What is the definition of the Breusch-Pagan Test and can you provide an example?

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The Breusch-Pagan Test is a statistical test used to assess the presence of heteroscedasticity (unequal variances) in a regression model. It measures the relationship between the squared residuals and the independent variables in the model. The null hypothesis of the test is that there is no heteroscedasticity present in the model. The test is commonly used in econometrics and can be applied to various types of regression models. For example, if we have a linear regression model that predicts housing prices based on square footage and location, we can use the Breusch-Pagan Test to determine if the variance of the errors (residuals) is constant across different locations. If the test results in a significant p-value, it indicates the presence of heteroscedasticity and the need for further investigation or a different modeling approach.

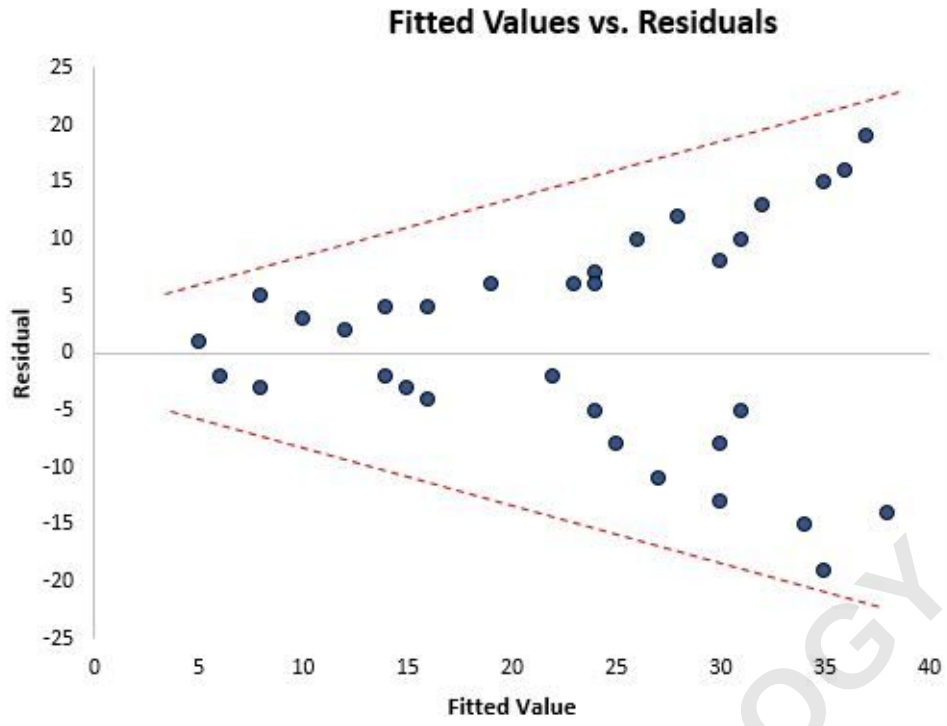
The Breusch-Pagan Test: Definition & Example

One of the key is that the are distributed with equal variance at each level of the predictor variable. This assumption is known as homoscedasticity.

When this assumption is violated, we say that is present in the residuals. When this occurs, the results of the regression become unreliable.

One way to visually detect whether heteroscedasticity is present is to create a plot of the residuals against the fitted values of the regression model.

If the residuals become more spread out at higher values in the plot, this is a tell-tale sign that heteroscedasticity is present.



A formal statistical test we can use to determine if heteroscedasticity is present is the Breusch-Pagan test.

This tutorial provides a brief explanation of the Breusch-Pagan test along with an example.

What is the Breusch-Pagan Test?

The Breusch-Pagan test is used to determine whether or not heteroscedasticity is present in a regression model.

The test uses the following null and alternative :

Null Hypothesis (H0): Homoscedasticity is present (the

residuals are distributed with equal variance)Alternative Hypothesis (HA): Heteroscedasticity is present (the residuals are not distributed with equal variance)

If the p-value of the test is less than some (i.e. α = .05) then we reject the null hypothesis and conclude that heteroscedasticity is present in the regression model.

We use the following steps to perform a Breusch-Pagan test:

1. Fit the regression model.

2. Calculate the squared residuals of the model.

3. Fit a new regression model, using the squared residuals as the response values.

4. Calculate the Chi-Square test statistic X2 as n*R2new where:

n: The total number of R2new: The R-squared of the new regression model that used the squared residuals as the response values

If the p-value that corresponds to this Chi-Square test

statistic with *p* (the number of predictors) degrees of freedom is less than some significance level (i.e. α = .05) then reject the null hypothesis and conclude that heteroscedasticity is present.

Otherwise, fail to reject the null hypothesis. In this case, it's assumed that homoscedasticity is present.

Note that most statistical software can easily perform the Breusch-Pagan test so you will likely never have to perform these steps by hand, but it's useful to know what's going on behind the scenes.

An Example of the Breusch-Pagan Test

Suppose we have the following dataset that contains information for 10 different basketball players:

rating	points	assists	rebounds
90	25	5	11
85	20	7	8
82	14	7	10
88	16	8	6
94	27	5	6
90	20	7	9
76	12	6	6
75	15	9	10
87	14	9	10
86	19	5	7

Using statistical software, we fit the following :

rating = 62.47 + 1.12*(points) + 0.88*(assists) - 0.43*(rebounds)

We then use this model to make predictions for the rating of each player and calculated the squared residuals (i.e. the squared difference between the predicted rating and the actual rating):

rating	points	assists	rebounds	predicted rating	squared residuals
90	25	5	11	90.17	0.03
85	20	7	8	87.62	6.86
82	14	7	10	80.05	3.81
88	16	8	6	84.88	9.73
94	27	5	6	94.54	0.30
90	20	7	9	87.19	7.88
76	12	6	6	78.64	6.96
75	15	9	10	82.93	62.96
87	14	9	10	81.82	26.88
86	19	5	7	85.16	0.70

Next, we fit a new regression model using the squared residuals as the response values and the original predictor variables as the predictor variables once again. We find the following:

n: 10R2new: 0.600395

Thus, our Chi-Square test statistic for the Breusch-Pagan test is n*R2new = 10*.600395 = 6.00395. The degrees of freedom is *p* = 3 predictor variables.

According to the , the p-value that corresponds to X2 = 6.00395 with 3 degrees of freedom is 0.111418.

Since this p-value is not less than .05, we fail to reject the null hypothesis. Thus, we assume that

homoscedasticity is present.

The Breusch-Pagan Test in Practice

The following tutorials provide step-by-step examples of how to perform the Breusch-Pagan test in different statistical programs: