Time series modelling and analysis

In class activities

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2023-08-20

# 1. 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](https://au.mathworks.com/help/ident/ug/estimating-transfer-function-models-for-a-heat-exchanger.html).
1. **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.
1. 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.

$$G\_{p}=\frac{2exp\left(−s\right)}{\left(10s+1\right)}  \left(1\right)$$

1. **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
1. Follow the [Building and Estimating Process Models Using System Identification Toolbox](https://au.mathworks.com/help/ident/ug/building-and-estimating-process-models-using-system-identification-toolbox.html) example from Matlab documentation.