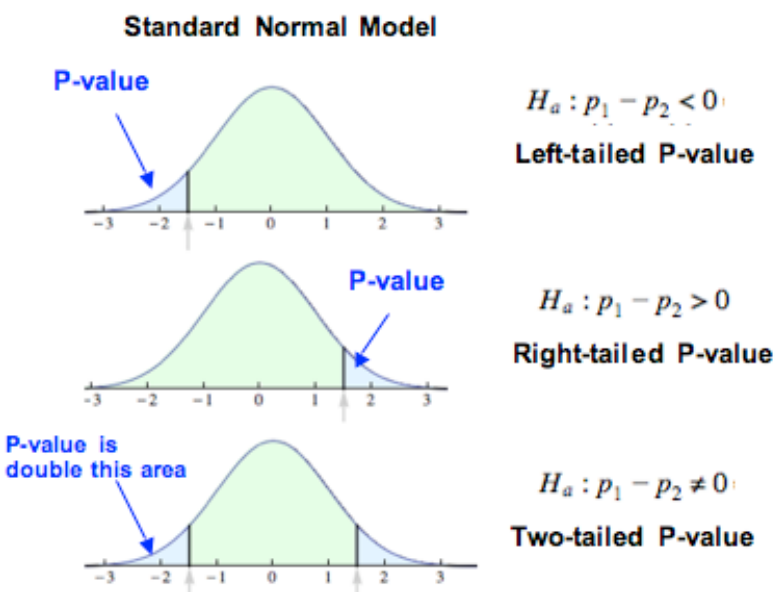
t-Test

- The t-test is used to measure the differences between two data sets that measure the same thing, but may be exposed to different stimuli
- William Gosset was employed by Guinness to improve the taste and quality of their beer. In order to monitor the quality of the hops that were used in the brewing process, he invented the t-test
- Only applies to Normally Distributed data
- Null Hypothesis will always be that the two means of each data set are equal $\bar{X}_1 = \bar{X}_2$ or $\bar{X}_1 < \bar{X}_2$
- Alternative Hypothesis is that the two means are not equal $\bar{X}_1 \neq \bar{X}_2$
- Allows scientists to decipher between random differences and actual/ statistically significant differences



Mary notices that the sun shines more on one side of her garden than the other. She wanted to know whether this had any effect on the height of the tulips on either side.

length of Tulips on Left side (cm)	24	25	25	26	32	29	31	27	26	28	22	22	28
length of Tulips on Right Side (cm)	21	21	26	25	28	24	22	22	29	28	28	27	21

(a) State H_0 and H_a

$H_0 : \bar{X}_1 = \bar{X}_2$

$H_a : \bar{X}_1 \neq \bar{X}_2$

★ TWO-tailed Test

(b) Find t-VALUE and P-VALUE for a t-test at the 5% significance level

[Calc] t-Test

Input data into L1 and L2

STAT → TESTS → 2-SampT Test

Input : Data
List 1 : L1
List 2 : L2
Freq 1 : 1
Freq 2 : 1
$\mu 1$: $\neq \mu 2$ State your null hypothesis
Pooled : Yes

Calculate

P-VALUE = 0.156

t-VALUE = 1.465

(c) Write down the conclusion for this test

P-VALUE > α

$0.156 > 0.05 \Rightarrow$ ACCEPT H_0

There is no significant difference between the two groups

Mr. Arthur gives his two math classes the same test. He wants to find out whether their is any difference between the achievement levels of the two classes.

Class 1	54	62	67	43	85	69	73	81	47	92	55	59	68	72
Class 2	73	67	58	46	91	48	82	81	67	74	57	66		

(a) State H_0 and H_a

$H_0 : \bar{X}_1 = \bar{X}_2$

$H_a : \bar{X}_1 \neq \bar{X}_2$

★ TWO-tailed Test

(b) Find t-VALUE and P-VALUE for a t-test at the 5% significance level

P-VALUE = 0.816

t-VALUE = -0.235

(c) Write down the conclusion for this test

P-VALUE > α

$0.816 > 0.05$

$\Rightarrow$ ACCEPT H_0

There is no significant difference between the two classes

An oil company claims to have developed a fuel that will increase the distance traveled for every liter of fuel. 10 scooters are filled with 1 liter of normal fuel, and 10 scooters are filled with 1 liter of the new fuel. The distances, in km, traveled by each scooter is shown below

X_1	Original Fuel	36	38	44	42	45	39	48	51	38	43
X_2	New Fuel	43	39	51	49	53	48	52	46	53	49

(a) State H_0 and H_a

$H_0 : \bar{X}_1 = \bar{X}_2$

$H_a : \bar{X}_1 < \bar{X}_2$ ★ One-tailed Test

(b) Find t-VALUE and P-VALUE for a t-test at the 5% significance level

P-VALUE = 0.0056 t-VALUE = -2.825

[Calc] μ1: < μ2

(c) Write down the conclusion for this test

P-VALUE < α

0.0056 < 0.05

⇒ Reject H_0

There is a significant difference between the two fuels
The new fuel goes further than the old fuel