Statistics Kingdom

Linear Regression Calculator

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

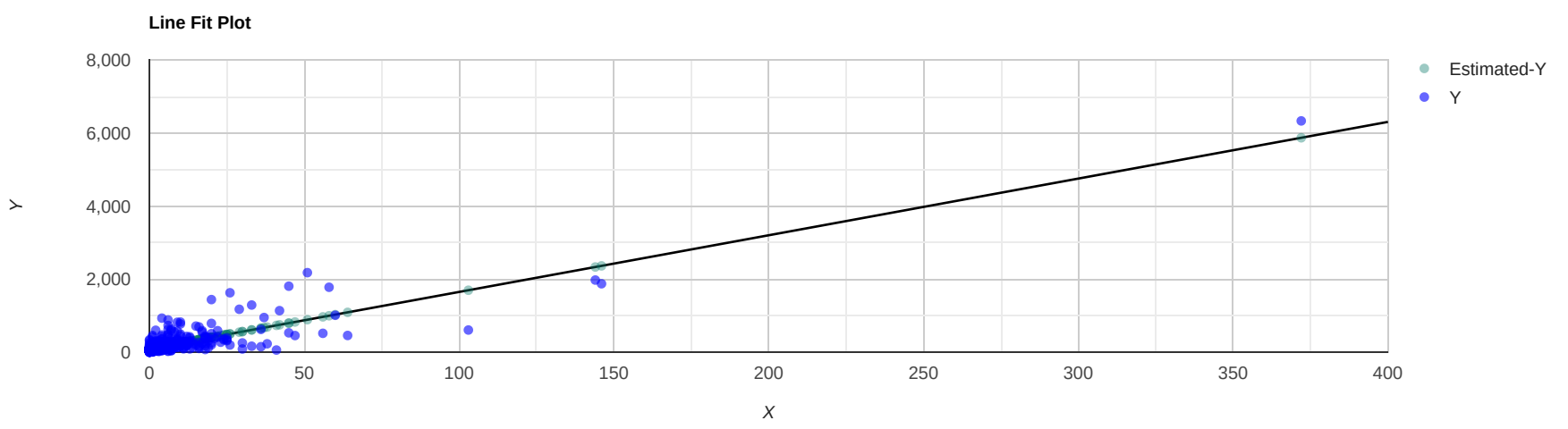
Regression line equation

$$\hat{Y} = 95.9455 + 15.5272X$$

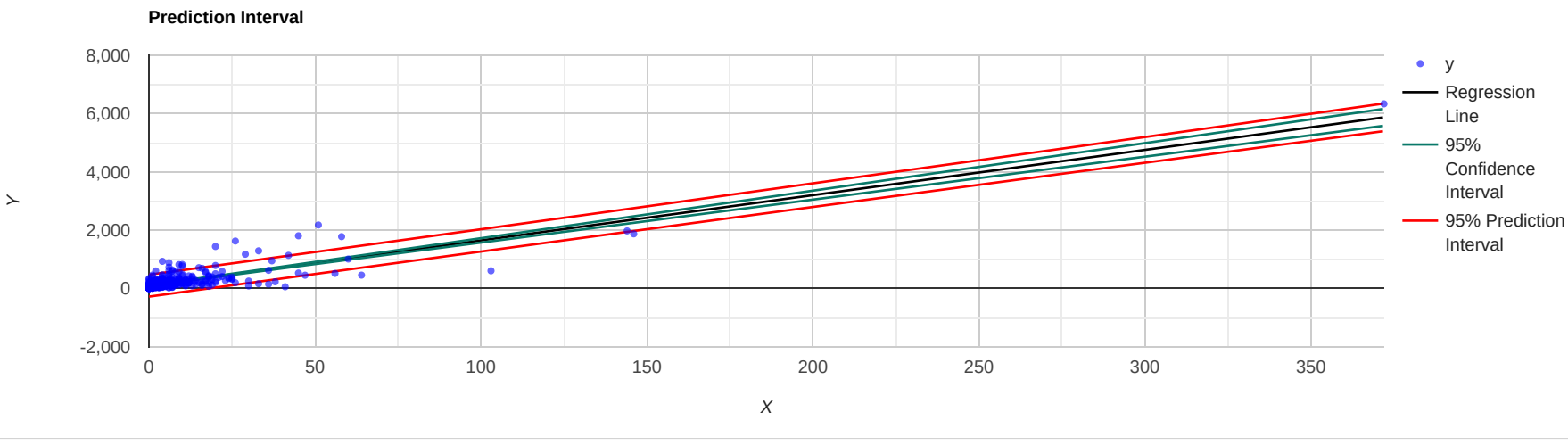
Reporting linear regression in APA style

X predicted Y, R^2 = .75, $F(1,498)$ = 1479.19, p < .001.
β = 15.53, p < .001, α = 95.95, p < .001.

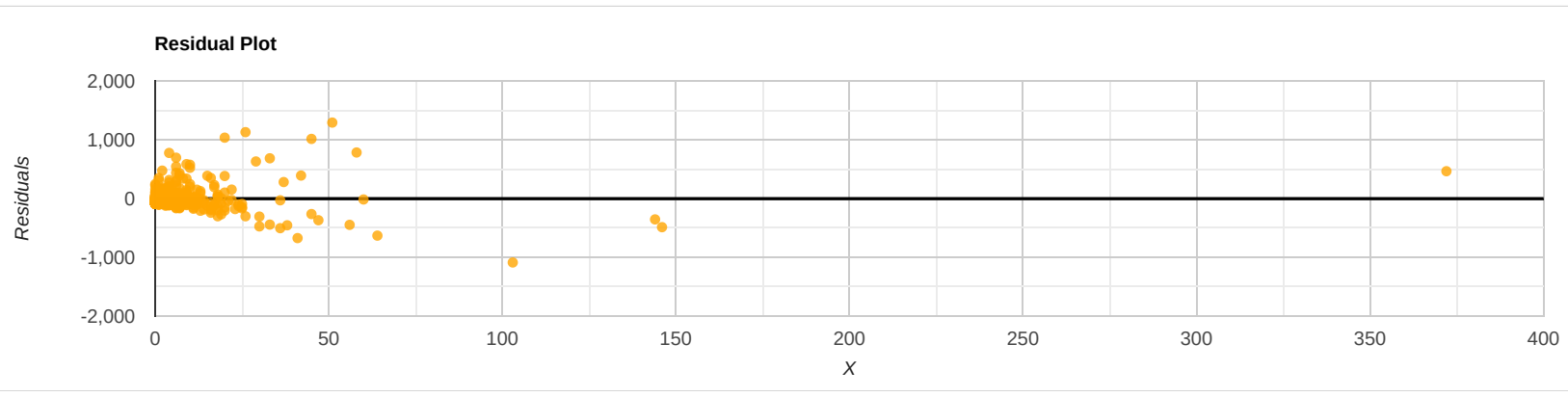
Line Fit Plot



Prediction online

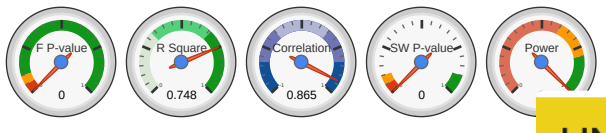


Residual Plot



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	53972966.3258	53972966.3258	1479.1941 (1,498)	0
Residual (between y_i and $\hat{y}_i$)	498	18171068.4742	36488.0893		
Total (between y_i and $\bar{y}$)	499	72144034.8	144577.224		

1. Y and X relationship

R-Squared (R^2) equals **0.7481.** This means that 74.8% of the variability of Y is explained by X.
Correlation (R) equals **0.8649**. This means that there is a **very strong direct relationship** between X and Y.
The Standard deviation of the residuals (S_{res}) equals **191.0186**.
The slope: b_1=**15.5272** CI[14.734, 16.3204] means that when you increase X by 1, the value of Y increases by 15.5272.
The y-intercept: b_0=**95.9455** CI[78.1431, 113.7478] means that when X equals 0, the prediction of Y's value is 95.9455.
The x-intercept equals -6.1792.

2. Goodness of fit

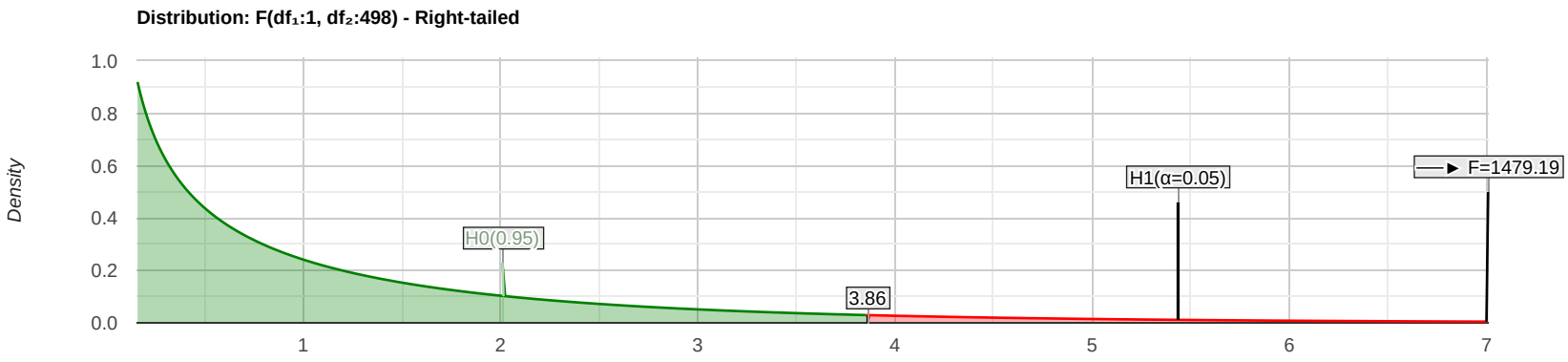
Overall regression: right-tailed, F(1,498) = **1479.1941**, p-value = **0**. Since p-value < α (0.05), we reject H_0.
The linear regression model, $\mathbf{Y = b_0 + b_1X + \varepsilon}$, provides a better fit than the model without the independent variable resulting in $\mathbf{Y = b_0 + \varepsilon}$.
The slope (b_1): two-tailed, T(498)=**38.4603**, p-value = **0**. For one predictor it is the same as the p-value for the overall model.
The y-intercept (b_0): two-tailed, T(498) = **10.5889**, p-value = **0**. 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

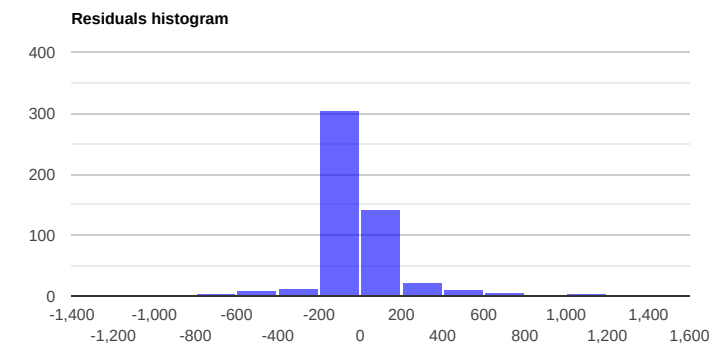
Outliers may affect the regression line.
In this case, the distribution of the residuals is normal. Therefore, the probability of detecting 13 valid outliers or more is 1, (outliers: -675.5608,-633.6865,-1090.2475,582.3097,691.8913,772.9457,627.7656,681.6568,1032.5105,1126.3472,780.4767,1011.3304,1289.1671).
You should only remove outliers if you identify them as errors!

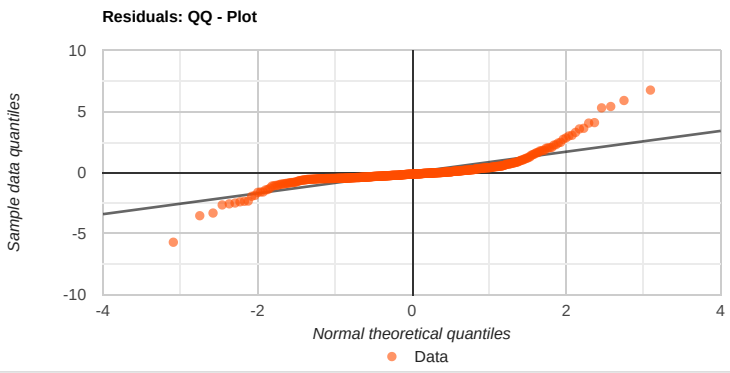


Significance level (α)

Annotations

Residuals normality





Calculation

Step-by-step solution

$\hat{Y} = b_0 + b_1X$

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

$b_1 = \frac{3476026.08}{223866.838} = 15.5272$

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

$\bar{x} = 7.482$

$\bar{y}$ = 212.12

b_0 = 212.12-15.5272*7.482 = 95.9455

$$R^2 = \frac{SS_{Regression}}{SS_{total}} = \frac{\Sigma(\hat{y}_i - \bar{y})^2}{\Sigma(y_i - \bar{y})^2} = \frac{53972966.3258}{72144034.8} = 0.7481$$

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} = √MSE = √36488.0893 = 191.0186.

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*191.0186 = ±573.0557.

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

SS_x and SP_{xy}

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

-7.482	-212.12	55.9803	1587.0818
-7.482	-212.12	55.9803	1587.0818
-7.482	-212.12	55.9803	1587.0818
-7.482	-212.12	55.9803	1587.0818
-7.482	-212.12	55.9803	1587.0818
-7.482	-212.12	55.9803	1587.0818
-7.482	-210.12	55.9803	1572.1178
-7.482	-210.12	55.9803	1572.1178
-7.482	-210.12	55.9803	1572.1178
-7.482	-209.12	55.9803	1564.6358
-7.482	-209.12	55.9803	1564.6358
-6.482	-208.12	42.0163	1349.0338
-7.482	-208.12	55.9803	1557.1538
-7.482	-207.12	55.9803	1549.6718
-7.482	-207.12	55.9803	1549.6718
-7.482	-206.12	55.9803	1542.1898
-6.482	-206.12	42.0163	1336.0698
-7.482	-206.12	55.9803	1542.1898
-7.482	-205.12	55.9803	1534.7078
-7.482	-205.12	55.9803	1534.7078
-7.482	-205.12	55.9803	1534.7078
-7.482	-205.12	55.9803	1534.7078
-7.482	-204.12	55.9803	1527.2258
-7.482	-203.12	55.9803	1519.7438
-7.482	-203.12	55.9803	1519.7438
-7.482	-202.12	55.9803	1512.2618
-7.482	-202.12	55.9803	1512.2618
-7.482	-202.12	55.9803	1512.2618
-6.482	-202.12	42.0163	1310.1418
-7.482	-200.12	55.9803	1497.2978
-6.482	-198.12	42.0163	1284.2138
-7.482	-198.12	55.9803	1482.3338
-6.482	-197.12	42.0163	1277.7318
-7.482	-197.12	55.9803	1474.8518
-7.482	-195.12	55.9803	1459.8878
-7.482	-195.12	55.9803	1459.8878
-4.482	-195.12	20.0883	874.5278
-6.482	-195.12	42.0163	1264.7678
-7.482	-194.12	55.9803	1452.4058
-7.482	-194.12	55.9803	1452.4058
-7.482	-194.12	55.9803	1452.4058
-1.482	-191.12	2.1963	283.2398
-7.482	-188.12	55.9803	1407.5138
-7.482	-187.12	55.9803	1400.0318
-7.482	-187.12	55.9803	1400.0318
-5.482	-184.12	30.0523	1009.3458
-7.482	-184.12	55.9803	1377.5858
-6.482	-183.12	42.0163	1186.9838
-7.482	-182.12	55.9803	1362.6218
-1.482	-180.12	2.1963	266.9378
-7.482	-180.12	55.9803	1347.6578
-5.482	-178.12	30.0523	976.4538
-5.482	-178.12	30.0523	976.4538
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-6.482	-176.12	42.0163	1141.6098
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-5.482	-174.12	30.0523	954.5258
-7.482	-174.12	55.9803	1302.7658
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-4.482	-173.12	20.0883	775.9238
-3.482	-173.12	12.1243	602.8038
-6.482	-173.12	42.0163	1122.1638
-7.482	-173.12	55.9803	1295.2838
-7.482	-172.12	55.9803	1287.8018
-7.482	-171.12	55.9803	1280.3198
-7.482	-170.12	55.9803	1272.8378
-7.482	-170.12	55.9803	1272.8378
-3.482	-168.12	12.1243	585.3938
-6.482	-168.12	42.0163	1089.7538
-7.482	-167.12	55.9803	1250.3918
-5.482	-167.12	30.0523	916.1518
-0.482	-166.12	0.2323	80.0698
-7.482	-164.12	55.9803	1227.9458
-6.482	-163.12	42.0163	1057.3438
-5.482	-163.12	30.0523	894.2238
-4.482	-162.12	20.0883	726.6218
-7.482	-159.12	55.9803	1190.5358
-4.482	-159.12	20.0883	713.1758
-5.482	-159.12	30.0523	872.2958
-7.482	-159.12	55.9803	1190.5358
-5.482	-158.12	30.0523	866.8138
-6.482	-158.12	42.0163	1024.9338
-3.482	-158.12	12.1243	550.5738
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-4.482	-157.12	20.0883	704.2118
-0.482	-156.12	0.2323	75.2498
-7.482	-156.12	55.9803	1168.0898
33.518	-155.12	1123.4503	-5199.3122
-7.482	-154.12	55.9803	1153.1258
-6.482	-154.12	42.0163	999.0058
-6.482	-154.12	42.0163	999.0058

-6.482	-153.12	42.0163	992.5238
-5.482	-153.12	30.0523	839.4038
-6.482	-152.12	42.0163	986.0418
-7.482	-152.12	55.9803	1138.1618
-7.482	-151.12	55.9803	1130.6798
-7.482	-150.12	55.9803	1123.1978
-4.482	-149.12	20.0883	668.3558
-6.482	-149.12	42.0163	966.5958
-7.482	-148.12	55.9803	1108.2338
-4.482	-147.12	20.0883	659.3918
-5.482	-147.12	30.0523	806.5118
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-7.482	-142.12	55.9803	1063.3418
-7.482	-142.12	55.9803	1063.3418
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-7.482	-128.12	55.9803	958.5938
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22.518	-127.12	507.0603	-2862.4882
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-6.482	-126.12	42.0163	817.5098
-7.482	-126.12	55.9803	943.6298
-3.482	-125.12	12.1243	435.6678
5.518	-125.12	30.4483	-690.4122
-6.482	-125.12	42.0163	811.0278
-7.482	-124.12	55.9803	928.6658
-6.482	-123.12	42.0163	798.0638
-6.482	-123.12	42.0163	798.0638
-4.482	-122.12	20.0883	547.3418
3.518	-122.12	12.3763	-429.6182
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-6.482	-122.12	42.0163	791.5818
-6.482	-122.12	42.0163	791.5818
-7.482	-121.12	55.9803	906.2198
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-7.482	-118.12	55.9803	883.7738
-3.482	-118.12	12.1243	411.2938
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-6.482	-117.12	42.0163	759.1718
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-3.482	-115.12	12.1243	400.8478

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-3.482	-104.12	12.1243	362.5458
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3.518	-102.12	12.3763	-359.2582
-6.482	-102.12	42.0163	661.9418
-7.482	-99.12	55.9803	741.6158
-5.482	-98.12	30.0523	537.8938
-3.482	-98.12	12.1243	341.6538
-7.482	-98.12	55.9803	734.1338
-5.482	-98.12	30.0523	537.8938
-7.482	-97.12	55.9803	726.6518
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-6.482	-97.12	42.0163	629.5318
-3.482	-97.12	12.1243	338.1718
-7.482	-95.12	55.9803	711.6878
-5.482	-95.12	30.0523	521.4478
-6.482	-95.12	42.0163	616.5678
-7.482	-95.12	55.9803	711.6878
-2.482	-95.12	6.1603	236.0878
-6.482	-94.12	42.0163	610.0858
-3.482	-94.12	12.1243	327.7258
-5.482	-94.12	30.0523	515.9658
-1.482	-94.12	2.1963	139.4858
11.518	-93.12	132.6643	-1072.5562
-0.482	-93.12	0.2323	44.8838
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-7.482	-93.12	55.9803	696.7238
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1.518	-91.12	2.3043	-138.3202
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-5.482	-90.12	30.0523	494.0378
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6.518	-87.12	42.4843	-567.8482
-7.482	-87.12	55.9803	651.8318
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-1.482	-86.12	2.1963	127.6298
-7.482	-86.12	55.9803	644.3498
-0.482	-85.12	0.2323	41.0278
-5.482	-84.12	30.0523	461.1458
-4.482	-84.12	20.0883	377.0258
-5.482	-83.12	30.0523	455.6638
1.518	-82.12	2.3043	-124.6582
-3.482	-81.12	12.1243	282.4598
-7.482	-80.12	55.9803	599.4578
-5.482	-80.12	30.0523	439.2178
-4.482	-79.12	20.0883	354.6158
-6.482	-78.12	42.0163	506.3738
-5.482	-77.12	30.0523	422.7718
0.518	-77.12	0.2683	-39.9482
-1.482	-76.12	2.1963	112.8098
-0.482	-76.12	0.2323	36.6898
-6.482	-75.12	42.0163	486.9278
-7.482	-75.12	55.9803	562.0478
-4.482	-74.12	20.0883	332.2058
-3.482	-73.12	12.1243	254.6038
-3.482	-73.12	12.1243	254.6038
-4.482	-70.12	20.0883	314.2778
-6.482	-70.12	42.0163	454.5178
-7.482	-69.12	55.9803	517.1558
8.518	-69.12	72.5563	-588.7642
-3.482	-68.12	12.1243	237.1938

-5.482	-64.12	30.0523	351.5058
-0.482	-64.12	0.2323	30.9058
28.518	-64.12	813.2763	-1828.5742
-3.482	-63.12	12.1243	219.7838
-7.482	-63.12	55.9803	472.2638
-2.482	-60.12	6.1603	149.2178
3.518	-60.12	12.3763	-211.5022
-6.482	-60.12	42.0163	389.6978
-7.482	-58.12	55.9803	434.8538
-7.482	-57.12	55.9803	427.3718
-6.482	-55.12	42.0163	357.2878
2.518	-54.12	6.3403	-136.2742
-3.482	-52.12	12.1243	181.4818
-5.482	-52.12	30.0523	285.7218
25.518	-50.12	651.1683	-1278.9622
0.518	-50.12	0.2683	-25.9622
-0.482	-50.12	0.2323	24.1578
-2.482	-50.12	6.1603	124.3978
-5.482	-49.12	30.0523	269.2758
8.518	-49.12	72.5563	-418.4042
-4.482	-49.12	20.0883	220.1558
-5.482	-49.12	30.0523	269.2758
-2.482	-48.12	6.1603	119.4338
-4.482	-48.12	20.0883	215.6738
-5.482	-47.12	30.0523	258.3118
-2.482	-47.12	6.1603	116.9518
-5.482	-46.12	30.0523	252.8298
-6.482	-46.12	42.0163	298.9498
-4.482	-45.12	20.0883	202.2278
-3.482	-44.12	12.1243	153.6258
-3.482	-42.12	12.1243	146.6618
-6.482	-41.12	42.0163	266.5398
-2.482	-40.12	6.1603	99.5778
-4.482	-40.12	20.0883	179.8178
-0.482	-39.12	0.2323	18.8558
10.518	-38.12	110.6283	-400.9462
-6.482	-38.12	42.0163	247.0938
0.518	-36.12	0.2683	-18.7102
2.518	-36.12	6.3403	-90.9502
-1.482	-34.12	2.1963	50.5658
-4.482	-33.12	20.0883	148.4438
-4.482	-33.12	20.0883	148.4438
-0.482	-32.12	0.2323	15.4818
-6.482	-32.12	42.0163	208.2018
-3.482	-30.12	12.1243	104.8778
-2.482	-29.12	6.1603	72.2758
-3.482	-28.12	12.1243	97.9138
-2.482	-27.12	6.1603	67.3118
-6.482	-26.12	42.0163	169.3098
2.518	-26.12	6.3403	-65.7702
-3.482	-24.12	12.1243	83.9858
4.518	-24.12	20.4123	-108.9742
4.518	-24.12	20.4123	-108.9742
-5.482	-23.12	30.0523	126.7438
4.518	-23.12	20.4123	-104.4562
4.518	-22.12	20.4123	-99.9382
-4.482	-22.12	20.0883	99.1418
-7.482	-20.12	55.9803	150.5378
-0.482	-19.12	0.2323	9.2158
-3.482	-18.12	12.1243	63.0938
-0.482	-18.12	0.2323	8.7338
18.518	-17.12	342.9163	-317.0282
-1.482	-13.12	2.1963	19.4438
12.518	-13.12	156.7003	-164.2362
-5.482	-12.12	30.0523	66.4418
-5.482	-12.12	30.0523	66.4418
2.518	-10.12	6.3403	-25.4822
7.518	-10.12	56.5203	-76.0822
1.518	-10.12	2.3043	-15.3622
2.518	-9.12	6.3403	-22.9642
-3.482	-9.12	12.1243	31.7558
-5.482	-8.12	30.0523	44.5138
-7.482	-8.12	55.9803	60.7538
-4.482	-4.12	20.0883	18.4658
-6.482	-2.12	42.0163	13.7418
-1.482	-1.12	2.1963	1.6598
-1.482	-0.12	2.1963	0.1778
0.518	-0.12	0.2683	-0.06216
-3.482	1.88	12.1243	-6.5462
-4.482	4.88	20.0883	-21.8722
-4.482	4.88	20.0883	-21.8722
-2.482	4.88	6.1603	-12.1122
3.518	5.88	12.3763	20.6858
1.518	5.88	2.3043	8.9258
-5.482	7.88	30.0523	-43.1982
1.518	9.88	2.3043	14.9978
-0.482	11.88	0.2323	-5.7262
-1.482	12.88	2.1963	-19.0882
1.518	12.88	2.3043	19.5518
-5.482	13.88	30.0523	-76.0902
-4.482	13.88	20.0883	-62.2102
30.518	15.88	931.3483	484.6258
2.518	15.88	6.3403	39.9858
-3.482	17.88	12.1243	-62.2582

-1.482	19.88	2.1963	-29.4622
-2.482	19.88	6.1603	-49.3422
6.518	20.88	42.4843	136.0958
-1.482	21.88	2.1963	-32.4262
1.518	21.88	2.3043	33.2138
10.518	22.88	110.6283	240.6518
1.518	23.88	2.3043	36.2498
4.518	24.88	20.4123	112.4078
9.518	25.88	90.5923	246.3258
-5.482	25.88	30.0523	-141.8742
-6.482	25.88	42.0163	-167.7542
1.518	29.88	2.3043	45.3578
-4.482	29.88	20.0883	-133.9222
-2.482	30.88	6.1603	-76.6442
-3.482	30.88	12.1243	-107.5242
-3.482	32.88	12.1243	-114.4882
-0.482	36.88	0.2323	-17.7762
12.518	38.88	156.7003	486.6998
-7.482	39.88	55.9803	-298.3822
-2.482	39.88	6.1603	-98.9822
22.518	39.88	507.0603	898.0178
-1.482	41.88	2.1963	-62.0662
-1.482	42.88	2.1963	-63.5482
9.518	44.88	90.5923	427.1678
-0.482	49.88	0.2323	-24.0422
-2.482	50.88	6.1603	-126.2842
2.518	51.88	6.3403	130.6338
-5.482	52.88	30.0523	-289.8882
-1.482	53.88	2.1963	-79.8502
3.518	56.88	12.3763	200.1038
-0.482	56.88	0.2323	-27.4162
-3.482	58.88	12.1243	-205.0202
-6.482	58.88	42.0163	-381.6602
8.518	58.88	72.5563	501.5398
15.518	58.88	240.8083	913.6998
-4.482	60.88	20.0883	-272.8642
-1.482	61.88	2.1963	-91.7062
-5.482	63.88	30.0523	-350.1902
-4.482	66.88	20.0883	-299.7562
3.518	67.88	12.3763	238.8018
-1.482	69.88	2.1963	-103.5622
6.518	69.88	42.4843	455.4778
3.518	72.88	12.3763	256.3918
-5.482	74.88	30.0523	-410.4922
-3.482	75.88	12.1243	-264.2142
5.518	77.88	30.4483	429.7418
4.518	81.88	20.4123	369.9338
0.518	82.88	0.2683	42.9318
-0.482	86.88	0.2323	-41.8762
3.518	87.88	12.3763	309.1618
-2.482	92.88	6.1603	-230.5282
-5.482	96.88	30.0523	-531.0962
-4.482	98.88	20.0883	-443.1802
11.518	98.88	132.6643	1138.8998
17.518	100.88	306.8803	1767.2158
1.518	100.88	2.3043	153.1358
-7.482	103.88	55.9803	-777.2302
1.518	117.88	2.3043	178.9418
17.518	122.88	306.8803	2152.6118
16.518	124.88	272.8443	2062.7678
-7.482	126.88	55.9803	-949.3162
1.518	129.88	2.3043	197.1578
-3.482	142.88	12.1243	-497.5082
-3.482	150.88	12.1243	-525.3642
16.518	154.88	272.8443	2558.3078
1.518	163.88	2.3043	248.7698
-0.482	165.88	0.2323	-79.9542
13.518	165.88	182.7363	2242.3658
5.518	174.88	30.4483	964.9878
17.518	177.88	306.8803	3116.1018
11.518	180.88	132.6643	2083.3758
10.518	191.88	110.6283	2018.1938
-1.482	196.88	2.1963	-291.7762
10.518	196.88	110.6283	2070.7838
14.518	197.88	210.7723	2872.8218
-6.482	207.88	42.0163	-1347.4782
5.518	208.88	30.4483	1152.5998
-3.482	216.88	12.1243	-755.1762
4.518	217.88	20.4123	984.3818
10.518	228.88	110.6283	2407.3598
2.518	234.88	6.3403	591.4278
39.518	241.88	1561.6723	9558.6138
56.518	243.88	3194.2843	13783.6098
-6.482	245.88	42.0163	-1593.7942
-3.482	257.88	12.1243	-897.9382
-1.482	259.88	2.1963	-385.1422
-1.482	277.88	2.1963	-411.8182
2.518	281.88	6.3403	709.7738
12.518	292.88	156.7003	3666.2718
48.518	302.88	2353.9963	14695.1318
37.518	315.88	1407.6003	11851.1858
9.518	337.88	90.5923	3215.9418
0.518	344.88	0.2683	178.6478
1.518	359.88	2.3043	546.2978

14.518	374.88	210.7723	5442.5078
9.518	374.88	90.5923	3568.1078
-0.482	383.88	0.2323	-185.0302
-5.482	386.88	30.0523	-2120.8762
95.518	392.88	9123.6883	37527.1118
28.518	409.88	813.2763	11688.9578
-1.482	411.88	2.1963	-610.4062
-0.482	420.88	0.2323	-202.8642
8.518	478.88	72.5563	4079.0998
7.518	500.88	56.5203	3765.6158
-1.482	517.88	2.1963	-767.4982
2.518	558.88	6.3403	1407.2598
12.518	574.88	156.7003	7196.3478
1.518	605.88	2.3043	919.7258
2.518	610.88	6.3403	1538.1958
-1.482	668.88	2.1963	-991.2802
-3.482	718.88	12.1243	-2503.1402
29.518	735.88	871.3123	21721.7058
52.518	796.88	2758.1403	41850.5438
34.518	923.88	1191.4923	31890.4898
21.518	961.88	463.0243	20697.7338
25.518	1077.88	651.1683	27505.3418
12.518	1226.88	156.7003	15358.0838
18.518	1413.88	342.9163	26182.2298
50.518	1564.88	2552.0683	79054.6078
37.518	1593.88	1407.6003	59799.1898
138.518	1660.88	19187.2363	230061.7758
136.518	1761.88	18637.1643	240528.3338
43.518	1964.88	1893.8163	85507.6478
364.518	6121.88	132873.3723	2231535.4538
0	0	**223866.838** (SS_x)	**3476026.08** (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

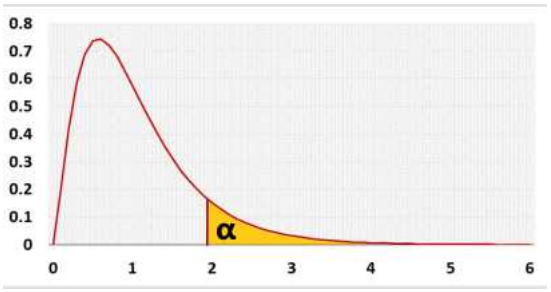
H_0: $Y = b_0$

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(0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,1,0,1,0,1,0,0,0,3,1,0,0,0,6,0,0,0,2,0,1,0,6,0,2,2,3,0,7,1,2,2,0,1,3,4,1,1,0,0,0,0,0,4,1,0,2,7,0,1,2,3,0,3,2,0,2,1,4,0,3,7,0,41,0,1,1,1,2,1,0,0,0,3,1,0,3,2,1,5,1,0,5,2,2,2
x11 <-
c(2,16,3,2,5,3,2,5,2,1,3,4,4,1,5,3,7,18,1,8,10,6,3,3,7,1,4,5,4,5,1,10,4,12,12,2,12,12,3,0,7,4,7,26,6,20,2,2,10,15,9,10,4,2,0,3,1,6,6,8,4,3,3,5,11,9,2,9,7,6,9,2,3,38,10,4,6,5,14,6,9,18,9,12,17,2,1,9,3,5,4,4,7,20,0,5,30,6,6
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