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Statistics Education on computer for Economists – past, present and future⁴

In today's accelerated socio-economic environment, it is essential for professionals who base and make economic and financial decisions to be aware of the multiplicity of data and the enormous amount of information that can be obtained from them. It is an important expectation from economists to read statistical tables, to draw conclusion from the diagrams, and to interpret the relationship of indicators. The technical change in the curriculum and education led to the transformation of the conduct of the examination. We introduce you how on our BSc course with the largest number of students the efficiency changed as the time progressed, and how much it influenced the drop-out-rate.

Keywords: education, development, efficiency

Introduction

At the Budapest Business School – now a university, formerly a college – from the academic year of 2013/14 we gradually started to teach the subjects Statistics I and Statistics II on computers. First we introduced this method for Master's degree courses, then we gradually changed the education of Bachelor's degree classes as well.

To facilitate the theoretical knowledge of the students and to create the technical background, the teachers of the university published a new textbook and a series

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of examples for Statistics I in 2013; for Statistics I–II, an electronic curriculum was prepared in 2014, which includes audio material, exercises and test questions.

Due to changes in the subject, the number of classes increased from three to four per week, and the lectures take place weekly instead of every second week. However, the number of practical lessons remained unchanged. During the semester, the change in computer capacities made it possible in the seminars to solve more and more examples using Microsoft Office Excel instead of the traditional paper and calculator. Currently the education of students at the faculty of Economics Informatics takes place in computer rooms, using Excel (Except General Statistics I and II).

Today's students basically "grew up with electronic devices in their hands" and learn statistics after completing Computer Science, so we can assume that using the computer does not cause any problems for them. Our study reveals how the acceptance and effectiveness of computer usage was developed at various faculties.

The technical change in the curriculum and education led to the transformation of the conduct of the examination. Students enrolled in computer education give an account of their theoretical knowledge through an electronic system, where teachers have compiled a questionnaire of approximately 1,000 questions. To implement the example solutions, we created paper based tutorials and prepared Excel files. The computing technicians of the university prepare the security coding for the tests.

We introduce you how on our BSc course with the largest number of students the efficiency changed as the time progressed, and how much it influenced the drop-out-rate. Then we would like to describe the results of our Master's Degree students. Next, we outline the new educational and accountability structure of the new educational system that is to be introduced in the future.

BSc

The highest number of students were enrolled to the BSc course at the Faculty of Finance and Accountancy of the University.

Full time training

The majority of students in the undergraduate classes attend a full time course, where they must complete several basic classes, including Statistics I.

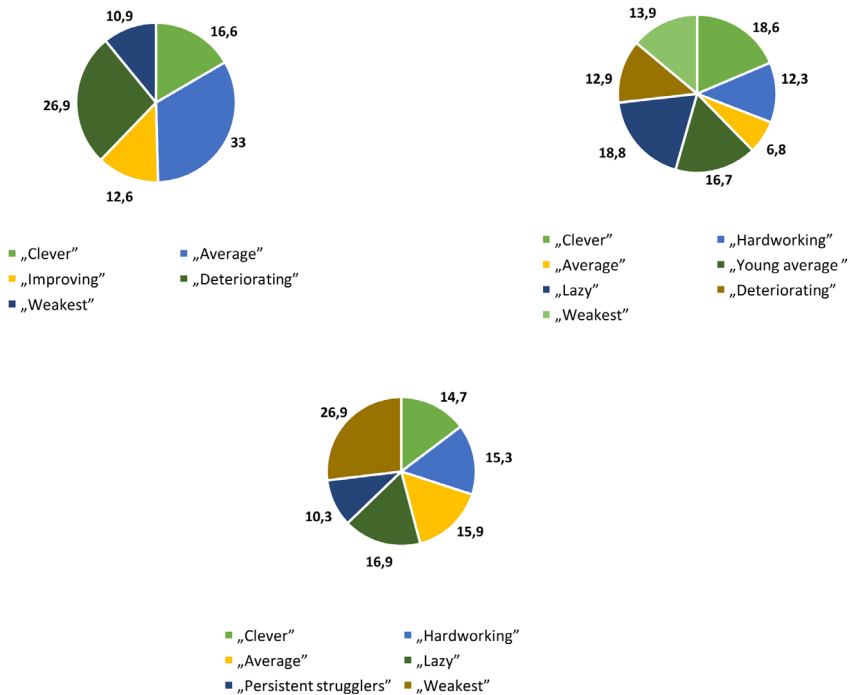
STATISTICS I – THE SUBJECT

During the period under review (between the first semester of 2011/12 and the second semester of 2016/17), we investigated the students' performance in the subject Statistics I in the autumn semesters.

Nearly 80–90% of the students wrote both mid-year closed exams, which are opportunities to get a practical mark for a semester, but only three quarters of them, or even fewer, completed this task in the second semesters of 2014/15 and 2015/16.

In the first three academic years, other data were available for full-time students (eg. sex, age, type of secondary school, maturity subjects, levels and their results, whether they took intermediate or advanced exams, language skills [number of languages, language exams degree]), but in many cases the three databases can not be compared as the criteria of the students are not the same for each period. Taking into consideration not only the information of the students' performance of the subjects, but also other factors, we divided them into clusters in our previous studies (1) as follows (*Figure 1*).

Figure 1: *Distribution of full-time students of the subject Statistics 1 at the closed exams in 2011/12; 2012/13 and 2013/14 II. terms, percentage (%)*

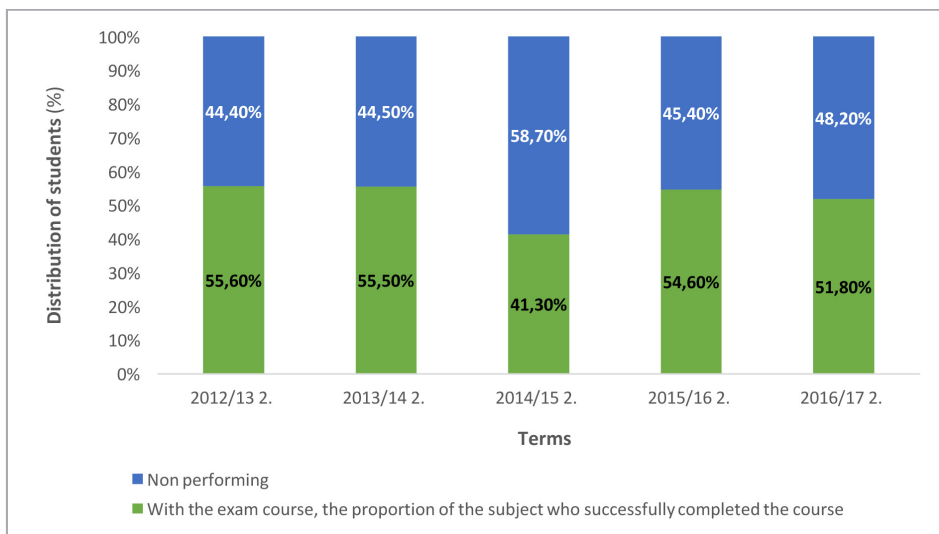


Seeing the data on the first two graphs, the students were still studying the subject on paper. In the 2013/14 academic year, they studied every two weeks in computer rooms and in the tests the interpretations of Excel outputs appeared. However, there are relatively slight differences in the results.

The group called “Clever” – in all cases below 20% – are those students who have done well in high school and have the best marks at the Statistics I course. One, and perhaps the most important feature of these students is the advanced maturity exam in Mathematics and its effect, which seems to improve their performance in Statistics I. The least performing, the weakest or worsening, is about 30 percent.

From the last full semester without using computers (2012/13 II) to the last exam period, when students are fully trained in the computer environment and give their knowledge of the subject not on paper sheets, we have seen the following results (*Figure 2*).

Figure 2: *Students of the Statistics I. course in 2012/13–2016/17 II. terms, full time training, percentage (%)*



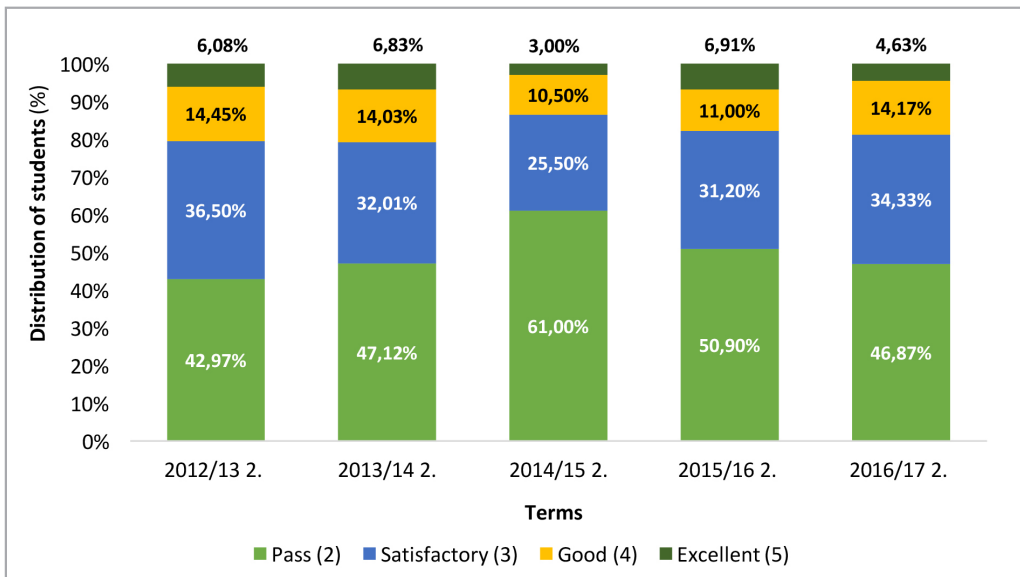
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In BSc education, only a few over half of the students completed the subject Statistics I successfully. The introduction of the computer educational system was a progressively method, so those students who have not succeeded in Statistics I formed a special course and they continued to study in the original way, on paper and with a calculator, with exams in a large classroom. Probably this also contributed to the fact that their

effectiveness was lagging behind their mates'. The “separation” of the non-accomplished ones was later abolished, and the regular courses included those who were already repeating the subject. As a consequence, repeaters can “distract” the performance of students arriving as first graders of the sample curriculum. The non-successful performance of the second semester of 2014/15 is also due to the fact that the new computer-based environment “paralyzed” the students, according to a number of students, and the Excel program was frustrating.

The Statistics I course ends with a practical mark that students can complete by passing two exams at the end of the study period. Continuous learning and practice are essential to successfully finish the subject. *Figure 3* shows the distribution of the grades received.

Figure 3: Rate of students performing the Statistics 1 course by marks in termtime, full time training, in 2012/13–2016/17 II. terms, percentage (%)



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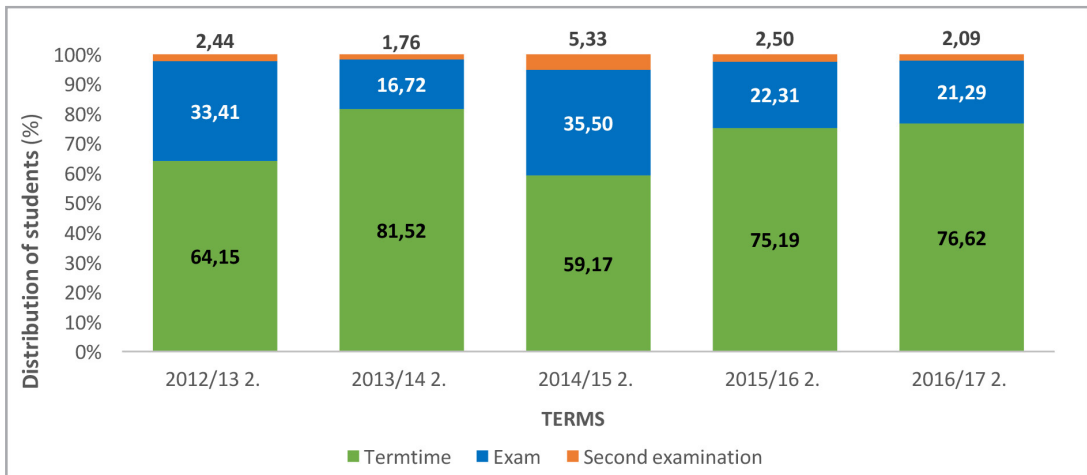
In the “weak” semester mentioned above, students did not only have a low accomplishment, but the results were lagging behind the other examined semesters: there were fewer of better and more of worse grades.

If someone has failed during the study period, there is a possibility of correction in the exam period. Since Statistics II is based on Statistics I, at the beginning of the

next semester students have a final opportunity to pass the subject in the exam course. *Figure 4* shows how this has been achieved in the examined semesters.

In the spring semester of 2014/15, the smallest part of the students completed the subject during the study period. This can be traced back to the above – mentioned reasons – many subject repeaters and high recruitment rates. Problem-solving on a computer is faster, and even in large computer rooms (30–40 people) there is more chance to help a student, and it is more likely for the members of the course to ask the teacher when problems occur. In the last two examined semesters of the study, a mark from the closed exams during the study period was accomplished for more than three quarters of the students. Permanent practice and preparation provide more thorough learning and understanding, than preparing fast for only the tests. This is also reflected by the fact that the results achieved during the exam period and the exam course are significantly weaker than the marks obtained during the study period.

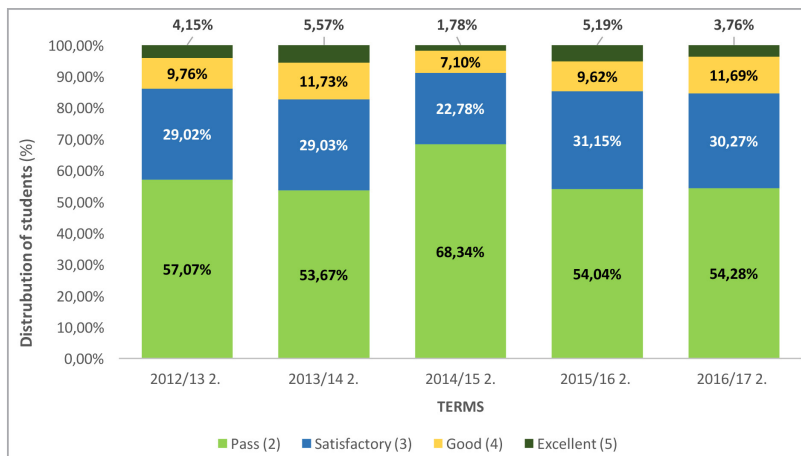
Figure 4: *Distribution of full-time students by the period of accomplishing Statistics I. in 2012/13–2016/17 II. terms, percentage (%)*



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Comparing the *Figures 3* and *5*, it can be seen that during the final performance, the ratio of weaker grades increases further and decreases the better. The correction – with a teacher’s eye – is only for “letting go” of the subject and picking up the next, which is based on it.

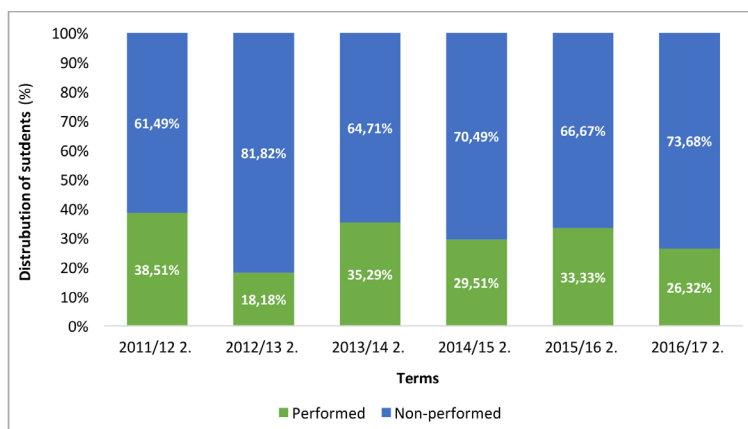
Figure 5: Rate of students performing the Statistics 1 course by final result, full-time course, in 2012/13–2016/17 II. terms, percentage (%)



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On average, more than 95% of the applicants appear in the exam course, not many retreat. However, as illustrated in *Figure 6*, not a very large proportion of students succeed. This probably supports the fact that attending classes, continuous studying, teachers' answers at classes will further deepen the knowledge and provide better preparation for the challenge.

Figure 6: Distribution of students in second exams of Statistics I., full-time courses, in 2012/13–2016/17 II. terms, percentage (%)



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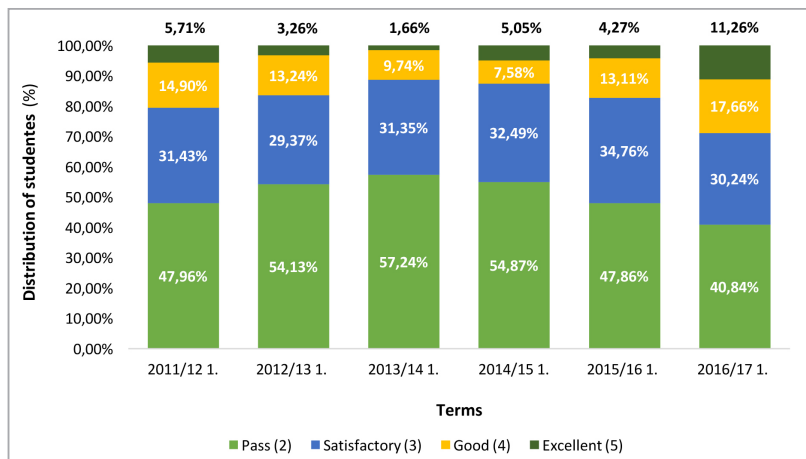
The subject Statistics II is based on the subjects Mathematics II and Statistics I. In the next section of our article, we would like to analyse the efficiency of the courses.

STATISTICS II – THE SUBJECT

According to the curriculum, **Statistics II** takes place in the third semester, but students often take the course later, because they haven't accomplished the criteria before. This assumes a certain amount of experience in learning at a higher educational institution, which makes students more serious when preparing for the exam. The course ends with a colloquium, the participation on contact hours is essential to achieve teachers' signature. Because of absenteeism from the lessons – contrary to the Statistics I study – students are barely receiving a signature refusal. Continuous work on seminars is considered important by most students; in the event of their foreseeable absenteeism, in many cases, the students enter and work on another course.

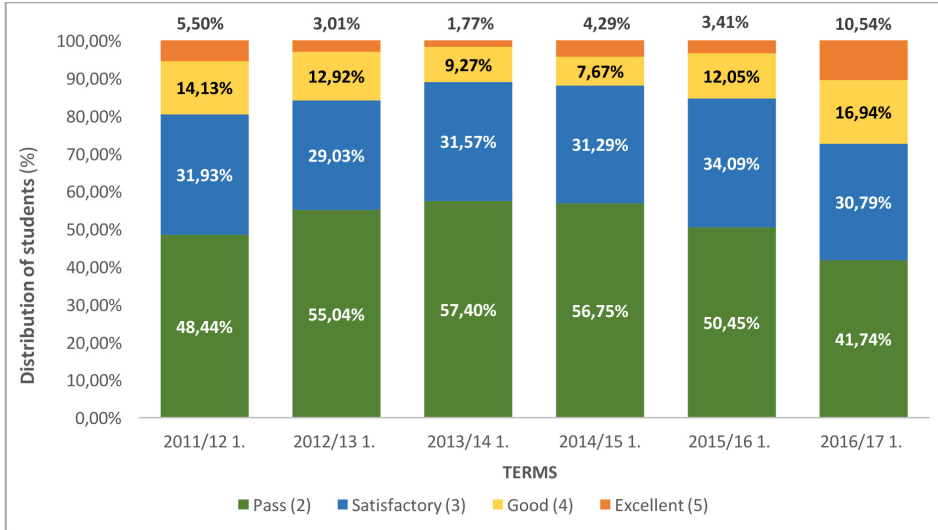
More than 96% of the applicants were present at the exams every year, and about 70% of the students passed in the exam period. In the third third of the examined period – from the first semester of 2015/16 – we introduced a new opportunity. Students can fill tests online on Coospace, which is not an obligatory task, but they can collect some points answering questions about the theoretical curriculum. These tests can be filled twice in a term, and maximum 20 points can be gathered from them (10-10). These points can be added to one's first exam points. From the results it can be seen (*Figure 7*), that this new idea had a motivating effect.

Figure 7: *Statistics II exam results, full time courses, in 2012/13–2016/17 I. terms; percentage (%)*



Significant change was that the proportion of students who just passed dropped below 50% compared to the semester before the introduction of the “Point-Collection”. In the last examined period it hardly exceeded over 40%. Satisfactory marks were achieved every term by almost one third of the students. In the last period more than a quarter of students got the marks good and excellent.

Figure 8: Rate of students performing the Statistics II. course by final results, full time training, in 2012/13– 2016/17 I. terms, percentage (%)



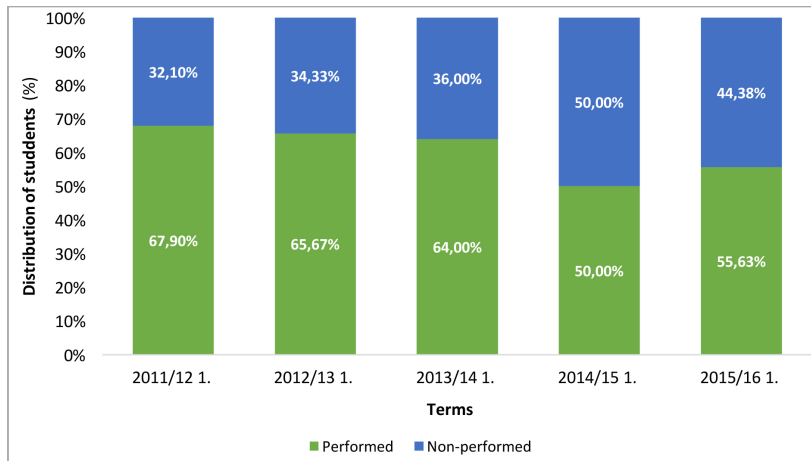
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Compared to the previous figure, *Figure 8* is completed with the exam course results. It shows that the share of weaker marks has increased and the number of the better ones decreased. While 70% of the students complete the course during the exam period, it increases with the exam course to around 75-80%. However, experience shows that two thirds of the candidates in the exam course have accomplished the subject during the first half of the examined period, and only about half of them in the remaining period (*Figure 9*).

Relatively few full-time students attend the lectures of subjects which are the basis for statistics. The most are interested and present at the last lectures of the quarters/semesters when the teachers hold summary lessons of the major topics that may occur during the exams. The nature of the subject would require a reduction in the number of lectures and an increase in the proportion of seminars and practical lessons. This would probably improve deeper and more secure knowledge of the students. However,

the huge number of students (Statistics I: 850–900 people, Statistics II: about 600 people in the examined semesters), the limited number of computer rooms and, in particular, the low number of teachers does not allow this.

Figure 9: *Distribution of students in second exams by Statistics II., full time training, in 2011/12–2015/16 I. Terms*



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Distance learning course

Many people want to get a university degree while working, so it is necessary to set up correspondence courses and distance learning. The contact hours can be visited by students on Friday afternoons and on the Saturdays.

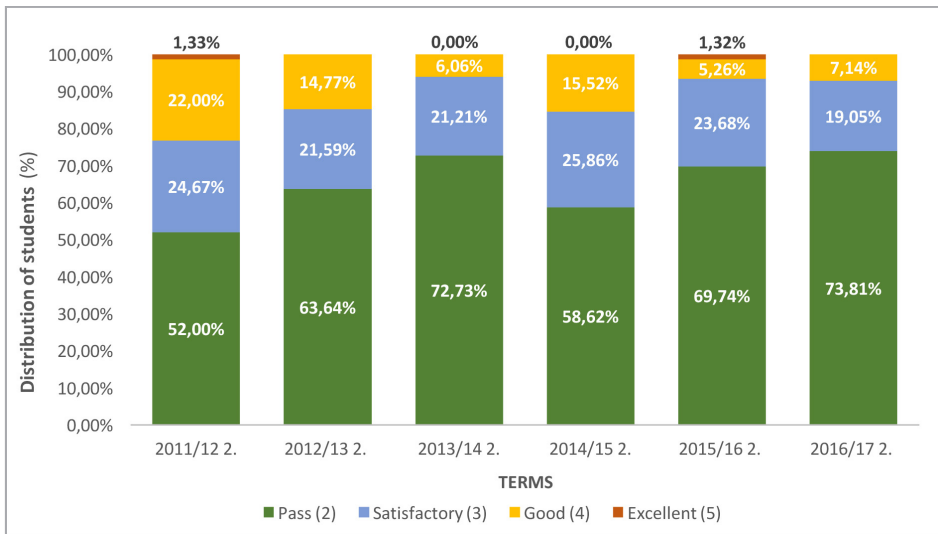
STATISTICS I. SUBJECT

Changes were also made in the distance learning training in Statistics I and II courses. “The credit value of the subject rose from three to four as a result of introducing education with Excel. The number of contact hours remained 16 (4×4), the distribution of which consisted of 12 seminars in classrooms and 4 hours in computer rooms in the 2013/14 academic year. “From the school year of 2014/15 we have also introduced computer-aided education for distance learning. All 16 contact hours are in the computer rooms, and we solve the excersises with Excel.”

Distance learning consultations provide students the opportunity to help home learning through explanations given in the institution, but attending the classes is not

obligatory. Many students try to take part in the lessons, but there are some people who can appear only sometimes, and some can not make it at all. Distance education is basically designed for working adults. We have assumed that many people are working with computers, and therefore Excel-supported task solution will cause few problems. However, compared to full-time students, we have experienced even greater differences in these skills and abilities. *Figure 10* shows the efficiency of **Statistics I** in the period under review.

Figure 10: *Distribution of students performing the Statistics I. course by final result, distance learning course in 2012/13–2016/17 II. terms*



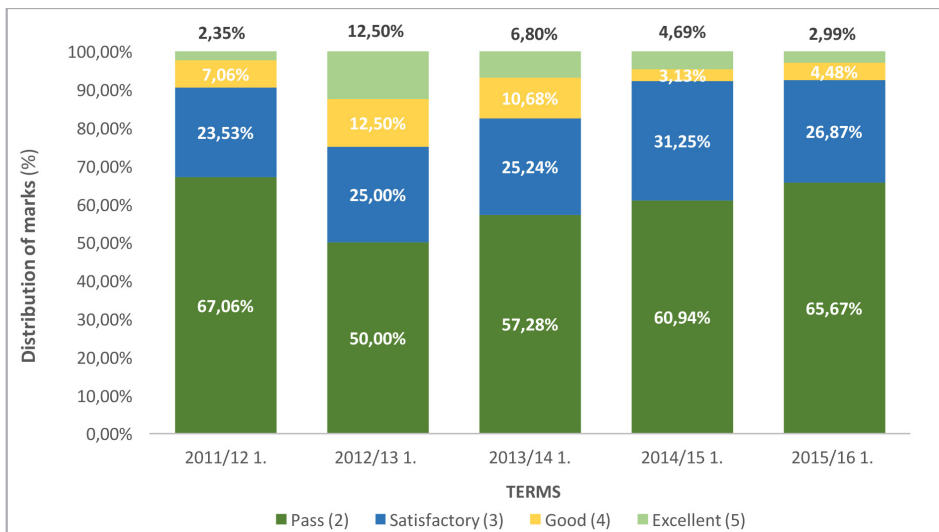
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In 2013/14 – the first semester using Excel – the proportion of students completing the subject dropped dramatically, and the frequency of fails increased compared to the previous semesters. The proportion of those who succeeded in distance learning courses on paper-based exams was higher than in daytime training; computer education and examination turned this situation back. This might be due to the fact that it is easier to learn the curriculum on paper on the basis of the given sample tasks, even if the student has no way of participating in the contact lessons. The lack of knowledge of computer usage can not be replaced by self-education or autodidact, which can be a burden of proper performance on exams. Another reason for the drop-outs may be that the places announced for the exam are not always used by the students, and even 10–20% of the applicants do not appear at the time of the exam.

STATISTICS II

In the case of the subject, the proportion of those passing in each semester was lower than that of full-time students. In the first two semesters using Excel (first terms of 2014/15 and 2015/16), the proportion of succeeding students dropped, but they improved by 6-10 percentage points in the exam courses. By the end of the exam period aided by computers, only 25–30% of the students could pass compared to the “paper age”, when an average 45% completed the subject. In the first semester of 2016/17, the proportion of those performing on the exam showed an improvement, over 40% passed, which is still not a very good result. The results expanded with the grades of the exam course can be found in *Figure 11*.

Figure 11: Rate of the marks of distance learning students in the exam period and exam courses of Statistics II., 2012/13–2016/17 I. terms, percentage (%)



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Compared to the results of the subject Statistics II (*Figure 8*) of full-time students, it can be seen that even in distance education, the proportion of middle-graders is around 25–30%. Better grades are less frequent for those who attend classes on weekends, but the proportion of those who just passed (due to the point-collection for daytime classes) is significantly higher in the last three semesters.

Curriculum/Syllabus

Both full-time and distance students like using the electronic learning material, which includes slides featuring theoretical explanations, examples for Excel and test questions. It would be ideal if students would use it not only before the exams, but continuously to deepen their knowledge.

Failures and drop-outs could be avoided if only those students would get admission to the university who really have interest in the subjects, and have some related experience. During the university admission, the scores of the best maturity exams – with most points - are taken into account. In many cases, mathematics is not included in this selection, because the marks acquired in high school and grades of the maturity exam do not count as the best. As a result, many students do not have the basic knowledge for Mathematics I before Statistics I, and the later subjects based on them, and without the adequate bases failure only accumulates.

Recommendations / Suggestions

Students who apply for economist trainings should be expected to reach a standard level of mathematics during the recruitment process, as without the right basic knowledge, the fulfillment of mathematics and statistics at higher educational institutions – in large proportion – is difficult.

High school graduates arrive to the university with very different levels of knowledge and skills. Differentiated education, catching up would be very important, but under the current educational conditions – it is also physically impossible.

Due to the currently high number of students and low number of educators, frontal methods are predominant in universities. With lower student numbers and more teachers, more practical lessons, consultations, and teamwork could be possible. For example, independent task-solution, student cooperation, project presentation and arguing are becoming more and more important in the labor market, and it would also be increasingly important in public education.

MSc training

From the beginning, the training of statistics is supported by computers. Students from different institutions of higher education have different data-processing experience, and they are able to use Excel's data analysis functions and the SPSS software package.

Future ideas

After introducing the past and the present, we outline the future ideas about the education of Statistics at the Budapest Business School.

In the first semester of 2017/18, a new system of training starts at our university after the review of the subjects. After describing the rearrangement of subjects and materials, we highlight some important changes that affect our department.

The number of Mathematics classes decreases, the teaching of probability theory – previously a full-time semester subject – is involved in the curriculum of Statistics I.

In a relatively new specialisation, the IT economy, General Statistics I–II subjects will also be computer supported.

The subject of students of higher vocational training, which had strong semblance to statistics (later Economic Calculations II., now the Basics of Statistics) was accepted on BSc courses at the application process. Credits for the training could be acknowledged, as the curriculum was similar. Now it is not possible, because a new subject, called Business Analysis contains a minimal level of Statistics on higher vocational training. This course's credits are not accepted on BSc levels, as the curriculum is too different from the university subjects.

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