Comments on student performance and common errors for MATH46132 and MATH66132 exams (both being identical) in June 2015.

The exams consisted of four problems, of which students were required to choose three to work on.

Problem 1: Most students chose to work on this problem. This problem tested basic concepts of n-dimensional optimization algorithms on an example which the students have not seen before but overall was not very complicated. The conjugate gradients technique has been discussed in the course, nevertheless a pseudo-code was given as a reminder. The course itself was using Matlab as essential ingredient, and students needed to do some programming as part of it for example in the coursework. Therefore, they were expected to be capable of translating pseudo-code into practical calculations. The results were quite mixed, with some students obtaining full marks and others losing marks for some parts. Most students identified well the steepest descent method, not all realized the connection to the conjugate gradient method. Some students did not apply exact line search in the steepest descent scheme, which resulted in loss of marks. In parts b and c, not all students were able to identify typical behaviour of the CG and Newton techniques for quadratic functionals.

Problem 2: This problem presented an example for output least squares data fitting which can be managed by hand. In order to avoid lengthy calculations in the exam, students were not required to do all the calculations of parts (c)-(e) explicitly, but only to indicate the general procedure in each case. Practically all students chose to work on this problem. In most cases students either obtained almost full marks here, or they had some basic difficulties which finally resulted in about half the total marks as result. Only very few students had significant difficulties with this problem.

Problem 3: This problem consisted of a ‘typical’ tomography setup which in a similar fashion was already discussed in the coursework and in the exercises, however without the ‘catch’ that now one of the system parameters ‘alpha’ was unknown as well. So, students needed to do a little bit of transfer work and they had to apply general concepts they have learned about inverse problems and ill-posedness to this situation. Here parts a and b usually did not cause great problems to the students. Part c was already more tricky identifying correctly the criteria of well-posedness. Part d was only answered correctly by a few students. Part e was then dealt with quite well by most students.

Problem 4: This problem was overall just book-work. All formulas and explanations were in the lecture notes and have been discussed in the class and in particular in the tutorials, students just needed to reproduce them. Since the underlying mathematics was slightly more abstract than in the other problems of this exam, in particular in the first part addressing the adjoint scheme, the solution of this problem required some good insight and therefore this problem was non-trivial. Few students addressed this problem. Some students only addressed the second part asking for the Wolfe Condition. Only very few students attempted both parts of this problem. Those who did obtained in most cases almost full marks.