

Are We Teaching Statistics Correctly to our Youth?¹

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ABSTRACT

This paper presents the results of a review undertaken by the Philippine Statistical Association, Inc., in 2005. Professional statisticians with extensive teaching experiences reviewed locally-authored elementary statistics textbooks that are most commonly used in the tertiary level. The review is a first step toward making recommendations on improving statistical literacy among the citizenry – one of the long-term visions of the Philippine Statistical Association, Inc. The review came up with specific recommendations in improving statistics teaching at the tertiary level and consequently, upgrading statistical literacy namely: (a) producing and using inferior books should be discouraged; (b) encourage the writing of better books and helping schools select judiciously among available options; (c) conducting seminars and conferences for teachers of basic statistics; and (d) strengthening the review process for locally-authored books in statistics.

Keywords: Philippine Statistical Association, Inc., probability, statistical methods, cookbook approach, higher education institutions, competency

I. INTRODUCTION

We live in a world full of data and information that can be harnessed in understanding, learning and making informed decisions. But, these data and information are not being utilized to their fullest to draw conclusions and directions, more so in a developing country like ours. Using data and information to support critical thinking and formulate approaches to solving problems seem to be uncommon among college students and even among young professionals. This is rather odd especially when statistics, the science that provides major analytical tools for this purpose, is presently being taught in most colleges and universities. What seems to be the problem? Do the textbooks being used in the colleges and universities give clear and precise explanations of statistical concepts and methods? Is the basic statistics course being taught well? Have our college graduates learned how to analyze data and process information scientifically to give them better insights to issues relevant to their well-being?

These questions prompted the Philippine Statistical Association, Inc. (PSA) to study how statistics is being taught in college. The 2005 PSA Board of Directors formed an Ad Hoc Committee composed of professional statisticians with extensive teaching experiences to review the elementary statistics books that are being used in college. The review is viewed as a first step toward making recommendations on improving statistical literacy among the citizenry – one of the long-term visions of the PSA. Although the questions above could be fully addressed through an evaluation by students who have taken an elementary statistics

¹ This is a revised version of a report prepared by I. P. David and D. S. Maligalig, chair and vice-chair of a 2005 Ad Hoc Committee set up by the Philippine Statistical Association, Inc. (PSA) to review basic statistics textbooks used in Philippine colleges and universities. The original report was presented at the PSA Annual Research Conference, 14 October 2005, Manila. The members of the said committee are listed in Appendix 2.

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course in college, a survey of teachers, a survey of school administrators of colleges and universities, and a review of textbooks, the PSA decided to limit this initial investigation on the statistics textbooks due to limited resources. Also, the said committee reviewed only the books written by local authors that are used as textbooks in the elementary statistics courses in colleges and universities, for two reasons. First, reviews of books written abroad are already available in the Internet and journals. Second, the PSA wanted to know if the quality problems of books used in elementary schools exposed single handedly recently by a concerned citizen-teacher, extend to statistics textbooks at the tertiary level.

The next section describes the review process. Section III summarizes the results of the review. The results provide a backdrop to what the committee thinks should be in a good elementary statistics textbook (Section IV). The last two sections discuss major issues and questions arising from the review and conclude with specific recommendations namely: (a) producing and using inferior books should be discouraged; (b) encourage the writing of better books and helping schools select judiciously among available options; and (c) improving statistics teaching at the tertiary level and consequently, upgrading statistical literacy.

II. THE REVIEW PROCESS

A. The Books

The following are the books that were reviewed by the committee:

1. *General Statistics Revised Edition* by Juan Birion, Fidela Cabacungan, Carmelita de Lara, Christie Hilario, Clarita Lico and Victoria Naval, 209 + iii pages, 1989, GIC Enterprises and Co., Inc., 2019 C.M. Recto, Manila, Philippines
2. *Introduction to Statistics*, by Francisco A. Febre, Jr., with Virginia F. Cawagas, Consultant. 211 + vii pages, 1987. Phoenix Publishing House, 937 Quezon Avenue, Quezon City.
3. *Basic Statistics*, by Lydia Monzon-Ybañez, 374 + vii pages, 1993. Phoenix Publishing House, 927 Quezon Ave., Q. C.
4. *General Statistics Made Simple for Filipinos* by Ferdinand Nocon, Joel Torrecampo, Ma. Magdalena Balacua and Wilfredo Daguia, 192 + xii pages. 2000. National Book Store, 125 Pioneer St., Mandaluyong City
5. *Introductory Statistics* by Cristobal M. Pagoso and Rizalina A. Montaño, 391 pages. 1985 Rex Book Store, 856 Nicanor Reyes Sr. St., Manila
6. *Fundamental Statistics for College Students* by Cristobal M. Pagoso, George Garcia and Cynthia R. Guerrero de Leon, 333 pages. First published in 1978 and reprinted in 1992. Sinagtala Publishers Inc.
7. *Applied Basic Statistics*, by Flordeliza C. Reyes. 356 + xii pages, 1999. Phoenix Publishing House, 927 Quezon Avenue, QC.

8. *General Statistics, Text/Workbook*, 2nd Edition, by Antonina C. Sta. Maria, Lorina G. Salamat, and Ferdinand P. Nocon, 173 pages, 1988, National Book Store, 125 Pioneer St., Mandaluyong City.
9. *Elementary Statistics Text/Workbook* by Carmela O. Zamora-Reyes and Lorelei B. Ladao-Saren, Copyright 2003. 230 pages. Reprinted in 2004, National Book Store, 125 Pioneer St., Mandaluyong City.

The list is not exhaustive. The committee failed to locate two others from major bookstores, possibly because these were out of print. Another was offered for review by the author after the committee had finished its work. And there could be a lot more that escaped the committee's attention.

The authors' vitae in the books showed that all were teachers in higher education institutions, a couple have bachelor's degrees in statistics, but none appears to have a graduate degree in statistics. Some have bachelor's degrees in mathematics or in education major in math teaching, while one is a civil engineer. Two of the authors are inactive members of the PSA.

Two names appear twice as authors (Nocon and Pagoso). One book lists an author (Febre) and a consultant (Cawagas) while one book has six authors (Birion, et.al.).

B. Review Criteria and Assignment of Reviewers

The committee reviewed the course outlines of introductory statistics courses at the University of the Philippines Diliman (UPD), University of the Philippines at Los Baños (UPLB) and the De La Salle University (DLSU), and after extensive discussions and consultations, the committee agreed to be guided by the following criteria in the review process:

- Content – The following topics should be included in an introductory statistics book:
 - i. Introduction – Nature, Meaning and a Little History of Statistics
 - ii. Collection and Presentation of Data
 - iii. Measures of Central Tendency and Location
 - iv. Measures of Dispersion and Skewness
 - v. Probability
 - vi. Random Variables and Probability Distributions
 - vii. Sampling and Sampling Distributions
 - viii. Estimation – Up to Two populations
 - ix. Testing hypothesis – up to Two populations
 - x. Correlation and Simple Regression Analysis
- Correctness and Clarity of Presentation of Concepts and Methods
- Relevance of Exercises and Data

Two reviewers were assigned randomly to each book and were asked to do separate and independent reviews based on the agreed criteria. They were also requested to give a general recommendation whether the book is suitable as a textbook for an elementary statistics course. The independent reviews were summarized and further discussions were

held by the committee to come up with the general findings and recommendations that are contained in this report.

III. SUMMARY OF FINDINGS

This section summarizes the major findings of the review. For more details, please refer to Appendix 1 which cites some excerpts from the reviewers' notes for each of the major findings.³ The major findings could be grouped into the following:

1. **There are important topics missing in some books.** Although some books (such as Monzon-Ybañez) included topics on the analysis of variance, contingency analysis, some books (eg. Febre, Zamora-Reyes) failed to include discussions on regression and correlation analysis which are the main statistical methods for studying relationships among variables. All the books that were reviewed were found to be inadequate on the topic of estimation which is at the core of statistical inference and of the modern scientific method.
2. **Some statistical concepts were not presented correctly.** For example, sampling was not presented correctly in both the books of Pagoso et.al., in Nocon et. al., and in Reyes. Pagoso and Nocon gives the notion that after simple random sampling everything else is systematic, while Reyes limits the discussion of sampling to stratification. Some books do not distinguish between the dependent and independent variables in regression and demonstrate the computations in which the two variables' roles could be interchanged, implying that one could do this in the real world (Monzon-Ybañez, Reyes).

Most of the books limited their discussion of probability to equally likely outcomes or events, without mentioning that unequal probabilities do exist and do in fact exist more often in the real world than equal probabilities.

The concepts that were not properly presented are far too many that they cannot all be mentioned here. For more details, please see the excerpts of the reviews in Appendix 1.

3. **All the books that were reviewed did not link probability and inferential statistics.** Probability is presented as a mathematical exercise without giving emphasis on its role in statistical reasoning. As a result, some basic concepts such as the law of large numbers, central limit theorem and sampling distributions that hinge on probability and are necessary in building the concepts in inferential statistics were not discussed thoroughly. In some books these concepts were ignored while in the others, the explanations were not based on statistical reasoning and logic but called for a leap of faith. This is unfortunate, since these concepts could be explained well in non-technical terms using simulation exercises. *Statistics* by David Freedman, et. al. is a good example of a book that uses this approach.

³ The full texts of the reviews can be accessed in the PSA website -- www.nscb.gov.ph/psa. The reviewers' names cannot be divulged for obvious reasons, but queries can be coursed through the PSA.

4. **Most of the books used the cookbook approach in presenting statistical methods.** Since the concepts that are the building blocks of statistical inference were not systematically presented in the books that were reviewed, the authors resorted to just enumerating the procedures for testing hypothesis, called the cookbook approach. Each statistical method is a recipe and there is no explanation offered why a particular method is the best solution for a given problem. The students are not informed of the limitations and assumptions of each of the methods. Since discussions of the statistical reasoning behind the tests were inadequate, the results of the tests of hypothesis are not interpreted correctly.
5. **All the books did not consider the prevalence of high-speed computers.** It is quite surprising that the authors did not give due attention to the increasing availability of easy interactive computing that could make data analysis more interesting and could eventually enrich the basic statistics course. As mentioned above, sampling distributions, notions of the central limit theorem, and so on could be taught using simulations that could easily be done with computers or even advanced calculators. In fact, the exercises in a book (*Interactive Statistics* by Martha Aliaga and Brenda Gunderson) that is used to teach elementary statistics in some universities in the United States were designed to compute real-life data using calculators only. Although most of the books that were reviewed were recently reprinted, the authors did not update the materials to make these relevant with the new technology. For example, the book by Pagoso, Garcia and de Leon states that "Some sophisticated statistical centers use IBM computer punch cards for tabulation. For our purposes, we will illustrate the process of manual tabulations." Most of these books also devote considerable space in teaching the readers short-cut formulas to ease manual computations. These long-winded discussions of computational procedures shift the focus of students from understanding the statistical concepts to overcoming these cumbersome arithmetic steps and in most cases, obsolete procedures.
6. **Most of the books did not use real-life data; the examples were not practical and relevant.** Examples are usually given to further explain the application of statistical methods and concepts. Using real-life data would help students learn how to apply these methods in the real world and would lead to better understanding of the concepts and the methods. With today's high-speed computers, using real-life data is not a problem anymore. Caution should be applied, however, so that there should be a systematic approach to the application of methods on these data such that concepts and ideas and not arithmetic and formulas are highlighted.

Most of the books under review did not fully utilize real-life data in their examples and exercises. Moreover, the examples and exercises in some of the books are not well thought of. A good illustration of this would be that from Sta. Maria on correlation analysis which asked the students to apply the three computational methods of correlation between the mathematics scores of 25 male and 25 female freshmen where the two samples were drawn independently. This shows that the author is unaware that independence implies no correlation, hence it would be illogical to check for correlation. It would seem that the emphasis is on the arithmetic, and not on the appropriate choice of method and on drawing a valid conclusion.

It was also observed that many exercises were dull, artificial, and sometimes dangerously illogical. The following from Febre best represents this observation: "Given the

population 10, 10, 12, 13, and 15, find the probability that a random sample of size 100, selected with replacement, will have a sample mean between 11.5 and 12.5." Although this could pass as an example of sampling with replacement, this exercise gives the wrong notion that it is a perfectly acceptable sampling procedure to over-sample a small population that could easily be measured directly. It is, of course, not logically correct nor sensible to draw a sample that is bigger than the population.

7. **There seem to be a general misconception of what statistics is in the books reviewed.** This can be due to several reasons, the main one being the lack of strong statistics background by the authors. As already mentioned, we could not confirm if any one of the authors have a graduate degree in statistics. The prerequisites specified by the authors in using their books reflect this observation. To illustrate, in one of the books, the author states that: "*Many students still carry the notion that if one is not good in mathematics, he will have some difficulty passing statistics. This misconception probably stemmed from the observation that many statisticians are also mathematicians and those who teach statistics have specializations in mathematics. Although it is true that statistics requires a good deal of arithmetic computation, one does not have to acquire mathematical sophistication to pass the course. With so many available calculating devices, perhaps the only prerequisites left for success in statistics are sound logic, good study habits, and a positive attitude toward the various materials presented.*" (Febre, Jr.) All the books, require nothing more sophisticated than a hand calculator. Still another states that "...only a modest knowledge of mathematics, mostly arithmetic and some algebra, is required." (Monzon-Ybañez). One book was given the title *General Statistics Made Simple for Filipinos* which implies that elementary statistics has to be made simple to match the mental capacity of Filipinos!
8. **Some books are full of typographical errors.** Typographical errors are detrimental to students' learning, especially in a subject like statistics that calls for the careful presentation of figures and formulas. Most of the books contain typographical errors that are crucial like missing decimal points, wrong subscripts or wrong symbols. These errors could be confusing to students, especially if the approach used is that of a cookbook. Four books were cited as full of typographical and grammatical errors (Febre, Nocon, Reyes and Sta. Maria). It seems that these books were not proofread well.

Word processing and desktop publishing softwares have built-in tools like Thesaurus and Spelling and Grammar since the 1990s, thus there is no excuse for so many typographical and grammatical errors that abound in these books. The only possible reasons were that these books are dated, and recent reprints or subsequent revisions did not make use of these tools.

The *Ad Hoc* Committee cannot recommend any of the books that were reviewed for an elementary statistics course in college for the reasons stated above. The book by Monzon-Ybañez, however, could be used as a reference book for social scientists and perhaps, could be used as a textbook for elementary statistics after appropriate modifications to address certain weaknesses discussed in Appendix 1.

On the basis of the reviews, we could surmise that the authors were probably skilled in the rudiments of the more popular statistical methods but the reviewers also perceived some inadequacy in the authors' background on statistical theory. Because of this

inadequacy, fundamental concepts in statistics, especially in statistical inference, were not sufficiently discussed. Further, the cookbook style of presentation of statistical methods observed in most of the books fails to provide the students with the concepts behind each method. It answers the how's but it does not address the why's. Unfortunately, this approach tends to create an unfavorable impression of statistics in the minds of the college students. It does not promote statistical thinking⁴ hence does not provide the students with the skill to determine the most appropriate statistical methods to apply given a certain real life situation.

All the books reviewed were written by statistics teachers without graduate degrees in statistics. It would seem that except for the book that Dr. Cristina Parel and colleagues wrote (Introduction to Statistics) in 1966 which has been out of print for quite some time, there is no book in elementary statistics that has been written by a local professional statistician. The textbooks on elementary statistics used in three big universities [Note: PUP and UE both offer BS Statistics and might be bigger than UPD, UPLB and DLSU in terms of student population so it is safer to describe the three as big and not biggest.] offering BS Statistics programs are written by foreign authors and reprinted locally. These books are comparable in price to those written by local authors. Moreover, these books have been reviewed by distinguished professors in statistics and peer-reviewed in mainstream statistics journals.

IV. ELEMENTS OF A GOOD TEXTBOOK FOR AN INTRODUCTORY STATISTICS COURSE

We believe that while a book in elementary statistics cannot transform novice students into expert statisticians, it should help students develop their statistical thinking, which they should be able to apply in the real world.

Hogg (1992) outlined the goals of a course designed to develop statistical thinking, where the focus is on learning how to ask the right questions, how to collect data effectively, how to summarize and interpret that information, and how to understand the limitations of statistical inferences. The details of this course, as follows, could also be used in evaluating a prospective textbook:

1. Emphasize the elements of statistical thinking:
 - (a) Need for data
 - (b) Importance of data production
 - (c) Omnipresence of variability
 - (d) Measuring and modeling of variability

⁴ Snee (1990) defined statistical thinking as thought processes which recognize that variation is all around us and present in everything we do. According to this definition, all work is viewed as a series of interconnected processes. Identifying, quantifying, controlling, and reducing variation provide opportunities for improvement. While Snee discussed statistical thinking as a way of improving products and services in business and industry, his ideas extend to students in a first course who should be able to recognize that variation occurs in almost everything and that their ability to respond to various situations should be at least partially determined by that recognition.

2. Incorporate more data and concepts, fewer recipes and derivations and wherever possible, automate computations and graphics. An introductory course should:
 - (a) Rely heavily on real (not merely realistic) data
 - (b) Emphasize statistical concepts such as causation vs. association, experimental versus observational and longitudinal vs. cross-sectional studies
 - (c) Rely on computers rather than computational recipes
 - (d) Treat formal derivations as secondary in importance

3. Foster active learning, through the following alternatives to lecturing:
 - (a) Group problem solving and discussion
 - (b) Laboratory exercises
 - (c) Demonstrations based on class-generated data
 - (d) Written and oral presentations
 - (e) Projects, either group or individual

Based on the results of the reviews described above and the reviews of books used in leading universities in the United States that were published by the Committee on the Curriculum in Statistics and Probability of the American Statistical Association, the following are the elements of a textbook best suited for an introductory statistics course in college:

1. The book should include the following topics:
 - (a) Designing experiments properly
 - (b) Describing and summarizing data
 - (c) Analyzing relationships
 - (d) Statistical reasoning -- probability, law of averages, sampling distributions
 - (e) Making valid generalizations from the sample

2. Statistical concepts and methods should be explained concisely in a clear but non-technical way. Explanations should be supported by interesting real-life examples that will further enhance the understanding of the particular statistical concept or method.

3. The exercises used in the book should be designed to encourage statistical thinking and not to hone arithmetic skills and memorize formulas.

4. The use of real life data and computers should be encouraged to help students apply the statistical methods and concepts in real life and to make the book more interesting to the readers. A good book, with the use of real-life data commonly known to students, should be better able to help them understand the proper use of the statistical methods.

5. Typographical errors should be avoided. If errors were found after publication, an errata page should be circulated to avoid propagation of the errors. The errors should be corrected in the reprint.

V. SOME ISSUES AND QUESTIONS ARISING FROM THE REVIEW

The results of the reviews forced the committee to ponder further on some possible consequences and issues about statistical education in the country.

- 1. What is the likely impact of the substandard textbooks on the statistical education of college students in particular, and on statistical literacy of the populace in general?** Statistics is supposed to be taught in high school as part of mathematics. However, the statistics part is left for last, so that in practice it has hardly been covered at all. The shortage of qualified high school mathematics teachers is thought to be critical; hence, the number of high school teachers qualified to teach statistics more likely is best described as nil – all the more reason for the teacher to skip the statistics part of the course. The migration of math and science teachers to the U.S. and other countries is bound to exacerbate the situation in the coming years. Thus, the great majority of students who reach college will have one introductory statistics course as their first and last brush with the statistics discipline throughout their life. It is rather unfortunate if this lone opportunity is spoiled by a substandard book. If such circumstances persist, then our youth and future generations will not have the analytical skills necessary to keep up with the pace of progress of our neighboring countries and the world.
- 2. What is there in the Philippine educational system that emboldens non-statisticians to write statistics textbooks?** This is a question for serious reflection by agencies like the Commission on Higher Education (CHED), National Book Development Board (NBDB), and academic boards of colleges and universities. One book, by Monzon-Ybañez, stands out as a labor of love by an engineer thrust into teaching statistics and advising researchers on statistical methods. As mentioned above, this book can serve as a useful reference for social science researchers and, with revisions suggested in its review, could be recommended as an introductory statistics course textbook.

As for the other books reviewed, one cannot help but see many of them as products of commercial transactions between authors and publishers. The authors, all teachers, perceive the demand for a book and, with the authority to prescribe it in their classes, can guarantee enough sales for a publisher to produce it. The committee has not looked into the role of higher education institutions' (HEIs) academic departments in the selection of books for use in their various courses.

As for the government agencies that may have to do with fostering quality education at the tertiary level, the National Book Development Board (NBDB) website has this to say in response to the 'defective textbooks controversy' spawned by Mr. Go (see footnote 2): the agency is ... "a policy-making and planning body and not a regulatory body. There is no government agency responsible for evaluating textbooks used in private schools, for these schools are supposed to do the evaluation themselves before selecting and buying the books. For the public schools, the Department of Education (DepEd) does the evaluation and selection." (But DepEd does it for the primary and secondary levels only.) "If the private schools and DepEd do their jobs well, the free market system itself will weed out the bad books." The article goes on to say that: "The NBDB is a developmental agency for publishers of all kinds of local books and not just textbooks. Thus, the most the NBDB can do to sanction a publisher of poor quality textbooks is to cancel its registration and thus exclude the publisher from availing of any services and incentives

the NBDB offers. The cancellation does not mean that it becomes illegal for the publisher to continue producing or selling a poor quality book.”⁵

The Commission on Higher Education (CHED) has three broad mandates: promote quality education, ensure education is accessible to all, and protect academic freedom. Nothing is mentioned about textbook development, evaluation or selection in its rather long list of services that are meant to carry out its mandates.⁶

Judging from the quality of the books reviewed here, the Philippine market has been unable to weed out the bad books, contrary to NBDB’s assumption. And it is just as well that NBDB and CHED or any government agency continue to keep away from evaluating and prescribing textbooks, as the practice could well lead to rent-seeking, corruption and bad books as the experience with elementary textbooks show.

Where does that leave us? What are lacking in the current scheme of things are peer reviews of the books and editorial review. Nothing stands between the authors and publishers that otherwise may have prevented the publication of substandard books, or else improved the drafts of these books. Compare this with textbooks written by foreign authors and produced by reputable publishing houses abroad. There, authors are well-known in the statistical community through long years of graduate level teaching and extensive research published in mainstream refereed journals. Publishers have editorial boards comprising of statistics luminaries that recommend acceptance or rejection of a manuscript. Books that are published passed through another tier of reviews that are regularly conducted by editorial boards of various statistics journals and professional organizations. A bad review will be a strong indicator that the book will not be designated as a textbook; hence poor sales.

3. **The flipside of the question above is: why have professional statisticians-teachers not authored and published statistics textbooks?** First, there are few who can – or feel confident they can - write a text comparable to available newsprints of books by foreign authors. These professors are concentrated in three campuses in or around Metro Manila, plus one or two campuses in the South. Until now, it seems they have found an acceptable solution in prescribing foreign books available in newsprint at prices comparable to locally authored books, and supplementing the former with workbooks that they have written themselves. With maybe one or two exceptions, the workbooks are reproduced by the universities or departments and priced on a cost-recovery basis. Some state colleges and universities, particularly those with statisticians in their faculties who graduated from the three campuses referred to above, also use these workbooks and possibly the same newsprint versions of foreign textbooks. Moreover, these professional statistician-teachers may prefer to do the more lucrative statistical consulting, or they may not be as commercially astute as non-statistician teachers (who tend to be found in big private campuses), and/or they have not established links with publishers.

A recent article by Bolasco (2005) presents another view on this matter, saying that the college textbook has long been dead – a casualty of extensive photocopying among students - and that Marcos’ reprinting decree made us totally dependent on foreign

⁵ See *On the Textbook Controversy*, in <http://www.nbdb.gov.ph>

⁶ See <http://www.ched.gov.ph>

textbooks. However, the same article claims that with the Marcos decree junked by the new copyright law, there is now a growing stimulus to develop and publish our own textbooks, and experts are now working on such textbooks at the commission of leading publishers. We hope this new stimulus will encourage statistician-teachers to write quality statistics books.

4. **What is happening in the other disciplines?** Is this phenomenon limited to statistics? We doubt this very much considering the widely-published results of Mr. Antonio Calipjo Go's review of science and English textbooks in elementary schools. It will be interesting - and important for assessing the state of the country's educational system - to know the kinds and qualities of textbooks used in introductory physical and life sciences courses (physics, chemistry, biology, etc.) at the tertiary level.

VI. NEXT STEPS

1. Improving the Availability and the Selection Process of Better Textbooks

The bottom line is to *make producing bad textbooks unprofitable for authors and publishers*. For statistics, the PSA can make this happen by creating a permanent committee to review all statistics books that enter the market and drafts for publication that are submitted to it by either the authors or publishers. Copies of the committee's reviews should be circulated widely through the PSA website, its publications – *The Philippine Statistician* and the *PSA Newsletter* – and to all private and state colleges and universities.

To help or encourage HEIs to select suitable texts for their statistics courses, the same committee's terms of reference should include conducting a survey of the courses and textbooks used, at regular intervals - say every two or three years - and the results circulated to all colleges and universities.

When and if done well, these twin activities of the proposed PSA permanent committee should make it rewarding for professional statistician- teachers to write textbooks.

What might be the role of government, such as CHED and NBDB, in this proposal? We believe nothing by way of regulation, prescription or policing of textbooks production and use. These agencies can perform useful roles by way of disseminating or endorsing the PSA book review committee's work to the colleges and universities and in helping PSA (a professional non-profit organization) find funds for its activities in this area.

2. Improving the Competency of Statistics Teachers

Making suitable books available and getting schools to prescribe them is winning half the war against the low quality of statistical education in tertiary schools. The other half is providing the teachers competency to select and use the better statistics books, and hence, teach the statistics courses effectively. This will be more difficult, will take longer and will be more costly to do. The first step is to estimate the magnitude and depth of the problem, by getting a profile – through a census or survey - of the backgrounds and qualifications of statistics teachers in private and public colleges and universities. Judging from the vitae of the authors of the books reviewed here, who should fall in the upper percentiles of the

statistics teachers' profile, we anticipate the problem to be enormous – but not insurmountable.

The management of colleges and universities should be proactive in encouraging their faculty to participate in statistical conferences and seminars to improve their teaching methods and understanding of the subject matter. Interaction and discussions on teaching the introductory course among colleagues and engaging colleagues in collaborative classroom research should also be encouraged. In the absence of a civil service examination, board examination or official certification for statisticians, the largest collegial body of professional and practicing statisticians in the country is the PSA. Universities and their statistics faculties may want to look into the benefits of becoming more involved in PSA activities, including possible membership⁷. Furthermore, universities may encourage their statistics faculties to join or form statistics research and teaching consortia. An example is the UP Diliman - UP Los Baños Annual Faculty–Student Research Conference, the sixth of which was held on 24 September 2005. These conferences are venues for presenting research papers, discussing teaching methods and meeting peers.

There are many teaching statistics, particularly in medical, biological and social sciences, business, engineering and mathematics who are not active in the statistics community. The PSA must find ways bring these into its fold, to inform and support them so that they may learn about and implement ways to improve their courses. For example, many instructors who are not active in the statistics community are unaware of the many excellent web resources⁸, such as applets, that may be used to enhance student learning.

Through its annual training program, the PSA has the experience to organize short courses in various areas of statistics and has competent members to handle such courses. Some of the major universities with undergraduate and graduate statistics programs, such as UP Diliman and UP Los Baños, also have comparable experience and expertise in conducting short non-degree programs. The Statistical Research and Training Center (SRTC), a government agency that is part of the Philippine Statistical System, is also an active provider of short-term statistics training. All of these institutions could be approached to develop courses for non-statistician teachers of elementary statistics courses to help the latter improve their understanding of the subject matter. However, conducting the courses nationwide will require substantial costs. Toward this end, these bodies could seek the help and cooperation of concerned agencies, including the Philippine Association of State Colleges and Universities and its private sector counterpart, non-government organizations (NGOs) concerned with improving higher education, CHED and NBDB.

There are other important issues that need to be addressed by schools, the government and non-government organizations alike. How do you teach large classes of a hundred or two

⁷ The PSA holds quarterly and annual conferences, conducts short-term training courses for its institutional members, and publishes a semi annual journal and a quarterly news letter that are given free to members.

⁸ To name a few: The American Statistical Association – www.amstat.org; Links to websites on teaching statistics -- <http://www.helsinki.fi/~jpuranen/links.html>; Teaching resources, Statistical Science Web -- <http://www.statsci.org/teaching.html>; International Association for Statistical Education Site for Resources for Teaching Statistics -- www.swin.edu.au/math/iase/resources.html; Sidney Tyrrell's resource page -- <http://www.mis.coventry.ac.uk/~styrrell/resource.htm>

hundred, which happens when introductory statistics is a required general education course? Teaching statistics with computers is the preferred approach in this internet age. In the Philippine context, is it reasonable to expect/require the students to have their own computers, or should the school strive to provide computing facilities to its students? Should schools be required to provide a minimum student-to-computer ratio, in much the same way that nursing and medical schools should have access to medical centers?

3. Beyond Statistics

Replace statistics with another discipline in this report, say biology or sociology, and many findings, observations and recommendations might also hold. This tantalizing possibility strongly suggests the need to do similar work in the other disciplines.

Also, since statistics is used to solve problems in other disciplines like medicine, biology, the social physical sciences⁹, the PSA perhaps could play a catalytic role in proposing a "wider college textbooks review". The PSA, for instance, is one of thirteen member societies of the Philippine Social Science Center (PSSC); at the same time, Statistics is also in the physical/mathematical sciences grouping of the National Research Council of the Philippines (NRCP). A review of textbooks used in general education courses in colleges and universities, coordinated by these two agencies, should lead to a more comprehensive assessment of the quality of tertiary education in the country.

Acknowledgement

The Committee wishes to acknowledge the influence and inspiration of Mr. Antonio Calipjo Go who meticulously documented many serious errors in a number of textbooks used in elementary schools. His reviews led to the Department of Education acknowledging said errors and took steps to correct them. See example in *The Philippine Star*, 22 September 2005, p. A-10 for the latest on the "defective textbooks controversy."

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⁹ This ubiquity of statistics can be explained by a recent quotation from C.R. Rao (2005), the most eminent living statistician: "Statistics is not a discipline like physics, chemistry or biology where we study a subject to solve problems in the same project. We study statistics with the main aim of solving problems in other disciplines."

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Appendix 1

Some Excerpts from the Reviews, by Major Findings

Appendix 1 contains excerpts from the reviews classified according to the major findings and authors. Excerpts under a specific finding and book were texts that were merged from the notes of the two designated reviewers. This appendix does not contain, however, the full text of all the reviews. Copy of individual reviews can be downloaded from the Philippine Statistical Association website -- www.nscb.gov.ph/psa

A. There are missing important topics in the book.

Febre

This book did not include sampling, regression and correlation analysis. In fact the concept of sample was introduced at the very start without explaining how to get the sample. The concepts of relationships/associations between variables or lack thereof are basic that should not be missing in an introductory statistics course that, for many college students, will be their first and last formal course in statistics.

Pagoso and Montaño

Some descriptive statistics were not discussed, e.g. geometric mean, harmonic mean, measures of kurtosis, coefficient of variation.

Pagoso, Garcia and de Leon

The book's real fatal omissions are topics on variables, parameters, statistics and estimators. Estimation is a basic statistical concern. Understanding the nuances of point and interval estimation, in addition to being able to test hypotheses and establish relationship between variables, are crucial to achieving even a basic level of statistical literacy.

Reyes

In Chapter 7 (Introduction to Probability and the Binomial Probability Distribution), the author omitted a discussion of basic concepts such as the random experiment, sample space, event and the occurrence of an event. This omission creates so much confusion when these terms are used or misused in this chapter. For example, in page 92 the author asks "*If a coin and a die are tossed simultaneously, how many events are possible?*" The term "event" was used when the more appropriate term is "outcome". This error was repeatedly committed by the author in the succeeding examples. And in page 100, the author wrote "*tossing a coin is a random event*" instead of referring to it as a random experiment. How can a student possibly compute for the probability that an event will occur if it is not even clear what an event is?

Sta. Maria

The book has very limited chapters to cover the usual topics in an undergraduate course. It has no chapters to cover random variables and probability distributions, sampling and sampling distributions, estimation and test of hypothesis. The topics that are covered presented are treated in a shallow manner. However, the book included separate chapters on correlation and regression.

Zamora

The book has a “subtitle” that indicates it is serving as a text-cum-workbook. However, this workbook lacks discussion and explanation of important concepts in elementary statistics. It did not include topics like measures of skewness, sampling distributions, and regression and correlation analysis. The sampling techniques were introduced in data collection and presentation. There is an extensive discussion on sampling methods but no mention about the different ways of making inference when these methods are used. It was also observed throughout the workbook that topics simply pop up in some chapters and thus, the coherence of the topics in a chapter was lost.

B. Some of statistical concepts were not presented correctly.Birion

Regression and correlation are presented in Lesson 12 just as measures of relationship. This is presented before statistical inference is discussed hence, it was not presented as a statistical inference method.

The treatment of sampling, confidence interval and in fact, most of part III is lacking in substance. Assumptions for the many tests are not discussed well and guidelines on how to validate these assumptions are lacking. In many cases, discussions are very vague and in others, somewhat convoluted that the net effect on readers is utter confusion. For example, “*Second, a confidence interval for a mean gives us the probability associated with the given confidence which we can level of significance*” (p. 150 4th sentence). Another example from page 172 – “*The chi-square distribution is obtained by getting from a normal population some random samples of size n and determining the χ^2 value of each sample. This distribution can be represented graphically by histogram.*” But how does χ^2 differ from other distributions was never addressed. Another example, from page 147 – “*If the population from which the samples of equal sizes (sic) are drawn has a normal distribution, the sampling distribution will also form a normal curve.*” Sampling distribution of what? And yet another one from page 148 – “*However, the value of the sample standard deviation, s , becomes closer to the population σ as n increases. This estimate of relationship is described as bias.*” Is this another version of the weak law of large numbers?

Febre

It is perhaps acceptable to restrict an introductory course, for the most part, to equally likely outcomes, events, samples and sampling distributions. However, it would be unwise to give students the impression that equal probability is all there is to know and that is what statistics deals with exclusively.

“The probability of occurrence of a single event is known as *marginal probability*.” (p103).

In the last chapter on tests of hypotheses there is confusion in the use or choice between t and z . More seriously, there is confusion in the use of or choice between t and z , and in the assumption concerning the variance of the two populations; i.e. equal or not.

Chebyshev’s Theorem was also discussed as a use of standard deviation and not on the merit of the theorem itself, that is, as a tool to describe the distribution of the data set. Another use

of the standard deviation that was discussed is to transform the raw observations into standard scores.

Monzon-Ybañez

I feel that in discussing regression it would be appropriate to first discuss the notion of a dependent and independent variables. These concepts were not properly introduced which perhaps explains why the notations X and Y are often interchanged. In addition, I find that the discussions of fitting two regression lines (Y on X and X on Y) are not only unnecessary but also confusing.

The discussion of probabilities seriously lacks substance, logic and correctness. I get the impression that the author does not have a good grasp of this topic and this has led to fundamental weaknesses in succeeding discussions (particularly on statistical inference). For instance, the concepts of a random experiment, sample spaces and events as subsets of the sample space were not formally discussed. I think this is fundamental in the presenting the topic. Also, we see inaccurate definition of a probability measure and that operations on probabilities are not properly presented. The author always assumes independence of events and never even bothered to introduce the notion of conditional probabilities that is important in defining independence of events. The author also (implicitly) assumes equally likely sample spaces. My sense is, students reading this book will be very confused on the concepts of probability.

Nocon

'Descriptive statistics refers to the collection, organization, presentation, computation and interpretation of data in order to describe the samples under investigation.' (Page 1, 2nd sentence, third paragraph) Descriptive statistics is the science or perhaps the art of summarizing and describing data – it normally does not include the collection of data.

Multi-stage sampling is a more complex sampling technique which includes the following steps: (a) Divide the population into strata; (b) Divide each stratum into clusters; (c) Draw a sample from each cluster using the simple random sampling technique' (Page 17, 1st paragraph under section 2.3.5). This is too narrow. When do you select the clusters? Will all clusters be selected? What happened to the concept of domain, primary sampling and ultimate sampling units and various selection techniques for each stage, etc.

Normal distribution is presented in terms of computing probabilities/area under the curve.

Pagoso and Motano

The section on sampling techniques should be completely revised. According to this section, there are two general types of sampling techniques: random sampling and systematic sampling. Classified as types of systematic sampling are: stratified sampling, cluster sampling, and multistage sampling.

There was mention about Chebyshev's inequality however, it does not provide justification as to why σ is the best measure of variation – the authors claim this.

On pp 158, the authors mentioned that the sample variance is an unbiased estimate of the population variance. Again, in here the notion of unbiasedness was not explained. This is better explained under inference which was not touched in the book.

The author also interprets the coefficient of variation as a measure of “consistent performance” but provided no explanation as to what it means.

The book introduced the “Slovin’s formula” as a method of sample size determination. In here, the authors never bothered to explain, much less simplify, what the margin of error means, which is a vital component of the formula. I still cannot see the theoretical merits of such formula.

Two methods of estimating Y for a given X during regression analysis were discussed. The first method employs the drawing of a “trend” line across the scatter diagram. Unfortunately, the authors regard this as a legitimate method of estimating values of the dependent variable. The method using the equation $Y = a + bX$ was next discussed using the same numbers as before. The resulting estimated value of Y was almost the same as in the “trend” method due to the fact that the points in the scattergram almost formed a straight line.

Pagoso, Garcia and de Leon

In planning a study a table for sample size given population size and margin of error are presented. No sufficient explanation of margin of error is given. We note that the selection procedure also was not linked to this sample size expression. This gives the reader an impression that this is how sample size is determined for any given situation. An extensive discussion on how to make questionnaires and how to perform random sampling is given and this could be useful to some. Sampling procedures are either random or systematic (under which are stratified sampling, cluster sampling and multistage sampling). Non-random sampling methods are those in which not all members of the population are given equal chances to be chosen.

The last section of the chapter on probability showed how baffled the authors are regarding the relationship of probability and statistics. “It (probability) is used in statistics for purely descriptive purposes....It is used to express statistical material in a short and concise way...”.

Reyes

Sampling Methods (Chapter 8) is restricted to equal probability of selection. “A random sample is one which is selected that every member of the population has an equal chance of being selected.” (page 129)

“Any intact group from the population having similar characteristics is a cluster” (page 136). It is implied that it is desirable to minimize the variance within the cluster.

In discussing simple linear regression the author regresses Y on X and then does the same for X on Y, thus confusing the student on the real meaning of the equation $Y = a + bX$.

On page 115, the author writes: “*The representation of the values of a random variable and the probability associated with those values is called a probability distribution.*” And in p.117, the author continues: “*A probability distribution for a discrete random variable is called a probability mass function, while that for a continuous random variable is know as a probability density function.*” This seems to be another common error among the books being reviewed. Although the probability density function is used to compute for probabilities, the value of the pdf $f(x)$ at the point x is not the probability associated with the value x. The

author did not mention, or failed to grasp, that for a continuous random variable X , $P(X=x)$ will always be 0.

Sta. Maria

Illustrations of concepts being presented incorrectly:

Random sampling limits the definition as that of the SRS, misleading the concept.

“Statistical sampling - ... divides the population into subgroups called strata.

Cluster sampling and convenience sampling are wrongly defined.

Zamora

The inclusion of the second chapter is welcome because it gives information on how to construct questions for surveys. It also presents the usual graphs and frequency distribution table. There is an extensive discussion on sampling methods but no mention about the different ways of making inference when these methods are used. In the section that discusses the Characteristics of A Good Question: #1 A good question is unbiased.

The chapter on probability includes a section on set operation and counting techniques but discusses very little on aspects of probability. In fact, conditional probability seems to be taken as an afterthought and not something with its own significance.

The authors failed to define and differentiate probability from non-probability sampling methods. They also did not discuss the role of probability samples in statistical inference. As presented, the reader might think that in both types of samples statistical inference could be applied. If that is so, this illustrates the misuse of statistics.

C. There is no bridge between descriptive and inferential statistics. Some fundamental concepts such as the law of large numbers, central limit theorem and sampling distributions that are necessary in building the concepts in inferential statistics are not were not discussed well.

Birion

Part III (Statistical Inference) is lacking in substance primarily because the discussions on the fundamental concepts of estimation, central limit theorem, sampling distributions are quite flimsy. These concepts should link probability to statistical inference and should help students grasp the logic of hypothesis testing.

Febre

In trying to explain why s^2 is divided by $(n-1)$, the book says “Various studies in advanced statistics show that the average of the values of s^2 computed from several samples of a population tend to be more accurate – that is, it tends to be closer to the population variance σ^2 – when the divisor is $(n-1)$ than when it is n .” (p. 67). Such way of explaining calls for leap of faith rather than logic.

Monzon-Ybañez

The way ideas were laid out in the book, the author has this restricted view of the subject being just a tool for researchers rather than a discipline in itself. Because of this very limited view, the book missed out very basic but important principles that could have led to more accurate discussion of the concepts and more logical presentation of the topics. The discussion on estimation is very sparse and misses out important details such as the difference

between a point and interval estimate, the concept (criteria) of choosing an estimator, the difference between precision and accuracy. It has also inaccurate statements such as the central limit theorem (which does not require normality of the parent population), level of confidence, the difference between a confidence statement and a probability statement (c.f. statement 2 on p 204).

Nocon

The authors also have a questionable understanding of sampling, probability, random variables, distributions, and other important statistical concepts. Regression analysis is presented simplistically as estimation of slope and intercept of a line. Because sampling distributions are not presented well, there is no bridge between the chapters on probability and on test of hypothesis.

Pagoso and Motano

The serious weaknesses of the book are the non-inclusion of more formal and thorough discussion of the concepts of a random experiment and how this notion is linked to statistical inference; the notion of a sampling distribution and a statistic; and, the notion of estimation including point and interval estimation.

One of the most serious observations from the chapter on the test of hypothesis which may lead the students to misunderstand the inferences they are supposed to make is the statement of the null hypothesis, e.g. $H_0 : \bar{X} = 300$ lbs. (page 268). Does this imply that the authors do not really understand what they are testing? This error seems to be prevalent among many statistics books sold in many stores. A few years ago, I saw this in a book sold in Claro M. Recto St.

Since the sampling distribution of the mean was not discussed, the students may wonder where the new formula for $Z = \frac{(X - \bar{X})}{\frac{\sigma}{\sqrt{n}}}$ came from. Similarly, they may get confused about

the use of the t -test as opposed to the Z -test.

Pagoso, Garcia and de Leon

Part II shows how much the authors lack statistical background to write a text on statistics. Part II is disorganized and each chapter is not properly motivated, and linked with the other chapters. It is as if the authors identified topics which they think are most useful to them as economists and they decided to write them in chapters and called the entire section 'Inferential Statistics'. The absence of the discussion of Probability Distributions, Sampling Distributions, The Central Limit Theorem and Parameter Estimation is proof of this. If the authors started their discussion of inferential statistics with sampling distributions and the central limit theorem then the other topics would have been well-motivated.

The chapter on normal distribution ends with reference to sampling distributions in one paragraph (three sentences). To someone who already knows what a sampling distribution is, the paragraph is more than enough. To someone who does not, the paragraph won't get him anywhere, unless the reader does a leap of faith, which is probably what the writers are asking him to do at this point. (Believe that the means of all possible samples from a large population will also (sic) be normally distributed.)

Reyes

Since random variables, probability and sampling distributions were not properly discussed, the tests of hypothesis were not also properly presented. To illustrate, on page 201, the author is correct in stating that "*the risk that a researcher is willing to take in rejecting a true H_0 is reflected in the level of significance of the test of hypothesis.*" But in p.203, the author interprets a level of significance of .05 as "*the probability of obtaining sample results similar to the one presently observed is 95% and the probability of obtaining different sample results is 5%*". This interpretation is consistent with the author's definition of level of significance that appears in the glossary as "*the probability of occurrence of the observed sample results due to plain chance or sampling error*". This definition is incomprehensible.

Zamora

The contents of Chapter Six did not cover all of the stated objectives for the chapter. I think objective d, which is to expect the student to *use probability to analyze and understand real world situations and problems* was neither fully attained in the discussion of the chapter as in Chapter Five.

The tests of hypotheses discussed in Chapter Eight involve assumptions to be satisfied in order to have valid results. There were no discussions made on this matter. In fact, the assumptions were not even stated. The validity of the statistical tests rests on how the data on hand satisfy the assumptions of the tests.

On page 190, Note No. 5 states that "*For a fixed sample size, the chance of committing one type of error can be made smaller at the risk of increasing the chance of committing the other type.*" This statement is not entirely correct since the risk of increasing the chance of committing one type of error when we decrease the other type of error for a fixed sample size can only occur if the decision rule or the value of the parameter at the alternative hypothesis remained constant.

On page 205, the tests on the difference of means of two populations are given. The test statistics are simply given without any explanation or discussions. We could not expect the proper use of these test statistics if these are not sufficiently discussed.

D. Most of the books used the cookbook approach – full of recipes, with emphasis on computational details.

Birion

The book is more like a lesson plan than a reference material. The style is too mechanical, it answers only to some extent the question "How". The "Why's" or "Why Not's" are not properly addressed. It gives the readers the procedures for computing various statistics but it fails to give in-depth and clear discussions on such statistical methods to be able to incite readers to think how data and statistical concepts could be used in their everyday activities.

Febre

The book in general is a "cook-book" style. Formulas are given but little discussion was made regarding on how to use and interpret the values obtained. Explanations are lacking for the reader to fully understand and appreciate the statistical concepts introduced in the book.

Monzon-Ybañez

I have also observed the penchant for more detailed discussions and examples on computations rather than principles and interpretation. This has led to inaccurate and incomplete discussions on statistical inference (e.g. interval estimation, test of hypothesis, regression and correlation, analysis of variance).

Nocon

Most chapters of this book contain step by step procedures of computing statistics, probability, or test of hypothesis similar to recipes found in cookbooks. The book oftentimes does not provide adequate discussion of underlying statistical principles that underpin the “recipes”. Because of these perceived short-cuts to make the presentation of statistical methods simple, the readers could form wrong notions, especially on the general concept of statistics, random variables, probability, distributions, sampling, test of hypothesis in general and regression.

Pagoso and Montaño

The book concentrated on formulas and procedures with little or no discussion of the important concepts behind such procedures. The F – test and the χ^2 test are illustrated by examples using step by step calculations.

Pagoso, Garcia and de Leon

The chapter on simple tests of hypothesis goes into the usual menu of tests to do under certain situations, muddling along with expressions like $H_0 : \bar{X} = 45$ or $H_0 : \bar{X}_1 = \bar{X}_2$. The symbols μ and σ appear mysteriously in the formulas without explanation where they come from and why they are so denoted.

There is a good introduction to the chapter on simple analysis of variance, citing R.A.Fisher as having developed the method specifically for agricultural research. The rest of the chapter is the usual cookbook recipe for coming up with and interpreting an F ratio.

Reyes

The chapters on Simple and Multiple Regression Analysis are mostly concerned with formulas and the use of the calculator to estimate coefficients. There is no mention of the problems on the assumptions about the error term or error of prediction such as autocorrelation, heteroscedasticity, etc. The author states that because the “F-test is a robust test, we can use multiple correlation and regression without worrying much about those assumptions.”

As in the case of multiple regression analysis, the chapter on analysis of variance is mostly formulas and computations. The author again cites the robustness of the F-tests which will allow the researcher to disregard some of the assumptions of ANOVA.

Sta. Maria

The book devoted more on the mechanical computations leaving no explanation or discussion of the results.

Zamora

This workbook might do for high school statistics but not for university students. It gives the whats and the hows but not the whys. It gives the levels of measurement but doesn't effectively differentiate the four levels. The discussion of topics lacks the depth to encourage critical thinking in students.

Most of the time, the book is presenting ideas in outline form or in "bullet" type of presentation. Hence, you could consider it more of lecture notes that need to be accompanied by oral discussions of the concepts being presented.

E. The books did not consider the prevalence of high-speed computers – quite outdatedBirion

While the use of real data was also the stated objective of the book, the use of computers or even calculators was not really considered. This observation becomes apparent when much space in the book was given on shortcuts on how to calculate statistics by hand. Do we really need to review rounding off numbers, operations with decimals, percent, fractions and signed numbers, which form the first four of the 17 lessons in the book?

Febre

By calculating devices, the author means nothing beyond a hand-held calculator. The book emphasizes computational procedures without the aid of computers. Therefore, most of the numerical examples and exercises are simple, smallish and artificial.

Monzon-Ybañez

What impacts more negatively on an otherwise excellent presentation all throughout the book is the (assumption of) non-use of computers. There is mention of a calculating machine (i.e. hand-held calculator) on p. 173. Thus, some presentations are dated and unnecessary; e.g. the statement on p. 96 about the ungrouped sample mean formula impractical to use for $n = 50$ or more; also the suggestion to move values about an arbitrary origin to avoid using large variate values; or constructing a frequency distribution for the purpose of computing a grouped mean instead of using the individual values. Last but not least, 4 pages (174-177) were used to illustrate grouping data for the purpose of computing the correlation coefficient. Indeed, the length of the book could have been cut significantly if it were assumed that its users have access to a computer.

Nocon

The book does not recognize that computers are now widely available and hence, statistical computations have since progressed. One example is the use of p-value of the test instead of fixing the level of significance of the test which could now be easily derived. Instead of focusing on the computational aspects of the statistical methods, the book could have shifted its focus to more in-depth analysis of results and wider range of exploratory and analytical discussions on data.

Pagoso, Garcia and de Leon

The age of this text is showing. In p. 51, in Tabular Presentations: "Some sophisticated statistical centers use IBM computer punch cards for tabulation. For our purposes, we will illustrate the process of manual tabulation." Students of today will hardly have the patience

for such details. The lengthy section on frequency distributions with the accessible technology is quite irrelevant already.

Reyes

The book goes to the extent of illustrating the use of calculator by actually drawing the keys to be pressed and the corresponding readouts in the various steps involved in the computation of the mean, the standard deviation, the correlation coefficient and other statistics. These drawings are found in most chapters in the book, even in the chapters on frequency distributions

Zamora

In this book, there is no hint of technology being used in statistics in the past 20 years. There is no mention of statistical software or hand calculators. Measures are computed from the use of formulae.

F. Examples are not very practical

Febre

Some examples and exercises are artificial, sometimes whimsical, and at times downright illogical. This is illustrated by Example 9.2.1 (p 155). "Given the population 10, 10, 12, 13, and 15, find the probability that a random sample of size 100, selected with replacement, will have a sample mean between 11.5 and 12.5." What are you trying to teach the student when you tell him/her to draw 100 from 5?

Nocon

The illustrations and exercises are also very mechanical, lacking of the more meaningful interpretations. In probability, examples are all coins, dice, cards, words.

Exercises and examples could have been chosen for their intrinsic interest – to show how statistics has helped solve major problems in health, medicine, education, economics, social science, etc. However, the exercises and examples, especially in the earlier chapters are all computational, without any analysis involved. Data are mainly from made-up list of numbers which are not meaningful. Applications of the methods are not also based on real life. And when there could be some opportunity for analysis, the exercises remain very mechanical. One example would be number 9 in Exercise 6.2.2 that involves the table on employment status by gender. Instead of asking for the conditional probabilities, the book could have asked more thought-provoking questions like "is there a difference between gender in terms of employment status?".

Pagoso and Montano

In one exercise given under contingency tests, the data (in tabular form) is not even appropriate for a chi-square test. In the examples given, one gets the impression that the sample size is determined as a fixed proportion/percentage of the population (e.g. 10%, 20%).

Pagoso, Garcia and de Leon

The book does not give enough exercises and answers to the few exercise given in the book.

Reyes

In Chapter 3, Graphical Presentation of Data, the author provided many examples of graphs but the author should have been more careful in constructing the graphs presented in the book.

Sta. Maria

There are also erroneous illustrations and exercises. An example is computing correlation coefficient of two variables using two independent samples. This exercise asks the students to apply the three methods to compute the correlation between math scores of male freshmen and female freshmen from a random sample of 25 male freshmen and another 25 female freshmen.

Zamora

On pages 213-216, Exercise Nos. 4 – 6 and on page 221, Exercise No. 10 did not state the assumption regarding the population variances. Are the variances assumed equal or unequal? Note that the solutions to the exercises are dependent on these assumptions.

The example given on page 81 shows that *64% of the scores are below 9* in the data set 1, 2, 5, 6, 7, 8, 8, 9, 10, 10. Suppose I change the value 9 with 8. Thus, the data set now is 1, 2, 5, 6, 7, 8, 8, 8, 10, 10. The 64th percentile is now 8. Following the given definition, I will now interpret the value as *64% of the scores are below 8*. This interpretation is now incorrect since only the values 1, 2, 5, 6, and 7 are below 8. What I would like to point out is to define percentile as a value to which a specified fraction or percentage of the observations in a given data set are less than or equal to it.

G. Some books are full of typographical errors – some examplesBirion

If a population distribution has a mean μ and a standard deviation σ then as the sample size increases the sampling distribution of the mean drawn from this population approaches a normal distribution with a mean μ and a standard deviation σ . (p. 147 second to last sentence of first paragraph) The standard deviation of the sampling distribution of the mean

should be $\frac{\sigma}{\sqrt{n}}$.

Febre

The book contains many errors, some minor and others serious. An example of a minor but critical one is on page 7, 1.7.b $X_1^2 + Y_2^2 + X_3^2 + X_4^2 + X_5^2$ should be written as $X_1^2 + X_2^2 + X_3^2 + X_4^2 + X_5^2$

Monzon-Ybañez

Incorrect functional form of a normal probability distribution was given (c.f. p148).

Nocon

Aside from the typographical errors that occur very frequently, the sentences are poorly constructed resulting in convoluted meanings. Examples of typographical errors: both figures on page 74 are labeled “Figure 5.1 Positively Skewed Distribution” when in fact the figure on

the right should be labeled "Figure 5.2 Negatively Skewed Distribution. The total of the proportions in Table 3.6 should be 1.0 instead of 1,000 (page 35). There should be 6.25% of students taking a secretarial course, not 26.62%.

Pagoso and Montaña

In various pages, δ^2 for population variance and \bar{X} or population mean. The following are used interchangeably throughout the book: N and n , S^2 and s^2 , \bar{X} and \bar{x} , Z and z

Pagoso, Garcia and de Leon

The book suffers for some typos, which though few, are crucial, like missing decimal points or wrong subscripts. For students following the procedures like cookbook recipes, such errors can be confusing, to say the least.

Reyes

Another shortcoming of this book is that, while it contains a wide array of useful statistical techniques, it also contains a wide array of errors. The types of errors range from the innocent typographical errors to vague definition of terms and even up to totally confusing discussion of certain statistical concepts. The author did not even bother to check some of the computations. For example, the author presented the relative frequency distribution of the test scores of a group of 93 high school students in p.15. The relative frequency of one class with 7 observations was erroneously reported as .03. The class before this has the same frequency but the reported relative frequency is correct this time at .08. Our poor college students will be so confused to observe two classes with the same frequency but different relative frequencies.

Sta. Maria

Formulas are not properly arranged and symbols, notations and terms are not properly aligned. Upper case and lower case notations are not distinguished. Typo errors of text may not change the concept but typo errors in math formula can change the concept entirely. For example, The formula for the normal probability distribution is wrong. The table they called normal-curve areas give wrong values.

Zamora

There are many typographical errors in this book that are critical to the learning process. An example: on page 199, in the solution of Example 2, a given information $\mu = 1.525$ meters $\sigma = 0.10$ meters should be $\mu_0 = 1.525$ meters $s = 0.10$ meters. On page 83, D_I should be D_i . On page 87, the computed value of D_6 should be 76.08 and not 78.45.

Appendix 2 Committee Members

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