The Importance of Mathematics Tests in the State University of Campinas General Admission Test for Students Applying for Engineering Courses

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Abstra ct: *We analys e the abilit ies necess ary to solve admiss ion test math questi ons for studen ts applyi ng for engine ering course s at State Univer sity of Campin as. Admiss ion test result s and subseq uent underg raduate grades were signif icantly correl ated up to 1994, when math test scores weight were increa sed twofol d.*

Introd uction

Since 1987, the State University of Campinas - regarded as one of Brazil's best universities - develops the admission tests for its undergraduation courses. In the present days, the admission examination tests are divided in two stages: The *first stage examination* is composed of an essay (worth 50% of the score) and twelve written questions (scoring the other 50%). The examinees that obtain the best scores in this first stage are selected for the second and final examination stage, which takes place about one month later. The *second stage examination* is composed of eight subject tests, made of twelve written questions each. The evaluated subjects in the second stage are mathematics, physics, chemistry, biology, geography, history, Portuguese (language and literature), and a foreign language. According to the current admission system, all examinees applying for undergraduate courses must take all tests, but in the second stage their raw scores are scaled differently, according to the specific course they apply to.

The examinee's skills in different subjects and the importance of such skills for a proper selection of students applying for different undergraduate courses have been and are still at issue in the present days. Many professors of exact sciences have complained about the proportions at which the essay scores and the scores of the various subject tests are scaled, specially the mathematics scores. On one side, stand those who consider that the Engineering applicants should be the students who are better skilled in exact sciences (and specially in mathematics), and who believe that the current admission system does not select the best mathematics skilled students. On the other side, stand the professors who believe in the modern theories for multiple intelligence, arguing that the professional profile needed for the work market today is that of a professional able to learn a diversified set of disciplines and also skilled in communication.

Up to 1994, the Admission Examination tests were scored as follows:

Table 1: Stage I scoring u p to 1994. The genera l question s are as f ollow: 2 m athematics questi ons, 2 phy sics quest ions, 2 bi ology ques tions, 2 chemis try questi ons, 2 his tory quest ions and 2 Geogra phy questi ons.

12 gen eral quest ions	+	an ess ay
(40%)		**(60%)**

Table 2: Stage I I scores u p to 1994. Each Stag e II sub ject test is compose d of 12 wr itten ques tions.

math test score	**+ phys ics** test score	**+ chem istry** test score	**+ biol ogy** test score
+ Portug uese test score	**+ fore ign langua ge** test score	**+ hist ory** test score	**+ geog raphy** test score

Table 3: Examine e's Final Score up t o 1994

$$\textbf{Final Score} = \frac{2(\textbf{Stage I score}) + (\textbf{Stage II scores})}{10}$$

It was then objected that such admission system did not properly select physics and engineering students, for it attributed excessive importance to the essay. So in 1995 some changes took place: in Stage I examination, the essay score was reduced from 60 to 50%, and the general questions started to determine 50 instead of 40% of Stage I final score. In Stage II examination, the *subject priority policy* was introduced. This new policy stated that the applicant's scores would

be scaled according to the course priorities. For example, engineering applicants would now have both their Stage II mathematics and physics test scores double scaled.

From 1995 on, the new scoring changed to:

Table 4: Stage I scoring from 1995 and on. The general questions are the same as table 1.

12 general questions	+	an essay
(50%)		**(50%)**

Table 5: Stage II scores from 1995 and on. Each Stage II subject test is composed of 12 written questions.

2 X math test score	**2 X + physics** test score	**+ chemistry** test score	**+ biology** test score
+ Portuguese test score	**+ foreign language** test score	**+ history** test score	**+ geography** test score

Table 6: Examine e's Final Score from 1995 and on

$$\textbf{Final Score} = \frac{2(\textbf{Stage I score}) + (\textbf{Stage II scores})}{12}$$

The present study describes a research on engineering student's undergraduate performance and its relation to their math scores in the admission test, either before and after the *subject priority policy* was stated. We hope it is a useful contribution to the educational programs for university admission examinations.

Sample

The 70 students selected for the electrical engineering course in the year 1995 composed the researched sample. They were the first 70 students selected using the *subject priority policy*.

Out of the former 1500 applicants, 650 were selected for the Stage II Tests, and seventy were effectively enrolled. These seventy students are among the 190 students who achieved the highest scores. It is common for high school students to apply for many different universities/ colleges, and the best applicants are usually admitted in more than one. This explains why 190 students had to be called before 70 were effectively enrolled. Such procedure is quite common, even at Unicamp, considered to have the best Engineering courses in the last 14 years.

Analysis

As a whole, there are 14 mathematics questions at the admission examination test for UNICAMP: two written questions in Stage I and 12 written questions in Stage II. The Stage I written questions are considered easy, and in Stage II, about 25% of the written questions are easy and about 25% are regarded as difficult questions.

It was observed that all electrical engineering students enrolled in 1995 had answered correctly the two mathematics questions in Stage I. Not much reasoning is necessary to answer correctly the Stage I questions, which means the enrolled students were basically skilled in mathematics.

Most applicants (87%) answered correctly the Stage II four easier tests, based mainly in algorithm solving. The remaining and more complex eight mathematics tests can give us some more information about the enrolled student's specific skills

The questions concern the common contents of Brazilian subjects taught in high school, including analytical geometry, combinatory analysis, matrixes, trigonometry, complex numbers, logarithms, graphics, etc. Solving these questions doesn't take long, but it requires mathematical reasoning and knowledge, creativity and some brainwork. Most difficulties were found: (1) in tests on geometry and trigonometry and (2) in combinatory analysis. It was also observed that the higher the degree of creativity required, the greater the difficulty level of the test, which suggests that a lot of work has to be done in order to improve the high school teaching of mathematics, a remark that occurs frequently on the subject.

Up to 1994, there used to be some correlation between the math test scores and the student's performance scores (At UNICAMP, a standard score, known as CR measures the undergraduate student performance): 0.47. In 1995, this relation was drastically reduced (to 0.1), which is below any statistical significance, showing that no correlation can be established.

Final Comments

The democratic access to universities is often at issue in the Brazilian government and media. It is very common to hear that the students who attend the public universities in Brazil belong to a privileged cultural and economical elite, formed of students who could, for example, afford private junior high and high schools, and also afford to study in schools specialised specifically in preparing for the admission examinations. Yet, such point of view does not seem to give much importance to the country's unfair social structure, ignoring that the quality of the given education, either public or private, is the greatest responsible for student's admission at the top Brazilian universities. At UNICAMP, for instance, 45.8% of the enrolled electrical engineering students attending evening classes had studied at technical public high schools, which in Brazil are schools that offer an excellent high school education.

Our analysis reveals that several elements, besides the quality of junior high and high school

education, affect the performance of students in their undergraduate studies. These elements are the way the undergraduate courses are organised and structured, the complexity of such courses, and the way the students deal with a growing demand of independence, responsibility and discipline.

The junior high and high school mathematical education also affects the future engineer's learning process. Such previous education is often based only in mechanical algorithm-solving exercises. Yet, we believe it is essential to stimulate the student's creativity in mathematical learning, from elementary school up to the undergraduation courses. Creativity is a skill that can and must be stimulated, something which can only be achieved in qualified schools, either private or public. In the Brazilian situation, great efforts still need to be done in order to improve the quality of education in elementary, junior high and high schools, as it is also necessary to stimulate educational programs that will bring up creative students and creative professionals.

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