Assignment #6

Brendan Drachler
ASTP-720 - Computational Astrophysics

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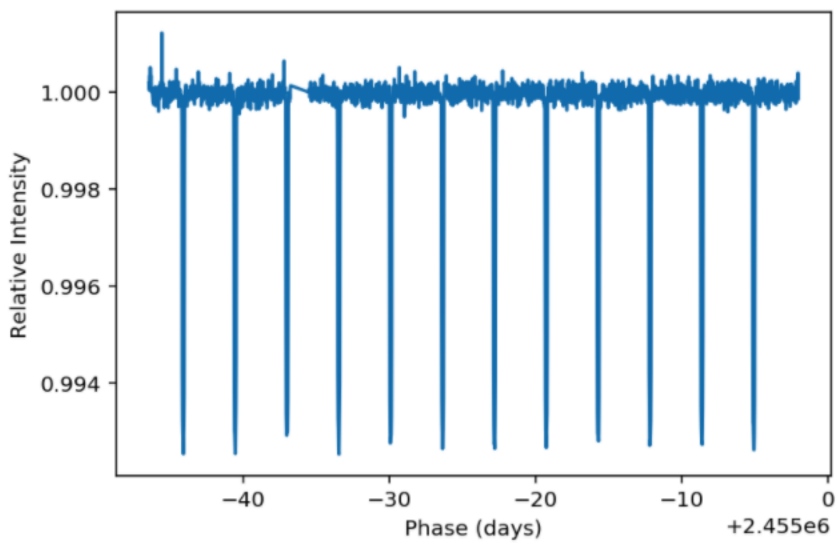
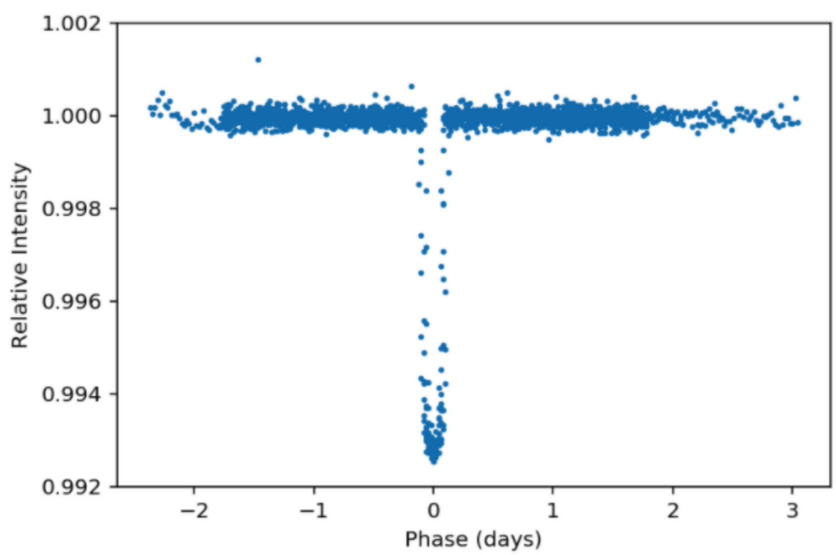
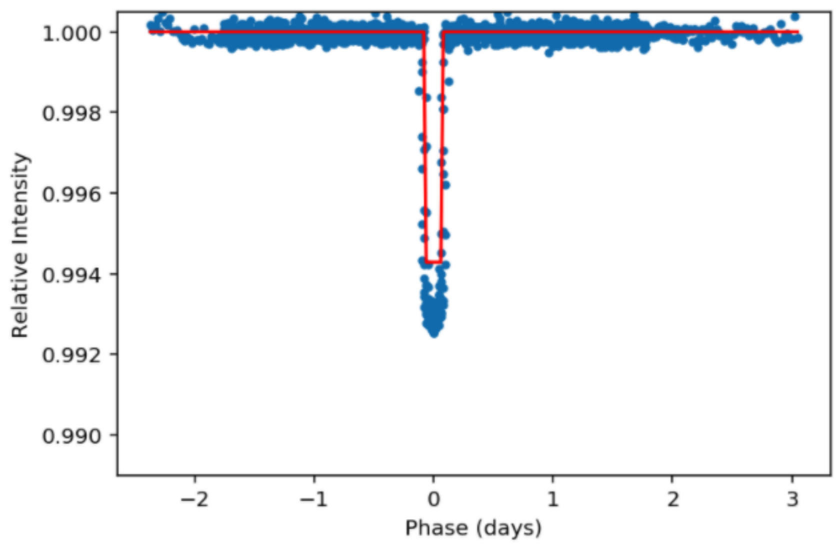
For this assignment I initially tried fitting the entire exoplanet lightcurve data as shown in Fig. 1.



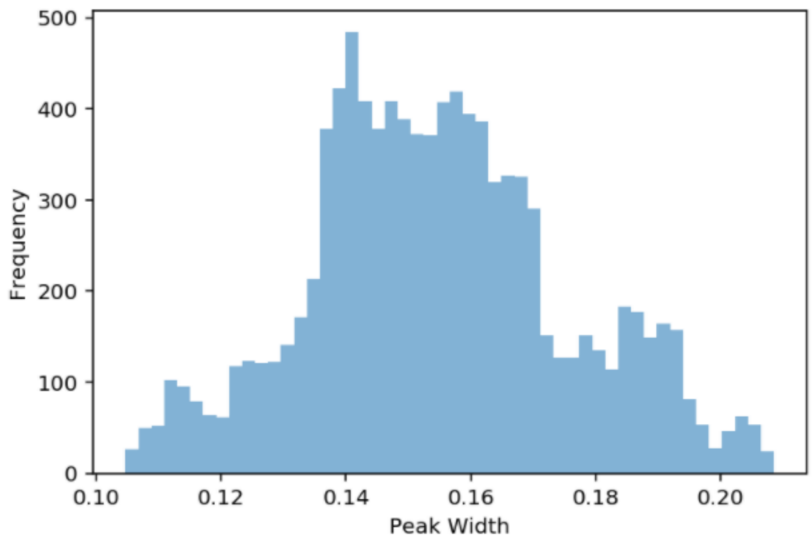
I was unable to come up with a function that could approximate the whole lightcurve. Therefore, I instead folded the lightcurve by using an awesome scipy function I didn't know existed - find_peaks! I used it to identify the local minima in the lightcurve and then stack them on top of each other. I then fit a boxcar function to Fig. 2.

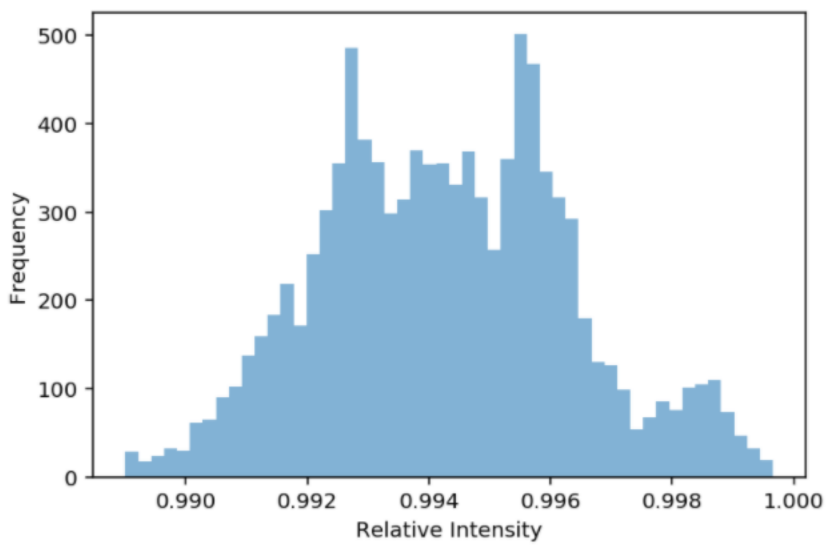


The MCMC (Metropolis-Hastings) Algorithm had a tough time approximating the width and amplitude of the lightcurve dip. I think it is due to the way I was searching the grid. At first, I was using a random number generator to move about the grid. Unfortunately, the algorithm failed to settle into the proper range of values because it jumped around at a magnitude not suited to the problem. In other words, we were trying to predict the difference between numbers like 0.994 and 0.996 but the random numbers were 3 orders of magnitude larger than that. It would be equivalent to trying to settle into a value of 5 with a random step-size of 1000 and a prior range on the order of $0 < n < 50000$. I was able to remedy this a bit by using a biasing factor on the random number generator to make sure I was doing a grid search at an order of magnitude that could actually settle into an appropriate value.
The final width and intensity I calculated for the dip in Fig. 2 were 0.155 and 0.994, respectively.



This is clearly a bad fit. The posterior distributions are shown in Fig. 4 and 5. You can notice that the biasing terms I put on the walkers enabled them to explore an appropriate range. Though, this is bordering on fine-tuning. But I'm not sure how else to solve it?





I calculate the radius of the planet to be $R_p = 0.135 R_\odot$. I ran out of time to compute the rest of the assignment - really, check the time of this commit!