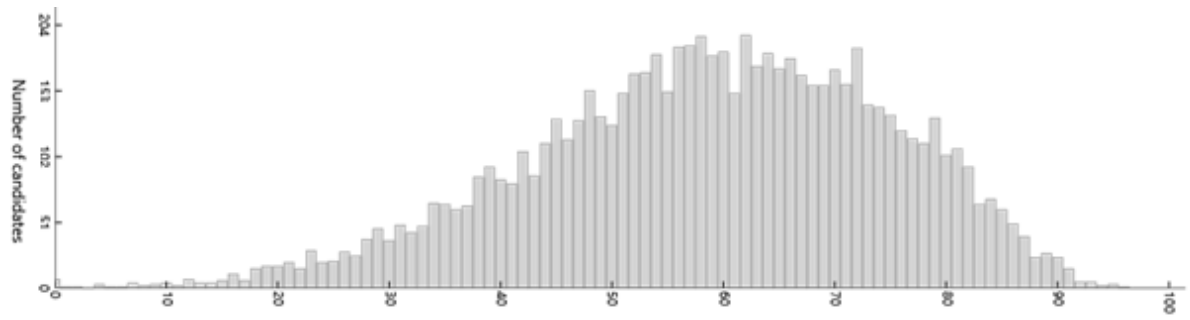
# 2020 ATAR course examination report:
# Mathematics Applications

| Year | Number who sat | Number of absentees |
|---|---|---|
| 2020 | 7611 | 192 |
| 2019 | 8047 | 163 |
| 2018 | 8451 | 178 |
| 2017 | 8992 | 174 |

The number of candidates sitting and the number attempting each section of the examination can differ as a result of non-attempts across sections of the examination.

### *Examination score distribution–Written*




### *Summary*

The examination consisted of two sections: a Calculator-free section and a Calculator-assumed section.

| | | | |
|---|---|---|---|
| Attempted by 7602 candidates | Mean 58.63% | Max 95.54% | Min 0.00% |
| | | | |
| Section means were: | | | |
| Section One: Calculator-free | Mean 67.37% | | |
| Attempted by 7601 candidates | Mean 23.58(/35) | Max 34.26 | Min 0.00 |
| Section Two: Calculator-assumed | Mean 53.92% | | |
| Attempted by 7601 candidates | Mean 35.05(/65) | Max 63.76 | Min 0.00 |

### *General comments*

Candidates appeared to have had adequate time to complete the examination, with the majority attempting all questions. The length of the paper seemed appropriate with 97% of the cohort attempting Question 15 and 96% attempting Question 16. The examination provided sufficient questions or question parts for candidates to score reasonably well, with a number of questions allowing for the discrimination of candidate ability. It was noted that candidates' written explanations have improved. However, basic arithmetic skills are still lacking amongst many candidates.

*Advice for candidates*

- Show working, even if the question is worth only two marks.
- Provide the correct units when required.
- Use brackets when squaring negative numbers on the calculator.
- Use a highlighter when indicating routes on a network.

*Advice for teachers*

- Continue to emphasise the importance of using correct terminology.
- Stress the importance of rounding to the appropriate whole number when dealing with discrete objects.
- Stress the importance of reading questions carefully.

***Comments on specific sections and questions***

**Section One: Calculator-free (47 Marks)**

Candidates performed well in this section, as shown by a mean of 67.37%. However, basic arithmetic skills, including converting simple fractions to percentages and calculating with decimals, are lacking among many candidates. Best candidate performances were seen in Question 6, while Question 1 appeared to be a good discriminating question.

Question 1 Attempted by 7596 Candidates Mean 2.24(/5) Max 5 Min 0

Part (a) was done poorly, with most candidates identifying the wrong explanatory variable. Generally, part (b) was done well, however, some candidates struggled to convert a simple fraction to a percentage. In part (c), most candidates were unable to identify the association in the table.

Question 2 Attempted by 7598 Candidates Mean 5.33(/8) Max 8 Min 0

Candidates were required to demonstrate knowledge of correct terminology in Question 2. Those lacking in this knowledge struggled to answer this question. Parts (a)(i) and (a)(ii) were done well. Part (a)(iii) was generally done well, however, many candidates who used Euler's formula did not subtract the two edges shown in the diagram to determine the additional edges required. Part (b)(i) was answered well. Part (b)(ii) was done reasonably well, apart from some candidates stating the plans were all semi-Eulerian and not answering the question as to whether any were Eulerian. Part (b)(iii) was done reasonably well.

Question 3 Attempted by 7595 Candidates Mean 6.17(/8) Max 8 Min 0

Most candidates performed well in this question. In part (b), some candidates minimised the number of sales rather than maximising the number of sales.

Question 4 Attempted by 7589 Candidates Mean 6.03(/11) Max 11 Min 0

Part (a) was done very well with only a few candidates reversing the axes. Part (b) was done reasonably well, although some candidates did not refer to the correlation coefficient being negative. Many candidates could not square $-0.6$ in part (c), with common responses being 1.2, 0.12 or $-0.36$. Part (d) was done poorly, with most candidates missing the key word 'variation' in their response, and some reversing the variables. Part (e) was not done very well. Most candidates could substitute correctly but struggled to multiply and then add/subtract decimals. Parts (f) and (g) were done poorly. A common response by candidates for part (f) was stating that it was an extrapolation and therefore not valid. In part (g), some candidates responded with a yes or no answer only, without any reference to statistical evidence in order to justify their response.

Question 5 Attempted by 7554 Candidates Mean 5.26(/7) Max 7 Min 0

Part (a)(i) was answered well, with most candidates correctly identifying the minimum spanning tree solution. Generally, part (a)(ii) was done well, however, some candidates were unable to add up the eleven numbers correctly. Part (b) was done well.

Question 6 Attempted by 7578 Candidates Mean 6.64(/8) Max 8 Min 0

Although part (a) was done reasonably well, some candidates did not answer the question in context. Part (b) was done well. The performance in part (c) was poor, with many candidates determining the total number of doorways rather than the number of doorways for each area. Candidates performed well in parts (d) and (e).

**Section Two: Calculator-assumed (105 Marks)**
Most candidates attempted all questions in this section. Questions 8, 11 and 16 proved to be the discriminating questions. Candidates were comfortable with routine calculations but had difficulty with questions that required written justification.

Question 7 Attempted by 7521 Candidates Mean 3.37(/6) Max 6 Min 0
Part (a) was done very well with only a few candidates answering in terms of height rather than annual growth. The performance in part (b) was poor, with many candidates struggling to give the correct rule. A common error involved stating a recurrence relation. Generally, parts (c) and (d) were done well, but a common error in part (d) was not adding the initial height in order to determine the maximum height.

Question 8 Attempted by 7378 Candidates Mean 4.22(/9) Max 9 Min 0
Part (a) was answered well, apart from candidates using 660 as $T_1$ rather than $T_0$, and writing the common ratio as either 1.9 or $\frac{0.09}{12}$. In part (b), most candidates stated the rule for the $n^{th}$ term in the form $A_n = 660 \times 1.09^{n-1}$ instead of $A_n = 660 \times 1.09^n$. Part (c) was done quite well; most candidates with a rule in part (b) could answer this part. Part (d) was done poorly, with many candidates using the value of 4000 instead of the actual value of 4031. In addition, many showed insufficient working for this 3 mark question part.

Question 9 Attempted by 7197 Candidates Mean 5.56(/11) Max 11 Min 0
Part (a) was done quite well. Common mistakes included rounding $Y$ to a whole number and not recognising that $Q$ was the opening balance. Part (b) was done reasonably well, however, some candidates were unable to determine the annual compound interest rate, giving answers such as 1.9%, 0.019 × 3 = 5.7%, 0.019 × 12 = 22.8% and 1.019 × 4 = 4.076%. Part (c) was not done well, with many candidates correctly calculating $n$ = 66 and then either quoting this as years or not converting this number of months into years. Part (d) was poorly done; many candidates could not calculate the quarterly payments. Of those candidates who attempted this part, many used $300 000 instead of $299 501.07. Many candidates could not use the effective interest formula correctly in part (e).

Question 10 Attempted by 7356 Candidates Mean 9.76(/15) Max 15 Min 0
Parts (a) and (b) were answered well. Performances were good in part (c), apart from those candidates that omitted the units. For part (d), most candidates were able to calculate the residual and plot it correctly on the graph. Part (e) was done well, except by those who stated that there was no pattern, without directly referring to the residual plot to justify their answer. Generally, part (f) was done well, however, some candidates missed the reference to the percentage **unexplained** by the variation. Part (g)(i) was done well as was part (g)(ii), with most candidates concluding it was not valid due to extrapolation. Part (h) was done reasonably well, although some candidates described the negative residual as being below the least-squares line instead of referring to the context.

Question 11 Attempted by 7094 Candidates Mean 3.27(/9) Max 9 Min 0
Part (a) was done reasonably well, however, a significant number of candidates did not understand that making more frequent payments reduced the total interest paid. Some even talked about budgeting. Part (b)(i) was done poorly. Common errors included using N = 12, C/Y = 1 or 12 or 24, and having the same sign for PV and PMT. Part (b)(ii) was done poorly. Common errors included not doubling the value of N and not using the balance from (b)(i) as the PV value. Part (c) was done poorly. Most candidates only stated the option, showing insufficient working for this 3 mark question part.

Question 12 Attempted by 7185 Candidates Mean 5.79(/10) Max 10 Min 0
Part (a)(i) was done well. Part (a)(ii) was done reasonably well, however, some candidates used 0.96 or 1.004 as their coefficient of $T_n$. Part (b) was done well. Part (c)(i) was done reasonably well, although some candidates divided the interest by 12 without dividing each repayment by 12. Part (c)(ii) was done reasonably well, apart from those candidates who did round up to the next term and gave their answer as 86 months. Part (c)(iii) was done poorly, with candidates either knowing what to do or not. In addition, many candidates did not show sufficient working, providing an answer only.

Question 13 Attempted by 7435 Candidates Mean 4.69(/9) Max 9 Min 0
Although part (a) was done reasonably well, it was common to see the Hamiltonian cycle ADCFHGEBA. Part (b) was done well, however, showing appropriate working was problematic with some candidates. Part (c) proved to be a good discriminating question, with very few candidates gaining full marks. Most candidates did not realise that a range of values was required.

Question 14 Attempted by 7458 Candidates Mean 8.79(/14) Max 14 Min 0
Part (a) was done very well. Generally, part (b) was done well. However, some candidates made rounding errors, which meant that the total of the seasonal indices did not equal 400, and therefore could not gain full marks. Part (c) was done reasonably well, however, some candidates incorrectly wrote that $\frac{13}{95.8} = 0.1358 = 13.6$. Part (d) was done well, with most candidates correctly choosing winter, although many failed to support this with correct mathematical evidence. Part (e) was done well. Part (f) was done reasonably well. Common errors included not multiplying by the seasonal index and rounding inappropriately. In part (g), most candidates identified the decline of the business, but did not support their answer with correct mathematical reasoning.

Question 15 Attempted by 7363 Candidates Mean 5.04(/8) Max 8 Min 0
Part (a) was done very well, although some candidates incorrectly wrote 38 + 19 + 6 = 57. Part (b) was done reasonably well, however, some candidates did not work systematically and calculated the maximum flow to be 51 L per minute. Part (c) was done poorly, with most candidates seemingly unaware of what was required by them in this question part. Part (d) was done reasonably well, with most candidates recognising that the flow would increase.

Question 16 Attempted by 7310 Candidates Mean 6.11(/14) Max 14 Min 0
Part (a) was done reasonably well. Common errors included having activity F following from A rather than C, having activity D following from B and going directly to H, missing arrows on the project network, and the dotted line from D to H either drawn as a solid line or missing altogether. Most candidates determined the correct minimum completion time in part (b) but did not identify that there were two critical paths. Part (c) was done poorly. Many candidates could not calculate float times. Part (d) was done poorly, with the most common response being that there was ‘no effect’. Of those candidates who identified two critical paths in part (b), the calculation of an increase of two days was done well, however, they frequently did not state the change to critical activities. Part (e) was done poorly. A number of candidates identified that activity B should be shortened, without providing a reason, and did not comment about activities E and F.