Time Series Analysis
Second Midterm 03/12/20

0.1. Short theoretical questions. (4 points.)

1. (1 point) Assume a stationary and invertible ARMA(p,q) model. Is it possible to estimate the unknown parameters using OLS? Is it possible to estimate the unknown parameters if the model is a pure AR(p)? Justify your answers.
2. (1 point) Assume an AR(1) model estimated with MLE. Do you always obtain an unbiased estimator of ϕ_1?
3. (1 point) Is it true that the use of aic criteria always yields the correct identification of the p and q orders in an ARIMA model. Justify your answer.
4. (1 point) Assume the last two observations of a time series are $x_n = 1$ and $x_{n-1} = 0{,}5$. Give the expressions and the values for the one-step and three-step ahead forecasts for the following cases:
   a) X_t is white noise with constant equal to 3.
   b) X_t is random walk with drift equal to 3.
   c) X_t is an AR(1) with $\phi_1 = 0{,}7$.
   d) X_t is an AR(2) with $\phi_1 = 0{,}7$ and $\phi_2 = 0{,}5$

0.2. Exercises (6 points).

1. (2 points)Take the series of Annual Industrial Production in US (annual data starting in 1860). Identify and estimate an ARIMA model (without outliers) and perform the diagnosis.
2. (1 point)Take the series of Milk production (monthly data starting 1962-01). Which is the identified ARIMA(no outliers) model? Justify the identification using plots , acf, and pacf.
3. (3 poins) In UK, front seat belts were compulsory equipment on all new registered cars from 1972, although it did not become compulsory for them to be worn until February of 1983.

   Take the series of Road injuries (monthly data starting 1969-01) and consider three different periods:

   - From 1969.1 to 1975.1 : most of UK registered cars did not have seat belts.
   - From 1975.1. to 1983.1: most of UK registered cars have seat belts but is not compulsory to wear them.
   - From 1983.2 : it is compulsory to wear seat belts.

   Then:

   a) Identify and estimate an ARIMA model for the road series in the second period (1975.1 to 1983.1).
   b) Identify and estimate an ARIMA model without and with outliers for the period (1975.1 to 1984.12) and explain the differences on the identification and estimation of the ARIMA parameters.
   c) Identify and estimate an ARIMA model with outliers for the period(1969.1 to 1984.12) and compare it with the models in a) and b).

   In which forms was the seat belt legislation effective to cut down the deaths and injuries in UK?