The estimated variance model is detailed in the Analysis of Variance table (ANOVA table)

ANOVA table

Source (of variability)	df (degrees of freedom)	SS (sum of squares)	MS (mean square)	F	p
Model/Regression	1	$SS_{Reg} = SS_{Total} - SS_{Error}$	...	later...	
Error/Residual	$n-2$	$SS_{Errors} = \sum e_i^2$	$\underbrace{MS_{Error} = \frac{SS_{Error}}{n-2}}_{\hat{\sigma}^2 \text{ est. of } \sigma^2}$		
Total	$n-1$	$S_{yy} = SS_{Total}$	.....		

We could calculate $MS_{Total} = \frac{SS_{Total}}{n-1} = s_y^2$

Total — this line is equivalent to the Null model $Y = \beta_0 + \varepsilon$

Model/Regression — this line is equivalent to the SLR model $Y = \beta_0 + \beta_1 X + \varepsilon \quad \varepsilon \overset{iid}{\sim} N(0, \sigma^2)$

Our key estimate of the error variance σ^2 is the MS_{Error}

To calculate this:

1. find $\hat{Y}_i = \hat{\beta}_0 + \hat{\beta}_1 x_i$ for all $i = 1, 2, \ldots n$ (the sample)
2. find $e_i = Y_i - \hat{Y}_i$ (the residuals)
3. find $\sum e_i^2 = SS_{Errors}$ & "average" over the df $= n-2$ (for SLR) to get $s^2 = \hat{\sigma}^2 = \frac{\sum e_i^2}{n-2}$

In our current example

Source	df	SS	MS	F	p
Regression (Year)	1	10.8685	10.8685	419.53	2.2×10^{-16}
Residuals (Error)	136	3.5232	0.0259		
Total	137	14.3917	0.1050		

Type I & Type II errors

		Null Hypothesis	
		H_0 valid	H_0 not valid
Outcome of test	Do not reject H_0	✓	False negative Type II error
	Reject H_0	False positive Type I error	✓

$P(\text{Type I error}) = \alpha$ (significance level)

$1-\alpha$ is called the confidence level

$P(\text{Type II error}) = \beta$

$1-\beta$ is called the power

A powerful test is one in which we are more likely to correctly reject a false null hypothesis

NB: about the only way we can reduce both α & β at the same time is to increase the sample size

NB (2): a one-tailed hypothesis test is more powerful than the equivalent two-tailed test (for the same sample size)