# Exoplanets Dataset 1

Submitted to Dr. Jayesh Mahendra Goyal
School of Earth and Planetary Sciences
NISER

Submitted by Sumegha M T
Batch 2019-24
School of Physical Sciences
NISER

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Click here to view the github repository containing the codes and tables

**QUESTION 1: Find the number of planets with radius in the range (0.5 to 1.6 REarth)?**

There are 1077 planets with radius in the range 0.5 REarth and 1.6REarth.

**QUESTION 2: Find the number of planets with radius in the range (0.5 to 1.6 REarth) around FGK stars? List them in a table. Make a plot of Equilibrium temperature vs Distance from Earth for these planets. How many of them have been discovered by direct imaging method?**

Of these 1077 planets,59 revolve around F,G,K stars. They are listed in the table q2.txt and $FGK_0.5to1.6.csv$ in the github repository
Plot of Equilibrium temperature vs Distance from Earth for these planets

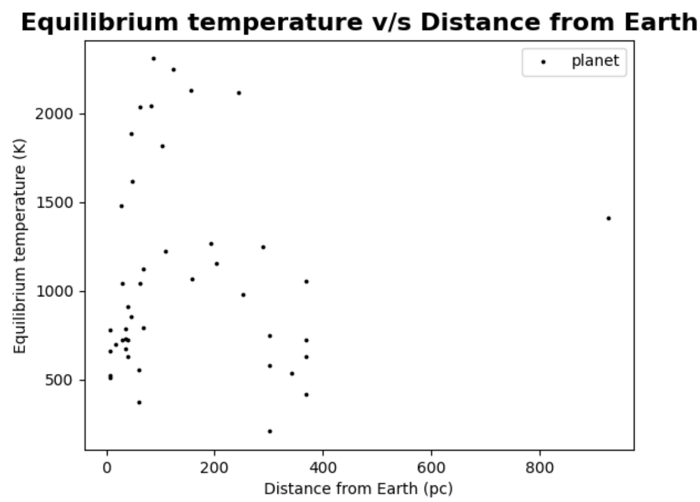


Figure 1: Plot of Equilibrium temperature vs Distance from Earth for the planets around F,G,K stars which has radius in the range 0.5 to 1.6 REarth

None of the planets among them are discovered through direct imaging method.

**QUESTION 3: Find the number of planets with radius in the range (1.6 to 4 REarth) around FGK stars? List them in a table.**

There are 299 planets with radius in the range 1.6REarth and 4.0REarth. They are listed in table q3.txt and $FGK_1.6to4.csv$ in the github repository.

**QUESTION 4: Make a plot of radius vs. mass of all the planets in the dataset and also mark Earth, Venus and Jupiter in the plot with their respective images.**

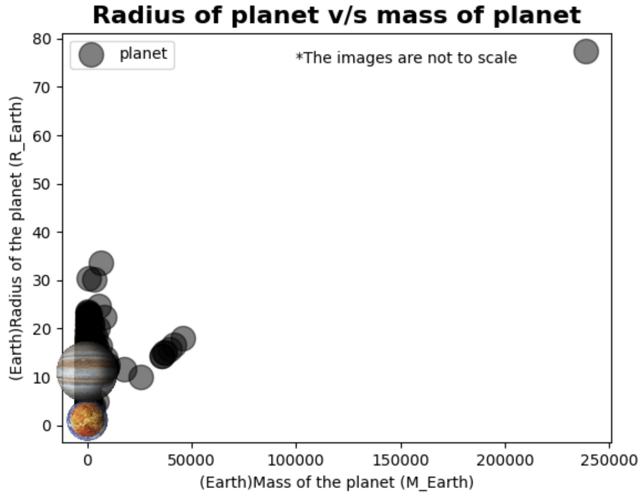


Figure 2: Plot of radius vs. mass of all the planets in the dataset with Earth, Venus and Jupiter marked with their images (Not to scale, only for illustrative purposes).

**QUESTION 5: Make a plot of radius vs. stellar metallicity and mass vs. stellar metallicity for all the planets. Use linear/log scale as required. Comment on the plot.**

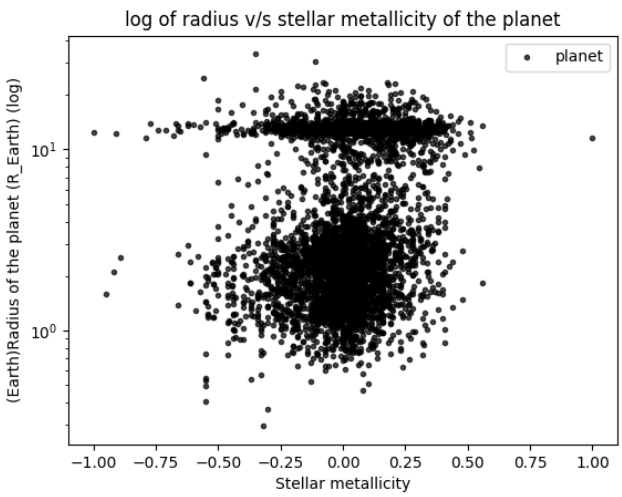


Figure 3: Plot of radius (in log scale) vs. stellar metallicity for all planets

Generally, planets around metal-rich stars tend to be larger than those around metal-poor stars. However, this plot suggests exceptions; there are planets of large radius with low metallicity host stars. It is seen from the plot that a group of planets with almost similar radii has metallicity ranging from -0.6 to 0.5 dex. There are two such clusters.

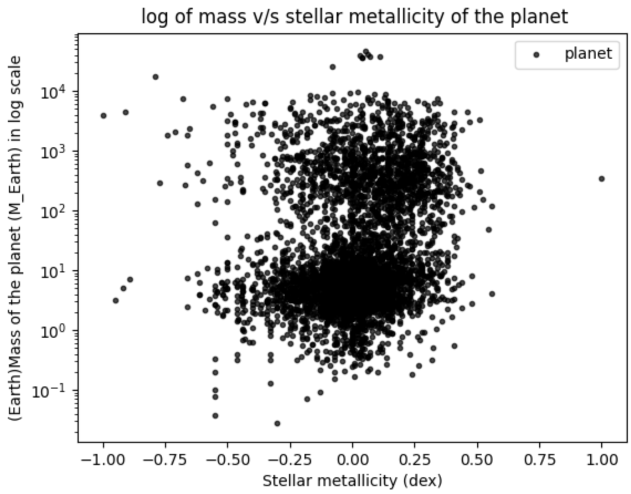


Figure 4: Plot of mass (in log scale) vs. stellar metallicity for all the planets.

There is a soft margin clustering of planets with respect to their masses. This plot shows that there are large massed planets with low metallicity. This challenges the current theory of planet formation wherein the presence of heavy elements in the host star play a crucial role in the creation of its core and therefore the mass of the planet. These exceptions suggest that these planets must have been formed through a different mechanism.

From these plots, it can be inferred that most exoplanets that are discovered have host stars with stellar metallicity in the range of -0.5 dex to 0.5 dex. There is only one planet with whose host star has a stellar metallicity beyond 0.75 dex. This planet is massive and has a large radius. Therefore, it is likely to be a gas giant.
The similarity of these plots suggest a relation between mass and radius of the exoplanets.

**QUESTION 6: Plot the density of all the planets (that have both mass and radius) as a function of their radius. Comment on the plot.**

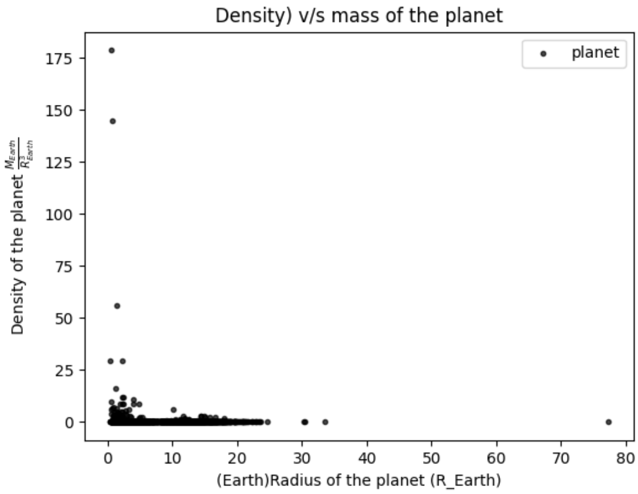


Figure 5: Plot of density of all the planets (that have both mass and radius) as a function of their radius.

The density v/s radius plot of all the exoplanets whose mass as well as radius are determined is plotted.This obviously resembles a inverse cube plot as

$$density = \frac{Mass}{\frac{4}{3}\pi R^3} \tag{1}$$

Many of the discovered exoplanets are of low density with respect to their radius in R$_{Earth}$ units. They could be gaseous giants. This plot also shows dense exoplanets with small radii. Such planets are called Super Earths. Two such Super Earths can be identified in the plot.

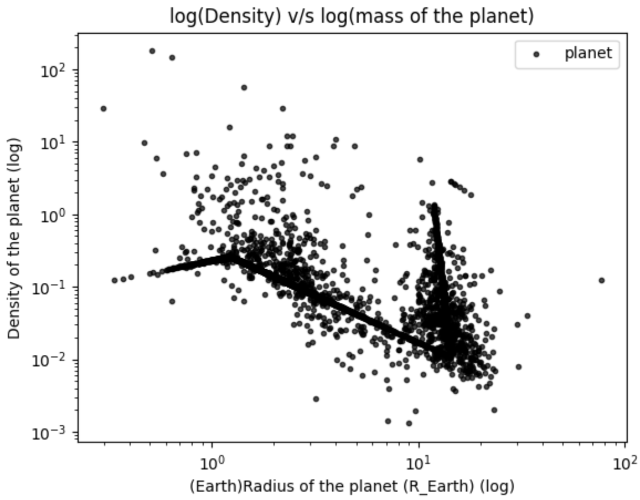


Figure 6: Plot of density of all the planets (that have both mass and radius) as a function of their radius

To achieve a better resolution in the plot, a logarithmic scale was used for the axes.