TEMPERATURE PREDICTION

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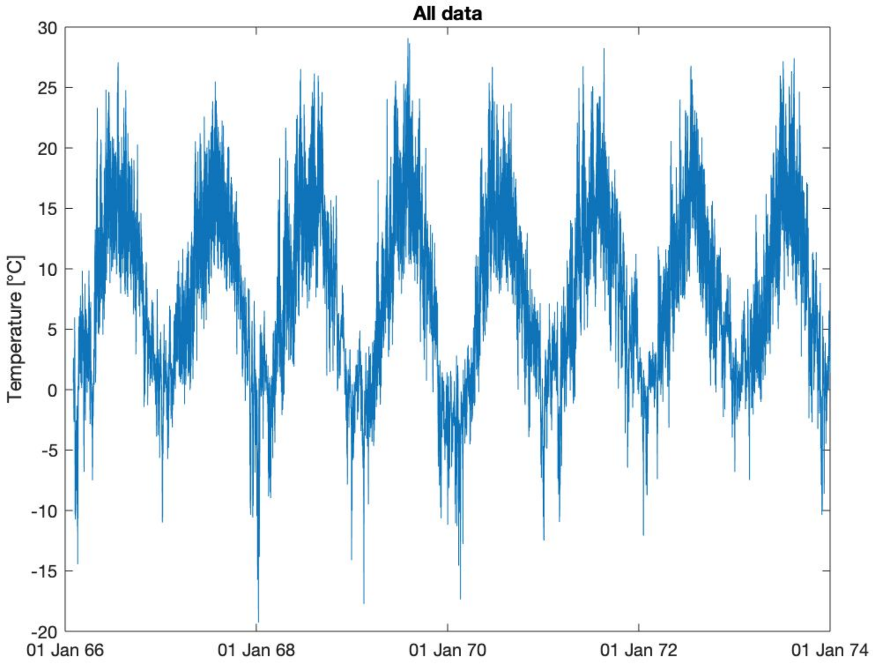
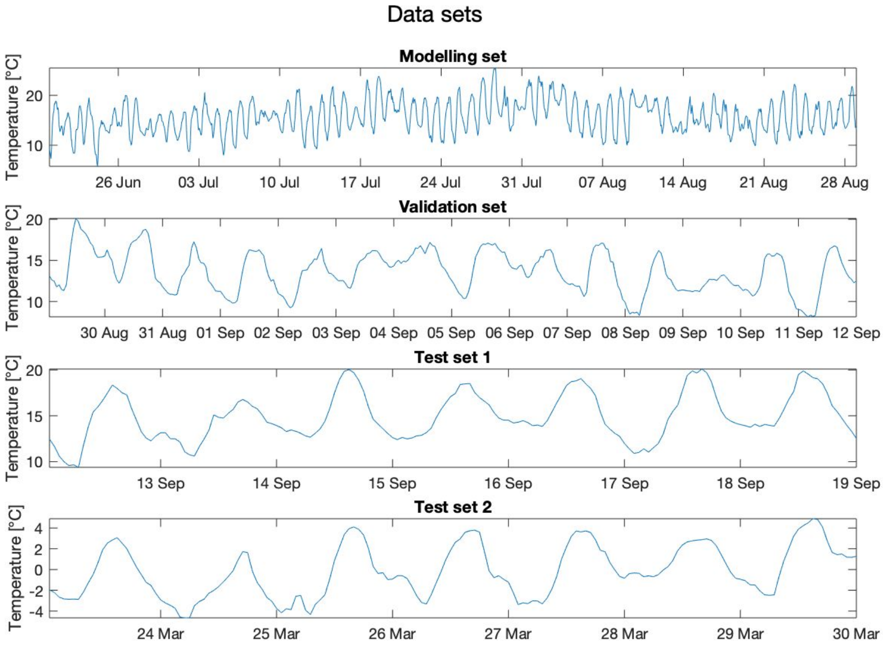
Data selection

Data selection



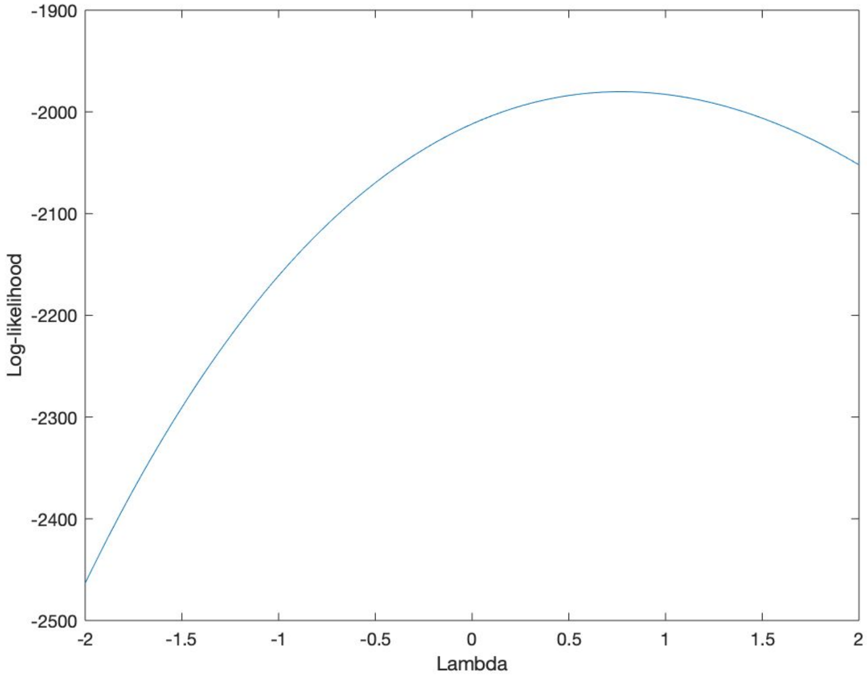


Summer of 67 and March of 68

Trends and transformations

Maximum log-likelihood: 0.71
no transformation

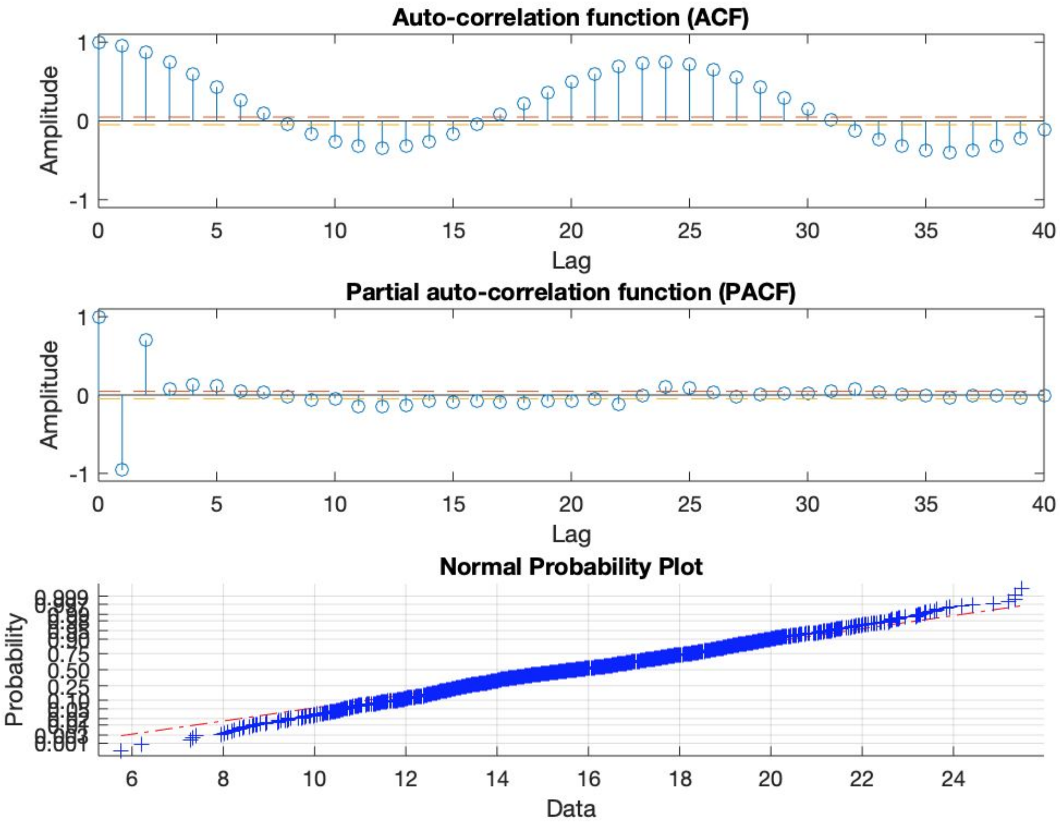
`testMean.m` suggested no deterministic trend



ARMA

ACF & PACF

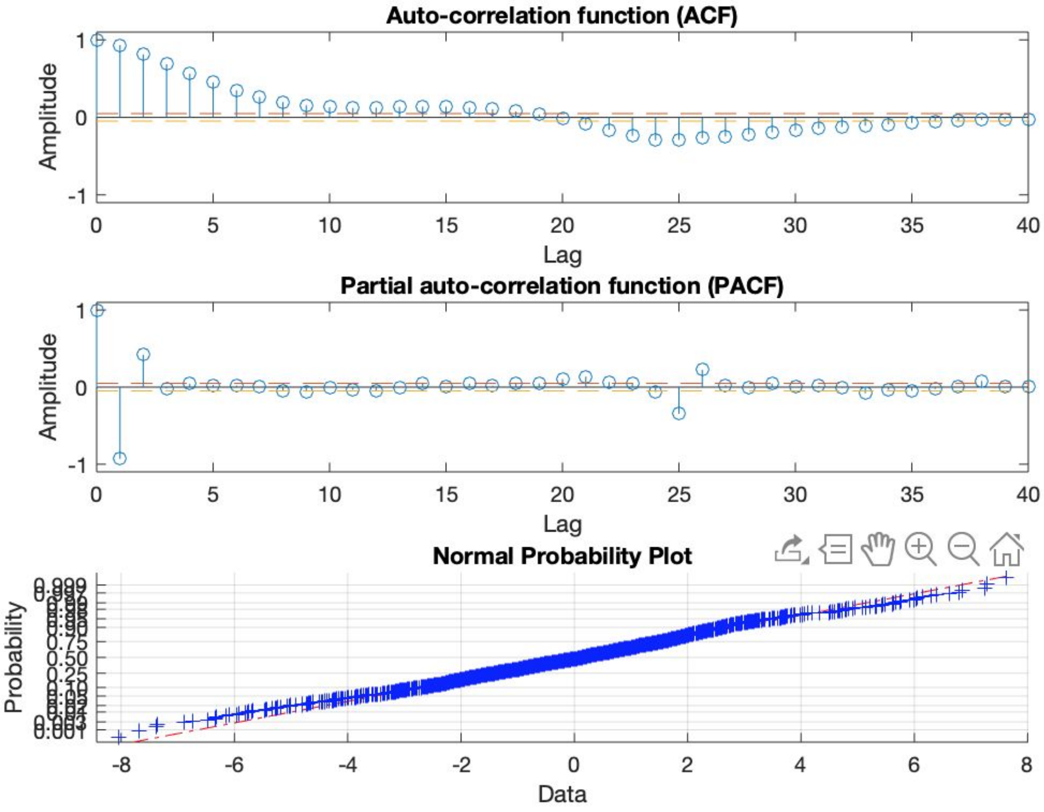
Strong 24 hour seasonality



Differentiate to remove season

No more seasonality

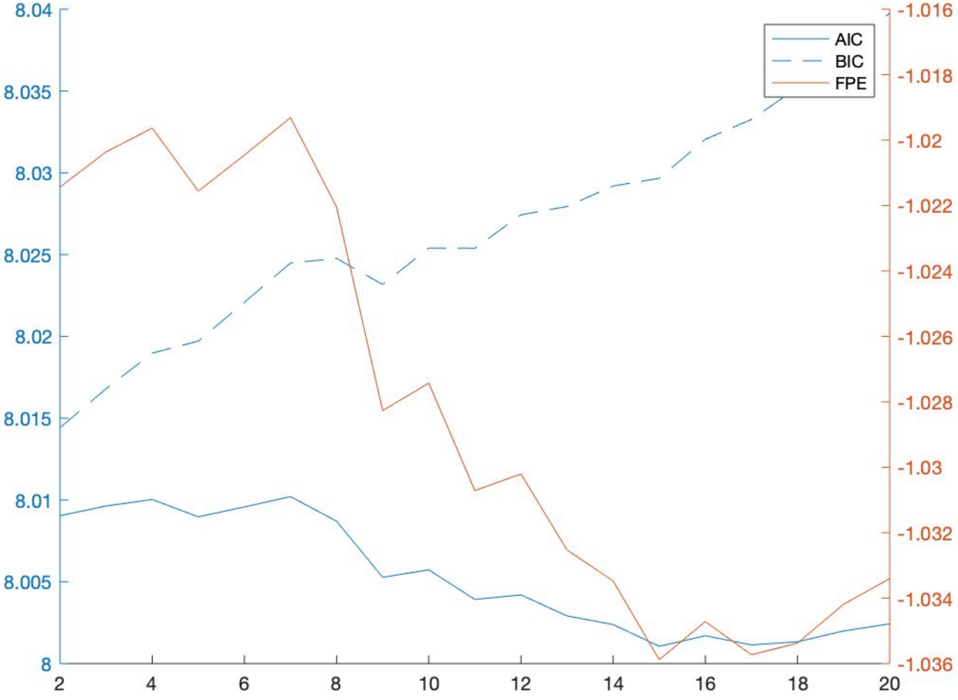
Time to start modelling



Choosing model orders

MA(24)-term to compensate for differentiation

AR(15) seems good

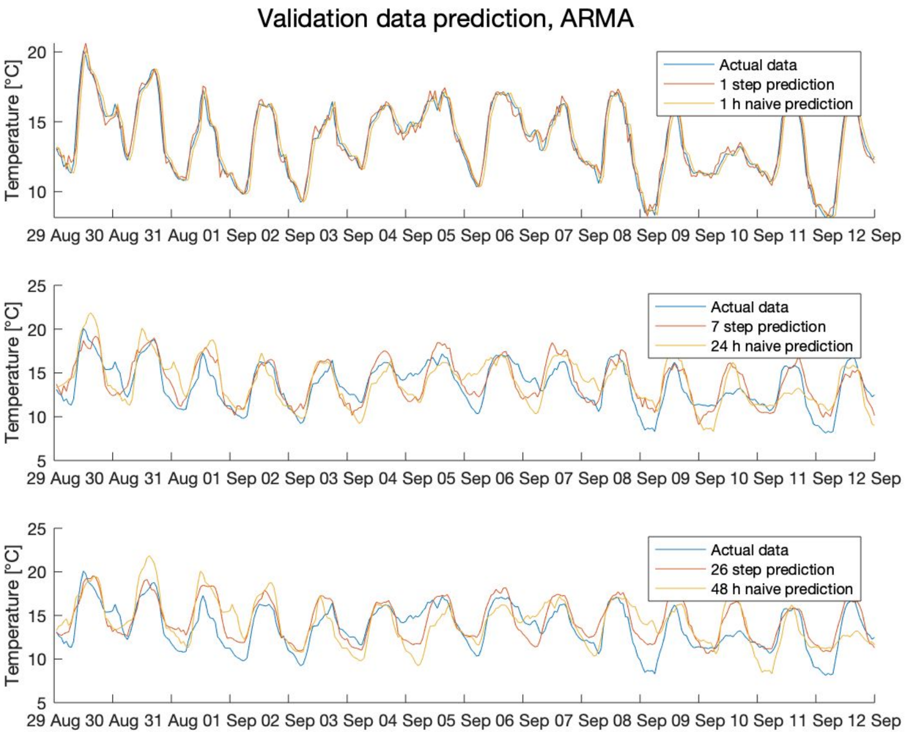


ARMA(15, 24)

After removing insignificant parameters:

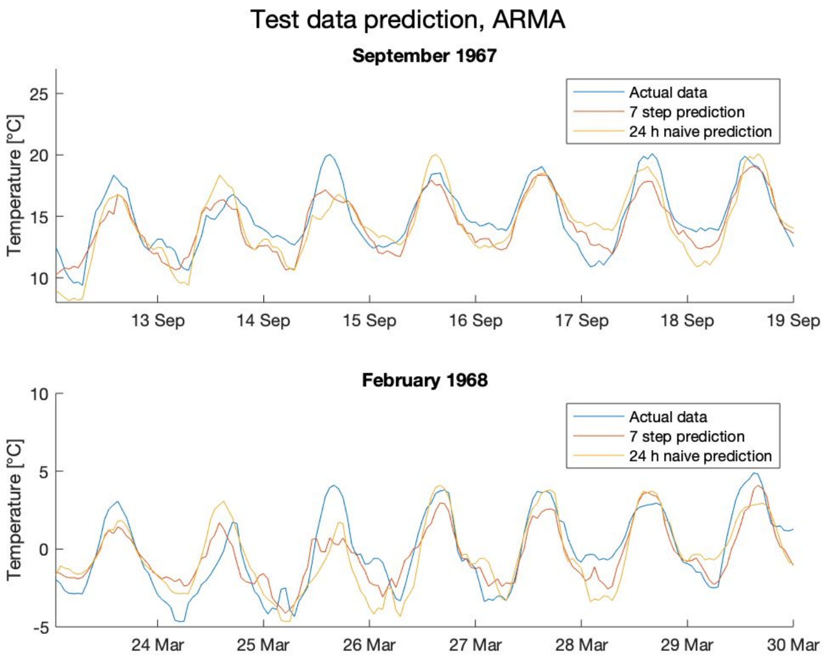
A: 8 remaining terms

C: Only z^{-24}-term



Model prediction	1 step	7 steps	26 steps
Naive prediction	1 h	24 h	48 h
Prediction residual variance	0.222	2.375	2.533
Naive residual variance	0.531	3.836	4.814

Validation



	Sep. 1967	Mar. 1968
24 h naive predictor	2.549	2.355
ARMA 7 h	1.447	1.736

ARMA Test

ARMAX

Introducing input signal

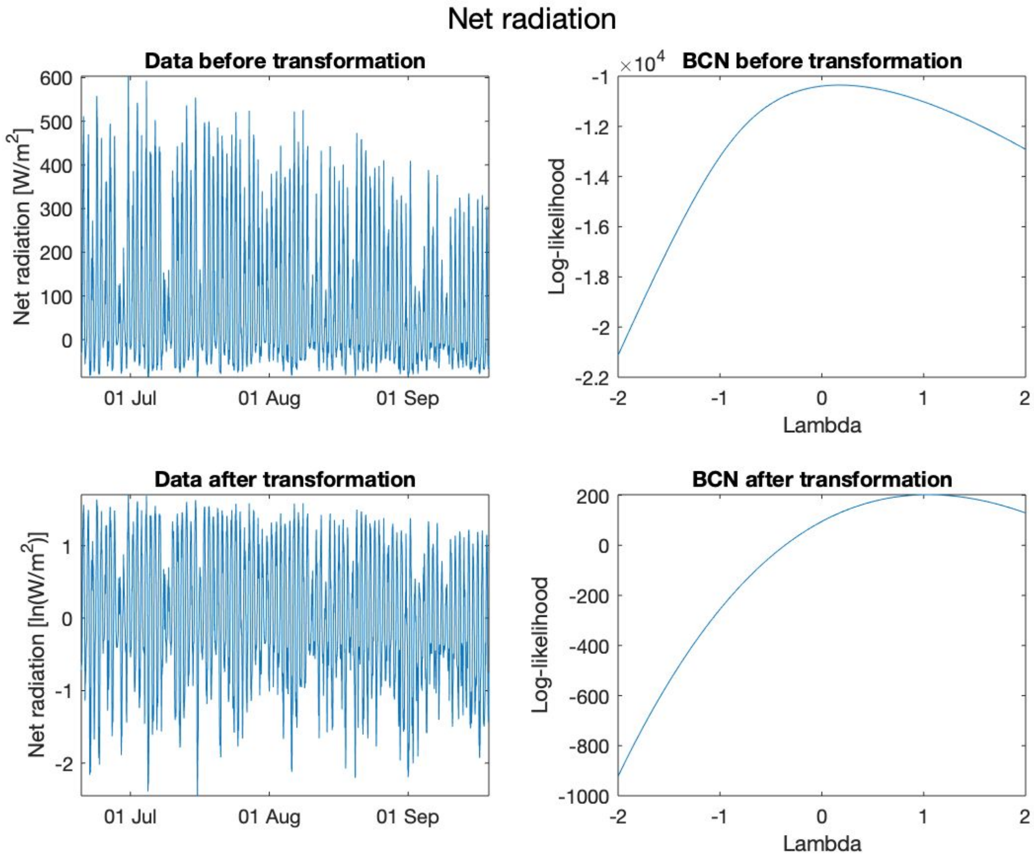
Max log-likelihood before transformation: 0.18

Transformation:

$$\boldsymbol{x} := ln(\boldsymbol{x} - min\{\boldsymbol{x}\} + 11)$$

$$\boldsymbol{x} := \boldsymbol{x} - mean\{\boldsymbol{x}\}$$

Max log-likelihood after transformation: 1.03



Removing season

- Fitted AR(24) with only z^{-24}-term
- Used resulting model to remove seasonality

Modelling input signal

- Fitted ARMA(12,24) with only z^{-24}-term in MA-part
- Removed least significant AR-terms one by one until FPE reached its maximum
- This was done automatically using or own function `removeInsignificant`

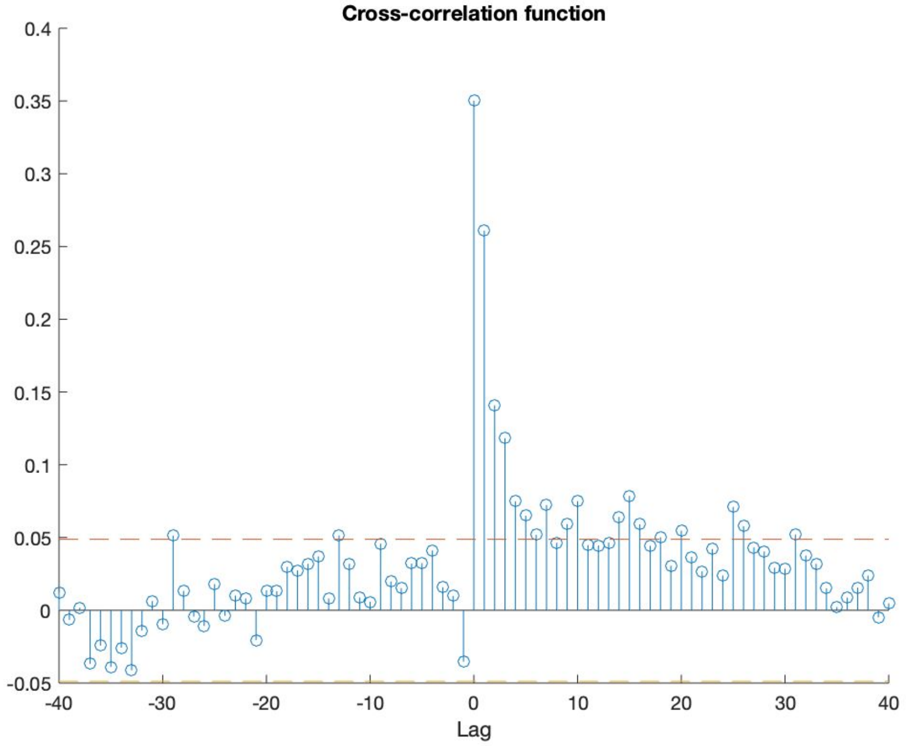
Finding transfer function

We calculated

$$w_t = \frac{C3}{A3\nabla_{24}}\boldsymbol{x}$$
$$\epsilon_t = \frac{C3}{A3\nabla_{24}}\boldsymbol{y}$$

and plotted their cross-correlation

It suggests (s,r,d) = (0, 1, 0), however we found (s, r,d) = (0, 3, 0) to work best



Box Jenkins model

Our ẽ=y-Hx was best modelled as with an ARMA(6,2)

This yielded the following Box Jenkins model:

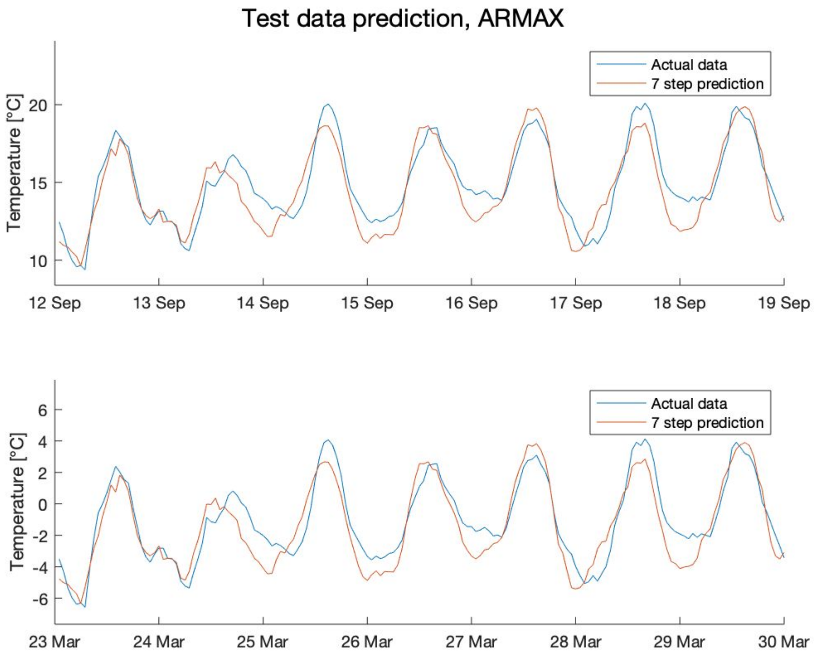
$$B(z) = 1.191 + 0.346z^{-1} - 1.083z^{-2} - 0.243z^{-3}$$

$$C(z) = 1 - 1.539z^{-1} + 0.607z^{-2}$$

$$D(z) = 1 - 2.875z^{-1} + 3.14z^{-2} - 1.636z^{-3} + 0.417z^{-4} - 0.037z^{-6}$$

$$F(z) = 1 - 0.0.518z^{-1} - 0.986z^{-2} + 0.520z^{-3}$$

ARMAX Test



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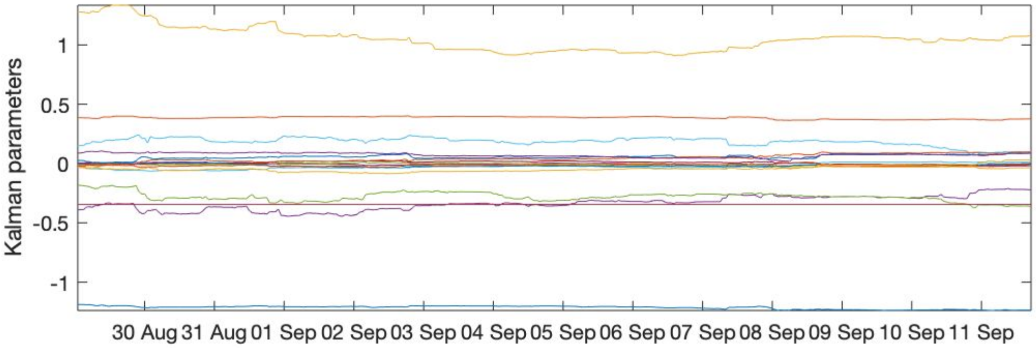
ARMA 7 h	1.447	1.736
ARMAX 7 h	1.147	1.679

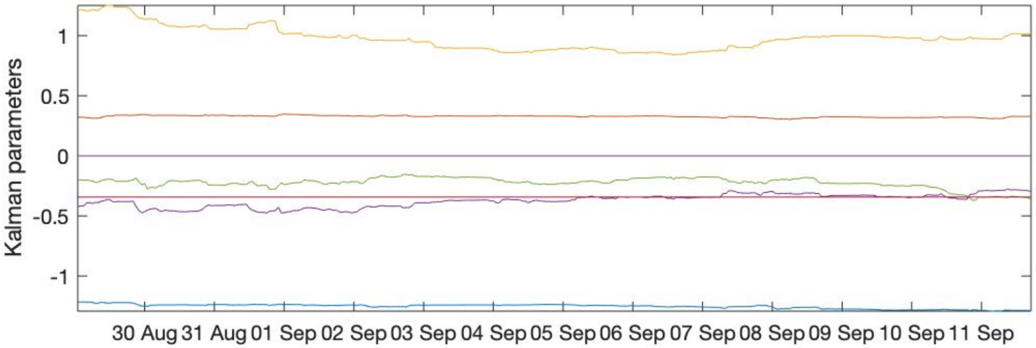
Kalman filter

Kalman filter

$x_0 = [A(2:\mathrm{end})\ \ B\ \ C(2:\mathrm{end})]$

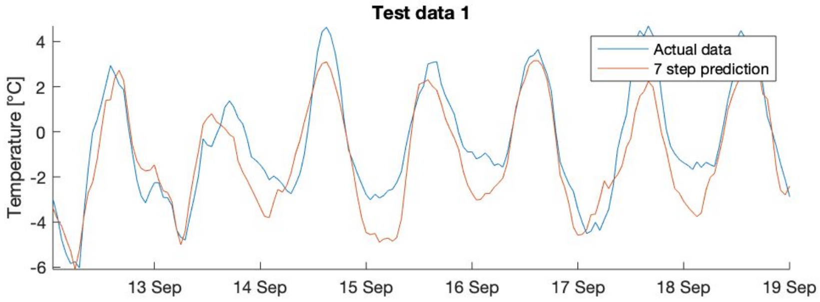
$C = [\hat{y}_{t-1} \dots \hat{y}_{t-p}\ x_t \dots x_{t-r}\ \hat{e}_{t-1} \dots \hat{e}_{t-q}]$

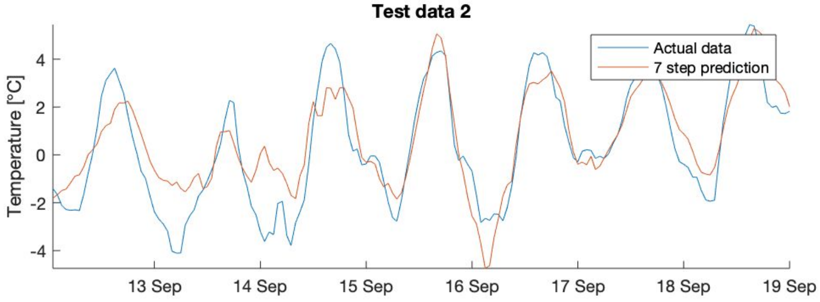




If $-0.2 < \bar{x}_i < 0.2$ we set $x_i = 0$

This removed 12 of 18 parameters





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ARMAX 7 h	1.147	1.679
Kalman 7 h	1.141	1.382

Kalman Test