1. Analyze the following residuals analysis plots. Do the residuals look like white noise?

   Source: Section 5.11 Exercise 4 from *Forecasting: Principles and Practice* (3rd ed).

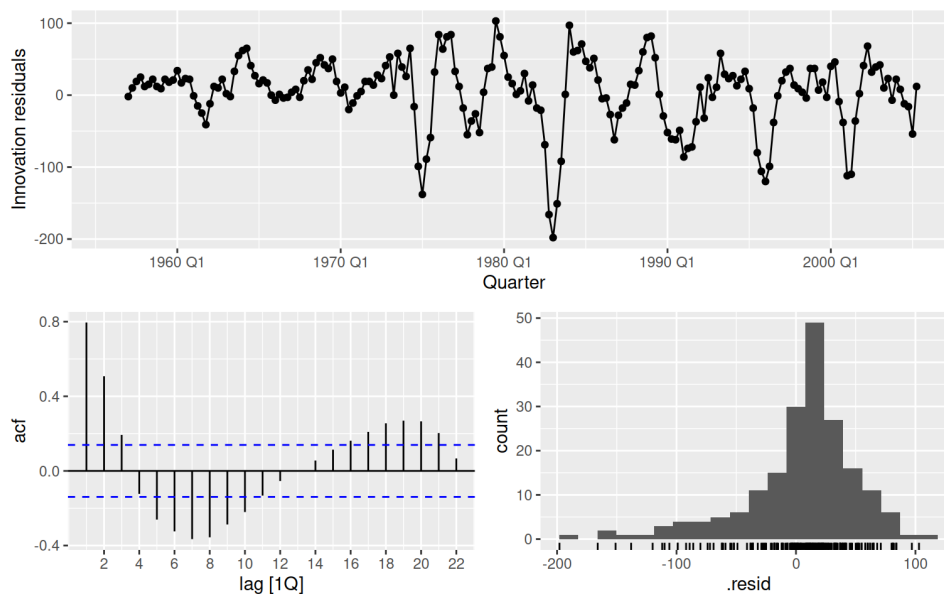   (a) Figure 1 showcasing the residuals of the seasonal naïve forecast for the Australian brick production.



Figure 1: Residuals of the seasonal naïve forecast for the Australian brick production.

   (b) Figure 2 showcasing the residuals of the naïve forecast for the Australian Exports series.
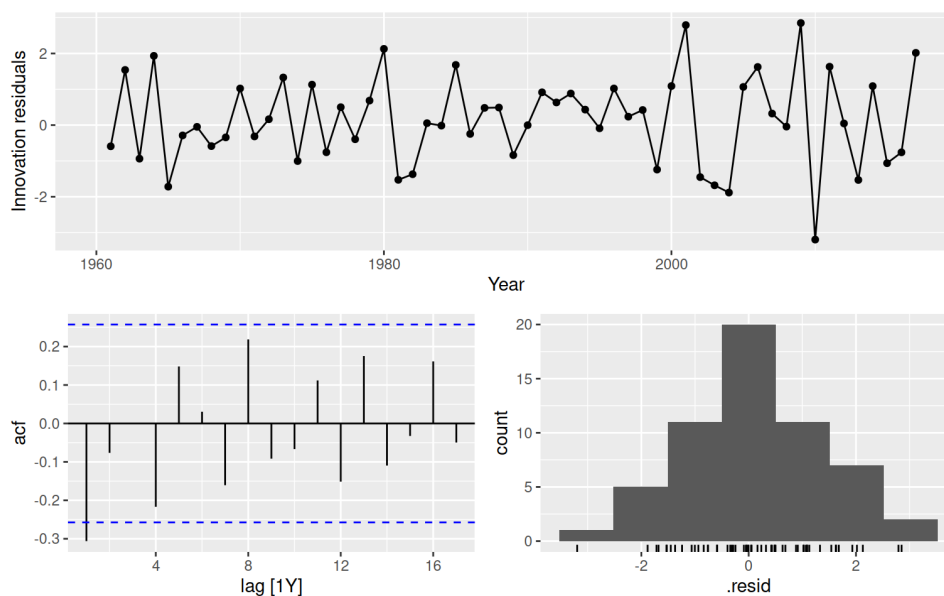


Figure 2: Residuals of the naïve forecast for the Australian Exports series.

2. Are the following statements true or false? Explain your answer.

   Source: Section 5.11 Exercise 6 from *Forecasting: Principles and Practice* (3rd ed).

    (a) Good forecast methods should have normally distributed residuals.

    (b) A model with small residuals will give good forecasts.

    (c) The best measure of forecast accuracy is MAPE.

    (d) If your model doesn't forecast well, you should make it more complicated.

    (e) Always choose the model with the best forecast accuracy as measured on the test set.

3. The following time series data represents quarterly sales (in units) for a product over the past fours years: $\{10, 12, 20, 22, 12, 14, 22, 24, 14, 16, 24, 26, 16, 18, 26, 28\}$.

    (a) Split the data into training (75%) and evaluation (25%) sets.

    (b) Provide forecasts for the evaluation set with two baselines of your choice.

    (c) Compute the baselines' mean absolute error.

    (d) The company model forecasted $\{25, 22, 28, 31\}$ for the evaluation set. Compute the mean absolute scaled error.

    (e) The forecasts produced by the company model have a horizon of half a year. Compute the rolling mean absolute error with a step size of one quarter.

4. A company is comparing two different time series models to forecast an economic indicator based on a dataset containing 500 observations. The models have the following properties:

    • AR(2) with intercept ($c \neq 0$), Log-likelihood = -150

    • AR(3) with intercept ($c \neq 0$), Log-likelihood = -145

    (a) Compute the AIC and BIC for both models.

    (b) Based on the AIC and BIC values, which model should be preferred? Explain your answer.

5. A company is forecasting its quarterly sales for the next year. The forecast for each quarter is 50, 55, 53, and 60 units respectively. The variance of the forecasted residuals is estimated to be 16. Compute the 95% confidence interval for the forecasted sales in the first quarter, assuming that the residuals follow a normal distribution.

6. Consider the process $x_t = 6 + w_t + w_{t-1}$ with $w_t \sim \mathcal{N}(0, \sigma^2)$, and the observed realization

$$(x_1, x_2, x_3, x_4) = (5, 7, 5, 7).$$

    (a) Compute the past one-step-ahead forecast errors.

    (b) Derive the forecasts $\hat{x}_{5|4}$, $\hat{x}_{6|4}$, $\hat{x}_{7|4}$.

    (c) Derive the forecast error and variance.

    (d) Compute 95% confidence intervals for $\hat{x}_{5|4}$, $\hat{x}_{6|4}$, and $\hat{x}_{7|4}$.