AN EVALUATION OF THE STATISTICAL METHODS USED BY BUSINESS RESEARCHERS IN SOUTH AFRICAN PUBLICATIONS

Gary D. Sharp, Warren J. Brettenny, Chantelle M. Clohessy and Catherine G. Logie
Nelson Mandela Metropolitan University, Port Elizabeth, South Africa
gary.sharp@nmmu.ac.za

Statistical training to service disciplines is common practice at tertiary institutions. In South Africa, training is generally restricted to under-graduate, first-year level commonly found in introductory texts. This is typical for service courses offered to students enrolled in the commercial based disciplines of management and economics. This research investigates the manner in which statistical methods have changed business related publications in South Africa and compares this to the curriculum currently on offer to students. A suggestion for future training and content design is considered.

INTRODUCTION

The demand for statistically trained expertise has been emphasized by many over the last decade. In South Africa this has been a point of discussion for many Presidential addresses of the South African Statistical Association (SASA). In 2009, at the International Statistical Institute's (ISI) conference in Durban, the President of South Africa, President Jacob Zuma, informed the audience of the importance of statistical expertise and the challenges faced to ensure solutions that benefit the nation are found. The constant clamour for expertise is based on the demand for evidence-based decision making and the availability of data and software packages which can run analytical routines to allow for inferential interpretation.

The majority of South African tertiary institutions have Statistics Departments which provide statistical training at under- and post-graduate level. Many departments are under resourced, yet continue to perform optimally as a result of the dedication of the staff and support from colleagues within the community. This study provides evidence-based support for Statistics Departments who are looking to revise their curriculums to align with the needs of current demands.

LITERATURE REVIEW

The use or more accurately the misuse of statistical techniques has been a cause of concern for many years. These concerns have been expressed by many; refer to Altman and Bland (1991), Garfield (1995) or Boshoff (2005) who identify the domains of medicine and business research as areas requiring statistical training. International evidence on how statistical expertise has changed the content of publications in various disciplines abounds. Much evidence has been provided in the medical journals. This evidence dates back to the eighties when Emerson, Graham and Colditz (1983) were trying to identify the most frequently used statistical techniques in publications of the New England Journal of Medicine (NEJM). This line of assessment was followed over the years by Donoho, Donoho and Gasko (1986), Altman and Bland (1991), Francis, Spencer and Fry (1998) through to the more recent evidence of Switzer and Horton (2007) and Strasak, Zaman, Marinell, Pfeiffer and Ulmer (2007).

In South Africa, research into the statistical skills of graduates began with Wegner (1983), Juritz, Money, Affleck-Graves and du Toit (1988), Wegner, Stray and Naude (1993) and was investigated more recently by Sharp, Logie and Tait (2008) and Ndou (2011). These lists are by no means exhaustive and provide a sample of the many studies undertaken over the last thirty years. What is clear from the literature is that there is indisputable evidence that statistical knowledge is required for persons who use quantitative methods to support their theories. Gone are the days when a few basic descriptive techniques will suffice, the necessity for advanced inferential procedures is growing.

EVIDENCE-BASED ANALYSIS AND DISCUSSION

The exploratory study of Sharp et al. (2008) was a result of the plenary address of Boshoff (2005) who addressed researchers in the business domain on how to get their research published.

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The emphasis of the presentation was the necessity for statistical support to validate their theories. The research in 2008 was exploratory and evaluated the statistical component of publications in a reputable South African business journal, the South African Journal of Business Management. It was noticed that authors were not always forthcoming in the descriptions of the statistical component of the publication. Whether this was an oversight or lack of editorial review is unclear, however it provides opportunity for criticism of the research, criticism which is avoidable. The methodology followed classifying the statistical techniques used in 125 research papers in the periods 1984-1985 and 2004-2005. The twenty year span was deemed satisfactory to identify whether or not the frequency of use of the techniques had changed. The conclusions of Sharp et al. (2008) were that:

- The level of sophistication of the statistical method had increased with time. As an example, the percentage of articles with no statistical component had declined from 46% to 21%, a statistically significant decrease.
- Business researchers should improve their statistical skills base.
- Business students would benefit from additional statistical training, more than the typical service course currently offered.

These conclusions were validated by Ndou (2011) who extended the exploratory nature of the study by increasing the time frame of the assessments and increasing the number of journals assessed. In all, Ndou (2011) evaluated the statistical component of four reputable business journals within South Africa. The journals evaluated were Acta Commercii, the South African Journal of Economic and Management Sciences (SAJEMS), the African Finance Journal (AFJ) and Management Dynamics. The period assessed in this study were grouped into two year periods with five year intervals; 1992-1993, 1997-1998, 2001-2002 and 2006-2007. In all, fourteen categories were identified, many following the original work of Switzer and Horton (2007). The classified categories were; no statistics, basic descriptive statistics, basic parametric inferential statistics, correlation, contingency tables, general non-parametric tests, dimension reducing methods, regression methods, analysis of variance, multiple comparisons, time series techniques, simulation methods, optimization and other advanced methods. These categories are by no means exhaustive, but provided a foundation for classifying the method used in the research papers. The findings of the research were:

- The statistical techniques in business research publications had changed over time.
- The more frequently used techniques were specific to the journal focus.
- Statistical techniques used in publications are not reflective of what is taught at tertiary level.
- Tertiary institutions should look to re-design the offerings to business students and in particular should include additional courses with advanced level statistical methods.

These findings are not hugely dissimilar to the recommendations of Wegner (1983) and Juritz et al. (1988) except that the level of complexity has changed. The methodologies followed in the research studies differed, survey instruments versus empirical assessments of publications. Despite the different methodologies, the conclusions showed a remarkable similarity, quantitative training at higher levels is required.

CURRICULUM REVISION

Given the findings of the previous South African studies, the question to be answered is "*what content should be reflected in courses offered to business students*"? There is no one size fits all answer to this question. As Ndou (2011) reports, some techniques are specific to the focus of the journal. However it is evident that the existing curriculum, which includes typical service level content, is inadequate. The typical service level content includes descriptive techniques, both graphical and numerical and follows this with a brief introduction to probability based on frequency counts. The majority of courses conclude with basic inferential statistics using a simple linear regression equation and the hypothesis testing of differences between two means. In many

cases, these courses are assessed using multiple choice questionnaires, limiting the practical training for the students. Unfortunately for those who seek to publish their research, this training is inadequate. Mid-to-advanced level knowledge is required to publish and understand what other researchers are doing. The fourteen classification categories used in Sharp et al. (2008) and Ndou (2011) included techniques earlier defined. The classification of the categories was based on the researchers' personal experiences and the categories defined by Strasak et al. (2007).

The current service level courses are suitable for introductory courses. However the demand for training at a mid-to-advanced level includes the following statistical methods and the interpretations thereof:

- Applied multiple regression (including categorical variables).
- Contingency tables.
- Small sample, nonparametric testing.
- Analysis of Variance (ANOVA), analysis of covariance (ANCOVA) and multivariate analysis of variance (MANOVA).
- Multiple comparison testing.
- Data reduction methods, exploratory and confirmatory factor analysis.

Ndou (2011) provides evidence of strong support for the growing demand for these techniques. A structured applied second year level statistics course could include many, if not all of these techniques. The emphasis of the curriculum would be on application based training, as the mathematical content would not be suitable for students enrolled in business studies. Rather the input of data, data cleaning and coding, computational assessment and interpretation would form the core of the content.

There is also evidence to support additional methods; these include simulation based analysis, missing data imputations, structural equation modelling, optimization methods, time series analysis and other less frequently used techniques. It is unlikely that one could include all these topics in an applied second year level course. These courses could be reserved for short learning programs, or advanced application based courses at graduate level. The advances made in time series analysis, could be reserved for a single application based module at graduate level. The findings of this study clearly indicate a need for these courses, especially for students who intend to pursue research based degrees at the masters and doctoral level.

CONCLUSION

Statistics Departments, who have the capacity, should be looking to exploit this gap in the demand for expertise. Structured courses with emphasis on application based training provide an opportunity for growth within the discipline and growth in terms of student participation. Within the higher education system of South Africa there is pressure to improve pass rates, increase student enrollments and improve the research skills of future graduates.

Statisticians are uniquely placed to benefit from these pressures; student enrollments can be increased. What is required, is that we, the statistics community, embark on marketing the discipline, we look to add to the curriculum mix currently on offer, and we coax university management and other departments within a university to allow and encourage students to enroll for courses above the service level. This is not an easy undertaking; the mindset for many institutions is that statistics is a course which students need at elementary level, but no further. This thinking needs to be changed, especially given the pressure to increase research output. Statistics Departments need to argue that statistical training has the long-term benefit in that those adequately trained will be able to produce more publishable research, they will not be beholden to a few applied statisticians waiting for them to come knocking on their door. They will be able to focus on their discipline specific research and use the statistical techniques to support their findings.

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