

Teaching Committee report to the Faculty Board

Examinations for Parts IA, IB and II of the Tripos, 2007

1 Introduction

The Committee met three times, for two hours, to consider the 2007 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 the Chairman of the Faculty Board's letter to Chairs of the Examiners.

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:

I was impressed with the excellent standard attained by almost all candidates, which is a testimony to the teaching of Mathematics in Cambridge. (Part IA)

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

I commend the system you presently have for its fairness, and the way you use it accurately to judge quality in candidates. (Part IB)

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. (Part II)

The redoubtable Mathematical Tripos retains justly its reputation for challenging, and sometimes defeating, the best young mathematicians in the country. In doing so, it also offers scope unequalled elsewhere, and in its breadth remains an example to us all. (Part II)

The programme has commendable breadth and quality and rightly attracts very able students. The examination process is thorough, efficiently run and provides good evidence for ranking the students. (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, in a total of about 280 questions: two minor errors in Part IA; three minor errors in Part IB; ‘a few’ minor errors 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 any part of the Tripos.

However, we were aware that there was at least one significant error in the CATAM projects (it was discussed in the Part IB CATAM assessors meeting) and we were surprised that no reference was made to it, and any other errors in CATAM, either in the CATAM assessors’ reports or in the Examiners’ reports. We **recommend** that in future errors in CATAM be reported to the examiners (this is apparently just a matter of forwarding the relevant page from the on-line documentation) and that the examiners mention in their report any errors of significance in the same way as errors on the written papers.

We considered ways of maintaining or even reducing the number of errors, and have two suggestions, as follows.

- We recalled that in the past it was the practice to read the examination papers out loud at the relevant meeting of examiners (and a Part II examiner mentioned that the papers were in fact read out this year, the pure and applied questions being taken separately to save time).
- The Part IB examiners emphasise the importance of typesetting the draft questions at the earliest possible stage, before the questions are sent to the external examiners.

We **recommend** that the letter from the Chairman of the Faculty Board to chairs of examiners has a paragraph on errors suggesting the two items recommended above.

2.2 Deadline for production of papers

The Part IB examiners refer to the deadline set by the Academic Division for the submission of examination papers, which was 13th April. After negotiation with the Reprographics Centre, this date was put back to 1st May. We believe that it is essential to have a deadline comfortably after the beginning of the Easter term in order to reduce the incidence of errors and we **recommend** that the Chair of the Faculty Board discusses this with the appropriate person in the Academic Division.

2.3 LateX vs TeX

At least two of the Part IB examiners expressed a strong preference for typesetting in LateX rather than in TeX (as is currently required). However, we noted that a significant minority of staff still use TeX.

2.4 Master cover sheets

The Part II examiners comment on the difficulties caused by candidates filling in the wrong examiner letter and/or the wrong question number on their cover sheets and ask the Faculty Board to consider providing specially prepared cover sheets incorporating question numbers. We thought this was a good idea and suggest that it might best be effected by having the master cover sheet stapled to the front of each examination paper, having been prepared automatically during the production of the examination paper. Candidates would fill in their personal details, tick the appropriate question boxes and tear off the sheet to be submitted with their bundle of scripts. We are not proposing any change to the examiner cover sheets which would be bundled up with the scripts as at present.

We **recommend** that the Faculty Board investigate the feasibility of this suggestion.

2.5 Provision of detailed marking schemes

The Part II examiners note that, while dealing with a query from a candidate, it emerged that the candidate had been provided with some details of the mark scheme from (we inferred) the solutions lodged in the Faculty Office. In their view, such details should be confidential to the examiners.

We recognise the value of the solutions lodged in the Faculty Office for the guidance of supervisors so we would not want to prevent supervisors having access to them. The marking scheme is not necessary for these purposes (though it might be useful), but it would be an extra chore for examiners or the Faculty

Office to provide a version from which the mark scheme was erased. We noted that the mark scheme on the solutions supplied to the Faculty Office may well not be the final mark scheme.

We do not feel that any action is required; however, if the Faculty Board is concerned, the simplest action would be to ask the Faculty Office to cross out all marks on the solutions.

2.6 Betas

It seems to be generally agreed by examiners in the last three years that it is useful to be able to discriminate between the two types of beta: those awarded for marks of 8 or more on section I questions; and those awarded for a marks of between 10 and 14 (inclusive) on section II questions.

Since this distinction seems now to be embedded, we **recommend** (as last year) that this distinction be made in the breakdown given to students and in the summary given to directors of studies. (The information is anyway available to students, but difficult to extract since the breakdowns are by individual question).

2.7 ‘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. A number of the externals commented that the system of long and short questions seems to be working well.

It was also remarked that the number of strong students attempting section I questions and weak students making poor attempts at section II questions was perhaps larger than might have been expected or hoped for. We noted that there may be good reasons for this. We also noted that some students might be confused about the classification criteria; if this is the case, our recommendation in section 2.8 below should help.

2.8 Classification criteria

Yet again, we discussed classification criteria at length.

The classification criteria, agreed by the Faculty Board and published in the Schedules booklet, are as follows:

Quality marks as well as numerical marks are taken into account by the examiners in deciding the class borderlines. The Faculty Board has recommended that the number of alphas should be of particular importance at the first/second borderline but that at the lower borderlines alphas, and betas, and total mark should each (individually or together) be regarded as indicators of quality. At the third/ordinary and ordinary/fail borderlines, individual considerations are always paramount. Very careful scrutiny is given to candidates near any borderlines and other factors besides marks and quality marks may be taken into account. The Faculty Board recommends approximate percentages of candidates for each class (30% firsts, 40- 45% upper seconds, 20-25% lower seconds, and not more than 6% thirds and below).

The Faculty Board also recommends to examiners the following criteria for deciding the different classes.:

The First Class

Candidates placed in the first class will have demonstrated a good command and secure understanding of examinable material. They will have presented standard arguments accurately, showed skill in applying their knowledge, and generally will have produced substantially correct solutions to a significant number of more challenging questions.

The Upper Second Class

Candidates placed in the upper second class will have demonstrated good knowledge and understanding of examinable material. They will have presented standard arguments accurately and will have shown some ability to apply their knowledge to solve problems. A fair number of their answers to both straightforward and more challenging questions will have been substantially correct.

The Lower Second Class

Candidates placed in the lower second class will have demonstrated knowledge but sometimes imperfect understanding of examinable material. They will have been aware of relevant mathematical issues, but their presentation of standard arguments will sometimes have been fragmentary or imperfect. They will

have produced substantially correct solutions to some straightforward questions, but will have had limited success at tackling more challenging problems.

The Third Class

Candidates placed in the third class will have demonstrated some knowledge but little understanding of the examinable material. They will have made reasonable attempts at a small number of questions, but will have lacked the skills to complete many of them.

Ordinary

Candidates granted an allowance towards an Ordinary Degree will have demonstrated knowledge of a small amount of examinable material by making reasonable attempts at some straightforward questions.

This year, as in most other years, some of the external examiners and the internal examiners in Part IA and Part IB commented that it was not easy to apply the verbal criteria, and that is a view shared by the Teaching Committee. Professor Lister provided an analysis of the actual criteria used by examiners over the last few years, as far as it could be judged from the classification of the candidates, and it is clear that there is considerable variation between years and between parts of the Tripos. This is particularly apparent at the first/second borderline: in some years the alpha-count is paramount, whereas in other years it only slightly modifies the merit mark. We believe that this muddled approach should not be allowed to continue: it is essential that it is made clear to students what strategy they must adopt if they are aiming for (say) a first; and that examiners classify accordingly.¹

Over the last few years, the Faculty Board has made a number of changes, including ensuring that examiners were aware of the importance of the published criteria. Nevertheless, it seems from examiners comments this year that more must be done: we **recommend** a shift to primary classification criteria that are quantitative rather than qualitative.

We discussed ways in which this might be achieved, noting that this is not a change of policy (what is intended is essentially a clarification of the existing criteria) and so could be implemented this year. We decided that the best way would be to give the primary classification criterion for each borderline. Examiners would agree a borderline using the primary criterion, but would of course be permitted to use their judgement to promote or demote candidates in cases where an injustice would otherwise result.

We did not agree (or even discuss at any length) the explicit criterion (precise combination of alphas, betas and marks) to be applied at each borderline: these would require further consideration.

For example (only!), the primary classification criteria may appear as

First class	number of alphas
2.1	$2\alpha + \beta$
2.2	$6\alpha + 3\beta + m$
3	marks together with $2\alpha + \beta$

We discussed whether, in the event of new quantitative criteria being adopted, the existing verbal criteria should be deleted. We noted that they make more sense to those unfamiliar to the system than a statement about alphas and betas; and further that, if they are retained, it is essential that they agree unambiguously with the adopted criteria.

2.9 Presentation of lists at the final meeting

Whether or not the above criteria, or any other criteria, are adopted, it would be sensible if the examiners were provided with a list a candidates which is ordered as far as possible by the relevant criteria: for example, by numbers of alphas down to the predicted middle of the 2.1 class. This would focus the minds of the examiners on the criteria; we **recommend** that steps are taken to provide more helpful lists.

2.10 Thirds

Dr Sankaran (Part II External) ‘very much dislikes being told in advance that we are to award no more than 6% thirds and below’. This is of course an inaccurate reading: the upper bound is only a recommendation by the Faculty Board. Nevertheless, we had some sympathy with his point.

¹Examiners use their judgement to set appropriate questions, and then to determine the mark scheme (and in particular what constitutes an alpha or beta question); they use their judgement in deciding where to place the borderlines; they may use their judgement in the final examiners’ meeting to argue that account should be taken, for example, of a candidate who has written an exceptional answer to a question that has turned out to be more difficult than intended, should be . But they should not, we believe, be allowed to say, for example, ‘In my opinion, two betas are better than one alpha’ since this is matter of general policy to be decided by the Faculty Board.

A separate but related point relates to the 6% figure. There is a long history of external examiners commenting on the long tail and speculating that such students would have been less generously rewarded at their own universities. We were of the view that in all parts of the Tripos, but in Part IA in particular, candidates are placed in the lower second class having achieved very little, and therefore that 6% is not realistic as a target and certainly not desirable as a recommended upper bound.

We also discussed this matter last year, as did the Faculty Board, as a result of disquiet expressed by one external examiner, who was concerned that generosity in Part IA (in particular) may be misplaced. Most of this year's externals complain about the quality of the tail, particularly given the availability of short betas which should allow even very weak candidates to show what they can do. This year it is our strong **recommendation** that the Faculty Board guidelines be amended; we advocate giving a range for thirds and below — perhaps 5% – 15%.

2.11 Criteria for a third class

In our discussion of classification criteria, we considered the idea of giving sufficient conditions at each borderline². For a number of reasons, we preferred the primary classification criteria recommended above. However, we noted that external examiners often make statements to the effect that certain candidates would have failed at their institutions³. We think that a pronouncement by the Faculty Board on what, in our almost unique examination system, constitutes a performance worthy of at least a third class would be helpful both to examiners and candidates and we **recommend** that the Faculty Board considers this further.

2.12 Rubric and excess questions

There were 155 attempts that infringed the restriction in Part IA; this figure was a slight increase over last year. This represents 40 per paper, and doesn't seem excessive. Nevertheless, we **recommend** (as last year) 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.

2.13 E-mail to Part IA students

In previous years, an e-mail explaining the rubric was sent to Part IA students a week before the examination. The main purpose was to ensure that they understood the necessity of bundling their attempts correctly and filling in cover sheets. This year the e-mail was not sent⁴ and the sorters reported unprecedented difficulties after the first paper.

The effect of the failure to send the e-mail has been to affirm its usefulness, and we **recommend** that it not be forgotten in future.

2.14 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 were particularly impressed that he managed to get to grips with our complicated arrangements in his first year.

3 Part IA

3.1 Probability

The external examiner noticed that 'the performance of candidates in probability was somewhat below their performance in other disciplines, so maybe teaching in this area should be looked at'. We noted that there is a new lecturer this year. We also noted that some of the questions on the examination were of

²For example: 'A candidate obtaining more than 14 alphas will be placed in the first class'.

³even though in almost all cases the examinations — ours being non-modular — are not comparable.

⁴Mea culpa (stcs)

a rather different character from either the examples sheets or the examination questions of the previous two or three years, and we **recommend** that this year's examiners bear this in mind when setting the questions.

3.2 Dynamics

Last year, the candidates' response to the dynamics questions was very poor and a number of changes have been set in train. The take-up rates and average marks per question improved this year (short — 62.2% (42.6%); long — 39.9% (31%)), and were comparable with those for probability; but they were still significantly lower than the averages (applied courses: short — 76.3%; long — 54.9%), despite the fact that the course under its present lecturer received the highest score of any Part IA course for comprehensibility.

4 Part II

One external examiner complained that algebraic geometry (his own particular subject area) is inadequately represented in the Tripos. We are aware that this matter is currently under discussion in DPMMS and that proposals may be brought to the Faculty Board to ameliorate the perceived deficiency.

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