Progress Review for Week 9

To model the new data that were created by stellar models a GP with input of Age, Effective Temperature and Mass were created to predict Rotation Period. To accommodate that a new a new kernel was used with three Exponentiated Quadratic kernels multiplied together. The lengthscales, amplitude and observational noise variance were all set as trainable parameters. The optimizer used was Adam. An attempt was made to employing stochastic gradient decent but was unsuccessful as the GP output was an array of 'null'. The learning rate in Adam was set to 0.5 through trial and error.

To describe the effect of the mass a new function was created. Initially the mass was not taken into account assuming it's correlation with Teff would be sufficient, however it was not and it resulted in large extremes towards the boundaries of the prediction. Several dependencies were attempted on mass, ln(m) and exp(m) and power laws. Through trial and error, the most successful dependency so far was multiplying the Barnes 2007 Equation 1 with m^0.5. Figure 1 shows the results of data – prediction. The data range from -25 to 5 and mostly centred at zero, a significant improvement from the 0 to 80 range of the previous mean function.

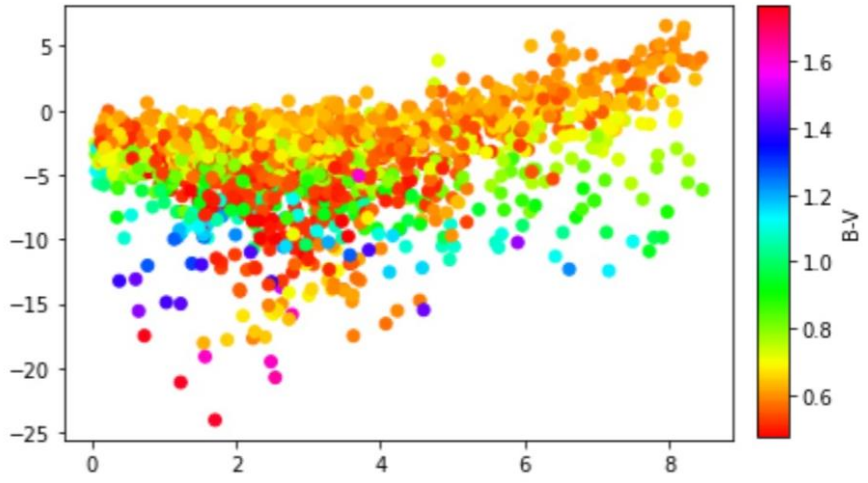

Figure 1: Data - Mean Function in Age vs Rotation

The results were fairly successful but need improvements. Figure 2 shows that the results overall follow a straight line and all fall on the y=x within one standard deviation. Note that in Figure 2 the variance is shown (std**0.5) as the std is too large to create a readable figure.

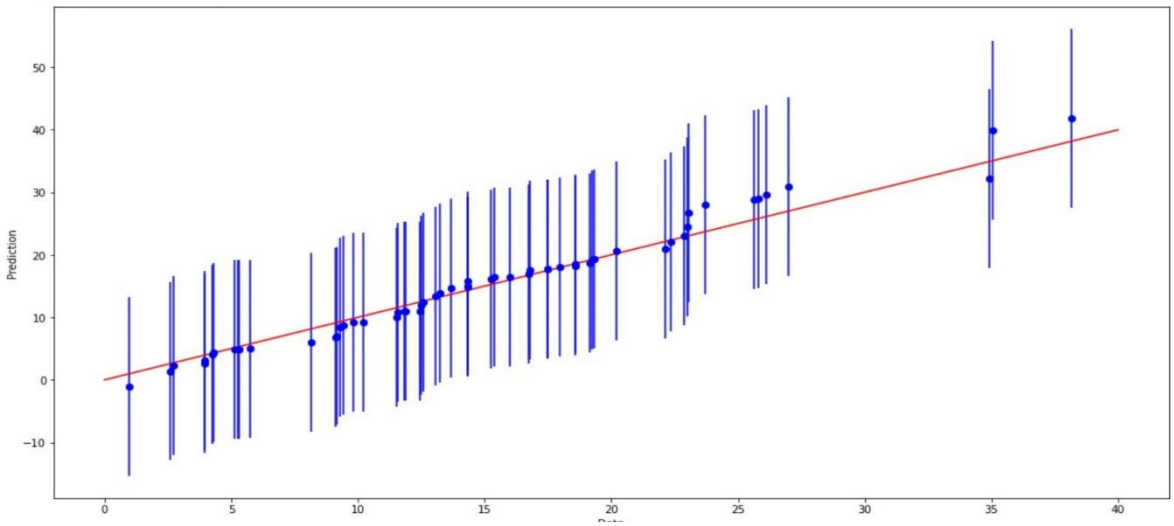

Figure 2:Prediction against Data

Figure 3 shows the difference between data and prediction divided by the variance. Overall, it resembles as Gaussian distribution centred at 0, as expected. However, plotting it against a N(0,1) distribution shows that it is too narrow. This is probably due to the large uncertainties.

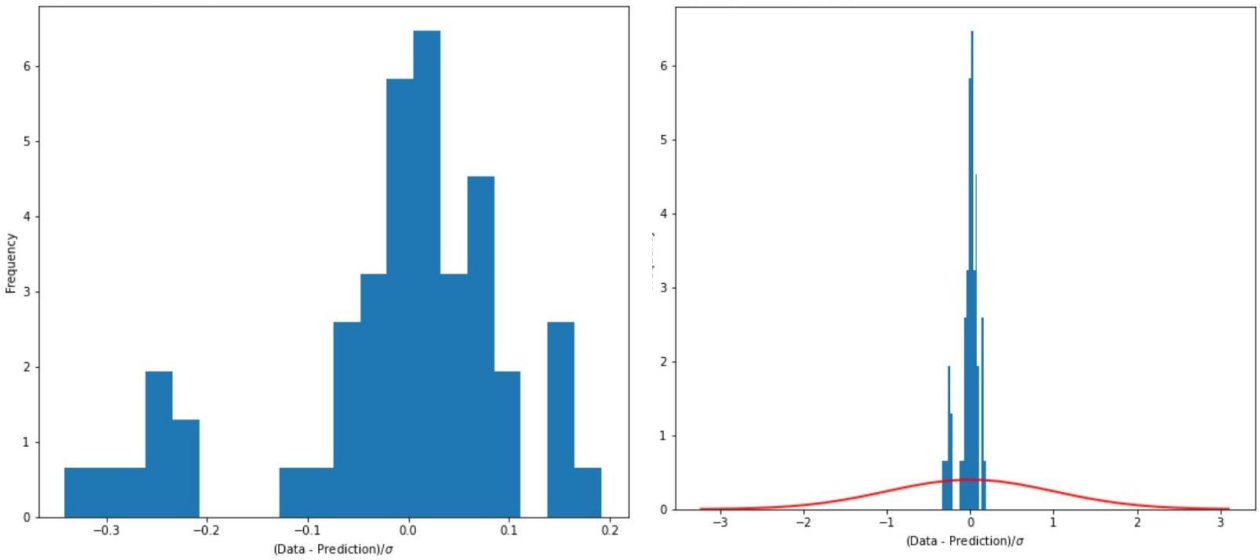

Figure 3: Data - Prediction divided by variance

The problems regarding the large variance are expected to be solved through a better mean function. An attempt was made to make the observational variance constant but the results were not satisfactory with the prediction vs data not following the y=x line without any significant change to the uncertainties.

An additional GP model was created to explore the correlation between the different parameters. The purpose of this is to visualise the parameters and create a better mean function. Different GPs were fitted to different parameters.

Aims for next week:

- Improve the fit and uncertainties
- Explore if setting the mass power law as a parameter improves the fit
- Explore how good the training process is through TensorBoard