Project Report

Stars' Lifespan-Mass Relation

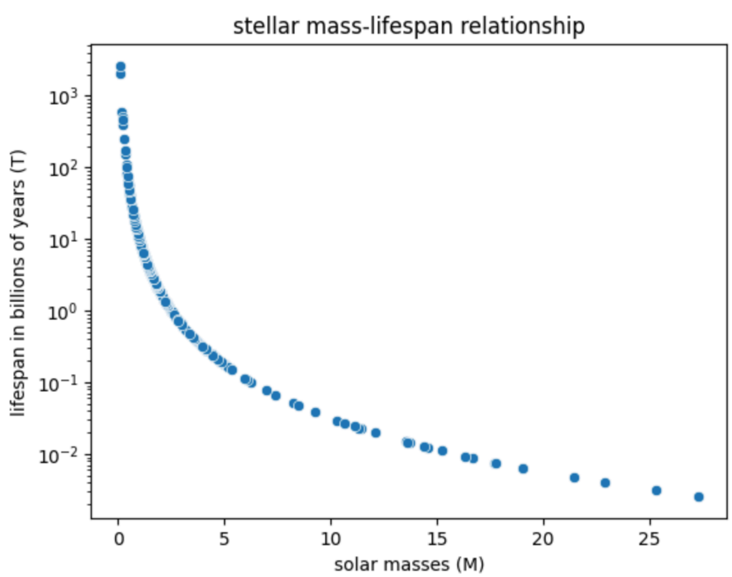
Naomi Diep
naomi.d@berkeley.edu

For my project, I examine and visualize the relationship between a star's mass and lifespan. I used Professor John Southworth of Keele University's DEBCat university, which observes eclipsing binary systems. To correlate the relationship between a star's mass and lifespan, I used the equation:

$$T \propto 10^{10}/M^{2.5}$$

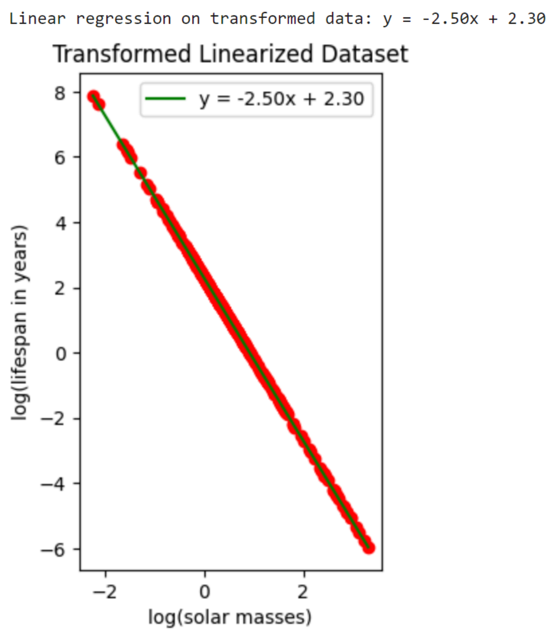
Where T is the star's calculated lifespan in years, 10^{10} (10 billion years) is our sun's lifespan, and M is the star's mass in solar masses. This equation represents an exponential decay model, and I tested it first with randomly generated data. I accessed Southworth's DEBCat catalog using Vizier. To filter the dataset, I used only the masses of the first and second star in each eclipsing binary system.

Plotting the data by anti-logging the masses, I get the following scatter plot:



This plot represents a clear exponential decay, where the more massive the star is, the shorter its lifespan.

I also attempted to linearize the data and apply a best fit linear regression line:



Based off of my data and the equation $T \propto 10^{10}/M^{2.5}$ which is also composed from $E=mc^2$, the luminosity equation $L = E/t$, and the mass-luminosity equation $L \propto M^{3.5}$, a star will live longer the less massive it is, representing an exponential decay model. This is due to the fact that a star is inherently less stable the more massive it is and that it burns through its fuel much quicker than less massive stars.