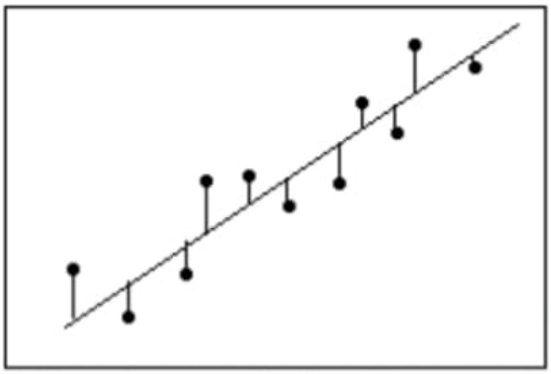
Regression Analysis Using R Square Method

Goodness-of-Fit for a Linear Regression Model



Definition: Residual = Observed value - Fitted value

Linear regression calculates an equation that minimizes the distance between the fitted line and all of the data points. Technically, ordinary least squares (OLS) regression minimizes the sum of the squared residuals.
In general, a model fits the data well if the differences between the observed values and the model's predicted values are small and unbiased.

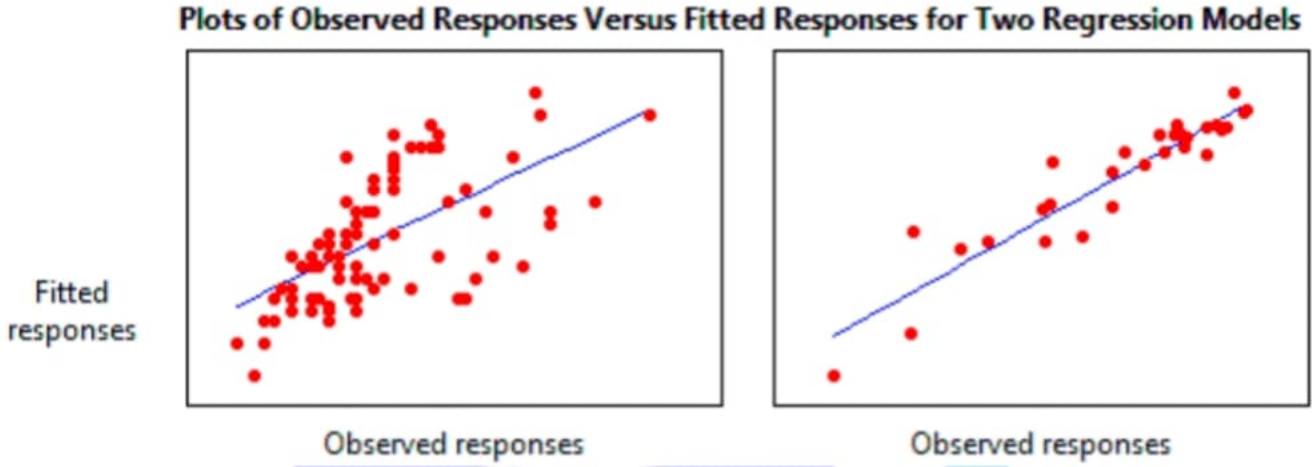
R-squared Method

R-squared is a statistical measure of how close the data are to the fitted regression line. It is also known as the coefficient of determination, or the coefficient of multiple determination for multiple regression.
The definition of R-squared is fairly straight-forward; it is the percentage of the response variable variation that is explained by a linear model. Or:
R-squared = Explained variation / Total variation
R-squared is always between 0 and 100%:

- 0% indicates that the model explains none of the variability of the response data around its mean.
- 100% indicates that the model explains all the variability of the response data around its mean.

Graphical Representation of R-squared

Plotting fitted values by observed values graphically illustrates different R-squared values for regression models.



The regression model on the left accounts for 38.0% of the variance while the one on the right accounts for 87.4%. The more variance that is accounted for by the regression model the closer the data points will fall to the fitted regression line. Theoretically, if a model could explain 100% of the variance, the fitted values would always equal the observed values and, therefore, all the data points would fall on the fitted regression line.

Low R-squared Values

There are two major reasons why it can be just fine to have low R-squared values.
In some fields, it is entirely expected that your R-squared values will be low. For example, any field that attempts to predict human behavior, such as psychology, typically has R-squared values lower than 50%. Humans are simply harder to predict than, say, physical processes.
Furthermore, if your R-squared value is low but you have statistically significant predictors, you can still draw important conclusions about how changes in the predictor values are associated with changes in the response value. Regardless of the R-squared, the significant coefficients still represent the mean change in the response for one unit of change in the predictor while holding other predictors in the model constant. Obviously, this type of information can be extremely valuable.

High R-squared Values

A high R-squared does not necessarily indicate that the model has a good fit. That might be a surprise, but look at the fitted line plot and residual plot below. The fitted line plot displays the relationship between semiconductor electron mobility and the natural log of the density for real experimental data.