APPLIED NUMERACY AND INTRODUCTORY STATISTICS COURSES

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The level of applied numeracy in the population is abysmal.

We are continually faced with numerical presentation of facts and numerical support for theories. In newspapers every day tables of figures and graphs are used to support interpretations of both historical and current events. Governmental policies are both justified and criticised with the aid of statistics, usually presented in a very simple form. In higher education and research institutes, statisticians and non-statisticians alike habitually handle official statistics and survey results presented in tabular and graphical form.

Yet the ability to interpret even simply presented numerical data of social issues, an ability requiring both caution and imagination, is severely lacking among all these people of whom it is assumed.

The connection between the slope of a graph as drawn and the axes' scales; the concept of an interaction in a two-way table; the implications of an ordinal scale for comparing groups of people; the difference between a random and a representative sample; all these are not well understood by the newspaper reader, the social scientist, nor by many statisticians, yet they are essential to a profitable reading of numerical data.

One could add the ability to compare proportions or percentages, the recognition that data sources may be reliable to different degrees, and the ability to relate a social hypotheses to an expected pattern in tabulated data.

Skills of this kind are skills of applied numeracy, and even statisticians rarely get a training in it. The gap left by poor applied numeracy is filled by a mixture of fear for facts or theories that are presented numerically, and a blind trust in the accompanying text as an honest guide and interpreter.

The responsibility of raising the level of'applied numeracy', or'numerical appreciation', in the population in general and the research population in particular, falls at the feet of the statistician. It does so by definition, by historical precedent, and by the possession of the required expertese that a statistician supposedly has; few outside the ranks of statisticians assume the duty of instilling that 'ability to critically appraise figures'.

And most importantly, it is the radical statisticians, those who have a forward-looking social perspective on the importance of their own work, who can best take on as a major task the popularisation of numerical analysis; the democratisation of statistics by mass access to numbers as a tool of social understanding. Large words maybe, but nonetheless urgent ones in a practical sense.

Consider the present poverty of most University level introductory statistics courses. A social science student (and for that matter a natural science or physical science student) taking such a course as a compulsory component of their degree requires and expects skills that will help the critical reading of applied research journals, give confidence in interpreting official statistics as reported in news items relevant to the main subject of study, and enable the translation of social hypotheses into numerical expectations to make possible intelligent research design. In short, that student requires a course in what I have called applied numeracy.

Instead, he or she is most likely to get a rushed lead-in to probabalistic analysis of numbers, with scant attention to what they might represent or how one might interpret them (though Tukey and Mosteller bravely attempt this at a rather higher level than I am thinking of). Neither will the standard introductory course teach interpretation of the type of results a social scientist will most often meet in newspaper reports, journals, and official statistics (non-probabilistic or non-matched samples, with a lot of causal inference based on them).

Take, for a not atypical example of a journal article that might be reported without caution in the newspapers, the following table from 'Community Health'. The respondents were asked if they were opposed to a suggested survey on the prevalence of glue-sniffing amongst Glasgow school-children.

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Table VII. Those opposed to the prevalence survey

Group	Yes	No
Police	—	9
Social workers	—	7
Medical care group	3	8
Education group	9	4
Parents	7	—

Degrees of Freedom = 2
$\chi^2 = 26{\cdot}2$ (significant at 1%)

Before taking an 'introductory statistics course', the thoughtful student might ask: "Well, who were those seven parents and why didn't they want a survey on glue-sniffing?" and other sensible questions.

But after an 'introductory statistics course', one is more likely to nod knowingly and say: "Oh, those people are the sample; a χ^2 statistic tests whether the groups answered the question in the same way; and it is highly significant that they did not." Such a statement, totally devoid of any understanding of the haphazard nature of much data-collection, and uninterested in the social implications of its interpretation, would be both false and useless.

In other words, statistics courses, as they are at present, are not only not what is required by most students (and therefore intensely disliked by them), but they are dangerous. A little knowledge ... .

As an aside, highly significant nonetheless, remember that most "trained" statisticians have had little preparation in applied numeracy either, despite being entrusted with the influential interpretation of statistical results. How many interviewers find that job-applicants with statistics degrees cannot 'read' a table of figures intelligently?

In summary, it must be recognised that acquisition of skills in applied numeracy, that confidence in critically interpreting even simple numerical reports, is lacking at all levels; in school students; in non-statistician social scientists; and in statisticians themselves. However, it is in courses for the middle category, non-statistician social scientists, that the lack can probably be most easily remedied.

I think that courses in applied numeracy would proceed from well-understood social or economic situations to the descriptive use of numbers, and not treat figures as though one could usefully describe them in isolation from what they represent, as is often attempted. One would aim to interpret those siuations descriptively with the aid of raw data, and with the results of probabilistic analysis where relevant. Such a course would concentrate on descriptive statistics, on debugging false interpretations, and on the clear presentation of numerical results.

I do not want to champion desriptive statistics against probabilistic statistics, though the implication is that the former can stand alone. Neither do I want to champion cartoon-texts and insist on relevance to the exclusion of dry mathematics, though again the implication is that the non-statistician does not require mathematical understanding in order to correctly interpret statistical results.

Above all, a statistics course for non-statisticians should aim to win respect for the power of numbers as an aid in social interpretation, to dispel the intimidation that numerical presentation usually creates, dispelling at the same time the consequent dependence on an expert's translation of figures into common language.

The textbook that comes nearest to satisfying these aims is 'Educational Statistics for Beginners' (S.R.Griffiths & L.W.Downes, Methuen Educational, 1969), whilst 'How to Lie With Statistics' (Darrell Huff, Penguin, 197?) does a grand job in debunking misleading graphical representation of numerical results.

I would be very grateful to hear of other texts along these lines from readers of Radical Statistics, and to collaborate in developing these ideas into a more concrete form.