

**ПРИНЦИПЫ ФОРМИРОВАНИЯ КОНТИНГЕНТА СТУДЕНТОВ
ИНЖЕНЕРНЫХ СПЕЦИАЛЬНОСТЕЙ В БЕЛЬГИЙСКИХ
УНИВЕРСИТЕТАХ**

В представленной статье обсуждается качество отбора кандидатов с помощью вступительного экзамена по математике на инженерных специальностях бельгийских университетов.

С помощью статистического анализа результатов, полученных за более чем десятилетний период на факультете прикладных наук Гентского университета (Бельгия), автор – ректор названного университета – делает вывод об эффективности и целесообразности использования вступительного экзамена для формирования контингента студентов.

In diesem Artikel wird die Qualitaet der Auswahl von Studienplatzbewerbern in den Ingenieur-technischen Fachrichtungen der Universitaeten Belgiens mittels der Aufnahmepruefung in Mathematik eroertert. Im Artikel wird die statistische Analyse der Ergebnisse, die an der Fakultaaet fuer angewandte Wissenschaften der Universitaet in Gent im Laufe von 10 Jahren durchgefuehrt wurden, eingeschaazt. Anhand herbeigefuehrten statistischen Angaben zieht der Autor – Rektor dieser Universitaet den Schluss von der Nuetzlichkeit und Zweckmaessigkeit der Aufnahmepruefung fuer die Gestaltung des Kontingents der Studenten.

Abstract

The present contribution discusses the quality of the selection realized by the admission examination to university engineering studies in Belgium. From a quantitative analysis of the results of over ten years at the Faculty of Applied Sciences of the University of Gent, the author concludes that the admission policy may be considered to be fair and efficient.

1. University engineering education in Belgium

Belgium is a bilingual country: in the Northern part, called Flanders, the language is Dutch; in the Southern part, called Wallonia, the language is French. Education, including university education, is not organized by the federal government of Belgium, but it is the responsibility of the regional government and the regional Parliament. In Flanders there are three universities with Engineering Faculties: the University of Gent, the Free University of Brussels and the Catholic University of Leuven.

In Belgium the academic engineering education is organized at general universities, and not as in many other European countries, in separate technical universities. The faculty which is responsible for engineering education is called the Faculty of Applied Sciences (the name could also be translated by Faculty of Engineering). The engineering studies take five years. The first two years are common for all engineering students (except for architectural engineering). During the last three years the students have to choose a particular field. Besides architecture, the following options exist: civil engineering, ship building, electrical engineering, mechanical engineering, mining, chemical engineering, materials engineering, textile engineering, engineering physics¹.

All students who obtain the diploma of general secondary education have the right to be admitted to the university; they are entitled to choose freely their own field of study, and moreover they are free to go to the university of their own choice. This freedom of choice is a very fundamental principle in the Belgian educational system. There is only one exception: to be admitted to engineering studies a student has to pass an admission examination. The selectivity characteristics of this examination are discussed in the present paper.

2. General comments on the admission examination to engineering studies

The admission examination to engineering studies has a long tradition. It is a generally accepted exception to the freedom of choice for the student, because engineering studies require specific knowledge and talents, which can be tested much easier than for other fields. The admission examination is made obligatory by the law on university education. The contents of the examination is determined by a common decision of the three Flemish universities which have an engineering faculty. A student who successfully passes the examination at one of the universities, is entitled to be admitted to the engineering faculty at any of the other universities. The subjects of the examination are restricted to mathematics: geometry, calculus, algebra, trigonometry, numerical techniques. There are several reasons for this: mathematics is very important in engineering studies, and mathematics is a basic subject, with a uniform contents, in secondary school education.

The objective of the admission examination is to realize a selection of the candidates in such a way that

- students who are considered not to have a chance to be successful in the engineering studies, are not admitted to the studies;
- there is a sufficient guarantee that students who are admitted to the studies have the required aptitude and knowledge.

A fortunate consequence of the admission examination is that the student population in the Faculty of Engineering is more motivated than the average student

¹ For historical reasons all graduates from the Faculty of Engineering are called *civil engineer*, such as *civil engineer in electronics*.

population, and that the success ratio of the students during their university studies in the engineering faculty is significantly higher than the university average, although engineering is generally considered to belong to the more difficult university studies.

It is essential to monitor the quality of the selection process, and in particular to find criteria to judge to what extent the objectives of the admission examination are realized. In the present paper a report is given on an analysis of the predictive value of the admission examination to engineering studies carried out on results relating to a period of more than ten years.

3. Characterization of the quality of the selection process

It is not easy and straightforward to test whether the selection of students realized by the admission examination is such that as exactly as possible the applicants who have the required qualifications are admitted. Since the selection process can never be perfect it is to be preferred to admit some students who do not have the qualifications rather than to reject suitable students. It is the author's conviction that the statistical correlation between the results obtained in the admission examination and the results obtained in the engineering studies is not a right indicator for the quality of the selection process. Indeed if a student obtains a mark of 60 % for the admission examination and a mark of 80 % for the examinations in his engineering studies and another student obtains respectively marks of 80 % and 60 %, then the correlation is affected unfavorably, but this is certainly no indication for an insufficient selectivity of the admission examination. Indeed the purpose of this examination is not to classify the candidates, but to distinguish between suitable and unsuitable candidates. Another obvious problem is that the "inverse" experiment is not possible, in the sense that it is impossible to know the results the rejected candidates would have obtained if they would have been admitted to the engineering study². It should also be emphasized that not only sufficient talent and knowledge (which are tested by the examination) are essential for a successful study, but also other qualities such as perseverance, good study method,..., are important. A perfect prediction of the future performance of the students by means of the results of an admission examination is hence certainly not possible.

An indicator which in the author's opinion makes much sense is the comparison of the results in the engineering study between the candidates which are admitted with a result comfortably above the threshold and the candidates with a result barely above the threshold. The analysis is restricted to the consideration of the results in the examinations of the first year of the engineering study since it is well known that almost all students who fail in the engineering study, fail in the first year³.

² However an experiment in the sense of the inverse experiment is described at the end of the next section.

³ An analysis of the results of the students over the complete engineering curriculum confirms the conclusions of the present report.

4. Main analysis

For a better understanding of the analysis below, a brief sketch is given first of the practical aspects of the process of the evaluation of the students as well in the admission examination as in the examinations of the first year of the engineering curriculum. The admission examination consists of five tests on various topics of mathematics. The candidate should obtain an average result of at least 55 %, and a result of at least 50 % for each test, although the examination committee may accept students which do not completely satisfy the requirement for some part of the examination. The examination takes place in July (first session), and the unsuccessful candidates can take the examination again in September (second session). The "marginally" admitted candidates are hence those which are admitted in the second session with a result close to the threshold of 55 %. The examinations of the first engineering year are organized in the same way. Students unsuccessful in the first year examinations can resume the study the next year.

The quality of the selectivity of the admission examination is therefore analysed by dividing the first year engineering students into categories according to their result in the admission examination (success in the first or the second session; average result between 55 % and 62 %, between 62 % and 68 %, between 68 % and 78 %, between 78 % and 86 %, and more than 86 %). For each category the total number of students⁴ is counted and the number which successfully complete the examinations of the first engineering year in the first session or in the second session.

The results are summarized in Table I (for the students who passed the admission examination in the first session) and in Table 2 (for the students who passed the admission examination in the second session). Table 3 and Table 4 repeat the results of Table I and Table 2 respectively, but with relative numbers of students passing the examinations. These statistics refer to the first year engineering students at the University of Gent from

result in admission examination	number of students successful in first session	number of students successful in second session	total number of participating students
less than 62 %	103	77	282
62 % to 68 %	174	111	435
68 % to 78 %	369	138	653
78 % to 86 %	227	43	295
more than 86 %	106	7	116
Total	983	376	1781

Table 1: Number of successful students in the first engineering year who passed the admission examination in the first session

⁴ Actually not all first year students are included. Students who passed the admission examination at another university are not taken into consideration, and also not the students who study the first year for the second time.

result in admission examination	number of students successful in first session	number of students successful in second session	total number of participating students
less than 62 %	35	45	229
62 % to 68 %	55	55	243
68 % to 78 %	73	48	204
78 % to 86 %	12	5	23
more than 86 %	0	0	0
Total	185	153	702

Table 2: Number of successful students in the first engineering year who passed the admission examination in the second session

result in admission examination	success ratio in first session	success ratio in second session	success ratio in both sessions
less than 62 %	36.52 %	27.30 %	63.83 %
62 % to 68 %	40.00 %	26.52 %	65.52 %
68 % to 78 %	56.51 %	21.13 %	77.64 %
78 % to 86 %	76.95 %	14.58 %	91.53 %
more than 86 %	91.38 %	6.03 %	97.41 %
Total	55.19 %	21.11 %	76.31 %

Table 3: Success ratio in the first engineering year for students who passed the admission examination in the first session

result in admission examination	success ratio in first session	success ratio in second session	success ratio in both sessions
less than 62 %	15.28 %	19.65 %	34.93 %
62 % to 68 %	22.63 %	22.63 %	45.27 %
68 % to 78 %	35.78 %	23.53 %	59.31 %
78 % to 86 %	52.17 %	21.74 %	73.91 %
more than 86 %	–	–	–
Total	26.35 %	21.79 %	48.15 %

Table 4: Success ratio in the first engineering year for students who passed the admission examination in the second session

the academic year 1981-1982 to the academic year 1991-1992. Note that the cumulative number of students successfully passing the first year examinations is 1797 on a total of 2483, or a success ratio of 68.34 %.

From these statistics the following conclusions are derived:

- Students who pass the admission examination in the first session, even with a low score, have at least an average chance to pass the first year examinations successfully.
- Students who fail in the admission examination in the first session but pass in the second session with a more than moderate score, have also a more than average chance of passing the first year examinations successfully. Probably this group concerns students who are suitable for the engineering study, but who did not prepare the examinations of the first session well enough.
- Students who fail in the admission examination in the first session and pass in the second session with a low score, have a much reduced chance of passing the first year examinations.

These considerations support the quality of the selectivity of the admission examination. They show that there is a high probability that candidates who do not pass the admission examination, would not pass the examinations of the first year engineering study.

These conclusions are further confirmed by some additional more detailed analysis. For the three academic years⁵ 1989-1990 to 1991-1992 the category of students who passed the admission examination with a result in the range from 55 % to 62 % in the second session is further split up into the range from 55 % to 58 % and the range from 58 % to 62 %. The remarkable result is that in these three years 13 students passed the admission examination with a result between 55 % and 58 % in the second session; none of them passed the examinations of the first year engineering studies, neither in the first, nor in the second session.

Another interesting indication on the satisfactory selectivity of the admission examination is given by the following observation. For the students who did not pass the admission examination in the second session in 1985 an analysis was made of their study results in other study programs. In particular 12 students started mathematics or physics (where the requirements in the first year are more or less the same as in the first year engineering study). Of these 12 students only 1 passed the first year examinations successfully.

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⁵ Only these years are considered because the results are available on a computer database.