Statistics Kingdom

Linear Regression Calculator

Linear regression calculator and prediction interval calculator with step-by-step solution.

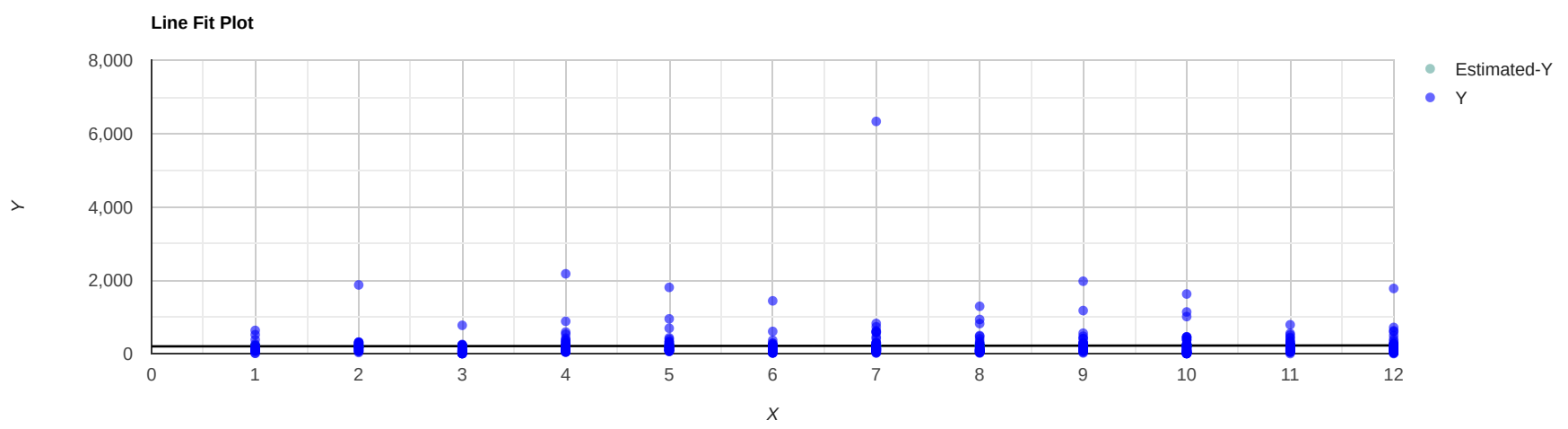
Regression line equation

$$\hat{Y} = 197.2653 + 2.1106X$$

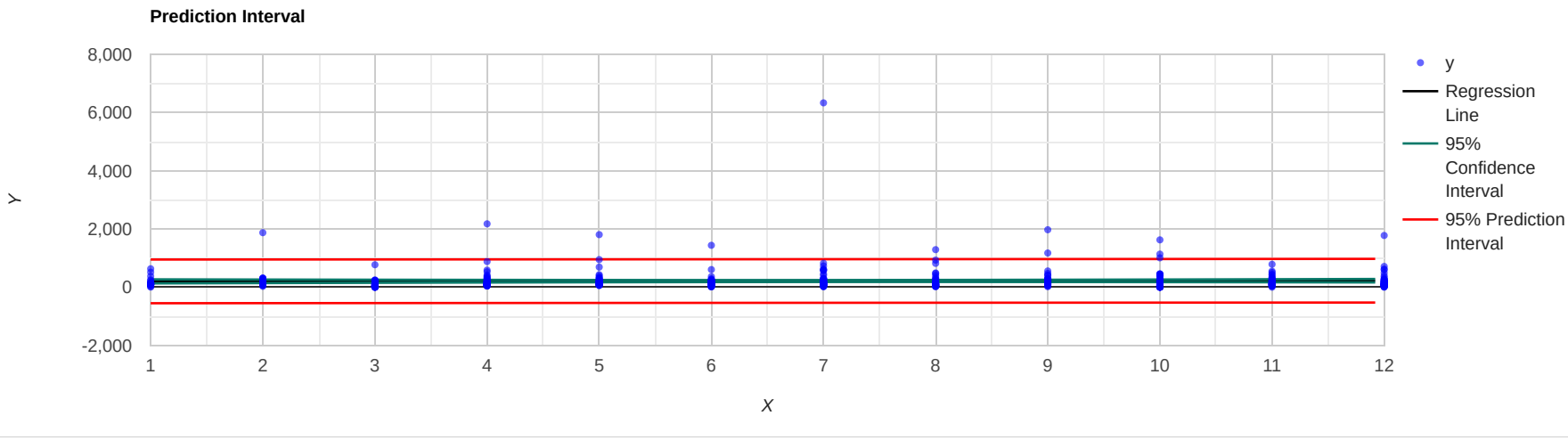
Reporting linear regression in APA style

R^2 = .00034, $F(1,498)$ = 0.17, p = .682.
β = 2.11, p = .682, α = 197.27, p < .001.

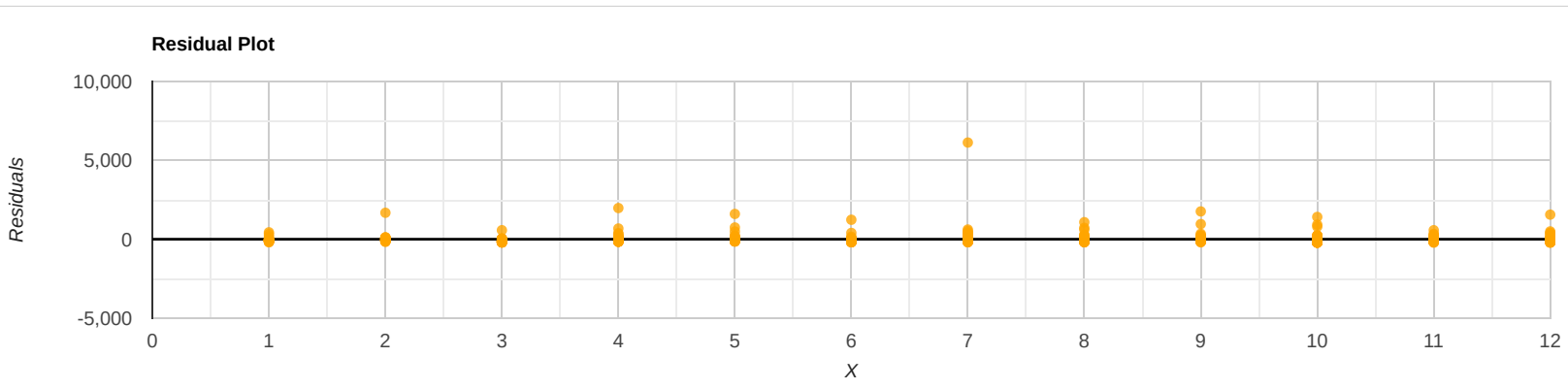
Line Fit Plot



Prediction online

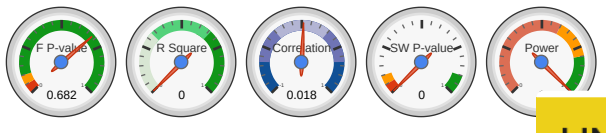


Residual Plot



Prediction

Interpretation of the results



Regression ANOVA

Hover over the cells to see the formulas.

Source	DF	Sum of Square	Mean Square	F Statistic (df_1,df_2)	P-value
Regression (between $\hat{y}_i$ and $\bar{y}$)	1	24324.617	24324.617	0.168 (1,498)	0.6821
Residual (between y_i and $\hat{y}_i$)	498	72119710.183	144818.6951		
Total (between y_i and $\bar{y}$)	499	72144034.8	144577.224		

1. Y and X relationship

R-Squared (R^2) equals **0.0003372.** This means that 0.03% of the variability of Y is explained by X.
Correlation (R) equals **0.01836**. This means that there is a **very weak direct relationship** between X and Y.
The Standard deviation of the residuals (S_{res}) equals **380.5505**.
The slope: b_1=**2.1106** CI[-8.0077, 12.229] means that when you increase X by 1, the value of Y increases by 2.1106.
The y-intercept: b_0=**197.2653** CI[118.5929, 275.9376] means that when X equals 0, the prediction of Y's value is 197.2653.
The x-intercept equals -93.462.

2. Goodness of fit

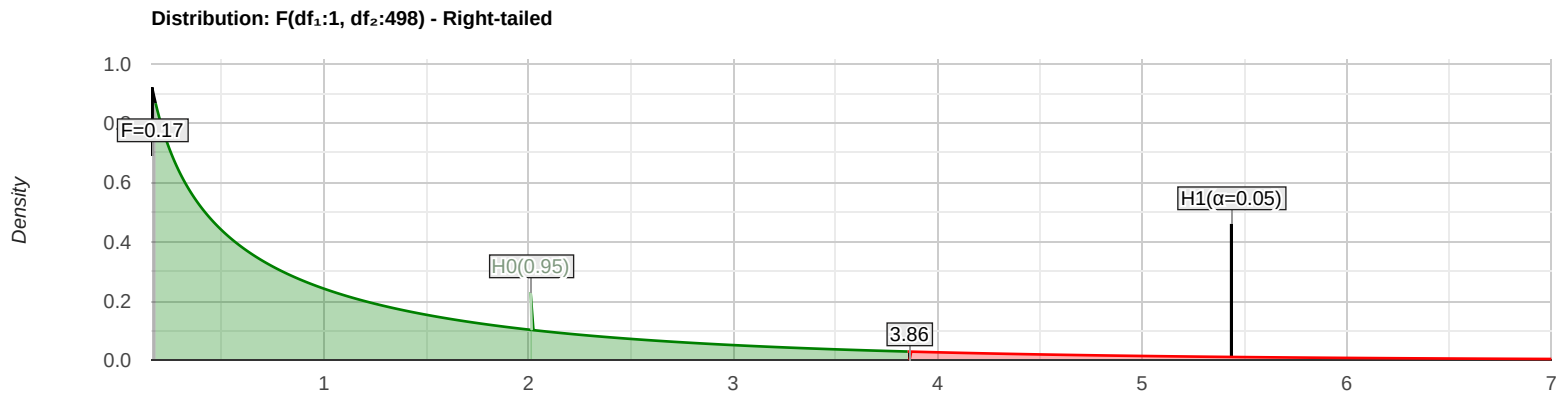
Overall regression: right-tailed, F(1,498) = **0.168**, p-value = **0.6821**. Since p-value ≥ α (0.05), we accept H_0.
The linear regression model, $\mathbf{Y = b_0 + b_1X + \varepsilon}$, doesn't provide a better fit than the model without the independent variable resulting in $\mathbf{Y = b_0 + \varepsilon}$.
The slope (b_1): two-tailed, T(498)=**0.4098**, p-value = **0.6821**. For one predictor it is the same as the p-value for the overall model.
The y-intercept (b_0): two-tailed, T(498) = **4.9264**, p-value = **0.000001142**. Hence, b_0 is significantly different from zero.

3. Residual normality

The linear regression model assumes normality for residual errors. The Shapiro-Wilk p-value equals **0**. It is assumed that the data is not normally distributed, But since the sample size is large, it should not adversely affect the regression model.

4. Outliers

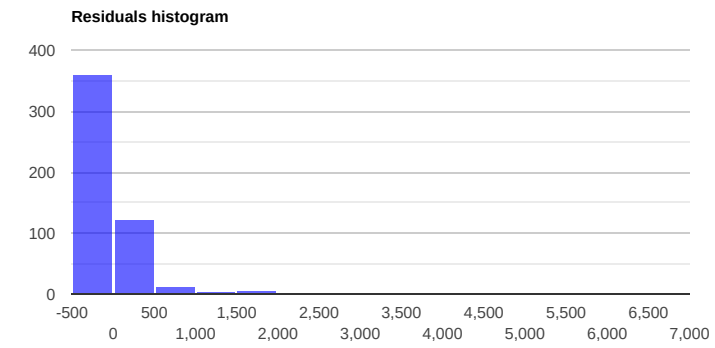
Outliers may affect the regression line.
In this case, the distribution of the residuals is normal. Therefore, the probability of detecting 8 valid outliers or more is 0.9999, (outliers: 1229.0709,1407.6283,1554.407,1598.1815,1671.5134,1757.7389,1971.2921,6121.9602).
You should only remove outliers if you identify them as errors!

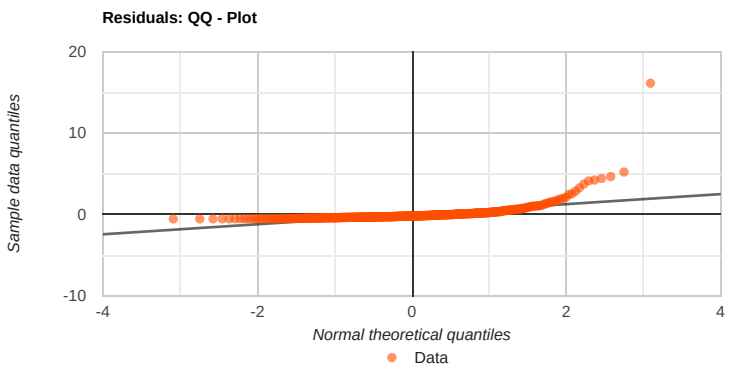


Significance level (α)

Annotations

Residuals normality





Calculation

Step-by-step solution

$\hat{Y} = b_0 + b_1X$

$b_1 = \frac{SP_{xy}}{SS_x} = \frac{\Sigma(x_i-\bar{x})(y_i-\bar{y})}{\Sigma(x_i-\bar{x})^2}$

$b_1 = \frac{11524.72}{5460.278} = 2.1106$

$b_0 = \bar{y} - b_1\bar{x}$

$\bar{x} = 7.038$

$\bar{y}$ = 212.12

b_0 = 212.12-2.1106*7.038 = 197.2653

$R^2 = \frac{SS_{Regression}}{SS_{total}} = \frac{\Sigma(\hat{y}_i - \bar{y})^2}{\Sigma(y_i - \bar{y})^2} = \frac{24324.617}{72144034.8} = 0.0003372$

The standard deviation of the residuals is:

$MS_{residual} = S^2_{res} = \frac{\Sigma(y_i - \hat{y})^2}{n - 2}$

Residual outliers

$S_{res} = \sqrt{MSE} = \sqrt{144818.6951} = 380.5505$.

The average of the residuals is always zero.

The thresholds used to calculate the outliers are: $\pm k*S_{res}$.

In this case, the thresholds are ±3*380.5505 = ±1141.6515.

We tagged the outliers with an arrow (⇐) at the 'Residual' column.

SS_x and SP_{xy}

$x-\bar{x}$	$y-\bar{y}$	$(x-\bar{x})^2$	$(x-\bar{x})(y-\bar{y})$

4.962	-212.12	24.6214	-1052.5394
3.962	-212.12	15.6974	-840.4194
2.962	-212.12	8.7734	-628.2994
2.962	-212.12	8.7734	-628.2994
-4.038	-212.12	16.3054	856.5406
-4.038	-212.12	16.3054	856.5406
2.962	-210.12	8.7734	-622.3754
-4.038	-210.12	16.3054	848.4646
-4.038	-210.12	16.3054	848.4646
2.962	-209.12	8.7734	-619.4134
-4.038	-209.12	16.3054	844.4266
2.962	-208.12	8.7734	-616.4514
-4.038	-208.12	16.3054	840.3886
2.962	-207.12	8.7734	-613.4894
-4.038	-207.12	16.3054	836.3506
2.962	-206.12	8.7734	-610.5274
2.962	-206.12	8.7734	-610.5274
-4.038	-206.12	16.3054	832.3126
2.962	-205.12	8.7734	-607.5654
2.962	-205.12	8.7734	-607.5654
-4.038	-205.12	16.3054	828.2746
-6.038	-205.12	36.4574	1238.5146
2.962	-204.12	8.7734	-604.6034
2.962	-203.12	8.7734	-601.6414
2.962	-203.12	8.7734	-601.6414
2.962	-202.12	8.7734	-598.6794
2.962	-202.12	8.7734	-598.6794
2.962	-202.12	8.7734	-598.6794
2.962	-202.12	8.7734	-598.6794
2.962	-200.12	8.7734	-592.7554
4.962	-198.12	24.6214	-983.0714
-6.038	-198.12	36.4574	1196.2486
0.962	-197.12	0.9254	-189.6294
-1.038	-197.12	1.0774	204.6106
2.962	-195.12	8.7734	-577.9454
2.962	-195.12	8.7734	-577.9454
-0.038	-195.12	0.001444	7.4146
-4.038	-195.12	16.3054	787.8946
4.962	-194.12	24.6214	-963.2234
1.962	-194.12	3.8494	-380.8634
-1.038	-194.12	1.0774	201.4966
-0.038	-191.12	0.001444	7.2626
-1.038	-188.12	1.0774	195.2686
-1.038	-187.12	1.0774	194.2306
-1.038	-187.12	1.0774	194.2306
0.962	-184.12	0.9254	-177.1234
-1.038	-184.12	1.0774	191.1166
-5.038	-183.12	25.3814	922.5586
-0.038	-182.12	0.001444	6.9206
4.962	-180.12	24.6214	-893.7554
0.962	-180.12	0.9254	-173.2754
2.962	-178.12	8.7734	-527.5914
2.962	-178.12	8.7734	-527.5914
-4.038	-178.12	16.3054	719.2486
2.962	-177.12	8.7734	-524.6294
4.962	-176.12	24.6214	-873.9074
-4.038	-176.12	16.3054	711.1726
3.962	-174.12	15.6974	-689.8634
1.962	-174.12	3.8494	-341.6234
-4.038	-174.12	16.3054	703.0966
4.962	-173.12	24.6214	-859.0214
3.962	-173.12	15.6974	-685.9014
2.962	-173.12	8.7734	-512.7814
-1.038	-173.12	1.0774	179.6986
-4.038	-173.12	16.3054	699.0586
-4.038	-173.12	16.3054	699.0586
-3.038	-172.12	9.2294	522.9006
-1.038	-171.12	1.0774	177.6226
4.962	-170.12	24.6214	-844.1354
0.962	-170.12	0.9254	-163.6554
-3.038	-168.12	9.2294	510.7486
-3.038	-168.12	9.2294	510.7486
0.962	-167.12	0.9254	-160.7694
-1.038	-167.12	1.0774	173.4706
4.962	-166.12	24.6214	-824.2874
2.962	-164.12	8.7734	-486.1234
-1.038	-163.12	1.0774	169.3186
-4.038	-163.12	16.3054	658.6786
0.962	-162.12	0.9254	-155.9594
3.962	-159.12	15.6974	-630.4334
2.962	-159.12	8.7734	-471.3134
-0.038	-159.12	0.001444	6.0466
-4.038	-159.12	16.3054	642.5266
4.962	-158.12	24.6214	-784.5914
-0.038	-158.12	0.001444	6.0086
-3.038	-158.12	9.2294	480.3686
3.962	-157.12	15.6974	-622.5094
-0.038	-157.12	0.001444	5.9706
-3.038	-156.12	9.2294	474.2926
-3.038	-156.12	9.2294	474.2926
0.962	-155.12	0.9254	-149.2254
4.962	-154.12	24.6214	-764.7434
3.962	-154.12	15.6974	-610.6234
-3.038	-154.12	9.2294	468.2166

4.962	-153.12	24.6214	-759.7814
-1.038	-153.12	1.0774	158.9386
0.962	-152.12	0.9254	-146.3394
-2.038	-152.12	4.1534	310.0206
-5.038	-151.12	25.3814	761.3426
-3.038	-150.12	9.2294	456.0646
-2.038	-149.12	4.1534	303.9066
-4.038	-149.12	16.3054	602.1466
3.962	-148.12	15.6974	-586.8514
2.962	-147.12	8.7734	-435.7694
-1.038	-147.12	1.0774	152.7106
0.962	-146.12	0.9254	-140.5674
-1.038	-146.12	1.0774	151.6726
-6.038	-146.12	36.4574	882.2726
1.962	-145.12	3.8494	-284.7254
-1.038	-145.12	1.0774	150.6346
-2.038	-145.12	4.1534	295.7546
-3.038	-145.12	9.2294	440.8746
-4.038	-145.12	16.3054	585.9946
2.962	-144.12	8.7734	-426.8834
-0.038	-144.12	0.001444	5.4766
-4.038	-144.12	16.3054	581.9566
-5.038	-144.12	25.3814	726.0766
3.962	-143.12	15.6974	-567.0414
-3.038	-143.12	9.2294	434.7986
3.962	-142.12	15.6974	-563.0794
1.962	-142.12	3.8494	-278.8394
0.962	-142.12	0.9254	-136.7194
0.962	-142.12	0.9254	-136.7194
4.962	-141.12	24.6214	-700.2374
-0.038	-141.12	0.001444	5.3626
-3.038	-141.12	9.2294	428.7226
-5.038	-141.12	25.3814	710.9626
2.962	-140.12	8.7734	-415.0354
1.962	-140.12	3.8494	-274.9154
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-4.038	-138.12	16.3054	557.7286
4.962	-137.12	24.6214	-680.3894
4.962	-137.12	24.6214	-680.3894
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4.962	-132.12	24.6214	-655.5794
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-4.038	-131.12	16.3054	529.4626
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-2.038	-129.12	4.1534	263.1466
-6.038	-129.12	36.4574	779.6266
1.962	-128.12	3.8494	-251.3714
-2.038	-128.12	4.1534	261.1086
-6.038	-128.12	36.4574	773.5886
-6.038	-128.12	36.4574	773.5886
-0.038	-127.12	0.001444	4.8306
-0.038	-127.12	0.001444	4.8306
-4.038	-127.12	16.3054	513.3106
0.962	-126.12	0.9254	-121.3274
-4.038	-126.12	16.3054	509.2726
-5.038	-126.12	25.3814	635.3926
3.962	-125.12	15.6974	-495.7254
-0.038	-125.12	0.001444	4.7546
-3.038	-125.12	9.2294	380.1146
-0.038	-124.12	0.001444	4.7166
-1.038	-123.12	1.0774	127.7986
-1.038	-123.12	1.0774	127.7986
3.962	-122.12	15.6974	-483.8394
1.962	-122.12	3.8494	-239.5994
-1.038	-122.12	1.0774	126.7606
-3.038	-122.12	9.2294	371.0006
-3.038	-122.12	9.2294	371.0006
3.962	-121.12	15.6974	-479.8774
-3.038	-121.12	9.2294	367.9626
4.962	-120.12	24.6214	-596.0354
-1.038	-119.12	1.0774	123.6466
2.962	-118.12	8.7734	-349.8714
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-1.038	-118.12	1.0774	122.6086
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-5.038	-117.12	25.3814	590.0506
4.962	-116.12	24.6214	-576.1874
2.962	-116.12	8.7734	-343.9474
0.962	-116.12	0.9254	-111.7074
3.962	-115.12	15.6974	-456.1054

2.962	-115.12	8.7734	-340.9854
-2.038	-115.12	4.1534	234.6146
-3.038	-115.12	9.2294	349.7346
-6.038	-115.12	36.4574	695.0946
1.962	-114.12	3.8494	-223.9034
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-2.038	-113.12	4.1534	230.5386
-2.038	-113.12	4.1534	230.5386
4.962	-112.12	24.6214	-556.3394
4.962	-112.12	24.6214	-556.3394
2.962	-112.12	8.7734	-332.0994
0.962	-112.12	0.9254	-107.8594
3.962	-111.12	15.6974	-440.2574
-0.038	-111.12	0.001444	4.2226
0.962	-109.12	0.9254	-104.9734
-6.038	-109.12	36.4574	658.8666
4.962	-108.12	24.6214	-536.4914
-3.038	-108.12	9.2294	328.4686
-2.038	-107.12	4.1534	218.3106
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4.962	-106.12	24.6214	-526.5674
-6.038	-106.12	36.4574	640.7526
0.962	-105.12	0.9254	-101.1254
-6.038	-105.12	36.4574	634.7146
4.962	-104.12	24.6214	-516.6434
-6.038	-104.12	36.4574	628.6766
-4.038	-102.12	16.3054	412.3606
-6.038	-102.12	36.4574	616.6006
4.962	-99.12	24.6214	-491.8334
3.962	-98.12	15.6974	-388.7514
1.962	-98.12	3.8494	-192.5114
-0.038	-98.12	0.001444	3.7286
-2.038	-98.12	4.1534	199.9686
-0.038	-97.12	0.001444	3.6906
-3.038	-97.12	9.2294	295.0506
-3.038	-97.12	9.2294	295.0506
-6.038	-97.12	36.4574	586.4106
4.962	-95.12	24.6214	-471.9854
3.962	-95.12	15.6974	-376.8654
1.962	-95.12	3.8494	-186.6254
-1.038	-95.12	1.0774	98.7346
-1.038	-95.12	1.0774	98.7346
-0.038	-94.12	0.001444	3.5766
-0.038	-94.12	0.001444	3.5766
-2.038	-94.12	4.1534	191.8166
-4.038	-94.12	16.3054	380.0566
3.962	-93.12	15.6974	-368.9414
3.962	-93.12	15.6974	-368.9414
1.962	-93.12	3.8494	-182.7014
-6.038	-93.12	36.4574	562.2586
-0.038	-92.12	0.001444	3.5006
-4.038	-92.12	16.3054	371.9806
4.962	-91.12	24.6214	-452.1374
1.962	-91.12	3.8494	-178.7774
-0.038	-91.12	0.001444	3.4626
-3.038	-91.12	9.2294	276.8226
3.962	-90.12	15.6974	-357.0554
-2.038	-90.12	4.1534	183.6646
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-3.038	-90.12	9.2294	273.7846
3.962	-89.12	15.6974	-353.0934
-3.038	-88.12	9.2294	267.7086
4.962	-87.12	24.6214	-432.2894
-1.038	-87.12	1.0774	90.4306
-5.038	-87.12	25.3814	438.9106
3.962	-86.12	15.6974	-341.2074
0.962	-86.12	0.9254	-82.8474
-0.038	-86.12	0.001444	3.2726
-3.038	-86.12	9.2294	261.6326
-6.038	-85.12	36.4574	513.9546
-0.038	-84.12	0.001444	3.1966
-5.038	-84.12	25.3814	423.7966
3.962	-83.12	15.6974	-329.3214
-0.038	-82.12	0.001444	3.1206
-5.038	-81.12	25.3814	408.6826
1.962	-80.12	3.8494	-157.1954
0.962	-80.12	0.9254	-77.0754
0.962	-79.12	0.9254	-76.1134
-2.038	-78.12	4.1534	159.2086
-0.038	-77.12	0.001444	2.9306
-1.038	-77.12	1.0774	80.0506
-2.038	-76.12	4.1534	155.1326
-6.038	-76.12	36.4574	459.6126
1.962	-75.12	3.8494	-147.3854
-6.038	-75.12	36.4574	453.5746
-3.038	-74.12	9.2294	225.1766
2.962	-73.12	8.7734	-216.5814
-0.038	-73.12	0.001444	2.7786
4.962	-70.12	24.6214	-347.9354
2.962	-70.12	8.7734	-207.6954
-0.038	-69.12	0.001444	2.6266
-4.038	-69.12	16.3054	279.1066
-0.038	-68.12	0.001444	2.5886

3.962	-64.12	15.6974	-254.0434
2.962	-64.12	8.7734	-189.9234
-0.038	-64.12	0.001444	2.4366
-3.038	-63.12	9.2294	191.7586
-4.038	-63.12	16.3054	254.8786
4.962	-60.12	24.6214	-298.3154
-1.038	-60.12	1.0774	62.4046
-6.038	-60.12	36.4574	363.0046
2.962	-58.12	8.7734	-172.1514
-1.038	-57.12	1.0774	59.2906
-3.038	-55.12	9.2294	167.4546
3.962	-54.12	15.6974	-214.4234
3.962	-52.12	15.6974	-206.4994
-0.038	-52.12	0.001444	1.9806
4.962	-50.12	24.6214	-248.6954
3.962	-50.12	15.6974	-198.5754
3.962	-50.12	15.6974	-198.5754
0.962	-50.12	0.9254	-48.2154
3.962	-49.12	15.6974	-194.6134
1.962	-49.12	3.8494	-96.3734
-1.038	-49.12	1.0774	50.9866
-5.038	-49.12	25.3814	247.4666
4.962	-48.12	24.6214	-238.7714
1.962	-48.12	3.8494	-94.4114
-3.038	-47.12	9.2294	143.1506
-5.038	-47.12	25.3814	237.3906
0.962	-46.12	0.9254	-44.3674
-2.038	-46.12	4.1534	93.9926
-2.038	-45.12	4.1534	91.9546
-3.038	-44.12	9.2294	134.0366
-5.038	-42.12	25.3814	212.2006
-0.038	-41.12	0.001444	1.5626
-1.038	-40.12	1.0774	41.6446
-5.038	-40.12	25.3814	202.1246
-3.038	-39.12	9.2294	118.8466
4.962	-38.12	24.6214	-189.1514
-2.038	-38.12	4.1534	77.6886
-5.038	-36.12	25.3814	181.9726
-6.038	-36.12	36.4574	218.0926
-5.038	-34.12	25.3814	171.8966
2.962	-33.12	8.7734	-98.1014
-2.038	-33.12	4.1534	67.4986
-2.038	-32.12	4.1534	65.4606
-2.038	-32.12	4.1534	65.4606
-5.038	-30.12	25.3814	151.7446
-3.038	-29.12	9.2294	88.4666
-1.038	-28.12	1.0774	29.1886
2.962	-27.12	8.7734	-80.3294
4.962	-26.12	24.6214	-129.6074
-0.038	-26.12	0.001444	0.9926
-0.038	-24.12	0.001444	0.9166
-1.038	-24.12	1.0774	25.0366
-2.038	-24.12	4.1534	49.1566
1.962	-23.12	3.8494	-45.3614
-3.038	-23.12	9.2294	70.2386
-2.038	-22.12	4.1534	45.0806
-2.038	-22.12	4.1534	45.0806
4.962	-20.12	24.6214	-99.8354
2.962	-19.12	8.7734	-56.6334
1.962	-18.12	3.8494	-35.5514
-1.038	-18.12	1.0774	18.8086
-0.038	-17.12	0.001444	0.6506
4.962	-13.12	24.6214	-65.1014
1.962	-13.12	3.8494	-25.7414
2.962	-12.12	8.7734	-35.8994
-3.038	-12.12	9.2294	36.8206
3.962	-10.12	15.6974	-40.0954
2.962	-10.12	8.7734	-29.9754
-0.038	-10.12	0.001444	0.3846
-0.038	-9.12	0.001444	0.3466
-2.038	-9.12	4.1534	18.5866
4.962	-8.12	24.6214	-40.2914
2.962	-8.12	8.7734	-24.0514
-4.038	-4.12	16.3054	16.6366
-3.038	-2.12	9.2294	6.4406
4.962	-1.12	24.6214	-5.5574
0.962	-0.12	0.9254	-0.1154
-3.038	-0.12	9.2294	0.3646
4.962	1.88	24.6214	9.3286
1.962	4.88	3.8494	9.5746
-0.038	4.88	0.001444	-0.1854
-5.038	4.88	25.3814	-24.5854
-1.038	5.88	1.0774	-6.1034
-1.038	5.88	1.0774	-6.1034
3.962	7.88	15.6974	31.2206
2.962	9.88	8.7734	29.2646
-5.038	11.88	25.3814	-59.8514
1.962	12.88	3.8494	25.2706
-3.038	12.88	9.2294	-39.1294
-1.038	13.88	1.0774	-14.4074
-6.038	13.88	36.4574	-83.8074
1.962	15.88	3.8494	31.1566
-4.038	15.88	16.3054	-64.1234
-4.038	17.88	16.3054	-72.1994

2.962	19.88	8.7734	58.8846
-2.038	19.88	4.1534	-40.5154
3.962	20.88	15.6974	82.7266
-0.038	21.88	0.001444	-0.8314
-1.038	21.88	1.0774	-22.7114
-1.038	22.88	1.0774	-23.7494
-3.038	23.88	9.2294	-72.5474
-4.038	24.88	16.3054	-100.4654
2.962	25.88	8.7734	76.6566
-1.038	25.88	1.0774	-26.8634
-5.038	25.88	25.3814	-130.3834
3.962	29.88	15.6974	118.3846
2.962	29.88	8.7734	88.5046
1.962	30.88	3.8494	60.5866
0.962	30.88	0.9254	29.7066
3.962	32.88	15.6974	130.2706
-4.038	36.88	16.3054	-148.9214
-2.038	38.88	4.1534	-79.2374
4.962	39.88	24.6214	197.8846
3.962	39.88	15.6974	158.0046
1.962	39.88	3.8494	78.2446
-2.038	41.88	4.1534	-85.3514
-2.038	42.88	4.1534	-87.3894
-6.038	44.88	36.4574	-270.9854
4.962	49.88	24.6214	247.5046
1.962	50.88	3.8494	99.8266
-5.038	51.88	25.3814	-261.3714
2.962	52.88	8.7734	156.6306
-5.038	53.88	25.3814	-271.4474
4.962	56.88	24.6214	282.2386
-0.038	56.88	0.001444	-2.1614
2.962	58.88	8.7734	174.4026
1.962	58.88	3.8494	115.5226
0.962	58.88	0.9254	56.6426
-1.038	58.88	1.0774	-61.1174
3.962	60.88	15.6974	241.2066
-0.038	61.88	0.001444	-2.3514
1.962	63.88	3.8494	125.3326
4.962	66.88	24.6214	331.8586
-3.038	67.88	9.2294	-206.2194
1.962	69.88	3.8494	137.1046
-5.038	69.88	25.3814	-352.0554
-1.038	72.88	1.0774	-75.6494
0.962	74.88	0.9254	72.0346
1.962	75.88	3.8494	148.8766
-0.038	77.88	0.001444	-2.9594
-0.038	81.88	0.001444	-3.1114
-3.038	82.88	9.2294	-251.7894
1.962	86.88	3.8494	170.4586
-0.038	87.88	0.001444	-3.3394
-5.038	92.88	25.3814	-467.9294
-2.038	96.88	4.1534	-197.4414
3.962	98.88	15.6974	391.7626
-5.038	98.88	25.3814	-498.1574
-2.038	100.88	4.1534	-205.5934
-5.038	100.88	25.3814	-508.2334
-3.038	103.88	9.2294	-315.5874
0.962	117.88	0.9254	113.4006
-2.038	122.88	4.1534	-250.4294
3.962	124.88	15.6974	494.7746
4.962	126.88	24.6214	629.5786
3.962	129.88	15.6974	514.5846
-3.038	142.88	9.2294	-434.0694
-1.038	150.88	1.0774	-156.6134
2.962	154.88	8.7734	458.7546
-3.038	163.88	9.2294	-497.8674
2.962	165.88	8.7734	491.3366
-6.038	165.88	36.4574	-1001.5834
2.962	174.88	8.7734	517.9946
-2.038	177.88	4.1534	-362.5194
4.962	180.88	24.6214	897.5266
0.962	191.88	0.9254	184.5886
1.962	196.88	3.8494	386.2786
-0.038	196.88	0.001444	-7.4814
1.962	197.88	3.8494	388.2406
-3.038	207.88	9.2294	-631.5394
3.962	208.88	15.6974	827.5826
-2.038	216.88	4.1534	-442.0014
2.962	217.88	8.7734	645.3606
3.962	228.88	15.6974	906.8226
2.962	234.88	8.7734	695.7146
2.962	241.88	8.7734	716.4486
-0.038	243.88	0.001444	-9.2674
2.962	245.88	8.7734	728.2966
0.962	257.88	0.9254	248.0806
1.962	259.88	3.8494	509.8846
0.962	277.88	0.9254	267.3206
4.962	281.88	24.6214	1398.6886
3.962	292.88	15.6974	1160.3906
-6.038	302.88	36.4574	-1828.7894
-3.038	315.88	9.2294	-959.6434
3.962	337.88	15.6974	1338.6806
1.962	344.88	3.8494	676.6546
-0.038	359.88	0.001444	-13.6754

-0.038	374.88	0.001444	-14.2454
-3.038	374.88	9.2294	-1138.8854
-0.038	383.88	0.001444	-14.5874
4.962	386.88	24.6214	1919.6986
-1.038	392.88	1.0774	-407.8094
4.962	409.88	24.6214	2033.8246
-0.038	411.88	0.001444	-15.6514
-6.038	420.88	36.4574	-2541.2734
-2.038	478.88	4.1534	-975.9574
4.962	500.88	24.6214	2485.3666
-0.038	517.88	0.001444	-19.6794
-4.038	558.88	16.3054	-2256.7574
3.962	574.88	15.6974	2277.6746
0.962	605.88	0.9254	582.8566
-0.038	610.88	0.001444	-23.2134
-3.038	668.88	9.2294	-2032.0574
0.962	718.88	0.9254	691.5626
-2.038	735.88	4.1534	-1499.7234
2.962	796.88	8.7734	2360.3586
2.962	923.88	8.7734	2736.5326
1.962	961.88	3.8494	1887.2086
0.962	1077.88	0.9254	1036.9206
-1.038	1226.88	1.0774	-1273.5014
2.962	1413.88	8.7734	4187.9126
4.962	1564.88	24.6214	7764.9346
-2.038	1593.88	4.1534	-3248.3274
-5.038	1660.88	25.3814	-8367.5134
1.962	1761.88	3.8494	3456.8086
-3.038	1964.88	9.2294	-5969.3054
-0.038	6121.88	0.001444	-232.6314
0	0	**5460.278** (SS_x)	**11524.72** (SP_{xy})

Linear regression calculator

The linear regression calculator generates the linear regression equation. It also draws: a linear regression line, a histogram, a residuals QQ-plot, a residuals x-plot, and a distribution chart.
It calculates the R-squared, the R, and the outliers, then testing the fit of the linear model to the data and checking the residuals' normality assumption and the priori power.

What is linear regression?

The linear regression is the linear equation that best fits the points.
There is no one way to choose the best fit ting line, the most common one is the ordinary least squares (OLS). The linear regression describes the relationship between the dependent variable (Y) and the independent variables (X).
The linear regression model calculates the dependent variable (DV) based on the independent variables (IV, predictors).

What is "ordinary least squares"?

The ordinary least squares method chooses the line parameters that minimize the sum of squares of the differences between the observed dependent variables (Y) and the estimated value by the linear regression ($\hat{Y}$).

Why do you need linear regression?

We may use linear regression when we want to do one of the following

- Predict the dependent variable ($\hat{Y}$).
- Estimate the effect of each independent variable (X) on the dependent variable (Y).
- Calculate the correlation between the dependent variable and the independent variables.
- Test the linear model significance level.

How to calculate linear regression?

Following the linear regression formula:

$$\hat{Y} = b_0 + b_1 x$$

b_0 - the y-intercept, where the line crosses the y-axis.
b_1 - the slope, describes the line's direction and incline.

$$b_1 = \frac{SP_{xy}}{SS_x} = \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\Sigma(x_i - \bar{x})^2}$$

$$b_0 = \bar{y} - b_1 \bar{x}$$

linear regression prediction

The prediction calculator uses the linear regrssion to predict the depdendent variable based on the independent value. The calculator also creates the confidence interval, and the prediction interval.

Confidence interval of the prediction

The prediction interval for the **mean value** of the dependent variable.
This is the interval for the equation line, the true value equation will be in this interval. If we would know the true equation then the width of this interval would be zero.
If you would calculate the confidence interval over an infinite number of regressions with the same sample size, 95% (confidence level) of the calculated confidence intervals will contain the mean's true value.
Since this interval is for the mean, the standard error is smaller and the the range is narrower than the range of the prediction interval.

$$MS_{residual} = S^2_{residual} = \frac{\Sigma(y_i - \hat{y})^2}{n - 2}$$

$$S.E^2_{ci} = S^2_{residual}\left(\frac{1}{n} + \frac{(x_0 - \bar{x})^2}{SS_x}\right)$$

$$\hat{Y} \pm T_{1-\alpha/2}(n-2) * S.E_{ci}$$

Prediction Interval

The prediction interval for a **particular observation** of the dependent variable.
This is the interval for any single value.
The prediction inteval takes into consideration the fact that you don't know the true equatio, and the fact the the liner regression explaned only part of the variance (the part is R-squared). Even if we would know the true equation then the width of this interval would be greater than zero.
Since this interval is for a single observation, the standard error is larger and the range is wider than the range of the confidence interval

$$S.E^2_{prediction} = S^2_{residual}\left(1+\frac{1}{n}+\frac{(x_0 - \bar{x})^2}{SS_x}\right)$$

$$\hat{Y} \pm T_{1-\alpha/2}(n-2)*S.E_{prediction}$$

How to calculate R squares?

R squares is the percentage of the variance explain by the regression ($SS_{Regression}$) from the overall variance (SS_{Total}).

$$R^2 = \frac{SS_{Regression}}{SS_{Total}}$$

Linear regression in calculator

This online calculator supports all the basic functionality and more.

The **right-tailed** F test checks if the entire regression model is statistically significant. Why only right tail?

For **Multiple regression calculator** with the stepwise method and assumptions validations: **multiple regression calculator**

The following statistic checks if the linear regression model supports better results than the average of Y.

Hypotheses

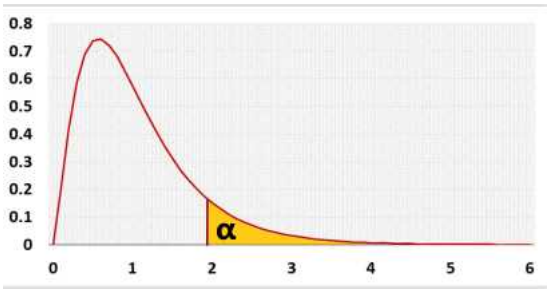
H_0: $Y = b_0$

H_1: $Y = b_0+b_1X$

Test statistic

$$F = \frac{MS(regression)}{MS\ (residual)}$$

F distribution



R Code

The following R code should produce similar results

```
rm(list = ls())
if(!"car" %in% installed.packages()){install.packages("car")}
library(car)
x10 <-
c(12,11,10,10,3,3,10,3,3,10,3,10,3,10,3,10,10,3,10,10,3,1,10,10,10,10,10,10,10,10,12,1,8,6,10,10,7,3,12,9,6,7,6,6,6,8,6,2,7,12,8,10,10,3,10,12,3,11,9,3,12,11,10,6,3,3,4,6,12,8,4,4,8,6,12,10,6,3,8,11,10,7,3,12,7,4,11,
x11 <-
c(11,9,6,2,12,9,4,2,8,5,5,4,2,7,6,2,4,12,5,2,1,2,10,5,5,5,2,4,6,10,12,7,7,6,5,9,4,5,5,12,10,9,6,7,12,9,10,4,11,10,7,7,5,12,10,3,4,12,8,4,12,9,7,2,6,6,11,10,2,9,4,6,1,9,3,3,10,5,11,7,6,6,4,3,10,6,2,11,10,9,8,11,3,5,12,11,9
x1 <- c(x10,x11)
y10 <-
c(0,0,0,0,0,0,2,2,2,3,3,4,4,5,5,6,6,6,7,7,7,7,8,9,9,10,10,10,10,12,14,14,15,15,17,17,17,17,18,18,18,21,24,25,25,28,28,29,30,32,32,34,34,34,35,36,36,38,38,38,39,39,39,39,39,39,40,41,42,42,44,44,45,45,46,48,49,49
y11 <-
c(163,163,163,163,164,164,165,165,166,166,167,168,170,171,172,172,173,174,174,176,176,178,179,179,180,180,182,183,184,185,186,186,188,188,188,189,189,190,190,192,193,194,194,195,199,199,200,200,20
y1 <- c(y10,y11)
model1 = lm(y1~x1)
summary(model1)
```

What is linear regression?

Tutorial

Calculators

Multiple regression
Correlation
Regression sample size