**Assignment 10**

**Task 10.2**

**Chart

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**Chart

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**Chart, diagram, histogram

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**Text, email

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**Text, letter

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Here, ans is mw2.InputName

Here, ans is mw2.OutputName

Here, ans is getreg(mw2)

**Text

Description automatically generated**

**Chart

Description automatically generated with medium confidence**

**Chart

Description automatically generated**

**Chart

Description automatically generated with medium confidence**

**Graphical user interface, chart, line chart

Description automatically generated**

**Chart

Description automatically generated**

**Chart, line chart

Description automatically generated**

**Graphical user interface, text, email

Description automatically generated**

**Graphical user interface, text, application, email

Description automatically generated**

**Text

Description automatically generated**

Here, ans is mhw1.InputNonlineratity.BreakPoints, i.e. the piecewise affine input function in the screenshot above.

Chart

Description automatically generated

Chart

Description automatically generated with medium confidence

**Task 10.3**

Using nn = [1 1 1] gives the regressor set {y(t-1), u(t-1)}, so only the most recent input and most recent output is used in the model.

Here is using default wavenet and wavenet with 20 units

Chart, line chart

Description automatically generated

Both are almost equal, and they seem to follow the input data better than above.

Chart, histogram

Description automatically generated

Wavelet function does well on training (z1), linear does okay, but not too well.

Chart, histogram

Description automatically generated

On validation (z2) both models perform not too well even though the data looks similar to the training data.

Chart, line chart

Description automatically generated

On second validation (z3) mw2 wavenet model does terribly. Linear also doesn’t do too well, but it performs better.

Chart

Description automatically generated

The correlation analysis shows that both models are only autocorrelated at lag 0 and +-1, which makes sense given which regressors we use. They are also both uncorrelated with the inputs. Compared to earlier there is less autocorrelation, but is likely just due to the fact that we’re using fewer regressors.

Diagram, histogram

Description automatically generated

Hammerstein-wiener model does very similar to earlier on the training set (z1).

Graphical user interface, chart, line chart

Description automatically generated

The input non-linearity is strikingly similar in shape, amplitude and input values as earlier. The main difference is in the beginning, it starts at 1 instead of 0. The similarity in input is expected as the same input is used. It is also not too unexpected that it has similar shape and amplitude since the same input is used.

Chart

Description automatically generated

The linear block is also very similar, but doesn’t achieve the same amplitude as earlier. It also seems smoother, but this can also just be a rendering artifact. Again, the similarities is not too unexpected as the same input is used, and the input non-linearity is similar to earlier.

The earlier regressors for input is just one input regressor with lag 3 instead of 1, and this indicates that there is much similarity between lags in the input, which is confirmed by looking at the input (first image) where we see that it is a square wave, and there is only change a few times.

Graphical user interface, chart

Description automatically generated

It’s in the output non-linearity that we see the biggest difference in both output range (x-axis), amplitude (y-axis) and shape.

A reason for this can be that the small dissimilarities from the two earlier blocks have now compounded so the output is very different.

Chart

Description automatically generated

The deadzone non-linearity affects this model with fewer regressors more, where it cannot “detect”/model the small jump at around 100-140 seconds, while the previous model did manage to capture this.

Diagram

Description automatically generated

Mhw6 uses only 7 iterations, while mhw7 uses 30 iterations, and both uses the same deadzone and saturation parameters. This shows that using more iterations yields better model (which is not surprising as it has more iterations to adapt to the data). One weird thing is that the deadzone for mhw7 is not as pronounced as earlier, but I’m not sure why…

**Task 10.4**

First wavenet model with 8 units training on z3

Chart

Description automatically generated

Validating on z1

Histogram

Description automatically generated

It does okay, but it seems like z3 is much harder to model than z1, which can make sense as it has more and faster variation.

The first Hammerstein wiener model with piecewise non-linearities does well modeling z3

Chart

Description automatically generated

On validation on z1 it also does okay, but struggles with the smaller one in the middle.

Chart

Description automatically generated with medium confidence

The change in performance might be due to different levels of excitation in the different datasets.