Statistics Kingdom

Linear Regression Calculator

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

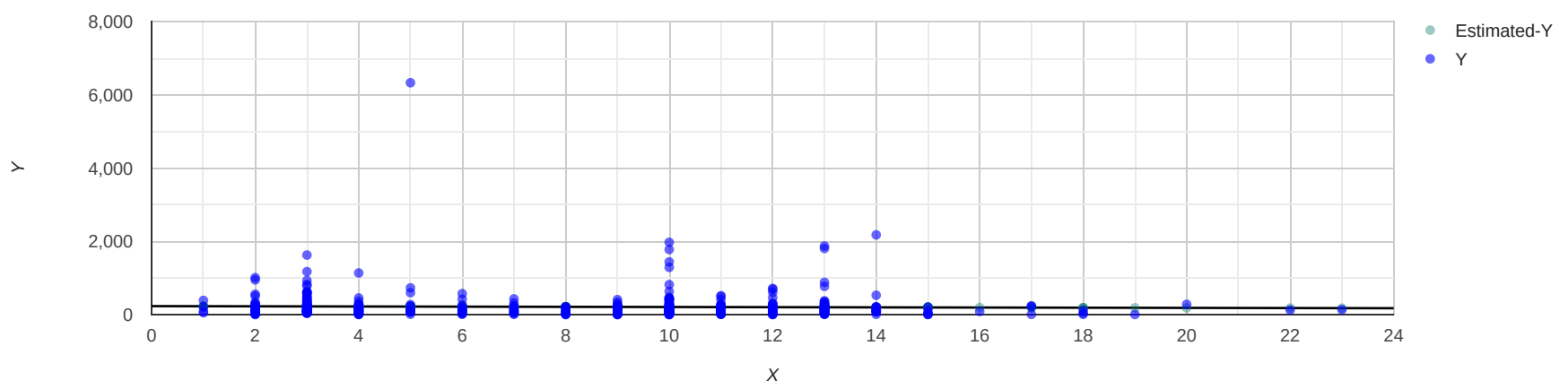
Regression line equation

$$\hat{Y} = 230.8312 - 2.3866X$$

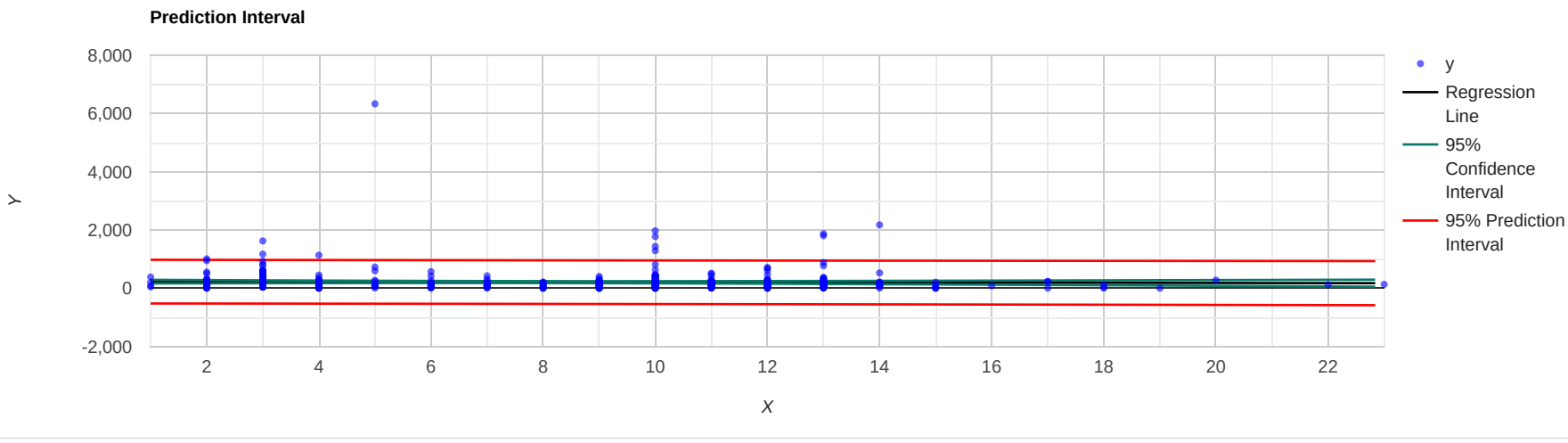
Reporting linear regression in APA style

R^2 = .00075, $F(1,498) = 0.37$, p = .541.
β = -2.39, p = .541, α = 230.83, p < .001.

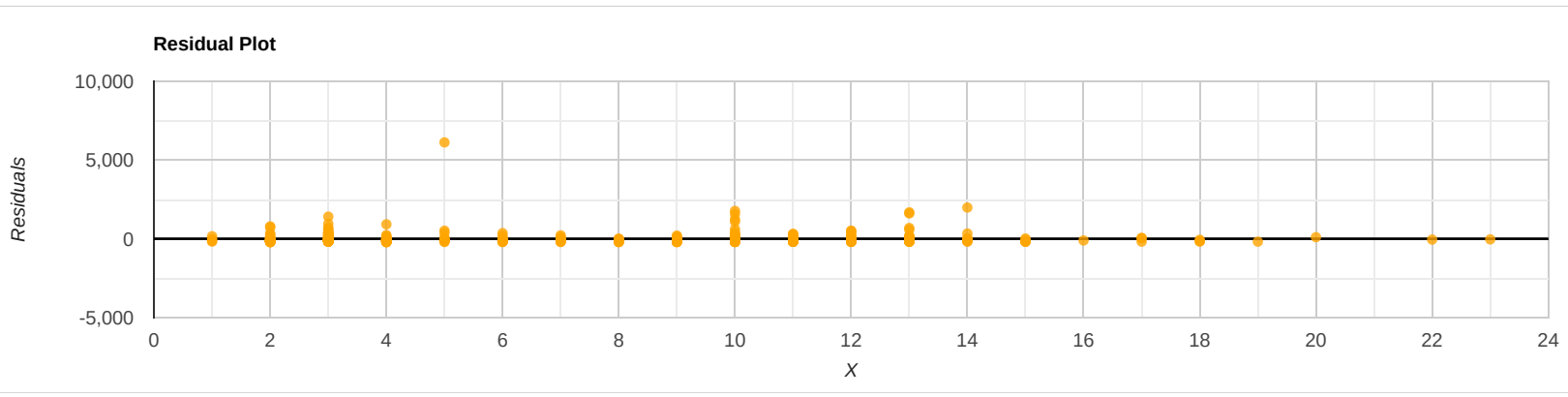
Line Fit Plot



Prediction online

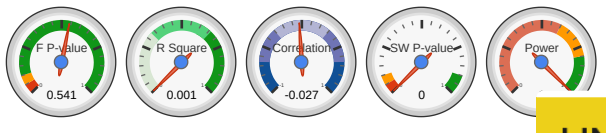


Residual Plot



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	54244.3891	54244.3891	0.3747 (1,498)	0.5407
Residual (between y_i and $\hat{y}_i$)	498	72089790.4109	144758.6153		
Total (between y_i and $\bar{y}$)	499	72144034.8	144577.224		

1. Y and X relationship

R-Squared (R^2) equals **0.0007519.** This means that 0.08% of the variability of Y is explained by X.
Correlation (R) equals **-0.02742**. This means that there is a **very weak inverse relationship** between X and Y.
The Standard deviation of the residuals (S_{res}) equals **380.4716**.
The slope: b_1=**-2.3866** CI[-10.0468, 5.2735] means that when you increase X by 1, the value of Y decreases by 2.3866.
The y-intercept: b_0=**230.8312** CI[162.0981, 299.5643] means that when X equals 0, the prediction of Y's value is 230.8312.
The x-intercept equals 96.7183.

2. Goodness of fit

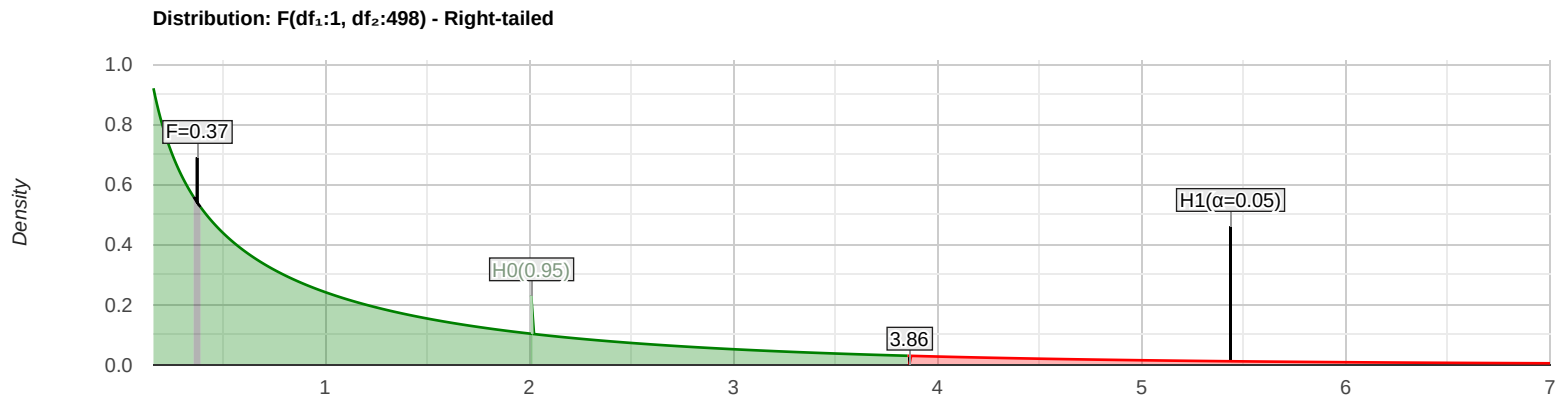
Overall regression: right-tailed, F(1,498) = **0.3747**, p-value = **0.5407**. Since p-value ≥ α (0.05), we accept H_0.
The linear regression model, $\mathbf{Y = b_0 + b_1X + \varepsilon}$, doesn't provide a better fit than the model without the independent variable resulting in $\mathbf{Y = b_0 + \varepsilon}$.
The slope (b_1): two-tailed, T(498)=**-0.6121**, p-value = **0.5407**. For one predictor it is the same as the p-value for the overall model.
The y-intercept (b_0): two-tailed, T(498) = **6.5983**, p-value = **1.066e-10**. 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

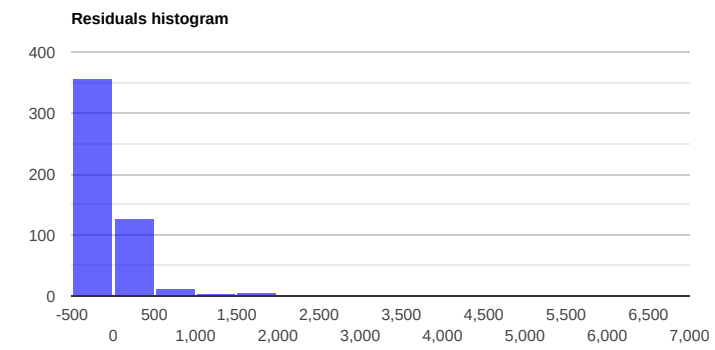
Outliers may affect the regression line.
In this case, the distribution of the residuals is normal. Therefore, the probability of detecting 8 valid outliers or more is 0.9999, (outliers: 1232.0351,1402.3287,1570.0351,1606.195,1673.195,1767.0351,1979.5817,6115.102).
You should only remove outliers if you identify them as errors!

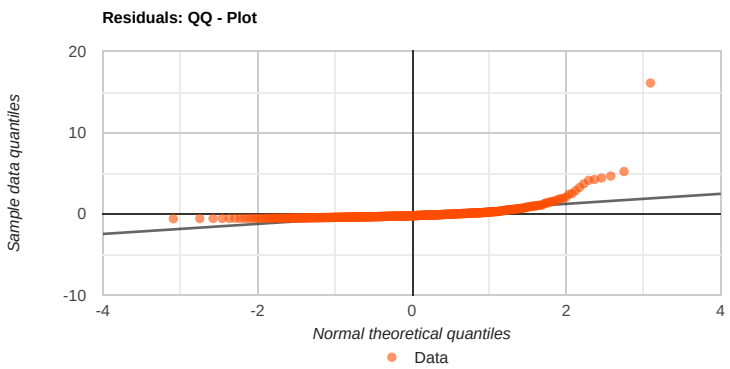


Significance level (α)

Annotations

Residuals normality





Calculation

Step-by-step solution

$\hat{Y} = b_0 + b_1X$

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

$b_1 = \frac{-22728.4}{9523.2} = -2.3866$

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

$\bar{x} = 7.84$

$\bar{y} = 212.12$

$b_0 = 212.12+2.3866*7.84 = 230.8312$

$R^2 = \frac{SS_{Regression}}{SS_{total}} = \frac{\Sigma(\hat{y}_i - \bar{y})^2}{\Sigma(y_i - \bar{y})^2} = \frac{54244.3891}{72144034.8} = 0.0007519$

The standard deviation of the residuals is:

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

Residual outliers

$S_{res} = \sqrt{MSE} = \sqrt{144758.6153} = 380.4716$.

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 $\pm 3*380.4716 = \pm 1141.4147$.

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

SS_x and SP_{xy}

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

2.16	-212.12	4.6656	-458.1792
-5.84	-212.12	34.1056	1238.7808
1.16	-212.12	1.3456	-246.0592
0.16	-212.12	0.0256	-33.9392
2.16	-212.12	4.6656	-458.1792
-3.84	-212.12	14.7456	814.5408
1.16	-210.12	1.3456	-243.7392
11.16	-210.12	124.5456	-2344.9392
7.16	-210.12	51.2656	-1504.4592
4.16	-209.12	17.3056	-869.9392
7.16	-209.12	51.2656	-1497.2992
0.16	-208.12	0.0256	-33.2992
4.16	-208.12	17.3056	-865.7792
5.16	-207.12	26.6256	-1068.7392
9.16	-207.12	83.9056	-1897.2192
4.16	-206.12	17.3056	-857.4592
-0.84	-206.12	0.7056	173.1408
6.16	-206.12	37.9456	-1269.6992
3.16	-205.12	9.9856	-648.1792
-1.84	-205.12	3.3856	377.4208
10.16	-205.12	103.2256	-2084.0192
-3.84	-205.12	14.7456	787.6608
2.16	-204.12	4.6656	-440.8992
2.16	-203.12	4.6656	-438.7392
-2.84	-203.12	8.0656	576.8608
5.16	-202.12	26.6256	-1042.9392
3.16	-202.12	9.9856	-638.6992
1.16	-202.12	1.3456	-234.4592
1.16	-202.12	1.3456	-234.4592
0.16	-200.12	0.0256	-32.0192
-5.84	-198.12	34.1056	1157.0208
3.16	-197.12	9.9856	-622.8992
-3.84	-197.12	14.7456	756.9408
-3.84	-195.12	14.7456	749.2608
5.16	-195.12	26.6256	-1006.8192
2.16	-195.12	4.6656	-421.4592
7.16	-195.12	51.2656	-1397.0592
2.16	-194.12	4.6656	-419.2992
2.16	-194.12	4.6656	-419.2992
3.16	-194.12	9.9856	-613.4192
-1.84	-191.12	3.3856	351.6608
3.16	-188.12	9.9856	-594.4592
-0.84	-187.12	0.7056	157.1808
5.16	-187.12	26.6256	-965.5392
-3.84	-184.12	14.7456	707.0208
4.16	-184.12	17.3056	-765.9392
1.16	-183.12	1.3456	-212.4192
-3.84	-182.12	14.7456	699.3408
-5.84	-180.12	34.1056	1051.9008
1.16	-180.12	1.3456	-208.9392
2.16	-178.12	4.6656	-384.7392
-1.84	-178.12	3.3856	327.7408
7.16	-178.12	51.2656	-1275.3392
3.16	-177.12	9.9856	-559.6992
2.16	-176.12	4.6656	-380.4192
2.16	-176.12	4.6656	-380.4192
4.16	-174.12	17.3056	-724.3392
-5.84	-174.12	34.1056	1016.8608
10.16	-174.12	103.2256	-1769.0592
2.16	-173.12	4.6656	-373.9392
-4.84	-173.12	23.4256	837.9008
0.16	-173.12	0.0256	-27.6992
-3.84	-173.12	14.7456	664.7808
2.16	-173.12	4.6656	-373.9392
-4.84	-173.12	23.4256	837.9008
0.16	-172.12	0.0256	-27.5392
3.16	-171.12	9.9856	-540.7392
3.16	-170.12	9.9856	-537.5792
4.16	-170.12	17.3056	-707.6992
5.16	-168.12	26.6256	-867.4992
-3.84	-168.12	14.7456	645.5808
1.16	-167.12	1.3456	-193.8592
-4.84	-167.12	23.4256	808.8608
-4.84	-166.12	23.4256	804.0208
2.16	-164.12	4.6656	-354.4992
4.16	-163.12	17.3056	-678.5792
-1.84	-163.12	3.3856	300.1408
-6.84	-162.12	46.7856	1108.9008
-4.84	-159.12	23.4256	770.1408
-4.84	-159.12	23.4256	770.1408
1.16	-159.12	1.3456	-184.5792
-3.84	-159.12	14.7456	611.0208
-4.84	-158.12	23.4256	765.3008
3.16	-158.12	9.9856	-499.6592
-5.84	-158.12	34.1056	923.4208
3.16	-157.12	9.9856	-496.4992
5.16	-157.12	26.6256	-810.7392
-0.84	-156.12	0.7056	131.1408
-4.84	-156.12	23.4256	755.6208
4.16	-155.12	17.3056	-645.2992
3.16	-154.12	9.9856	-487.0192
1.16	-154.12	1.3456	-178.7792
1.16	-154.12	1.3456	-178.7792

-4.84	-153.12	23.4256	741.1008
5.16	-153.12	26.6256	-790.0992
5.16	-152.12	26.6256	-784.9392
4.16	-152.12	17.3056	-632.8192
5.16	-151.12	26.6256	-779.7792
-5.84	-150.12	34.1056	876.7008
-5.84	-149.12	34.1056	870.8608
5.16	-149.12	26.6256	-769.4592
-4.84	-148.12	23.4256	716.9008
-4.84	-147.12	23.4256	712.0608
-4.84	-147.12	23.4256	712.0608
-4.84	-146.12	23.4256	707.2208
-5.84	-146.12	34.1056	853.3408
-5.84	-146.12	34.1056	853.3408
2.16	-145.12	4.6656	-313.4592
3.16	-145.12	9.9856	-458.5792
-5.84	-145.12	34.1056	847.5008
1.16	-145.12	1.3456	-168.3392
-2.84	-145.12	8.0656	412.1408
-5.84	-144.12	34.1056	841.6608
3.16	-144.12	9.9856	-455.4192
-2.84	-144.12	8.0656	409.3008
-1.84	-144.12	3.3856	265.1808
2.16	-143.12	4.6656	-309.1392
5.16	-143.12	26.6256	-738.4992
3.16	-142.12	9.9856	-449.0992
-0.84	-142.12	0.7056	119.3808
-3.84	-142.12	14.7456	545.7408
-5.84	-142.12	34.1056	829.9808
-4.84	-141.12	23.4256	683.0208
-4.84	-141.12	23.4256	683.0208
6.16	-141.12	37.9456	-869.2992
5.16	-141.12	26.6256	-728.1792
3.16	-140.12	9.9856	-442.7792
2.16	-140.12	4.6656	-302.6592
-4.84	-140.12	23.4256	678.1808
5.16	-140.12	26.6256	-723.0192
0.16	-139.12	0.0256	-22.2592
2.16	-139.12	4.6656	-300.4992
1.16	-139.12	1.3456	-161.3792
4.16	-138.12	17.3056	-574.5792
-4.84	-137.12	23.4256	663.6608
-4.84	-137.12	23.4256	663.6608
3.16	-137.12	9.9856	-433.2992
4.16	-137.12	17.3056	-570.4192
4.16	-137.12	17.3056	-570.4192
0.16	-137.12	0.0256	-21.9392
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2.16	-133.12	4.6656	-287.5392
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6.16	-129.12	37.9456	-795.3792
4.16	-129.12	17.3056	-537.1392
2.16	-128.12	4.6656	-276.7392
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8.16	-128.12	66.5856	-1045.4592
-5.84	-128.12	34.1056	748.2208
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4.16	-127.12	17.3056	-528.8192
-4.84	-127.12	23.4256	615.2608
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-4.84	-126.12	23.4256	610.4208
4.16	-126.12	17.3056	-524.6592
-4.84	-125.12	23.4256	605.5808
2.16	-125.12	4.6656	-270.2592
5.16	-125.12	26.6256	-645.6192
0.16	-124.12	0.0256	-19.8592
-3.84	-123.12	14.7456	472.7808
-5.84	-123.12	34.1056	719.0208
2.16	-122.12	4.6656	-263.7792
-4.84	-122.12	23.4256	591.0608
-4.84	-122.12	23.4256	591.0608
-4.84	-122.12	23.4256	591.0608
2.16	-122.12	4.6656	-263.7792
1.16	-121.12	1.3456	-140.4992
5.16	-121.12	26.6256	-624.9792
3.16	-120.12	9.9856	-379.5792
5.16	-119.12	26.6256	-614.6592
2.16	-118.12	4.6656	-255.1392
-3.84	-118.12	14.7456	453.5808
3.16	-118.12	9.9856	-373.2592
-4.84	-117.12	23.4256	566.8608
-3.84	-117.12	14.7456	449.7408
-4.84	-116.12	23.4256	562.0208
2.16	-116.12	4.6656	-250.8192
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2.16	-115.12	4.6656	-248.6592

-4.84	-115.12	23.4256	557.1808
6.16	-115.12	37.9456	-709.1392
1.16	-115.12	1.3456	-133.5392
-4.84	-115.12	23.4256	557.1808
-4.84	-114.12	23.4256	552.3408
2.16	-114.12	4.6656	-246.4992
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-4.84	-112.12	23.4256	542.6608
2.16	-112.12	4.6656	-242.1792
2.16	-112.12	4.6656	-242.1792
-0.84	-112.12	0.7056	94.1808
-4.84	-111.12	23.4256	537.8208
-4.84	-111.12	23.4256	537.8208
-1.84	-109.12	3.3856	200.7808
-5.84	-109.12	34.1056	637.2608
2.16	-108.12	4.6656	-233.5392
-4.84	-108.12	23.4256	523.3008
-4.84	-107.12	23.4256	518.4608
2.16	-106.12	4.6656	-229.2192
-4.84	-106.12	23.4256	513.6208
5.16	-106.12	26.6256	-547.5792
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-3.84	-105.12	14.7456	403.6608
2.16	-104.12	4.6656	-224.8992
-0.84	-104.12	0.7056	87.4608
7.16	-102.12	51.2656	-731.1792
3.16	-102.12	9.9856	-322.6992
-4.84	-99.12	23.4256	479.7408
3.16	-98.12	9.9856	-310.0592
2.16	-98.12	4.6656	-211.9392
5.16	-98.12	26.6256	-506.2992
3.16	-98.12	9.9856	-310.0592
4.16	-97.12	17.3056	-404.0192
-5.84	-97.12	34.1056	567.1808
-4.84	-97.12	23.4256	470.0608
-5.84	-97.12	34.1056	567.1808
-4.84	-95.12	23.4256	460.3808
-5.84	-95.12	34.1056	555.5008
-3.84	-95.12	14.7456	365.2608
3.16	-95.12	9.9856	-300.5792
6.16	-95.12	37.9456	-585.9392
-1.84	-94.12	3.3856	173.1808
5.16	-94.12	26.6256	-485.6592
6.16	-94.12	37.9456	-579.7792
2.16	-94.12	4.6656	-203.2992
-4.84	-93.12	23.4256	450.7008
-4.84	-93.12	23.4256	450.7008
-4.84	-93.12	23.4256	450.7008
-3.84	-93.12	14.7456	357.5808
-2.84	-92.12	8.0656	261.6208
10.16	-92.12	103.2256	-935.9392
2.16	-91.12	4.6656	-196.8192
-5.84	-91.12	34.1056	532.1408
6.16	-91.12	37.9456	-561.2992
-2.84	-91.12	8.0656	258.7808
2.16	-90.12	4.6656	-194.6592
1.16	-90.12	1.3456	-104.5392
-4.84	-90.12	23.4256	436.1808
-2.84	-90.12	8.0656	255.9408
3.16	-89.12	9.9856	-281.6192
-4.84	-88.12	23.4256	426.5008
1.16	-87.12	1.3456	-101.0592
14.16	-87.12	200.5056	-1233.6192
4.16	-87.12	17.3056	-362.4192
3.16	-86.12	9.9856	-272.1392
2.16	-86.12	4.6656	-186.0192
2.16	-86.12	4.6656	-186.0192
5.16	-86.12	26.6256	-444.3792
-3.84	-85.12	14.7456	326.8608
-5.84	-84.12	34.1056	491.2608
4.16	-84.12	17.3056	-349.9392
1.16	-83.12	1.3456	-96.4192
5.16	-82.12	26.6256	-423.7392
5.16	-81.12	26.6256	-418.5792
-4.84	-80.12	23.4256	387.7808
-4.84	-80.12	23.4256	387.7808
2.16	-79.12	4.6656	-170.8992
-2.84	-78.12	8.0656	221.8608
15.16	-77.12	229.8256	-1169.1392
-4.84	-77.12	23.4256	373.2608
5.16	-76.12	26.6256	-392.7792
3.16	-76.12	9.9856	-240.5392
-5.84	-75.12	34.1056	438.7008
3.16	-75.12	9.9856	-237.3792
5.16	-74.12	26.6256	-382.4592
-3.84	-73.12	14.7456	280.7808
2.16	-73.12	4.6656	-157.9392
2.16	-70.12	4.6656	-151.4592
3.16	-70.12	9.9856	-221.5792
-0.84	-69.12	0.7056	58.0608
5.16	-69.12	26.6256	-356.6592
3.16	-68.12	9.9856	-215.2592

-3.84	-64.12	14.7456	246.2208
1.16	-64.12	1.3456	-74.3792
5.16	-64.12	26.6256	-330.8592
-3.84	-63.12	14.7456	242.3808
2.16	-63.12	4.6656	-136.3392
-4.84	-60.12	23.4256	290.9808
4.16	-60.12	17.3056	-250.0992
-4.84	-60.12	23.4256	290.9808
-4.84	-58.12	23.4256	281.3008
4.16	-57.12	17.3056	-237.6192
0.16	-55.12	0.0256	-8.8192
1.16	-54.12	1.3456	-62.7792
-4.84	-52.12	23.4256	252.2608
-1.84	-52.12	3.3856	95.9008
-5.84	-50.12	34.1056	292.7008
-5.84	-50.12	34.1056	292.7008
2.16	-50.12	4.6656	-108.2592
2.16	-50.12	4.6656	-108.2592
-4.84	-49.12	23.4256	237.7408
3.16	-49.12	9.9856	-155.2192
5.16	-49.12	26.6256	-253.4592
-4.84	-49.12	23.4256	237.7408
2.16	-48.12	4.6656	-103.9392
2.16	-48.12	4.6656	-103.9392
-1.84	-47.12	3.3856	86.7008
5.16	-47.12	26.6256	-243.1392
-4.84	-46.12	23.4256	223.2208
-0.84	-46.12	0.7056	38.7408
5.16	-45.12	26.6256	-232.8192
5.16	-44.12	26.6256	-227.6592
-4.84	-42.12	23.4256	203.8608
4.16	-41.12	17.3056	-171.0592
-4.84	-40.12	23.4256	194.1808
-1.84	-40.12	3.3856	73.8208
-4.84	-39.12	23.4256	189.3408
3.16	-38.12	9.9856	-120.4592
6.16	-38.12	37.9456	-234.8192
-5.84	-36.12	34.1056	210.9408
2.16	-36.12	4.6656	-78.0192
-1.84	-34.12	3.3856	62.7808
-3.84	-33.12	14.7456	127.1808
5.16	-33.12	26.6256	-170.8992
-3.84	-32.12	14.7456	123.3408
-5.84	-32.12	34.1056	187.5808
-3.84	-30.12	14.7456	115.6608
-0.84	-29.12	0.7056	24.4608
-4.84	-28.12	23.4256	136.1008
2.16	-27.12	4.6656	-58.5792
1.16	-26.12	1.3456	-30.2992
3.16	-26.12	9.9856	-82.5392
5.16	-24.12	26.6256	-124.4592
5.16	-24.12	26.6256	-124.4592
0.16	-24.12	0.0256	-3.8592
2.16	-23.12	4.6656	-49.9392
-5.84	-23.12	34.1056	135.0208
0.16	-22.12	0.0256	-3.5392
1.16	-22.12	1.3456	-25.6592
-4.84	-20.12	23.4256	97.3808
2.16	-19.12	4.6656	-41.2992
2.16	-18.12	4.6656	-39.1392
-4.84	-18.12	23.4256	87.7008
-4.84	-17.12	23.4256	82.8608
3.16	-13.12	9.9856	-41.4592
-3.84	-13.12	14.7456	50.3808
3.16	-12.12	9.9856	-38.2992
-4.84	-12.12	23.4256	58.6608
2.16	-10.12	4.6656	-21.8592
-4.84	-10.12	23.4256	48.9808
5.16	-10.12	26.6256	-52.2192
-6.84	-9.12	46.7856	62.3808
5.16	-9.12	26.6256	-47.0592
-4.84	-8.12	23.4256	39.3008
-4.84	-8.12	23.4256	39.3008
6.16	-4.12	37.9456	-25.3792
7.16	-2.12	51.2656	-15.1792
-4.84	-1.12	23.4256	5.4208
2.16	-0.12	4.6656	-0.2592
6.16	-0.12	37.9456	-0.7392
3.16	1.88	9.9856	5.9408
1.16	4.88	1.3456	5.6608
0.16	4.88	0.0256	0.7808
5.16	4.88	26.6256	25.1808
1.16	5.88	1.3456	6.8208
-3.84	5.88	14.7456	-22.5792
3.16	7.88	9.9856	24.9008
3.16	9.88	9.9856	31.2208
-4.84	11.88	23.4256	-57.4992
-3.84	12.88	14.7456	-49.4592
5.16	12.88	26.6256	66.4608
5.16	13.88	26.6256	71.6208
2.16	13.88	4.6656	29.9808
2.16	15.88	4.6656	34.3008
-5.84	15.88	34.1056	-92.7392
9.16	17.88	83.9056	163.7808

1.16	19.88	1.3456	23.0608
3.16	19.88	9.9856	62.8208
-5.84	20.88	34.1056	-121.9392
3.16	21.88	9.9856	69.1408
5.16	21.88	26.6256	112.9008
-2.84	22.88	8.0656	-64.9792
5.16	23.88	26.6256	123.2208
9.16	24.88	83.9056	227.9008
-3.84	25.88	14.7456	-99.3792
-5.84	25.88	34.1056	-151.1392
-4.84	25.88	23.4256	-125.2592
1.16	29.88	1.3456	34.6608
-4.84	29.88	23.4256	-144.6192
-4.84	30.88	23.4256	-149.4592
2.16	30.88	4.6656	66.7008
-4.84	32.88	23.4256	-159.1392
-0.84	36.88	0.7056	-30.9792
4.16	38.88	17.3056	161.7408
2.16	39.88	4.6656	86.1408
-4.84	39.88	23.4256	-193.0192
2.16	39.88	4.6656	86.1408
-3.84	41.88	14.7456	-160.8192
-4.84	42.88	23.4256	-207.5392
-5.84	44.88	34.1056	-262.0992
3.16	49.88	9.9856	157.6208
-1.84	50.88	3.3856	-93.6192
-4.84	51.88	23.4256	-251.0992
2.16	52.88	4.6656	114.2208
5.16	53.88	26.6256	278.0208
1.16	56.88	1.3456	65.9808
2.16	56.88	4.6656	122.8608
-4.84	58.88	23.4256	-284.9792
-5.84	58.88	34.1056	-343.8592
4.16	58.88	17.3056	244.9408
5.16	58.88	26.6256	303.8208
3.16	60.88	9.9856	192.3808
-2.84	61.88	8.0656	-175.7392
3.16	63.88	9.9856	201.8608
-4.84	66.88	23.4256	-323.6992
12.16	67.88	147.8656	825.4208
-4.84	69.88	23.4256	-338.2192
-4.84	69.88	23.4256	-338.2192
1.16	72.88	1.3456	84.5408
2.16	74.88	4.6656	161.7408
-3.84	75.88	14.7456	-291.3792
5.16	77.88	26.6256	401.8608
-3.84	81.88	14.7456	-314.4192
5.16	82.88	26.6256	427.6608
-5.84	86.88	34.1056	-507.3792
4.16	87.88	17.3056	365.5808
4.16	92.88	17.3056	386.3808
-4.84	96.88	23.4256	-468.8992
2.16	98.88	4.6656	213.5808
5.16	98.88	26.6256	510.2208
2.16	100.88	4.6656	217.9008
5.16	100.88	26.6256	520.5408
-0.84	103.88	0.7056	-87.2592
2.16	117.88	4.6656	254.6208
-5.84	122.88	34.1056	-717.6192
-4.84	124.88	23.4256	-604.4192
1.16	126.88	1.3456	147.1808
-4.84	129.88	23.4256	-628.6192
5.16	142.88	26.6256	737.2608
-4.84	150.88	23.4256	-730.2592
-3.84	154.88	14.7456	-594.7392
5.16	163.88	26.6256	845.6208
-4.84	165.88	23.4256	-802.8592
2.16	165.88	4.6656	358.3008
-6.84	174.88	46.7856	-1196.1792
2.16	177.88	4.6656	384.2208
-4.84	180.88	23.4256	-875.4592
2.16	191.88	4.6656	414.4608
1.16	196.88	1.3456	228.3808
3.16	196.88	9.9856	622.1408
2.16	197.88	4.6656	427.4208
-1.84	207.88	3.3856	-382.4992
-4.84	208.88	23.4256	-1010.9792
-0.84	216.88	0.7056	-182.1792
2.16	217.88	4.6656	470.6208
2.16	228.88	4.6656	494.3808
2.16	234.88	4.6656	507.3408
-3.84	241.88	14.7456	-928.8192
-4.84	243.88	23.4256	-1180.3792
4.16	245.88	17.3056	1022.8608
-4.84	257.88	23.4256	-1248.1392
2.16	259.88	4.6656	561.3408
-4.84	277.88	23.4256	-1344.9392
3.16	281.88	9.9856	890.7408
-5.84	292.88	34.1056	-1710.4192
3.16	302.88	9.9856	957.1008
6.16	315.88	37.9456	1945.8208
-4.84	337.88	23.4256	-1635.3392
-5.84	344.88	34.1056	-2014.0992
-1.84	359.88	3.3856	-662.1792

-4.84	374.88	23.4256	-1814.4192
-4.84	374.88	23.4256	-1814.4192
-4.84	383.88	23.4256	-1857.9792
-2.84	386.88	8.0656	-1098.7392
4.16	392.88	17.3056	1634.3808
-4.84	409.88	23.4256	-1983.8192
-4.84	411.88	23.4256	-1993.4992
2.16	420.88	4.6656	909.1008
4.16	478.88	17.3056	1992.1408
4.16	500.88	17.3056	2083.6608
-2.84	517.88	8.0656	-1470.7792
5.16	558.88	26.6256	2883.8208
-4.84	574.88	23.4256	-2782.4192
2.16	605.88	4.6656	1308.7008
-4.84	610.88	23.4256	-2956.6592
5.16	668.88	26.6256	3451.4208
-4.84	718.88	23.4256	-3479.3792
-5.84	735.88	34.1056	-4297.5392
-5.84	796.88	34.1056	-4653.7792
-3.84	923.88	14.7456	-3547.6992
-4.84	961.88	23.4256	-4655.4992
2.16	1077.88	4.6656	2328.2208
2.16	1226.88	4.6656	2650.0608
-4.84	1413.88	23.4256	-6843.1792
2.16	1564.88	4.6656	3380.1408
5.16	1593.88	26.6256	8224.4208
5.16	1660.88	26.6256	8570.1408
2.16	1761.88	4.6656	3805.6608
6.16	1964.88	37.9456	12103.6608
-2.84	6121.88	8.0656	-17386.1392
0	0	**9523.2** (SS_x)	**-22728.4** (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

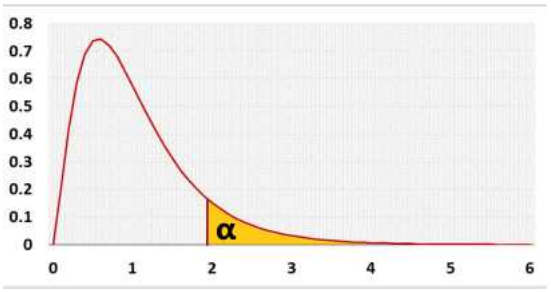
H_0: $Y = b_0$

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(10,2,9,8,10,4,9,19,15,12,15,8,12,13,17,12,7,14,11,6,18,4,10,10,5,13,11,9,9,8,2,2,11,4,4,13,10,15,10,10,11,6,11,7,13,4,12,9,4,2,9,10,6,15,11,10,10,12,2,18,10,3,8,4,10,3,8,11,11,12,13,4,9,3,3,10,12,6,1,3,3,9,4,3,11,
x11 <-
c(3,11,13,3,10,10,6,13,3,7,13,13,3,12,3,6,3,11,14,2,10,6,4,13,4,2,4,7,3,10,9,11,13,13,8,10,2,8,9,3,10,10,3,3,11,4,11,3,10,3,13,1,13,3,3,14,15,3,10,14,11,9,8,13,9,4,11,11,3,4,13,13,10,10,2,17,9,11,2,11,13,5,13,17,4,2,
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