

# NG and ADF test (excess return)

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## Data

Data: 131-8=123 series in total.

The “spread” series (difference between two I(1) series) are removed.

log() is done.

## ADF test

Step 1, ADF test to the 146 original series.

Step 2, mark “I(0)” variables as “I(0)”.

Step 3, ADF test to the first-differenced 146 series.

Step 4, check for contradictions, found “PCED\_RecServices” in AIC.

Step 5, mark “I(1)” variable as “I(2)” (including “PCED\_RecServices”).

Step 6, mark the rest as “I(1)”.

Step 7, repeat the above 6 steps for both “AIC” and “BIC”.

## Lasso 1

I(2) is first differenced, others are original.

$$\begin{aligned} y_t = & I(0)_{t-1} + I(0)_{t-2} + I(0)_{t-3} + I(0)_{t-4} \\ & + I(1)_{t-1} + I(1)_{t-2} + I(1)_{t-3} + I(1)_{t-4} \\ & + \Delta I(2)_{t-1} + \Delta I(2)_{t-2} + \Delta I(2)_{t-3} + \Delta I(2)_{t-4} \end{aligned}$$

## Lasso 2

All stationary.

$$\begin{aligned} y_t = & I(0)_{t-1} + I(0)_{t-2} + I(0)_{t-3} + I(0)_{t-4} \\ & + \Delta I(1)_{t-1} + \Delta I(1)_{t-2} + \Delta I(1)_{t-3} + \Delta I(1)_{t-4} \\ & + \Delta^2 I(2)_{t-1} + \Delta^2 I(2)_{t-2} + \Delta^2 I(2)_{t-3} + \Delta^2 I(2)_{t-4} \end{aligned}$$

### Lasso 3

Combination of Lasso 1 and 2.

$$\begin{aligned}y_t = & I(0)_{t-1} + I(0)_{t-2} + I(0)_{t-3} + I(0)_{t-4} \\& + \Delta I(1)_{t-1} + \Delta I(1)_{t-2} + \Delta I(1)_{t-3} + \Delta I(1)_{t-4} \\& + \Delta^2 I(2)_{t-1} + \Delta^2 I(2)_{t-2} + \Delta^2 I(2)_{t-3} + \Delta^2 I(2)_{t-4} \\& + I(1)_{t-1} + \Delta I(2)_{t-1}\end{aligned}$$