Exoplanets Project

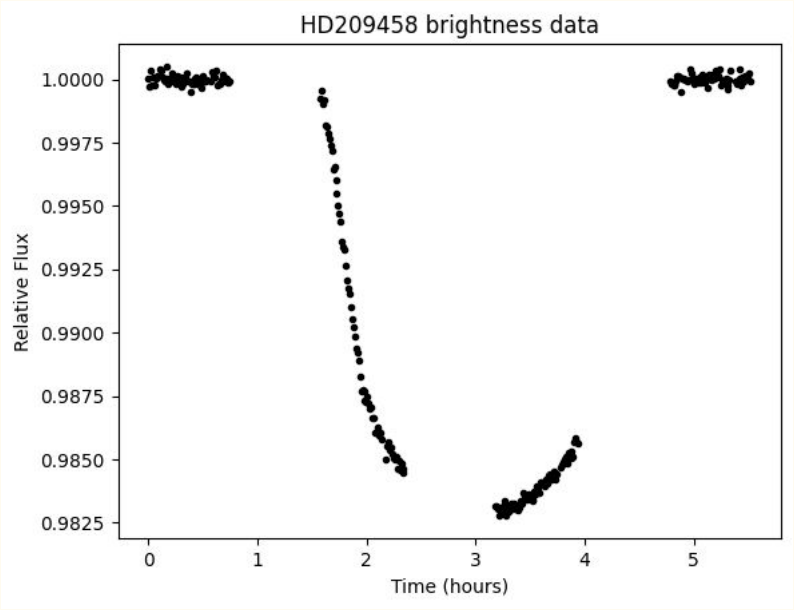
Zachary Cohen, Dechong Wang, John Wright

Motivation

- What can we learn about planets orbiting other stars?
- We can estimate exoplanet sizes by analyzing fluctuations in light levels of their stars
- This is called the **transit method**
- We want to apply this method

Methods

- Star: HD209458
- Brightness data from NASA exoplanets archive



Methods

- Fit a box model:

$$f(t) = 1 - \delta 1_{[t_0 - \tau/2, t_0 + \tau/2]}(t)$$

Using Bayesian methods.

Methods

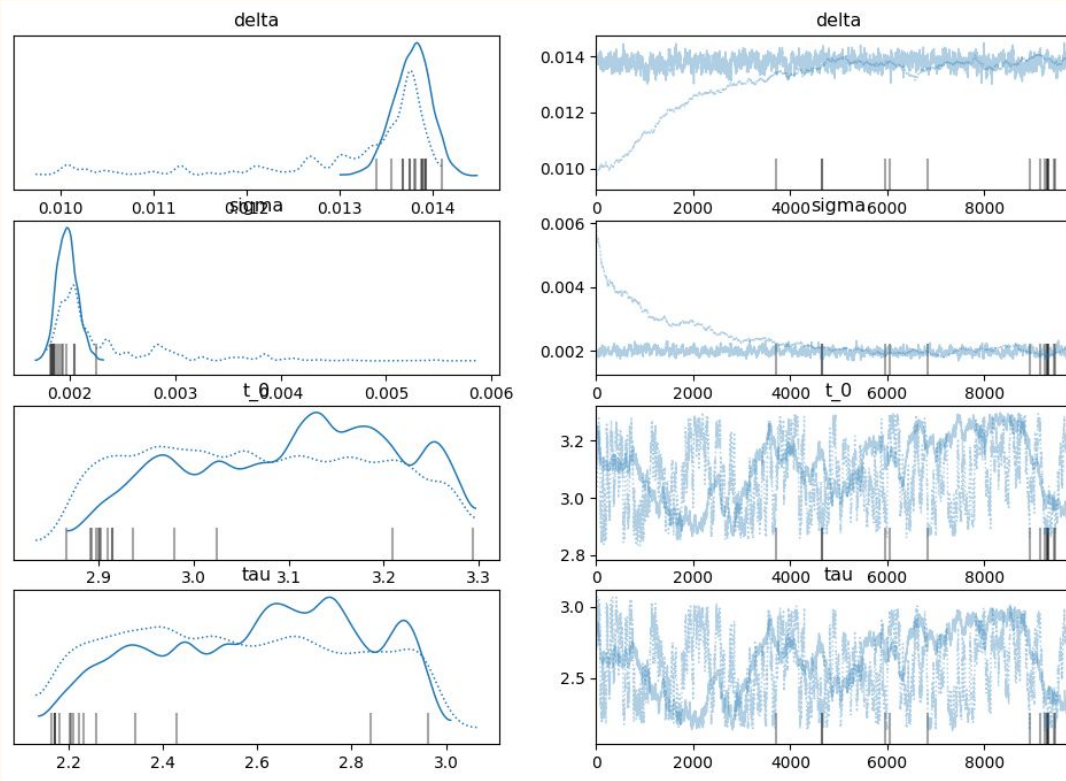
Our estimate of delta then allows us to estimate the size of the planet via the equation

$$\sqrt{\delta} = \frac{R_p}{R_S}$$

Results

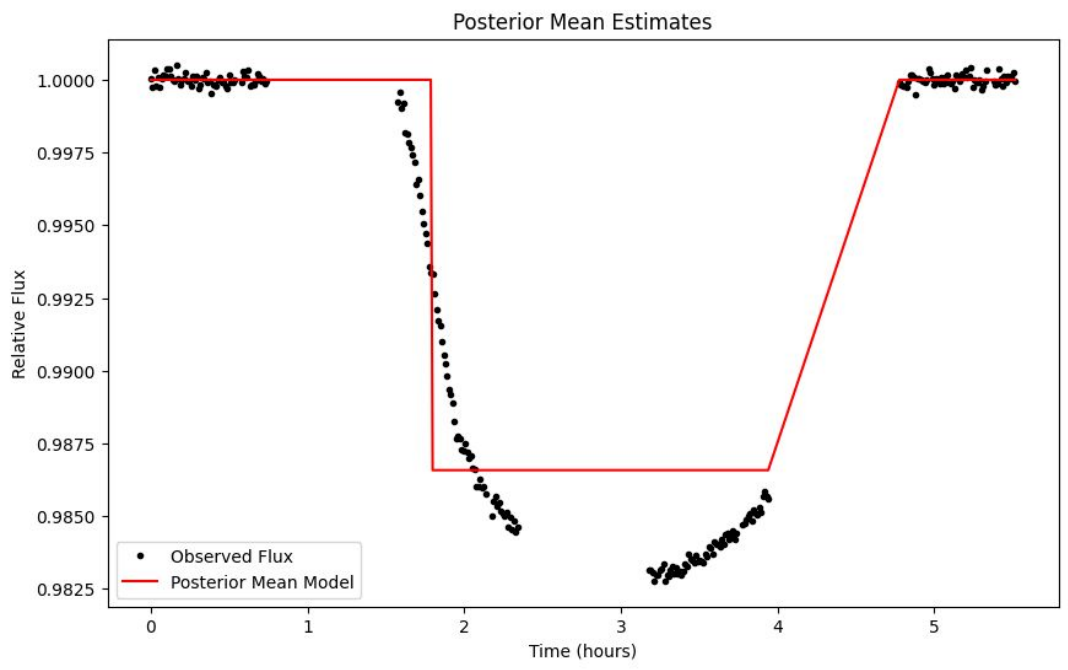
Posterior means (approximate)
delta : 0.014
t_0: 3.1
tau : 2.7

(sqrt(delta) approx 0.12)



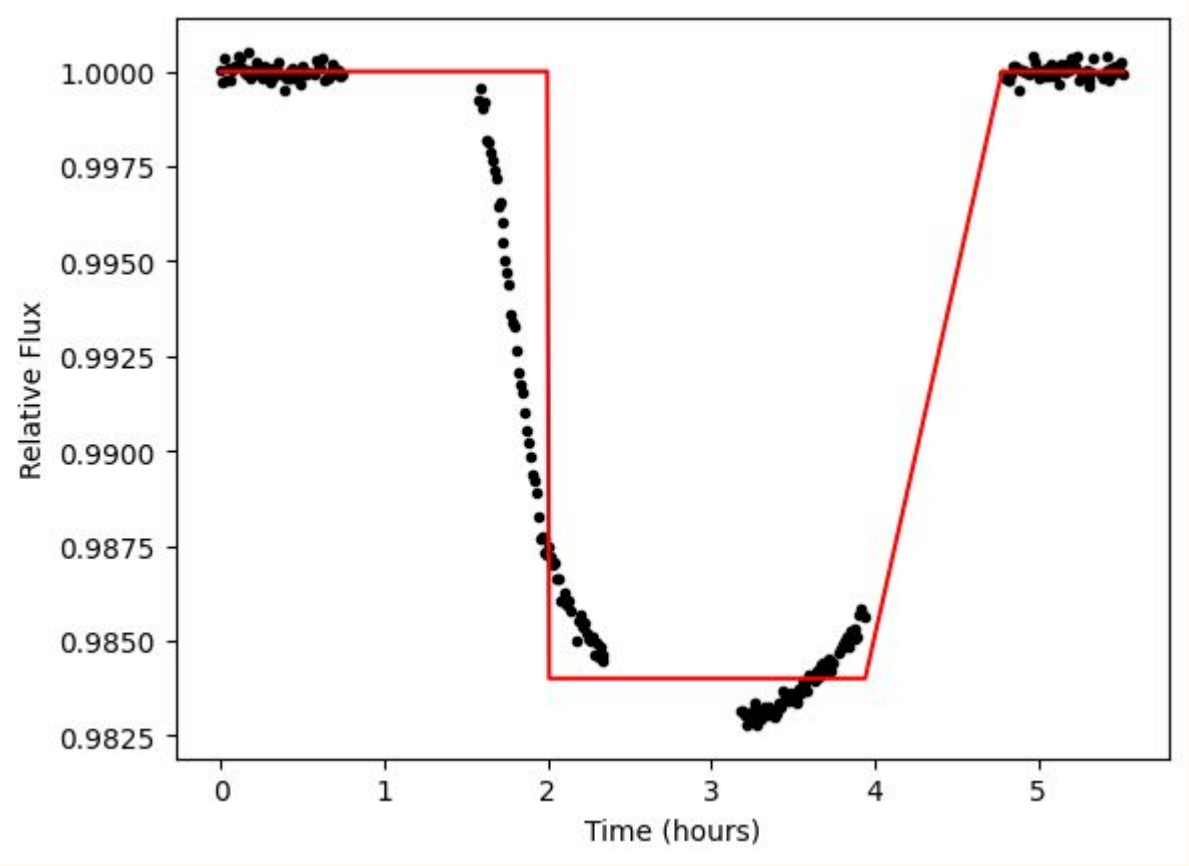
Results

Model using posterior mean estimates.

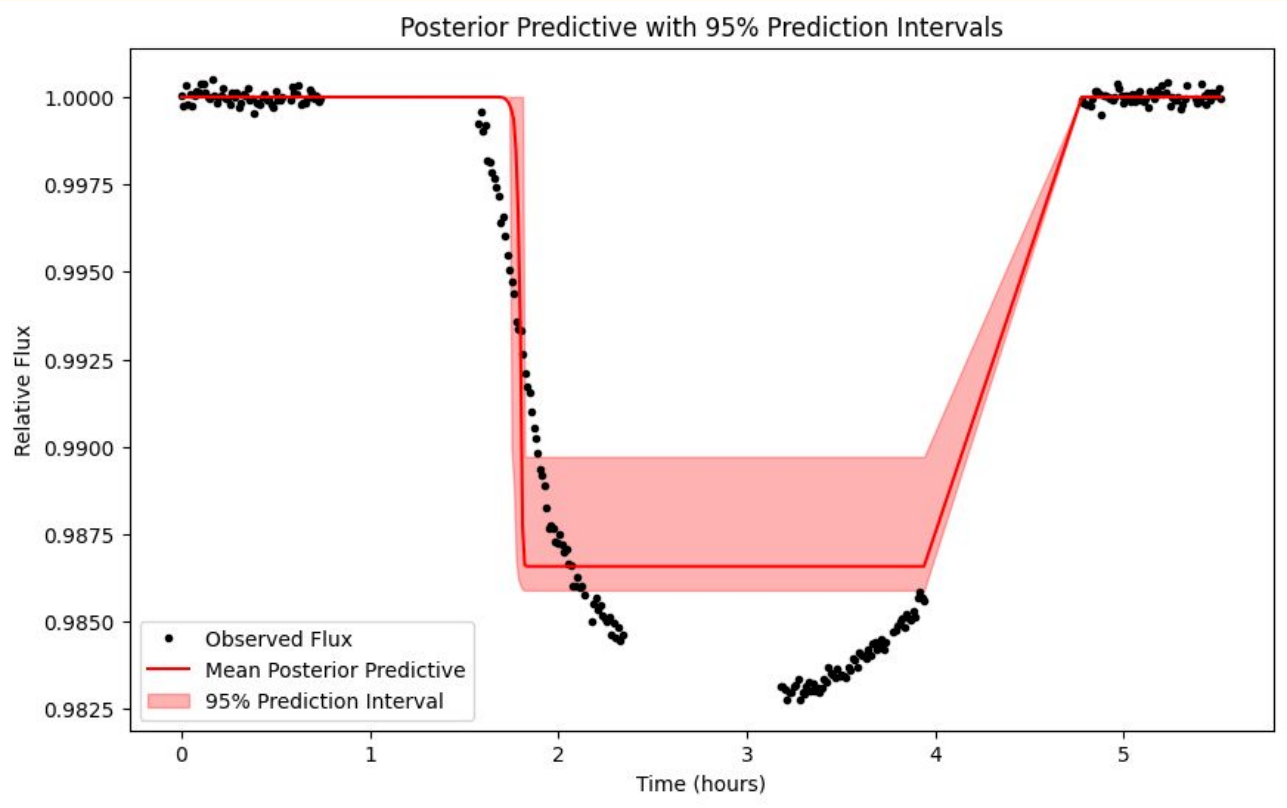


Results

This model might look better visually, but it has a reduced chi-squared statistic of about twice the previous model (2.3 vs 1.1)



Results: Posterior Predictive Distribution



Conclusion

- The transit method is an efficient way to locate exoplanets, while also determining other data such as the planet's size.
  - Using observed data of the planet, HD 209458 b, it is possible to determine the flux dip visually, representing the amount of light blocked by the planet over a set interval.
- The box model is not perfect
- The planet we observed probably had a radius about 12% of that of its sun

References

- https://exoplanetarchive.ipac.caltech.edu/overview/HD209458

AI Statement

AI was used to generate posterior predictive plots, but not otherwise.

Contribution Statement

Individual Contributions:

- John Wright used his code to complete the “Motivation”, “Methods”, and “Results” slides
- Dechong Wang wrote the “References” slide
- Zachary Cohen wrote the “Conclusion”, “AI Statement”, “Contribution Statement”, and “References” slides