

Teaching Committee report to the Faculty Board

Examinations for Parts IA, IB and II of the Tripos, 2008

1 Introduction

The Committee met three times, for two hours, to consider the 2008 undergraduate Tripos examinations. We looked, for each part of the Tripos, at:

- the Examiners' report;
- the External Examiners' reports;
- the Examiners' comments on their questions;
- the examination statistics;
- the examination papers;
- the analysis of the paper lecture questionnaires;
- the responses to the on-line questionnaires;
- the report from the CATAM assessors (Parts IB and II).

We also looked at letters sent each year by the Chair of the Faculty Board to Chairs of the Examiners and to lecturers (regarding exam questions), and the instructions for checkers.

We noted with pleasure that the External Examiners, without exception, commented favourably both on the examination process and also on the performance of the candidates. The six External Examiners' reports include comments such as:

Once again I am happy to say that the examination procedure was very fair, the scripts were marked extremely carefully and the vast majority of the candidates achieved an excellent standard of mathematics. (Part IA)

My general impression was of many high quality students producing good work on demanding courses. (Part IB)

At the upper end of the scale, the standards are very high indeed, and would do credit to any world-class university. The procedures for setting and marking the papers, processing the marks and allocating students to the classes, seemed to me to be well designed and carefully carried out. (Part IB)

The best mathematics students at Cambridge are exceptionally high quality, and the average standard is also high. Correspondingly, the courses provided for Part II are of exceptionally high quality and range. (Part II)

Part II of the Mathematical Tripos is an excellent course at high level, offering candidates a wide choice in a variety of mathematical subjects. (Part II)

The Mathematical Tripos remains an impressive course for those interested in studying mathematics at the highest level. The exam-based final year assessment is challenging, but fair, and compares favorably with qualifications around the country. (Part II)

There follows a summary of the points raised in the Examiners' reports which the Committee believe need the attention of the Faculty Board. We have not generally highlighted points of a purely administrative nature: that is for the Chairs of this year's Examiners to pick up from the previous year's Examiners reports. This year, we were pleased that the annual meeting of the Directors of Studies has requested a copy of this report in time to be able to contribute to the Faculty Board discussion.

2 General Matters

2.1 Errors

This year the following errors were reported, out of a total of about 280 questions: no errors in Part IA; three minor errors in Part IB (all in fluid dynamics questions); ‘a small number’ in Part II. The Examiners reported that the errors caused no detectable problems for candidates. Although it would be good to have no errors at all, it seems that this year there were no errors of any significance in the written papers for Parts IA and IB of the Tripos; for Part II, no assessment of the effect is given in the report.

Following our recommendation last year, corrections to the CATAM projects were supplied in the Examiners’ reports, which was useful and, this year, reassuring.

We **recommend**, as last year (but more strongly), that the letter from the Chair of the Faculty Board to Chairs of Examiners asks the Examiners to report on any errors occurring in their papers or in the CATAM projects. We believe it would be useful if the actual errors were listed.

We also believe that it would be a good idea of the Board were to list, perhaps in the Chair’s letter to Chairs of Examiners, what it would like to see in the examiners’ reports (for example, an explicit list of errors and corrections, approximate borderlines, number of students in each class). we **recommend** that the Board considers this.

2.2 Cover sheets

Following our recommendation last year, question numbers were provided on the master cover sheets for Part IA so that candidates had only to tick boxes. This seems to have considerably reduced the number of problems at the sorting stage, including mis-sorted scripts. Anecdotal evidence from Ms Louise Mortimer in the Faculty Office suggests that this innovation was very successful. We **recommend** that this practice be continued and extended to the other parts of the Tripos. For Part IB and Part II, it would be useful to list the course beside the question number.

The Part II Examiners recommend the introduction of paper-specific cover sheets, of different colours and pre-marked with the appropriate paper number, partly to increase security and partly to reduce sorting and other errors. We note that if the above recommendation is adopted, the paper number should appear on each cover sheet.

2.3 Mark checking

Some errors that should have been caught by mark checkers were reported. Professor Gregory (Part II External Examiner) found scripts on which the totals on the cover sheet differed from those in the script and also transcription errors. In one case (at least) these would have resulted, but for the vigilance of the External Examiners, in a candidate incorrectly being placed in the first class. One candidate had to be reclassified after an appeal. This seems to us to be a very serious matter: clearly, some checkers (and maybe examiners) were careless. We noted that it is examiners who bear the responsibility for the integrity of the whole process.

We **recommend** that the three Chairs of examiners meet to discuss the problem, having regard to the clarity of the instructions, and to the process described, in the document ‘Mathematical Tripos: Tripos Script Mark Checking’. We noted that this document refers to marks books, even though many examiners do not use mark books (preferring to transfer marks directly from the cover sheets to the computer).

2.4 Lecturers’ comment questionnaires

The Chair of the Faculty Board writes to all lecturers in Part IA and Part IB asking them to comment on the draft examination questions. One of the requests in this letter is for comments on the appropriateness and level of difficulty of the questions. The External Examiners in both these parts of the Tripos have commented on the unevenness of the standard of the questions. Although the responsibility for the level of difficulty of the questions lies with the Examiners, we **recommend** that lecturers be encouraged to take a more active role, for example, by asking for a separate comment on the level of difficulty (though not in a form that suggests a transfer of responsibility to the lecturers).

2.5 ‘Short’ questions

The agreed and advertised description for ‘short’ questions is:

Short questions should be accessible to any student who has studied the material conscientiously. They should not contain any significant ‘problem’ element. We found no evidence to suggest that this guideline was being ignored, or that the short questions were failing to fulfil their function. A number of the externals commented that the system of long and short questions seems to be working well.

2.6 Classification criteria

Professor Mörters (Part II External Examiner) commented on the ‘6% thirds and below’ recommendation of the Faculty Board; his view was that this year about 10% of candidates fell into this category (the Examiners gave 17 candidates out of 203 thirds and below).

This Faculty Board recommendation was in fact changed last year, following a recommendation of the Teaching Committee to ‘the percentage of Thirds should be in the range of 0% up to 10% thirds’.

The Teaching Committee was asked to review the impact of this change. However, it seems that this new Faculty Board recommendation may not have reached all examiners; we noted that the schedules booklet contained the defunct recommendation (necessarily, since the new recommendation was formulated after the schedules booklet was produced). We also noted that the letter from the Chair of the Faculty Board to Chairs of Examiners also gave the defunct recommendation (for the same reason), though the new recommendation was explained to Chairs of Examiners in a later letter.

Professor Mörters also suggested that a more clearly formulated distinction between what is required for a third class against an unclassified degree may be helpful. This year, the new quantitative guidelines agreed last year by the Faculty Board on the recommendation of the Teaching Committee, come into force; these will provide a more clearly formulated distinction at all the boundaries.

These guidelines are published in the schedules, but they constitute such a significant change that we **recommend** that the Faculty Board bring them explicitly to the attention of the Examiners.¹

We further **recommend** that section 9 of the letter from the Chair of the Faculty Board to Chairs of Examiners, headed ‘Class percentages’ be amended (and the reference to Mathematics with Computer Science candidates should now be removed).

2.7 Rubric and excess questions

There were 115 attempts that infringed the rubric in Part IA, from 70 candidates; this figure was much smaller than last year’s (155).

Only 14 candidates submitted excess questions in Part IB, a surprisingly small number in comparison with Part IA, given that the rubric (at most 4 questions from section I and 6 questions from section II) is quite restrictive. In Part II, there is no record of the number of excess questions, but here the rubric is much less restrictive (at most 6 questions from section I, no limit on the number of section II questions).

We **do not recommend** that the Board discuss alternative marking conventions to tackle this problem (such as retaining the worst 6 questions instead of the best 6).

We **recommend** that the advice ‘Past examiners have been of the opinion that some candidates have put themselves at a disadvantage by tackling excess questions.’ be included in the e-mail sent to candidates before the examination.²

2.8 Statistical analysis of response to questions

Recommendations relating to the provision of statistical information about the level of difficulty of courses are made below for each Part of the Tripos. In summary, these are:

¹A suggested wording: *New classification criteria for 2008/9, agreed by the Faculty Board, are set out on page 2 of the Schedules booklet. In order to achieve consistency and transparency to students, the Board recommends that the primary classification criteria represent the relative importance that should be attached to alphas, betas and marks at each border. However, the Board also recommends that examiners consider carefully all borderline candidates to determine whether other factors apply that, in the judgement of examiners, should affect the classification.*

²Currently, the text of the relevant portion of the e-mail is:

You should also be aware of the rubric regarding the number of questions you may attempt: all four of the questions in Section I; and up to five of the questions in Section II with no more than three on each of the two courses examined on that paper. More details can be found in the introduction to the Schedules booklet (www.maths.cam.ac.uk/undergrad/schedules). Every year, the examiners note that candidates wasted time by attempting too many questions.

1. a statistical analysis along the lines of that provided for Part II (originally produced by Dr Altham) be provided for all three parts of the Tripos;
2. a one-page summary of the data for the past three years be provided for each part of the Tripos;
3. the data for Part II be provided to the lecturers as well as to the Examiners.

2.9 On-line questionnaires

Although the on-line questionnaire has been a huge improvement on its e-mail predecessor, there are quite a few instances of incomplete comments, which is worrying. This seems to be caused by the innocent use of certain characters, such as quotation marks, that cause subsequent text to be irretrievably lost.

One way of trying to fix this would be simply to tell students not to use these control characters. This is not wholly satisfactory, because they will forget and anyway they may find it harder to comment without using (e.g.) quotation marks.

The alternative would be use a more robust questionnaire. Some faculties apparently use one provided by Camtools, but a more sensible option for our students (who don't use Camtools) would be to use CamSIS, which is used by all students. We **recommend** the Faculty to investigate this as a matter of urgency.

2.10 Faculty Secretary and Computer Officer

All the Examiners' reports remarked on the excellent support given by Ms Louise Mortimer. We **recommend** that the Chair of the Faculty Board expresses the appreciation of the Board for her work.

The Examiners in all Parts of the Tripos found the expertise of Mr Gareth Marlow was invaluable. We **recommend** that the Chair of the Faculty Board expresses the appreciation of the Board for his work.

3 Part IA

3.1 Disparity in difficulty between subjects

Professor Doney (External Examiner) commented on the apparent difference between candidates' performances on the pure and applied questions. Even allowing for the fact that mark profiles differ between different subjects,³ it does appear that it was easier to obtain marks from certain courses (Differential Equations, Vectors and Matrices) than from others.

In principle, this should not matter: all courses in Part IA are 'compulsory' so no particular group of candidates should be disadvantaged. There is also a choice of questions in Section II of each paper, so to some extent questions perceived as being more difficult can be avoided. In practice, some students may concentrate their final revision on (say) 6 out of the 8 courses; there may be an adverse effect on such students.

Professor Doney does not suggest any action at present, except to 'keep an eye on it'. One way of doing this would be to perform a statistical analysis as recommended in section 2.8.

3.2 Education Tripos

In 2007/08, for the first time, candidates for the Preliminary Examination for Part I of the newly revamped Education Tripos (*vice Education Studies Tripos*), took courses from Part IA of the Mathematical Tripos, namely Differential Equations, Probability and Newtonian Dynamics. In 2008/09, these same students, now candidates for Part I of the Education Tripos, are taking Algebra and Geometry (*sic*) and Numbers and Sets, and some will also take Analysis I. In 2008/09, candidates for the Preliminary Examination for Part I are taking Vectors and Matrices, Probability and Numbers and Sets.⁴

The Chair of Examiners reports that as a group the Education Tripos candidates performed very badly. Comparisons with Mathematical Tripos candidates are not straightforward because the Education Tripos candidates did not take the whole examination. Nevertheless, the average merit mark of the 8 candidates on Paper 2, the whole of which was accessible to them, was only 50, even though marks across all candidates on Paper 2 tended to be relatively high compared with the other papers. A total merit mark of 200 corresponded, for a Mathematical Tripos candidate, to a low third.

³For example, one might expect more extreme marks in pure questions than in applied.

⁴Source: *Statutes and Ordinances* 2007 and 2008.

We do not recommend a change of the policy whereby these students are permitted to take papers from the Mathematical Tripos. Instead we believe strongly that tighter control should be placed on students being admitted to read the Education Tripos (special subject Mathematics).⁵ We **recommend** that the Chair of the Faculty Board conveys our concern to the Faculty Board of Education.

4 Part IB

4.1 University Standard Marks

Professor Joyce (External Examiner) refers to the impenetrability to outsiders of the system of marking and mentions the desirability of reporting the results in a standard format (70/100 = first class, etc). As the Board is aware, this format has already been introduced for the undergraduate parts of the Tripos.

However, the Committee noted that the existing method of scaling means that students who obtain a very high first may still only receive a mark in the low/middle 70s. This of course is similar to the profile in most other subjects (except the few students who score in the 90s), but it is atypical for a mathematics degree. The Committee **recommend** that the Faculty Board considers a different scaling; for example, giving the 15th Wrangler 90% instead of, as at present, giving the 5th Wrangler 95%.

4.2 Level of difficulty of questions

Professor Joyce comments at length on his conviction that it was relatively hard for candidates to obtain marks in some courses (either because the questions were harder or because the marking was stiffer). He does not advocate scaling the marks of 'hard' courses; rather, he suggests alerting the Examiners in the following year. This we have recommended in section 2.8.

4.3 Complex Methods/Analysis

Every year, there are complaints in the questionnaires about the lack of fairness in the system of examining these two courses by means of three joint questions (two long and one short) plus a long question and a short question for each course. Usually, the complaint is that one of the joint questions strongly favours candidates who attend one particular course. This year the complaint is that the paper 4 Complex Methods question (on conformal mappings) was easily accessible to those who attended Complex Analysis, thereby giving them an extra question (they could get 100 instead of 80 marks on this one course).

We **recommend** strongly that in future the two courses are examined by means of three long and two short questions, all in the either/or format, with care taken to place similar questions on the two courses as parts of the same question. Clearly, if the Examiners are sure that a given question is appropriate for both courses, there is no need for an either/or.

5 Part II

5.1 Data supplied to Examiners

Professor Steiner (external) has suggested that it would be helpful to indicate the subjects of the questions (which would need wider paper); he also says that it would be good to have more details on marks for individual computer projects. We **recommend** that the Faculty Board considers these suggestions.

5.2 Statistical analysis

In view of the fact that it is lecturers who propose questions in this part of the Tripos, it seems to us that the best way of trying to ensure uniformity of level of difficulty across subjects would be for each lecturer to be sent Dr Altham's statistical analysis for the previous year. Lecturers change less frequently than examiners, so this would provide better continuity; furthermore, it is very difficult for examiners to judge the difficulty of questions at this level. We strongly **recommend** that this be done.

⁵We noted that colleges require applicants for the Computer Science (with Mathematics option) Tripos, in which candidates offer two papers from the Mathematical Tripos, to take STEP.

6 Examination data

The table below shows the classification of candidates from the 2008 undergraduate Tripos examinations by Tripos class and gender. The Board will recall that the corresponding data from the 2007 examinations raised a concern about the relative performance of male and female students. It was agreed that an offer from Cambridge Assessment (who administer the STEP examinations) to undertake a comparison between Tripos results and STEP results be accepted. This analysis has not yet been undertaken.

		1	2.1	2.2	3	Other	Totals
Part IA	Men	62 (31.6%)	77 (39.3%)	40(20.4%)	11(5.6%)	6(3.1%)	196(83.8%)
	Women	7 (18.4%)	17(44.7%)	10 (26.3%)	2(5.3%)	2(5.3%)	38(16.2%)
Part IB	Men	64(34.4%)	71(38.2%)	39(21.0%)	10(5.4%)	2(4.5%)	186(80.9%)
	Women	8(18.2%)	21(47.7%)	12 (27.3%)	2(4.5%)	1(2.3%)	44(19.1%)
Part II	Men	57(35.6%)	64(40.0%)	26(16.3%)	7(4.4%)	6(3.8%)	160(78.8%)
	Women	5(11.6%)	21(48.8%)	13(30.2%)	3(7.0%)	1(2.3%)	43(21.2%)

The heading 'Other' includes (but does not differentiate between):

- a) Candidates who failed their examinations
- b) Honours candidates who have received an allowance from the Examiners.
- c) Candidates who have received allowances (Deemed to have Deserved Honours (DDH) or granted an allowance towards the Ordinary degree) by the Applications Committee of the Council. (Allowances may be granted to candidates who have been ill or who have extenuating circumstances and have thus been prevented from taking an examination or whose performance has been adversely affected as a consequence.)
- d) Candidates who have been granted a deferral.

Richard Lau	Catherine Cutts	Keith Carne	Thanasis Fokas	Imre Leader
Peter Friz	John Lister	Colm Caulfield	Tom Fisher	Stephen Siklos (Chair)

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