# Agricultural Science subject report

2021 cohort

February 2022

Queensland Government

QCAA Queensland Curriculum & Assessment Authority

220032

For all Queensland schools

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# Contents

# Introduction

Despite the challenges brought about by the COVID-19 pandemic, Queensland's education community can look back on 2021 with satisfaction at having implemented the first full assessment cycle in the new Queensland Certificate of Education (QCE) system. That meant delivering three internal assessments and one external assessment in each General subject.

This report analyses that cycle — from endorsing summative internal assessment instruments to confirming internal assessment marks, and designing and marking external assessment. It also gives readers information about:

- applying syllabus objectives in the design and marking of internal and external assessments
- patterns of student achievement.

The report promotes continuous improvement by:

- identifying effective practices in the design and marking of valid, accessible and reliable assessments
- recommending where and how to enhance the design and marking of valid, accessible and reliable assessment instruments
- providing examples of best practice where relevant, possible and appropriate.

## Audience and use

This report should be read by school leaders, subject leaders and teachers to:

- inform teaching and learning and assessment preparation
- assist in assessment design practice
- assist in making assessment decisions
- help prepare students for external assessment.

The report is publicly available to promote transparency and accountability. Students, parents, community members and other education stakeholders can learn about the assessment practices and outcomes for General subjects (including alternative sequences (AS) and Senior External Examination (SEE) subjects, where relevant) and General (Extension) subjects.

## Report preparation

The report includes analyses of data and other information from endorsement, confirmation and external assessment processes. It also includes advice from the chief confirmer, chief endorser and chief marker, developed in consultation with and support from QCAA subject matter experts.

# Subject data summary

## Subject completion

The following data includes students who completed the General subject or AS.

For the purposes of this report, while the 2021 summative units for the AS are AS units 1 and 2, this information will be included with the General summative Units 3 and 4.

**Note:** All data is correct as at 17 December 2021. Where percentages are provided, these are rounded to two decimal places and, therefore, may not add up to 100%.

Number of schools that offered the subject: 49.

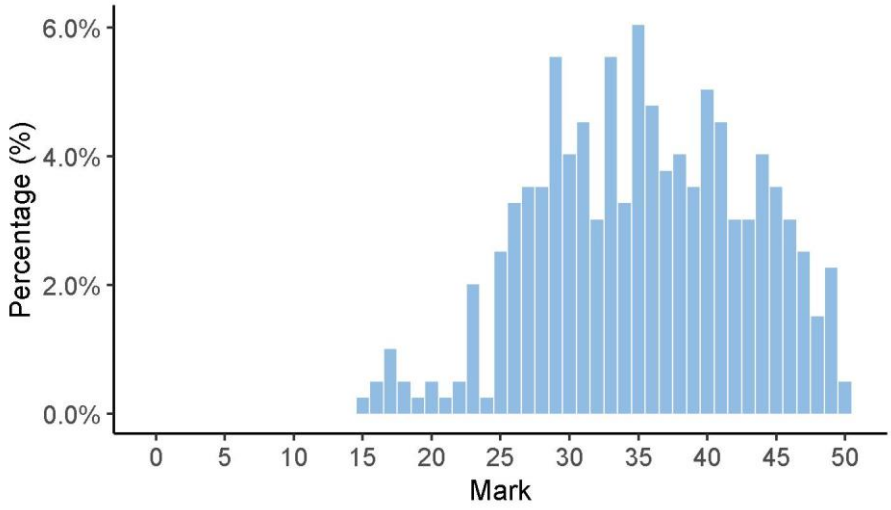
| Completion of units | Unit 1 | Unit 2 | Units 3 and 4 |
|---|---|---|---|
| **Number of students completed** | 398 | 370 | 393 |

## Units 1 and 2 results

| Number of students | Satisfactory | Unsatisfactory |
|---|---|---|
| **Unit 1** | 353 | 45 |
| **Unit 2** | 344 | 26 |

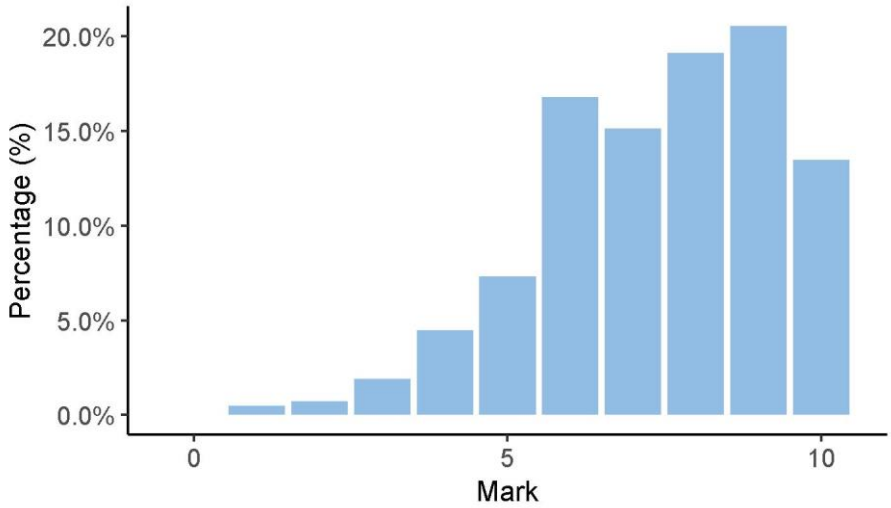
## Units 3 and 4 internal assessment (IA) results

### Total marks for IA

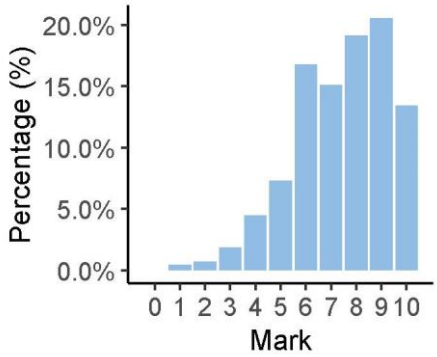


# IA1 marks

## IA1 total

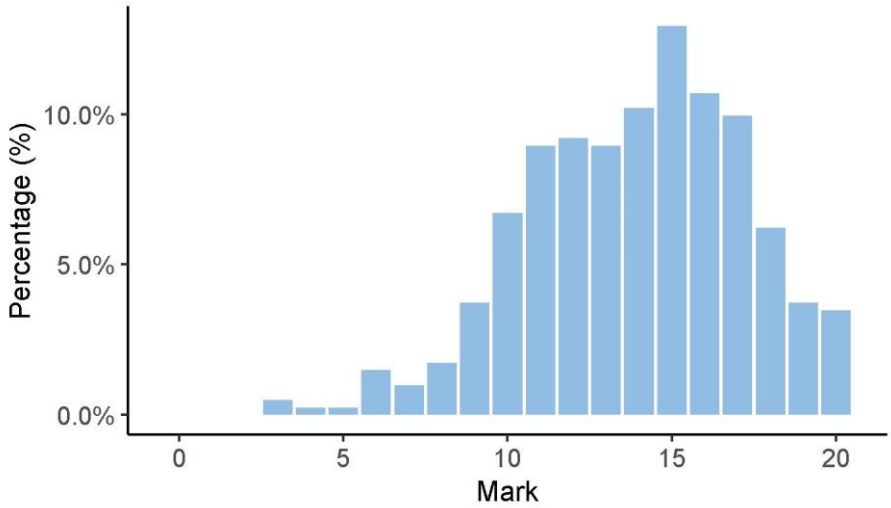



## IA1 Criterion: Data test

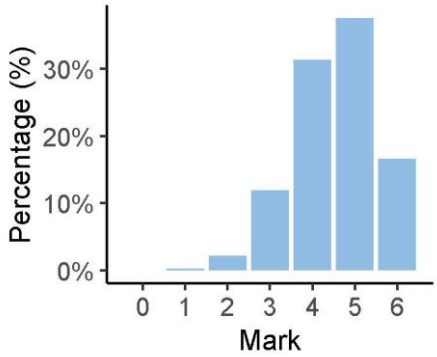


# IA2 marks

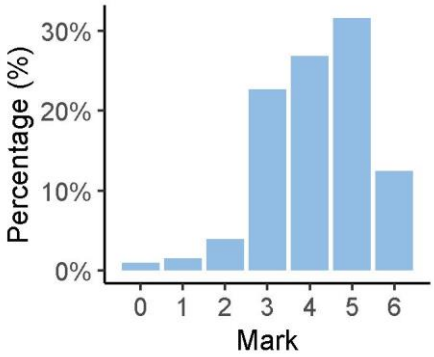
## IA2 total



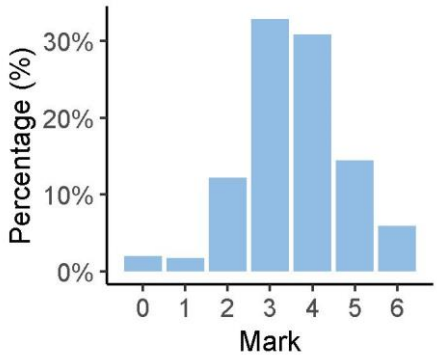

## IA2 Criterion: Research and planning



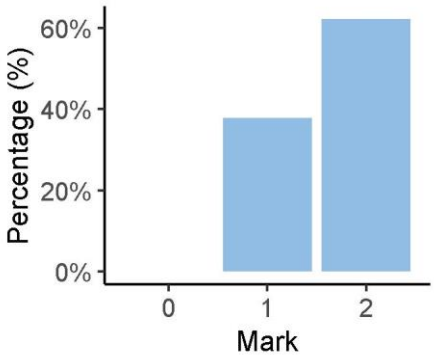

## IA2 Criterion: Analysis of evidence




## IA2 Criterion: Interpretation and evaluation

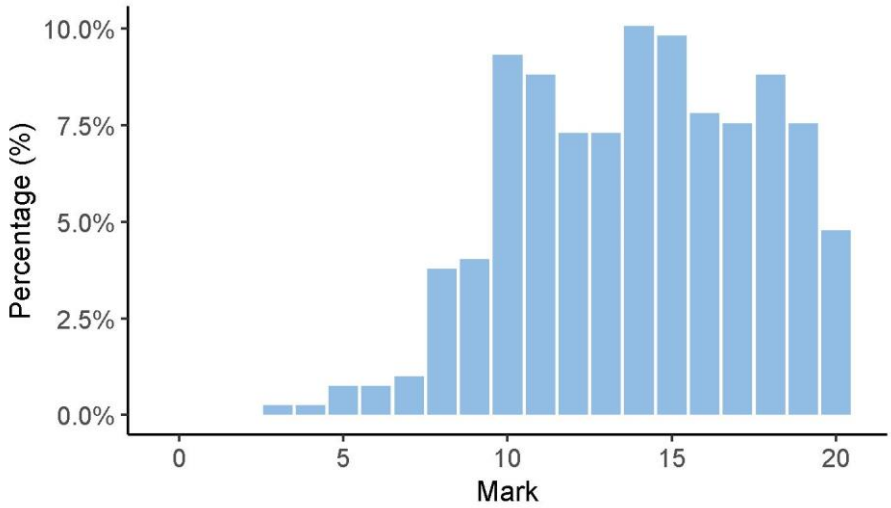



## IA2 Criterion: Communication

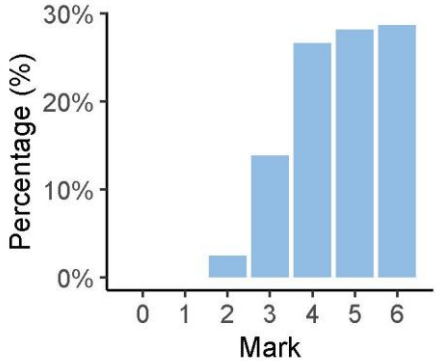


# IA3 marks

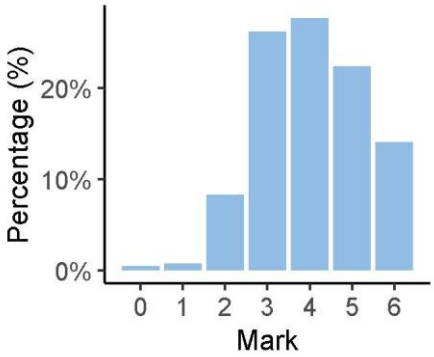
## IA3 total



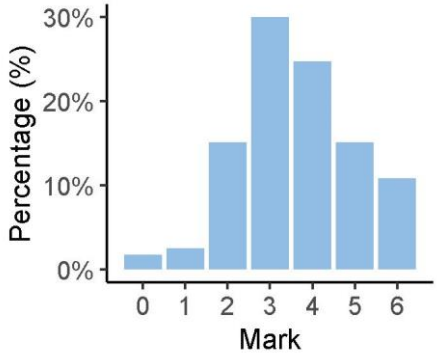

## IA3 Criterion: Research and planning



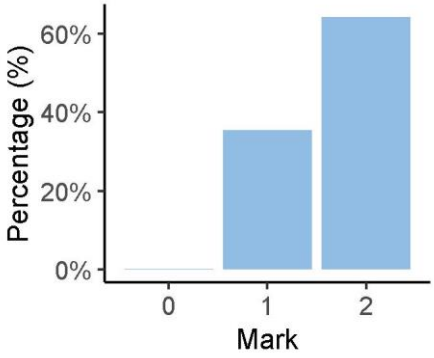

## IA3 Criterion: Analysis and interpretation



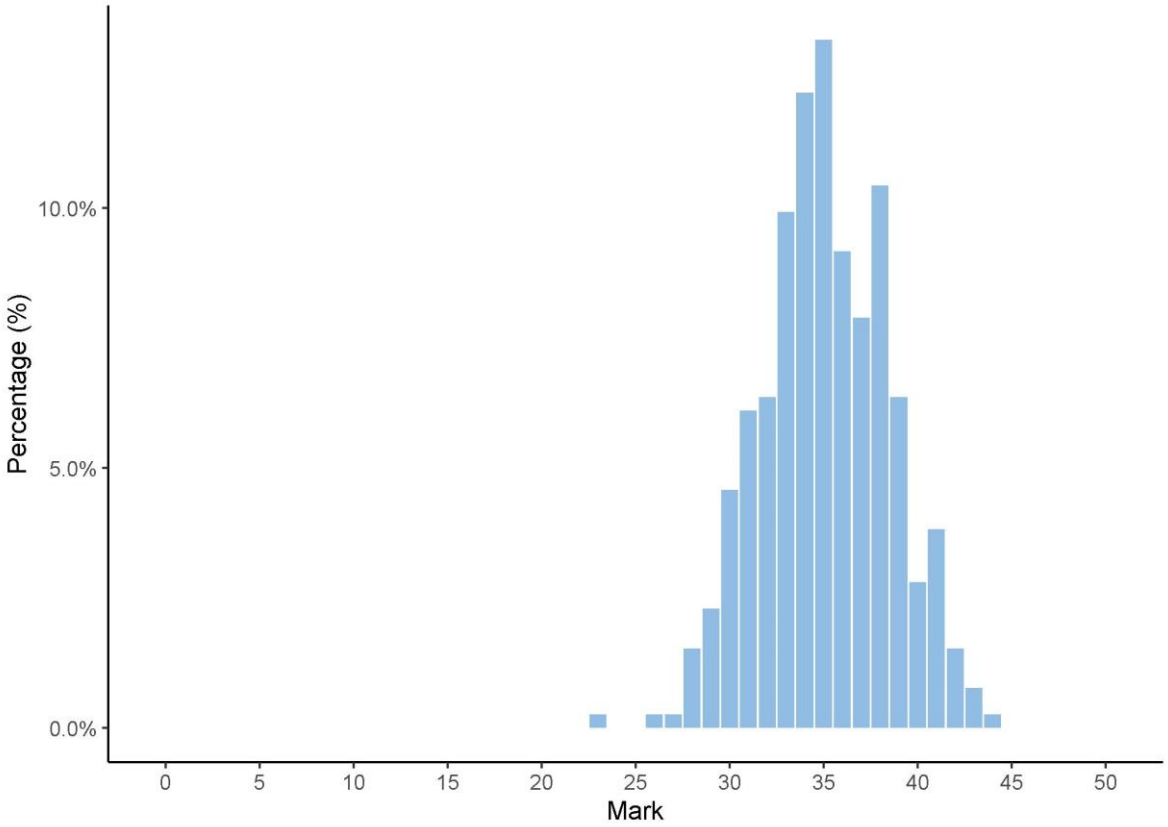

## IA3 Criterion: Conclusion and evaluation




## IA3 Criterion: Communication

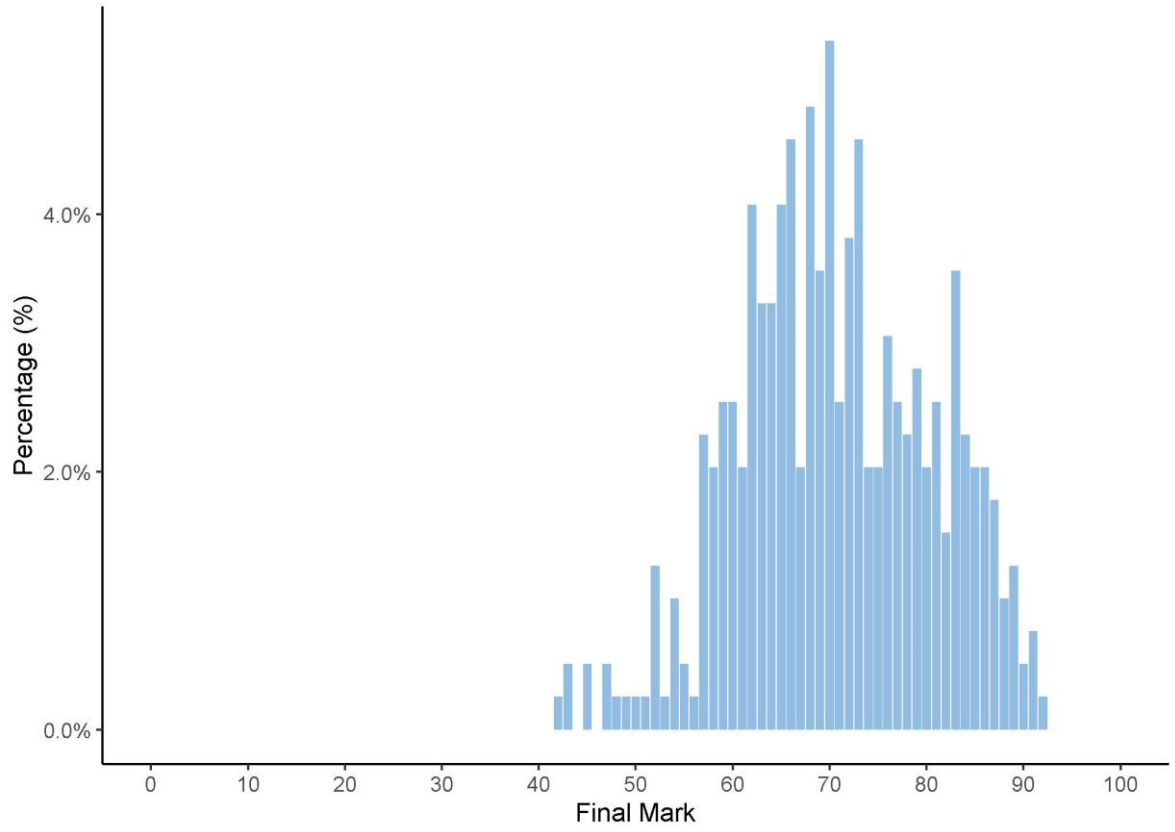


# External assessment (EA) marks



# Final subject results

## Final marks for IA and EA




## Grade boundaries

The grade boundaries are determined using a process to compare results on a numeric scale to the reporting standards.

| Standard | A | B | C | D | E |
|---|---|---|---|---|---|
| **Marks achieved** | 100–81 | 80–65 | 64–46 | 45–21 | 20–0 |

## Distribution of standards

The number of students who achieved each standard across the state is as follows.

| Standard | A | B | C | D | E |
|---|---|---|---|---|---|
| **Number of students** | 77 | 205 | 106 | 5 | 0 |

# Internal assessment

The following information and advice pertain to the assessment design and assessment decisions for each IA in Units 3 and 4. These instruments have undergone quality assurance processes informed by the attributes of quality assessment (validity, accessibility and reliability).

## Endorsement

Endorsement is the quality assurance process based on the attributes of validity and accessibility. These attributes are categorised further as priorities for assessment, and each priority can be further broken down into assessment practices.

Data presented in the Assessment design section identifies the reasons why IA instruments were not endorsed at Application 1, by the priority for assessments. An IA may have been identified more than once for a priority for assessment, e.g. it may have demonstrated a misalignment to both the subject matter and the assessment objective/s.

Refer to the quality assurance tools for detailed information about the assessment practices for each assessment instrument.

### Percentage of instruments endorsed in Application 1

| Number of instruments submitted | IA1 | IA2 | IA3 |
|---|---|---|---|
| **Total number of instruments** | 50 | 50 | 50 |
| **Percentage endorsed in Application 1** | 20% | 98% | 76% |

## Confirmation

Confirmation is the quality assurance process based on the attribute of reliability. The QCAA uses provisional criterion marks determined by teachers to identify the samples of student responses that schools are required to submit for confirmation.

Confirmation samples are representative of the school's decisions about the quality of student work in relation to the ISMG and are used to make decisions about the cohort's results. If further information is required about the school's application of the ISMG to finalise a confirmation decision, the QCAA requests additional samples.

Schools may request a review where an individual student's confirmed result is different from the school's provisional mark in one or more criteria and the school considers this result to be an anomaly or exception.

The following table includes the percentage agreement between the provisional marks and confirmed marks by assessment instrument. The Assessment decisions section of this report for each assessment instrument identifies the agreement trends between provisional and confirmed marks by criterion.

### Number of samples reviewed and percentage agreement

| IA | Number of schools | Number of samples requested | Number of additional samples requested | Percentage agreement with provisional marks |
|---|---|---|---|---|
| **1** | 48 | 212 | 0 | 100% |
| **2** | 48 | 214 | 41 | 66.67% |
| **3** | 48 | 214 | 2 | 72.92% |

# Internal assessment 1 (IA1)

## Data test (10%)

The IA1 data test requires students to apply a range of cognitions to multiple provided items. Students respond to items using qualitative and/or quantitative data derived from practicals, activities or case studies. The task requires students to identify unknown scientific quantities or features; identify trends, patterns, relationships, limitations or uncertainty in datasets; and draw conclusions based on the analysis of data.

In 2021, both the General syllabus and the Alternative Sequence drew data from the topics covering animal production, plant production and agricultural enterprises.

### Assessment design

#### Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

##### Reasons for non-endorsement by priority of assessment

| Validity priority | Number of times priority was identified in decisions* |
|---|---|
| **Alignment** | 29 |
| **Authentication** | 0 |
| **Authenticity** | 6 |
| **Item construction** | 10 |
| **Scope and scale** | 5 |

* Each priority might contain up to four assessment practices.

Total number of submissions: 50.

##### Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- included datasets that were clearly aligned to Unit 3 subject matter, e.g. mandatory and suggested practicals, and that were of appropriate scope and scale for students to respond to within the task conditions
- included datasets that were authentic for a variety of agricultural activities featured in the relevant unit, e.g. 'Identify and analyse trends in market price for an agricultural commodity over a period of time'
- contained datasets that were of an appropriate scope and scale, e.g. assessed each cognitive process only once.

### Practices to strengthen

It is recommended that assessment instruments:

- contain items that are clearly aligned with the corresponding objective by using an appropriate cognitive verb and requiring an appropriate nature of response, e.g., in an objective 3 item, '*identify* a trend in the dataset'. Teachers should refer to the Mark allocations table in Syllabus section 4.5.1 for guidance on the appropriate cognitive verbs and nature of response that is appropriate for each objective
- do not use items that assess objective 1 *describe and explain scientific concepts, theories, models and systems and their limitations*
- contain items that assess only one cognition each
- only include items that require the use of the dataset to answer the item.

## Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

### Reasons for non-endorsement by priority of assessment

| Accessibility priority | Number of times priority was identified in decisions* |
|---|---|
| **Bias avoidance** | 8 |
| **Language** | 17 |
| **Layout** | 16 |
| **Transparency** | 6 |

* Each priority might contain up to four assessment practices.

Total number of submissions: 50.

### Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- contained clear instructions, e.g. 'Answer all questions in the space provided' or 'Each question is associated with the dataset that immediately precedes it'
- contained clearly labelled datasets, e.g. Dataset 1, Dataset 2
- provided a response space that was adequate and reflected the required length of the response.

### Practices to strengthen

It is recommended that assessment instruments:

- use language that is consistent between the dataset and questions, e.g. avoid using the terms hot weight, carcass weight and dressed weight interchangeably
- contain datasets that have minimal distractors, i.e. only data that is needed to answer the questions asked
- use images, diagrams and other visual elements that are clear, legible and presented on the same page.

# Assessment decisions

## Reliability

Reliability is a judgment about the measurements of assessment. It refers to the extent to which the results of assessments are consistent, replicable and free from error.

### Agreement trends between provisional and confirmed marks

| Criterion number | Criterion name | Percentage agreement with provisional | Percentage less than provisional | Percentage greater than provisional | Percentage both less and greater than provisional |
|---|---|---|---|---|---|
| 1 | Data test | 100% | 0% | 0% | 0% |

### Effective practices

Accuracy and consistency of the application of the ISMG for this IA was most effective when:

- school-developed marking schemes clearly matched each mark to a valued feature of the expected response
- marking schemes were updated during the marking process to demonstrate how unexpected responses were marked
- ISMGs were correctly used with calculated mark totals to determine the final mark out of 10.

#### Samples of effective practices

There are no student response excerpts because either the student/s did not provide permission or there were third-party copyright issues in the response/s.

### Practices to strengthen

There were no significant issues identified for improvement.


# Internal assessment 2 (IA2)

## Student experiment (20%)

The IA2 student experiment requires students to modify (i.e. refine, extend or redirect) an experiment to address their own hypothesis or question related to topics. Students may use a practical performed in class as the basis for their methodology. They develop a research question, collect and process primary data, analyse and interpret evidence, and evaluate the reliability and validity of their experimental process.

In 2021, both the General syllabus and the Alternative Sequence used practicals from the topics covering animal production, plant production and agricultural enterprises.

### Assessment design

#### Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

##### Reasons for non-endorsement by priority of assessment

| Validity priority | Number of times priority was identified in decisions* |
|---|---|
| **Alignment** | 1 |
| **Authentication** | 0 |
| **Authenticity** | 0 |
| **Item construction** | 1 |
| **Scope and scale** | 0 |

*Each priority might contain up to four assessment practices.

Total number of submissions: 50.

##### Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- provided practicals that were more closely related to the topics of the relevant summative unit than topics from earlier formative units or from other subjects
- contain the appropriate topic headings, e.g. Topic 3: Agricultural enterprises B was listed when the mandatory practical ‘Conduct an investigation into post-harvest handling of fresh plant products and its impact on product quality’ was included
- provided clear scaffolding that modelled processes and directed students to address all components of the task without leading students to a predetermined response

- contained practicals that provided scope for student modification (e.g. the mandatory and suggested practicals from the syllabus) as opposed specific experiments (e.g. ‘Lamb feed lotting trial investigating the relationship between gender and weight gain’).

#### Practices to strengthen

| |
|---|
| There were no significant issues identified for improvement. |

### Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

#### Reasons for non-endorsement by priority of assessment

| Accessibility priority | Number of times priority was identified in decisions* |
|---|---|
| **Bias avoidance** | 0 |
| **Language** | 1 |
| **Layout** | 0 |
| **Transparency** | 0 |

*Each priority might contain up to four assessment practices.

Total number of submissions: 50.

#### Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- avoided jargon, specialist language and colloquial language that does not contribute to understanding of the subject matter
- featured language that was free from cultural, gender or socio-economic bias
- provided clear instructions that aligned to the specifications of the syllabus, the assessment objectives and the ISMG.

#### Practices to strengthen

| |
|---|
| There were no significant issues identified for improvement. |

## Assessment decisions

### Reliability

Reliability is a judgment about the measurements of assessment. It refers to the extent to which the results of assessments are consistent, replicable and free from error.

### Agreement trends between provisional and confirmed marks

| Criterion number | Criterion name | Percentage agreement with provisional | Percentage less than provisional | Percentage greater than provisional | Percentage both less and greater than provisional |
|---|---|---|---|---|---|
| 1 | Research and planning | 81.25% | 18.75% | 0% | 0% |
| 2 | Analysis of evidence | 83.33% | 16.67% | 0% | 0% |
| 3 | Interpretation and evaluation | 77.08% | 22.92% | 0% | 0% |
| 4 | Communication | 97.92% | 0% | 2.08% | 0% |

### Effective practices

Accuracy and consistency of the application of the ISMG for this IA was most effective when:

- in the Research and planning criterion
  - a *considered* rationale showed evidence of deliberate choices of background scientific research on relevant aspects of the research question
  - *justified* modifications showed evidence of a real-life application of the investigation or links to background scientific research
  - the research question was *relevant* to the unit being studied, i.e. relevant to 'production/yield' for Unit 3 in the General syllabus and relevant to 'growth' for AS unit 1 in the Alternative Sequence
  - the research question was *specific* about the type of analysis being investigated, e.g. correlation or difference
- in the Interpretation and evaluation criterion
  - conclusions were *justified* when they addressed the specific dependent variable stated within the research question
  - a *justified* discussion identified issues that affected both reliability (e.g. the scale of the experiment and the reproducibility of the results) and validity (e.g. how well the results answered the research question) and the specific impacts of these issues were explained
  - suggested improvements explained how they would reduce the uncertainty identified earlier in the response, e.g. in standard error calculations
  - suggested extensions were drawn from aspects of the research question, e.g. a more specific dependent variable.

#### Samples of effective practices

The following are excerpts from responses that illustrate the characteristics for the criteria at the performance level indicated. The excerpts may provide evidence of more than one criterion. The characteristics identified may not be the only time the characteristics have occurred throughout a response.

These student response excerpts have been included:

- to demonstrate the following characteristics in the Research and planning criterion
  - a considered rationale
  - a specific and relevant research question
  - justified modifications.

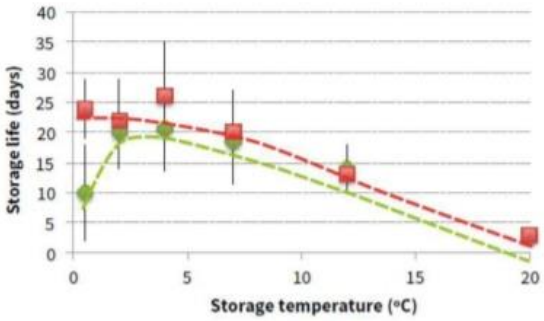
**Research and planning (5–6 marks)**

- considered rationale

**Excerpt 1**

[redacted] Processes include the selection of fruit and vegetables against a certain market criterion, washing and packing of the product, transportation and storage. Throughout all these processes' conditions must be kept optimum and specific to what the product is which includes temperature, $CO_2$,$O_2$ and ethylene levels (Scott Trimble, 2019), to maintain a high quality and shelf life.

Australia produces around 77 000 tons of capsicums (Capsicum annumn) every year valuing at $171 million in 2019 (Capsicum production and growth in Australia during 2019, 2020), making it a valuable industry with strong growth predicted into the future. Capsicums require a careful post-harvest management plan, with temperature one of the most important factors along with light, humidity and packaging. The optimal conditions for capsicums to maintain a >20 day shelf life, according to Ekman, Goldwater and Winley, is between 1-5°C with shelf life degrading quickly when temperature increases, as can be seen in figure 1. To investigate the influence of temperature on the shelf life and quality of capsicums is a worthwhile experiment due to the importance of reducing waste in the agricultural industry.




Storage life of red (■) and green (●) greenhouse grown capsicums at different temperatures. Bars indicate the likely variability around each mean value.

Figure 1: Optimal temperatures for red and green capsicums (Ekman, Jenny; Goldwater, Adam; Winley, Emma (2016)

- a specific and relevant research question

**Excerpt 2**

Research Question:

What is the most suitable temperature between 3 and 29°C for Capsicum annum in terms of shelf life (mass) and post-harvest quality (i.e. visual appearance)?

- justified modifications to the methodology

**Excerpt 3**

| Modification to original experiment | Reasons for modifications |
|---|---|
| Refine and extend temperatures from room temperature and 4 degrees to 3°C, 6°C, 18°C and 29°C. | The original experiment investigated the effect of two different temperatures, so this was refined to see how a wider range of temperatures effected the post-harvest quality of capsicums. |
| Refine by having no plastic wrap on any capsicum. | The original had some trials with plastic wrap and some without, however to refine this experiment no plastic wrap is used. Capsicums don't get stored in individual plastic wraps, only in larger plastic bags in supermarkets when chosen. |
| Redirect by using red capsicums instead of bananas, strawberries and apples. | Instead of looking at a variety of produce, one was chosen that frequently goes rotten post-harvest. |
| Extend by investigating the colour and observations of capsicums. | By investigating how the capsicums appear visually, it will ensure that the quality is suitable for consumers. |

These student response excerpts have been included:

- to illustrate the following characteristics in the Analysis of evidence criterion
  - *correct and relevant* processing of data
  - *thorough* identification of relevant trends
  - *thorough and appropriate* identification of uncertainty and limitations
  - collection of *sufficient and relevant* raw data.

**Analysis of evidence (5–6 marks)**

- correct and relevant processing of data

**Excerpt 1 (AS)**

Processed data:

| 0 | | 100 | | 250 | | 500 | | 800 | |
|---|---|---|---|---|---|---|---|---|---|
| Mean | 33.6 | Mean | 51.15 | Mean | 43.95 | Mean | 36.35 | Mean | 29.6 |
| Standard Error | 2.458319209 | Standard Error | 5.830499312 | Standard Error | 6.975134407 | Standard Error | 4.381812157 | Standard Error | 2.327134623 |
| Median | 31.5 | Median | 56.25 | Median | 43.5 | Median | 35.5 | Median | 32 |
| Mode | 30 | Mode | #N/A | Mode | #N/A | Mode | 35.5 | Mode | 32 |
| Standard Deviation | 7.773887916 | Standard Deviation | 18.43765772 | Standard Deviation | 22.05731171 | Standard Deviation | 13.85650669 | Standard Deviation | 7.359045832 |

*Table 3: Descriptive Statistics of all 5 Different Trials for Final Plant Height*

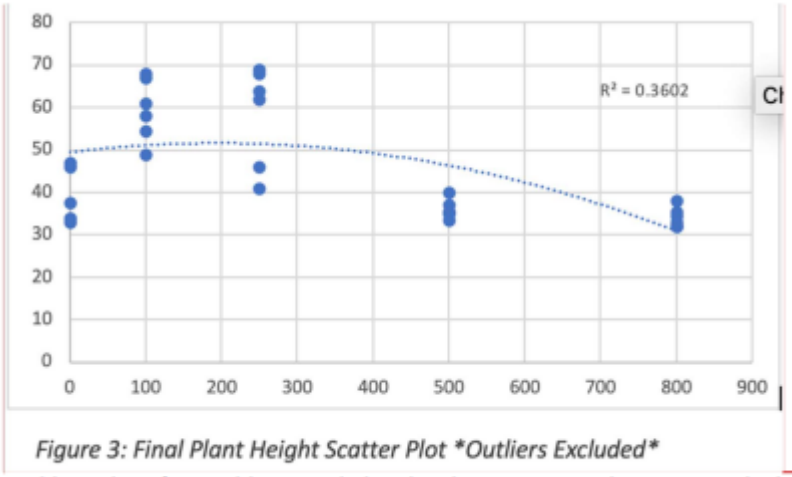



*Figure 3: Final Plant Height Scatter Plot *Outliers Excluded**

**All possible outliers from table 2: Final plant height was removed to receive a higher $r^2$ value.**

- thorough identification of relevant trends

The data from table 3 shows that Gibberellic acid affects plant height (increases the height) to a certain level of gibberellic acid. The mean height for the 0 mg/L solution was 33.6cm and this had a significant increase to 51.15cm with the 100 mg/L solution but then this increase drops slightly with the 250 mg/L being a mean of 43.95cm then another significant drop for the 500 mg/L being a mean of 36.35cm which is a more significant effect than the controlled solution. But then at the 800mg/L level solution there is a significant drop in the mean plant height, being at 29.6 which was significantly lower than that of the controlled solution or any other concentration.

- thorough and appropriate identification of uncertainty and limitations

When comparing the uncertainty of this data the standard error of the mean and standard deviation, it is evident that there was a very large spread of data. The 250 mg/L trial had the largest error of the mean and standard deviation meaning that this trial had the largest spread of data. The most reliable trial from the data was the 800mg/L have a standard error of 2.33 and standard deviation of 7.36, although the standard error and standard deviation are still very high this data set is the closest to 0. Due to the standard deviation also being high this means that the data is widespread from the mean. Because of the data having such a widespread, the standard error and standard deviation being so high from 1, there is a lot of uncertainty meaning that the data is not overly reliable. But when looking at the descriptive statistics of dry plant mass, the standard error and standard deviation were a lot lower meaning that the spread of data was a lot closer together also meaning that the data was a lot less uncertain. When comparing the standard deviation and standard error between the two dependent variables of plant height and dry plant mass there is little to no correlation and similarities. As the most reliable data for dry pant mass was the 250 mg/L

- collection of sufficient and relevant raw data

**Excerpt 2**

**Quantitative Data (Raw data):**

Table 4: Raw data of Forage Dry Matter Mass for three treatments at week 7.

| **Treatment 1 Ferrosol Soil** | Total Plant Wet Mass (g) | Plant Wet Mass without roots (g) | Plant *Dry matter (g) |
|---|---|---|---|
| 1 | 8 | 5 | 0.75 |
| 2 | 6 | 3 | 0.45 |
| 3 | 11 | 6 | 0.90 |
| 4 | 10 | 6 | 0.90 |
| 5 | 9 | 7 | 1.05 |
| 6 | 9 | 6 | 0.90 |
| 7 | 9 | 5 | 0.75 |
| 8 | 10 | 6 | 0.90 |
| 9 | 9 | 5 | 0.75 |
| 10 | 7 | 4 | 0.60 |
| **Treatment 2 Heavy Clay** | Total Plant Wet Mass (g) | Plant Wet Mass without roots (g) | Plant *Dry matter (g) |
| 1 | 6 | 3 | 0.45 |
| 2 | 3 | 5 | 0.75 |
| 3 | 4 | 2 | 0.30 |
| 4 | | | |
| 5 | 10 | 3 | 0.45 |
| 6 | 4 | 5 | 0.75 |
| 7 | | | |
| 8 | 4 | 3 | 0.45 |
| 9 | 6 | 3 | 0.45 |
| 10 | 5 | 2 | 0.30 |
| **Treatment 3 Sandy Clay Loam** | Total Plant Wet Mass (g) | Plant Wet Mass without roots (g) | Plant *Dry matter (g) |
| 1 | 6 | 2 | 0.30 |
| 2 | 5 | 1 | 0.15 |
| 3 | 6 | 2 | 0.30 |
| 4 | 0 | 1 | 0.15 |
| 5 | 7 | 2 | 0.30 |
| 6 | | | |
| 7 | | | |
| 8 | 6 | 1 | 0.15 |
| 9 | 7 | 2 | 0.30 |
| 10 | | | |

*Standardised dry matter: 15%, Blank cells means plant did not germinate.

These student response excerpts have been included:

- to illustrate the following characteristics in the Interpretation and evaluation criterion
  - *insightful* interpretation of evidence to draw justified conclusions
  - suggested improvements and extensions that are *logically derived* from the analysis of the evidence
  - a *justified discussion* of the reliability and validity of the experimental process.

**Interpretation and evaluation (5–6 marks)**

- insightful interpretation demonstrated by justified conclusion
- suggested improvements and extensions

**Excerpt 1**

## Interpretation and Evaluation

Overall, the data from this experiment demonstrates the ewes that were feed the loose grain ration had the highest total live weight gain throughout the trial whilst the ewes feed the pellets from Riverina had the best performance throughout the trial. As shown in Graph 1, the ewes in pen 2 on average gained over one kilogram more in liveweight throughout the trial. Despite this, Graph 2 demonstrates that the average daily gain (ADG) of pen 1 had a general positive trend whilst pen 2 had a general negative trend, therefore demonstrating that pen 1 had a greater performance over the period. Also, as shown in Table 3, the ewes in pen 1 had a considerably better feed conversion (FCR) ratio of (5.2:1 compared to 5.63:1), demonstrating higher overall performance.

## Conclusion

As optimal performance is determined by the gaining the most weight from the least amount of ration as well as having a positive average daily gain (ADG) between weeks, it can be determined that the Riverina Lamb pellets had the best performance over the trial when compared to the loose grain ration. This therefore demonstrates that feeding white-Suffolk dorper cross ewes Riverina Lamb feedlot pro pellets increase their overall performance. Whilst the ewes in pen 2 on average gained 1.3kg more over the trial, the ewes in pen 1 had a more desirable trend in their ADG as well as having a better feed conversion ratio (FCR). Whilst both pens FCR was better than the industry average of 6:1 (NSW Department of Primary Industries, 2016), when compared within this trial pen 1 had the most desirable. Also, both pens were within the industry standards for ADG of 250-300g.

**Excerpt 2**

To improve the reliability of the data these processes should be considered when completing the next experiment:

justified discussion of the reliability and validity of the experimental process

- Increase the number of replications in each trial group to increase the accuracy of the mean.
- Increasing the number of replications also allows for outliers to be removed where necessary, this should also ensure that the p-value is lower than 0.05, ensuring the data is reliable.
- The sheep could be placed into separate pens for feeding, this ensures that the pecking order does not impact the amount of feed that each lamb gets.
- A uniform line of sheep by from 1 property, by 1 lamb and a select line of ewes could be used to ensure there is less genetic variability.

Further Investigation:

- The change in fat score over the course of the experiment could be collected to analyse, to see how each feed affects the amount of fat on the animal. great extension
- More feed types could be included in the experiment, for example one group of lambs could be grass fed and another could be grain fed. very practical
- The experiment could be completed in a commercial feedlot so that the results could be properly applied to the feed lotting industry. well said

| | |
|---|---|
| • justified discussion of the reliability and validity | **Excerpt 3**<br>Evaluation:<br>Reliability:<br>Low standard deviation suggests that the data collected is very reliable, however slightly decreasing in preciseness as temperatures cool which may be due to sources of error including:<br>- The fridge temperatures (3°C and 6°C conditions) were variable (see appendix 5) however, stayed within a range. This may have caused the capsicums to hold or loose mass faster than a controlled temperature. The anomaly of the 18°C at 5 days may have been due to the variable temperatures of the fume duct that was exposed to outdoor temperatures.<br>- Electronic scales may not be as accurate as possible, hence the ±0.01% in the data which may be more evident in smaller mass changes.<br>- Data collection intervals were not in even (5,8,12,14 days), so could have skewed the data slightly.<br>Validity:<br>Very low standard errors in the data show that the data has a high accuracy and therefore is valid. Though some reliability issues occurred, these issues are also valid in the real world.<br>- The constant light in the 29°C conditions may have affected the mass loss of the capsicums. The other conditions also had variable light (fume duct regular light/darkness; fridges constant dark), however as the standard error was low it is unlikely that this impacted the results.<br>- The lighting in photographs were different initially to the final photos taken as it was difficult to photograph wrinkled capsicums without light reflecting, so colours may be different to real life. However, as the majority darkened as expected, the photos are relatively reliable.<br>- Converting the raw mass data into the percentage change increased the validity significantly as all capsicums had different initial weights, so therefore the raw data could not have shown a clear conclusion. |

### Practices to strengthen

To further ensure accuracy and consistency of the application of the ISMG for this IA, it is recommended that:

- in the Analysis of evidence criterion
  - data is processed correctly through the application of techniques that are relevant to the specific type of analysis being conducted as per the research question, e.g. t-test and column graphs with error bars to test for statistical significance, scatter plot with regression analysis to investigate correlation
  - relevant trends are thoroughly identified when all treatment groups are discussed and all trends relevant to the research question are described
  - uncertainty is thoroughly identified through the discussion of measures of uncertainty relevant to the specific analysis being conducted, e.g. standard error, $R^2$ value, error bars
  - limitations can be thoroughly identified through the discussion of the size, data collection method and environment of the experiment or outliers in the raw data.

## Additional advice

- Experiments should explicitly address the subject matter of the unit being investigated, e.g. production/yield in Unit 3 in the General syllabus and growth in Unit 1 for the Alternative Sequence. Yield can be measured in biomass or dry matter production if this parameter is specifically relevant to the crop being studied, e.g. dry matter production is a relevant measure of yield for pastures but not for tomato plants.
- Explicitly modelling different types of research questions (e.g. correlation or difference) and their methodologies and data processing promotes best practice.

- Modelling of the processing methods relevant to different types of research question (e.g. a correlation should be analysed with a scatterplot and regression analysis while a difference should be analysed with a t-test and column graph with error bars) will assist students with their responses.
- The mandatory and suggested practicals provide opportunities for modelling the evaluation of experiments, including
  - how improvements can be logically derived from the analysis of the uncertainty of evidence gathered from that practical
  - a justified discussion of the reliability and validity of the practical that is consistent with the definitions of these two parameters within the glossary of the syllabus.


# Internal assessment 3 (IA3)

## Research investigation (20%)

The IA3 research investigation requires students to gather secondary evidence related to a research question in order to evaluate a claim about topics. Students develop a research question, collect and analyse secondary data, interpret evidence to form a justified conclusion, discuss the quality of the evidence and extrapolate the findings of the research to the claim.

In the General syllabus, claims are based on the Unit 4 topics Enterprise management and Evaluation of an agricultural enterprise's sustainability. In the Alternative Sequence in 2021, claims are based on the AS unit 2 topics Management of renewable resources, Physical resource management and Agricultural management, research and innovation.

### Assessment design

#### Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

**Reasons for non-endorsement by priority of assessment**

| Validity priority | Number of times priority was identified in decisions* |
|---|---|
| **Alignment** | 5 |
| **Authentication** | 1 |
| **Authenticity** | 1 |
| **Item construction** | 2 |
| **Scope and scale** | 1 |

*Each priority might contain up to four assessment practices.

Total number of submissions: 50.

**Effective practices**

Validity priorities were effectively demonstrated in assessment instruments that:

- provided claims that were more closely related to the topics of the relevant summative unit than topics from earlier formative units or from other subjects
- included claims from which multiple research questions could be generated, e.g. for the General syllabus, 'Dryland salinity is affecting Australian agriculture', and for the Alternative Sequence, 'Effluent management is essential in intensive animal production systems'
- clearly informed students of all task requirements.

### Practices to strengthen

It is recommended that assessment instruments:

- provide broad claims that allow for students to develop unique student responses, e.g. for the Alternative Sequence, 'Agriculture adversely affects the Great Barrier Reef'
- provide claims that encourage students to develop research questions of suitable scope and scale, e.g. 'Social perceptions on animal welfare requirements will influence Australian livestock management' or 'Ethical perceptions on animal welfare requirements will influence Australian livestock marketing'.

## Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

### Reasons for non-endorsement by priority of assessment

| Accessibility priority | Number of times priority was identified in decisions* |
|---|---|
| **Bias avoidance** | 0 |
| **Language** | 2 |
| **Layout** | 0 |
| **Transparency** | 2 |

*Each priority might contain up to four assessment practices.

Total number of submissions: 50.

### Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- avoided jargon and specialist language, e.g. not all students will know that the term 'wild canids' refers to feral dogs
- avoided bias and/or inappropriate content, e.g. excessively emotive claims
- included a checkpoint for the submission of the student response
- provided students with all the necessary information on how to complete the task, e.g. gather secondary evidence, work individually, use scientifically credible sources.

### Practices to strengthen

There were no significant issues identified for improvement.

# Assessment decisions

## Reliability

Reliability is a judgment about the measurements of assessment. It refers to the extent to which the results of assessments are consistent, replicable and free from error.

### Agreement trends between provisional and confirmed marks

| Criterion number | Criterion name | Percentage agreement with provisional | Percentage less than provisional | Percentage greater than provisional | Percentage both less and greater than provisional |
|---|---|---|---|---|---|
| 1 | Research and planning | 91.67% | 6.25% | 2.08% | 0% |
| 2 | Analysis and interpretation | 83.33% | 14.58% | 0% | 2.08% |
| 3 | Conclusion and evaluation | 81.25% | 18.75% | 0% | 0% |
| 4 | Communication | 97.92% | 2.08% | 0% | 0% |

### Effective practices

Accuracy and consistency of the application of the ISMG for this IA was most effective when:

- in the Research and planning criterion, a rationale is considered when it showed evidence of careful and deliberate thought linking the reasons for the investigation to the key aspects of the claim
- in the Analysis and interpretation criterion, justified scientific arguments were supported by the trends, patterns or relationships identified
- In the Conclusion and evaluation criterion
  - an *extrapolation* of credible findings of the research question to the claim was demonstrated when the student response used the evidence identified to address other aspects of the claim rather than just the topic/s explored by the research question
  - suggested improvements were *considered and relevant* when the response reflected the limitations of the evidence cited
  - suggested extensions were *considered and relevant* when they addressed aspects of the claim other than those explored in the research question.

#### Samples of effective practices

The following are excerpts from responses that illustrate the characteristics for the criteria at the performance level indicated. The excerpts may provide evidence of more than one criterion. The characteristics identified may not be the only time the characteristics have occurred throughout a response.

These student response excerpts have been included:

- to demonstrate, in the Research and Planning criterion, a considered rationale that identifies a clear development of the research question from the claim. The response demonstrates careful and deliberate thought linking the reasons for the investigation to the claim.

**Research and planning (5–6 marks)**

- development of the research question from the claim

## Excerpt 1

### Claim

Sustainable management of the physical, chemical and biological properties of soil is essential for agricultural production.

With fibre and food production currently using more than half of the world's ice-free land, sustainable management strategies must be implemented. The term sustainable refers to the production of agricultural products without damaging the land or natural resources (One Plate, 2019). One of these natural resources vital to agriculture is soil. This makes it essential that its physical, chemical and biological properties are sustainably managed. Tillage is a major factor affecting soils physical, biological and chemical properties as it changes its structure, organic matter content and microbes all affecting yield. Traditional tillage fractures the structure of the soil and reduces organic matter leaving the soil more prone to erosion and causing poor water infiltration (Iowa State University, 2019). This will further negatively affect the biological properties of soil as microbes depend upon good water infiltration to stay alive (Iowa State University, 2019). Tillage affects the soil's organic matter content which will affect the soils chemical properties. Higher amounts of organic matter increase soil nutrition (Funderburg, 2019). There are numerous techniques that farmers use to till soil depending on its requirements and the machinery they have access to. Zero-tillage (no-till) is a technique in which seeds are directly planted into the soil which has not been tilled and still retains stubble from the previous crop (Vic No-Till, 2020). For the purpose of this investigation, how zero-tillage affects the properties of soil will be investigated.

### Research Question

To what extent does zero-tillage compared to conventional tillage farming improve yield and sustainability in the production of corn?

## Excerpt 2

### Claim

Animal welfare in agricultural production systems is improving.

### Rationale

The Australian sheep industry has been looking for ways of improving the animal welfare of their sheep. The sheep industry faces many issues regarding animal welfare such as fly strike in their flock. Flystrike is condition, where sheep are affected by fleece rot which then attracts blowfly that lay eggs on the sheep, growing to maggots which will eat the flesh of the sheep (Victorian Farmers Federation, n.d.). flystrike will need to be actively monitored to ensure the best animal welfare and minimal productivity loss for the producers (Smith, 2017).

Key terms in the claim addressed.

Flystrike also causes major profitability loss to Australian sheep farmers not only due to lack in production due to fly strike on the sheep but also because of the large amount of time and money that is put into treating the fly strike in the sheep (Smith, 2017). If sheep producers in Australia are able to reduce the risk of flystrike in their flock, then the sheep will endure an immense benefit in their wellbeing and health along with the production of the farm and profit increasing. Flystrike costs around $280 million to the sheep industry in Australia each year from treatments, preventions and loss in productivity and income. If Australian sheep farmers are able to reduce flystrike in their flocks through management strategies, then millions of dollars will be saved in the industry which they will be able to put back into their farms to further improve their farming strategies.

Different management strategies that Australian sheep farmers are looking at to reduce the number of flystrike cases in their flocks include mulesing and breeding a flystrike resistant sheep. Mulesing is a practice where crescent shaped flaps of skin with wool on them are removed from around the breech area using sharp shears (RSPCA, 2021). However, the animal welfare of the sheep is still being questioned when they are mulesed as it is known that an acute pain can occur from mulesing these sheep and so does the risk of infection to the sheep on the exposed flesh sites where the cuts were made. If a farmer is to breed a flystrike resistant sheep flock this will take approximately 10 to 15 years where farmers will have to use Australian Sheep Breeding Values (ASBV's) to select which sheep, they will breed to create this flystrike resistant flock. Not only will this take a long time while many sheep are still undergoing flystrike it will also cost large amounts of money for the farmers in research and breeding of the sheep along with treatment for the sheep that are still getting flystrike.

Considered rationale that steps the reader through from claim to research question.

### Research Question

To what extent are Australian sheep farmers able to improve the welfare of their sheep by implementing management techniques to reduce the risk of flystrike with minimal implications to the sheep?

These student response excerpts have been included:

- to demonstrate, in the Analysis and interpretation criterion, evidence of justified scientific arguments that identify relationships between scientific concepts.

| | |
|---|---|
| **Analysis and interpretation (5–6 marks)**<br>• interpretation of research evidence demonstrated by justified scientific argument/s | **Excerpt 1**<br>It can be identified from table 1 that all of the saltbush species most commonly found in W.A are very tolerant of the salt drenched soils and all showed high (xxxx) results. This is very beneficial as each of the salt bush species are able to tolerate the high levels of salt in the soil which in turn eliminates majority of the surface salinity improving the environment. However, in terms of waterlogging the old man saltbush had the lowest result (low [xx]) compared to the other three species (river saltbush, wavy-leaf saltbush, and quail brush) which all had moderate (xxx) results. It can also be seen that the two most beneficial saltbush species were river saltbush and wavy-leaf saltbush. River saltbush was very beneficial in palatability (xxxx) and grazing recovery (xxxx). This is very favorable as various livestock species are able to consume it without being heavily impacted by the salts, and it regrows relatively quickly from heavy grazing. The wavy-leaf saltbush, however, is very suitable for direct seeding. This means that the species is able to move around and regrow efficiently as the seed can be carried in animal faeces and via wind distribution, which allows for quick regeneration and seed dispersal. It can be concluded that various salt bush species are advantageous in treating and further preventing salinity impacts on the environment, as well as providing an efficient and palatable source of feed for livestock.<br><br>**Excerpt 2**<br>Similarly to the experiment conducted in table 1, a separate experiment was conducted using a rating scale (3 being the highest) to assess pain-related behaviour up to 8 hours post mulesing. From figure 1 it is evident that untreated (not administrated with pain relief) lambs experienced a significant ($P<0.001$) response over time to light touch stimulation to the wound and skin surrounding the mulesed area. Such responses were significantly reduced ($P<0.01$) by the administration of pain relief as it is evident that Tri-Solfen treated lambs experienced significant reduced pain-related behaviours (Sheil, et al., 2018). These results signify that through the administration of pain relief (Tri-Solfen) the effects of pain and discomfort originally inflicted on the animals is significantly reduced. This highlights that from the administration of pain relief, the pain levels can almost be minimised to those of normal behaviours. |

This student response excerpt has been included:

- to demonstrate, in the Conclusion and evaluation criterion
  - extrapolation of credible findings to the claim
  - suggested improvements and extensions that are considered and relevant to the claim.

| | |
|---|---|
| **Conclusion and evaluation (5–6 marks)**<br>• extrapolation of findings<br>• suggested improvements and extensions | **Evaluation of the Claim and Recommendations:**<br>The research question posed for this report was "To what extent does salt bush decrease the impacts of secondary salinity on agriculture in Western Australia?". Even though possible limitations were present, each source reached the same conclusion and was able to the answer the question that saltbush does decrease the impacts of secondary salinity on agriculture in Western Australia. Therefore, the chosen claim "one of the key impacts on Australian agriculture is salinity" can be supported. However, this report only focussed on one form of salinity, which is only one of the three forms of salinity impacting the agricultural industry. Therefore, further research is required in order to expand on the claim.<br><br>The report provided was able to reach a reasonable conclusion, however, improvements need to be taken into account to further support the development of the claim. Evidence should be collected on another form of salinity (such as irrigation salinity), its effects on the environment, and its management strategies. Each source form this report looked at the benefits of saltbush made in decreasing dryland salinity, so if the next report focussed on another form of salinity, its effects, and its management strategies, it would be similar to the impacts of a real farming enterprise and would be just as easy to support the claim.<br><br>In order to extend this report evidence should be collected comparing the other various environmental impacts, such as land degradation, climate change, water quality, and many more. When investigating and comparing the effects of salinity to any of the other following impacts, it could further support the idea that salinity has one of the largest impacts to Australian agriculture. Salinity could also be compared to the crop industry and its effects on it to also further support the preliminary claim. |

### Practices to strengthen

To further ensure accuracy and consistency of the application of the ISMG for this IA, it is recommended that:

- In the Conclusion and evaluation criterion
  - *justified conclusions* should show an understanding of the relationships between the background scientific information and the findings of the evidence
  - an *insightful discussion* of the quality of the evidence should draw upon specific features (e.g. variables measured) to examine the merits and faults of the evidence when used to draw conclusions
  - a *reasonable description* of the quality of evidence should address how well the evidence can be used to answer the research question, rather than using simplistic statements, e.g. limited availability of evidence.

## Additional advice

- If students investigate a claim that is different to the claims provided in the endorsed assessment task, they should ensure that the alternative claim is posed as a statement (rather than a question) and that it is directly aligned with the subject matter for the relevant unit, i.e. Unit 4 for the General syllabus or Unit 2 for the Alternative Sequence.
- ISMGs should be clearly annotated to identify the characteristics for each performance level that match the evidence in the response, rather than just awarding a mark for each criterion. Highlighting is not always visible once scanned.
- Due to the large number of inter-unit links within the syllabus (e.g. decision-making in property management in Unit 4 links to Agricultural management, research and innovation in Unit 2), providing regular feedback to students throughout the investigation will identify when students start to address subject matter that is more aligned with an earlier unit rather than the one relevant to the investigation.

# External assessment

External assessment (EA) is developed and marked by the QCAA. The external assessment for a subject is common to all schools and administered under the same conditions, at the same time, on the same day.

## Summative external assessment (EA) — Examination (50%)

### Assessment design

The assessment instrument was designed using the specifications, conditions and assessment objectives described in the summative external assessment section of the syllabus. The examination consisted of one paper:

- Paper 1, Section 1 consisted of multiple-choice questions (20 marks)
- Paper 1, Section 2 consisted of short response questions (40 marks)
- Paper 2, Section 1 consisted of short response questions (40 marks)
- Paper 2, Section 2 consisted of an extended response question (15 marks).

The examination assessed subject matter from Units 3 and 4. Questions were derived from the context of:

- Animal production B
- Plant production B
- Agricultural enterprises B
- Enterprise management
- Evaluation of an agricultural enterprise's sustainability.

The assessment required students to respond to multiple choice items, short response items and an extended response item.

The AS assessment instrument was designed using the specifications, conditions and assessment objectives described in the summative external assessment section of the AS. The AS examination consisted of one paper:

- Paper 1, Section 1 consisted of multiple-choice questions (20 marks)
- Paper 1, Section 2 consisted of short response questions (34 marks)
- Paper 2, Section 1 consisted of short response questions (32 marks)
- Paper 2, Section 2 consisted of an extended response question (16 marks).

The AS examination assessed subject matter from AS units 1 and 2. Questions were derived from the context of:

- Agricultural enterprises A
- Animal production A

- Plant production A
- Management of renewable resources
- Physical resource management
- Agricultural management, research and innovation.

The AS assessment required students to respond to multiple choice items, short response items and an extended response item.

## Assessment decisions

Assessment decisions are made by markers by matching student responses to the external assessment marking guide (EAMG). The external assessment papers and the EAMG are published in the year after they are administered.

### General multiple choice item responses

There were 20 multiple choice items in Paper 1.

#### Percentage of student responses to each option

**Note:**

- The correct answer is **bold** and in a blue shaded table cell.
- Some students may not have responded to every question.

| Question | A | B | C | D |
|---|---|---|---|---|
| **1** | 4.15 | 13.1 | **57.83** | 24.6 |
| **2** | 5.11 | **57.51** | 15.34 | 22.04 |
| **3** | 0.64 | 16.61 | **54.95** | 27.8 |
| **4** | 3.83 | 10.54 | 44.73 | **40.89** |
| **5** | **45.05** | 0.96 | 1.28 | 52.72 |
| **6** | 22.36 | 24.6 | 17.25 | **35.46** |
| **7** | **65.81** | 14.7 | 19.49 | 0 |
| **8** | 8.31 | **49.84** | 4.47 | 37.38 |
| **9** | 26.2 | **28.12** | 19.81 | 25.88 |
| **10** | 15.34 | 9.27 | **69.33** | 5.75 |
| **11** | 17.89 | **33.55** | 10.86 | 37.7 |
| **12** | 24.28 | **41.85** | 30.67 | 3.19 |
| **13** | 3.19 | 7.03 | **75.72** | 13.42 |
| **14** | 4.47 | **20.77** | 71.57 | 2.88 |
| **15** | **57.51** | 10.22 | 22.04 | 10.22 |
| **16** | 7.67 | **39.94** | 7.35 | 45.05 |

| Question | A | B | C | D |
|---|---|---|---|---|
| **17** | 48.88 | 9.27 | **28.12** | 13.42 |
| **18** | 28.75 | 21.09 | 25.88 | **24.28** |
| **19** | **45.37** | 10.54 | 40.26 | 2.88 |
| **20** | 42.49 | 3.83 | 39.62 | **14.06** |

## AS multiple choice item responses

There were 20 multiple choice items in Paper 1.

### Percentage of student responses to each option

**Note:**

- The correct answer is **bold** and in a blue shaded table cell.
- Some students may not have responded to every question.

| Question | A | B | C | D |
|---|---|---|---|---|
| **1** | 2.6 | **45.45** | 41.56 | 10.39 |
| **2** | 1.3 | 1.3 | **14.29** | 83.12 |
| **3** | 20.78 | 18.18 | **15.58** | 44.16 |
| **4** | 6.49 | **49.35** | 19.48 | 23.38 |
| **5** | 12.99 | 28.57 | **33.77** | 24.68 |
| **6** | 9.09 | **31.17** | 40.26 | 18.18 |
| **7** | 12.99 | **37.66** | 20.78 | 28.57 |
| **8** | **25.97** | 10.39 | 58.44 | 5.19 |
| **9** | 12.99 | 51.95 | 5.19 | **29.87** |
| **10** | 33.77 | 7.79 | **54.55** | 3.9 |
| **11** | 35.06 | **40.26** | 12.99 | 11.69 |
| **12** | 9.09 | 22.08 | **46.75** | 22.08 |
| **13** | **28.57** | 44.16 | 20.78 | 6.49 |
| **14** | 19.48 | **35.06** | 31.17 | 12.99 |
| **15** | 32.47 | 12.99 | **50.65** | 3.9 |
| **16** | **18.18** | 63.64 | 10.39 | 7.79 |
| **17** | 18.18 | 5.19 | **40.26** | 36.36 |
| **18** | 16.88 | **57.14** | 22.08 | 3.9 |
| **19** | 11.69 | 2.6 | 9.09 | **76.62** |
| **20** | 2.6 | 20.78 | 3.9 | **72.73** |

## Effective practices

Overall, students responded well to:

- analysis and interpretation questions about nutritional requirements for animal production
- questions related to financial sustainability of agricultural enterprises
- application questions relevant to physical and biological sustainability of farming enterprises
- questions requiring simple analysis of relationships between two variables.

The following excerpts have been selected to illustrate effective student responses in one or more of the syllabus assessment objectives. The characteristics identified may not be the only time the characteristics have occurred throughout a response.

## Samples of effective practices

### Short response

Assessment objective: 1

Paper 1 (General)

Question 24c

This question required students to explain a biological method of pest control.

Effective student responses:

- identified a biological method of pest control
- explained how the biological method controls the animal pest
- explained the conditions that should be met before the biological method is used.

This student response excerpt has been included:

- to demonstrate an effective response for this question type
- to show alignment of the response with the EAMG.

| | |
|---|---|
| **Describe and explain (0–3 marks)** | An example of a biological control method is the dung beetle - brought in to control buffalo fly populations. Before introducing the biological control you must understand the life cycles and tendancies of the targeted pests - the dung beetle was only successful as it was understood that fly larvae thrive in animal ~~fa~~ feces ∴ introducing a dung beetle would affect a critical point in the buffalo fly life cycle. no larvae = no mature buffalo fly = reduced populations. |

Assessment objective: 2

Paper 2 (General)

Question 9

This question required students to respond to a piece of stimulus relevant to property management and key issues that impact on agricultural production.

Effective student responses:

- identified a management issue
- explained two processes that may have caused the issue
- proposed two solutions for the identified issue.

These student response excerpts have been included:

- to identify a management issue in one excerpt and an alternative correct response in the other excerpt
- to demonstrate and identify two processes that would cause either issue
- to provide two solutions that would alleviate each of two issues.

| | |
|---|---|
| **Apply understanding (0–3 marks)** | **Excerpt 1**<br>overgrazing → leads to increased erosion<br><br>Overgrazing can result from having too many livestock in a particular area for an extended period of time. This could result from overstocking a paddock or having no where else to put stock to prevent over grazing (generally in times of drought).<br>To firstly prevent overgrazing, paddock rotation systems could be implemented, stocking rates can be decreased or stock could be sent on agistment. Proposed solutions would include removing all stock until a certain amount of vegetation has grown back or planting cover crops to prevent soil erosion from not having any group cover<br>**Excerpt 2**<br>Wind erosion.<br>Two processes include the use of tillage which took all crop residue away that held down the top soil and a lack of vegetation, protecting the bare ground outside the paddock, that could have been drought.<br>The first solution is to use no-till practises to protect the top soil with old crop residue and the second is to use vegetation barriers as a wind block to also protect the top soil and hold the soil together. |

Assessment objective: 4

Paper 1 (General)

Question 27c

This question required students to decide which fertiliser a farmer should use, based on the data in the graph.

Effective student responses:

- selected the correct fertiliser
- identified a statistical difference for Tomato crop 1
- identified a statistical difference for Tomato crop 2.

This student response excerpt has been included:

- to show evidence of the student analysing the data
- to show alignment of the response to the first three criteria in the EAMG.

| | |
|---|---|
| **Interpret evidence (0–3 marks)** | c) Decide which fertiliser tomato farmers should use to optimise production in this cropping system. Justify your decision with two pieces of evidence and give a reason this type of fertiliser would be expected to improve the yield of a tomato crop. *[4 marks]*<br><br>Tomato farmers should implement the use of the ROF fertiliser as it increased tomato yield in the case of both tomato crops. Tomato 1 had a controlled yield of ~75 t/ha while tomato 2 had a controlled yield of ~80 t/ha. With the use of ROF the yield of each crop increased to ~83 t/ha and ~110 t/ha, respectively. The error bars for this treatment do not overlap suggesting the difference can be considered significant in the case of tomato 1, the other fertilisers demonstrate little to ~~none~~ no difference against control while in the case of tomato 2 each fertiliser produced a significant change relative to the control. other conditions must also be considered for ~~optimal~~ optimality to be reached. It would be expected that this fertiliser (ROF) increases crop yield as it ~~to~~ resulted in increased yield for BOTH tomato crops planted. |

Assessment objective: 4

Paper 2 (Alternative Sequence)

Question 8

This question required students to decide which river catchment would benefit the most from a proposed strategy to improve water quality.

Effective student responses:

- identified the correct catchment in which the strategy would be the most effective
- identified the human activity responsible for lower water quality
- contrasted the amount and sources of suspended sediment in each catchment
- justified the identified strategy.

This student response excerpt has been included:

- to show alignment of the response to the criteria in the EAMG.

| | |
|---|---|
| **Interpret evidence (0–5 marks)** | Catchment 1 requires a large reduction in fine sediment (a drop of 85 kt) to reach the 2013 baseline. More then 68% of sediment in this area is due to streambank erosion. Fencing rivers in this area will reduce agricultural activity on streambanks, allowing natural, native vegatative rearvitment to occur, stabilising the streambank and reducing fine sediments levels. Alternatively, in Catchment 2, a reduction of only 11 kt of fine sediment is required, and streambank erosion contributes just 10% to sediment levels. Fencing rivers in this area will have little impact, instead grazing mitigation should be investigated as it contributes 80% of sediment in the area. Overall, Catchment 1 requires large reduction in fine sediment levels especially due to ~~rivert~~ streambank erosion and would benefit most from river fencing. |

### Extended response

Paper 2 (General)

Question 10

This question required students to assess environmentally sustainable practices for a production system.

Effective student responses:

- demonstrated justified analysis of each of the environmental management criteria
- identified three management criteria for environmental sustainability.

This student response excerpt has been included:

- to demonstrate evidence of a justified analysis of three strengths and/or weaknesses for an environmental criterion
- to identify the three management criteria relevant to assessing environmental sustainability.

**Objectives 1–4**
**(0–15 marks)**

Draw a justified conclusion about the sustainability of the production system.

(1) waste management – plant, animal, chemical
(2) physical resource managment, land, water
(3) biological resource managment – animals, plants.

(1) waste management

A weakness of the production system is the lack of control over the run-off from the feedlot. This could be managed by having allocated run-off areas that do not impact the surrounding water sources.

A weakness is the inability of the production system not meeting the industry standard of 13-week routine waste removal. The waste should be removed routinely to meet standards.

Run-off should be removed from the farm where appropriate to a designated facility as the odour and continuous stockpile on-site. is a weakness

## Practices to strengthen

It is recommended that when preparing students for external assessment, teachers consider:

- the multiple choice items where students answered incorrectly to ensure subject matter is sufficiently covered
- revising cognitive verbs and expected responses. For example, a question that requires students to ‘compare’ requires the recognition of a similarity, a difference and the significance

of the similarity and/or difference. Similarly, the stem ‘draw conclusions’ requires students to make a judgment based on evidence or reasoning

- responses to items relating to Assessment objectives 3 and 4 that require analysis of data (e.g. from mandatory and suggested practicals) to support conclusions
- providing opportunities for students to apply understanding of concepts, theories, models and systems using unseen stimulus under examination conditions.