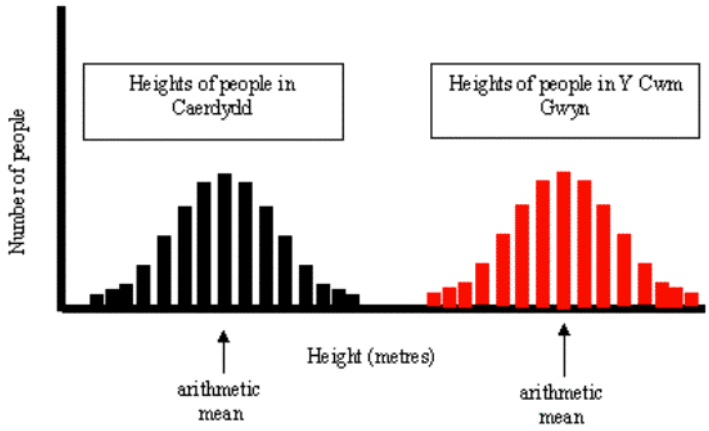
T Test

http://www.theseashore.org.uk/theseashore/Stats%20for%20twits/T%20Test.html

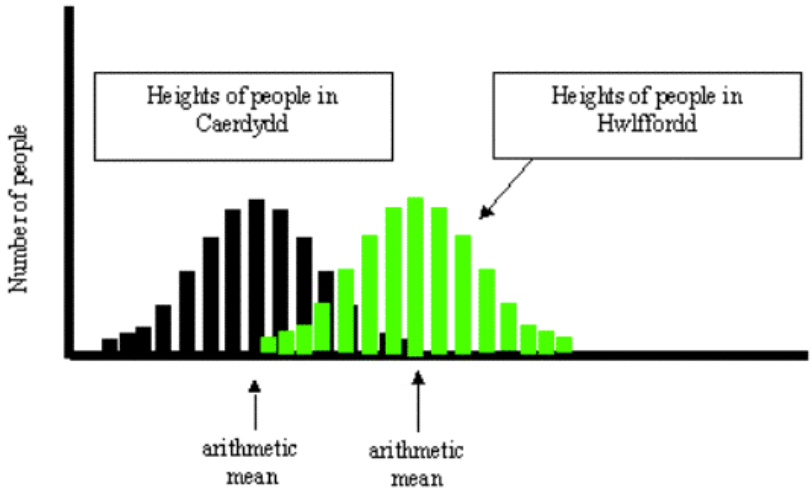
A T test will tell you if the means of two sets of normally distributed, unmatched, continuous data, with interval level measurements are significantly different to one another.

For example, look at the following graph:



If you were to ask the question "Is the mean height of people in Y Cwm Gwyn significantly different to the mean height of people in Caerdydd; you would find it easy to answer "yes". The shortest person in Y Cwm Gwyn is taller than the tallest person in Caerdydd. There is no overlap, they are significantly different.

But now look at this graph:



If you were to ask the same question about people in Caerdydd and people in Hwlffordd; the answer is not so clear. The means are much closer together and there is considerable overlap between the two sets of data. A T test allows you to answer the question "Are these two means significantly different or not?" It takes into account the differences between the means and the amount of overlap of the two sets of data. The null hypothesis for every T test you will ever do is this:

"There is no significant difference between the means of the two sets of data"

To perform a T test we need to know three things about each set of data:

- The number of items in each data set (n) (count them).
- The mean: Add up all the individual items of data and divide by the number of items of data. (= sigma x divided by n)
- The variance (a measure of the spread of the data about the mean)

To obtain the variance (s^2) for each set of data, use the formula we used before:

$$\frac{\Sigma (x - \bar{x})^2}{n - 1}$$

Obtain the mean and variance for each set of data and you are in the happy position of being able to calculate the value of the t-statistic (using a formula we will not include here).

An example is as follows.

Let us suppose that you are conducting an investigation into the weight of people in a school. Half the subjects are boys and half are girls. You think that the boys might have a significantly bigger mean weight than the girls.

You weigh all the individuals and come up with the following information:

- Mean weight (boys) = 54 Kg, variance = 16 (number of measurements = 25)
- Mean weight (girls) = 47 Kg, variance = 19 (number of measurements = 25)

When you calculate the value of T for these two sets of data, the calculated value for t is 5.93.

All we have to do now is compare this with the critical value which we get from a table of critical values of t prepared for us by cunning statisticians. Here is such a table:

degrees of freedom	significance level					
	20%	10%	5%	2%	1%	0·1%
1	3·078	6·314	12·706	31·821	63·657	636·619
2	1·886	2·920	4·303	6·965	9·925	31·598
3	1·638	2·353	3·182	4·541	5·841	12·941
4	1·533	2·132	2·776	3·747	4·604	8·610
5	1·476	2·015	2·571	3·365	4·032	6·859
6	1·440	1·943	2·447	3·143	3·707	5·959
7	1·415	1·895	2·365	2·998	3·499	5·405
8	1·397	1·860	2·306	2·896	3·355	5·041
9	1·383	1·833	2·262	2·821	3·250	4·781
10	1·372	1·812	2·228	2·764	3·169	4·587
11	1·363	1·796	2·201	2·718	3·106	4·437
12	1·356	1·782	2·179	2·681	3·055	4·318
13	1·350	1·771	2·160	2·650	3·012	4·221
14	1·345	1·761	2·145	2·624	2·977	4·140
15	1·341	1·753	2·131	2·602	2·947	4·073
16	1·337	1·746	2·120	2·583	2·921	4·015
17	1·333	1·740	2·110	2·567	2·898	3·965
18	1·330	1·734	2·101	2·552	2·878	3·922
19	1·328	1·729	2·093	2·539	2·861	3·883
20	1·325	1·725	2·086	2·528	2·845	3·850
21	1·323	1·721	2·080	2·518	2·831	3·819
22	1·321	1·717	2·074	2·508	2·819	3·792
23	1·319	1·714	2·069	2·500	2·807	3·767
24	1·318	1·711	2·064	2·492	2·797	3·745
25	1·316	1·708	2·060	2·485	2·787	3·725
26	1·315	1·706	2·056	2·479	2·779	3·707
27	1·314	1·703	2·052	2·473	2·771	3·690
28	1·313	1·701	2·048	2·467	2·763	3·674
29	1·311	1·699	2·043	2·462	2·756	3·659
30	1·310	1·697	2·042	2·457	2·750	3·646
40	1·303	1·684	2·021	2·423	2·704	3·551
60	1·296	1·671	2·000	2·390	2·660	3·460
120	1·289	1·658	1·980	2·158	2·617	3·373

First work out how many degrees of freedom. (For a t test this is the total number of pieces of data minus 2.) In our case this is (25 + 25) - 2 = 48. Enter the table at the nearest number of degrees of freedom to yours. If you're between two values always take the lower one. This makes it harder for us to beat the critical value and thus represents a cautious approach. Our appropriate entry point is therefore 40 degrees of freedom.

Next you have to decide how precise you wish to be in your acceptance or rejectance of your null hypothesis. Usually we will pick 5%.

Working down the 5% column and across the 40 degrees of freedom row we get a critical value of 2.021

Our calculated value is 5.93

5.93 is bigger than 2.021. In a t test if our calculated value is bigger than the critical value we reject our null hypothesis. In rejecting our hypothesis of no difference we are saying that there is indeed a significant difference between the means of the two sets of data. In choosing the 5% significance level we are saying that we would expect to be correct in accepting or rejecting our null hypothesis 95% of the time. We might get a different result due to chance 5% of the time.