

## IMPROVED AND EXPANDED TEACHING OF STATISTICS IN THE PHILIPPINES

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### Introduction

As a solution for one problem may also alleviate another some overlapping in the following text is unavoidable. Care has been taken to minimize this by first describing the situation in terms of (1) degree programs, (2) applied statistics courses in tertiary education, (3) statistics in high school and (4) equipment and service. In part two we propose measures for improvement and expansions following as much as possible these same four areas. As clearly financial aspects have implications in most areas, a special note about these is added at the end.

### 1. Situation

#### 1.1 Degree programs in statistics

1.11 Bachelor's degree. The Bachelor degree in statistics is offered primarily at the University of the Philippines in Diliman, Quezon City, Metro Manila (UP Diliman) and at the University of the Philippines in Los Banos (UPLB) which is about 60 km South of Manila. Both of them have good academic levels. Among those who tried recently to increase the teaching of statistics we have the De La Salle University (DLSU) in Manila and the Ateneo de Manila University in Quezon City, Metro Manila. De La Salle University has been trying to add a statistics major or stream to its program of Applied Mathematics, but so far there is only one candidate.

1.12 Master's Degree. Here we are even more limited and the main schools are again the Universities of the Philippines in Diliman and Los Banos. We are happy to state that also for this degree the academic level is very good.

1.13 Doctoral Program. Although the University of the Philippines had a Ph.D. program for a long time, lately nobody was graduating. More, except for a temporary visiting professor, no faculty member, including the chair, had a Ph.D. degree. A consortium was planned by the four major schools (Universities of the Philippines in Diliman and Los Banos, Ateneo de Manila and De La Salle University). The two government schools (UP Diliman and UPLB) who are the strongest (among the weak) in terms of faculty and finances concluded that they can do it alone and they have now a consortium for a Ph.D. program in statistics.

1.14 General. In general we can state that we have few candidates for degrees in statistics in a small number of schools with a too limited staff but with a very good academic level.

## 1.2 Applied Statistics in Tertiary Education

1.21 Areas and Quantity. On the Bachelor's level some students have a course in applied statistics in areas such as psychology, economics etc. On the Master's level, however, we have a **very large number** of students taking up applied statistics in a wide range of fields such as education, psychology, sociology, business administration, economics etc.

1.22 Academic Quality and Content. Although the level depends of course on the kind of school, we can state that in general the **academic level** of these applied statistics courses on both the Bachelor's and Master's level is **low**.

The curriculum includes most often topics as descriptive statistics, Pearson correlation, chi-square, t-test with often a one-way analysis of variance and seldom an idea of analysis of covariance.

### 1.23 Problems.

- a. *Students*. The students are often rather **weak** in elementary mathematics and understanding of statistical concepts. They say "mathematics is my Waterloo", but if you teach practically without any mathematics, then they have a hard time with the concepts. A very difficult concept for them is probability (be it head and tails of a coin, lotteries, etc.).
- b. *Faculty*. Many instructors were hired for their computational skills and still tend to put too much emphasis on **calculations** and not enough on concepts. Many have **limited understanding** of what is higher than the t-test. If they have access to a computer, they may use it just "to verify the calculations done first by hand".
- c. *Advisors*. Thesis advisors often do not pay enough attention to the **research design**. Most understandably they frequently have difficulties finding an appropriate statistical tool for a particular case. It also happens more than once that an advisor does not like to have a student, even upon recommendation from others, propose a test which he/she does not know.

## 1.3 Statistics in High School

1.31 Year level and Curriculum. Statistics exists as an optional course for one term in the last year of high school. (Remember that in the Philippines we have only four years of high school after a regular six-year elementary school program or a total of 10 years.) The curriculum covers mainly descriptive statistics and may extend up to the Pearson correlation.

1.32 How many schools teach statistics? As no one could give me any figures on how many high schools teach statistics I gave a questionnaire to

the participants of the annual meeting of the Mathematics Society of the Philippines. Without entering here in the details of the different questions and the clerical problems we had with the distribution, we can conclude that with the exception of very small number of better schools, **almost no schools** teach statistics on the secondary level.

1.33 Problems. Generally the teachers do not favor it. They are already weak in mathematics and have no training to teach statistics. Further, they do not see the reasons why it should be taught.

#### 1.4 Equipment and Services for Statistical Analysis

1.41 Major Universities. Most of the top 10 universities have a mainframe or minicomputer as well as a few or up to about 100 micros. These mainframe and/or minicomputers are most likely to be used primarily for administrative purposes and not for statistical applications. Even at these universities, students still have difficulties in getting their data analyzed. As an example I can mention that at one of these top universities they found no better solution for a factor analysis than to send the data to another continent. Besides being time consuming this is extremely expensive when you consider Philippine salaries.

1.42 Most Universities and Colleges. The overwhelming majority will have at the most a few small microcomputers. They are used primarily for some introductory programming classes and their possibilities to perform statistical analyses are very limited.

#### 1.43 Data Analysis Centers.

a. *Commercial Centers*. There are several commercial data analysis centers in Metro Manila but they are geared primarily to the business sector which has jobs that return regularly with only minor variations. Using mainframe computers (and not familiar with statistics) they are not interested in one-time statistical jobs such as theses or dissertations and charge prohibitive rates. We should mention here the national computer center which is run by the government but accepts jobs for a fee just as the commercial centers.

b. *Private, non-profit Centers*. I know only of one place where they are specifically geared to statistical analysis for theses, dissertations and research studies. It is the **Statistical Analysis for Research (STAR)** at the De La Salle University in Manila. It started begin 1979 before most people had heard about micros (and even fewer had seen one) upon the recommendation of Andrew Gonzales, Ph.D., FSC, who is the actual president of the same De La Salle University. The setup is in line with what was recommended during the 1979 Biannual meeting of the International Statistical Institute (ISI) in Manila. It uses a statistical package written by this author. Besides the normal file features it contains a very extensive series of statistical applications from descriptive over non-parametric statistics to a very flexible stepwise regression program. It is menu driven with sufficient explanations and error checks so that secretaries without statistical or computer background can easily run it. For multivariate statistics it uses BMDP subprograms. A special sub-

program was made so that the secretaries can use the regular STAR file program and have the BMDP commands made automatically. As this author uses his package, is present when the secretaries use it and listens to the comments of students and faculty he has been able to update and continuously improve his programs during all these years.

Among the users we have, of course, students and faculty of De La Salle University but also people of other schools in Metro Manila, even some from the provinces. As it is non-profit it can only break even or lose money. Refusing commercial projects which pay well and working for low-paid faculty and non-paid students while the equipment comes from overseas, STAR has had a large deficit from the beginning (which is carried totally by this author). We are most happy though to have a center which enjoys an undisputed reputation and where students, faculty and researchers can go for low cost but high quality statistical analysis.

- c. *Analyses done "by a friend"*. Some students with more access to micro-computers may find somewhere a statistical package or write a program to perform a data analysis for a friend. The little experience we have so far is not totally encouraging in terms of program quality, choice of statistics and correctness of data entry. These kind of analyses will increase but most likely they will also improve. On the other hand this will remain limited as it is done primarily among students of more or less the same year level in between their regular course work, is limited by the statistics they studied and after a while they move out of the system.

## 2. Ways of Improvement and Expansion

### 2.1 Degree Programs in Statistics

As the main problem is the shortage of faculty we should have more Ph.D. holders who can and are willing to teach in the Philippines. While there is a need for training students, we have to admit that, as is most areas, there are quite a few highly qualified statisticians in the country and even more abroad. A main problem is that education is so poorly paid. Industry pays much better (and salaries in developed countries are of course still much higher). With the country in such a severe economic slump and a tradition of poorly paid teachers, there is absolutely no hope that this will improve much in the near future. Maybe we can hope that international funding agencies will alter a bit their method of helping and will not just pay for the studies of a person but mainly **support the effective service of Ph.D. holders in a developing country.**

To increase the number of candidates we can organize several local activities which are relatively simple. This will become even easier once we have more professors and more places where statistics are offered.

### 2.2 Applied Statistics in Tertiary Education

2.21 Students. As it is a generally established educational fact that students perform better in a subject if they have mastery of the prerequi-

sites, I think that preparing the students for a course in statistics is extremely useful. During all the previous years (from grade 1 on) their mathematics classes were generally on a very low level, problem solving skills were not taught (and even in language classes they could not develop thinking skills as these activities were easily considered subversive under Marcos' martial law). Therefore, better **problem solving and thinking development** activities from grade one on will be most useful.

It is most appropriate to check if the students have a sufficient mastery of elementary mathematical functions as fractions, squaring, square root etc. as well as a basic understanding of such concepts as probability etc.

2.22 Faculty. Here a reorientation of faculty is called for. The people who had sufficient skills to teach the computational aspects of statistics can most likely be taught to teach also the concepts, use more real life data, have a creative use of microcomputers etc. I think that **in-service seminars** and continued contact through a **newsletter/journal** will be sufficient for this.

2.23 Advisors. Maybe we can tell thesis advisors that it is not a crime not to lack full understanding of the wide range of statistical procedures which are now available to their advisees with the advent of microcomputers and that it is all right to **send their advisees to a statistical consultant**. On the other hand we would like them to look more carefully at the **hypothesis, research design, data gathering**, etc. otherwise we have the "junk in, junk out" problem. Here again **seminars** and continued contact with a **newsletter/journal** will be effective and sufficient to greatly improve the situation.

### 2.3 High School Statistics

Although not all the aspects are unique for the Philippines I do mention nevertheless a few which should receive special attention.

2.31 Curriculum. It might be good to add and/or to ensure sufficient emphasis on aspects as:

- graphs, including two-variable plots with detection of outliers.
- concepts as:
  - proportion, mean, median
  - spreading, variance and standard deviation
  - probability (which is very difficult for them)
- data: in general: as much as possible **real life data** (with the understanding that sometimes a concept can be made very clear using simple data), preferably data that were collected by the students. It would be appropriate to pay special attention to the importance of **careful observation, exact coding**, examination of data collected by others, newspaper data etc.

Note: several of these aspects could be included in other subjects such as sciences, etc.



**2.32 Students.** It would be most appropriate to explain them the increasing importance of statistics in a world with information explosion, including considerations as where data are given, where more data are needed, how to cope with them to obtain meaningful information, interpretation etc.

**2.33 Teachers.** We will have to train teachers in elementary statistics during their Bachelor's studies. Besides motivating them to study it, we will have the task of convincing the professional organizations, the administrators of the colleges and the Bureau of Higher Education that it is most appropriate to adapt the teacher training program. We could assist in these by continuing the active participation in the Mathematics Society of the Philippines, the mathematics teachers association (to both of which I belong) and the personal contacts with the Bureau of Higher Education and the Minister of Education herself.

#### **2.4 Equipment and Services for Statistical Analyses**

**2.41 Equipment.** The number of computers is likely to increase slowly. With the actual budgetary problems schools cannot buy as much as they would wish, but with their commitment to updating I am sure they are trying to obtain at least some micros.

**2.42 Software.** As all real programmers know, quality software takes a great amount of time to develop and is, therefore, expensive. If people in developed countries are tempted to copy software, how much more in poorer countries where, with their low salaries, software costs are so often prohibitive? This is even more so if there are no local laws which forbid this.

In Singapore a bill has been introduced and in Hong Kong a group of people started an action against copying. I tried to start something against the copying of programs in the Philippines, but there is not the slightest appearance of success – or even sympathy. I wonder if companies would not agree to sell their software at a cost adapted to average salaries or gross national product per capita. Then at least they would have something for their efforts and the buyer would pay an amount corresponding to the number of working hours as in a developed country.

**2.43 Data Analysis Centers.** As the commercial centers are much too expensive and the system of analyses done "by a friend" is no sufficient solution, I could perhaps expand the services of "Statistical Assistance for Research" (STAR). It would be possible to hire more staff (but then I would also need an extra computer). I am also thinking at finding people who can do something in the same line in the centers of the two other major parts of the country: Cebu for the Visayas (in the middle) and Davao for Mindanao (in the south). Together with Manila for Luzon (northern part) we could help quite a bit. It will not be easy though to find people who are willing to invest in a non-profit system modeled after my money losing STAR.

### 3. General Financial Considerations

As financial aspects have an affect on so many aspects, I group them here somewhat. I would like to note however that I do not deal here with the question "how much" financial aid there should be, but "how to distribute" the meager resources.

#### 3.1 Faculty

A main need for development is developed people. Now money is often given to Ph.D. students in the hope that they will teach afterwards in his/her country. It needs no proof here to state that so many do not work in their country but are now in developed nations and, if they work in their country, they are most often in non-educational institutions. We realize the low salary problem. Could we not shift from support for a degree to **support for effective teaching?** I.e. instead of giving to a person who might teach, support her/him who for years has been teaching, is involved in seminars on and off campus, is active in professional organizations, etc. This could be given as e.g. a **salary complement, transportation support for home leave** with extra studies every 3 years. This would have the advantage that the money is given only to those who **effectively work** in the developing country and who, as regular faculty members fall under the normal supervision of the university. It is also by far more effective than occasionally paying transportation and full home salary for a visiting professor who returns before he/she is acquainted with the different conditions and almost surely before there is an adaptation to the new culture.

#### 3.2 Hardware and Software

Making clones and copying software even if local laws do not forbid it is not an adequate answer to a low income problem. I wonder if arrangements could not be made; e.g. the hardware company could sell the original core of its product, e.g. the ROM Bios, at a fair price and let the buyer in the third world country add the other parts from different brands. In the software world, the company could sell its products at a cost reflecting the average buying power of the people so that the company would receive a fair amount where now they receive nothing.

#### 3.3 Seminars/In-Service Training

As mentioned in 2.22 and 2.23 (about faculty/advisors and applied statistics), seminars are asked for to help teachers and advisors to adjust to the new orientation, develop new skills, etc. We had a series of seminars in this line. I taught in most of them from 1979 to 1983. They were quite successful (though a bit too short). We have now more experience, new content and we have also more than enough new participants (plus the previous ones who need now some updating). The financial assistance could consist of partial support for room and board, transportation of the speaker, eventually also honorarium and assistance for the handouts and other materials.

It is with the intention of promoting statistics education that in 1984 I started the **Statistics Education Center (SEC)**. It followed the recommendations of the ISI-sponsored round table conference of August 20-23, 1984 in Canberra, Australia. The goals are in line with these of the "Centre for Teaching Statistics" at Sheffield, U.K. (but the activities are still in infancy stage). Here we see again how little local scholars spend for journals etc. So far I have spent personally about \$750 (with the journal SEC info taking up the large part) while the total receipts (mainly for the subscriptions, including the not yet published issues) is not even 8.5%.

### 3.4 Local Publications

We definitely will need new textbooks for **statistics in high schools**. In most cases an author cannot have a decent royalty to compensate for his efforts because the high school textbooks have to be sold at a very low price. Financial support would be most appropriate.

At the tertiary level the textbook problem is not so great, as it is easier to use foreign books. It should be noted though that the principle of "real life data" is not equally well implemented when you use a book of another continent. Also, it will not be so culturally adapted. (See also last paragraph of 3.3 above concerning another local publication: SEC info).

### 3.5 Books

While many universities may receive sample copies free from a publishing company in the hope that the faculty may recommend them as textbooks for their classes, this does not happen in the Philippines. Not only is this kind of motivation not present in third world countries because of the high costs involved, but the companies of developed countries may even fear that their complementary book will just be copied when it is put in the library. Some U.S. university libraries remove regularly old books from their shelves and a group of universities in the Philippines (including the various Ateneos and De La Salle schools) work together to pick them up and pay for the shipment. We are happy with this. To have new books though, we still pay the full price. Perhaps faculty could mail us books received without strings attached if they are of a kind where there are already enough in the library. Also they could inform the library acquisition that if duplicates arrive (which happens with some frequency), they could forward one overseas. I am most thankful to the person who sent already a whole series of books to our "Statistics Education Center" (SEC). (He did not even charge me for the postage!)

### 3.6 Periodicals and Memberships

While local periodicals and membership are normally not very expensive for university professors, their content is of course reflective of their low price. Foreign periodicals became prohibitive for so many universities two years ago with the new economic crisis. While we realize that library copies are sold at higher cost because they will be read by more people, in most places in the Philippines they will normally be read at the most by one faculty member. The companies charge also much more for overseas desti-



nations. (To the best of my knowledge the difference is higher than the difference in postage; there are different requirements though for the wrapping.)

Several professional organizations have a "student membership rate." As they do not lose on it, I wonder if it could be the regular rate for people in third world countries (with an adaptation for the extra postage). I would like to mention here most thankfully that the International Statistical Institute (ISI) gives a 50% discount to the members in developing countries.

#### 4. Resume

With some shortcuts and limitations as well as the risk of being too incomplete we can try to list the following as a short resume of the main problems and possible solutions towards improvement and expansion of teaching statistics in the Philippines:

##### *1. Degree Programs.*

Needed are: faculty for teaching, involvement in seminars and leadership in professional organizations.

Assistance could be given to faculty effectively teaching in the developing countries. (See 1.1, 2.1 and 3.1)

##### *2. Applied Statistics in Tertiary Education*

Needed are: updating of curriculum and teaching methods, inservice training of teachers and advisors, primarily through seminars and newsletter/journal.

Assistance could be given for seminars (mainly local transportation of speaker(s) and handouts) and publication of newsletter/journal.

##### *3. High School Statistics*

Needed are: motivation of mathematics teachers, adapted directives from the Ministry of Education, new manuals, training of faculty (during bachelor's studies)

Assistance for writing textbooks would be most appropriate.

##### *4. General (but primarily for nos. 1 and 2)*

Needed are: adapted pricing system for hardware, software, memberships in professional organization and updated books.

Assistance could be given for purchasing of hardware, software. Forwarding of new books would be most appropriate. Reduced cost of memberships in professional organizations is hoped For.

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