CH E 572 - Time Series Modelling Workshop

Problem #1

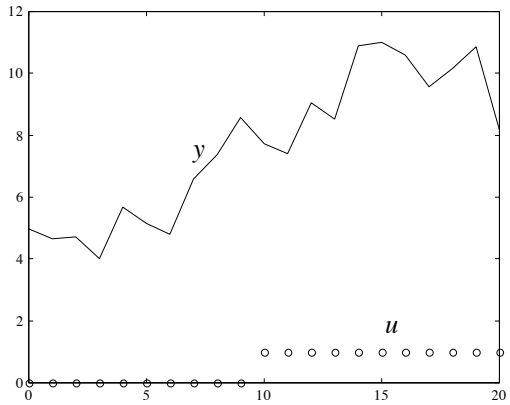
Introduction

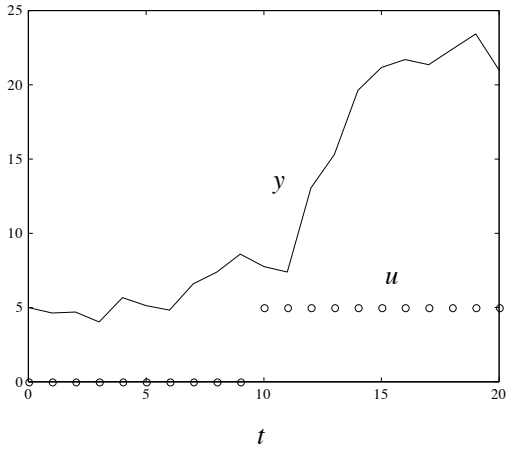
- The actual process model is:

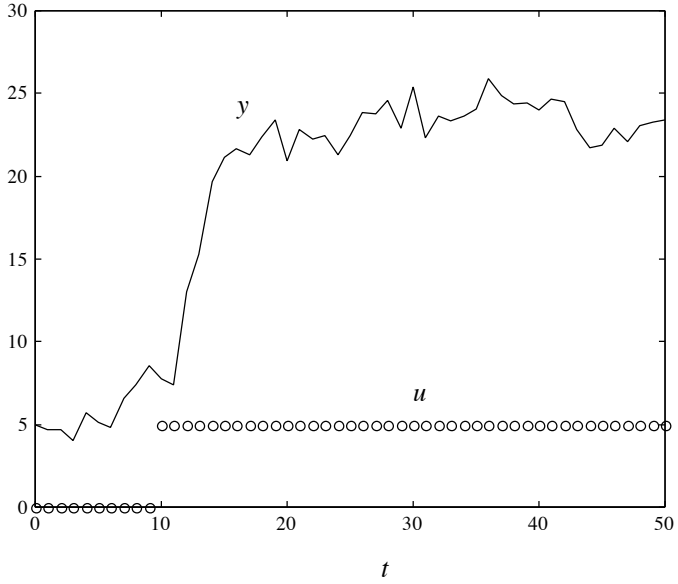
$$y_t = \frac{z^{-2}}{1 - 0.7z^{-1}} u_t + \frac{1}{(1 - 0.5z^{-1})(1 - z^{-1})} \varepsilon_t, \qquad \varepsilon_t \in N(0,1)$$

- Plant experiments:
  - First,
    - steps of various heights,
  - Second,
    - plant excited with a white noise ($u_t \in N(0,0.25)$),
    - switch time chosen as 1 minute,
    - 4097 data points collected.

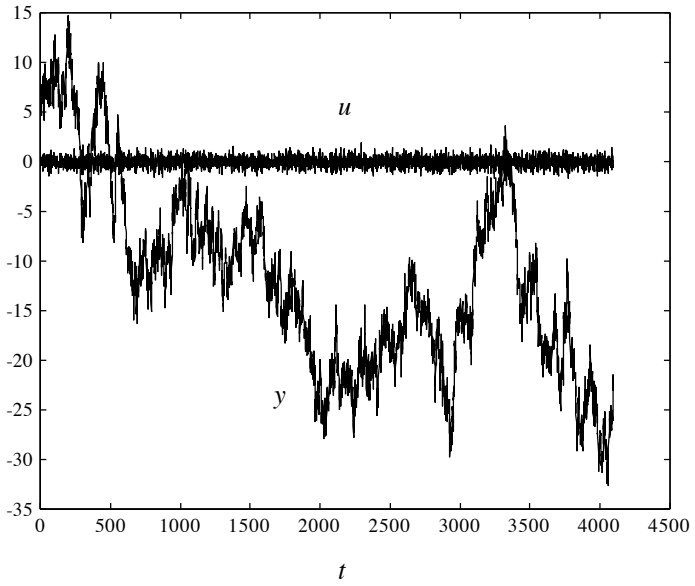
Step Testing



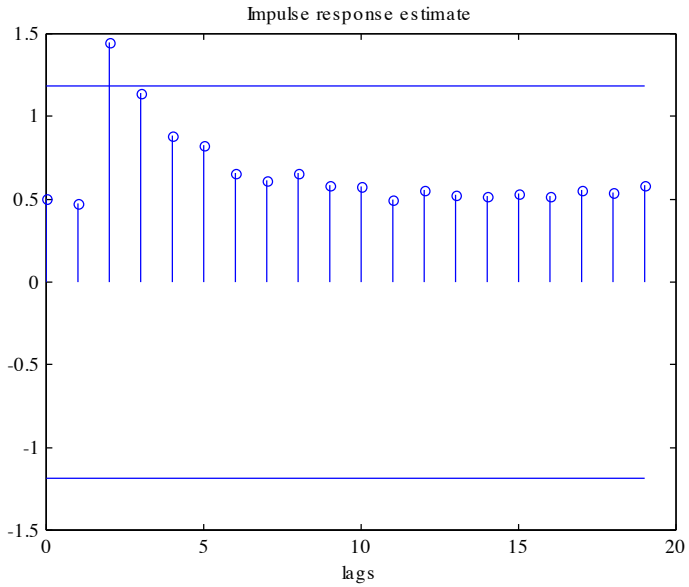




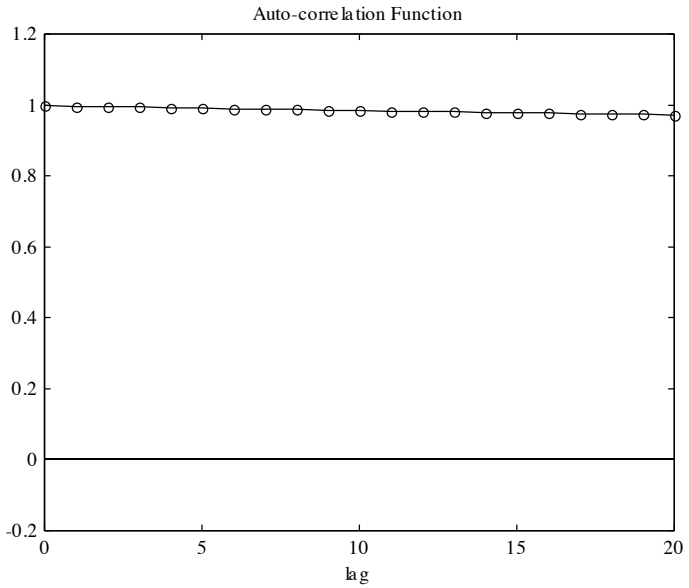
White Noise Input - Raw Data

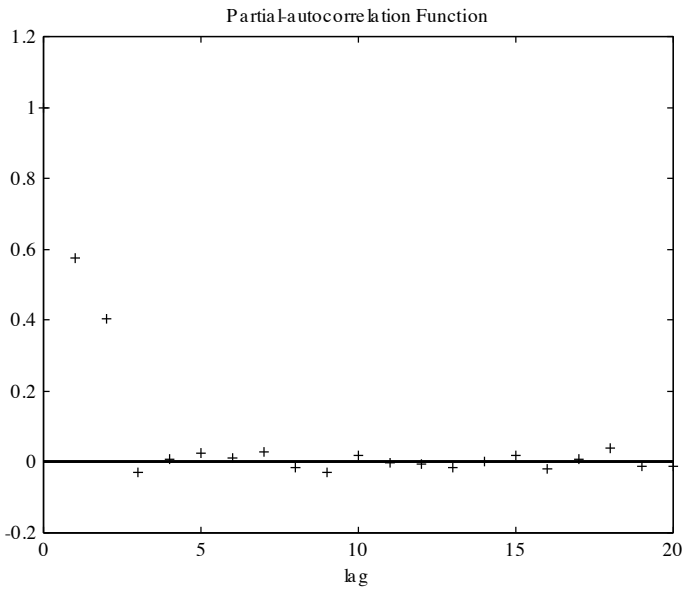


Output from CRA



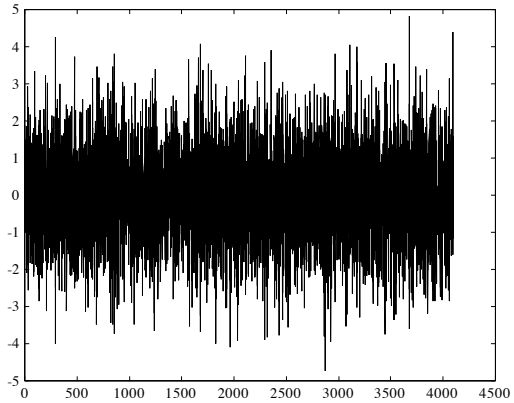
Correlation Functions - Raw Data





White Noise Input - Differenced Data

$(1-z^{-1})y$



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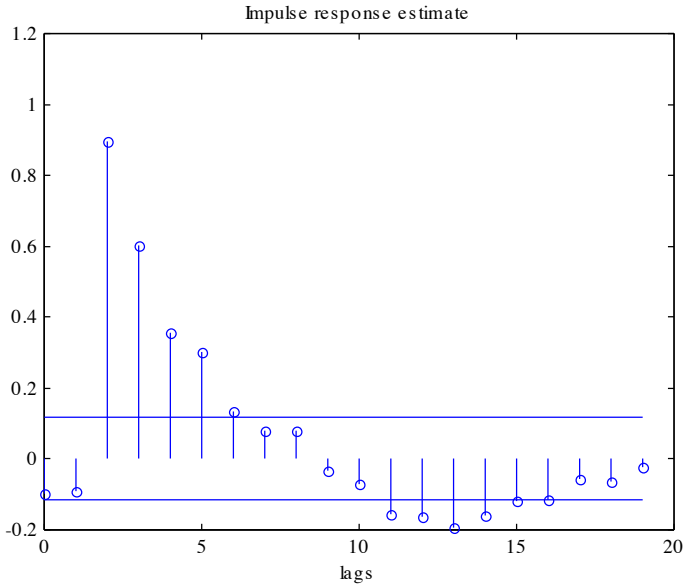
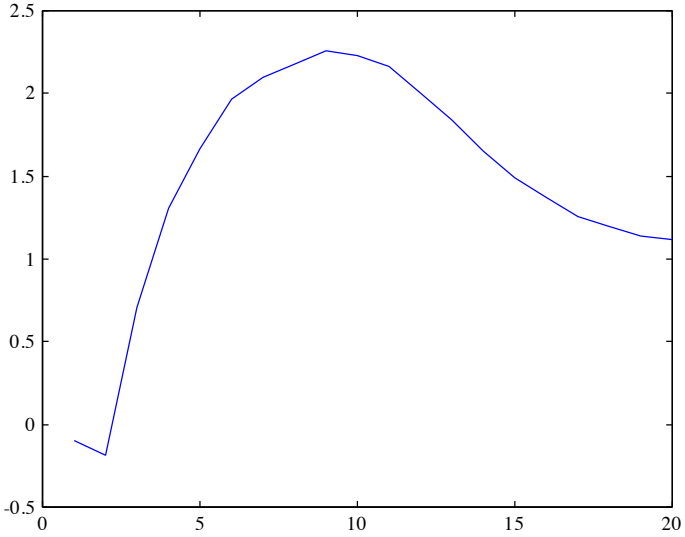
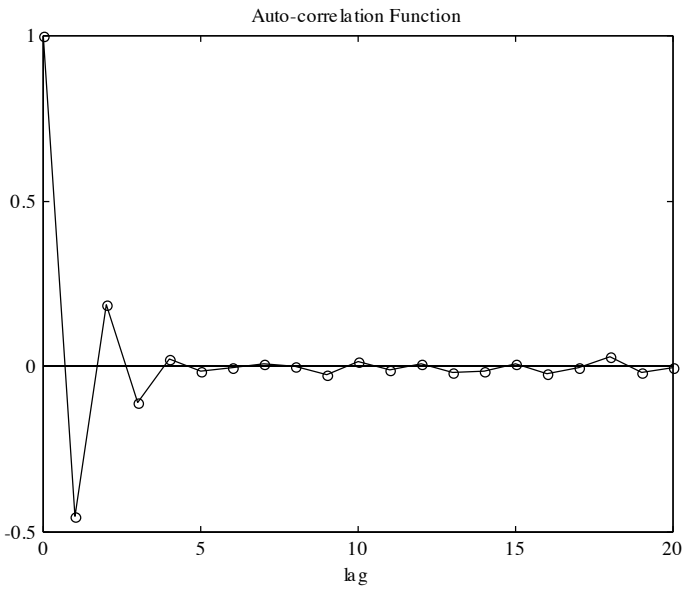
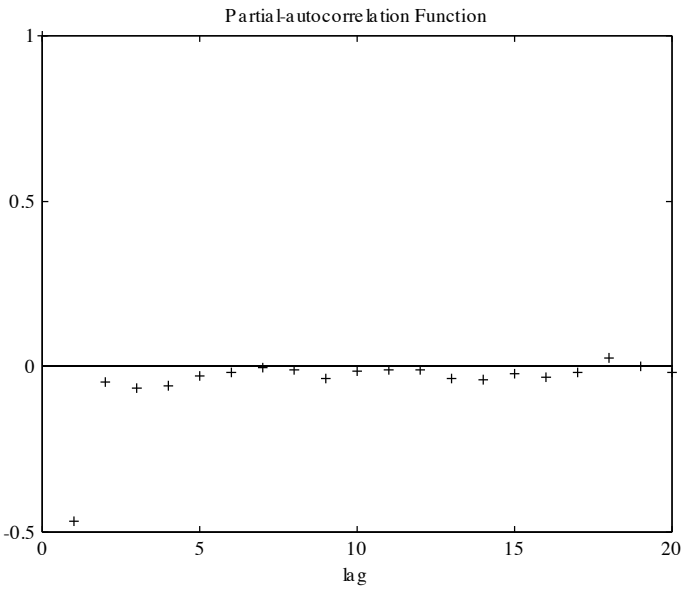




Correlation Functions - Differenced Data





Results

- Estimated model order:
  - plant (1,0,1),
  - noise (1,1,0).

- Estimated parameters (using BJ):
  - raw data,

$$y_t = \frac{(0.9551 \pm 0.0292)z^{-2}}{1-(0.6564 \pm 0.0293)z^{-1}}u_t + \frac{1-(0.0021 \pm 0.0309)z^{-1}}{1-(0.4949 \pm 0.0267)z^{-1}-(0.5038 \pm 0.0266)z^{-2}}\varepsilon_t$$

  - differenced data,

$$y_t = \frac{(0.9459 \pm 0.0269)z^{-2}}{1-(0.6712 \pm 0.0219)z^{-1}}u_t + \frac{1-(0.0035 \pm 0.0309)z^{-1}}{(1-(0.5030 \pm 0.0267)z^{-1})(1-z^{-1})}\varepsilon_t$$