

Teaching Committee report to the Faculty Board

Examinations for Parts IA, IB and II of the Tripos, 2003

Introduction

The Committee met three times to consider the Examiners' reports on the 2003 Undergraduate Tripos examinations. We also looked at the examination statistics, the analysis of the lecture questionnaires and, in a few cases, the examination papers. This year, the analysis of the e-mail questionnaires was not yet available.

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:

The standards achieved by the students were of the highest; I have seen none better. The assessment and examination procedures are robust. (Part IA)

I wish to compliment the examiners upon their very careful marking of a vast number of scripts and upon the level of consistency and accuracy achieved. (Part IA)

Overall the standard of candidates was good, and as in the previous two years there were some really excellent individual performances by a high number of candidates. (Part IB)

I am satisfied that the syllabus and teaching of Part IB are working well and that the assessment process is being conducted efficiently and fairly. (Part IB)

Part II of the Mathematical Tripos is an impressive and challenging examination, the majority of students taking it perform very well, and the whole of the complex examination process is administered fairly and efficiently. (Part II)

It is a pleasure to finish again by acknowledging the enormous strengths of the Cambridge Mathematical Tripos in equipping large numbers of very able students with an outstanding training in a broad range of contemporary mathematics. (Part II)

I believe that all students have benefitted from a rigorous mathematical course which continues to maintain the very highest standards. (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 highlighted points of a purely administrative nature (such as the provision of extra keys to the sorting room to enable examiners to pick up scripts over the weekend) or ones that concern the arrangements for the examination that are in the hands of the Examiners (such as the suggestion from the External Examiner for Part IA to the effect that he would have preferred two days to examine scripts).

General Matters

Errors

No errors were reported in Part IA; three errors were reported in Part IB, one of which was serious and was not dealt with effectively (it was the subject of a formal complaint from the Tutor of one candidate); and no errors were reported in Part II. This represents a huge improvement over last year (and over most previous years).

It is clear from the reports of Part IB Examiners and of the External Examiners that everything that could possibly be done to ensure that no candidates were placed in the wrong class because of these errors was done. Nevertheless, the fact that the duty examiner (who was an inexperienced examiner) announced only part of the correction and did not announce the correction in all examination rooms when the error came to light is worrying.

The Committee believe that it would be good practice for the Chairman of Examiners to be alerted as soon as an error is discovered and that the Chairman should liaise with the duty examiner to ensure that the error is corrected effectively. We **recommend** that this practice be included in the guidance to Chairmen of Examiners.

The Teaching Committee **commend** to the Faculty Board a note produced originally by Professor Körner explaining how the role of duty examiner might be undertaken.

Rubric

There have been lengthy discussions on the subject of rubrics on the Faculty Board and elsewhere and it is clear the opinion is divided on various matters. The Committee believe that it would be helpful if some consistency over the three Parts of the Tripos could be achieved. This year's rubrics differed in significant ways and the Committee have the following suggestions:

1. Rubrics for Part IA and Part IB refer to 'examination number', and the rubric for Part II refers to 'candidate's examination number'. The correct terminology is 'candidate number'. It seems extremely unlikely that any candidate was confused by this, but there is no reason not to use the correct terminology.
2. Of the various versions, the Committee preferred 'Additional credit will be given to substantially complete answers' in bold and on a line of its own.
3. On the thorny question of extra answers, the Committee thought that a good compromise is to use the Part IB formulation 'You should attempt at most **four** questions ...'. Even though this does not make much sense on its own, the intention is clear enough and the explanation of what will be done in the case of additional answers being handed in could be given in the Schedules Booklet, together with a statement to the effect it would be very rare for it to be in the candidates' best interest to ignore the rubric.
4. The Committee thought that the IB rubric describing what to do at the end of the examination (mentioning the colours of the cover sheets, for example) was clearer than the corresponding rubrics for Part IA and Part II.
5. The Committee preferred the use of the same font (a nice big one) for 'Before you begin ...' as for 'At the end of the examination ...'.

Personal circumstances of candidates

Two of the External Examiners mention the possibility of the examiners taking into consideration the personal circumstances of candidates (those with warning letters, for example). They feel strongly that personal circumstances should be taken into consideration in determining the class of a candidate.

This matters are determined by University policy. It has been discussed recently widely within the University. It is in fact now possible for a candidate's personal circumstances to be taken into account in this way, though only in very limited situations (where, for example, the candidate is affected for one paper out of four).

Does the Faculty wish to recommend a change of practice?

(Blue) cover sheets

Yet again, examiners complained about the inappropriateness of the cover sheet (having, for example, a box for 'section' and an instruction to write on both sides of the paper). The Committee **strongly recommend** the Faculty Board to investigate the possibility of designing suitable cover sheets.

Mark processing programs

The Part IB Examiners note that the current mark processing program is over 15 years old. The Committee **recommend** that the Faculty Board investigate the possibility of providing a modern version incorporating, for example, the use of machine-readable master cover sheets.

Marking Schemes

Several of the External Examiners complained that even though they received solutions to all the proposed examination questions, some were without marking schemes and some omitted to indicate (right hand column of the standard template) whether the material is (for example) bookwork, or standard calculation, or similar to an examples sheet question, or completely unseen. Clearly, this information is important in allowing External Examiners and other Examiners to judge the level of questions (especially short questions). The Committee **recommend** that the letter to Chairmen of Examiners emphasises the importance of this point.

Lecturers' comment forms

The Committee noted that two different comments forms are given to Chairmen of Examiners, one for lecturer's initial comments and one for lecturers to 'sign off' questions that have been significantly altered. The lecturers on the Committee could not remember having ever been asked to sign the second form and the Committee **recommend** that both forms are used routinely.

Quality Marks

The Part IA Examiners suggest that the Faculty Board should consider changing the allocation of quality marks, so that just one quality mark (α or β) is available on long questions and only one β is available for short questions. The Part IA External Examiner, Dr Scott, believes that this proposal would encourage examiners to set more straightforward 'short' questions, which would help to address the Committee's concern, mentioned below, about the short questions.

The Committee did not discuss this suggestion, believing it to be beyond their remit, but **suggest** that the Faculty Board ask the Curriculum Committee to consider it both for Part IA and for Part IB, especially if the similar recommendation from the Part II Committee for Part II is accepted.

However, if this suggestion is adopted, the Committee **recommend** that it be adopted for all parts of the Tripos (or, if not, that there should be some coherent strategy). The Committee further **recommend** that, if this suggestion is adopted, the way in which quality marks are used for classing be explained to students. The Committee believe that the suggestion would only be successful if it were agreed that betas would be a significant factor at lower borderlines and that it would be necessary to advertise this information because otherwise the weaker students might feel compelled to concentrate on the alpha-bearing long questions.

The Committee note that a recent change of regulations means that the responsibility for providing a coherent strategy across the three parts of the Tripos for the use of quality marks in classing probably lies with the Faculty Board, rather than with the Examiners.¹

'Short' questions

The agreed and advertised description for short questions (i.e. Section I questions in Part IA and Part IB, and Part (i) of any question in Part II(A)) is:

Short questions should be accessible to any student who has studied the material conscientiously. They should not contain any significant 'problem' element.

¹Grace 4 of 24 July 2002 (Reporter, 2001-2, p. 1277) entitles Faculty Boards to issue to Examiners details of the conventions and criteria to be applied in determining class-lists. Stats and Ords 2003, page 216.

The Committee, having studied some of the questions, were of the opinion that, in some cases, examiners are still not adhering to this description sufficiently strictly, to the great detriment of weaker candidates. This view is supported by comments from Professor Duck (Part IB) and from Professor Laws (Part II) who wonders if there is sufficient information about weaker candidates to class them reliably. It seems that some examiners set short questions of the same sort as long questions, but half as long.

An example from Part IA:

Paper 3, Q2B Show that if a group G contains a normal subgroup of order 3, and a normal subgroup of order 5, then G contains an element of order 15. (etc)

This attracted 171 attempts and, unsurprisingly, only 21 alphas (average mark 4.2).

Last year, the Committee recommended that item (5) in the Chairman of the Faculty Board's letter to the Chairmen of Examiners be rewritten to emphasise the importance of the above description. This does not seem to have been sufficient.

The Committee **strongly recommend** that the descriptor for short questions (above) be given on the lecturers' comment form and that lecturers be asked specifically if the relevant questions adhere to the criteria.

Inexperienced examiners

Last year, Professor Jones suggested that guidance should be given to new examiners. The Committee felt that this task might reasonably be undertaken by the mentor of the new examiner and recommended that Heads of Department consider including this explicitly in the duties of mentor. On reconsideration, the Committee believe that it would be more effective for Chairmen of Examiners to identify and give guidance to inexperienced examiners; the Committee **recommend** that advice to this effect be included in the letter to the Chairmen of Examiners.

Continuity of examiners

This year, as last year, External Examiners comment on the desirability of some continuity in examiners from year to year. The Committee recognise the difficulty the Heads of Department face in this respect but **recommend** (as last year) that they should bear in mind the importance of this matter, and do their best to arrange that a reasonable proportion of examiners have served the previous year or have previous experience of examining in the same Part of the Tripos.

Professor Duck (Part IB External Examiner) points out that continuity is also desirable for External Examiners; he notes in particular that he and Professor Jones have served their three-year term concurrently, so that next year's External Examiners will both be new. The Teaching Committee **recommend** that steps be taken to try to ensure that the next appointments of Externals are staggered.

Examining breadth of curriculum

Three External Examiners (Professor Jones, Part IB, Professor Laws, Part II and Professor King, Part II) comment that some weaker students manage to pass by answering questions on a very narrow range of courses. It should first be said that our aims and objectives for Part IB and Part II do not specify that students should study a wide (or even non-narrow) range of courses, and allow the possibility of excellence in one area to be compared equally favourably with competence across a broad range of courses. (For example, the relevant objective for Part IB is '... covered material from a range of pure mathematics, statistics and OR, applied mathematics and theoretical physics and have studied some of this material in depth.' It is the latter part that applies to the examination; the former part applies to the supervision work done over the year.)

Given our cross-sectional, as opposed to modular, style of examination², the only ways of changing this situation would be to set fewer questions on each course or to group courses on papers. The latter would not be feasible in Part II, given the large number of courses and the Faculty's commitment to allowing students complete freedom in choice of courses, and is probably not feasible now in Part IB for the same reason. In Part IA, which is in a sense a foundation year, the courses are grouped on the papers to ensure that students study a wide range of courses in depth.

There is currently a proposal to reduce the number of questions per course on the Part IB papers, and this would make it more difficult for students to concentrate on a very few courses. The Committee **recommend** that the Curriculum Committee be asked to bear in mind the External Examiners' comments when they consider this proposal.

Proposals for a completely revised Part II are now under consideration, and it is difficult to predict how students will react to the completely new structure. This matter should be reviewed once the new structure is in place.

Faculty Secretary

All the Examiners' reports remarked on the excellent support given by Ms Kathryn Ayres.

Computer Officer

In each part of the Tripos the indispensability (or words to that effect) of Mr David Harris is mentioned. The Committee **strongly recommend** that the Faculty Board investigate whether he is indeed indispensable, and takes steps to provide back up if that proves to be the case.

Part IA

Education Tripos

There was one candidate for the Education Tripos taking Route 1 with subject Mathematics, and he or she took paper 1–3 of Part IA. The performance of such candidates is of indirect interest to the Faculty Board, so the Committee **recommend** that the Faculty Board asks the Chairman of Part IA Examiners to include some information in the final report. Dr Williams informed the Teaching Committee that this year's candidate would have obtained a high 2.2, based on his or her actual marks scaled by a factor 4/3.

Standards

The Examiners remarked that the borderlines were significantly (about 10%) lower than last year; some Examiners felt that their questions turned out to be harder than had intended. There was no general impression that the cohort was weaker than in previous years. The Committee noted that the borderlines were within the usual range of variation (for example, in 2000 the 1/2 boundary was approximately 825 merit marks, compared with 850 this year and 1040 last year). Nevertheless, the Committee felt that weaker candidates could do better justice to themselves on less severe papers and hope that greater attention to the guidelines for short questions (see recommendation above) might help in this respect.

The Committee noted that the difficulty of the Dynamics questions this year might have been a contributory factor to the lower borderlines (remarking that a question that fills an entire side is unlikely to prove attractive) and **regretted** the absence of a report from the relevant examiner.

²The form of our examinations was widely debated within the Faculty last year, and it was (eventually) reaffirmed that cross-sectional examining is preferred.

The Committee also noted the Examiners' comment that the present cohort had difficulty in relating the visual to the symbolic and **recommend** that the Faculty Board consider whether measures should be taken to address this situation.

E-mail to students

This year (2003), at the suggestion of last year's Part IA Examiners, the Teaching Committee provided the text of an e-mail to explain the rubric which was sent to all Part IA students by the Faculty Office. This year's Examiners request that students should be e-mailed again next year, and the Teaching Committee **recommend** that this should be done.

Rubric violations

The Examiners report that a large number of candidates violated the rubric by handing in too many answers. The violators were distributed through the class list with a higher concentration at the bottom end. They make some suggestions for dealing with this situation. However, the External Examiner thinks it best that no action is taken, and the Committee thought so too.

The Examiners expressed hope that Directors of Studies will encourage students to concentrate on completing the correct number of questions as far as possible. The Committee believe that a suitable rubric with accompanying explanation and advice in the Schedules Booklet will be helpful in this matter.

Part IB

Computational Projects

This was the first year of the new format for Part IB, in which two of the four projects are handed in at the start of the Lent term using a pro-forma report, the aims being to give students clear guidance about what is required and to provide feedback for later projects. The number of submissions was slightly higher than in previous years (222/228 students cf. 206/217 in 2002), and the proportion of α s was substantially higher (6.1ave/8max cf. 5.2ave/9max in 2002). These figures suggest that the new arrangements are succeeding in their aims and raising the level of achievement.

The Committee noted that a breakdown by project of attempts/marks/ α s/ β s (in the same way as is given for each question on the written papers) is not routinely provided and **recommend** that this should be included with the rest of the examination statistics in future. In view of the change in format this year, the Committee noted the following statistics

Project	1.1	1.2	2.1	2.2	2.3	2.4
Attempts	212	218	172	124	38	87
Ave.Mark	15.8	17.4	16.8	16.3	14.8	14.6

showing that the pro-forma core projects (1.1, 1.2) gave similar marks to the two most popular optional projects.

The Committee noted that there is currently a somewhat complicated algorithm for the allocation of α s and β s. Since each project in IB is now marked out of 20, the Committee **recommend** that α s and β s are allocated for each project according to the same scheme as for an exam question marked out of 20.

One External Examiner (Professor Duck) is concerned about the impact that the Computational Projects mark has on the overall mark of some weaker candidates, noting that one candidate obtained 42% of his or her marks this way. This relates also to the point about examining the breadth of the curriculum raised above. The only way of preventing this from occurring, given

our cross-sectional system of examining, seems to be to cap the Computational Project mark (e.g. at 20% of total mark); this did not seem desirable to the Committee. The case referred to be Professor Duck is a, perhaps unfortunate, consequence of a system that the Faculty believes has great benefits.

Calculators

The External Examiners (Professors Duck and Jones) are concerned about effect, in particular to Numerical Analysis and Statistics, of not permitting calculators in the examinations. They raise the possibility of allowing calculators in (perhaps) just two papers. The Committee were not persuaded that this would be desirable, but **recommend** that the views of the Statistical Laboratory and the Numerical Analysis group be sought.

Variability of questions standards

One External Examiner (Professor Duck) commented on the variability of the questions again this year: for example, some candidates score 0/10 on a short question and 20/20 on the corresponding long question. The Committee noted in particular a large disparity between the standard of Methods questions on Papers I and II. They also noted the many of that short Fluid Dynamics questions had significant ‘problem’ elements, despite the guidelines.

The Committee believe that examiners have a corporate responsibility for the questions that they set, and (especially in the case of the Methods questions referred to above, which should have been accessible to more than half of the examiners) examiners and lecturers should make efforts to work together to reduce variability.

Part II

Standards

External Examiners were as usual content that classes obtained by most students were appropriate.

Professor King (External Examiner, Part II) repeated and elaborated on the comments he made last year to the effect that some students might have appeared in a lower class (or might have failed) at other universities. He finds it hard to see the justification for the Teaching Committee’s response of last year.³

Members of the Faculty Board will recall that the Education Committee of the General Board were also not satisfied with that response, and asked for elaboration from the Faculty Board. This was duly provided, and it seems likely that the elaboration, which was accepted by the Education Committee, was not forwarded to Professor King.

The main point that Professor King makes this year is that there is a rather long tail of weak candidates and that it is not clear that they are classed correctly. He gives some calculations to enable a comparison with other universities.

Professor King’s calculations are interesting and revealing, but the Teaching Committee are still not persuaded that it is reasonable, on the basis of such calculations, to (for example) fail a larger proportion of candidates. The Teaching Committee are aware of the high standard of work produced even by our very weak students over the course of the year.

It is the view of the Teaching Committee that Professor King’s analysis highlights the difficulty faced by the Faculty over the years in providing an examination that is suitable both for the weak and the strong candidates. The Committee noted that the proposals for revising Part II address

³‘The Committee are convinced that comparisons of our system (non-modular, unscaled marks) with very different systems used at other universities (in particular with modular systems with a fixed number of papers and scaled marks) do not provide a reliable guide to placing border lines.’

exactly this point, which, together with some of the recommendations in this report, should allow weaker candidates to achieve more in the examination.

Statistics

Class	1		2.1		2.2		3		**		Tot	
	M	F	M	F	M	F	M	F	M	F	M	F
Part IA 2003	65	8	65	28	35	15	15	7	1	2	181	60
%	35.9	13.3	35.9	46.7	19.3	25.0	8.3	11.7	0.6	3.3	75.1	24.9
Part IA 2002	71	5	78	19	32	20	10	7	4	0	195	51
%	36.4	9.8	40.0	37.3	16.4	39.2	5.1	13.7	2.1	0	79.3	20.7
Part IB 2003	64	8	67	18	30	17	14	4	1	1	176	48
%	36.4	16.7	38.1	37.5	17.0	35.4	8.0	8.3	0.6	2.1	78.6	21.4
Part IB 2002	56	7	67	21	37	10	7	6	2	1	169	45
%	33.1	15.6	39.6	45.7	21.9	22.2	4.1	13.3	1.2	2.2	79.0	21
Part II 2003	61	11	68	18	28	7	7	4	5	1	169	41
%	36.1	26.8	40.2	43.9	16.6	17.	1 4.1	9.8	3.0	2.4	80.5	19.5
Part II 2002	55	8	63	15	28	11	5	1	6	0	157	35
%	35.0	22.9	40.1	42.9	17.8	31.4	3.2	2.9	3.8	0.0	81.8	18.2

Notes.

1. The column marked ** includes candidates who failed, received an allowance from the examiners (but not from Council – e.g. not students visiting MIT) , and about whom an application has been submitted to the Applications Committee but who have not yet received an allowance.
2. It should be borne in mind that all examination scripts are marked and processed ‘blind’ (i.e. identified only by the candidate number).
3. The statistics related to gender above should be considered in the light of the statistical progression data by gender analysed by Dr Altham and presented to the Faculty Board at its meeting of 23 October 2003.

Chris Gibbs	Lucy Colwell	Tom Körner
Thanisis Fokas	Imre Leader	John Lister
Ruth Williams	Stephen Siklos (Chairman)	

September 27, 2006