Simple Linear Regression

Assessing Conditions

Dr. Maria Tackett

Topics

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- Identify the conditions for simple linear regression

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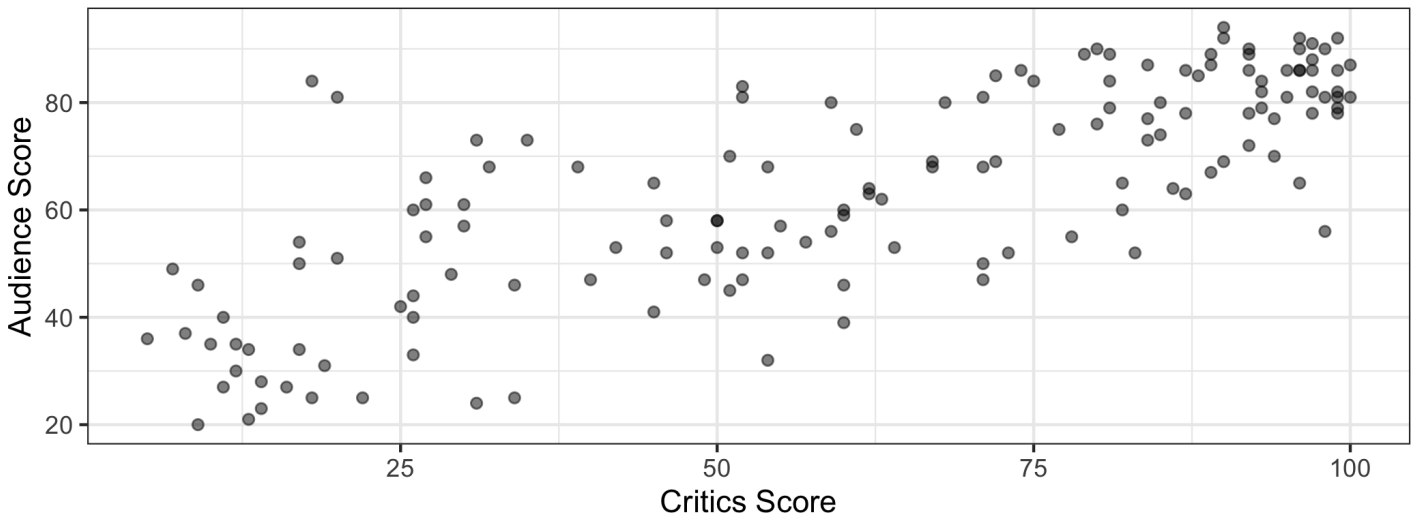
- Identify the conditions for simple linear regression
- Use plots of the residuals to assess the conditions.

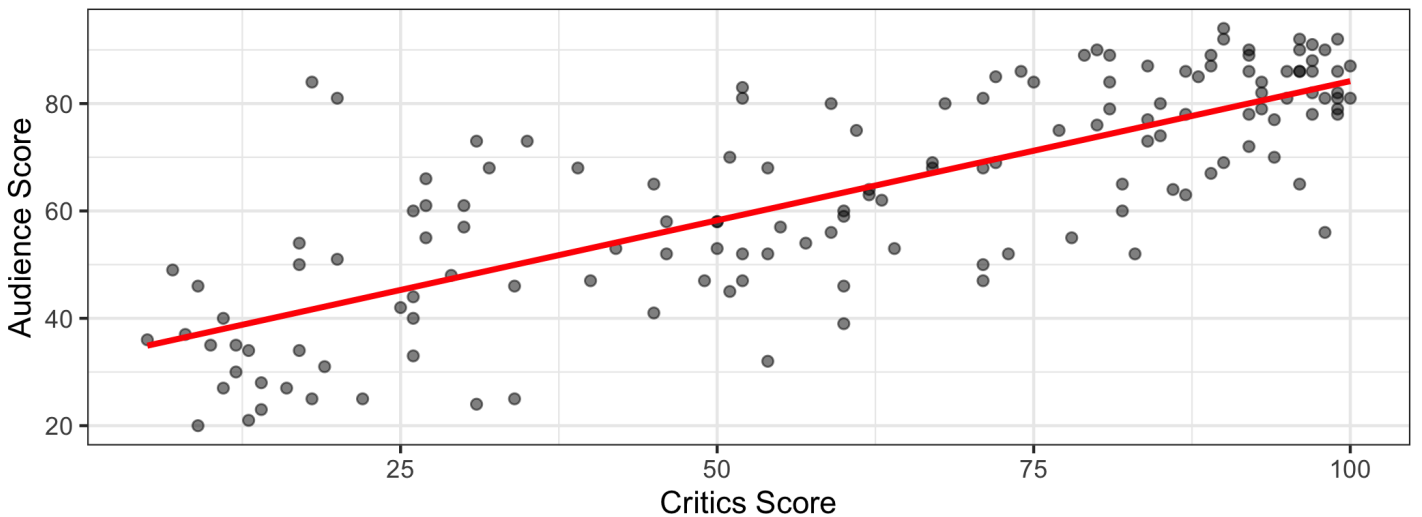
Movie ratings data

The data set contains the "Tomatometer" score (**`critics`**) and audience score (**`audience`**) for 146 movies rated on rottentomatoes.com.



We fit a line to describe the relationship between the critics score and audience score.

term	estimate	std.error	statistic	p.value
(Intercept)	32.316	2.343	13.795	0
critics	0.519	0.035	15.028	0



Model conditions

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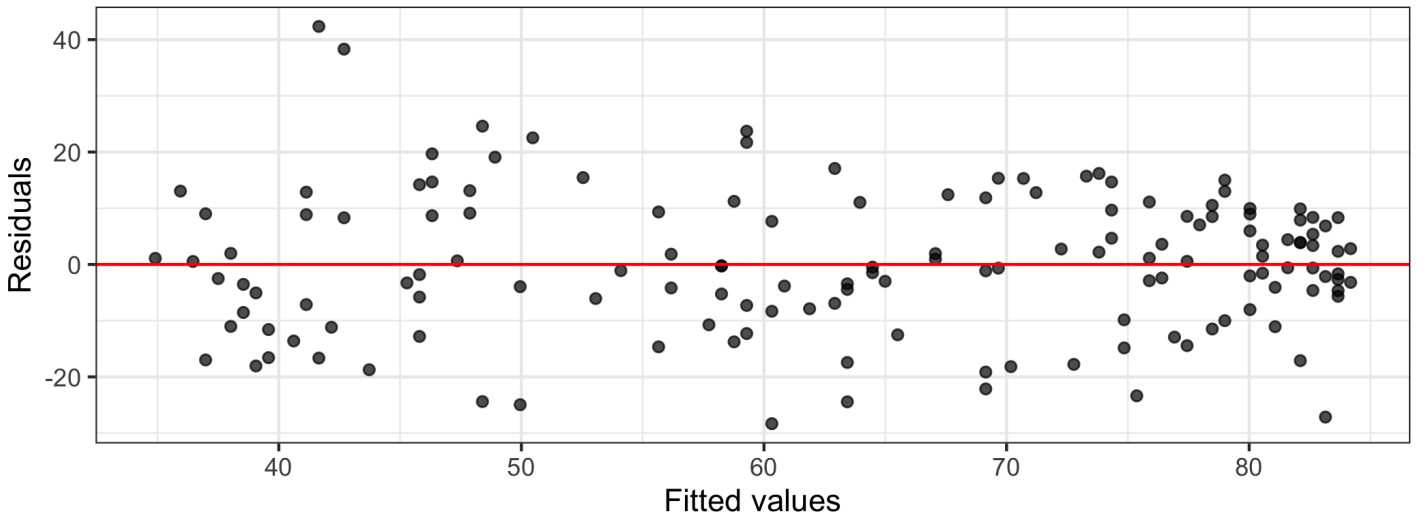
2. **Constant Variance:** The variability of the errors is equal for all values of the predictor variable.

3. **Normality:** The errors follow a normal distribution.

4. **Independence:** The errors are independent from one another.

$$\text{residual} = y - \hat{y}$$

Plot of residuals vs. fitted values



Assessing linearity

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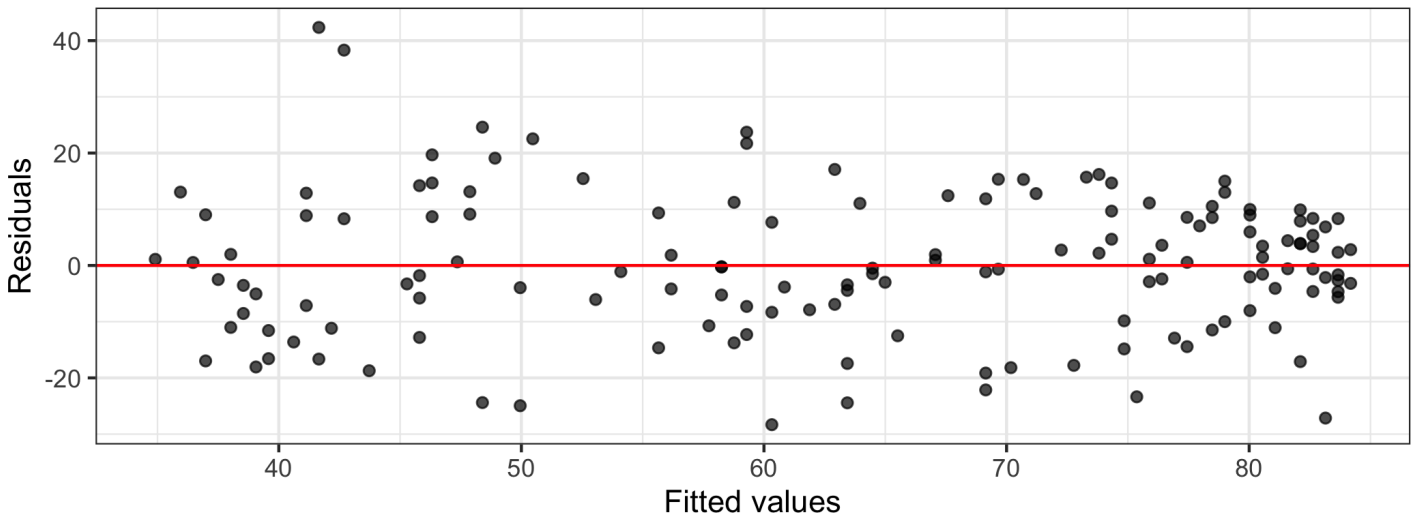

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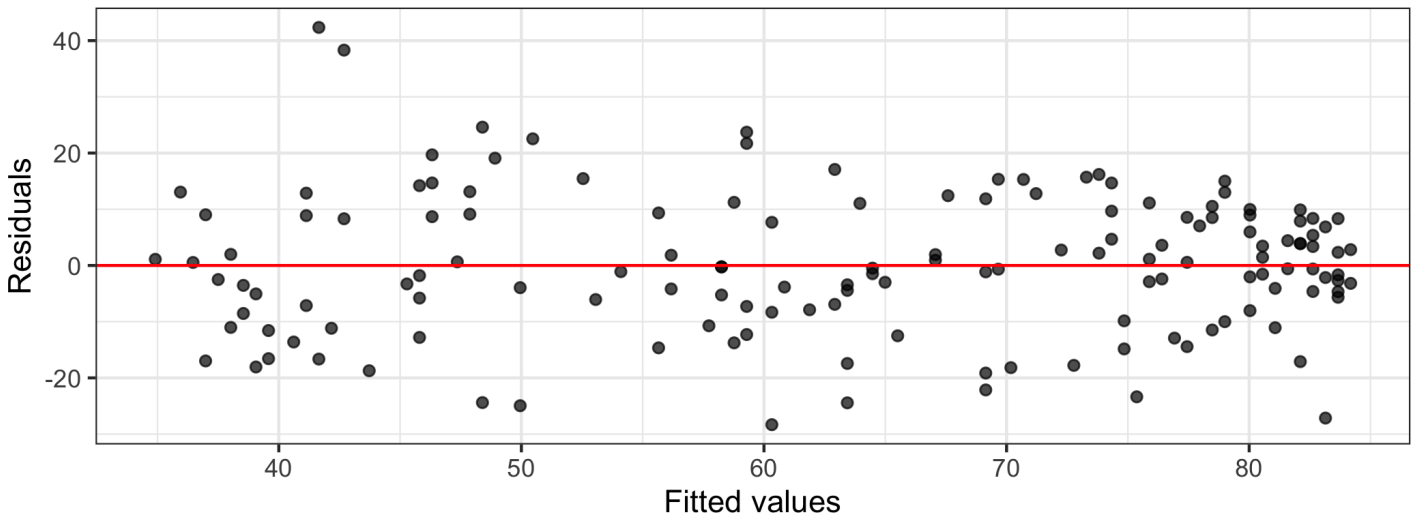

✅ There is no distinguishable pattern or structure. The residuals are randomly scattered.

Assessing constant variance

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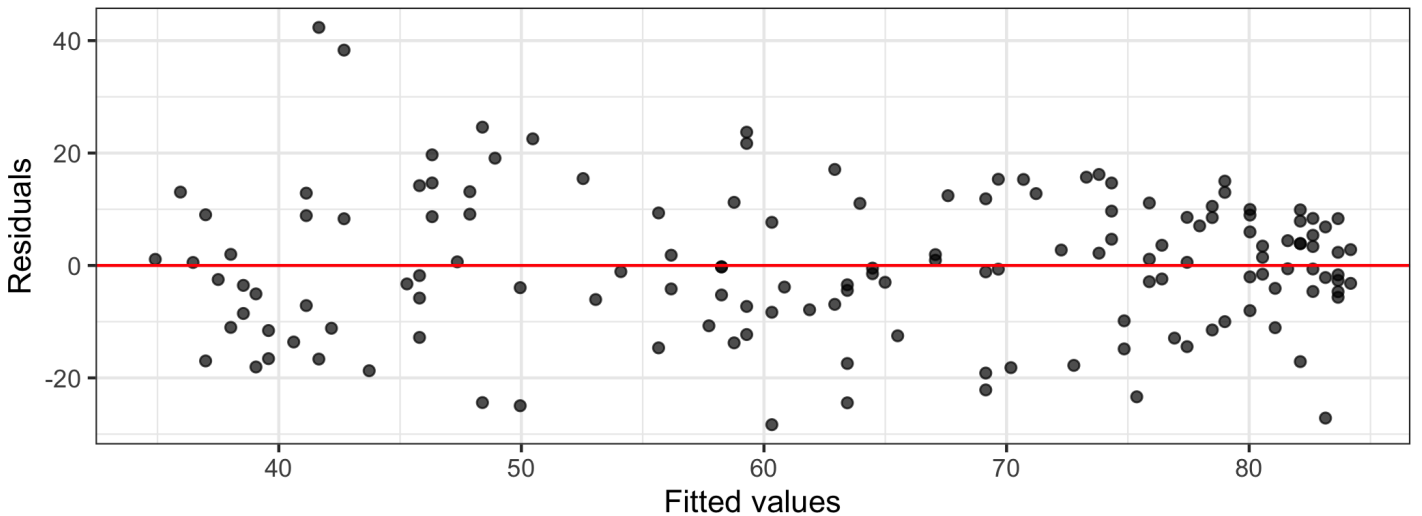
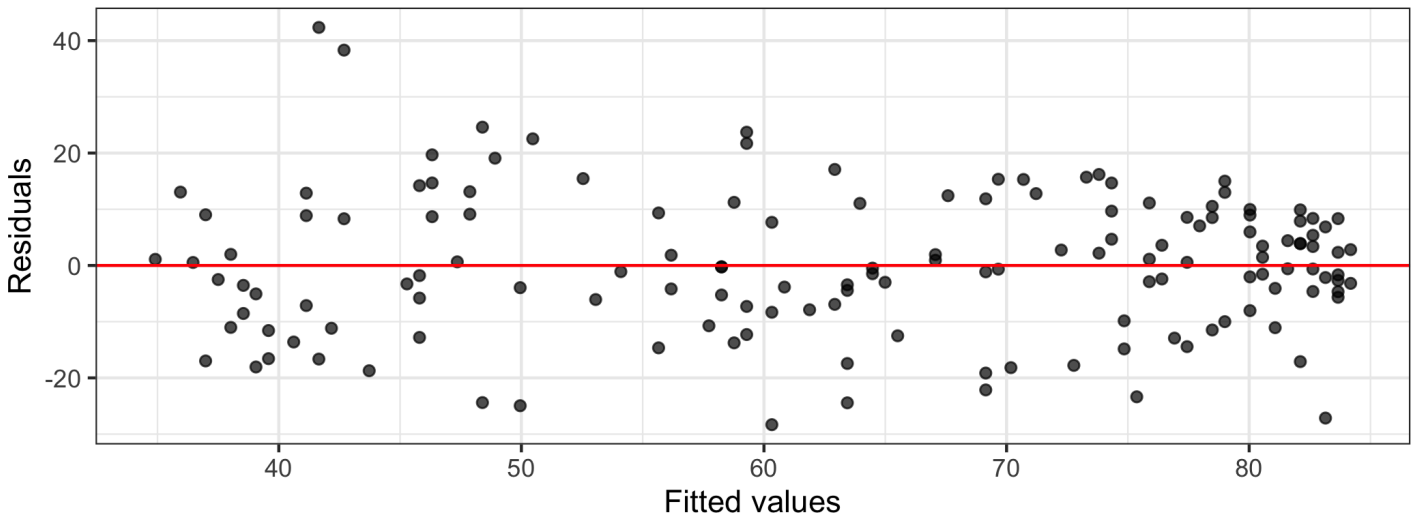


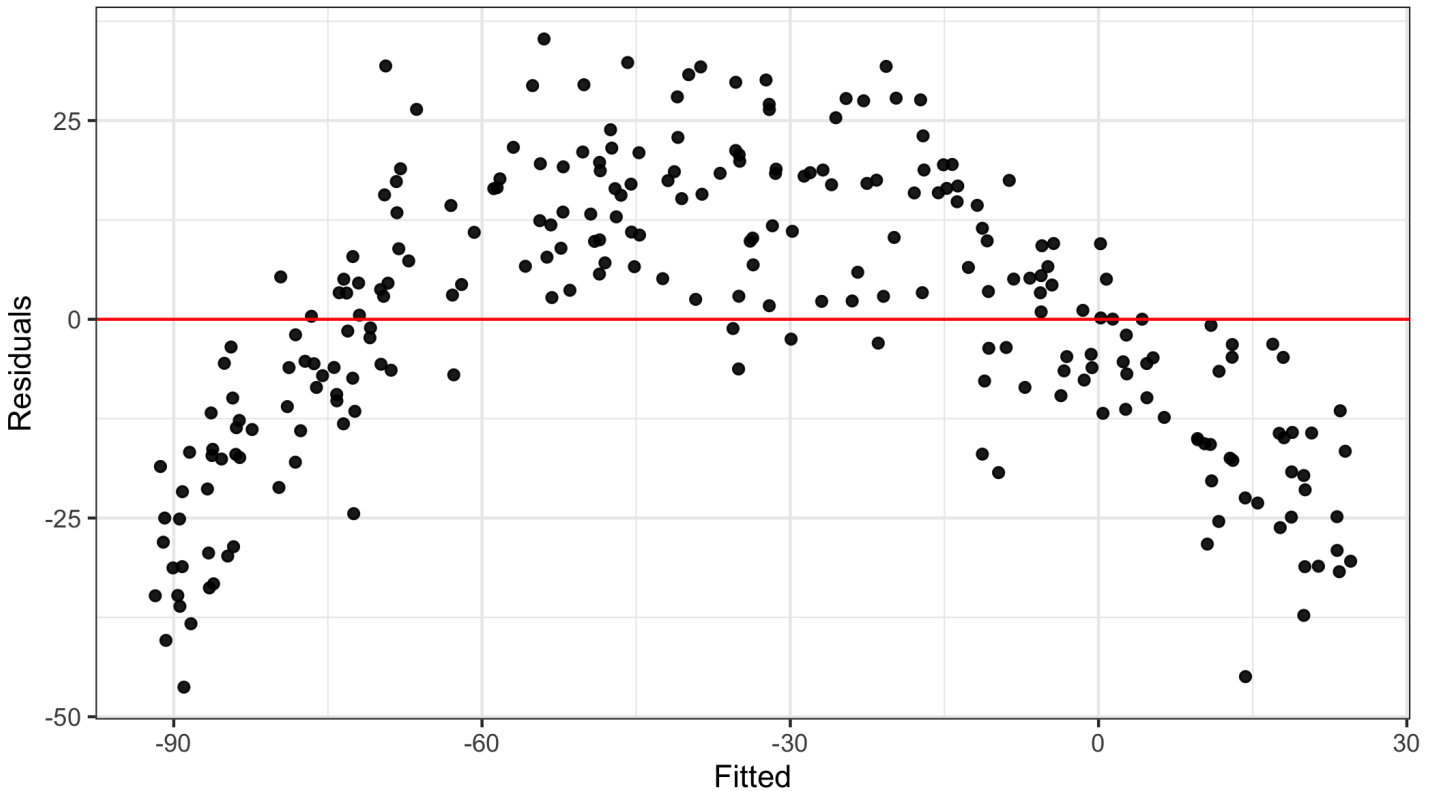
Assessing constant variance

Constant Variance: The variability of the errors is equal for all values of the predictor variable.

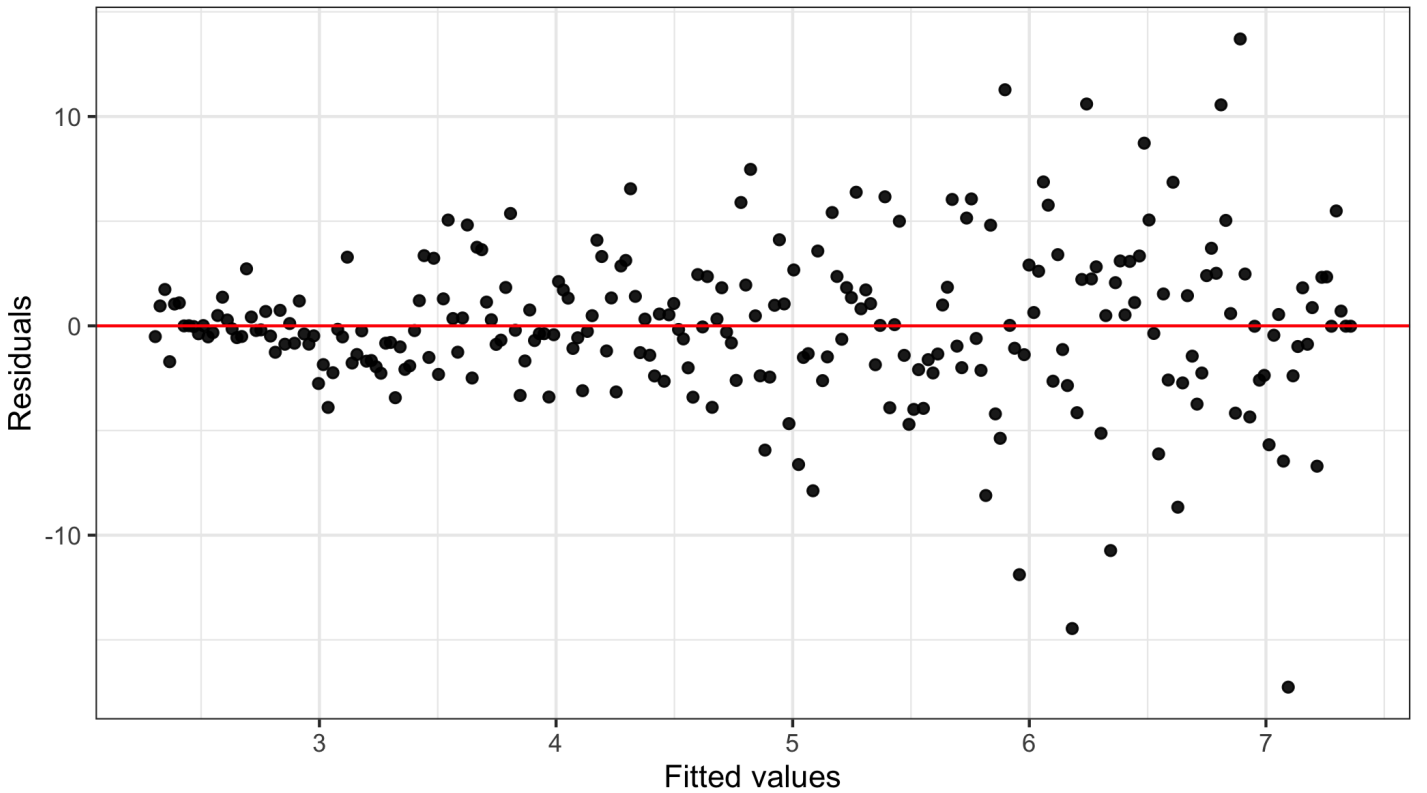


✅ The vertical spread of the residuals is relatively constant.

Violation: distinguishable pattern



Violation: non-constant variance



Normal quantile plot

A **normal quantile plot** is a scatterplot of the quantiles of the observed data (x-axis) versus the theoretical quantiles from a sample of the same size that is perfectly normal.

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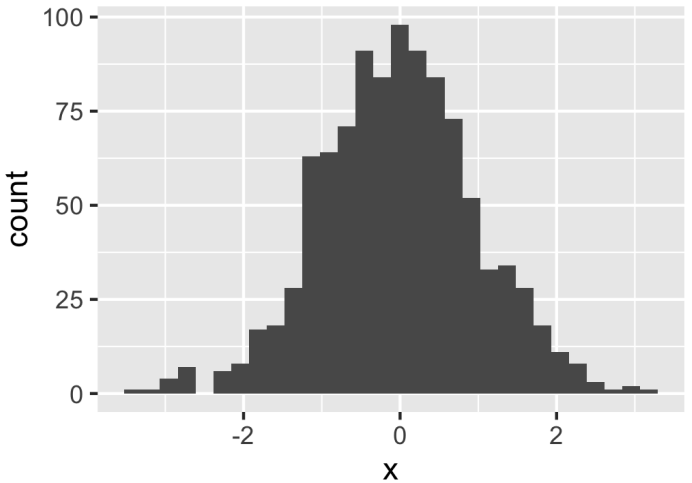

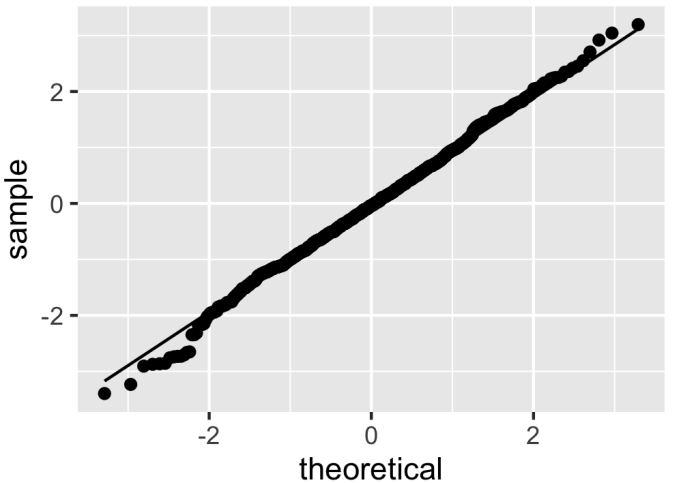

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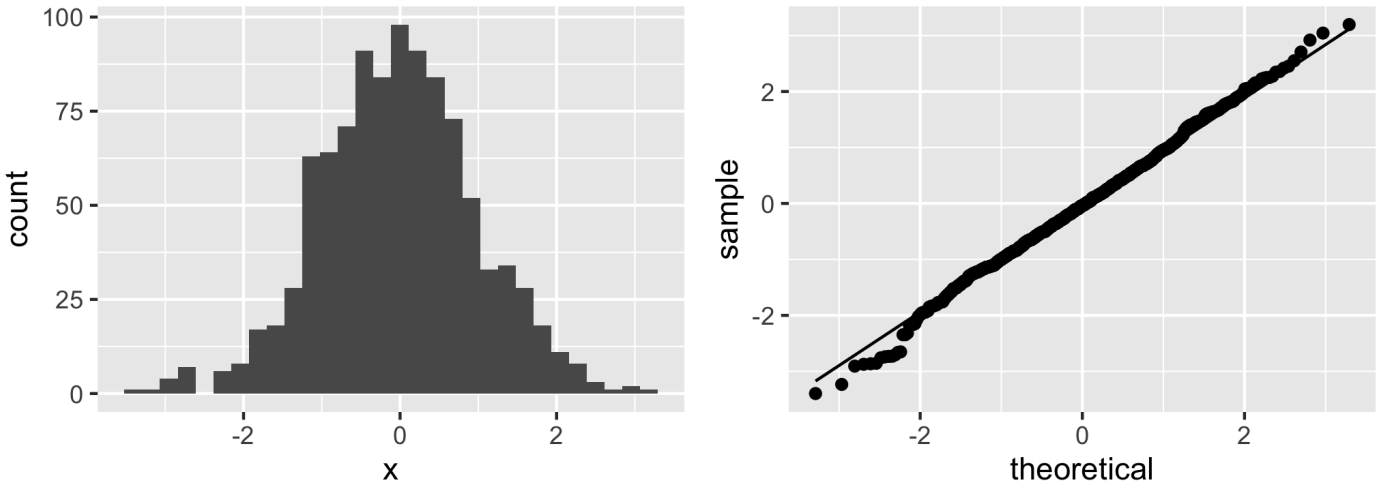

If the distribution of the observed data is approximately normal, the points will follow a straight diagonal line.

Assessing normality

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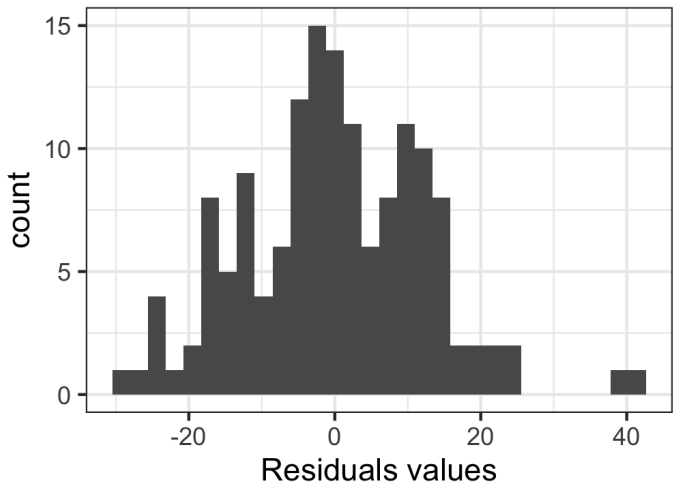

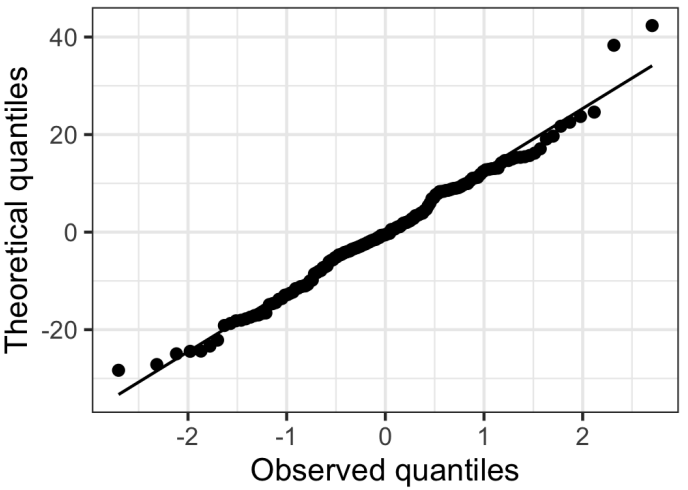

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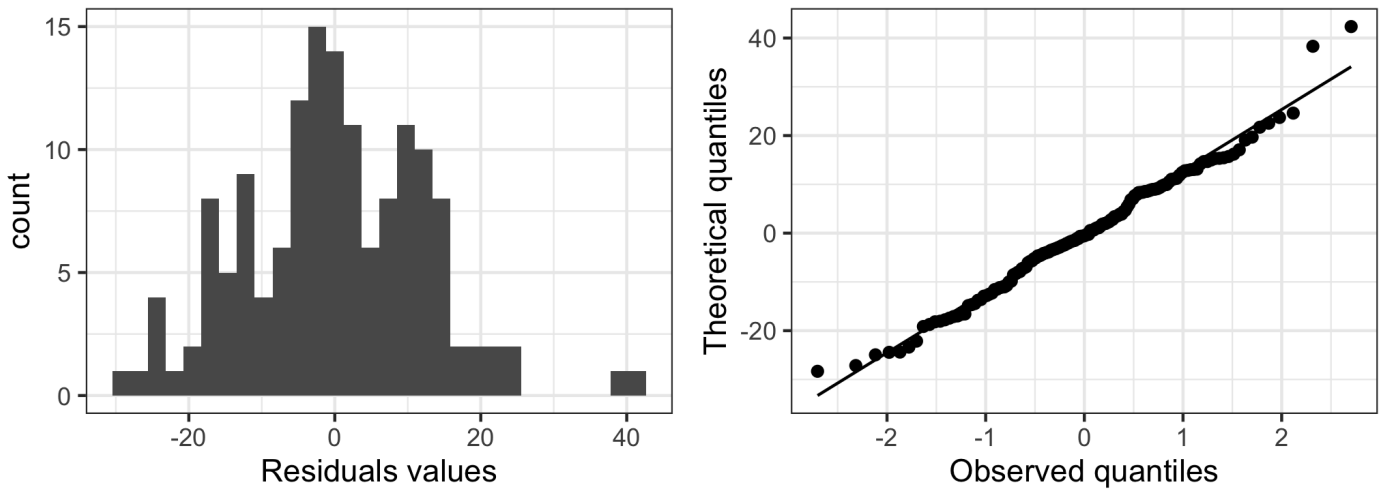

✅ Points follow a straight diagonal line on the normal quantile plot.

Assessing independence

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- We can often assess the independence assumption based on the context of the data and how the observations were collected.
- If the data were collected in a particular order (e.g., over time), you can examine a scatterplot of the residuals versus order in which the data were collected.

In practice

As you assess the model conditions, ask if any observed deviation from the model conditions provide sufficient evidence that

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If not, the conditions are satisfied sufficiently enough to proceed.

Recap

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- Identified the conditions for simple linear regression:
  1. Linearity
  2. Constant Variance
  3. Normality
  4. Independence

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- Identified the conditions for simple linear regression:
  1. Linearity
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- Used plots of the residuals to assess the conditions.

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