RenR 480/711

One sample t-Test

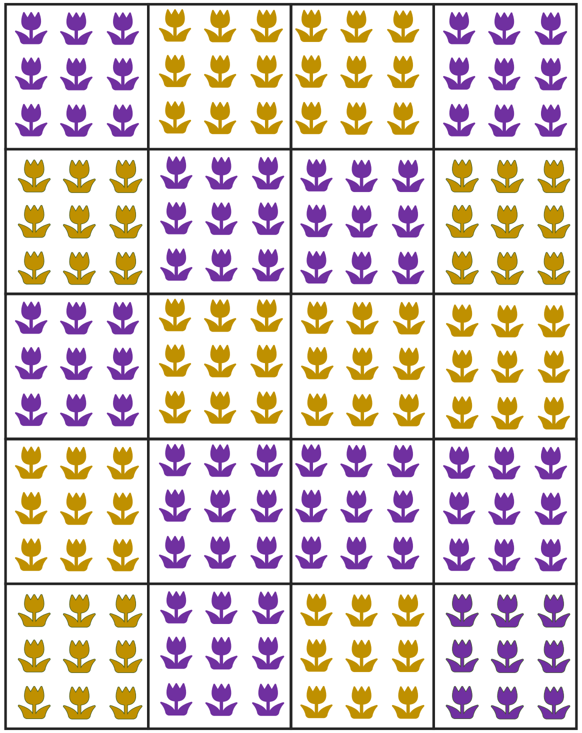
Two sample t-Test

Paired Two sample t-Test

t-Test

ID	Variety	Yield
O1	OLD	570
O2	OLD	426
O3	OLD	642
O4	OLD	612
O5	OLD	390
O6	OLD	525
O7	OLD	620
O8	OLD	492
O9	OLD	690
O10	OLD	533

$\bar{x} = 550\ kg/ha$
SEM = 30.3
n=10



ID	Variety	Yield
N1	NEW	846
N2	NEW	833
N3	NEW	812
N4	NEW	829
N5	NEW	650
N6	NEW	807
N7	NEW	907
N8	NEW	871
N9	NEW	685
N10	NEW	893

$\bar{x} = 813\ kg/ha$
SEM = 26.5
n=10

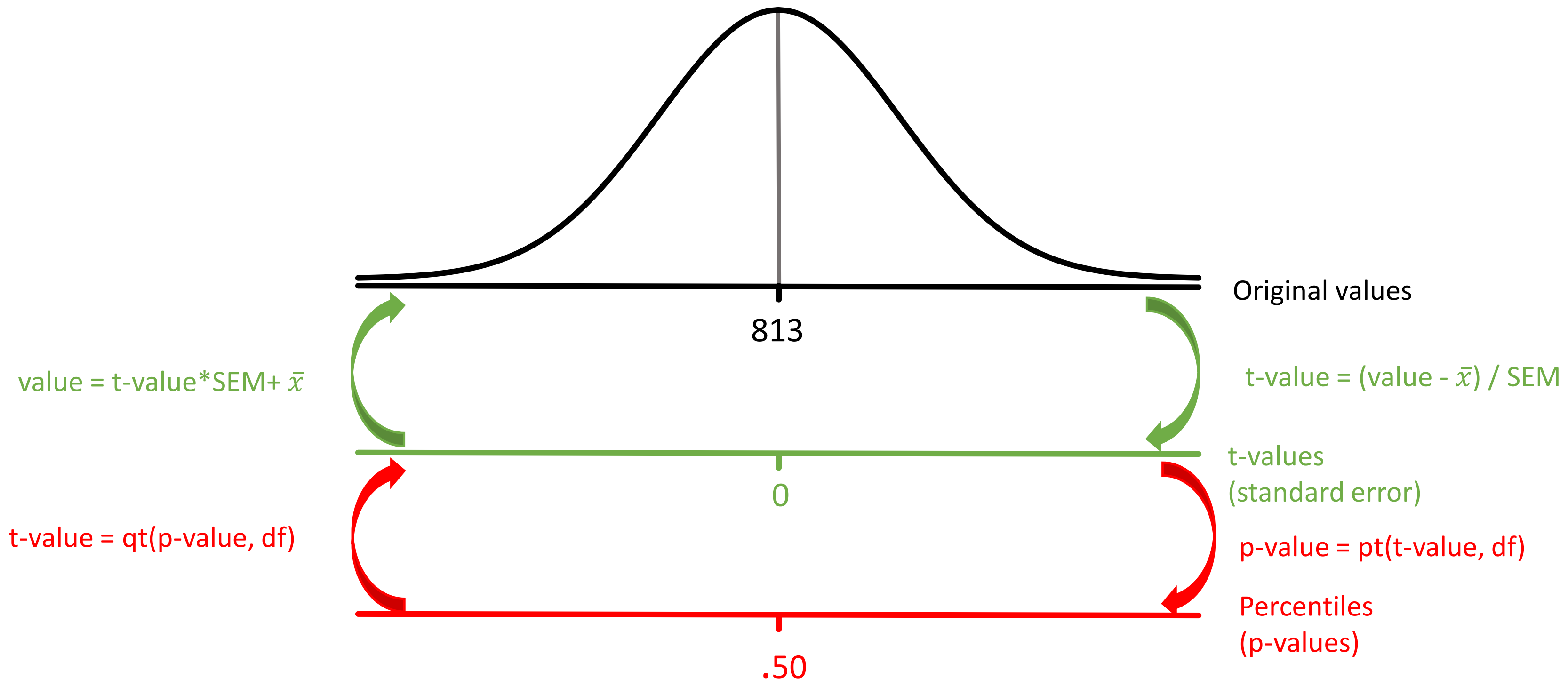
One sample t-Test

- Average yield of variety in use: 550 kg/ha
- Condition for introduction of new variety: at least 30% more yield
- We want to be 95% sure that the new variety produces at least 30 % more yield

William Sealy Gosset

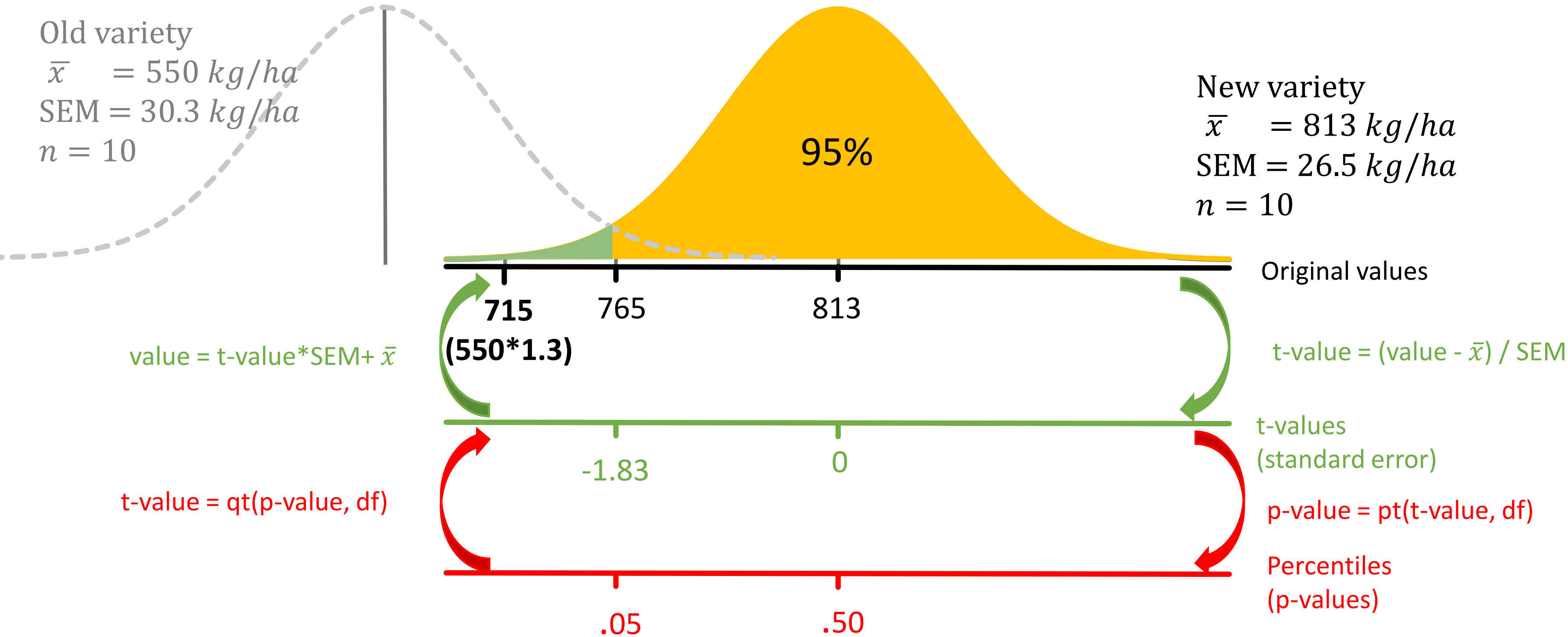
How can you gain confidence that the new variety will meet this condition?

One sample t-Test (one tail)



One sample t-Test (one tail)

Are you 95% confident that the new variety has a yield of 715 or more?



Critical t-value: qt(0.05,9)

$t_{critical} = -1.83$

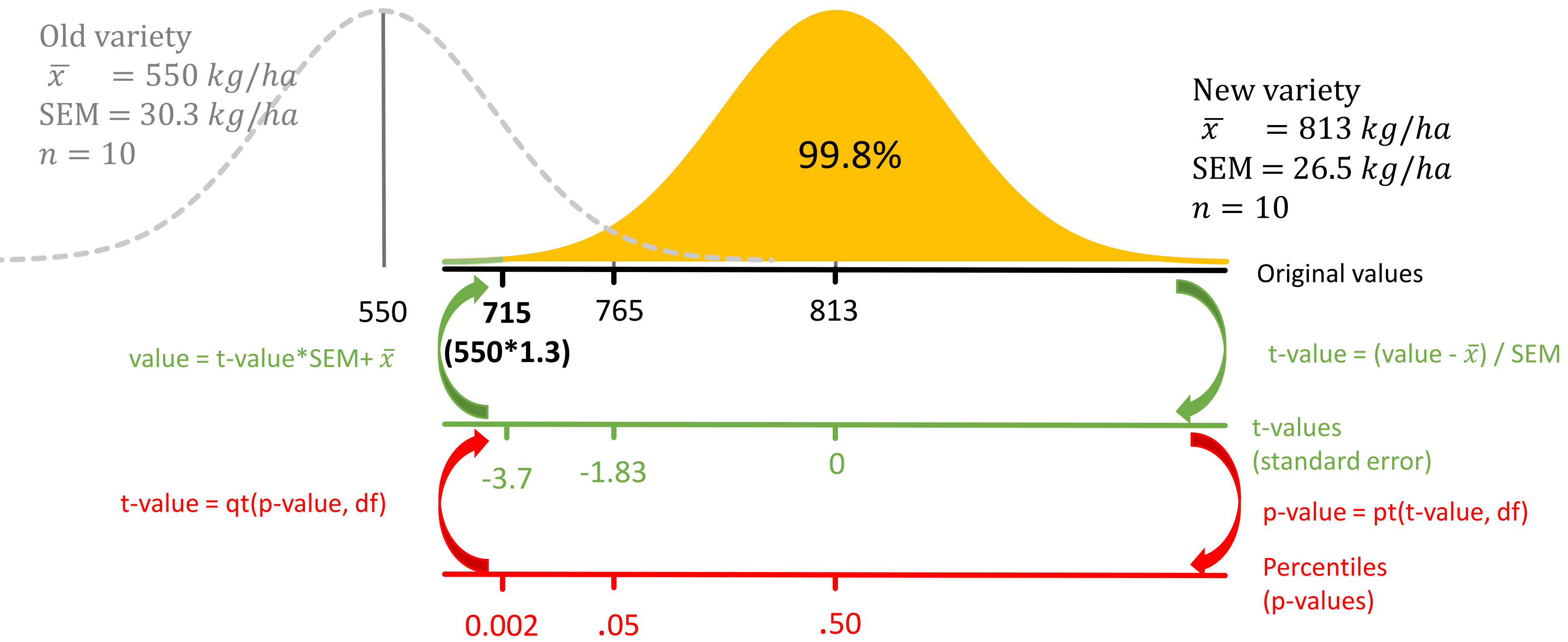
5th percentile = 765

Therefore, the answer is yes!

Real value: t-value*SEM+ $\bar{x}$

$real\ value = 765$

One sample t-Test (one tail)

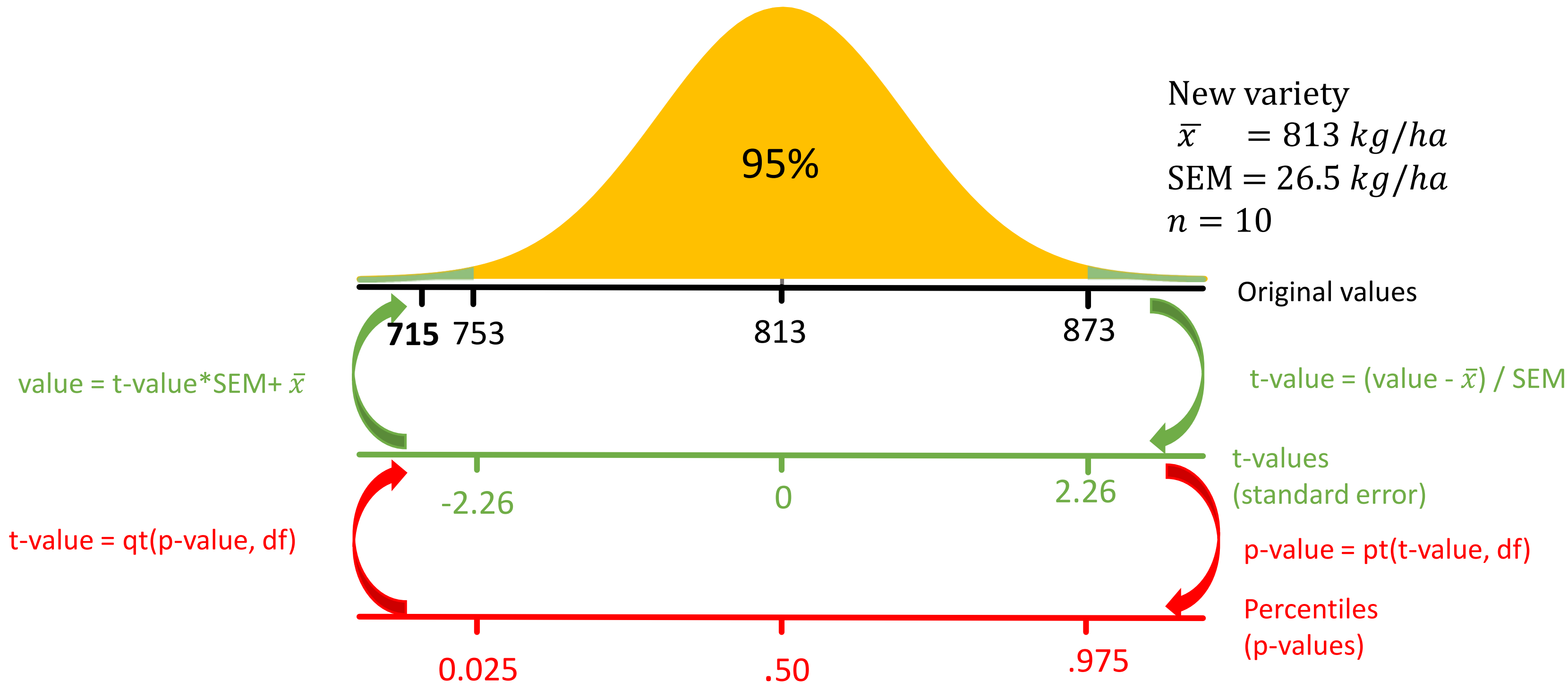


How confident are you exactly?

Because we are on the left side: p-value=1-0.002 = 0.998

We can be 99.8 % confident!

One sample t-Test (two tails)

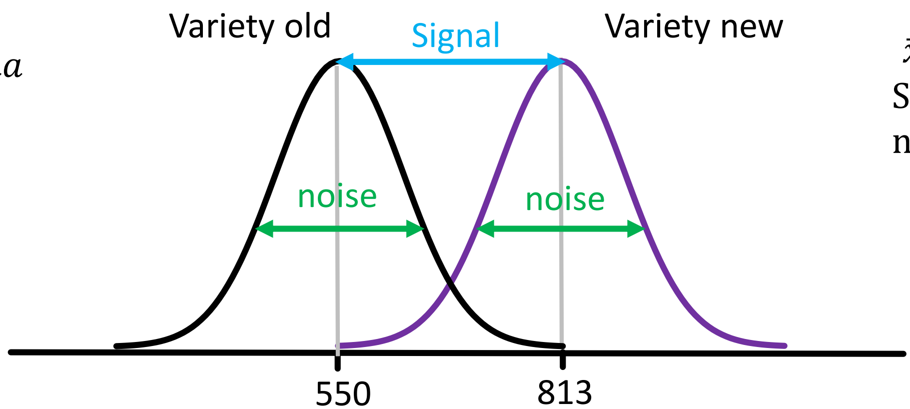


Different question: Is the value of 715 kg/ha from the same distribution as New variety (95% confidence)?

715 is not within 753-873, therefore, the answer is no!

t-Test for two samples (two sided)

$\bar{x} = 550\ kg/ha$
SEM = 30.3
n=10



$\bar{x} = 813\ kg/ha$
SEM = 26.5
n=10

$$t = \frac{signal}{noise}$$

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

$$SE = \frac{\sqrt{s^2}}{\sqrt{n}} = \frac{\sqrt{s^2}}{\sqrt{n}} = \sqrt{\frac{s^2}{n}}$$

$$SE_{pooled} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

This methods allows for different n per sample

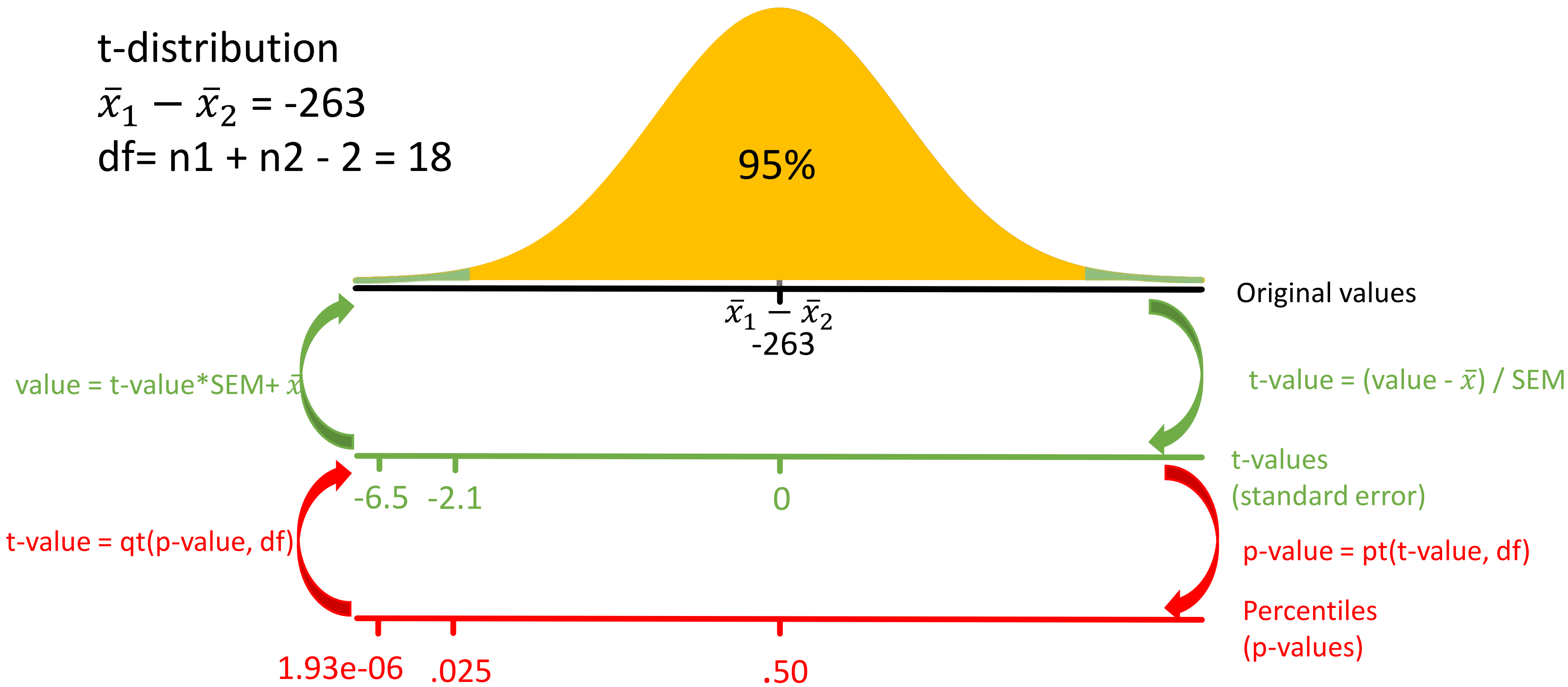
$$SE_{pooled} = \sqrt{\frac{Variance_1}{n_1} + \frac{Variance_2}{n_2}}$$

$$t = \frac{\bar{x}_1 - \bar{x}_2}{pooled\ SE} = \frac{550 - 813}{\sqrt{\frac{9162}{10} + \frac{7037}{10}}} = -6.5$$

t-Test for two samples (two sided)

Question: Are the means the same?

t-distribution
$\bar{x}_1 - \bar{x}_2$ = -263
df= n1 + n2 - 2 = 18



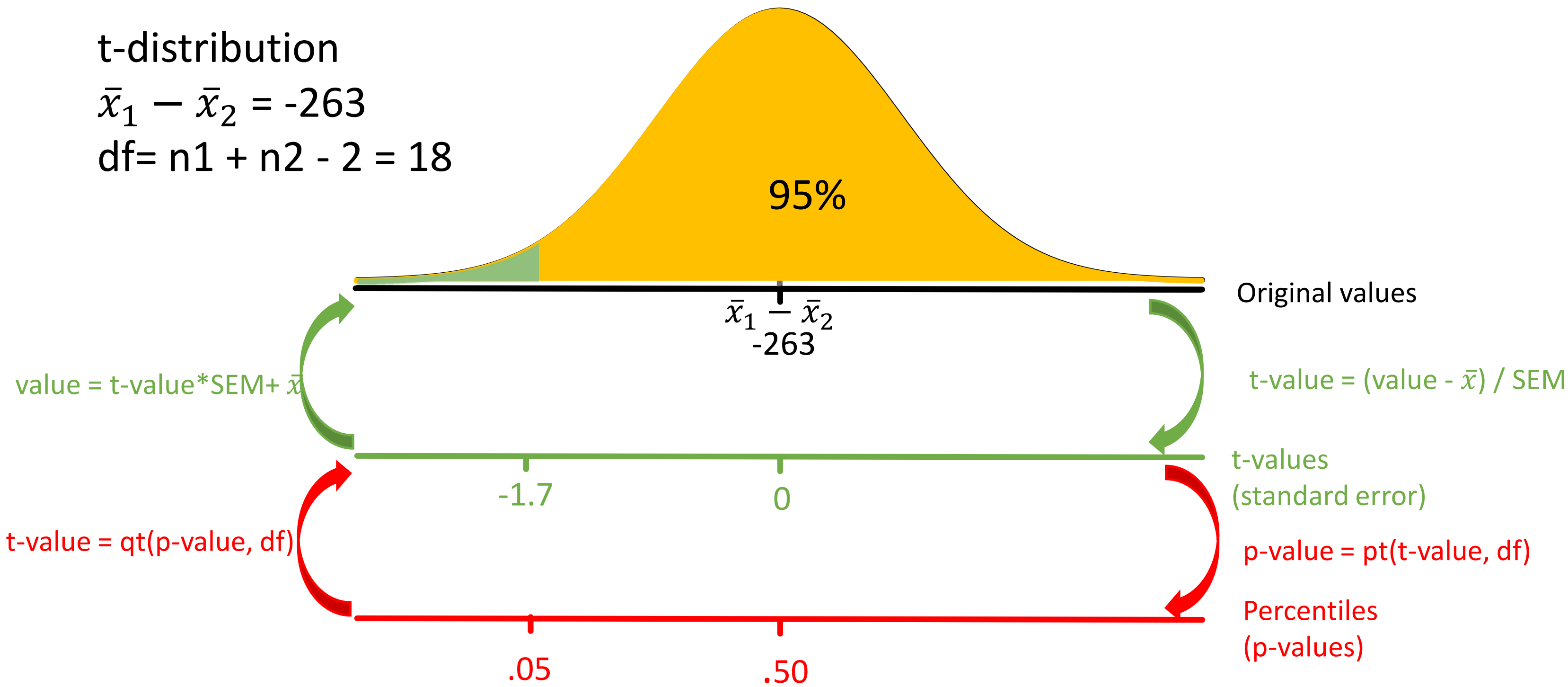
Very significant difference!

$t_{critical} = \pm 2.1$

t-Test for two samples (one sided)

Question: Is one mean greater ***or*** less than the other mean?
(direction matters)

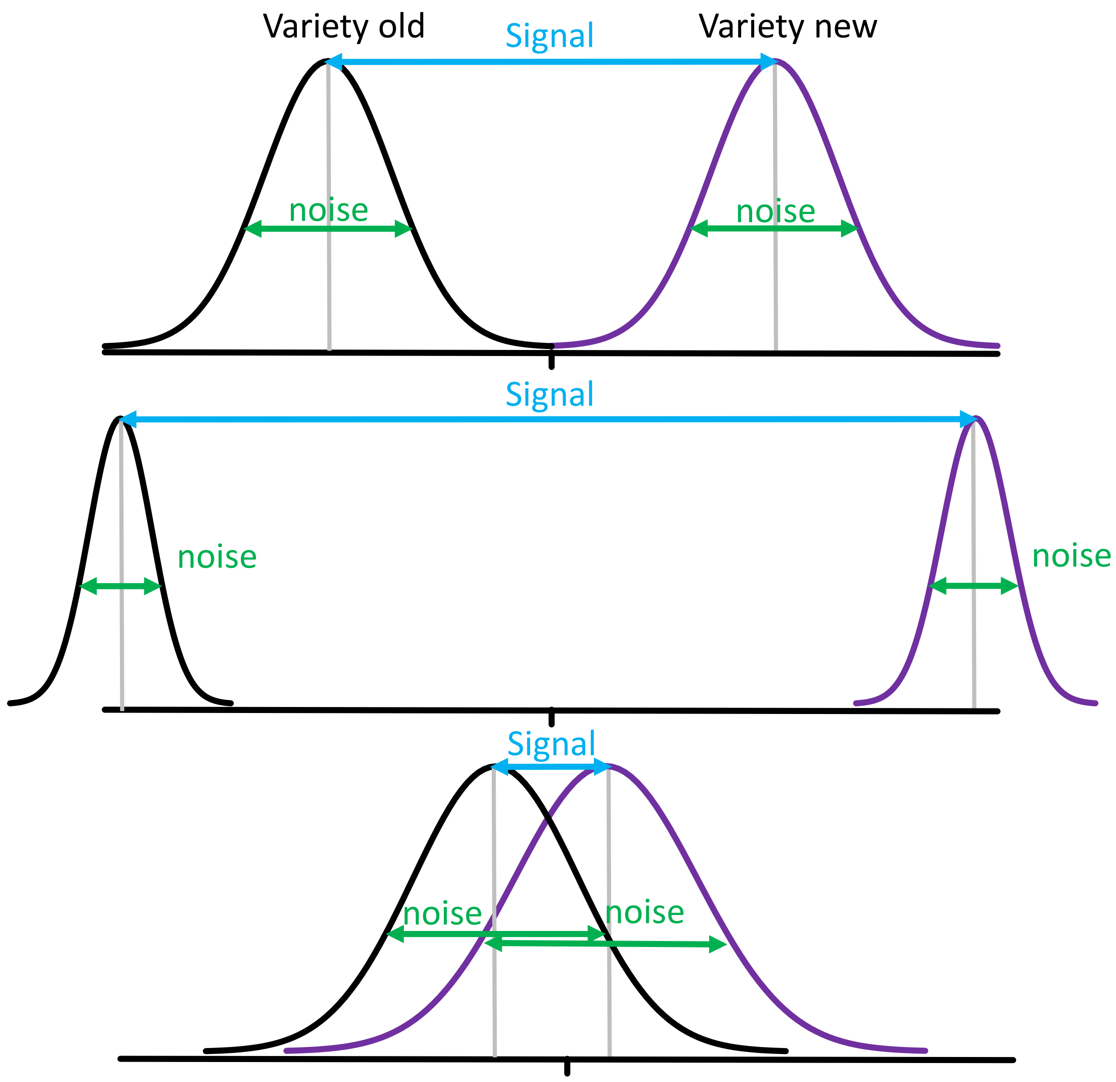
t-distribution
$\bar{x}_1 - \bar{x}_2$ = -263
df= n1 + n2 - 2 = 18



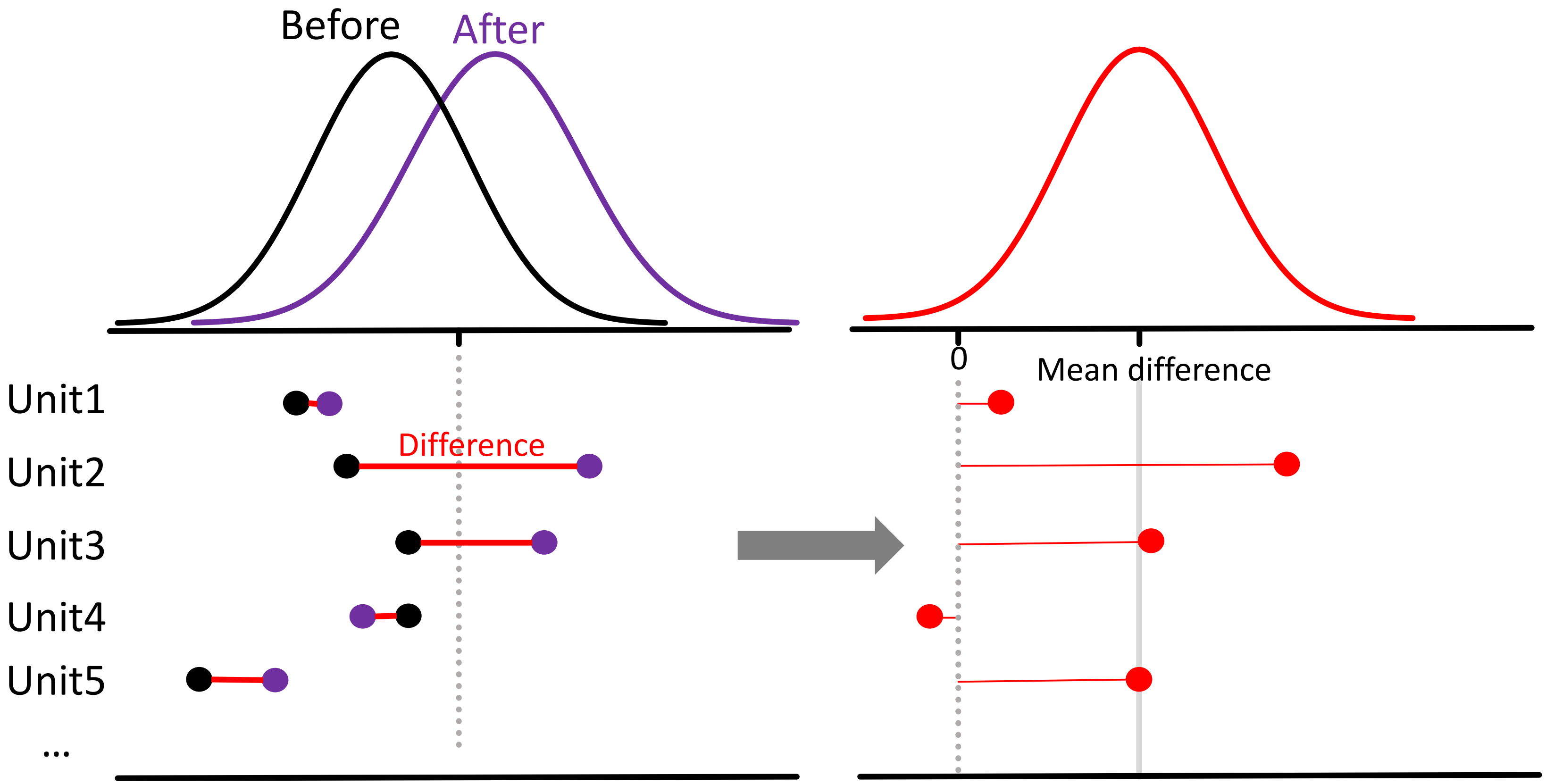
$t_{critical} = -1.7$

t-Test for two samples (two sided)

$$t = \frac{signal}{noise}$$



paired t-Test for two samples (two sided)



Now we can run the t-test on the differences.

Note: the t-test function in R does all this for you:

t.test(Before, After, mu=0, alternative="two.sided",paired=T)

More powerful test because the units are the same and we only have to account for the error once.

t-Test assumptions

The results of t-Tests are meaningful if:

- Each unit (row) is independent of other units
  - In case of the paired t-Test pair differences must be independent
- Normal distribution of experimental errors
- Similar variances between groups