Time Series Analysis

Homework assignment #5

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Problems

1. Show that the innovations $v_t = Y_t - \mathsf{E}(X_t|Y_{1:t-1})$ in the local level model are mutually independent for different values of t.

2. Download 5 years worth of most recent daily levels of AAPL and S&P 500. Use Bloomberg as the data source: adjusted daily closes (Bloomberg symbols AAPL Equity and SPX Index, respectively). Let r_t and m_t denote
Percentage or Log returns
the daily returns on AAPL and SPX, respectively. Consider the following CAPM model:

$$r_t = \alpha_t + \beta_t m_t + u_t, \tag{1}$$

where u_t are the residuals. The parameters α_t and β_t are estimated daily by means of a linear regression based on a 3 month (63 days) rolling window. You are interested in observing α_t as a trading signal.

   (i) We will formulate this model as the following local level model. Set $X_t = \alpha_t$, $Y_t = r_t - \beta_t m_t$; then

$$X_{t+1} = X_t + \varepsilon_{t+1},$$
$$Y_t = X_t + u_t.$$

Estimate from data
Assume that the variances of ε_t and u_t are constant, and treat the values of β_t as known.

(ii) Construct and run the Kalman filter for this model. Plot the graph of the observed vs filtered values of α_t. Plot the graph of the smoothed values of α_t. Evaluate the predictive power of this model.

This assignment is due on March 16