ASSIGNMENT #4

Determining and removing drawbacks of exponential and running mean. Task 2

Group 2

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Part 1. Comparison of the traditional 13-month running mean with the forward-backward exponential smoothing for approximation of 11-year sunspot cycle

Using the same function that we had used in the first assignment sunspot dataset was loaded and parsed. We applied smoothing functions for sunspots and got the result presented in fig. 1.

To find the optimal coefficient for exponential smoothing, we programmed function that makes a test smoothing with changing coefficient alpha from 0 to 1. The step of each iteration was 0.01. After smoothing, the program was calculating deviation and variability indicators to rate it. A coefficient that had minimal indicators was taken.

$\alpha = 0.13$

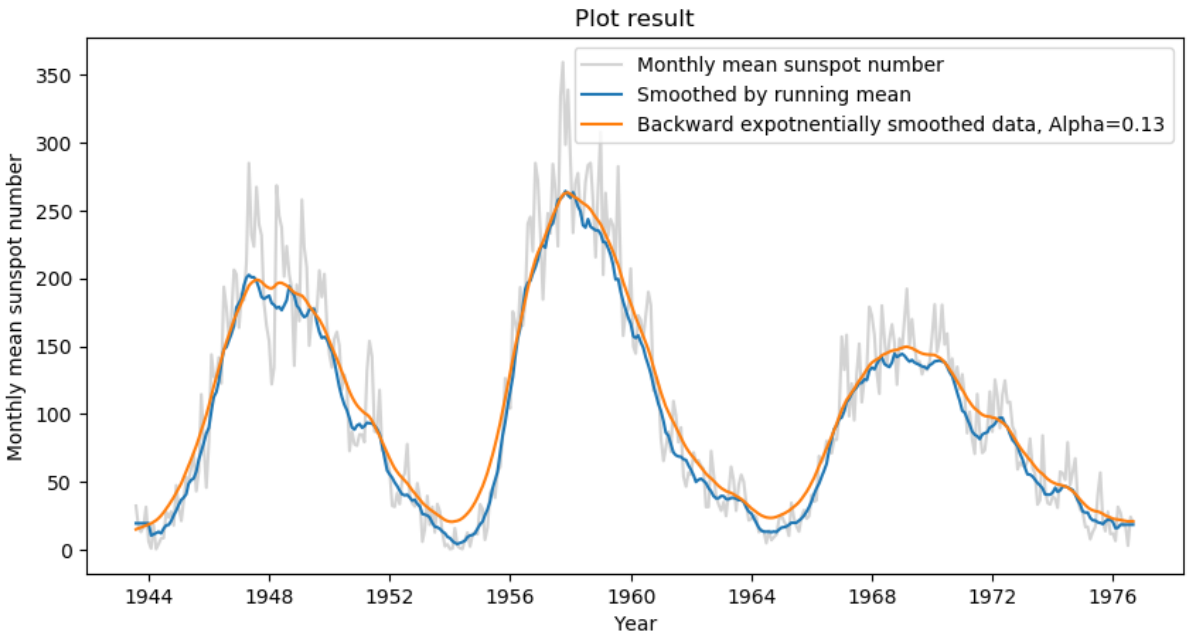

Figure 1

Examining the figure, the exponential smoothed curve has the same shift as a running mean smoothed and measurements. The exponential curve lost frequent small deviations and has a higher value of sunspot at moments when that amount was minimal.

Part 2 3D surface filtration using forward-backward smoothing

We have plotted noisy and true 3D surfaces. They are presented in fig. 2 and 3.

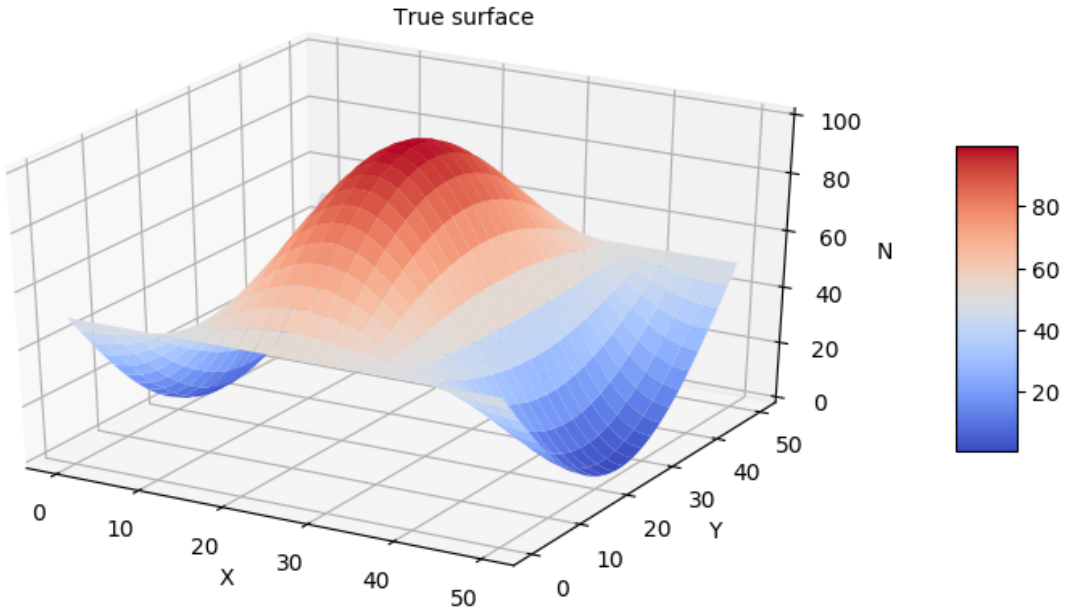

Figure 2

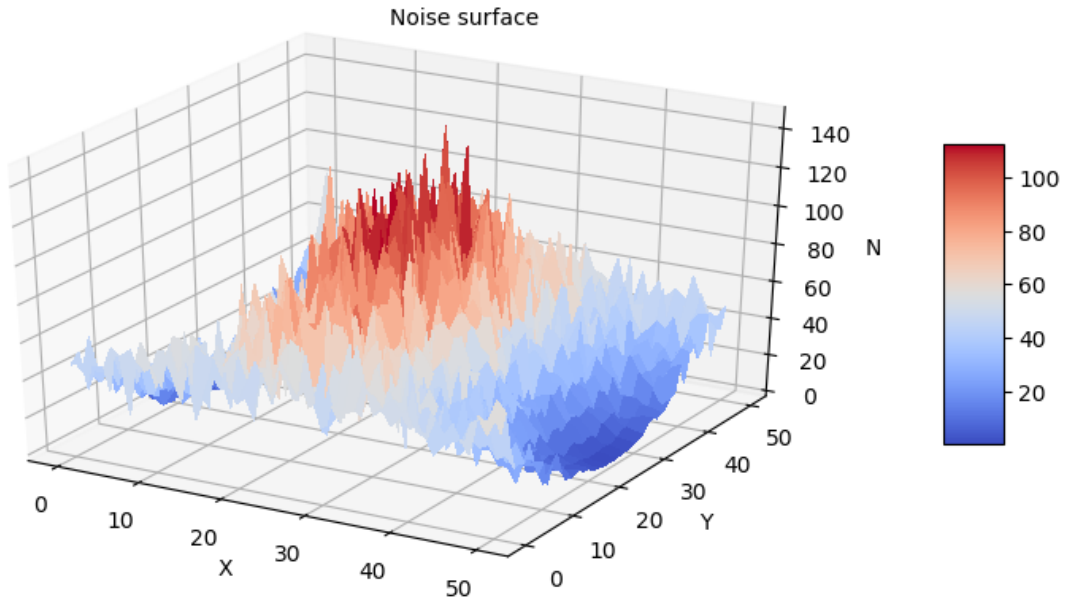

Figure 3

The variance of a noisy surface is equal to 122.

We applied forward-backward exponential smoothing with smoothing constant $\alpha = 0.335$ and got the result, which presented in fig. 4.

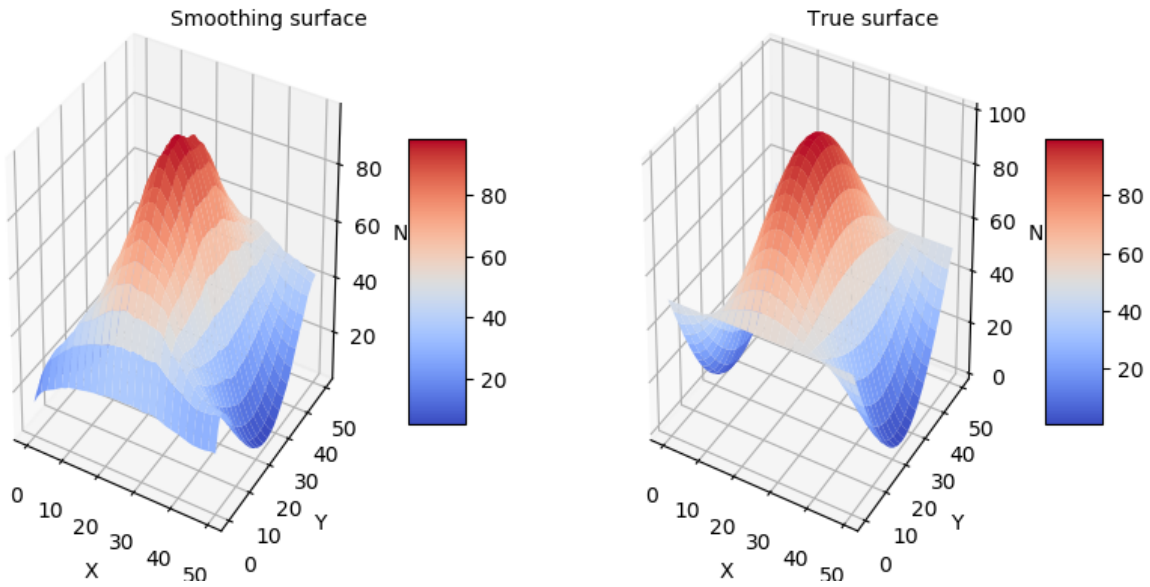

Figure 4

The smoothed surface is like the original one. The main difference between them is locating around edges.

The variance of a smoothed surface is equal to 29.

We have tried to use different coefficients that greater and smaller of previous.

When we were increasing alpha, the result surface had more noise in comparison with 0.335. Variance of a surface is increase.

When we were decreasing alpha, the result surface had less noise, but variance of a surface is also increase.

Conclusions

During the work we experienced in 3d plotting and learnt how to work with multidimensional experimental data. We also learned how to check, that chosen method gives effective solution at certain conditions. We simulated conditions under which optimal approximation methods are not working compared approximation methods when working with noised signal.