ASTP-720 Homework 6

Zach Diermyer

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Github Link: https://github.com/zrd7527/ASTP720.git

1 Problems 1 and 2

To start this problem I read the cepheid data text file and stored all of the information for each star into an array. I then appended each of those arrays to a data array. I use the distance modulus to find the "observed" absolute magnitudes in each band for each star. I then use the CreateModel function to find the best guess absolute magnitudes for each star. The function does this with a triple nested for loop which loops through different values of α, β, and γ and plugs them all into Equation 1. The result of this equation is found for each star and is then used to find the sum of squares. The function I made to find the sum of squares takes the observed absolute magnitude values and subtracts the model absolute magnitude values then squares the result. Whichever combination of the parameters finds the lowest sum of squares is returned as the best fit. The best fit values found are listed in Table 1. I found gamma to be 0 in all of the bands so this may be a result of the large uncertainty in my parameters or an artifact of the large loop that finds the value. In the same cell I plotted my model's expected value for each star along with the absolute magnitude data in that band. These plots are shown in Figures 1-4 and look to be a good fit for each band.

$$M = \alpha + \beta Log_{10}(T) + \gamma[Fe/H] \tag{1}$$

Band	V	J	H	K
α	-2	-3	-3	-3
β	-2.3	-2.7	-3.0	-3.1
γ	0.0	0.0	0.0	0.0
$\Delta\alpha$	1	1	1	1
$\Delta\beta$	0.1	0.1	0.1	0.1
$\Delta\gamma$	0.1	0.1	0.1	0.1

2 Problem 3

For this part I only made a minor change to the process I used in the first problem. I changed my function which finds the observed absolute magnitude to add and subtract the uncertainty from the apparent magnitude before finding the absolute magnitude. Then if the model's absolute magnitude
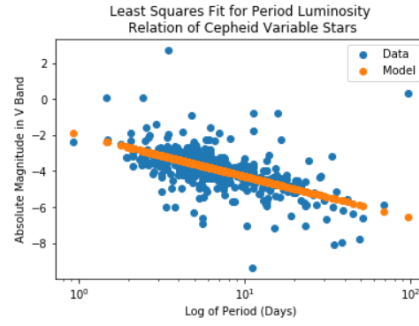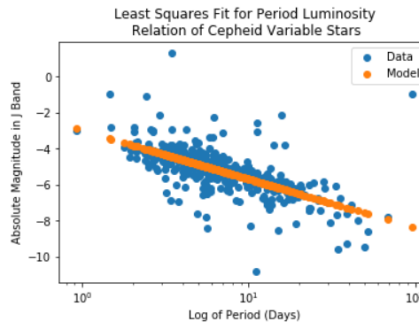
Figure 1

Figure 2

is lower than the low observed absolute magnitude, the sum of squares is found the same way as previously. If the model value is greater than the high observed value, the sum of squares is found as before. Finally if the model is between the two observed values then the residual for that star is taken to be zero. The new values for the parameter values are shown in Table 2. I found the same values as in problem 1. This may again be due to the large uncertainty in my parameters.

Band	V	J	H	K
α	-2	-3	-3	-3
β	-2.3	-2.7	-3.0	-3.1
γ	0.0	0.0	0.0	0.0
$\Delta\alpha$	1	1	1	1
$\Delta\beta$	0.1	0.1	0.1	0.1
$\Delta\gamma$	0.1	0.1	0.1	0.1

3   Bonus

To do the bonus question I created a function to find the χ^2 values. I found the χ^2 value in each band for the full model equation and the nested model given in Equation 2. The ν values I used were 449 and 450 for the full and nested models respectively. These numbers are the result of $N - k$
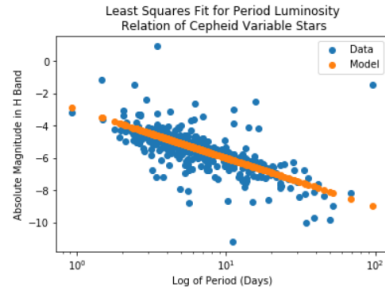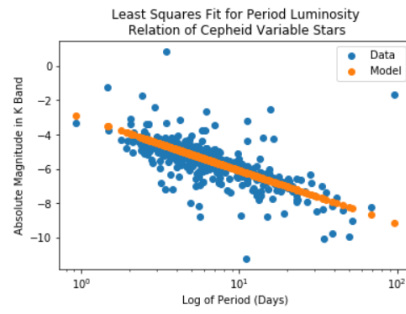
Figure 3

Figure 4

where N is the number of data points and k is the number of parameters. There were 452 stars in the data set, the full model had 3 parameters, and the nested model had 2 parameters. My F statistic, found using Equation 3, was 0 for all bands.

$$M = \alpha + \beta Log_{10}(T) \tag{2}$$

$$F = \frac{\frac{\chi^2_{nested} - \chi^2_{full}}{\nu_{full} - \nu_{nested}}}{\frac{\chi^2_{full}}{\nu_{full}}} \tag{3}$$