# Government of South Australia LogoSACE Board Logo2023 General Mathematics Subject Assessment Advice

Overview

Subject assessment advice, based on the 2023 assessment cycle, gives an overview of how students performed in their school and external assessments in relation to the learning requirements, assessment design criteria, and performance standards set out in the relevant subject outline. They provide information and advice regarding the assessment types, the application of the performance standards in school and external assessments, and the quality of student performance.

Teachers should refer to the subject outline for specifications on content and learning requirements, and to the subject operational information for operational matters and key dates.

School Assessment

Teachers can improve the moderation process and the online process by:

* thoroughly checking that all grades entered in school online are correct
* ensuring the uploaded files are a reasonable scan quality, that the work has the correct orientation, and that blank pages and student notes have been removed
* uploading the SATs as a single scanned file
* preferably providing a summary of student results in each of the SATs on the first page of the uploaded SATs file
* filling in the variation form if a student did not complete one or more skills and applications tasks or mathematical investigation(s)
* for SATs and mathematical investigations responses, clearly marked answers showing which mathematical calculations are fully or partially correct and which are incorrect is a requirement of moderation. Showing marks and totals for SATs is also helpful.

Assessment Type 1: Skills and Application Tasks

Students undertake five skills and applications tasks, including at least one skills and applications task from each of the non-examined topics. The equivalent of one skills and applications task must be undertaken without the use of either a calculator or notes.

It is a requirement for moderation that SATs are marked to clearly indicate how much of each mathematical problem a student has been successful in attempting. Marking of all calculations in assessment responses is essential to support the moderation process.

All nine assessment criteria should be assessed at least once in either the skills and applications tasks or in the mathematical investigation. In particular, RC5 (‘forming and testing of predictions’) is easier to assess within Assessment Type 2: Mathematical Investigations. If it is assessed in the skills and applications tasks, then students should have plenty of opportunity to meet the specific feature to an A standard.

Teachers can elicit more successful responses by:

* designing tasks that provide a mix of routine and more complex problems that effectively differentiate student mathematical knowledge and understanding of concepts and relationships across the grade bands. A complexity guide has been provided to support teachers to identify key questions and key concepts that provide the opportunity for complexity in responses. The document ‘Complexity Guide General Mathematics’ is available at the following link: <https://www.sace.sa.edu.au/web/general-mathematics/stage-2/support-materials/subject-advice-and-strategies> .
* providing multiple opportunities for students to demonstrate their interpretation of concepts and results in the context of the problem, including discussion of the assumption and limitations of the results in all skills and applications tasks
* using appropriate verbs such as state, explain, and interpret to guide students to form an appropriate response
* strategically placing ‘show’ questions that allow students back into a question if they were not able to complete a previous part successfully. An example of a ‘show’ question is providing the approximate answer to an annuity problem so that students who are not able to find the value can use the provided figure to continue through the following questions. In a ‘show’ question, students are required to not only present the final value but also provide evidence of the method used to determine that value, with marks not awarded for simply stating the given value in the question stem
* guiding students with information on the allocated marks for each question and the provided space for writing the answers, helping them understand the expected level of detail in their answers.

The more successful responses commonly:

* showed clear working out of all relevant steps, in particular for the ‘show that’ questions (an example of this is when students provide N, I, PV, PMT, FV, P/Y, C/Y as well as the exact answer in a ‘show that’ finance question)
* discussed the assumptions and limitations of the result in the context of the problem.

The less successful responses commonly:

* were seen in skills and applications tasks that provided limited opportunities for students to respond to questions of a complex nature. Teachers need to ensure that at least 30% of the marks in each task are composed of questions covering complex concepts or requiring complex processes to solve the questions. Making changes to questions such as changing a transition matrix and comparing the impact, or changing a constraint in a linear programming question is a great way to add complexity
* were seen where questions requiring complex processes or concepts were heavily scaffolded to support progress through the solution, and the complexity was reduced. An example of a reduction in complexity due to scaffolding is in linear programming, where the constraints are stepped out using a table format with some parts already filled in, or in comparison rates where each step was asked for
* were seen when questions required the use of answers from previous parts of the question, yet no ‘show’ question was provided to allow students to attempt the latter parts of the question if they were unable to complete the initial parts
* were evident when the students were not given opportunity to interpret the mathematical results in the context of the problem across all five skills and applications tasks
* provided generic responses to assumptions and limitations rather than responses in context. An example of this is in critical path analysis, where a student writes ‘delay to a job’ with no indication of what might cause a delay, such as building materials might be taking longer to arrive
* provided responses to assumptions and limitations that did not provide enough detail. An example of this is in finance where a student writes ‘interest rate changing’ with no indication of whether the interest rate is to increase or decrease
* occurred where teachers indicated that they were assessing RC5 (forming and testing of predictions) and CT3 (application of mathematical models), yet the students were not given an opportunity to show these skills at an A level, or at all
* were seen when questions were based on tasks that used directly used questions from a textbook or from past exams. Questions from past examinations or exemplar skills and application tasks can be used as the basis for questions in skills and applications tasks, however they should be amended so they are not easily recognisable and do not form the majority of questions assessed in any individual task
* occurred where an open topic was included that did not have enough complexity for students to achieve in the higher-grade bands.

Assessment Type 2: Mathematical Investigations

Students undertake two mathematical investigations with a maximum length of 12 A4 single-sided pages with a minimum of size 10 font. The evidence presented in the two investigations should include key ideas and key concepts from at least two different topics.

Teachers may need to provide support and clear directions for the first investigation. However, the second investigation must be less directed and set within more open-ended contexts.

It is a requirement for moderation that teachers ensure that all mathematical solutions produced by the student in the investigations are marked for accuracy and errors are identified, as well as making comments about the written component. This supports both student understanding and the moderation process.

Before uploading, teachers should check the file for reasonable scan quality and that the work has the correct orientation. It also assists moderators with the moderation process if both tasks are uploaded in the same file.

Teachers can elicit more successful responses by:

* providing some structure of an initial problem leading to a more open-ended problem to investigate, to allow the student to develop the model at the higher-grade bands
* ensuring the task provides multiple opportunities for students to make, test, and discuss predictions, as well as use these results to make further predictions
* ensuring that the design of the task allows for the discussion of limitations and reasonableness in context, both in the initial problem as well as the open-ended section
* students presenting the response in report format. Communication of mathematical information is best done by using appropriate headings, labelling graphs and tables, referring to them in the main body of the response, and using appendices for repetitive calculations
* students using a sub heading for predictions and assumptions and limitations to make it clear to the moderator where they are covered.

The more successful responses commonly:

* occurred in response to tasks designed with enough scaffolding for students to achieve at the C grade band in the initial parts of the task, but also with an open-ended section which required students to extend their investigation in a direction of their own choosing. This allowed them to demonstrate their understanding at the higher-grade bands
* included a detailed development and application of a mathematical model beyond the initial model, with enough complexity. A complexity guide has been provided to support teachers to identify key questions and concepts that provide the opportunity for complexity. The document ‘Complexity Guide General Mathematics’ is available at the following link: <https://www.sace.sa.edu.au/web/general-mathematics/stage-2/support-materials/subject-advice-and-strategies>
* were seen where students made appropriate predictions before they began calculations, as well as using their calculations to refine future predictions and finally discussing the accuracy of their predictions. An example of this is when students:
* make a prediction of how much money they may save on a home loan if they increase the repayment by $100
* perform calculations to find the savings gained through the $100 increase

- compare the calculated value to their prediction

- use their answer to make a more refined prediction about how much they will save if they were to, for instance, double the payment to $200

- could also refine their predictions when combining two interest minimisation strategies.

* used tables to summarise results
* showed comprehensive interpretation of the results, by providing complete interpretations of the answers in context, as well as comparing the results of different scenarios and discussing the key findings. An example of this is when students:
* interpret a variety of interest minimisation strategies including time and interest saved
* compare how much was saved by different interest minimisation strategies
* discuss some key findings such as that increasing a payment is better than reducing the term of the loan, as it has less risk for the same money saved.
* demonstrated a comprehensive understanding of the assumptions made in their investigations, the reasonableness of their results, and the limitations of the models they had investigated
* were seen in statistics tasks where students made a prediction about the model instead of subbing into a model and calling this a prediction. An example of an appropriate prediction in the coffee cooling experiment would be, due to a lid being on the coffee cup it will take longer to reach 30 degrees compared to a coffee without a lid.

The less successful responses commonly:

* were in response to tasks that used the same starting parameters or data, reducing the individuality of responses
* were in responses where calculations had been marked correct, yet it was obvious that they were incorrect. An example of this is a lump sum of $10 000 saving more than a $20 000 lump sum
* had evidence of all students following the same modelling processes (with the same changes implemented to their model), which indicated excessive teacher scaffolding. This particularly impacted the students in the higher-grade bands as scaffolding reduces complex mathematical modelling to a more routine level. An example of this is in the coffee cooling statistics task where all students in the assessment group would do the initial plus the exact same changes to their model, for example, add milk or change cup
* did not show enough complexity in calculations and model development at the A level, even though the task allowed them to. Examples included:
* in Topic 1: Modelling with Linear Relationships, where students did not cover concepts such as wastage, change of constraints, multiple solutions, or non-integer solutions
* in Topic 3: Statistical Models, where students only looked at residual plots for the exponential model instead of all models or did not look at the impact of removing an outlier
* in Topic 4: Finance Models, where students only changed one variable at a time, or completed an offset like a lump sum that goes and stays in for the term of the loan.
* included excessive routine and often repetitive calculations that were prescribed in the task design. This, in turn, limited the students’ ability to show more complex changes
* lacked depth in the analysis due to the response providing evidence of a recount of what the student did rather than an analysis of the outcomes of the mathematical calculations in the context of the problem. Students should be informed that the analysis of the mathematical results should include:
* interpretation of the answers in context
* comparison of results
* discussion of key findings rather than a recount of what they did and how they did it.
* lacked evidence of both drawing conclusions and understanding of assumptions and limitations to address RC2 - most commonly providing minimal evidence of explanation of the assumptions and limitations in context
* were difficult to follow, lacking an explanation of choices made in developing a model
* lacked evidence in either task of predictions being made prior to calculations being completed or a further discussion of the accuracy of the predictions
* occurred where only one opportunity was allowed for a prediction to be made. This limited the students’ ability to show their understanding at the higher-grade bands
* occurred in the statistics task where students thought a prediction is simply subbing into an equation they have found and discussing if it was reliable based on extrapolation or interpolation. In this case, the students are not actually making a prediction, as they have not indicated what they think the outcome of the model will be. An example of a more appropriate prediction in the coffee cooling task would be that if milk was used in the coffee, the initial temperature would be lower, and the rate of decrease would be slower than a coffee without milk, or if milk was added it is predicted to reach room temperature more quickly
* when an open topic was covered; however, the task did not allow the students to show enough complexity to achieve in the higher-grade bands.

External Assessment

Assessment Type 3: Examination

The evidence in the students’ responses to the 2023 examination showed that the vast majority of well-prepared students were able to complete the paper in the time available.

Unlike previous examinations, the 2023 examination only had eight questions. There was however a continued even or approximately even allocation of marks across topics. Again, this year, students performed best in the Hungarian algorithm question, with the Discrete models topic again being the most successfully answered of the three topics.

The most successful students continue to show clear process in their calculations, including in the recording of calculator inputs (especially for the Financial and Statistical models questions) and displaying calculator solutions before rounding them appropriately based on the needs of the question. Where a worded response was required, these students paid attention to what the question asked for and the marks available, giving clear and distinct responses in the context of the question rather than generic responses from their cheat sheet.

The most common concepts that students struggled with were:

* (1)(c) and (d) the explanation of a dummy link and the completion of a forward/backward scan where a dummy link is in place
* (2)(c) selection of the incorrect tail and area combination for inverse normal calculations
* (3)(c)(ii) understanding that interest is generated in sinking funds
* (3)(e) explaining why you may select a more expensive loan option
* (4)(g) comparison of the time taken to reach a population level in differing scenarios
* (6)(c)(iii) calculation of the interest saved when using an offset account facility
* (6)(e) providing mathematical reasoning to recommend using either the offset or the investment option
* (7)(b)(ii) using the evidence provided to explain why a model better fits the data provided
* (7)(c) underestimated data from a residual plot
* (7)(d) interpretation of the ‘a’ and ‘b’ values for an exponential regression model in context
* (7)(f) making predictions about when the two models provided, produced the same number of tricks
* (8)(d)(i) finding the latest starting time of a task
* (8)(e) the calculation of the possible time taken to complete a task.

Examination markers aim to award marks for evidence of student understanding in response to examination questions wherever possible, however students should be advised not to cross out their responses or attempted responses to questions in the examination booklet unless they are confident that no part of what is crossed out should be considered by the marker.

If a student crosses out a response and then decides that it was the correct (or the most correct) answer, then the student should indicate clearly to the marker which part of their response should be considered. This could be done by circling or highlighting all or part of the response that the student wants to be considered and writing ‘please mark this work’. Students do not need to rewrite their answers in this case unless the crossing out has rendered the response unreadable. With this in mind, students should avoid completing the exam in pencil and using an eraser to remove completed work. Pencils should only be used for diagrams or graphical representations and not as the main writing implement. Remember also that there is an additional page at the back of the exam booklet if further space is required for any question, rather than squashing responses and making them harder to read.

In financial modelling questions, students should always round a monetary solution to two decimal places, providing an answer correct to the nearest cent. It is also always better to provide more decimal places in solutions, than an insufficient number. Examples of this would be when calculating a proportion in a normal distribution question or when describing the rate of increase ‘b’ in an exponential regression question. Rounding will be discussed where appropriate in the review of questions.

In several questions each year, students will be asked to “show that xxxxx is approximately $X”. These questions are in the exam to provide students who are unable to complete one section with a way back into the question and to show knowledge in subsequent parts to the question. This commonly occurs in financial questions. When this happens, students can continue, without penalty, using either the value that they have calculated themselves or the ‘show that’ value stated in the question. Exam markers will follow the student’s working to look for correct process and will be provided with marking schemes to suit both calculated and ‘show that’ solutions.

Question 1 – Discrete modelling - Precedence table and critical path analysis

This question was split into two main sections, with parts (a), (b), and (c) analysing the information provided in the network diagram. Parts (a) and (b) were routine and completed very well by the majority of students. Part (c) required students to explain why the dummy link was required, with reference to the diagram. This was similar in design to question (7)(b) from the 2022 examination; however, this year, 2 marks were allocated, indicating that two statements would be required, one about the prerequisites of task E and the other about the prerequisites of tasks C and D. It was evident that students’ understanding of this concept is slightly improving, although it remains one of the concepts highlighted by markers as being poorly completed by the cohort as a whole. The second section focussed on the completion of a forward/backward scan and then an interpretation of the minimum completion time, where students need to remember to include appropriate units. Again, the dummy link provided issues for large numbers of students with the most common errors evident in the node following task A and the dummy link.

Question 2 – Statistical modelling – Normal distribution

This question on normal distribution should have provided students with routine sections which have been commonplace in previous examinations. Part (a) was answered well; it did not require the use of the graphics calculator, as the upper and lower boundaries were 1 standard deviation apart, and the mean was one of the boundaries. In this section, the solution would be accepted as either a decimal or as a fraction. However, it is worth noting that rounding of the decimals to fewer than two decimal places (i.e. nearest percentage) would be considered incorrectly rounded here. Rounding too early or severely in part (b) was also an issue for some students. As previously stated, a minimum of two decimal places is needed for your calculation of p. Part (c) utilised the inverse normal function, with the most common errors occurring where students selected the incorrect combination of tail and area. Part (d) introduced a new hospital to test a claim. This part could be answered using either the Ncd function or the InvN function, however students needed to be clear with a statement to either support or refute the claim. Students who made a guess about the claim but provided no calculation evidence received zero marks here. In general, there seemed to be a better understanding of the layered graphing question, with the majority of students able to successfully identify the mean and standard deviation from the graphs. Part (f) was less well done, with lots of students struggling to explain why negative time is not possible.

Question 3 – Financial modelling – Sinking fund, Comparison rate and Inflation

This is the first of the two financial modelling questions. This question was split into three main sections. The first section in parts (a), (b), and (c) focused on an interest only loan and sinking fund. The most common errors in part (a) were where students attempted to use compound interest instead of simple interest, however in general this was completed well. Part (b) involved calculating pmt. The most common error here was reversing Pv and Fv to treat the sinking fund as a loan instead of an investment. Students who did this were still able to gain the first mark in part (c) but would not have been able to explain that a sinking fund generates interest as it is an investment. Unfortunately, lots of students found (c)(ii) difficult to explain.

The second section, in part (d), focused on a comparison rate calculation for a loan. It is pleasing to note that we are now seeing very few students complete this calculation using the old Mathematical Applications method. In general, most students were able to gain two of the three marks available here. The most common error was when the fee was added and students used an incorrect sign in the calculator, thus reducing pmt instead of increasing it. Part (e) was poorly completed with lots of students finding it hard to explain why the club would go for the more expensive option. In this part, the context was important to the answer provided. Potential solutions include that a relationship with the more expensive provider was already in place or that the quarterly option worked better for them than monthly due to cash flow issues with membership.

The final section in this question, part (f), focussed on inflation. This section was attempted well, with both the calculation and explanation answered well. The recent news coverage of higher inflation and cost of living increases possibly helping with student understanding overall here.

Question 4 – Statistical modelling - Linear regression

This is another example of a question split into two main sections and a final part which compares both sections. Parts (a) to (c) answered questions relating to data provided about potoroos in a breeding program, with parts (d) to (f) focussing on data about the species once released to their natural habitat.

Part (a)(i) was completed well, with the majority of students able to successfully calculate Pearson’s Correlation Coefficient (r). The most common error here was stating the value of r2 instead of r. Part (a)(ii) was asked a little differently to how it has been posed in previous years, however most students were able to explain that there was a ‘strong relationship/correlation’ between the variables. Alternatively, students could have followed the subject outline and stated that ‘as r > 0.84, predictions can be made’. This was however seen less frequently. Parts (b) and (c) were generally well attempted, with most students who attempted this section able to gain 2 out of the 3 marks on offer.

The second section of this question looked at parts (d), (e), and (f), where a new table was provided. Most students were able to correctly identify the outlier in part (d). It is worth noting that should students remove the incorrect outlier, they could still gain maximum marks from the remaining sections provided they followed through correctly. Part (e) required students to use correct variables to state their new linear model. This was not completed particularly well. It would be good practice to use correct variables in all linear and exponential regression questions, whether required or not. This way, students will not forget to use them if specifically required. Again, depending on how students rounded their ‘a’ and ‘b’ values for their model, their solution to part (f) will vary. In this section, two decimal places would be appropriate rounding for ‘a’ and ‘b’. Part (f) was generally answered well.

The final section was poorly completed with very few students gaining both marks. Most students forgot to add on the initial 60 months when considering comparing part (f) to part (c)(ii). This was the most common error in this question.

Question 5 – Discrete modelling – Hungarian algorithm

As stated in the introduction to this section, this question was very well attempted overall by the vast majority of students with approximately 75% of students gaining a minimum of 10 out of the 12 marks available here. Parts (a) and (b) were routine and completed well. In part(b), students again need to make sure that they state the correct units. The most common incorrect solution in part (c) was that ‘all apprentices had repairing systems as the highest hours of training’. Part (d)(i) required an explanation of the first step of a maximisation problem. This was generally well answered. Part (d)(ii) was the mechanics of the Hungarian algorithm itself. Most students were able to gain 3 of the 4 marks with the most common errors being forgetting to add where lines cross. It needs to be noted that an alternate method of solving this problem was seen, where students did not apply row/column reduction, but went straight into adding lines. While a correct allocation will result here, full credit cannot be applied in this case, as the steps of the Hungarian algorithm were not fully completed to obtain the allocation of tasks. In general, part (d)(iii) was answered well and students were able to successfully come up with an appropriate limitation in the context.

Question 6 – Financial models – Home loans with offset or investment option

This was a larger question worth 18 marks, however each individual page could be treated separately due to the multiple ‘show that’ parts which allowed students opportunities to get back into the question.

Parts (a)(i) and (a)(ii) were completed well by most students. Again, the most common error in part (a)(i) was to mix up Pv and Fv, to treat this as an investment. In this scenario students should realise the error as their pmt solution will be quite different to the approximate $2100 stated. As stated in the introduction to this section, students can then continue with either the $2100 stated or the $2104.02 that was calculated, with markers following both solutions without penalty for correct process. In part (a)(iii) students were generally able to achieve at least 1 mark. Students who only provided interest minimisation strategies would only receive a maximum of one mark as this would be treated as the same reason. Part (b) was answered well by students who attempted this question. It could be answered using both PM1, PM2, Balance, or using the compound interest menu to find a future value after 3 years. Noting the space available for part (b), students are encouraged to use the amortisation method. In general, the use of amortisation is improving, however it would be good to see more students using this method moving forward as it is more time efficient for the student.

The second page of this question focussed on the utilisation of an offset account for a four-year period. This page was not completed as well with part (c)(iii) being the worst attempted question in the examination. Parts (c)(i) and (c)(ii) are routine and relatively simple calculations with (c)(i) only requiring a simple subtraction of $50 000 from whatever solution students provided to part (b). Part (c)(ii) was somewhat similar to part (b), with a balance to be calculated after a further 4 years. This was completed well by the students who attempted this question, however it was left blank by large numbers of students. Part c(iii) could have been attempted in multiple ways. No matter which way you decide to go, the first thing that needed to occur was to add the $50 000 back to the Pv. This was one of the most common errors for students attempting this question. After adding the $50 000, students should then calculate the time taken (n value) to now repay the loan. From this point, students would then need to compare the loan costing or sum interest sections with and without the offset facility. Most students making a reasonable attempt at this question were able to gain at least one mark, however this was very poorly attempted overall or left blank.

Most of the third page, part (d), was essentially an independent section looking at the investment of a $50 000 lump sum. Again, this was simplified by providing an approximate final balance which allowed students to still access parts (d)(ii) and (d)(iii). Students who attempted part (d) in full generally picked up the majority of the marks here. Sadly, many students who did not attempt the final stages of part (c) left this blank. Students should be encouraged to still attempt sections even if they struggle with a previous section. The exam is written in a way to make this accessible.

Part (e) tied pages 2 and 3 together by asking students to provide two financial reasons to support either the use of the offset account or the investment. In this scenario students needed to think about the features of the offset account which would benefit the person. The most common solutions being access to the funds in case of emergency and saving of time or more interest. Students were only able to pick up a maximum of one mark by selection of the investment option, although this was not seen very often. In general students answered this final question quite well if they attempted it. Students who left part (c)(iii) blank found this question difficult to gain marks in.

Question 7 – Statistical modelling – Linear regression residual plot and exponential regression

This question was statistically the poorest answered in the examination with students struggling in multiple sections. Part (a) required a calculation of a residual value for a linear model. This should be a routine calculation on the graphics calculator. The most common error was for students to forget the negative sign. This was also left blank by a large number of students who may have overlooked that the question was there. Part (b) required the calculation of r2 for both a linear and an exponential model. In this question, rounding is again important and a minimum of two decimal places would be required for full credit here. The reason for this is that rounding to 1 decimal place would provide the exponential model with an r2 of 1, indicating a perfect relationship, which is incorrect. Part (b)(ii) required evidence from parts (a) **and** (b)(i). For two marks, students would need to provide a piece of evidence from part (a) (clear pattern/no random scatter in linear model residual plot **or** large residual values) and a piece of evidence from part (b) (higher r2 value for the exponential model). Part (c) was another question that was missed by a large number of students. The idea of an underestimate seems to be misinterpreted, with many students who attempted part (c) circling the dot below the 80. This is in fact the largest overestimate, as at this point the exponential regression (the x axis on the residual plot) is the greatest distance above this point. Part (d) required students to interpret the values of ‘a’ and ‘b’ for the exponential model in the context of the question. This was something that students did struggle with, however many students were able to gain 1 mark. Students need to think about what each value means and what it represents in context. This is something that students would benefit from writing on their cheat sheet. It is also worth noting that students frequently confuse the ‘a’ and ‘b’ values for linear and exponential regressions. Part (e) was generally completed well by students who attempted the question, however there were large numbers of students who left this blank. Part (f) was not attempted particularly well. Here students needed to find the point of intersection of the two exponential models. This part is a little different, however students were guided to use graphing, something that all students should be able to complete within this course.

Question 8 – Discrete modelling – Critical path analysis

This question is similar in structure to the second half of question 2 from the 2022 exam. This was completed a little better than that question, however students are still struggling with the idea of only having a forward and backward scan, without completion times for tasks. In this type of question, students need to work through to establish the length of time each task takes. With this approach, parts (a), (b), and (c) become more straightforward. In general, parts (a), (b), and (c) were well answered. Students again struggled with the calculation for latest starting time as required in part (d). If the task time (21 minutes) is known, this again becomes more routine in nature. Alternatively, this can be calculated by adding the slack time of task K to the earliest starting time of task F. Part (d)(ii) was better attempted with the majority of students attempting this question getting it correct. Part (e) was very poorly attempted. The wording of the statement is very important here. Essentially the task needs to take more than **zero minutes** but at most 21 minutes. Note that the initial statement says that t > 0 minutes. This is the clue here, but also there is nothing to say that a task needs to take a full minute. It might be less than a minute, but it cannot be zero, as zero indicates a dummy link. Parts (f)(i) and (f)(ii) were both well attempted, with the majority of students gaining 2 of the 3 marks available. The advice from last year around changes to the critical path and changes to the completion time seems to have been taken on board with students answering this section successfully, in good detail.