

Residual Plots and Regression Diagnostics

Select a fixed residual pattern below to see its description and what it implies about your regression model's assumptions.



StatReason

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Residual pattern

Consistent with a correctly specified linear model and constant variance.

Visual description

Points scatter evenly above and below zero across the full range, with no visible trend or change in spread.

What it suggests

Consistent with a correctly specified linear model and constant variance.

Likely fix

No change needed based on this diagnostic.

Run this diagnostic on your own model: [Residual Diagnostics Calculator](#)

What this answers

This page answers "what does a residual plot's shape actually tell me about my model?" A residual plot shows the difference between each observed value and the model's prediction,

plotted against the predicted value or the predictor itself. Its shape reveals whether key regression assumptions hold, without requiring you to interpret a single summary statistic.

Four patterns and what they mean

Random scatter around zero, with no visible trend or changing spread, is the pattern a well-specified linear model should produce. A curved, U-shaped pattern suggests the true relationship is not linear and the model is systematically over- or under-predicting in different ranges. A funnel shape, where the spread of residuals widens or narrows across the range of predicted values, indicates unequal variance, which affects the reliability of standard errors and confidence intervals. A single point far removed from the rest on the predictor axis has high leverage and can disproportionately affect the fitted line, worth checking with Cook's distance directly.

Worked example

Select "Curved (U-shaped) pattern" above. The description shows residuals that are positive for both low and high predicted values but negative in the middle, the signature of a relationship that a straight line cannot capture. The suggested fix is adding a polynomial term or transforming a variable, not simply accepting the linear fit as final. Select "Funnel shape (widening spread)" instead and the fix changes entirely: rather than changing the functional form of the relationship, the model needs a variance-stabilizing transformation or a method that tolerates unequal variance, since the linear shape of the relationship may already be correct.

Assumption audit

Calculated from your data: the actual residual values and their pattern, once you fit your model using the linked engine.

Evidence to review: which of these four patterns, or a combination, most closely matches your own residual plot, since real data rarely matches a textbook example exactly.

You must verify: that any transformation or model change you make in response to a diagnostic pattern still answers your original research question.

Source

This comparison follows the residual-diagnostics guidance in the NIST/SEMATECH e-Handbook of Statistical Methods and the shared statistical reasoning contract every StatReason engine is built against.

Limitations

This page describes four common textbook patterns; real residual plots often show a mix of issues, and judging severity still requires comparing against the actual scale of your data.