Question 1

Not yet answered

Marked out of 10

Which of these ARMA processes are stationary?

1. $X_t = 0.9X_{t-1} + \epsilon_t$
2. $X_t = 20 + \epsilon_t$
3. $X_t = -0.1X_{t-1} + \epsilon_t$
4. $X_t = 0.5X_{t-1} - 0.5\epsilon_{t-1} + \epsilon_t$

- ○ a. Only 1
- ☒ b. All of them
- ○ c. None of them
- ○ d. Only 1 and 3

Question 2

Not yet answered

Marked out of 10

Naive forecasts, such as lag-1 persistent, lag-T persistent and mean-value forecasts are... (select the CORRECT statement):

- ○ a. ...useful to ensure that the optimal confidence intervals are obtained
- ☒ b. ...useful to use as a benchmark against forecasts based on sophisticated methods.
- ○ c. ...needed to improve the forecast made by sophisticated methods, such as ARMA, ARIMA, ARMAX or ARIMAX.
- ○ d. ...used to find the optimal lag in an ARMA/ARIMA model

Question 3

Not yet answered

Marked out of 10

Select the CORRECT statement

- ☒ a. If Y_t is an ARIMA process, $X_t = LY_t$ with L a combination of differencing and deseasonalizing filters, is an ARMA process.
- ○ b. Consider Y_t, a generic (i.e. not necessarily stationary) time series. If we fit an ARMA-model on this time series and calculate the residuals $\epsilon_1, \ldots, \epsilon_t$, they are, by construction, iid $\mathcal{N}(0, \sigma^2)$.
- ○ c. An ARMA(p,q) process is equivalent to an ARIMA(p,1,q) process
- ○ d. Consider $Y_t, t = 1, \ldots$ a time series that follows an ARMA(0,0) process. This timeseries is equivalent to a random walk that converges to 0 as $t \to \infty$

Question 4

Not yet answered

Marked out of 10

Consider the following finite impulse response:

$h_0 = 1$

$h_1 = 0$

$h_2 = -1$

$h_n = 0, n > 2$

Which of these filters correspond to this impulse response?

- ○ a. Δ_2^2 (lag-2 differencing filter of order 2)
- ☒ b. Δ_2^1 (lag-2 differencing filter of order 1)
- ○ c. Δ_1^1 (lag-1 differencing filter of order 1)
- ○ d. Δ_1^2 (lag-1 differencing filter of order 2)

Question 5

Not yet answered

Marked out of 10

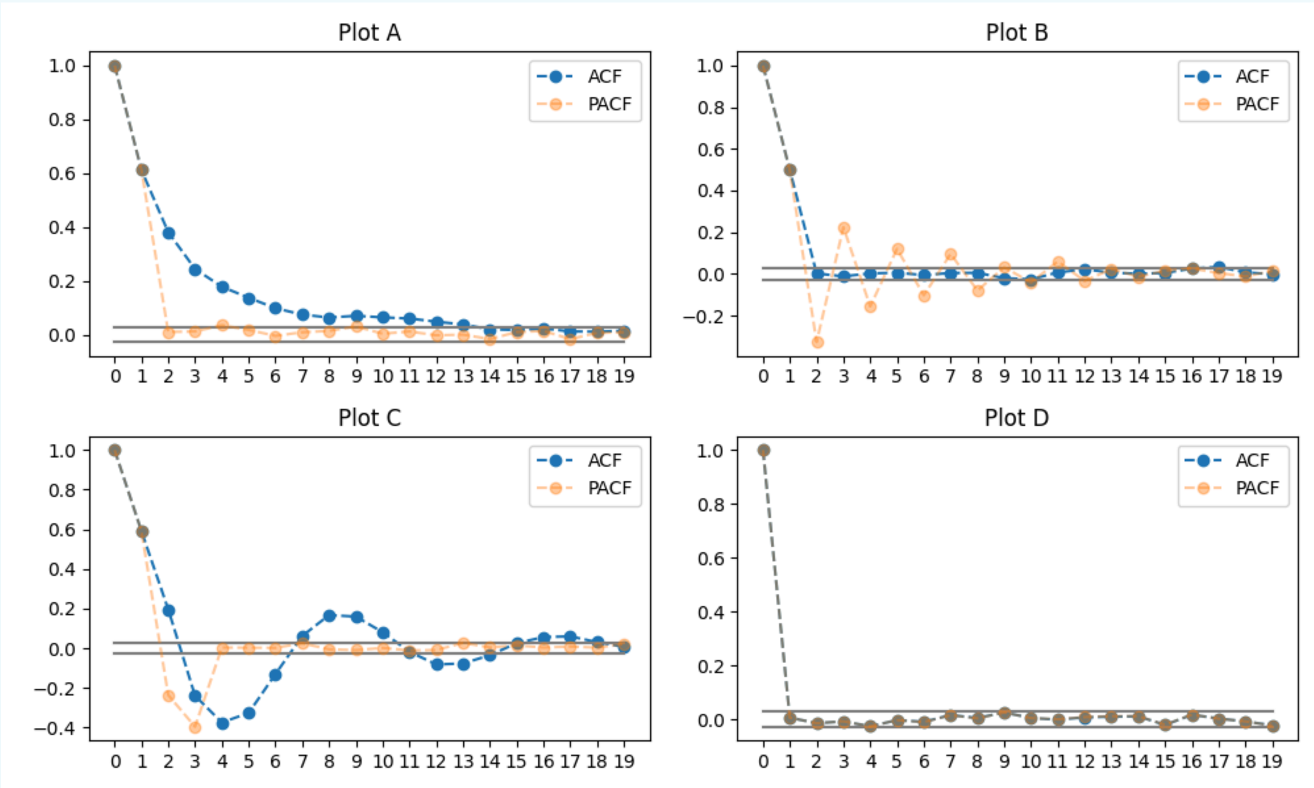
The four plots below show the results of applying the autocorrelation function (ACF) and the partial autocorrelation function (PACF) to four different ARMA-processes. Identify the mapping between the plots A-D and the four ARMA-processes below.

1: ARMA(0,0)

2: ARMA(1,0)

3: ARMA(0,1)

4: ARMA(3,0)



- ○ a. (1-A), (2-C), (3-D), (4-B)
- ○ b. (1-A), (2-D), (3-B), (4-C)
- ☒ c. (1-D), (2-A), (3-B), (4-C)
- ○ d. (1-D), (2-B), (3-A), (4-C)

Question **6**

Not yet answered

Marked out of 10

We want to create a linear regression model to forecast the **hourly** electricity demand at the EPFL campus. We specify the model as follows: $Y_t = \sum_{j=1}^{p} \beta_j f_j + \epsilon_t$, where Y_t is the electricity demand at time t, ϵ_t is iid. white noise ($\mathcal{N}(0, \sigma^2)$), β_j are regression coefficients and f_j are arbitrary functions of time. We also have access to the hourly temperature on campus T_t. We want to select suitable f_j to achieve the most accurate forecast. From our expert knowledge, we have selected the following functions f:

- $f_0 = 1$
- $f_1 = y_{t-24}$
- $f_2 = y_{t-168}$
- $f_3 = T_t$
- $f_4 = T_t^2$

Choose the TRUE statement.

- a. This model is equivalent to an ARMA(2,0) process.
- b. This model can not be fit with linear regression due to the nonlinearity present in f_4
- ☒ c. The distribution of the $\hat{\beta}$-vector follows a multivariate gaussian distribution.
- d. The maximum likelihood estimator of the β vector, $\hat{\beta}$ can only be calculated if the matrix X, where $X_{ij} = f_j(t_i)$, $i = 1, \ldots, n$ and $j = 1, \ldots, p$ is invertible (and thus square).

Question **7**

Not yet answered

Marked out of 10

The 1-lag differencing filter of order 2 can be represented by the following differencing equation: (select the CORRECT statement)

- a. $X_t = Y_t + Y_{t-1} - Y_{t-2}$
- ☒ b. $X_t = Y_t - 2Y_{t-1} + Y_{t-2}$
- c. $X_t = Y_t - 2Y_{t-1} - Y_{t-2}$
- d. $X_t = Y_t - Y_{t-1} - Y_{t-2}$

Question 8

Not yet answered

Marked out of 10

Select the CORRECT statement.

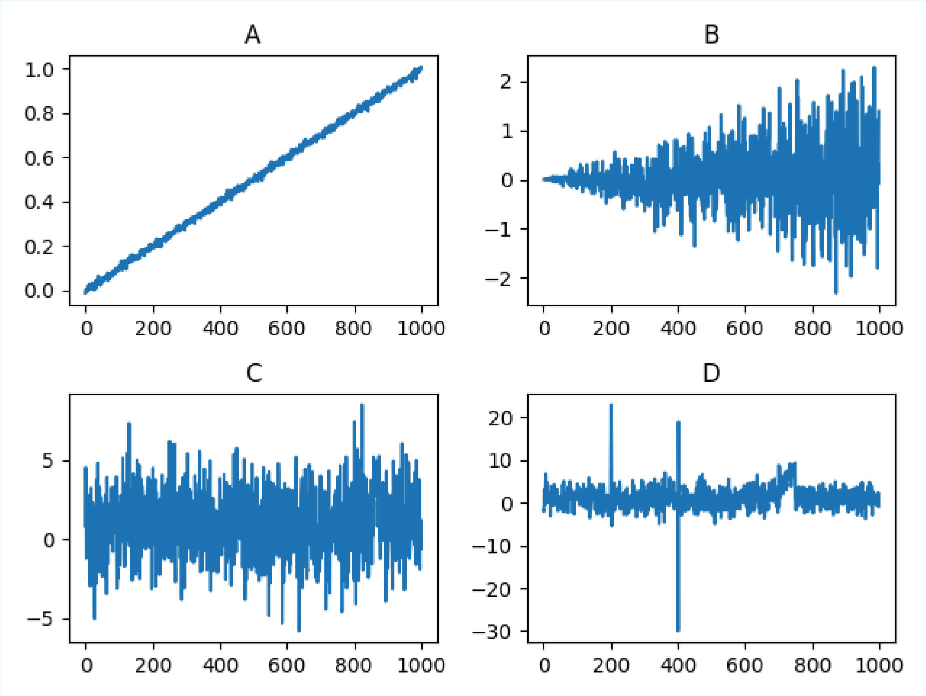
- a. Uncertainty in electricity demand is not an issue as long as the expected value of the residuals is 0
- b. Considering the 5-95% confidence intervals produced by an ARMA model, we can **certainly** say that 90% of **out-of-sample values** (future values)of the forecasted time series will lie inside this confidence interval
- c. Consider $X_t = \sum_{i=1}^{p} A_i X_{t-i} + \epsilon_t$, an AR(p) process, where ϵ_t is **iid white noise** ($\epsilon_t \sim \mathcal{N}(0, \sigma^2)$). This process is stable if the zeros of $(1 + A_1 z^{-1} + ... + A_p z^{-p})$ are within the unit disk.
- d. Uncertainty in electricity demand should always be modeled using Gaussian distributions

Question 9

Not yet answered

Marked out of 10

Below are shown four different time series A, B, C and D. Which of these time series are **definitely not stationary?**



- a. A and C
- b. A and B
- c. B and C
- d. A and D

Question 10

Not yet answered

Marked out of 10

Select the CORRECT statement

- a. The impulse response of a causal filter F, is defined as $\begin{bmatrix} h_0 \\ h_1 \\ \dots \\ h_{n-1} \end{bmatrix} = F(X^T X)^{-1}$, where X is the design matrix containing all the discrete samples of the regressors.
- b. Electricity demand is generally uncorrelated with ambient temperature
- c. The deseasonalizing filter of periodicity T maps an arbitrary time series $Y_t, t = 1, \dots, n$ into a time series $X_t = R_T Y_t$ such that $X_t = \sum_{k=0}^{T-1} Y_{t-k}$.
- d. A stationary time series is equivalent to white noise with a fixed mean and variance, and thus is not predictable