others. The daily work of many statisticians involves advice to other persons on the planning of quantitative investigations, analysis of data that others have collected, production of reports that may influence society at large, and the teaching of these skills to students. They, who would perhaps classify themselves as applied statisticians, are in a more complex ethical environment. The principles to be adopted in respect of confidentiality and concern for truth are doubtless essentially the same as those applicable to members of any other profession, doctors and lawyers, bankers and social workers for example, but some features possibly deserve special emphasis for statisticians.

This paper is designed to examine some aspects of ethical behaviour that are especially relevant to the work and duties of a statistician, and also to raise concern about what steps may be desirable in order to instil a proper outlook in those who are being trained to become professional statisticians. To this last, there is no simple solution: formal lectures on ethics might be no more than cosmetic and possibly also soporific, yet surely the environment in which a statistician is taught or trained ought deliberately to point him in the right direction.

For the sake of clarity of exposition, much of the paper will be expressed in the first person: in writing so, I certainly make no claim to moral superiority, and indeed I look back with some shame to 40 years as a teacher, during which time I have never explicitly taught or discussed ethical standards with my classes, or taken conscious steps to ensure maintenance of the highest standards in those who will be the practising statisticians of the future. Today, women have a properly important share in the practice of applied statistics and biometry. For simplicity of phrasing, I follow the standard presumptions of language and law that, in any general statement, use of a masculine pronoun includes the feminine unless the contrary is made explicit.

2. The International Statistical Institute

In 1985, the International Statistical Institute (ISI) published *A Declaration on Professional Ethics* (Anon., 1985). This followed years of discussion in committees and vigorous argument at

international meetings. Of course, there was no serious disagreement about content, but plenty of scope for differing opinions about how ideas were best expressed, and indeed about whether the Institute should publish anything of the kind. The outcome was a lengthy document, in somewhat ponderous prose, full of unexceptionable statements but a bit repetitive and at times perhaps no more than an exhortation to conform to those standards of decent behaviour that an earlier age might have taken as being natural to a *gentleman*.

Nevertheless, the ISI *Declaration* should be read alongside the present paper, in order that details that I omit and some differences in emphasis can be noted. It begins by stressing the obligations of a statistician to society, especially in respect of the objectivity of his approach to information. It then turns to his obligations towards an employer, comprising expert assessment of the appropriateness of whatever analytical methods are used, refusal to accept restrictions or constraints on any aspect of the results that will be obtained, and maintenance of confidentiality of data.

The *Declaration* emphasizes that each statistician also has an obligation towards his profession and all its members, in that his work should help in maintaining confidence in the quality of statistical method and in the associated ethical standards. It then stresses obligations towards the subjects of inquiries, in that an investigation should involve minimal invasion of privacy, informed consent to any experimental study, and protection of confidentiality of personal information.

3. Personal Outlook

My own career in statistics has been largely spent in biometric activities. For the present paper, I regard biometricians as a not very sharply defined subset of statisticians. The fact that some excellent biometricians may have begun their careers within specifically biological disciplines need cause no confusion here: if a botanist or geneticist is now working, *de facto* even if not exclusively, as a professional biometrician, I believe that his behaviour in relation to that work is subject to the same ethical considerations as is the work of another who was originally more formally trained in statistics, although he may indeed find his conduct also influenced by ethical standards specific to his original discipline. Of course the nature of biometric work, perhaps especially if related to human medicine, may introduce stresses and ethical emphases that differ from those affecting other statisticians.

The ISI *Declaration* (Anon., 1985) is excellent in intent, and contains nothing with which a person who has serious regard for any ethical standards would disagree. My own past failure to make explicit a concern for personal ethics in statistical work, and my lack of any close involvement in the production of the ISI document, probably derive from an intuitive but complacent belief that everything is covered by general standards of honesty and decent behaviour towards working associates. Recently, there have been distressingly many reports of apparently reputable scientists publishing false accounts of their researches, accounts in which quantitative evidence is distorted or even invented in order to support a desired end. Probably each one of us believes that his own standards of honesty and behaviour towards others are maintained and are beyond reproach. But I begin to suspect that pious optimism on this issue is not enough, and that a more detailed statement of ethical standards that concern the statistician is desirable.

In recent years, attacks have been made on the British Central Statistical Office and on British official statistics in general, with accusations that published figures are sometimes modified at the behest of a politician or government department because publication of the unadorned truth might be politically uncomfortable. I would not be surprised to learn that similar accusations have been made in other countries. On this matter, I am ignorant, for I have never been involved in the production of official statistics nor have I had much occasion to use them. Such charges, if they were to be proved, would indeed be serious blemishes upon the integrity of statisticians.

What follows below has no direct connexion with the official statistics, although I believe that the underlying principles are essentially the same.

4. The Statistician, Employee or Consultant

A statistician who is employed in his professional capacity by any organization, commercial or governmental or other, obviously has duties towards his employer. His ethical position is similar to, but not identical with, that of another statistician who is associated with some particular project purely as a consultant, whether that project is a piece of research in a university department, an independent project to which he is providing a statistical service or for which he is a temporary employee, or even a legal action in which he is involved as an expert witness. Even when he is clearly a full-time employee, the statistician should see his relations with his current employer as analogous to those of any other qualified professional expert.

If, employed as a civil servant, he were to be instructed to prepare tables or diagrams demonstrating that the government is conquering crime, reducing unemployment, or eliminating poverty, despite the fact that the data available to him strongly indicate the contrary, he is indeed in difficulty. He remains answerable to his personal conscience. His moral situation is surely much the same as that of a chemist employed in the food packaging industry who is ordered to find certain regular samples free of all trace of a contaminant. One can easily multiply such hypothetical illustrations. I am far from suggesting that my examples are based on reality or on personal suspicion, but in an imperfect world they can scarcely be dismissed as impossible. It is easy for me to state that, for the statistician, refusal is the only honourable course: I do not have to face the economic consequences for myself or my family that could follow a black mark in my employer's staff records or even summary dismissal. The statistician who is operating entirely as a consultant is in a simpler situation; at much lower personal cost, he can decline to continue working with a client who expects him to act in a manner that he considers unethical.

Whatever the precise relation of the statistician to a problem, he is likely to have access to statistical data and other information related to what he is asked to do. Without the express permission of those for whom he is working, he must not use such data in any way for his personal advantage, whether for pecuniary gain or as material for his own scientific publication. Indeed, he must see his duty as comprising preservation of the confidentiality of all data shown to him, and of his statistical analyses and conclusions, until his employer or client releases him from any such obligation. The physical form of data passed to the statistician is also to be treated with care and respect. Whether it be in manuscript or recorded on some electronic medium, the client clearly has a responsibility for ensuring that it is adequately described and unambiguously understood by the statistician, who in his turn must ensure that it is preserved undamaged, without potentially obscuring annotations, alterations, or deletions. It should be available for return to its originator when analysis is complete or on request at any time.

Obviously the statistician is ethically obliged to bring to his employment, to consultation, and to any analysis resulting therefrom his best professional skill and experience. He should be prepared to support his advice by specifying the methods that he has adopted as fully as his client may wish. However, he cannot be held responsible for any difficulty that the client may have in understanding the technical details! The confidentiality that applies to data has no place in respect of the methods and techniques of statistical analysis. Commonly these will be standard methods, well documented in methodological literature: if for a particular problem the statistician finds need to develop some novel technique, this should be adequately explained in any report to the client and should be available for presentation in subsequent publication about the problem and its investigation.

Special difficulties can arise today because of the diversity of computer software that exists and that rapidly increases. A statistician ought to be familiar with the nature of software that he himself uses or recommends, and satisfied of its quality. If he reports to his client that data have

been analyzed by the *WONDERSTAT* package, he implicitly takes responsibility for the quality of the package and its appropriateness to the problem in hand. The growing tendency for research scientists to undertake their own statistical analyses, using standard packages on microcomputers, has many merits and will continue, but has its dangers since responsibility for the choice of package and correct use of it now rests with the scientist. The danger of unwise choice may be aggravated by the ease with which a micro-chip, programmed to undertake statistical computations, can be incorporated into sophisticated laboratory instruments such as micro-analyzers, the nature of the program possibly being regarded by the manufacturer of an instrument as a commercial secret. The consequence may be that the program is occasionally used on data for which an experienced statistician would have judged it unsuitable. This can have ethical implications for the nonstatistician scientist concerned, especially perhaps with some medical instrumentation.

Before he begins to analyze any data, I believe that the statistician has an obligation to scrutinize them, with a view to satisfying himself that they accord with what he has been told about their character and to detecting any clear anomalies. In my opinion, to omit such scrutiny is irresponsible. It should be part of any applied statistician's standard practice, although neither the necessity nor the potential receives much attention in elementary textbooks and is probably seldom mentioned in teaching (Finney, 1988). According to circumstances, it may be conducted entirely by visual scanning or by applying routine computational devices intended to discover individual values discrepant from the general pattern.

For example, a rapid visual scrutiny might disclose a frequent occurrence of zeros that is a pointer to some inhibitory mechanism, possibly well known to the client, that should modify the choice of analysis, or to a misleading recording of missing observations. A repetitive pattern of subtotals may show that what at first sight appear to be contingency records for independent observations, surely standard data for χ^2 analysis, are in reality repeated classifications of the same entities. Many another possibility could be listed: only advance scrutiny, taking into account whatever is known about the nature of the data, can guard against the absurdities that may result from uncritical submission of data to analysis by standard software. Medical records from pregnant males, or animal weights that have become absurd because of an unintended multiplication by 10, are not unknown occurrences!

5. Professional Colleagues

As the ISI *Declaration* pointed out, every statistician has ethical responsibility towards other members of his profession. To give exact definition to this is scarcely possible, but a member of any profession who performs his duties at less than the highest standard contributes to bringing that profession into disrepute and thus to loss of standing for his colleagues. We who have long practised statistics should not expect to be collectively popular. Many harmless jokes are made at our expense, and to declare our profession to a stranger can be a stopper of social conversation! We are not the only profession to be viewed in this manner. We must not seek to exaggerate our collective importance, but surely we should consciously avoid performing our duties in any way that may lend support to such tedious assertions as "You can prove anything by statistics!" We act improperly towards our colleagues if by carelessness, lack of conscientiousness, or other weaknesses in our work we diminish the standing that our profession should enjoy. In this context, the software problems mentioned above are relevant. I believe that any involvement in the production of general statistical software places upon us a duty of seeking to build in safeguards against misuse. This can never be perfect: many human products (like the internal combustion engine and books) carry the potential for damaging misuse, but a statistician should be wary of association with any software product the authors of which have given no thought to possibilities of use that might lead to scientific confusion or might have truly harmful consequences. I personally would not be willing to assist a commercial enterprise in the production of

an instrument for some public health use that incorporated a chip with statistical capabilities the nature of which was to be kept secret.

This last point relates closely to our professional duty to society. We should be seen as upholders of honest and objective analysis and interpretation of all data that we handle. This is no counsel of perfection, for we cannot be totally free from misjudgment and mistake, but we should not give our explicit or implicit approval to anything emerging from our work that does not conform to our own standards of propriety.

A statistician who becomes involved in any form of editorial activities, whether actually in being a referee of papers submitted to a statistical journal for publication or in preparing submissions that have been accepted for the final processes of printing, has the opportunity of seeing new ideas and results before they become available to the general body of his profession. He needs to exercise care that, until after publication, he does not, even inadvertently, permit this knowledge to assist him in his own research or writings. Adherence to this principle is not easy. Perhaps yesterday an editorial board of which I am a member accepted for publication, despite my report as a referee, a more than usually silly paper by John Doe! I must firmly resist the temptation immediately to begin preparing for publication my demolition of Doe's so-called logic. This point is not peculiar to statisticians, but applies to many scientists, not only in an editorial context but whenever they are taken around a colleague's laboratory or attend an informal seminar. In his efforts to behave properly, the statistician may encounter special complexities of behaviour, because his expertise may cause him from time to time to be involved in refereeing or editing for a discipline other than statistics. He must then beware of casual comment to a pharmacologist friend about something that he has seen in a paper referred to him for an opinion on its statistical validity.

I cannot escape the impression that recent years have seen a deplorable increase in reports of scientific investigators being accused, on fairly convincing evidence, of deliberate forgery of results of experiments or other inquiries, presumably in order to achieve some degree of personal fame. I can conceive of no defence for such betrayal of truth. Suppose that a statistician, during his scrutiny or analysis of data provided by an employer or client, were to detect indications of this kind of fraud, perhaps by noticing recurrent sequences of measurements or other suspicious patterns in the data but alternatively perhaps by physical signs of alterations to documents, what is he to do? He faces an unenviable and severe moral dilemma. He may have been shown the data under an explicit request for confidentiality, which will restrain him from immediately making public his suspicions. In some contexts, for example falsified evidence of a medical discovery, his failure to do so might have serious consequences. The present general discussion obviously cannot state any simple solution that removes dependence upon individual conscience. Moreover, the problem is not specific to statisticians; in other circumstances, a secretary or a technical assistant might be the first person to encounter traces of dishonesty. Possibly a deep study of crooked scientists and their motivations, so far as I know not yet written, would help us here.

A few years ago, the notorious Darsee case provided a major example of massive falsification of data. A reader whose concern is aroused by the previous paragraph will find it instructive to read two somewhat controversial reports upon that case in which the evidence of dishonesty was probed in a statistical manner (Braunwald, 1987; Stewart and Feder, 1987).

6. The Client

He whom I have called the client, whether an employer or a scientific colleague, is driven by his own interests to make clear to the statistician what he considers to be the salient features of his problem or data on which he seeks assistance. Consultation of a statistician by any other specialist can be fully effective only if it is treated as collaboration between experts and equals, with willing sharing of information. A grossly erroneous notion has possibly been encouraged by

the style of numerical exercises that adorn some elementary textbooks of statistical method. At the end of a chapter on the t -distribution, for example, the reader may be invited to "Estimate the population mean from the following measurements of a sample of 20 from a distribution, and test whether it differs significantly from 14.5." Correspondence published in the *Biometric Bulletin* during 1989 illustrates that even a statistician can manifest an extreme form of the belief that he can properly be asked to analyze and interpret (in terms of significance tests or estimates of parameters) a set of numerical values the origin of which is not revealed to him.

This also has ethical aspects. A scientist might ask a statistician to help with analysis of a set of percentages representing the frequencies of occurrence of a specified event during observational periods of two weeks. Scrutiny would perhaps disclose many values to be 7.1, 56.3, 71.4, and so on, obviously derived from $k/14$. If the statistician also sees 33.3 and 80.0, he may immediately suspect that not all periods were exactly 14 days, and that possibly record taking was sometimes a little irregular at weekends. Such a departure from the stated protocol of observation might affect the proper choice of analysis or warn of unsuspected biases important to the interpretation of what may have been a clinical trial. The statistician should ask his client for elucidation of what had happened. I have been told that, in some environments, such questions about the data might be treated as an impertinence, the statistician stepping out of line and seeking information to which he had no right! If I am an independent consultant, and my client keeps me in such ignorance, I can tell him to find another statistician! In the case that gave rise to this particular example, the statistician was a junior employee who was reluctant to damage his career prospects by appearing obstructive or incompetent to an employer who asked for nothing more than a routine t -test on percentages from two sets of subjects.

This is not a matter of rights or status. Is it ever ethical of a scientist from another discipline to submit percentages for statistical analysis without making available to his statistical colleague the numerators and denominators from which they were calculated? The statistician is expected to determine the correct form of analysis, yet, as is well known, special considerations of discrete frequencies, transformations, and normality may be relevant to the analysis of percentages, quite apart from the question of who takes responsibility for arithmetical correctness. Similar considerations apply to analysis of any variate, such as a percentage increase or other ratio that is derived from the raw data by some preliminary elementary arithmetic; the statistician should not be asked to analyze its values without being permitted to inspect the calculations from the data originally measured or recorded; in my view, for him to go ahead without access to this information is ethically questionable. This is allied to a broader requirement that the statistician shall be freely informed on how data were acquired, on how an experiment was conducted, and on any circumstances that may be relevant to the understanding of what the data purport to be. Far from it being impertinent for a statistician to ask a senior colleague for information about the origins of data, it is in fact his duty to be inquisitive; he will be unwise to continue voluntary collaboration with a client who tries to prevent or discourage his access to information.

When he agrees to work for a particular employer or client, a statistician implicitly assumes that information or data supplied to him will be honest statements of fact. In the previous section, I have mentioned the contrary situation of deliberate falsification of data. I would decline to work with a client whom I suspected to be capable of such forgery; part of the function of data scrutiny is to maintain alertness on this issue and to guard against corruption of data that may have occurred accidentally or through carelessness. The statistician who establishes his reputation for care in such matters can scarcely be regarded as blameworthy if he is unfortunate enough to be misused by one of the rare villains of science who produces skilfully forged "data."

These are not mere matters of prestige or status for the statistician, although any profession may rightly show concern that its members be accorded a status appropriate to their special

qualifications. We need to say unambiguously that any client is using us improperly if he shows unwillingness to inform us fully on his problem and his data. An extreme instance was brought to my attention some years ago by a member of my own staff. An agronomist known to him telephoned and asked for a design for an experiment on potatoes that would compare five treatments in five replicates. "What are the treatments?" my colleague asked: "That is no business of yours; you are only the statistician." Quite apart from its discourtesy, that attitude is unlikely to secure a good design. It is about as useless as would be going to one's physician and saying "I feel unwell; please prescribe a cure for me," and then declining to answer any questions about symptoms or diet! Truly ethical behaviour to the statistician requires that the client shall willingly supply raw data as collected (measured, counted, automatically recorded, etc.), and not merely some transformation of these regarded by the client as the variate in the analysis of which he is chiefly interested.

These statistical obligations of an employer or client towards his statistical associate perhaps receive mention even more rarely than do the ethical standards of the statistician himself. Another point arises more evidently in academic or research circles than in industry and commerce. A scientist who is himself engaged in research should not unreasonably deny the statistician use of data from that research in publications on methodology, or in teaching, where new ideas developed during the collaboration may add to the general pool of statistical knowledge or to the scientific repute of the statistician. Obviously safeguards are needed, especially in an age obsessed with priority of publication, but not to the extent of preventing every such use until all novelty has gone from the statistician's contribution to the research.

7. Society

The *ISI Declaration* includes clear recognition of the ethical obligation of statisticians towards the community at large, especially in respect of such matters as informed consent of individuals to being used as sources of information, minimal disruption of personal privacy, confidentiality of personal data, and so on. Precisely how these objectives are to be achieved needs thorough consideration at the planning stage of each new study. Responsibility here does not rest solely with statisticians, but we need to develop our sensitivities, for example in respect of the special care needed in help that we may give to planning for sample surveys of human populations. Much has been written from a medical viewpoint about the ethical conduct of clinical trials. Few would question today that a clinical trial using human subjects can be entirely ethical, although continuing concern about the effective implementation of sound principles is evident from a recent paper (Lock, 1990). A statistician is unlikely to be in a position to monitor the obtaining of informed consent or the maintenance of personal privacy, but he should be sensitive to any flagrant disregard for the established ethical requirements on such matters and should question his own willingness to be professionally associated with a survey or trial that offends. The commercial importance of getting a new drug on the market quickly may encourage an unscrupulous manufacturer to offer substantial financial inducements to any physician who will submit detailed case reports on patients for whom they prescribe the drug. This may indeed provide information valuable to the codification of experience with a new therapeutic entity, but danger lies in the built-in encouragement for overprescribing. Under such conditions, I see great need for a statistician to watch carefully any attempts to draw quantitative conclusions from what may have the appearance of being carefully collected data, and certainly he would need to oppose any suggestion of using a selection of these case histories as though they came from a planned clinical trial.

A statistician should also have in mind his obligations to society every time that he draws up a report on his findings or prepares tables, diagrams, or other material that may eventually appear in a report that is published or given wide circulation. Not only must he enable his client to

comprehend what has been done to the data, but techniques of analysis should be open to critical inspection and assessment by a knowledgeable reader, as should be the essential logic contained within any standard software even though the authors of that software maintain commercial confidentiality on the details of coding. Equally important is ensuring that tables and diagrams are fully informative on the data from which they have been derived. For example, any modification or adjustment of raw values, possibly adopted with perfect propriety in order to aid clarity of presentation, should be fully explained. To use distorted diagrams or corrupted tables in order to support a tendentious argument obviously contravenes all ethical standards. Even without intent to deceive, a sophisticated statistical analysis or a complicated graphical representation may easily leave a reader unable to be sure of how what he sees relates to the original data. The fine book by Tufte (1983) contains much reinforcement of this warning.

The caution I express here is not to be interpreted as urging that individual statisticians protect the purity of their consciences by trying to avoid involvement with problems of society. On the contrary, if as individuals we are asked to participate, as consultants or as committee members, in inquiries of some public importance, where policies and decisions may turn upon essentially statistical considerations, I believe that we have a professional duty to try to make our services available, of course maintaining these at the highest level of competence of which we are capable. From its earliest days of tendering advice on the conduct of population censuses, the British Royal Statistical Society has taken this view, and in recent years has been active in promoting statistical study of such problems as the spread of rabies and the quantitative risks associated with AIDS.

In the magnificent National Museum of Kuwait is (or was) exhibited a beautifully ornamented bronze penbox. It carries an Arabic inscription, inlaid in silver and gold; the attached English translation reads:

So do not write with your hand except that which will delight you if you see it on the day of judgment.

This expresses well the essence of integrity in all forms of intellectual activity. Insofar as we succeed, perhaps a wish inscribed on the same penbox will be fulfilled:

To its owner happiness and peace and long life in which no pigeon coos in a plaintive manner.

This seems an appropriate note on which to end.

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RÉSUMÉ

Cet article expose la vision personnelle de l'auteur sur les considérations éthiques qui lui semblent devoir être présentes à l'esprit de tout statisticien appliqué ou de tout biométricien, que son travail conduit à être en constante collaboration avec d'autres personnes ou organisations. Il regarde particulièrement la contribution de l'Institut International de Statistique pour la codification des principes, les devoirs du statisticien en relation avec des données et les intérêts de son employeur ou client, ses responsabilités envers les collègues de sa profession et envers la société dans son ensemble et, ce qui n'est pas le moindre, la responsabilité du client envers le statisticien qui travaille avec lui.

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