CmpE 482 - Homework 2 (Due: Nov 16th, 2017 midnight)

Part 1: QR Factorization

Write a MATLAB function called *qr_householder()*, which computes QR factorization of matrix $\mathbf{X}$ of size $m \times n$ (with $m \geq n$) using Householder Triangularization. The function takes matrix $\mathbf{X}$ as an input. The output is a modified matrix $\mathbf{X}$ of size $(m+1) \times n$ such that the modified matrix contains both the upper triangular $\mathbf{R}$ and the $\mathbf{v}$ vectors used to form the Householder reflectors. The function should not form $\mathbf{Q}$ explicitly.

Part 2: Least Squares Fitting of AR model

Suppose that $\mathbf{x}$ is an N-vector representing time series data. The (one step ahead) prediction problem is to predict x_{t+1}, based on $x_1, ..., x_t$. We will base our prediction $\hat{x}_{t+1}$ of x_{t+1} on the previous M values, $x_t, x_{t-1}, x_{t-2}, ..., x_{t-M+1}$, where M is the memory length of our predictor. The prediction model will be in the following form:

$$\hat{x}_{t+1} = \beta_0 + \beta_1 x_t + \beta_2 x_{t-1} + \beta_3 x_{t-2},$$

where $M = 3$. Given observed data $x_1, x_2, ..., x_N$, we want to minimize the error: $\sum_{t=M+1}^{N} (\hat{x}_t - x_t)^2$.

- Formulate this as a least squares problem.
- Load hw2_data.mat, which shows the annual number of worldwide earthquakes with magnitude greater than 7 on the Richter scale for $N = 100$ years. Estimate β_0, β_1, β_2, and β_3 by solving the least squares problem using the *qr_householder* function you have implemented for Part 1 (which will not return $\mathbf{Q}$ and do not form $\mathbf{Q}$ explicitly).

Deliverables

Work in pairs and send the following by email to evrim.acarataman@gmail.com:

- MATLAB scripts: *qr_householder* and your script for Part 2.
- Your estimates for β_i for $i = 0, 1, 2, 3$.