Final report FEEST

FEedback on Exams for Students and Teachers

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Abstract

A course often ends with a final exam. This exam should test how well a student understands the various topics discussed in the course. An analysis of the work of an individual student, as well as, the the work of the whole class, provides valuable information for the student and for the teacher.

Informed students will be aware of their strong and weak points. For students that passed the course, this can be of importance when starting new courses in which pre-knowledge on topics of the exam is used, and, for those that failed the exam, when they are preparing for the resit.

Informed teachers will not only get a better idea of the quality of the exam, but will also be able to offer better support to students preparing for a resit of the exam.

The goal of the project FEEST is twofold:

- provide teachers with a tool to analyze exams and report this analysis to their students;
- use the analysis of the exam to guide students preparing for a resit of the exam.

This report consists of the following documents

- reportFeest.pdf (document, this report)
- manualFeest.pdf (document)
- manualMailMerge.pdf (document)
- spreadsheetFeest.xlsx (spreadsheet)
- feest.nb (mathematica notebook)

Introduction

The performance of a student on an exam is usually captured by the partial scores he or she obtains. These scores lead to the final grade for the student, and he or she is informed about this grade. Sometimes a student will make use of the opportunity to look into his graded work, but often this does not happen. The information hidden in the partial scores, however, is valuable for the students.

Especially when they are not only provided with the partial scores they obtained in the exam, but also with information on how they performed on the various topics tested in the exam. In this way a student becomes aware of his or her strong and weak points. This can be of importance when he or she starts a new course in which pre-knowledge on topics of the exam is used, and, of course,if he or she has failed the exam, and wants to prepare for the resit.

Also teacher and the educational management can profit from the information hidden in the partial scores of the exam. An analysis of the exam provides them with information on the quality of the test and the various parts of it.

Our tools

We have developed a tool based on a spreadsheet that on input of the partial scores on an exam provides the teacher with an analysis of the exam. This includes a standard item analysis, including p-values as well as rir and rit-values of each individual item.

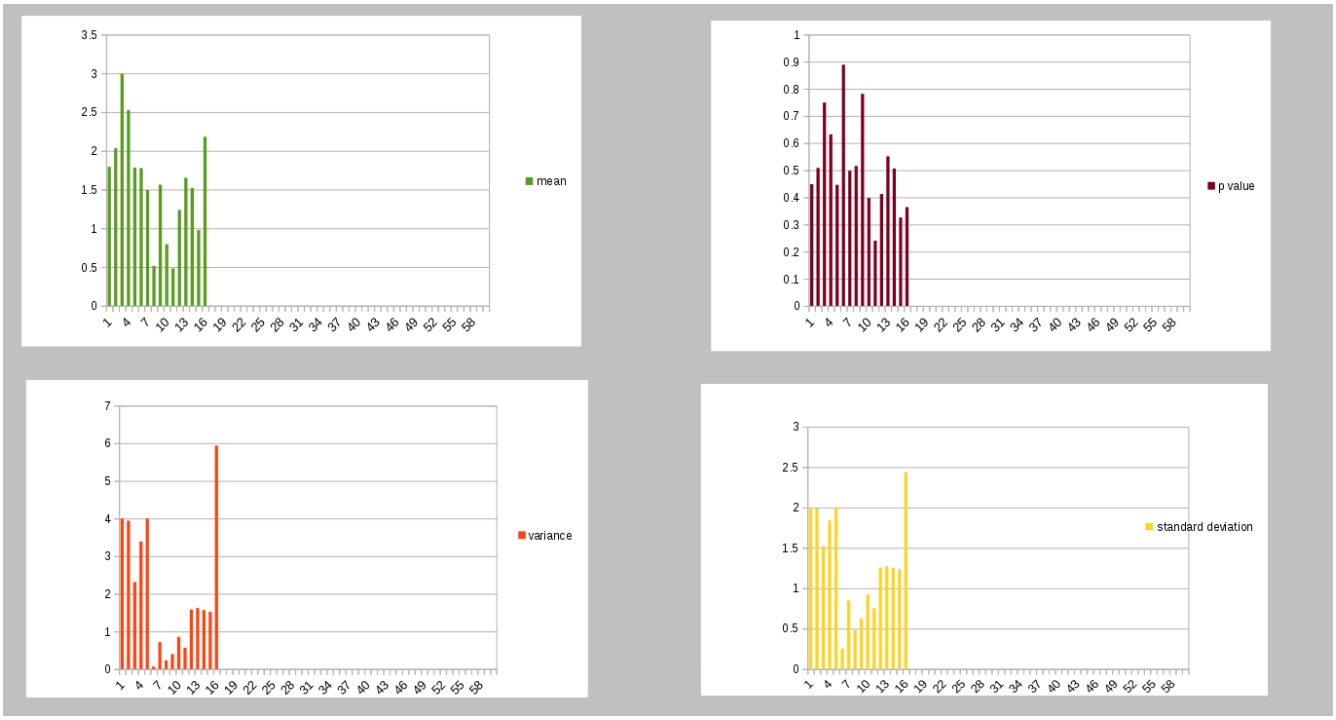


Illustration 1: Analysis of the Test

Moreover, the teacher can divide the various items of the exam into topics. In this way he or she also gets an analysis of the exam with respect to these topics.

Analysis of Exams with Open Questions

Exam	2WBB1							
Date	11/02/15							
Number of students	1523	(maximal 2000)						
Number of items	16	(maximal 60)						
Passing score	5							
ITEM		1	2	3	4	5	6	
Name		1	2	3	4	5	6a	6b
Maximum score		4	4	4	4	4	2	
Weight of Items (multiplier, usually 1)		1	1	1	1	1	1	
TOPICS (provide your topics)								
MC		1	1	1	1	1		
Open Questions							1	
Linear Algebra						1		
Limits		1						
Differentiation			1		1		1	
Integration								
Differential Equations								
functions		1		1				

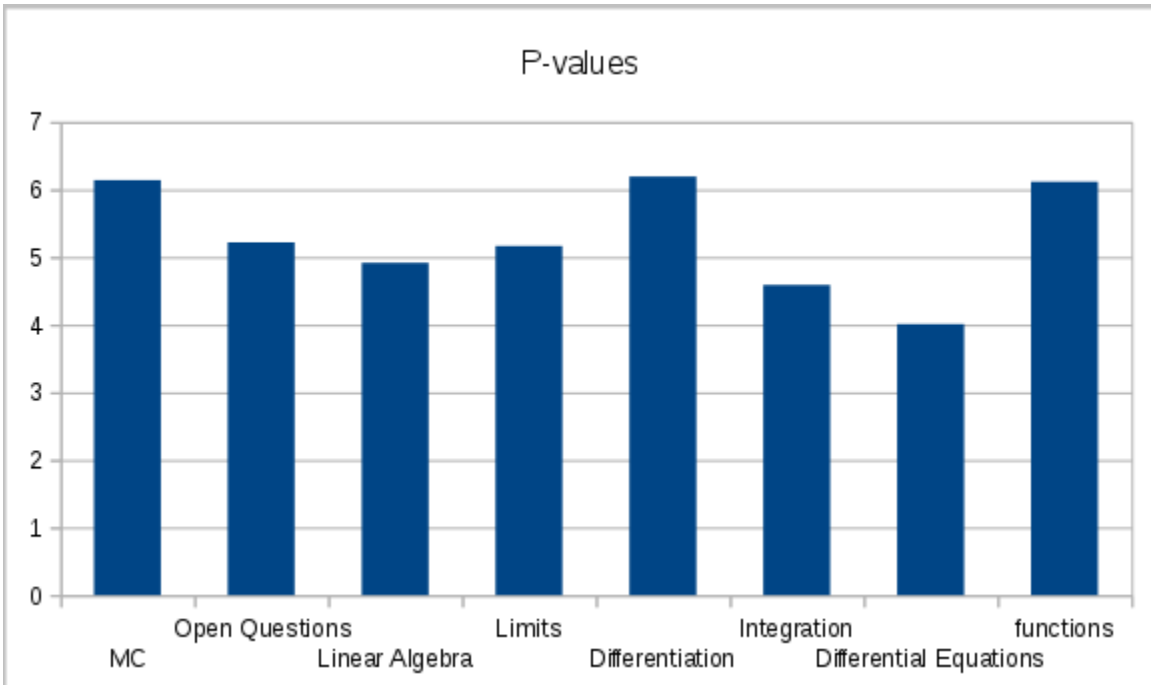


Illustration 2: Topics and their analysis

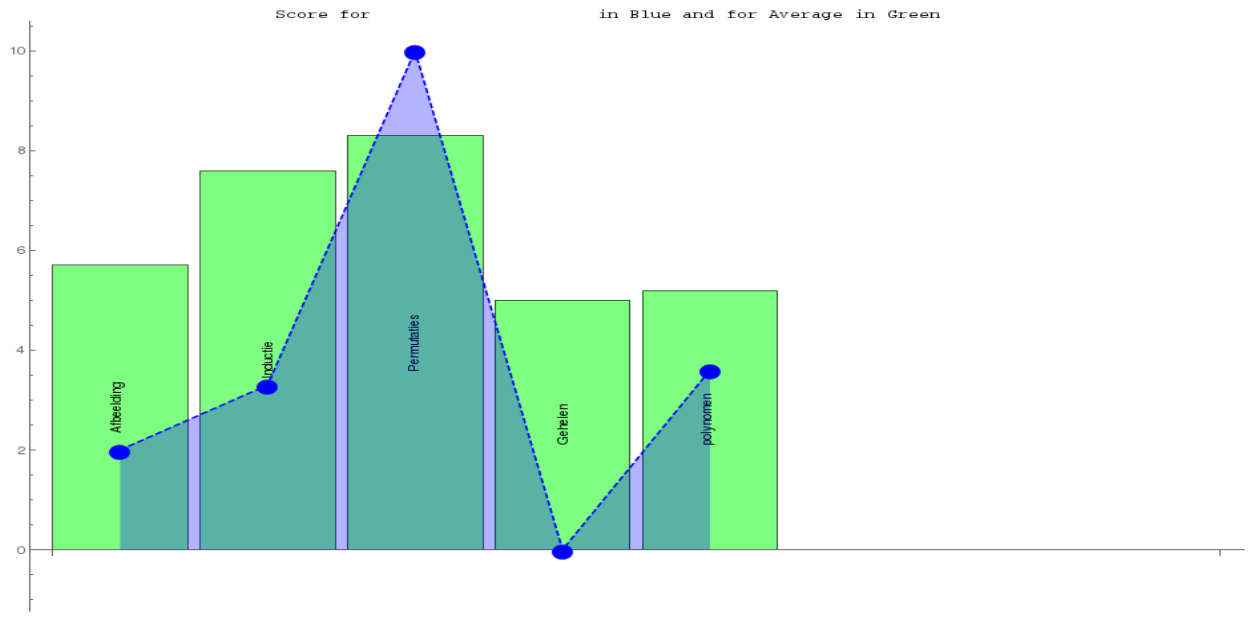


Illustration 3: Graphical presentation of performance of a student compared to the average, created with Mathematica

The tool also provides information on the performance of an individual student with respect to its peers. By connecting the spreadsheet to Mathematica, a graphical representation of this information is created which can be communicated to the student by a personal email. For mailing the personal information and feedback to individual students we have been using the Merge Mail facilities of an email client. How to use the Spread sheet, the Mathematica-program and Mail Merge has been described in manuals.

Our experiments

Within the project we have used our tools in two ways:

- Feedback on the final exams
- Feedback on the entrance test

In the next sections we will report on the results of these experiments.

Feedback on the final exams

In the fall of 2015 about 1400 students followed a Calculus course, called Calculus B, at the TU/e. This is a mandatory course for all freshmen studying Electrical Engineering, Mechanical Engineering, Industrial Engineering and Chemistry. The passing rate for the exam in November 2015 was 63%. The students that failed the exam have been offered a resit exam in January 2016. There have been 441 students signing in for the resit. In order to help these 441 students in their preparation for the resit, we organized the following.

We used our tool to analyze the exam and provided the students that failed the first exam with feedback about their performance. They did not only get information on how they performed on the individual items of the test, but also how they performed on the various topics covered by the test.

Based on the analysis they were given advice to pay extra attention to those topics on which their performance was poor. For this purpose they also have been offered extra homework mainly focusing on the topics in which they did not perform well.

The homework was offered to the students as an assignment within our learning management system (LMS, based on Moodle). The students that handed in this homework by uploading it to the LMS , were offered extra support:

- The student obtained a worked out solution of the homework and a grading scheme. In this way the student was able to not only correct his or her own work, but also grade it. This worked out solution was provided to the student via the feedback tools of the LMS assignment.
- The student could attend an extra one hour tutor meeting in groups of 8 to 10 students, to discuss the homework and ask questions preparing for the resit.

The last two days before the resit, a help desk was installed where all students, not only those that did hand in homework, could ask questions.

Exactly 50 students (11%) handed in the homework and made use of the extra support. It turned out that their scores for the resit have been considerably better than for the remaining students.

There where the passing rate for the resit was only 31%, the passing rate among the students participating in the experiment was 44%. (Over the last couple of years, the passing rate for the resit of this Calculus exam has always been around the 30%.) Of the 50 students participating, 78% scored better for the resit than for the original exam, while this was only the case for 64% of the remaining students. The increase in score was much higher for the participants in the test. Indeed, on average they improved their grade with 1.1 point out of 10, while the average improvement for all students was 0.6 points.

	Passing rate for resit	Average score out of 10 in resit	Average score in first exam	Increase in score	Better score in resit
Students with homework	44%	4.7	3.6	1.1	78%
All students	31%	3.9	3.3	0.6	64%

Table 1: Results for the resit and original exam

Discussion and conclusions

We created a tool that not only provides a teacher with an analysis of an exam on item or topic level, but also gives him or her the opportunity to give students personalized feedback on the exam. We have used the tool to give students that failed a Calculus exam feedback on their performance and advice on how to prepare for the resit. There have been 50 out of 441 students that took advantage of our efforts and participated in the experiment. These student performed much better (although still not very good) than the remaining students. This indicates that our intervention has a positive effect on the performance of the participants.

Of course there are many other factors that can have an impact on the performance of these students, than just the feedback and advice and support that we have offered them. For example, the fact that these students voluntarily participated in the experiment, shows that they are well motivated to work for the resit. However, besides the positive impact being a reason for providing students with this feedback and help , we also feel it to be right to offer students that prove to be motivated, extra possibilities to prepare well for an exam.

Future experiments and implementation

The course *Set Theory and Algebra* (2WF40) is also taught in the first quarter, the course Modelling (0LEB0) in the third quarter. The exam results of these courses (2015-2016 and 2016-2017) as well as the courses Calculu (2016-2017) have been analyzed by the use of our tools. Reports of the analysis have been and will be provided to the teachers and education management. Moreover

- Students have and will be provided with the information about their performance. They obtained information on how well they performed on the individual items of the test, but also on the various topics covered by the test.
- Students get an advice to pay extra attention to those topics on which their performance was bad.
- Students have been and will be offered extra homework mainly focusing on the topics in which they did not perform well.

- If they hand in this homework, they also have been offered an extra tutor meeting or instruction, to prepare for the resit.

More than 4000 students have received such analysis of their exam.

Feedback on entrance test

One of the intermediate tests of the Calculus courses (2WAB0, 2WBB0, 2WCB0) is the so called Entrance test. This test is conducted in the first week of the course. This test consists of 22 multiple choice questions on high school mathematics.

The purpose of the test is threefold:

- provide the teachers with an idea of what the math-level of their students is
- provide individual students with feedback on how well prepared they are for the Calculus course
- create the right atmosphere for Calculus course: students start working from day one.

Using our tools we have analyzed the results of the test. The analyzes provided welcome insight to the teachers of the course. Moreover, we mailed students their answer sheet, together with an individual analysis. In this way we obtained the following:

- Students have been provided with the information about their performance. They obtained information on how well they performed on the individual items of the test, but also on the various topics covered by the test.
- Students had the chance to look into their work, without having to contact a teacher. In this way *all* students had the opportunity to check the grading of the test.
- Students got an advice to pay extra attention to those topics on which their performance was bad.. They have been offered online exercises for more practicing.

The analysis and answer sheet was sent to about 2400 students. As a result, very few students visited the teachers to have a look at their work, saving the teachers a lot of work.

Appendix 1: Example of a feedback report to a student

Dear XXXXXXX (Name of the student).,

With this mail we want to provide you with some extra information on your Entrance Test Calculus.

A scan of your answer sheet can be found below and your version of the test (with answers) is attached to this mail.

You can use these documents to check how you have done on the test and its individual questions.

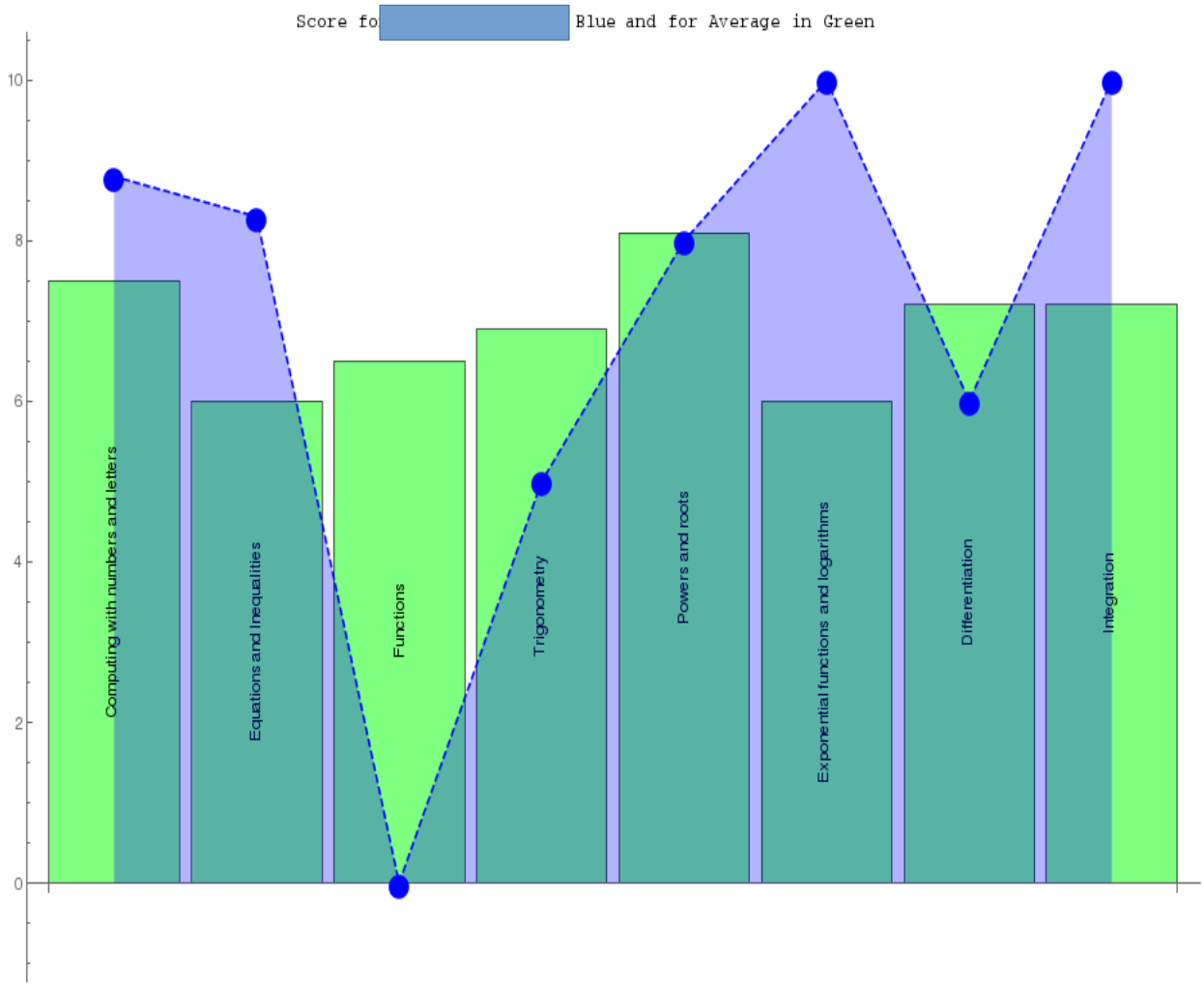
Below you also find an analysis of your exam. Here you can see how you scored on the various topics from the test and the average scores of all students.

If you want to practice for a resit of the test, or just to improve your skills, you can make use of the material you can find on the site https://www.wistue.nl
or in the reader AlgebraicSkills.pdf which can be found in the Oncourse-site of the Calculus course.

Sincerely,
Emiel van Berkum and Hans Cuypers

Analysis

Part of the exam	**Your Score**	**Average Score**
Final Grade	8.1	7.1
Topics	**Your Score**	**Average Score**
Computing with numbers and letters	8.8	7.5
Equations and Inequalities	8.3	6.0
Functions	0	6.5
Trigonometry	5	6.9
Powers and roots	8	8.1
Exponential functions and logarithms	10	6.0
Differentiation	6	7.2
Integration	10	7.2


Score fo
Blue and for Average in Green
10
8
6
4
2
0
Computing with numbers and letters
Equations and Inequalities
Functions
Trigonometry
Powers and roots
Exponential functions and logarithms
Differentiation
Integration

Technische Universiteit
Eindhoven
University of Technology

Starttest mathematics

september 2016
18:30 or 20:00
Aud, Pav, Matrix

☐ 2DA00(part of 2DL10, 2DB03, 2DL03)
☐ 2WOB2 (part of Calculus A, B or C)

STUDENT NUMBER

name & initials

exam room

vers

mark your answer ■
do not encircle ⬭

modify your answer: not this way ☐ ☒ ■ ☐ ☐ ☐ ☐ ☐
but this way ☐ ☒ ☐ ☐ ☐ ☐ ■ ☐
your modification will be used

	answers in the left green column				modifications in the right red column				
1	☐ A	☐ B	■ C	☐ D	⟷	☐ A	☐ B	☐ C	☐ D
2	■ A	☐ B	☒ C	☐ D	⟷	■ A	☐ B	☐ C	☐ D
3	☐ A	☐ B	■ C	☐ D	⟷	☐ A	☐ B	☐ C	☐ D
4	☐ A	■ B	☐ C	☐ D	⟷	☐ A	☐ B	☐ C	☐ D
5	☐ A	☐ B	☐ C	■ D	⟷	☐ A	☐ B	☐ C	☐ D
6	■ A	☐ B	☐ C	☐ D	⟷	☐ A	☐ B	☐ C	☐ D
7	☒ A	☐ B	☐ C	☐ D	⟷	☐ A	☐ B	☐ C	■ D
8	■ A	☐ B	☐ C	☐ D	⟷	☐ A	☐ B	☐ C	☐ D
9	☐ A	☐ B	☐ C	■ D	⟷	☐ A	☐ B	☐ C	☐ D
10	☐ A	■ B	☐ C	☐ D	⟷	☐ A	☐ B	☐ C	☐ D
11	☐ A	☐ B	■ C	☐ D	⟷	☐ A	☐ B	☐ C	☐ D
12	■ A	☐ B	☐ C	☐ D	⟷	☐ A	☐ B	☐ C	☐ D
13	☐ A	☐ B	☐ C	■ D	⟷	☐ A	☐ B	☐ C	☐ D
14	■ A	☐ B	☐ C	☐ D	⟷	☐ A	☐ B	☐ C	☐ D
15	☐ A	■ B	☐ C	☐ D	⟷	☐ A	☐ B	☐ C	☐ D
16	☐ A	☐ B	■ C	☐ D	⟷	☐ A	☐ B	☐ C	☐ D
17	■ A	☐ B	☐ C	☐ D	⟷	☐ A	☐ B	☐ C	☐ D
18	☐ A	☐ B	■ C	☐ D	⟷	☐ A	☐ B	☐ C	☐ D
19	☐ A	☐ B	■ C	☐ D	⟷	☐ A	☐ B	☐ C	☐ D
20	☐ A	■ B	☐ C	☐ D	⟷	☐ A	☐ B	☐ C	☐ D
21	☐ A	☐ B	☐ C	■ D	⟷	☐ A	☐ B	☐ C	☐ D
22	■ A	☐ B	☐ C	☐ D	⟷	☐ A	☐ B	☐ C	☐ D

Remarks in this box:

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