Department of Mathematics and Statistics

Junior Mathematics Competition

The University of Otago Junior Mathematics Competition 2021

2021 Competition Report

General Comments

The 2021 competition saw the dawn of a new structure to the competition — that of a two part competition with an 'easier' first part and a 'harder' second part. Despite the technical difficulties encountered during the sitting of the first part of the competition this was mostly successful.

The number of pupils taking part in the competition in 2021 up from last year; about 4500 students from 140 schools. The second part of the competition had nearly 1600 pupils sitting, which is about our target number. Since schools have not been able to have new international students come in this year, it is a little hard to tell if numbers will climb to 2019 numbers or not in future years of the competition.

We faced two problems with the running of the competition that delayed results to schools. The first was the number of pupils trying to sit the first part of the competition on the morning of the official Wednesday date, which unfortunately overloaded our testing system. We managed to make a configuration change that fixed the issue fairly quickly, but not before a large number of pupils had been adversely affected. For more on how we plan to rectify this in future years please refer to the following section.

The second problem was that the overall quality of the participants of the second part of the competition was very high, which meant that marking 400 papers this year took considerably longer than marking 400 papers in previous years. This slowed the release of papers to the check markers and meant results were not ready until the middle of September, which was unfortunate.

Last year we did not award Top 100 and Top 200 certificates at all, and we have continued this practice this year. We have now determined that we will no longer be awarding such certificates. As noted earlier in the year, we are now awarding Distinction certificates to roughly the top 15% of participants in each year level, and Merits are now awarded to roughly the top 50% of participants in each year level. Note that to achieve a Merit or Distinction, a given pupil must place in the top 50% or 15% respectively in *either part of the competition*. This means that some pupils on your part two results sheet will receive Distinctions having earned a lower mark in the second part than other students who have only received a Merit.

As a whole most candidates found the first part of the competition relatively easy, while the second part was much harder (which was the intent). For the overall scores in 2021 see the table on page 3.

We continue to emphasise that doing as much as possible in a question before moving onto another question is better than jumping back and forth between questions. Another good idea is to write the answer down with the minimum working possible. Students can return to 'pad' the working out when they have done as much of the competition as they can do. Once again several 'capable' students answered the early questions nearly perfectly but ran out of time and could not do justice to the later ones, mainly because they wrote too much at the beginning. There is a fine line between explaining and over-explaining your answers.

FOR FURTHER INFORMATION CONTACT:
Tel: 03 466 7498
Email: jmc@maths.otago.ac.nz
Twitter: @uojmc

Next Year's Competition

Assuming the competition runs next year, the structure of the competition will be essentially the same, in that we will hold the competition in two parts, held roughly a month apart.

Dates for next year's competition have not yet been determined. If the competition proceeds then we will announce dates on the website, certainly by mid October.

What is certain is that the first part of the competition will be held in April, and like this year will be an online test featuring multi-choice and short answer questions. Next year we will set the time limit to 50 minutes rather than one hour, which will hopefully fit in better with school timetables. We will also ask schools to nominate when they would like to sit the competition. Each school will be able to list their chosen time slots in order of preference. For logistical reasons larger schools will be given preferences in the case of clashes. Note that because there are no prizes involved in the first part of the competition, it is likely that we will run the competition over one week in April, to allow more choices for schools.

The second part of the competition will once again be held in May, and will have the same structure as this year's competition, although again the time limit will be changed to 50 minutes. We will tweak entry to the second part of the competition next year. Pupils from most schools will only be able to enter the second part of the competition if they place in the top 15 percent of their year level nationwide in the first part of the competition. However it has become clear that this policy may adversely affect small schools. As such, if a school does not have 5 students in the top 15 percent of their year level nationwide in the first part, they may enter students who reached the top 50 percent of their level nationwide in the first part into the second part instead (up to a maximum of 5 students). For example, if your school only has 2 students in the top 15 percent, you may include up to 3 other students of your choice from the top 50 percent (but no more than 3). Note: we will not allow substitutions.

Schools may opt to do either both parts of the competition, or only the first part — there is no direct entry into the second part alone.

Once again we do not intend to raise the cost to enter beyond the $5 per pupil it is for schools currently.

Brief Comments on Individual Questions

Question One (Year 9 and below)

This was mostly well answered. Quite a few candidates just wrote down the word without given any of the associated numbers. It was clear that quite a few pupils got most of the clues then guessed the word.

Question Two (Year 10 and below)

The first three parts were mostly well answered; it was only the last part that tripped up a lot of pupils. It was not too uncommon to see candidates mix up the two plans in part (d).

Question Three

This was actually quite a hard question in the end. Most candidates managed the first two or three parts without too much trouble. It was the last two parts that the vast majority of candidates could not do. The key thing in parts (d) and (e) was to find not only a number that worked, but to also show that any larger number *did not work*. Those pupils who did find the correct answers frequently could not adequately explain why other options were incorrect, so full marks were rare in this question.

Question Four

The going was easier here than in Question Three, but it still proved tricky for a lot of pupils. The key subtlety in the middle part of the question was to realise that the smaller ratio of screen dimensions was the one to choose in each case, which eluded quite a few candidates. Also tricky was the deletion of pixels in part (c) - the pixels are removed from the screen and not the photo, and the amount to subtract was in fact 20 pixels in both directions — many pupils only subtracted 10 pixels in both directions, or added pixels instead.

Question Five

In hindsight this probably should have been Question Three. The initial concern from the competition setters about too many symbols proved to be unfounded. Most pupils found this question to be quite easy, and high and full marks were commonplace. The only real stumbling block was in part (c), where it was frequent to see no mention of 29 not being perfect.

Question Six

This was a question where it was easy to find the correct answers, but not so easy to explain how you found them. In practice brute force was actually a quick and sufficient way of reaching the correct answers, and those who tried more complicated and elegant mathematics often did not explain themselves sufficiently for full marks. A differently structured question with a far larger gap between events may have been better here.

Question Seven (Years 10 and 11)

This was quite an abstract question, and most pupils struggled here. There was discussion amongst the competition setters about putting in a diagram of a triangle to help guide students, but it probably would have made part (a) too easy. Part (b) was rarely answered correctly — in the end the number of candidates with full marks in this question was in the single digits across Years 10 and 11.

Question Eight (Year 11)

Year 11 pupils found this question slightly easier than Question Seven on average. Part (a) was less well done then had been hoped — candidates over-complicated a relatively simple situation. This was also true in part (b) — once again the Cosine rule was often employed, when a simpler approach was readily available. It was pleasing however that most pupils who answered (c) correctly were able to spot the answer was exact. (Perhaps we gave a clue by not mentioning rounding…)

Percentiles

The percentiles for the second part of the competition at each level are given below. (The total possible marks for all candidates was 100.) Note that the top papers (about 18% at each level) have been check-marked by experienced members of the Mathematics and Statistics Department of the University of Otago. This does use up considerable time in returning results, but we feel that the greater accuracy in final marks makes the check-marking justified.

	2021			2020		
	Year 9	**Year 10**	**Year 11**	**Year 9**	**Year 10**	**Year 11**
Distinction (15%ile)	54	55	66	59	65	76
70%ile	46	48	57	48	56	66
60%ile	42	45	52	42	50	59
Merit (50%ile)	38	40	48	36	45	53
25%ile	26	28	38	24	32	39

A direct comparison to last year's competition is always difficult, but it appears that the competition was harder for Year 10 and Year 11 pupils this year, while there was no real difference in difficulty between years for Year 9 candidates.

Note: Students received a Merit or Distinction based on their *best* performance across both parts of the competition. This means that it was entirely possibly to do poorly in the second part of the competition and receive a Distinction if a pupil did very well in the first part of the competition.

A Note on Calculators

We continue to stress how difficult it is for students without calculators to cope in a Mathematics competition. Even a simple calculator with the 'four basic functions' would save much time. Certainly Years 10 and 11 students cannot be expected to work out the more complicated problems towards the end without a calculator.

Explanation of the Symbols on the Mark-Sheets

The following symbols have been utilised on the mark sheets:

Questions 3, 4, 5, and 6 (up to 20 marks each):

(blank)	No work presented.
0	Work presented, but ungradeable, or fundamentally incorrect.
-	Minimal partial credit (1 – 5 marks).
+	Significant partial credit (6 – 13 marks).
✓	Near complete solution (14 – 17 marks).
✓✓	Full, or near full credit (18 – 20 marks).

Questions 1, 2, 7, and 8 (up to 10 marks each):

(blank)	No work presented or not applicable.
0	Work presented, but ungradeable, or fundamentally incorrect.
-	Minimal partial credit (1 – 4 marks).
+	Significant partial credit (5 – 8 marks).
✓	Near complete solution (9 – 10 marks).

Our Website and email

Please remember to check the front page of our website (particularly the News section) regularly for updates on the availability of results. You should monitor the website before emailing us for information which is already on there. We have emailed results to all schools. Many thanks to those who continue to use email – we have found this to be the most effective form of communication by far, and has reduced our administrative burden no end.

Final comments

Much like last year, this year the competition faced several challenges — there is no longer a formal manager, and the burden of running the competition continues to rest with several members of the Department of Mathematics and Statistics. We do hope to run the competition again next year — if we do, we hope you participate again!