Comparing the abundance of plant species in grasslands under different management strategies

WALT

- describe a method
- collect valid data
- assess the strength of any
correlation using statistics

- Choose a plant species for your group to investigate

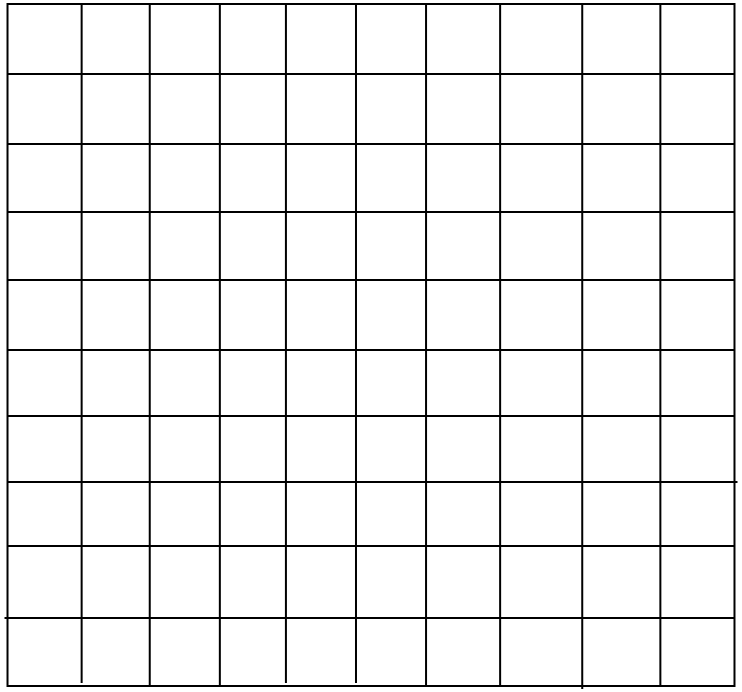
- Write a null hypothesis for your investigation

Method

- How can we measure the abundance of plants?

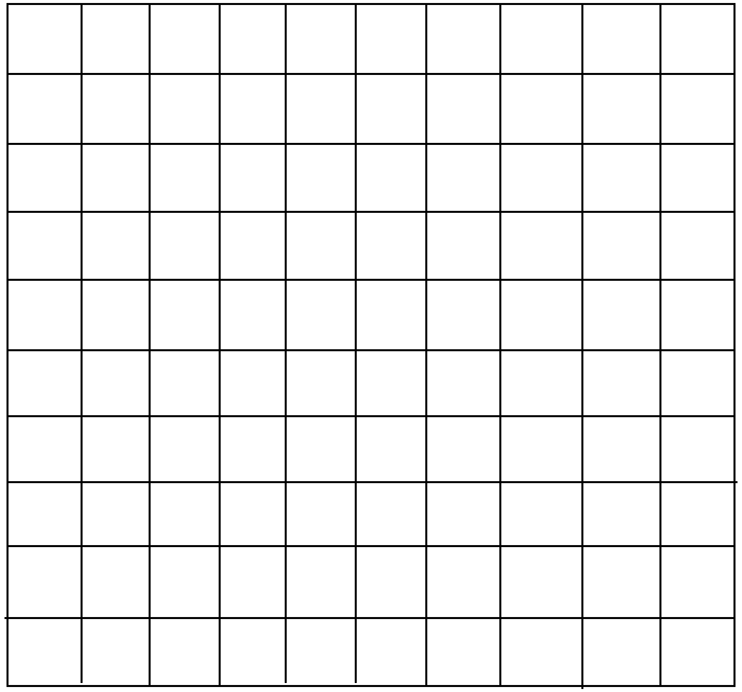
1. Use a quadrat

2. Measure frequency, percentage cover or density



What are the advantages and disadvantages of each method?

3. Where to site each quadrat and how many?



Now you have your data

- Calculate means for each grassland area

- Plot the mean percentage cover on a bar chart

Worked example:

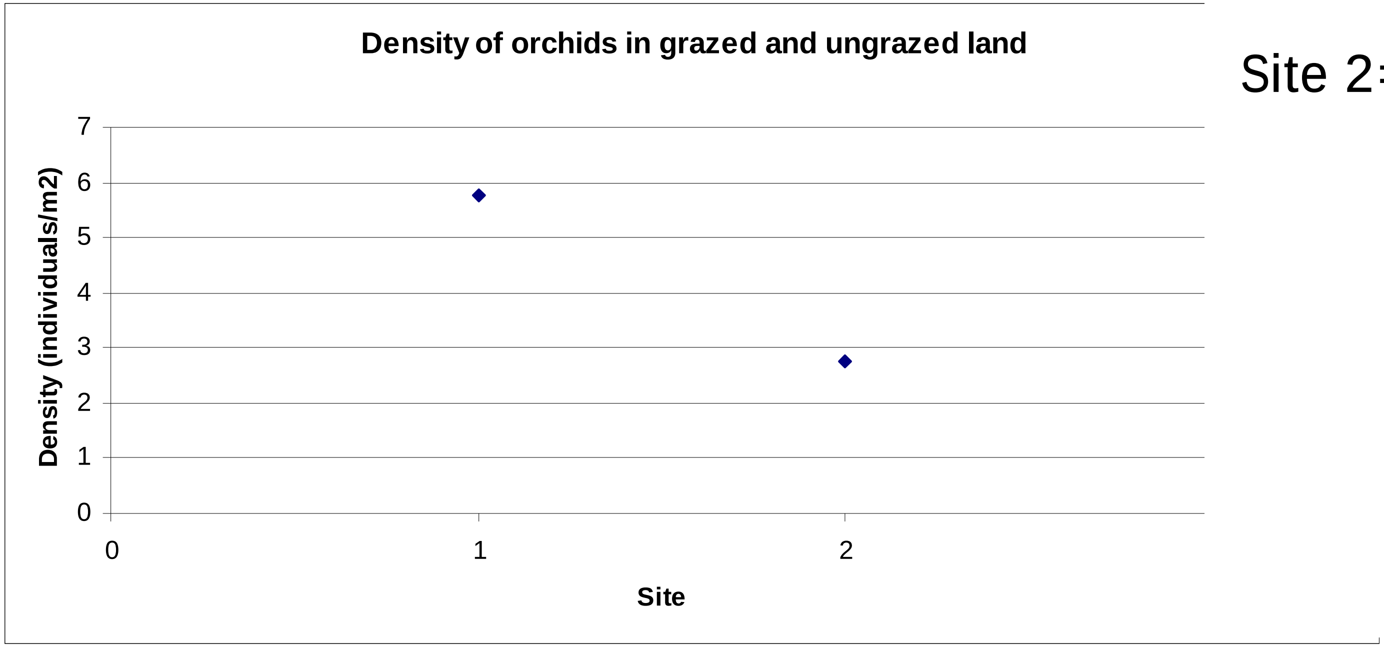
A scientist wants to find out the best way to manage a nature reserve to encourage orchids.

He compares orchid numbers on grazed land and an ungrazed field.

What conclusion can you draw from this graph?

Site 1= grazed

Site 2= ungrazed



Mean density: site 1=5.75 site 2=2.75

What extra information would you like to assess the strength of the conclusion?

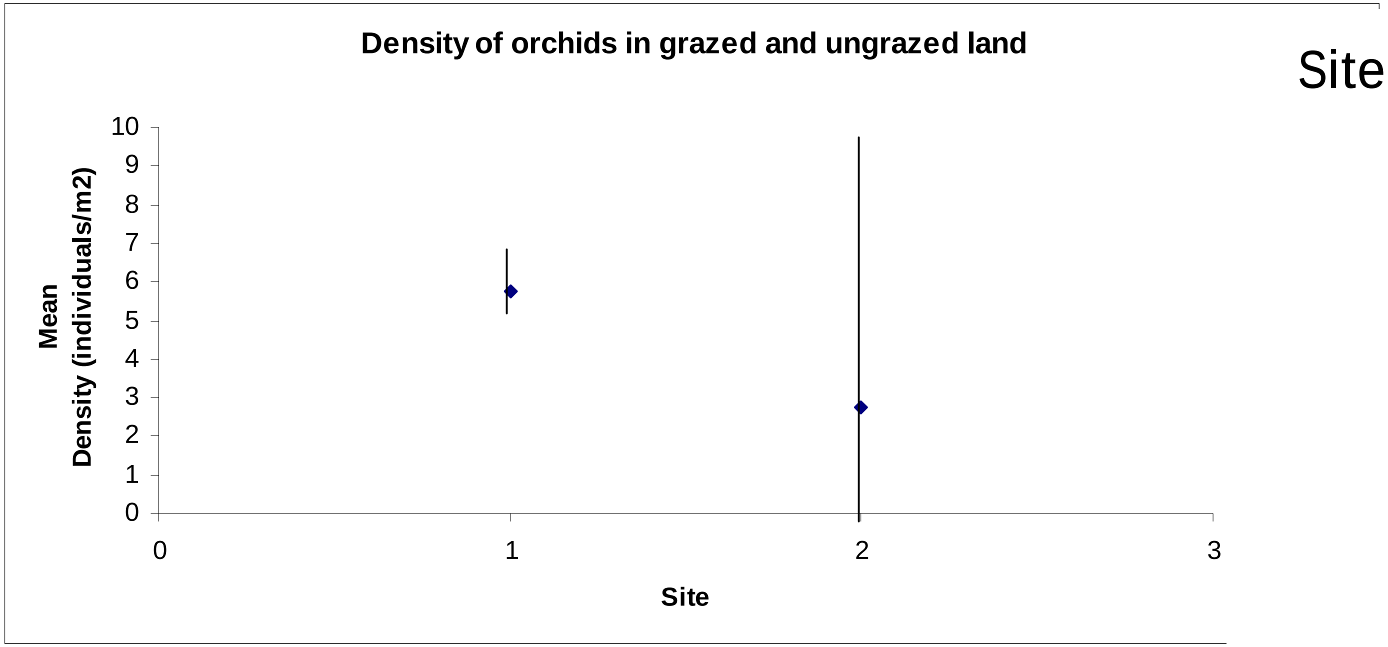
- Sample size
- Variability

Look at the graph again - the bars show the range of the densities he found at each site

How does this change your conclusion?

Site 1= grazed

Site 2= ungrazed



What’s the problem with using the range?

Imagine an experiment with:

- 100 readings
- a mean of 49
- 98 readings are 49
- one reading is 0
- one reading is 100

The range makes your data look unreliable because there are one or two extremes.

Raw data: number of individuals per m2

Site 1: 5 ,6 ,7,5

Site 2: 0,1,0,10

A better measure of the variability of data is the standard deviation of the mean (you did this at AS!)

$$\sigma = \sqrt{\frac{\sum (x - \overline{x})^2}{n - 1}}$$

σ = lower case sigma

$\sum$ = capital sigma

$\overline{x}$ = x bar

You can:

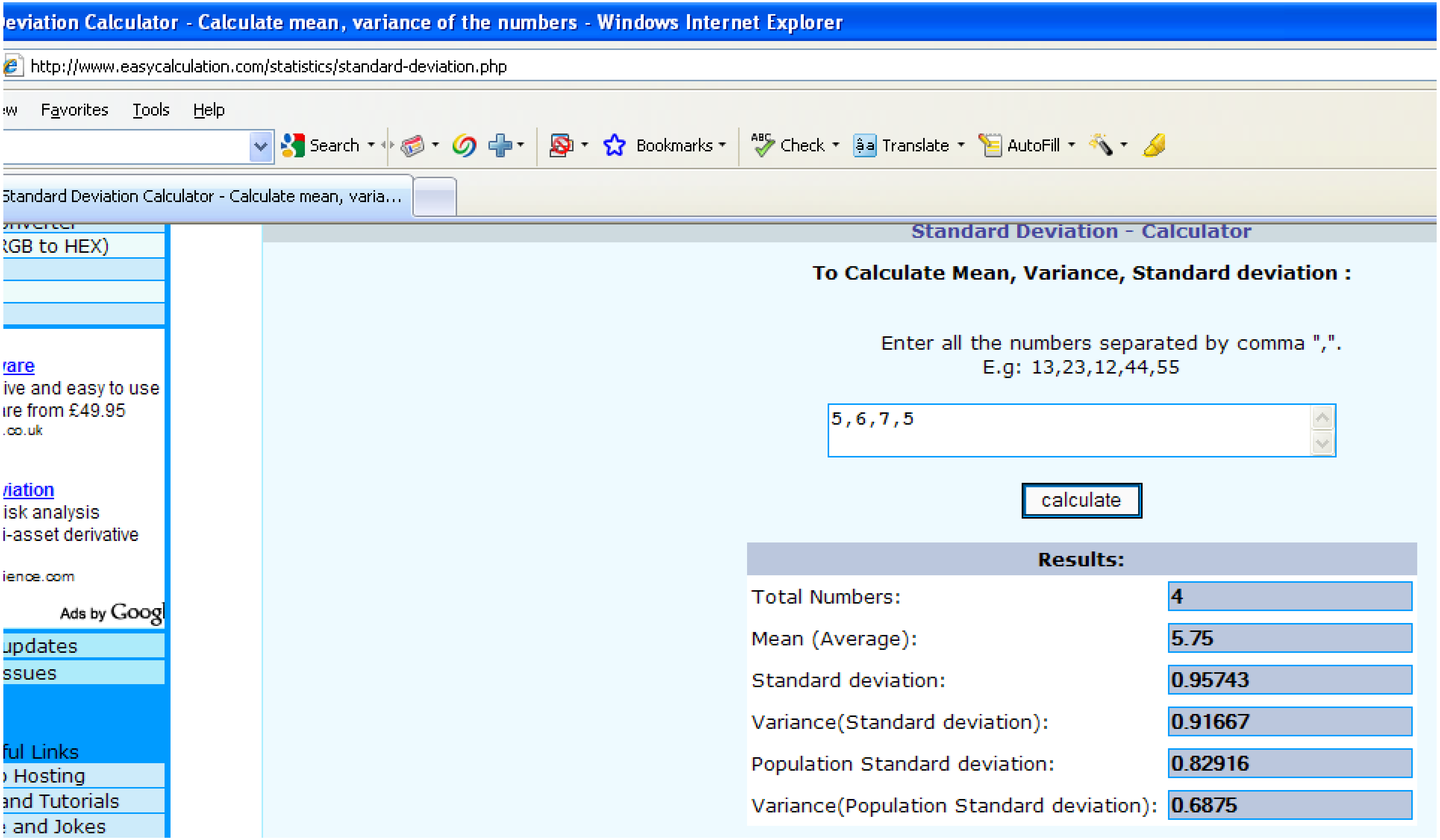
work out a standard deviation manually using the formula

or

type the numbers into your calculator

or

www.easycalculations.com



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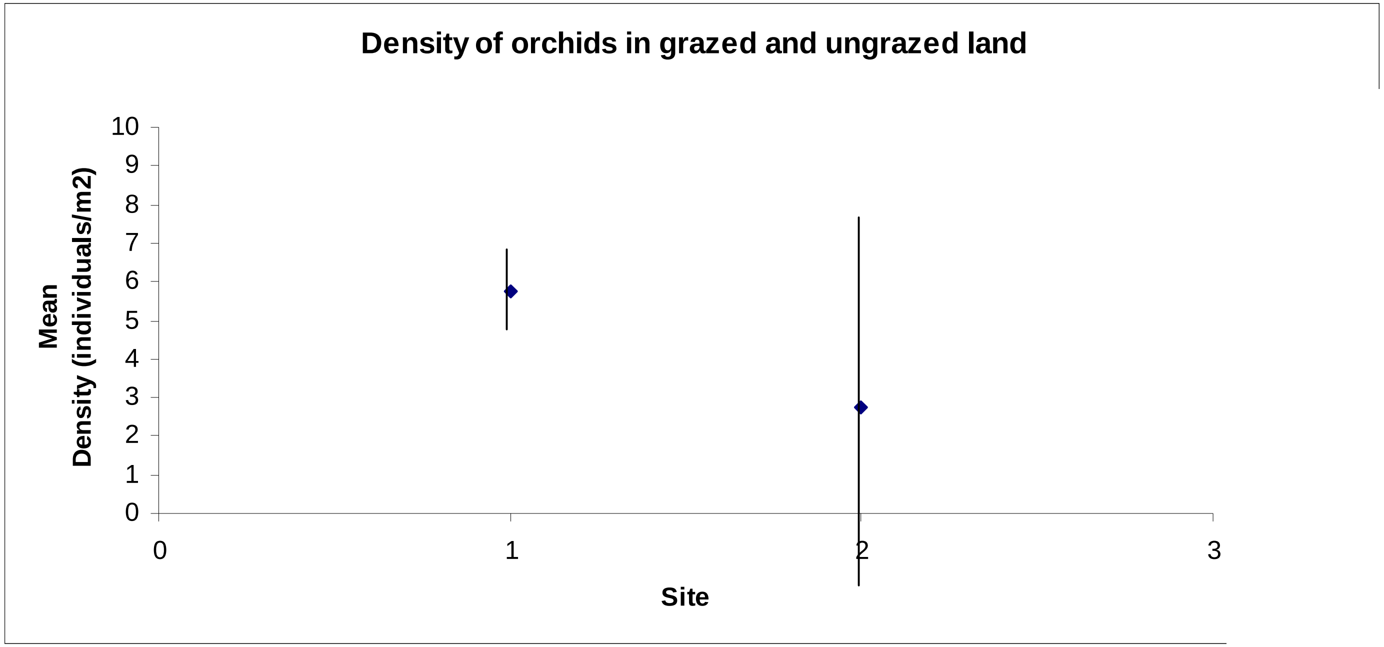
Standard Deviation - Calculator
To Calculate Mean, Variance, Standard deviation :
Enter all the numbers separated by comma ",".
E.g: 13,23,12,44,55
5,6,7,5
calculate
Results:
Total Numbers: 4
Mean (Average): 5.75
Standard deviation: 0.95743
Variance(Standard deviation): 0.91667
Population Standard deviation: 0.82916
Variance(Population Standard deviation): 0.6875

Bars show the standard deviation of the mean



Site 1: =0.95

Site 2: = 4.9

The standard deviation gives a great measure of the variability of a sample.

Statisticians calculate a value based on the standard deviation **and** sample size to judge whether 2 means are really different

This new value is called the standard error

Standard error

- standard deviation divided by the square root of the sample size

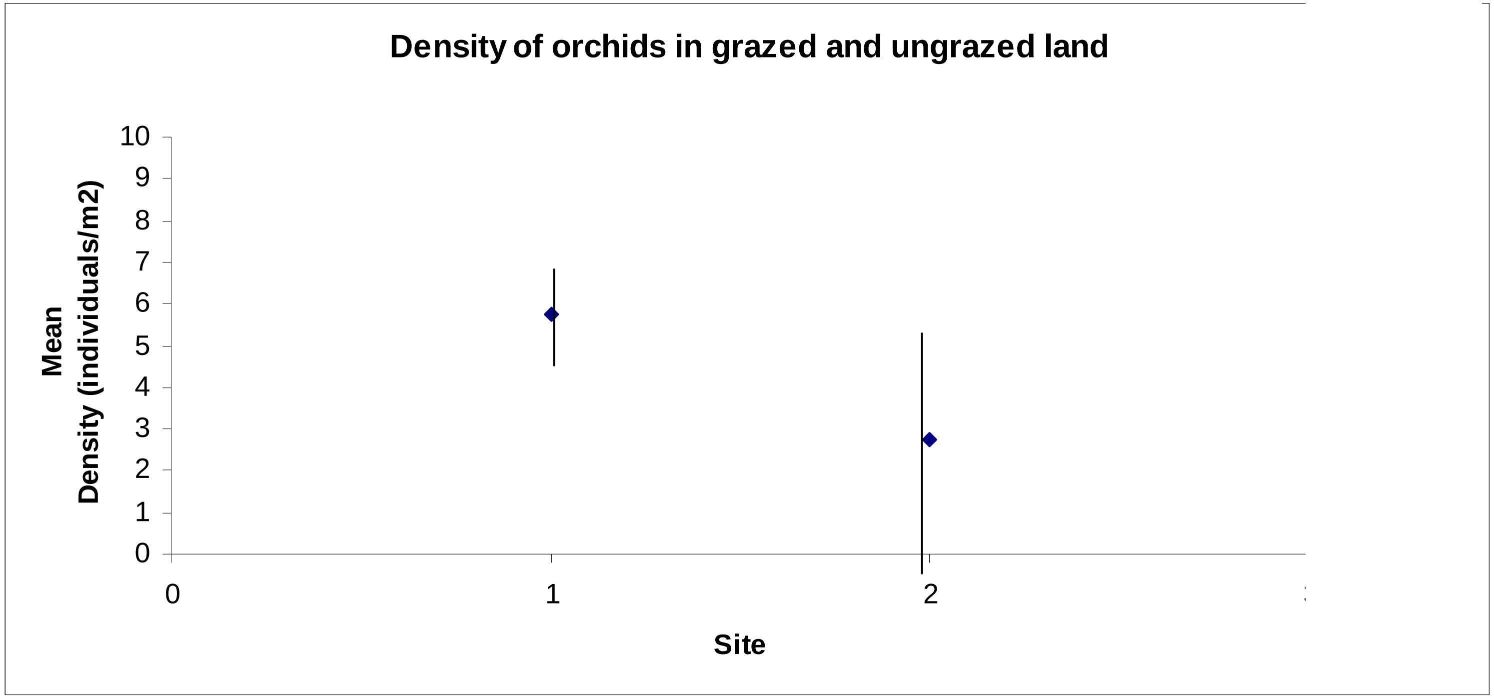
$$s = \frac{\sigma}{\sqrt{n}}$$

- we can say with 95% confidence that the true mean of a sample lies within 1.96 standard errors of the sample mean

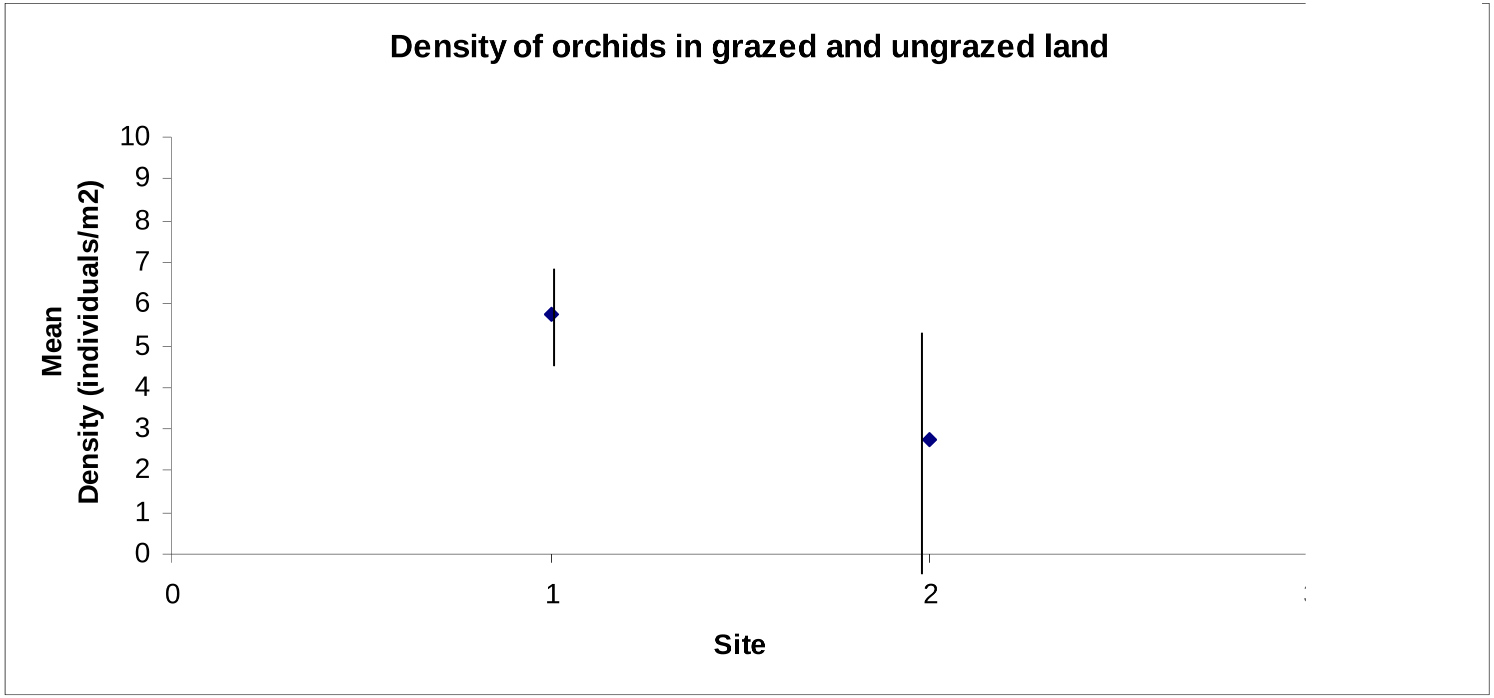
Error bars show 1.96 standard errors of the mean

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

For our example:
Site 1: Standard error = 0.95/2
Site 2: Standard error = 4.85/2



As the error bars from each sample overlap we cannot conclude that there is a difference in the density of pyramid orchids at each site



Let’s apply this to your example:

1) Write a null hypothesis
2) Calculate
   mean
   standard deviation
   standard error
3) Plot the means and add error bars (1.96 x s.e)
4) Reject the null hypothesis if error bars do not overlap

You have seen the 95% confidence interval graphically.

You can also write this:

Sample 1:
95% confidence interval = mean +/- 1.96 x standard error

Sample 2:
95% confidence interval = mean +/- 1.96 x standard error

And reject the null hypothesis if the confidence interval values do not overlap

Caveats:

We should only use standard error to assess statistical significance if:

- sample size is 30 or bigger
- the data is normally distributed

(but for exam purposes you will be given smaller samples!)