

Interactive Example Candidate Responses

Paper 5 (May/June 2016), Question 1

Cambridge International AS & A Level

Biology 9700

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- 1 Grassland is an important breeding habitat for some birds. These birds feed on plant material and invertebrates. Biodiversity of the habitat is maintained by domestic herbivores, such as sheep, cows and goats, grazing on growing plant material.

A group of students investigated the effect of grazing by domestic herbivores on the plant biodiversity of a grassland as measured by Simpson's Index of Diversity. They investigated two areas. One area was grazed by herbivores and the other area was not grazed for many years because it was surrounded by a fence to keep out the herbivores.

- (a) State the data that the students would have collected from the grazed and ungrazed areas to calculate Simpson's Index of Diversity.

The number of individuals ^{plant} of each species in the grazed area and the ungrazed area ^{separately}
The total number of individuals ^(from all species) in the grazed area and total number of individuals (from all species combined) in the ungrazed area. [2]

- (b) Describe a random (unbiased) method which the students could have used to collect the data needed to calculate the biodiversity of the plant species in the two areas.

The description of your method should be detailed enough for another person to follow.

With a measuring tape, measure the dimensions of the fence surrounding the ungrazed area - Using the same dimension, (length and width), mark out the ^{ungrazed} area with a tape - This is to ensure the perimeters of both the ~~ungrazed~~ grazed and ungrazed area are kept ~~at~~ same - Now place quadrats of the same size each time (e.g. 1m x 1m) randomly scattered within the determined boundaries ^(imposed) of the grazed land - ~~Use~~ Use a random number generator app to determine the coordinates of where to place the quadrats to avoid bias - In each quadrat, identify the different species of plants carefully and tabulate the number of ~~with~~ plants in each species from all the quadrats - we do not need to know the name of the species

Your
Mark

1(a)

1(b)

1(c)

1(d)(i)

1(d)(ii)

1(d)(iii)

1(d)(iv)

1(e)

1(f)

Q1	Mark scheme	
	Expected answer	Extra guidance
(a)	number of individuals or population of each type of / sort of / species present (in the sample) ; total number of individuals / all populations (of all species);	A count the number in different species A in context of any named organisms
(b)	any 8 from: 1 ref. to sampling in both areas / grazed and ungrazed ; 2 any idea of marking out the area to be sampled ; 3 use a method of generating random numbers (to use coordinates); 4 use a (frame or point) <u>quadrat</u> (for individual samples) ; 5 place (quadrat A/V) at coordinates ; 6 ref. to method of identifying or distinguishing different species / types / sorts of plant ; 7 ref. to counting / recording of: number of individuals or the population of / each type / sort / species present (in quadrat / plot) or the total number of all the plants present (in quadrat / plot) ;	I any ref. to standardising environmental factors. I if listed as the independent I ref. to transects e.g. tape measures / use string and marker pole / make a grid of plot e.g. random number generator / app / select number from a hat I throwing of quadrat must be clear that the quadrat is the counting frame spelling of quadrat must be correct at least once A descriptions, e.g. frame placed on the ground e.g. photographs / key / app / expert / nature guide / A/V A using letters or numbers for different species I percentage cover / abundance scale

of a certain plant, just be able to identify that they are two different species of plant. Using the same total number of quadrats, repeat this procedure inside the fence that is the ungrazed land. The table should look as follows:-

Species	No. of individuals grazed land	ungrazed land
A		
B		
C		

We might have to use a magnifying glass to identify some plant species. We will now use the formula for Simpson's Index of Diversity to calculate the ^(plant) species diversity in the grazed and ungrazed land separately. Formula = $1 - \frac{\sum n(n-1)}{N(N-1)}$ where 'n' is the number of individuals of a species and 'N' is the total number of plants for all species in grazed/ungrazed land. The answer obtained will be a numerical value from 0 to 1. A value close to zero shows low species diversity. A value closer to 1 shows high plant biodiversity. We will obtain two values for the Simpson's Index of Diversity one for grazed land and one for ungrazed land.

→ for example if table was like this:-

species	grazed land (number of individuals)
A	20
B	30

Simpson's Index by $1 - \left[\left(\frac{20}{50} \right)^2 + \left(\frac{30}{50} \right)^2 \right]$ for this grazed land

Your
Mark

1(a)

1(b)

1(c)

1(d)(i)

1(d)(ii)

1(d)(iii)

1(d)(iv)

1(e)

1(f)

Q1 Mark scheme

	Expected answer	Extra guidance
(b)	<p>8 same size quadrat / same quadrat A/W ;</p> <p>9 same size plot in each area ;</p> <p>10 same number of different quadrats / samples per plot ;</p> <p>11 replicate the procedure with a different plot in a given area ;</p> <p>12 sample at different times of year / seasons ;</p> <p>13 safety</p> <p>any 1 from:</p> <ul style="list-style-type: none"> • ref. to injury / getting lost and staying with group ; • allergy to plants and wearing gloves / protective clothing ; • allergy to pollen / hay fever and wearing mask or taking medication ; • ref. to uneven ground / hazardous plants or animals or environment and wearing suitable shoes / protective clothing ; 	<p>e.g. 10 quadrats in each plot</p> <p>I repeat 3 times and find a mean</p> <p>A if only replicate with different plots in one area</p> <p>I repeat 3 times and take a mean</p> <p>I sampling on same day / next week</p> <p>I low risk</p> <p>A any suitable example – thorny / stinging plants, insect bites / stings, snakes, belligerent grazing animals and a suitable precaution</p> <p>[max8]</p>

The students also investigated the effect grazing had on the height of one particular species of plant. Their hypothesis was:

The mean height of the plant is greater in the ungrazed grassland than the grazed grassland.

- (c) State the independent and the dependent variables in this investigation.

independent variable ungrazed or grazed (grassland)
dependent variable mean height of the plant [1]

- (d) Table 1.1 shows the results of their investigation.

Table 1.1

sample number	height of plant/mm	
	grazed area	ungrazed area
1	586	858
2	549	879
3	526	864
4	589	901
5	545	847
6	538	862
7	573	864
8	549	879
9	604	864
10	611	888
mean	567	870
mode	549	864
median	561	864

- (i) Complete Table 1.1 by writing the values of the mode and median for the ungrazed area. [1]

862
847, 858, 864, 864, 873, 879, 888, 901

Your
Mark

1(a)

1(b)

1(c)

1(d)(i)

1(d)(ii)

1(d)(iii)

1(d)(iv)

1(e)

1(f)

Q1	Mark scheme	
	Expected answer	Extra guidance
(c)	independent: grazed and / or ungrazed grassland and dependent: (mean) height (of plant) ;	A type of grass land I extent of grazing [1]
(d)(i)	mode = 864 and median = 864 ;	[1]

- (ii) Use the information and formula below to calculate the standard error for these results.

Give your answers to 3 significant figures.

$$S_M = \frac{s}{\sqrt{n}}$$

S_M = standard error

s = standard deviation

n = sample size (number of observations)

grazed area: $s = 29.5$

ungrazed area: $s = 15.7$

standard error, grazed area = 9.33

standard error, ungrazed area = 4.96 [2]

Standard error is used to calculate 95% Confidence Intervals (CI).

The values for the grazed area are 548.3 mm to 585.7 mm.

- (iii) Use the formula below to calculate the confidence intervals for the **ungrazed** area.

$$95\% \text{ CI} = \text{mean} \pm 2 S_M$$

Show your working.

$$\begin{aligned} & 870 + 2(4.96) \quad \text{and} \quad 870 - 2(4.96) \\ & = 879.9 \quad \text{and} \quad 860.1 \end{aligned}$$

ungrazed area 860.1 mm to 879.9 mm [2]

- (iv) State what information is gained by calculating the confidence intervals.

A 95% confidence interval means that we can be 95% certain that the true value for mean lies ^(within the range of) above or below two times the standard error - for example, for grazed area, if another sample is collected we'll be ^{height of the plants in that sample} 95% certain the mean would be between 548.3 ^{mm} and 585.7 ^{mm} [2]

Your
Mark

1(a)

1(b)

1(c)

1(d)(i)

1(d)(ii)

1(d)(iii)

1(d)(iv)

1(e)

1(f)

Q1	Mark scheme	
	Expected answer	Extra guidance
(d)(ii)	SM grazed = 9.33 ; SM ungrazed = 4.97 / 4.96 ;	max 1 if answers are to 1 dp or 3 dp (9.3 / 9.329, 5.0 / 4.965) [2]
(d)(iii)	860.1 ; to 879.9 ;	A ecf from 1(d)(ii) for correct calculation from incorrect S_M [2]
(d)(iv)	any 2 from: 95% confident / sure / certain that the mean lies within these limits ; shows the reliability of the mean ; the ungrazed mean is more reliable (because it's smaller) ; the difference between means is significant because there is no overlap between CI for ungrazed and grazed ;	must be a clear statement R if ref. to accuracy or results AW ora the grazed is less reliable (because it is bigger) [max2]

- (e) The students used the mark-release-recapture method to estimate the population of an invertebrate animal found living on the grassland. They used the formula:

$$\frac{\text{number of animals marked in the first sample} \times \text{total number of animals in the second sample}}{\text{number of marked animals in the second sample}}$$

State two precautions the students should have taken to ensure that the results they obtained were valid.

1. The animals that they marked were given sufficient time to mix with the other grassland animals randomly taken when they were first released.
2. The markers that they used did not affect the future survival of the animals when they were released.

[2]

- (f) The population of an invertebrate that feeds on seeds was estimated in both the grazed and ungrazed areas. Predict which area would have the greatest population and give a reason for your choice.

choice the grazed one

reason Because animals remove plants (graze on them) (continued below) [1]

Answer 1 of continued

→ sometimes by uprooting the whole plants or grasses so that their seeds are no longer covered with soil. The seeds and embryos are exposed like this, also when soil erosion occurs so the invertebrates are able to feed on many of these that are scattered on bare or almost bare (grazed land) -

[Total: 21]

Your
Mark

1(a)

1(b)

1(c)

1(d)(i)

1(d)(ii)

1(d)(iii)

1(d)(iv)

1(e)

1(f)

Q1 Mark scheme

	Expected answer	Extra guidance
(e)	<p>any 2 from: sample from a large area ; idea that there is a long enough time interval, for marked individuals to mix into the population / between capture and recapture ; idea that the marking technique must not be toxic AW ; idea that the marking technique must not increase / decrease chances of survival ; marking technique must not fall off / be rubbed off / washed off animal ; idea that time is not so long that migration / life cycle changes (of the species) have occurred ;</p>	<p>1 sample size 1 any specified times need the idea of <i>long enough for dispersal</i> e.g. increases or decreases chance of predation A in terms of inhibiting / changing movement or behaviour [max2]</p>
(f)	<p>ungrazed and because there are more seeds (to eat) / AW ;</p>	<p>A ungrazed as there will be larger plants and more places for inverts to hide from predators / protection from predators. [1]</p>
		Total [21]

- 1 Grassland is an important breeding habitat for some birds. These birds feed on plant material and invertebrates. Biodiversity of the habitat is maintained by domestic herbivores, such as sheep, cows and goats, grazing on growing plant material.

A group of students investigated the effect of grazing by domestic herbivores on the plant biodiversity of a grassland as measured by Simpson's Index of Diversity. They investigated two areas. One area was grazed by herbivores and the other area was not grazed for many years because it was surrounded by a fence to keep out the herbivores.

- (a) State the data that the students would have collected from the grazed and ungrazed areas to calculate Simpson's Index of Diversity.

n = Number of individuals of a particular species

~~(Herbivores)~~ / (Plant species)

N = Total number of all organisms in the area of investigation.

[2]

- (b) Describe a random (unbiased) method which the students could have used to collect the data needed to calculate the biodiversity of the plant species in the two areas.

The description of your method should be detailed enough for another person to follow.

- ① Two different areas are sampled. One area that was grazed by herbivores and another area not grazed by herbivores for many years. Future that sampling occurs in these 2 distinct areas. ^{Areas of these details are chosen}

- ② Diversity is calculated using Simpson's Index of Diversity. Formula = $1 - \sum \left(\frac{n}{N} \right)^2$

- ③ The same student should carry out random sampling in each of the 2 areas. The shape and size of quadrat should be the same. A square of 1m^2 is used. Samples are taken at the same time of day, for example, in the morning.

- ④ Use quadrat sampling technique. A student, with eyes closed, randomly throws a quadrat in one of the 2 areas. The area in which the quadrat lands is observed. The number of different and

Your
Mark

1(a)

1(b)

1(c)

1(d)(i)

1(d)(ii)

1(d)(iii)

1(d)(iv)

1(e)

1(f)

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distinct plant species that is in the quadrat is noted and written down as numerals. Plant species that are not part of the quadrat are omitted.

⑤ Step 4 is repeated for a further 4 times at different positions in the area grazed by herbivores and the area not grazed by herbivores. formula is used to calculate Diversity of area.

⑥ few assumptions are made. Number of organisms present in quadrat in the experiments are representative of total population in a particular area. Throwing of quadrat should be completely random.

⑦ Low risk experiment. Ensure that only 1 person throws quadrat and all other students are a considerable distance away to avoid being hit by quadrat.

⑧ 5 times throw of quadrat is repeated 2 times and the average values from the experiment and of Simpson's Biodiversity Index is calculated.

⑨ Same person should calculate the number of plant species in each quadrat. This is to avoid biasness. Sampling is done at same time of day to give the same temperature. Ensure that sampling in grazed area is done when there are no herbivores grazing so as to not affect hurt herbivores and for them not to interfere with experiment.

⑩ A control experiment is set up on an area other than a grassland. Ensure for ungrazed area that quadrat is not thrown out of fence. Carry out experiment during the day for easy visualisation of number of organisms.

[8]

Your
Mark

1(a)

1(b)

1(c)

1(d)(i)

1(d)(ii)

1(d)(iii)

1(d)(iv)

1(e)

1(f)

Q1	Mark scheme	
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(b)	<p>8 same size quadrat / same quadrat AW ;</p> <p>9 same size plot in each area ;</p> <p>10 same number of different quadrats / samples per plot ;</p> <p>11 replicate the procedure with a different plot in a given area ;</p> <p>12 sample at different times of year / seasons ;</p> <p>13 safety</p> <p>any 1 from:</p> <ul style="list-style-type: none"> • ref. to injury / getting lost and staying with group ; • allergy to plants and wearing gloves / protective clothing ; • allergy to pollen / hay fever and wearing mask or taking medication ; • ref. to uneven ground / hazardous plants or animals or environment and wearing suitable shoes / protective clothing ; 	<p>e.g. 10 quadrats in each plot</p> <p>I repeat 3 times and find a mean</p> <p>A if only replicate with different plots in one area</p> <p>I repeat 3 times and take a mean</p> <p>I sampling on same day / next week</p> <p>I low risk</p> <p>A any suitable example – thorny / stinging plants, insect bites / stings, snakes, belligerent grazing animals and a suitable precaution</p> <p>[max8]</p>

The students also investigated the effect grazing had on the height of one particular species of plant. Their hypothesis was:

The mean height of the plant is greater in the ungrazed grassland than the grazed grassland.

- (c) State the independent and the dependent variables in this investigation.

independent variable: the type of grassland (grazed or ungrazed) - presence or absence of herbivores.
dependent variable: Mean height of a particular species of plant [1]

- (d) Table 1.1 shows the results of their investigation.

Table 1.1

sample number	height of plant/mm	
	grazed area	ungrazed area
1	586	858
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mean	567	870
mode	549	864
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- (i) Complete Table 1.1 by writing the values of the mode and median for the ungrazed area. [1]

847, 858, 862, 864, 864, 864, 873, 879, 888, 901

Your
Mark

1(a)

1(b)

1(c)

1(d)(i)

1(d)(ii)

1(d)(iii)

1(d)(iv)

1(e)

1(f)

Q1 Mark scheme

	Expected answer	Extra guidance
(c)	independent: grazed and / or ungrazed grassland and dependent: (mean) height (of plant) ;	A type of grass land I extent of grazing [1]
(d)(i)	mode = 864 and median = 864 ;	[1]

- (ii) Use the information and formula below to calculate the standard error for these results.

Give your answers to 3 significant figures.

$$S_M = \frac{s}{\sqrt{n}}$$

S_M = standard error

s = standard deviation

n = sample size (number of observations)

grazed area: $s = 29.5$

ungrazed area: $s = 15.7$

$$S_{M \text{ grazed}} = \frac{29.5}{\sqrt{10}}$$

$$S_{M \text{ ungrazed}} = \frac{15.7}{\sqrt{10}}$$

standard error, grazed area = 9.33

standard error, ungrazed area = 4.96 [2]

Standard error is used to calculate 95% Confidence Intervals (CI).

The values for the grazed area are 548.3mm to 585.7mm.

- (iii) Use the formula below to calculate the confidence intervals for the ungrazed area.

$$95\% \text{ CI} = \text{mean} \pm 2 S_M$$

Show your working.

$$= 870 \pm (4.96) 2$$

$$= 870 + 9.92 \quad \text{or} \quad = 870 - 9.92$$

$$= 879.92 \quad = 860.08$$

Print Script

ungrazed area 860.1 mm to 879.9 mm [2]

- (iv) State what information is gained by calculating the confidence intervals.

whether the difference between 2 means is significantly different. If difference between means is significantly different, then those differences have occurred not by chance. If differences are not significant, they have occurred by chance. (to ascertain the probabilities or values at which the means are considered to be significantly different. [2]

Your
Mark

1(a)

1(b)

1(c)

1(d)(i)

1(d)(ii)

1(d)(iii)

1(d)(iv)

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1(f)

Q1	Mark scheme	
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- (e) The students used the mark-release-recapture method to estimate the population of an invertebrate animal found living on the grassland. They used the formula:

$$\frac{\text{number of animals marked in the first sample} \times \text{total number of animals in the second sample}}{\text{number of marked animals in the second sample}}$$

State two precautions the students should have taken to ensure that the results they obtained were valid.

1. Animals don't lose their marks. Enough time is given for marked and unmarked animals to intermingle. Marks don't hurt animals.
2. Nothing has happened to upset the balance of the number of animals. Examples are predation, migration, mortality. [2]

- (f) The population of an invertebrate that feeds on seeds was estimated in both the grazed and ungrazed areas. Predict which area would have the greatest population and give a reason for your choice.

choice Ungrazed areas.

reason Height of plants increases and they can reach a greater reproductive age and undergo pollination. This produces seeds. [1]

[Total: 21]

Your
Mark

1(a)

1(b)

1(c)

1(d)(i)

1(d)(ii)

1(d)(iii)

1(d)(iv)

1(e)

1(f)

Q1	Mark scheme	
	Expected answer	Extra guidance
(e)	<p>any 2 from: sample from a large area ; <i>idea that</i> there is a long enough time interval, for marked individuals to mix into the population / between capture and recapture ; <i>idea that</i> the marking technique must not be toxic AW ; <i>idea that</i> the marking technique must not increase / decrease chances of survival ; marking technique must not fall off / be rubbed off / washed off animal ; <i>idea that</i> time is not so long that migration / life cycle changes (of the species) have occurred ;</p>	<p>1 sample size 1 any specified times need the idea of <i>long enough for dispersal</i> e.g. increases or decreases chance of predation A in terms of inhibiting / changing movement or behaviour [max2]</p>
(f)	<p>ungrazed and because there are more seeds (to eat) / AW ;</p>	<p>A ungrazed as there will be larger plants and more places for inverts to hide from predators / protection from predators. [1]</p>
		Total [21]

- 1 Grassland is an important breeding habitat for some birds. These birds feed on plant material and invertebrates. Biodiversity of the habitat is maintained by domestic herbivores, such as sheep, cows and goats, grazing on growing plant material.

A group of students investigated the effect of grazing by domestic herbivores on the plant biodiversity of a grassland as measured by Simpson's Index of Diversity. They investigated two areas. One area was grazed by herbivores and the other area was not grazed for many years because it was surrounded by a fence to keep out the herbivores.

- (a) State the data that the students would have collected from the grazed and ungrazed areas to calculate Simpson's Index of Diversity.

Total number of species in the grazed and ungrazed area.
Number of organisms of each species in both grazed and ungrazed areas.
This information is required to calculate Simpson's Index of Diversity. [2]

- (b) Describe a random (unbiased) method which the students could have used to collect the data needed to calculate the biodiversity of the plant species in the two areas.

The description of your method should be detailed enough for another person to follow.

The person must follow the method of random sampling.
First, take a quadrat and place it anywhere in the area randomly so that the results are not biased and represent the entire area. Count the different number of species present organisms in the quadrat. Also count how many of that same species is present in that quadrat. These values must be plotted in a table as follows.

Handwritten table:

Species	Number of organisms
1	1
2	1
3	1
4	1
5	1
6	1
7	1
8	1
9	1
10	1

Readings for Quadrat used in grazed area.

Species Number	Number of organisms in that species
1	1
2	1
3	1
4	1
5	1
6	1
7	1
8	1
9	1
10	1

Simpson's Index of Diversity can be used to find the species diversity which will represent the biodiversity of that area.

Your
Mark

1(a)

1(b)

1(c)

1(d)(i)

1(d)(ii)

1(d)(iii)

1(d)(iv)

1(e)

1(f)

Q1 Mark scheme

	Expected answer	Extra guidance
(a)	number of individuals or population of each type of / sort of / species present (in the sample) ; total number of individuals / all populations (of all species);	A count the number in different species A in context of any named organisms
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$$\text{Simpson's Index of Diversity} = 1 - \left(\frac{\sum n}{N} \right)$$

where,

N is the total number of organisms in all the species.

n is the number of species in any particular species.

• Divide number of ^{organisms} species for each species by the total number of organisms, N .

• Add all of them up and subtract the value obtained by 1.

The Value must be between 0 and 1. More the Value closer to 1, more is the species diversity and Hence more is the biodiversity.

Species Diversity depends on two things: %age abundance of each species and Total Number of species. More the number of species and more equally their abundances are, more would be the biodiversity of that area.

• Readings for ungrazed area should be taken in exactly the same way as that for grazed area. Quadrat shall be replaced randomly so that the results are not biased.

All over again, Simpson's Index of diversity can be used to find a Value.

These Values indicate how much the biodiversity of that area is.

These Value, calculated using Simpson's Index of Diversity can also be compared to get an idea which area has more Biodiversity.

~~Maximum values calculated for species diversity can be used because~~

Test crosses must also be done between the same species of plant as more alleles ^(more genetic variation) also represents an increase in biodiversity [8]

Your
Mark

1(a)

1(b)

1(c)

1(d)(i)

1(d)(ii)

1(d)(iii)

1(d)(iv)

1(e)

1(f)

Q1 Mark scheme

	Expected answer	Extra guidance
(b)	<p>8 same size quadrat / same quadrat AW ;</p> <p>9 same size plot in each area ;</p> <p>10 same number of different quadrats / samples per plot ;</p> <p>11 replicate the procedure with a different plot in a given area ;</p> <p>12 sample at different times of year / seasons ;</p> <p>13 safety</p> <p>any 1 from:</p> <ul style="list-style-type: none"> • ref. to injury / getting lost and staying with group ; • allergy to plants and wearing gloves / protective clothing ; • allergy to pollen / hay fever and wearing mask or taking medication ; • ref. to uneven ground / hazardous plants or animals or environment and wearing suitable shoes / protective clothing ; 	<p>e.g. 10 quadrats in each plot</p> <p>I repeat 3 times and find a mean</p> <p>A if only replicate with different plots in one area</p> <p>I repeat 3 times and take a mean</p> <p>I sampling on same day / next week</p> <p>I low risk</p> <p>A any suitable example – thorny / stinging plants, insect bites / stings, snakes, belligerent grazing animals and a suitable precaution</p> <p>[max8]</p>

The students also investigated the effect grazing had on the height of one particular species of plant. Their hypothesis was:

The mean height of the plant is greater in the ungrazed grassland than the grazed grassland.

- (c) State the independent and the dependent variables in this investigation.

independent variable *grazing*

dependent variable *mean height of the plant* [1]

- (d) Table 1.1 shows the results of their investigation.

Table 1.1

sample number	height of plant/mm	
	grazed area	ungrazed area
1	586	858
2	549	873
3	526	864
4	589	901
5	545	847
6	538	862
7	573	864
8	549	879
9	604	864
10	611	888
mean	567	870
mode	549	864
median	561	864

- (i) Complete Table 1.1 by writing the values of the mode and median for the ungrazed area. [1]

Your
Mark

1(a)

1(b)

1(c)

1(d)(i)

1(d)(ii)

1(d)(iii)

1(d)(iv)

1(e)

1(f)

Q1	Mark scheme	
	Expected answer	Extra guidance
(c)	independent: grazed and / or ungrazed grassland and dependent: (mean) height (of plant) ;	A type of grass land I extent of grazing [1]
(d)(i)	mode = 864 and median = 864 ;	[1]

- (ii) Use the information and formula below to calculate the standard error for these results.

Give your answers to 3 significant figures.

$$S_M = \frac{s}{\sqrt{n}}$$

S_M = standard error

s = standard deviation

n = sample size (number of observations)

grazed area: $s = 29.5$,

ungrazed area: $s = 15.7$

standard error, grazed area = 9.33

standard error, ungrazed area = 4.96 [2]

Standard error is used to calculate 95% Confidence Intervals (CI).

The values for the grazed area are 548.3mm to 585.7mm.

- (iii) Use the formula below to calculate the confidence intervals for the **ungrazed** area.

$$95\% \text{ CI} = \text{mean} \pm 2 S_M$$

Show your working.

$$95\% \text{ CI} = 567 \pm 2 \times 4.96$$

$$= 567 \pm 9.92$$

$$- 567 + 9.92 = 576.92$$

$$- 567 - 9.92 = 557.08$$

ungrazed area 576.92 mm to 557.08 mm [2]

- (iv) State what information is gained by calculating the confidence intervals.

The information gained by calculating the confidence intervals tell us that we are 95% sure that plants with heights $576.92 - 557.08$ were found in ungrazed and their height has not been effected by grazing.

[2]

Your
Mark

1(a)

1(b)

1(c)

1(d)(i)

1(d)(ii)

1(d)(iii)

1(d)(iv)

1(e)

1(f)

Q1	Mark scheme	
	Expected answer	Extra guidance
(d)(ii)	SM grazed = 9.33 ; SM ungrazed = 4.97 / 4.96 ;	max 1 if answers are to 1 dp or 3 dp (9.3 / 9.329, 5.0 / 4.965) [2]
(d)(iii)	860.1 ; to 879.9 ;	A ecf from 1(d)(ii) for correct calculation from incorrect S_M [2]
(d)(iv)	any 2 from: 95% confident / sure / certain that the mean lies within these limits ; shows the reliability of the mean ; the ungrazed mean is more reliable (because it's smaller) ; the difference between means is significant because there is no overlap between CI for ungrazed and grazed ;	must be a clear statement R if ref. to accuracy or results AW ora the grazed is less reliable (because it is bigger) [max2]

- (e) The students used the mark-release-recapture method to estimate the population of an invertebrate animal found living on the grassland. They used the formula:

$$\frac{\text{number of animals marked in the first sample} \times \text{total number of animals in the second sample}}{\text{number of marked animals in the second sample}}$$

State two precautions the students should have taken to ensure that the results they obtained were valid.

1. *The should have used a non-toxic waterproof paint to mark the animals so that each one marked remains marked until the recapture*
2. *They should give enough time to the organisms to randomly spread in their habitat so that the results are not biased and represent the entire area being investigated.* [2]

- (f) The population of an invertebrate that feeds on seeds was estimated in both the grazed and ungrazed areas. Predict which area would have the greatest population and give a reason for your choice.

choice *ungrazed area.*
have been eaten
 reason *More plants so more availability of seeds as the seeds have been exposed when the plant was eaten as seeds can not be digested by grazing animals and so are left behind.* [1]
 [Total: 21]

Your
Mark

1(a)

1(b)

1(c)

1(d)(i)

1(d)(ii)

1(d)(iii)

1(d)(iv)

1(e)

1(f)

Q1 Mark scheme

	Expected answer	Extra guidance
(e)	<p>any 2 from: sample from a large area ; idea that there is a long enough time interval, for marked individuals to mix into the population / between capture and recapture ; idea that the marking technique must not be toxic AW ; idea that the marking technique must not increase / decrease chances of survival ; marking technique must not fall off / be rubbed off / washed off animal ; idea that time is not so long that migration / life cycle changes (of the species) have occurred ;</p>	<p>1 sample size 1 any specified times need the idea of <i>long enough for dispersal</i> e.g. increases or decreases chance of predation A in terms of inhibiting / changing movement or behaviour [max2]</p>
(f)	<p>ungrazed and because there are more seeds (to eat) / AW ;</p>	<p>A ungrazed as there will be larger plants and more places for inverts to hide from predators / protection from predators. [1]</p>
		Total [21]

Cambridge Assessment International Education
The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA, United Kingdom
t: +44 1223 553554 f: +44 1223 553558
e: info@cambridgeinternational.org www.cambridgeinternational.org

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