Time series modelling and analysis

In class activities

Ranjeet Utikar

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Activities

1. Estimating Transfer Function Models for a Heat Exchanger

   In this example we estimate the transfer function for a heat exchanger. The heat exchanger consists of a coolant temperature, product temperature, and disturbance ambient temperature. We will estimate the coolant to product temperature transfer function.

   The measured data is stored in an excel file heat_exchanger.xlsx and includes measurements of changes in coolant temperature around a nominal and changes in product temperature around a nominal. Estimate a transfer function for the heat exchanger.

   1. From the physics of the problem we know that the heat exchanger can be described by a first order system with delay. Use the `tfest` command specifying one pole, no zeroes, and an unknown input/output delay to estimate a transfer function.
   2. The `compare` and `resid` commands allow us to investigate how well the estimated model matches the measured data.

   Detailed instructions are given here.

2. **AR model**: Australia COVID-19 Infection

   The cumulative daily data for COVID-19 infections is given in Australia_covid_cases.xlsx. Fit an autoregression model to the data.

3. For the transfer function below, develop an ARX model for the above system, with 1 unit step change in input and sampling time Ts = 1 unit.

$$G_p = \frac{2exp(-s)}{(10s+1)} \tag{1}$$

4. **Iron ore prices**: The price history for iron ore spot prices is given in iron_ore.xlsx.

   Use the following Matlab functions

   1. `arima(p,d,q)` => to build ARIMA model
   2. `estimate(Mdl,X)` => to estimate the ARMA model parameters
   3. `simulate(EstMdl,t)` => to simulate the ARMA model

    4. `plot(tx,X,tx,y)` => to compare the data and model estimation

5. Follow the Building and Estimating Process Models Using System Identification Toolbox example from Matlab documentation.