$\mathcal{GP}$ **Write Up 9**

October 31, 2018

Nature of the latent variable v

1. How v differs wrt to the kernel function

For the experiments shown below consider the signal below which is a mixture of three different sine waves:
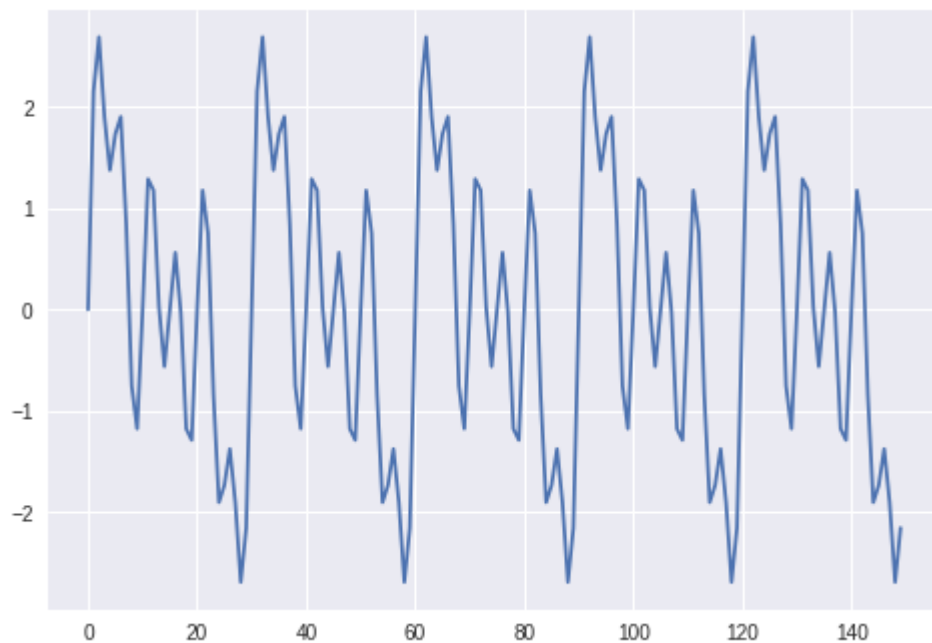

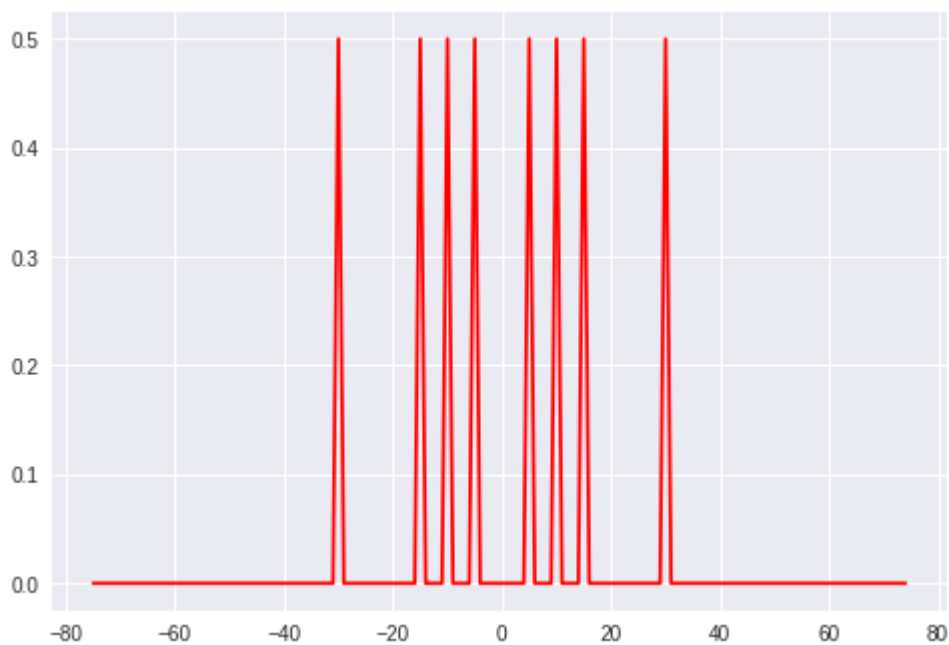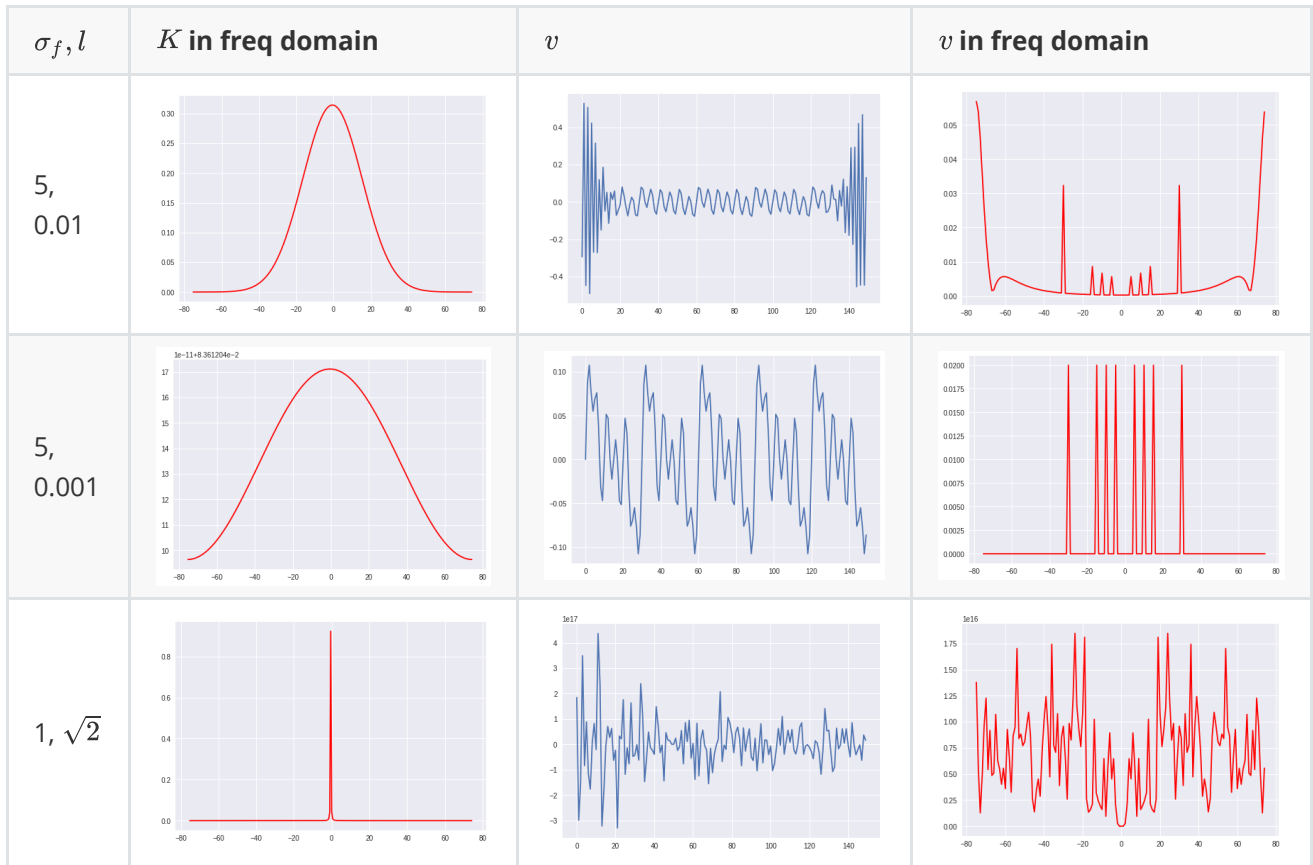**Figure 1**: The signal(y) we are trying to approximate

Figure 2: The signal(y) in the frequency domain

The signal(y) is noise free and we are interested in v such that $y = Kv$ where K is the covariance matrix of the signal.

For the covariance function we choose the squared exponential $k(x, y) = \sigma_f^2 exp(\frac{-||x-y||_2^2}{2l^2})$.

σ_f, l	K **in freq domain**	v	v **in freq domain**
5, 0.01			
5, 0.001			
1, $\sqrt{2}$			

From the above table only the first two kernels were able to recreate the signal y with machine precision(tolerance of 10^{-15}). These kernels have a wide spectrum and hence were able to approximate all the frequency components from our input signal. Infact for second case the spectrum is wide enough that v is similar to the input signal. What this means is that the kernel k should atleast encopass the frequency spectrum of the input signal. This is the reason why we were not able to achieve machine precision before.