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FORECASTING

PRINCIPLES AND PRACTICE

A comprehensive introduction to the latest forecasting methods using R. Learn to improve your forecast accuracy using dozens of real data examples.



3RD EDITION

 **OTexts**
Oxford Texts in Finance and Probability

7. Time series regression models

7.1 Evaluating the regression model

OTexts.org/fpp3/

Regression residuals

Residuals are defined as:

$$\begin{aligned}e_t &= y_t - \hat{y}_t \\ &= y_t - \hat{\beta}_0 - \hat{\beta}_1 x_{1,t} - \hat{\beta}_2 x_{2,t} - \cdots - \hat{\beta}_k x_{k,t}\end{aligned}$$

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Useful properties

$$\sum_{t=1}^T e_t = 0 \quad \text{and} \quad \sum_{t=1}^T x_{k,t} e_t = 0 \quad \text{for all } k.$$

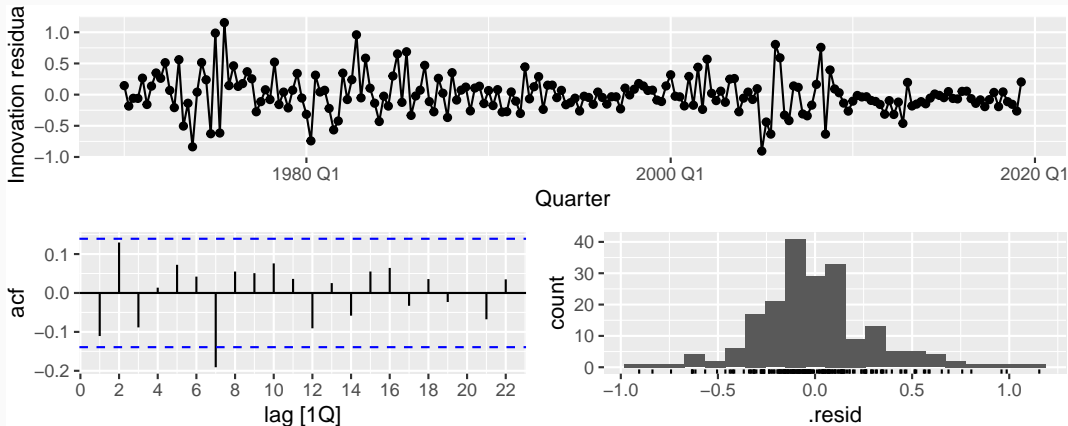
Checking assumptions

- ε_t have mean zero and are uncorrelated, $\text{NID}(0, \sigma^2)$.
- ε_t are uncorrelated with each $x_{j,t}$.
 - ▶ Timeplot, ACF, Histogram (`gg_tsresiduals()`)
 - ▶ Against predictors (non-linearity)
 - ▶ Against fitted values (heteroscedasticity)
 - ▶ Against predictors not in the model (include predictor in the model)

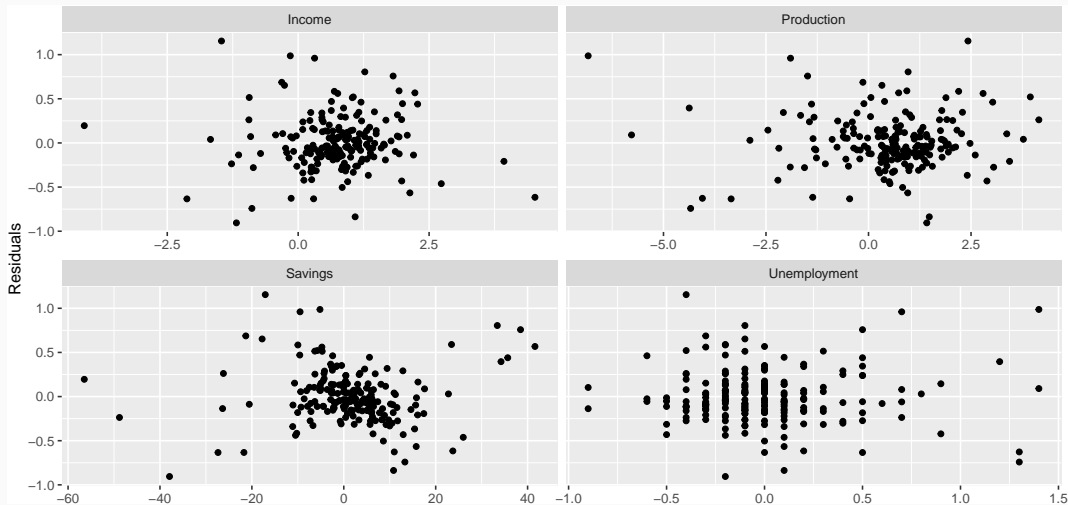
Expect to see scatterplots resembling a horizontal band with no values too far from the band and no patterns such as curvature or increasing spread.

Example: US consumption expenditure

```
fit_consMR |> gg_tsresiduals()
```



Example: US consumption expenditure



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