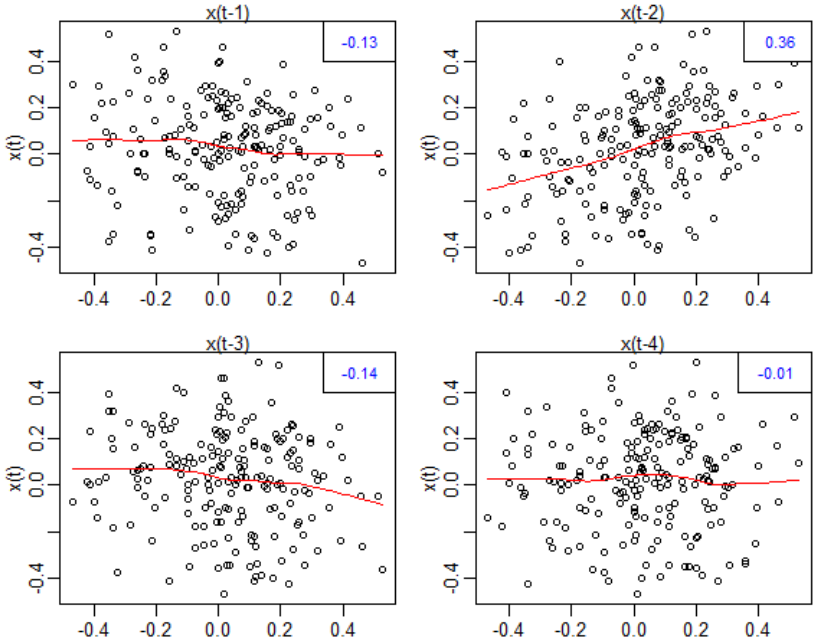
Examination

Linköping University, Department of Computer and Information Science, Statistics and Machine Learning

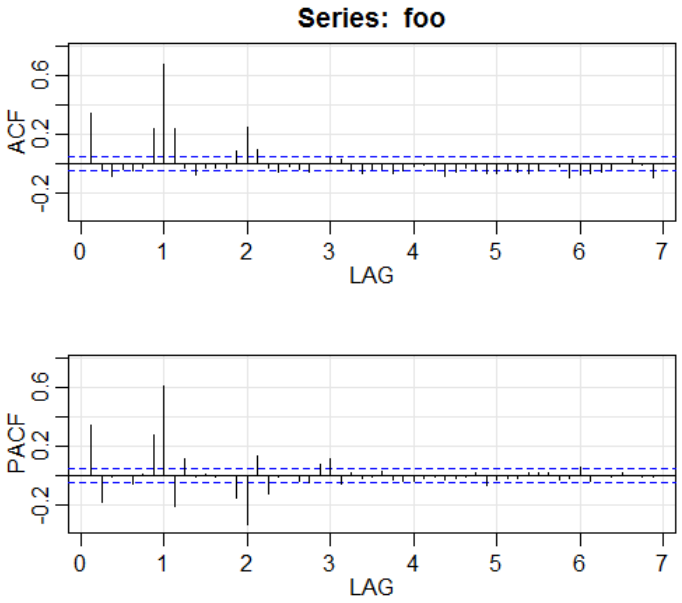
Course code and name	732A62 Time Series Analysis
Date and time	2017-12-04, 08.00-12.00
Assisting teacher	Oleg Sysoev
Allowed aids	"Time series analysis and its application" by Shumway & Stoffer or/and "Time series analysis" by Cryer and Chan, Information Sheet, Calculator.
Grades:	A=19-20 points B=16-18 points C=13-15 points D=11-12 points E=9-10 points F=0-8 points

Give motivated answers to the questions. If an answer is not motivated, the points are reduced.

1. The figure below shows dependence of x_t on x_{t-1}, x_{t-2} x_{t-3}, x_{t-4}. Based on this information, decide which lagged variables should be taken as inputs explaining x_t. You may also discover that the smoothing function is nonlinear. Suggest how this information may be incorporated into the model for x_t. **(1p)**



2. Use the coefficient matching method to compare the following two models: $x_t = 0.4x_{t-1} + 0.1x_{t-2} + w_t + 0.1w_{t-1}$ and $x_t = w_t + 0.5w_{t-1} + 0.3w_{t-2} + 0.2w_{t-3}$, i.e. show whether these models are similar or they are rather too different. **(3p)**
3. The following sample ACF values were reported: $\hat{\rho}(0) = 1, \hat{\rho}(1) = 0.7, \hat{\rho}(2) = 0.4, \hat{\rho}(3) = 0.1$. What is the smallest possible sample size for which one can decide that MA(2) model is reasonable given these ACF values? **(1p)**
4. Write down an equation of the following model $ARIMA(1,0,0) \times (0,2,2)_4$. The final expression should not contain backshift operators **(2p)**
5. Assume that x_t is a stationary AR(1) model with some parameter ϕ and $\sigma_w^2 = 1$. Derive the autocovariance function for $y_t = \frac{1}{2}(x_t + x_{t-1})$. Is this process stationary? **(2p)**
6. Assuming that $x_t = 0.5x_{t-4} + w_t + 0.1w_{t-1}$, use general homogeneous equations to derive $\rho(h)$ for $h = 2,6,10,14,18, \ldots$ **(2p)**
7. Given the data set $x_1 = 3, x_2 = 1$ and $x_3 = 4$, estimate parameters θ and ϕ of ARMA(1,1) model by using the conditional least squares principle. **(3p)**
8. Which of the following ARIMA models is the most suitable according to the plot below: a) ARIMA(2,0,1) b) $ARIMA(2,0,0) \times (0,0,2)_8$, c) $ARIMA(1,0,1) \times (0,0,3)_8$ **(1p)**



9. Autocovariances of a stationary process were computed in a previous study as $\gamma(0) = 1, \gamma(1) = 0.2, \gamma(2) = 0.4$ and $\gamma(3) = 0.1$. Compute a confidence interval for the 1-step ahead forecast assuming the following data set: $x_1 = 4,\ x_2 = 2$ **(3p)**
10. Identify whether there is an indication of the redundancy in the following estimated ARMA process **(2p)**

```
> arima(x, order = c(2,0,0), seasonal=list(order=c(0,0,1), period=4))

Call:
arima(x = x, order = c(2, 0, 0), seasonal = list(order = c(0, 0, 1), period = 4
))

Coefficients:
         ar1      ar2     sma1  intercept
      0.6250  -0.0625  -0.0622     0.0003
s.e.  0.0223   0.0228   0.0225     0.0492
```