

TIME SERIES RESIDUALS DIAGNOSTICS

① INNOVATION RESIDUALS ARE UNCORRELATED

$$\text{cov}(e_t, e_{t-s}) : \text{cov}(e_{t-j}, e_{t-j-s}) = 0$$

→ IS THERE INFORMATION IN THE RESIDUALS?

→ CHECK

• ACF Plot

• Test →

Box-Pierce TEST
Ljung-Box TEST

See book and
notebook

→ SOLUTIONS: harder →
• Introduce more regressors
• ...
• CHANGE Model

→ If a model does not satisfy ① + ②

↓
it can be improved

② INNOVATION RESIDUALS HAVE 0 MEAN

$$E[e_t] = E[y_t] - E[\hat{y}_t] = 0 \leftrightarrow E[y_t] = E[\hat{y}_t]$$

$$e_t = y_t - \hat{y}_t$$

$$\text{Linearity of expectation } (E[a+b] = E[a] + E[b])$$

→ ARE THE PREDICTIONS BIASED?

→ CHECK: compute the average of the residuals.

→ Formal statistical test on the mean (C-test)

→ SOLUTION: subtract the mean of the residuals
from the forecasts

↓
If a model satisfies ① + ②

↓
it may be possible to improve it

(Multiple models may satisfy ① + ② and
we need to select among them)

③ CONSTANT VARIANCE OF THE RESIDUALS OVER T (HOMOSKEDASTICITY)

$$\text{var}(e_t) = \text{var}(e_{t-1}) = \dots = \sigma^2$$

→ EASIER CALCULATION OF PREDICTION INTERVALS

→ CHECK

• ③ → VISUAL INSPECTION → Time plot
• TESTS → Box-Plots → Time plot of Box-plots
→ Bechsch-Pagan
→ McLeod-Li → See previous courses

• ④ → VISUAL INSPECTION → Histogram/Kernel
• → QQ-Plots
• → Box-Plots (Symmetry)

→ TESTS: Shapiro, Diagnóstico, Jarque-Bera...

→ SOLUTIONS → Box-Cox TRANSFORMATION

↓ Deal with it (alternatives to obtain
prediction intervals)

→ CHANGE MODEL

↓
If a model does not satisfy ③ + ④

↓
Calculation of the prediction intervals
more elaborate

⊕

Prediction INTERVALS MAY BECOME
TOO WIDE (HETEROSENASTICITY)

↓
Low reliability of the forecasts