Student Opinions and Expectations vs. Reality of Grading: Use of Cluster Profiling in Statistics Education

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1. Introduction

Segmentation serves as a powerful marketing tool in business environment and is widely applied to student population as well. However, it seems to be rarely used in research on statistics education. The contemporary research in this field appears to be primarily focused on the intertwined issues of syllabi development (Davies et al., 2002), quantitative literacy (Schield, 2002; Moreno, 2002), as well as changes in approaches to teaching and course administration procedures due to rapid new developments in information and telecommunications technology (Bregar et al., 2000; Cobb, 2002).

Although in general students benefit from modern ITT-supported teaching and administration, it is not particularly emphasized in the literature that these benefits could be unevenly spread among students because of their differing acceptance of ITT-supported teaching and administration. A study of students' attitudes towards the course on Business Statistics taught at the University of Ljubljana's Faculty of Economics to second year students conducted in 2003 dealt with this topic in detail (Ograjenšek and Bavdaž, 2003). Data collected in a survey were analysed with the help of cluster analysis and the assumption of student heterogeneity was confirmed by identifying three notably different groups of students.

In this paper, this initial segmentation of students is further amended by profiling the clusters with a set of new variables including grades. With such an integral analysis the teachers should gain important new insights facilitating custom-tailored curricular approaches and activities for different groups of students. Whether these insights can be acted upon remains open to discussion.

2. Initial Study: Summary of Results

Our initial study was conducted among the full-time second-year students of Business Statistics at the University of Ljubljana's Faculty of Economics. The convenience sample (students who attended the last lecture prior to Christmas vacation) included 274 units (which represent slightly more than 50% of the whole population).

An exploratory multivariate analysis (the hierarchical cluster analysis) was used to investigate the collected data. The analysis was based on variables that examined different aspects of the pedagogic process in the framework of the course on Business Statistics as observed from the viewpoint of our students:

- Students' evaluation of/opinion on the difficulty, attractiveness and usefulness of a particular pedagogic activity, i.e. lectures, tutorials, and the computer lab seminar. The variables were measured on a 7-point scale (with –3 standing either for "not difficult",

"not attractive" or "not useful" and +3 standing either for "difficult", "attractive" or "useful").

- Students' attendance of the non-obligatory lectures and tutorials.
- Students' expectations regarding their final grade.

On the basis of squared Euclidean distances and Ward's cluster method, three clear clusters of students emerged: "enthusiasts" (n=58), "critical selectors" (n=65), and "the reluctant" (n=32). The rest of the students (n=119) were excluded from the cluster analysis due to the problem of missing values dispersed across the variables. However, the good news was that the mean values (or percentage structures where applicable) of this "excluded" student group were within the bounds of the global average. The "excluded" seemed to be quite similar to the "critical selectors" who were placed between the "enthusiasts" and "the reluctant". On the basis of this check-up we therefore concluded that the listwise exclusion as described above did not pose severe limitations on our results.

As stated in the introductory section, the results confirmed our assumption of students' non-homogeneity with regard to acceptance of ITT-supported teaching and course administration. Three notably different groups of students could be identified:

- the "enthusiasts" that found all types of pedagogic and support activities most demanding, most interesting and most useful;
- the "reluctant" that were at the opposite end compared to the "enthusiasts": very critical, not interested, valuing all types of pedagogic and support activities as neither interesting nor helpful;
- the "critical selectors" who placed themselves in the middle – sometimes quite similar to the "enthusiasts" and sometimes to the "reluctant".

Because it turned out that students are in fact differently inclined to accept the ITT-induced changes in teaching and course administration, we suggested that the best pedagogic approach would be to custom-tailor different ITT-supported activities according to students' computer and web literacy levels, abilities, and interest in statistics. Given the present level of resources (only three teachers available for a group of around five hundred full-time students), however, this is not a suggestion that could be easily implemented in the near future.

3.   Student Opinions and Expectations vs. Reality of Grading: Preliminary Findings

In order to deepen our investigation, we decided to amend the initial results as summarised in the previous section with further profiling of identified clusters using their final exam grades for the course on Business Statistics as well as selected other variables. These variables can be grouped as follows:

- Students' grades (where 6 indicates a pass and 10 the highest possible grade).
- Number of students' attempts to pass the exam (students are allowed to take an exam more than once during a single academic year).
- Dates of students' examinations (students usually have six possible dates of examination within one academic year).

If only one indicator should be selected to measure students' achievement, then students' final grade would be chosen. However, the analysis can be enriched by additional information: e.g. how fast the students fulfilled the requirements of the course and achieved a passing grade, whether they needed more than one trial to pass the exam, etc. Additionally, we decided to take into account all examinations within two subsequent academic years – the academic year during which the survey was carried out (2002/2003) and the next academic year (2003/2004).

Although we would gladly report huge differences among the pre-identified clusters with regard to students' academic achievements, our preliminary results do not support this hypothesis. The average final grade is almost identical in all three clusters. There exists only a slight indication that the "enthusiasts" on average needed more attempts to pass the exam than the "critical selectors", and that these needed more attempts than the "reluctant".

From the viewpoint of the time dimension, however, the results tell another story: among those students who successfully passed the final exam (within the observed period of two academic years) the "critical selectors" were the fastest. They have the highest percentage of those who achieved a passing grade on the first possible examination date and the lowest percentage of those who were not done with this exam within the same academic year. The "reluctant" were much slower: they have the lowest percentage of those who passed the exam in the same academic year, and also the lowest percentage in the whole period of observation.

In order to shed more light on these results, we added students' achievements in their first statistical course (Introductory Statistics) taught in the second semester of the first year of study. The course covers basic descriptive statistics, bivariate regression analysis and introduction to time series analysis. A passing grade in this course is a necessary prerequisite to take the exam in Business Statistics.

A quick review of academic results for Introductory Statistics shows that the average final grade is again almost identical in all three clusters. There is only a slight indication that the "critical selectors" and the "enthusiasts" on average needed more attempts to pass the exam than the "reluctant". On the other hand, the time dimension analysis reveals that "the reluctant" had committed their original sin in the first year when they failed either to take the exam in Introductory Statistics or to pass it. As a consequence, less "reluctant" than members of the other two clusters fulfilled the requirement of passing the exam in Introductory Statistics when enrolling into the course on Business Statistics. This, in turn, probably highly influenced their motivation as well as ability to actively participate in pedagogic activities in the framework of the course on Business Statistics (lectures, tutorials, obligatory computer lab seminar).

4. Discussion

In view of the results described in the previous section our suggestion of custom-tailoring the ITT-supported activities to different student segments made in the introduction seems like a complete waste of resources. This, however, holds only at a first glance and without additional background information.

At a second glance a need to administratively and pedagogically bundle both statistics courses students are obliged to take at the undergraduate level becomes evident especially given the fact that an increasingly larger group of students manages to avoid taking exam in Business Statistics prior to starting their senior year of the undergraduate studies. Making use of the gap in the system that allows students to carry over one exam into the next academic year, many "reluctant" students choose Introductory Statistics as the first, and Business Statistics as the next exam to be dealt with at a conveniently later date. In the most paradox of cases, some students even finish their thesis prior to passing the exam on Business Statistics.

Stating this, it needs to be pointed out that ITT-supported internal course administration should make it possible to monitor inidivuals' progress and enable early identification of potentially "reluctant" students prone to postpone the statistics exams indefinitely.

As for the other two groups of students, the fact that evaluation of their progress is not continuous but takes place at the end in the form of a written exam (with a set of multiple and another set of open questions) probably could be identified as the key reason for their overwhelming similarity. Unfortunately, at present continuous monitoring and evaluation of progress is not feasible, again due to the fact that only three teachers are available for a group of around five hundred full-time students.

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RÉSUMÉ

Les opinions et les attentes des étudiants vis-à-vis de la realité des notes: l'analyse de profil des conglomérats dans l'éducation de la statistique

L'article apporte les premiers résultats de l'analyse de profil des conglomérats pour les étudiants de la statistique en gestion. Les conglomérats sont formés sur la base des données d'une enquête et ils sont décrits par des variables différentes, y comprises des notes.