

Confidence Interval vs Prediction Interval

Adjust the residual spread and sample size below to see how a confidence interval for the mean response and a prediction interval for one new observation respond differently to the same regression fit.



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Residual standard deviation

5 units

Sample size used to fit the line

20 observations

Prediction interval is 4.6 times wider than the confidence interval.

95% confidence interval half-width (mean response)	± 2.19
95% prediction interval half-width (one new point)	± 10.04
Prediction interval is wider by	4.6×

Need this on your own fitted model? [Regression Prediction Interval Calculator](#)

What this answers

This visual answers "why does a prediction interval always look wider than a confidence interval from the same regression line?" It holds the fitted line fixed and lets you change the residual spread and the sample size used to fit it, so you can see both intervals respond to the same inputs at once instead of reading two separate formulas.

Two different questions, two different intervals

A confidence interval for the mean response answers "where does the true average outcome fall for this predictor value?" A prediction interval answers a harder question: "where will one new individual observation fall?" A single new point carries the full residual variability of the model in addition to the uncertainty in estimating the line itself, which is why its interval is always at least as wide, and typically much wider, than the interval for the mean.

Worked example

With a residual standard deviation of 5 and 20 observations, the confidence interval for the mean response is narrow because averaging washes out individual scatter. The prediction interval for one new point stays wide because that single point still carries the full residual spread. Raise the sample size toward 200 and the confidence interval narrows further while the prediction interval barely moves, since more data pins down the line but does not reduce how scattered individual outcomes are around it.

Assumption audit

Calculated from your data: in this visual, the half-widths from your chosen residual spread and sample size at the predictor value used to fit the line; your own regression calculator computes this from your actual data and predictor value.

Evidence to review: a residual plot to confirm the constant-spread assumption both intervals rely on.

You must verify: that the new point you are predicting for falls within the range of predictor values used to fit the model; extrapolating beyond that range makes both intervals unreliable regardless of their calculated width.

Source

This distinction follows the standard regression-inference treatment in the NIST/SEMATECH e-Handbook of Statistical Methods and the shared statistical reasoning contract every StatReason engine is built against.

Limitations

This visual uses a fixed illustrative predictor value and a simplified formula relationship; it does not fit a model to your data. Use the linked calculators for an interval computed from your own observations.