Lab 01

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Task 1

In this task I had to implement a ARMAX processes and do data transformations on the data, I have read into the variable *u*. Regarding this, I had written down the first two exercises in the script.

3/4/5/6. Plot the original and transformed data

Regarding these exercises I had plotted and transformed the data as it can be seen on *[Figure 1]* with the colors accordingly.

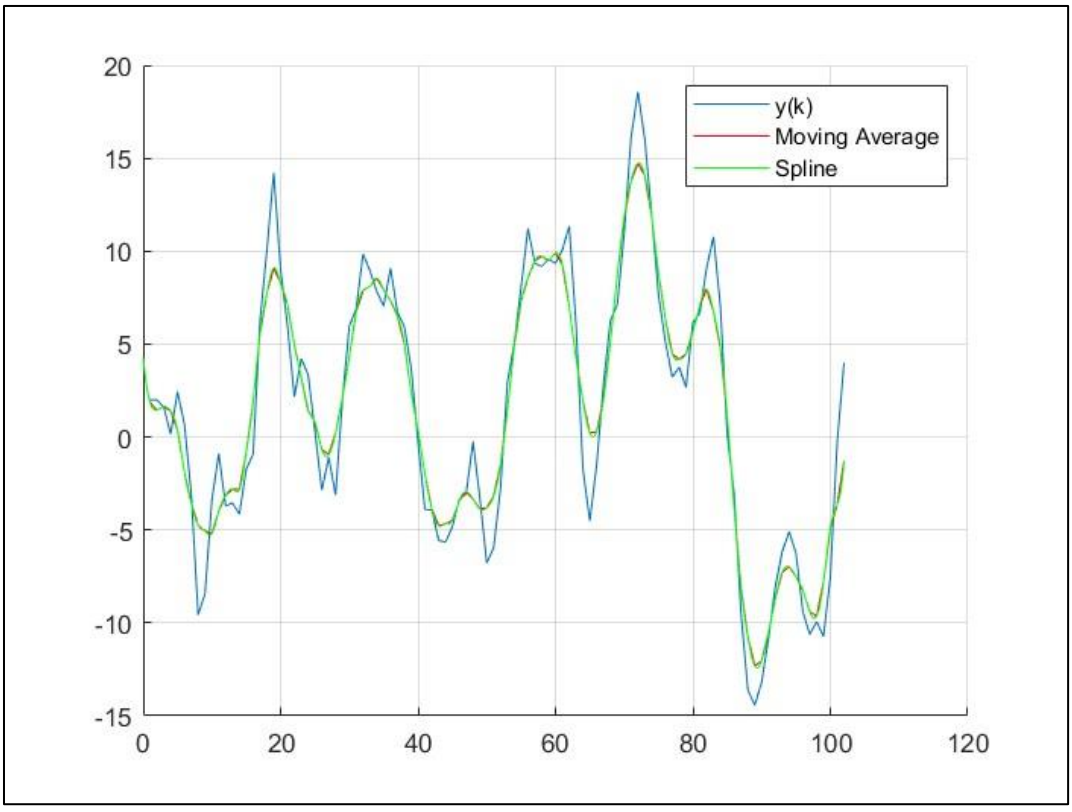

Figure 1 Original and transformed data

7. *Calculate the first, second and third derivative of the spline using diff:*

I have calculated the first, second and third derivative of the spline and changed the sampling time sizes accordingly.

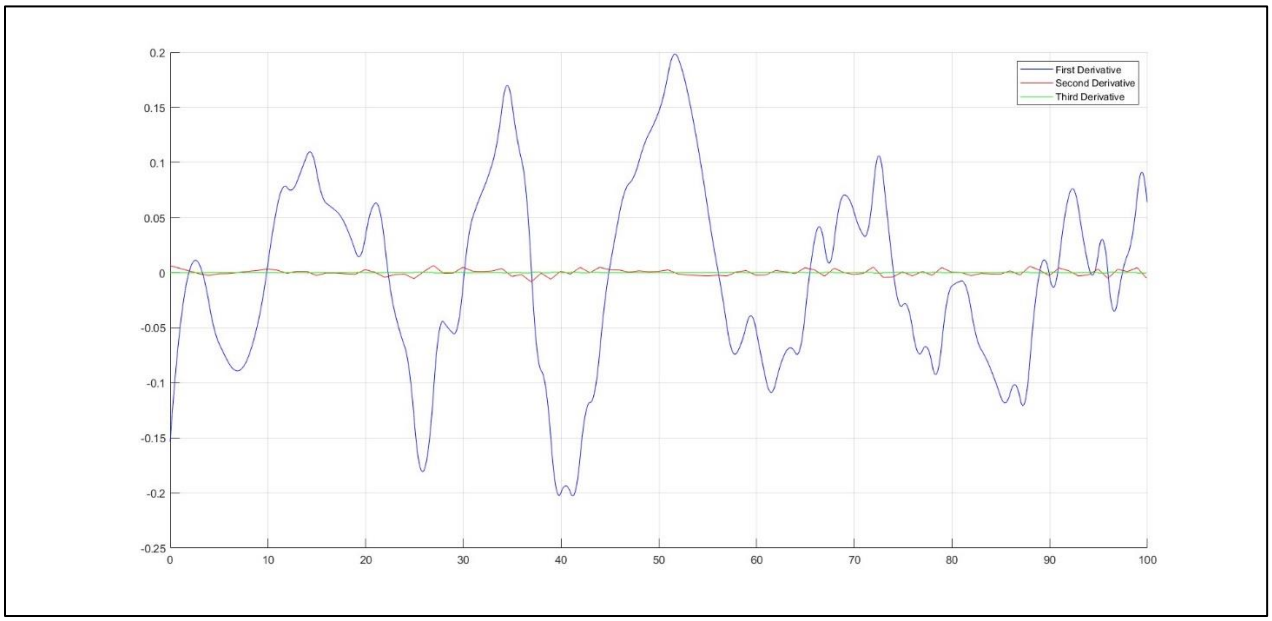

Figure 2 First, Second and Third Derivative of the spline.

As the following *[Figure 2]* shows, the first derivative of the spline is shows the slope or rate of change of the curve, having closly related changes in its sctructure to the original spline. The second derivative is curvature, rate of change of the slope. The third derivative supposed to show the changes in the curvature. As each derivative of a spline shows finer and finer details, the peaks height's drop rapidly.

Task 2

In the second task named probability recap I had to work on a probability density function, with the providied data in *X*. The first two exercises are highlighted in the script.

3. *Plot the multivariate probability density function:*

As the exercise mentioned, it is a 3D plot, with the provided values mentioned in the script. I had chosen the *mesh()* function for visualisation.

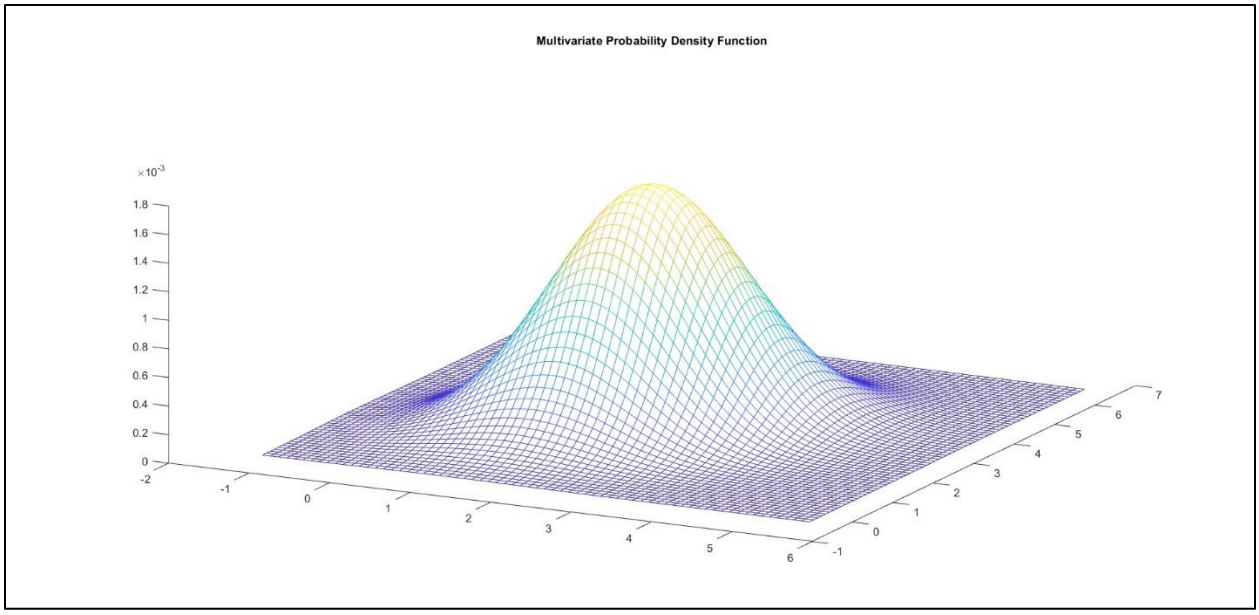

Figure 3 Multivariate Probability Density Function

4. *Check the positive definiteness of the covariance matrix:*

$$\begin{bmatrix} 0.9979 & 0.2905 \\ 0.2905 & 0.9920 \end{bmatrix}.$$

This is the covariance matrix, I have worked with. It is indeed symmetric, however, it is not true, that it is positive definite, as for the the *chol(A)* function it returns false, which means that this matrix does not has all all positive eigenvalues.

5. *Considering the covariance matrix, what can you tell about the independence of the two random variables that belong to the X and Y axes?*

In the covariance matrix, we can see, that the off-diagonal elements have some level of positive correlation. However, from this we can not assume a very strict dependency between them(there can be), we can only state, that they are not independent as they are not zeros.