Examiners' Report: Preliminary Examination in Mathematics and Philosophy Trinity Term 2024

November 12, 2024

Part I

(1) Numbers and percentages in each class

See Table 1. Overall, 19 candidates were classified.

Table 1: Numbers in each class (Preliminary Examination)

	Numbers				Percentages %			
	(2024)	(2023)	(2022)	(2021)	(2024)	(2023)	(2022)	(2021)
Distinction	5	4	7	7	26.32	23.53	38.89	35
Pass	13	12	10	11	68.42	70.59	55.56	55
Partial Pass	1	1	0	2	5.26	5.88	0	10
Incomplete	0	1	0	0	0	0	5.56	0
Fail	0	0	0	0	0	0	0	0
Total	19	17	17	20	100	100	100	100

B. NEW EXAMINING METHODS AND PROCEDURES

None.

C. CHANGES IN EXAMINING METHODS AND PROCEDURES CURRENTLY UNDER DISCUSSION OR CONTEMPLATED FOR THE FUTURE

None.

D. NOTICE OF EXAMINATION CONVENTIONS FOR CANDIDATES

The Notice to Candidates, containing details of the examinations and assessments, was issued to all candidates at the beginning of Trinity term. The Examination Conventions in full were made available at https://www.maths.ox.ac.uk/members/students/undergraduate-courses/examinations-assessments/examination-conventions.

Part II

A. GENERAL COMMENTS ON THE EXAMINATION

Acknowledgements

First, the Moderators should like to thank the Undergraduate Studies Administration Team.

We should also like to thank Matthew Brechin and Waldemar Schlackow for maintaining and running the examination database and their assistance during the final examination board meeting.

We should like to thank the lecturers for their feedback on proposed exam questions; the assessors for their extraordinary assistance with marking; and the team of graduate checkers for their rapid work checking the marks on the papers.

Timetable

The examinations began on Monday 17th June and ended on Friday 21st June.

Setting and checking of papers

The Moderators set and checked the questions, model solutions, and mark schemes. Every question was carefully considered by at least two moderators, and feedback was sought from lecturers. In a small number of cases feedback from lecturers was not available, and those were discussed in more detail until the Board of Moderators was satisfied that all questions were appropriate.

The questions were then combined into papers which were considered by the Board of Moderators and small changes were made to satisfy the Board that the papers were appropriate. After this a final proof-reading of the papers was completed before the Camera Ready Copies (CRCs) were produced. The whole Board of Moderators signed off the CRCs which were submitted to Examination Schools.

Marking and marks processing

The Moderators and Assessors marked the scripts according to the mark schemes and entered the marks. Small adjustments to some mark schemes were made at this stage, and care was take to ensure these were consistently applied to all candidates.

A team of graduate checkers, supervised by academic administration sorted all the scripts for each paper and carefully cross checked these against the mark scheme to spot any unmarked parts of questions, addition errors, or wrongly recorded marks. A number of errors were corrected, with each change checked and signed off by a Moderator, at least one of whom was present throughout the process.

Mitigating Circumstances

The Mitigating Circumstances Panel convened to band the impact level of the circumstances described in each Mitigating Circumstances Notices. Three bands labelled 1, 2, and 3 were used, with 1 being the least severe and 3 being the most severe.

Determination of University Standardised Marks

Marks for each individual assessment are reported as a University Standard Mark (USM) which is an integer between 0 and 100 inclusive. The Moderators used their academic judgment to map the raw marks on individual assessments to USMs using a process similar to previous years. In coming to this judgement the board followed the advice from the Mathematics Teaching Committee that the percentages awarded for each USM range of the examination should be in line with recent years. This alignment can be seen in Table 1; in more detail, for Papers I–V, a piecewise linear map was constructed as follows:

1. Candidates' raw marks for a given paper were ranked in descending order.
2. The default percentages p_1 of Distinctions and p_2 of Nominal Upper Seconds were selected.
3. The candidate at the p_1 percentile from the top of the ranked list was identified and assigned a USM of 70, and the corresponding raw mark denoted R_1.
4. The candidate at the $(p_1 + p_2)$ percentile from the top of the list was assigned a USM of 60 and the corresponding raw mark denoted R_2.
5. The line segment between $(R_1, 70)$ and $(R_2, 60)$ was extended linearly to USMs of 72 and 57 respectively, and the corresponding raw marks denoted C_1 and C_2 respectively.
6. A line segment through $(C_2, 57)$ was extended towards the vertical axis, as if it were to join the axis at $(0, 10)$, but the line segment was

terminated at a USM of 37 and the raw mark at the termination point was denoted C_3.

With these data a piecewise linear map was constructed with vertices at $\{(0,0),\ (C_3,37),\ (C_2,57),\ (C_1,72),\ (100,100)\}$.

Reports from the Assessors describing the apparent relative difficulty and the general standard of solutions for each question were then considered, and the Board decided that the values of $p_1 = 31\%$ and $p_2 = 48\%$ were suitable for all papers.

In line with previous years, for the Computational Mathematics assessment the linear map with gradient 2.5 was used to map from raw marks to USMs.

The vertices of the final maps used in each assessment are listed in Table 2.

Table 2: Vertices of final piecewise linear model

Paper	Vertices				
I	0;0	24.4;37	42.5;57	80;72	100;100
II	0;0	22.1;37	38.5;57	72.5;72	100;100
III	0;0	19.7;37	34.4;57	64.7;72	80;100
IV	0;0	27;37	41;57	69;72	100;100
V	0;0	20.2;37	35.1;57	66.1;72	80;100
CM	(0.0,0)	(40,100)			(0.0,0)

With the USMs, a provisional outcome class for each candidate was produced as follows: Write MI, MII, $MIII$, MIV and MV for the USMs on Papers I–V respectively, and CM for the USM on the Computational Mathematics assessment. Write Av_1 and Av_2 for the quantities

$$\frac{MI + MII + \frac{6}{5}MIII + MIV + \frac{4}{5}MV + \frac{1}{3}CM}{5\frac{1}{3}}$$

and

$$\frac{MI + MII + \frac{6}{5}MIII + MIV + \frac{4}{5}MV}{5}$$

respectively, symmetrically rounded. With these auxiliary statistics the provisional outcome class was determined by the definitions:

Distinction: both $Av_1 \geq 70$ and $Av_2 \geq 70$ and a USM of at least 40 on each paper and for the Computational Mathematics assessment;

Pass: not a Distinction and a USM of at least 40 on each paper and for the Computational Mathematics assessment;

Partial Pass: not a Pass or Distinction and a USM of at least 40 on three or more of Papers I–V;

Fail: not a Partial Pass, Pass, or Distinction, and a USM of less than 40 on three or more of Papers I–V.

The scripts of those candidates at the boundaries between outcome classes were scrutinised carefully to determine which attained the relevant qualitative descriptors and changes were made to move those into the correct class.

Mitigating Circumstances were then considered using the banding produced by the Mitigating Circumstances Panel, and appropriate actions were taken and recorded.

Table 3 gives the rank list ordered by the average of Av_1 and Av_2 (as defined above), showing the number and percentage of candidates with USM greater than or equal to each value.

Table 3: Rank list of average USM scores

		Candidates with USM $\geq x$	
USM (x)	Rank	Number	Percentage
79.88	1	1	5.26
75.19	2	2	10.53
73.81	3	3	15.79
67.62	4	4	21.05
66.94	5	5	26.32
64.19	6	6	31.58
63.75	7	7	36.84
63.31	8	8	42.11
63.06	9	9	47.37
62.62	10	10	52.63
62.38	11	11	57.89
61.75	12	12	63.16
61.56	13	13	68.42
61.5	14	14	73.68
61.44	15	15	78.95
57.38	16	17	89.47
57.38	16	17	89.47
57.06	18	18	94.74
42	19	19	100

Recommendations for next year's Moderators and Teaching Committee

1. It is recommended that markers completing assessor reports be told that a detailed mapping between raw marks and USMs will be arrived

at by the Board of Moderators later and so their report does not need to include this.

2. It is recommended that assessor reports be produced for the Computational Mathematics assessments.
3. The Board noted that there are definitions of gender that do not partition populations into those who are male and those who are female and asks Teaching Committee for guidance on whether the reporting in §B could usefully be different or expanded in future years to capture this or other equal opportunity issues.

B. EQUAL OPPORTUNITY ISSUES AND BREAKDOWN OF THE RESULTS BY GENDER

Table 4 shows the performances of candidates by gender. Here gender is the gender as recorded on eVision.

Table 4: Breakdown of results by gender

Outcome	Number								
	2024			2023			2022		
	Female	Male	Total	Female	Male	Total	Female	Male	Total
Distinction	1	4	5	0	4	4	3	4	7
Pass	5	8	13	9	3	12	6	4	10
Partial Pass	1	0	1	0	0	0	1	0	0
Incomplete	0	0	0	0	0	0	0	0	0
Fail	0	0	0	0	0	0	0	0	0
Total	7	12	19	9	7	16	10	8	18
Outcome	Percentage								
	2024			2023			2022		
	Female	Male	Total	Female	Male	Total	Female	Male	Total
Distinction	14.29	33.33	26.31	0	57.14	25	30	50	38.89
Pass	71.42	66.67	68.42	100	42.86	75	60	50	55.56
Partial Pass	14.28	0.00	5.26	0.00	0.00	0.00	10	0.00	5.56
Incomplete	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

C. STATISTICS ON CANDIDATES' PERFORMANCE IN EACH PART OF THE EXAMINATION

Table 5: Numbers taking each paper

Paper	Number of Candidates	Average raw mark	Std dev of raw marks	Average USM	Std dev of USMs	Number failing
I	19	55.47	7.83	62.21	3.29	0
II	19	46.89	17.75	59.42	14.88	0
III	19	40.11	10.42	58.53	7.53	0
IV	18			69.22	13.58	0
V	18			63.33	17.29	0

Tables 6–8 give the performance statistics for each individual assessment, showing for each question the average mark, first over all attempts, and then over the attempts used; the standard deviation over all attempts; and finally the total number of attempts, first those that were used, and then those that were unused.

Table 6: Statistics for Paper I

Question Number	Average mark All	Average mark Used	Std dev	No. of Attempts Used	No. of Attempts Unused
Q1	15.32	15.32	2.96	19	0
Q2	9.82	9.82	3.7	17	0
Q3	10.42	10.42	2.17	19	0
Q4	6.5	6.5	6.36	2	0
Q5	13.17	13.17	3.13	12	0
Q6	9.2	9.2	2.21	15	0
Q7	8.09	8.09	2.98	11	0

Table 7: Statistics for Paper II

Question Number	Average mark All	Average mark Used	Std dev	No. of Attempts Used	No. of Attempts Unused
Q1	13	13	3.56	16	0
Q2	8	8	2.79	10	0
Q3	11.44	11.44	4.82	9	0
Q4	12.06	12.06	4.04	18	0
Q5	9.83	9.83	5.15	18	0
Q7	5.89	5.89	3.5	18	0

Table 8: Statistics for Paper IIIP

Question Number	Average mark All	Average mark Used	Std dev	No. of Attempts Used	No. of Attempts Unused
Q1	9.95	9.95	3.92	19	0
Q2	11	11	5.29	3	0
Q3	9	9	3.98	15	0
Q4	9.63	9.63	3.05	16	0
Q5	11.5	11.5	3.06	12	0
Q6	11.3	11.3	4.85	10	0

D. COMMENTS ON PAPERS AND ON INDIVIDUAL QUESTIONS

Please see separate Mathematics Report for Papers shared with Mathematics, and similarly for Philosophy Papers see Philosophy Report.

Elements of Deductive Logic

There were 43 entries for this paper: 13 Computer Science and Philosophy candidates, 18 Mathematics and Philosophy ones, and 12 Physics and Philosophy ones. Four students, all reading Physics and Philosophy, failed the paper. Overall, the standard was high. Several candidates did not have time to finish the paper or visibly rushed their last question. Many candidates threw away marks needlessly by giving proofs that were insufficiently clear or rigorous.

Question 1. 22 takers. Average mark = 16.86/25. The great majority of candidates who attempted this question picked up the great majority of the marks available for parts (a) to (e), i.e. 17 marks. Part (f) was trickier, very few candidates making any sort of headway with it. One way to solve it is to use the Interpolation Theorem to show, towards a reductio, that a non-contradictory greatest lower bound must contain an infinity of sentence letters.

Question 2. 34 takers. Average mark = 16/25. There was a typo in part (c)(i) which did not seem to throw anyone, the great majority of students answering the intended question. Although the question was generally well done, many students lost some 'method' marks, because their arguments, although broadly on the right lines, were not clear or rigorous enough.

Question 3. 17 takers. Average mark = 16.88. The EDL lecturer had covered most of this question in lectures. It was generally well done, although some candidates gave arguments that appealed without proof to de Morgan's laws or distributive laws, despite the point of most of this question being to prove generalisations of these very laws. When candidates give separate arguments for each side of a biconditional, it would be helpful if they could preface each with 'For the left-to-right direction' and 'For the right-to-left direction' (or some such) respectively.

Question 4. 18 takers. Average mark = 14.89. Candidates found this to be the hardest question, mainly because of its length. Each of the parts was fairly easy, but there were many of them.

Question 5. 28 takers. Average mark = 17.29 Part (a) was generally well done, although several candidates thought that part (a)(iv) was true.

Part (b) was less well done: in (b)(i), people ignored the time dimension; in (b)(ii), some candidates strangely failed to recognised the two definite descriptions; in (b)(iii), some candidates failed to pick up on the fact that 'the builders' are a plural collective of unspecified number; and in (b)(iv) most candidates did not think carefully about the role of the expression 'It's vacuously true that'.

Question 6. 1 taker. Most probably, the question's length put candidates off.

Question 7. 26 takers. Average mark = 16.35. A generally well-done question. Some of the conditions were impossible to fulfil, and for these the right-hand side had to be a false statement. Not all candidates were clear about this.

Question 8. 24 takers. Average mark = 15.46. A range of answers, some very good, some less so. Part (b) generally gave people trouble – most takers wrongly thought that the set M has 8 members — although the technique was covered in lectures and in the supplementary notes. Part (e), an application of the Compactness Theorem, also proved tricky.

Frege: Foundations of Arithmetic 18 candidates, all reading Mathematics and Philosophy, sat the exam, 17 returning answers.

Question 9. 5 takers. Average mark = 57.4. A poor set of answers. Candidates did not generally explain how the question relates to Frege's views, and in assessing the claim were too quick to dismiss enumerative induction in mathematics without properly assessing what role it might have to play in mathematical discovery and justification.

Question 10. 12 takers. Average mark = 67.3 By far the most popular question, it was generally well-answered. Candidates discussed Mill's view and Frege's criticisms of it. Some of the better answers considered the resources that could be used to strengthen a weak version of Mill's view. Candidates also considered the significance of this point for Frege's project in the Grundlagen as a whole.

Question 11. 1 taker

Question 12. 1 taker

Question 13. No takers

Question 14. 5 takers. Average mark = 69.8 An excellent set of answers. Answers to (a) generally displayed familiarity with and made good use of the literature relating to the 'Bad Company Objection', specifically focusing on the kind of abstraction principle Hume's Principle is, as instructed. Answers to (b), arguably an easy question, pointed out in an interesting and fleshed-out way that versions of the Julius Caesar objection arise even under the stated stipulation, and explored how a stipulation could affect the ontological status of an object.

Paper IIIP

Question 1. Q1: This question was generally popular with students and was done well on the whole. In part (b) some candidates struggled to find an ansatz for the particular solution — they did not try a high enough power of x early on. In part (c), successful candidates either spotted that $m = -1/2$ simplified the ODE significantly (the intended solution) or did a little more work with $m = -1$ and the additional substitution $V = v(x)^2$.

Question 2. This question was very well done. Most students were able to do parts (a) and (b) relatively easily. Part (c) was well done in general, though some candidates failed to realize that a triangle had to be subtracted from $\int_0^{\pi/3} r(\theta)^2 \, \mathrm{d}\theta$ to determine the area to the right of the line $x = a$ correctly.

Question 3. The bookwork parts of this question were done well on the whole, though a number of candidates did not *explain* how a critical point is classified using insight from (a)(ii) instead quoting standard results by rote. Part (b) was also well done, though many candidates suffered from not being sufficiently careful with their algebra, making simple algebraic errors or introducing spurious critical points. Part (c) was not well done — very few candidates seemed to spot that the fourth-order Taylor expansion about the critical point $(0, 1)$ is exact and demonstrates that this critical point is a minimum.

Question 4. For this question, there were a number of very good answers, but also many who mixed up various formulas and ended up with wrong results or did not manage to solve the problem. Some few answers were somewhat disappointing, in that they did not seem to know where to start. There were also quite a number of copies where it seems the student ran out of time - after a good start, the answers stop.

Part a) was generally done very well, except for subpart iv), on which many did only achieve partial marks. The subpart a)i) was generally done well. Some people lost a mark here for not justifying the use of the infinite geometric series. a)ii) was equally not a problem for most people, though some did not justify the crucial step where one drops the intersection with the event that Z is larger than 2. a)iii) was the question that almost everyone managed to solve and got full marks on. For question iv), most people found the mean after some calculation and using the hint, but struggled to show that the variance diverges.

For part b), many people were able to derive at least some of the distributions, but equally many used the wrong formula or forgot to take into account part of the given information, deriving results that did not make sense. Subpart ii) depended on subpart i), hence those who struggled with i) generally could not answer ii).

Part c) was often answered well, with people recognizing the correct link to part a).

Question 5.

This was a popular question achieving a good spread of marks. (a) was mostly done well, with the occasional mark lost for a complete lack of logical structure and terminology. (b) was also done well by many, but a significant number either assumed $e_0 = n^2$ or in some incorrect way deduced two unknowns from a single linear equation instead of realising that $e_0 = 1 + e_1$, which can serve as a boundary condition. Some students also completed (c) in one of several different ways, and many who did not complete (c) (or made mistakes) scored some good partial marks.

Question 6.

This was a popular question and generally done well with a good spread. Some students lost one or both marks by only stating a finite special case in (a)(i) or by forgetting the disjointness assumption. Many students did not remember an accurate definition of what we call a continuous random variable. Some only proved special cases of (a)(ii) and (a)(iv) rather than explicitly using (a)(i). (b)(i) and (b)(ii) were usually done well, with some marks lost for not specifying the cdf for x outside [-1,1]. Answers to (b)(iii) were more variable, with many scoring well on the first transformation, which is bijective, but gradually less well on the second and third transformations, which are not bijective.

Elements of Deductive Logic

No comments submitted.

E. COMMENTS ON PERFORMANCE OF IDENTIFIABLE INDIVIDUALS

Prizes

The Departmental Prize was split between the two top candidates:

Luke Corey, Balliol College.
Inha Choi, University College.

F. MODERATORS AND ASSESSORS

Moderators: Prof. Andras Juhasz (Chair), Prof. Andrew Dancer, Dr. Adam Caulton, Dr. Alexander Paseau.

Assessors: Dr. Alexander Paseau, Dr. Adam Caulton, Dr. Aleksander Horawa, Dr. Antonio Girao, Dr. Richard Wade, Dr. Maria Christodoulou, Dr. Guillem Cazassus, Dr. Francis Aznaran, Dr. Gissell Estrada-Rodriguez, Dr. Josh Bull, Dr. Barnabus Janzer, Dr. Davide Spriano, Dr. Andrea Guidici, Dr. David Brantner, Dr. Kathryn Gillow, Dr. Matija Tapuskovic, Dr. Yurij Salmaniw, Dr. Felix Foutel Rodier, Dr. Jane Tan, Dr. Yang Liu, Dr. Adrian Fischer, Dr. Francis Aznaran, Dr. Tara Trauthwein.