

Assignment 13: Exoplanets

60 Points scaled to 20 Points

Introduction

In this exercise you will explore a dataset of exoplanets that have been detected using different methods. Exoplanets are those outside of our solar system. This dataset is made available on Kaggle: <https://www.kaggle.com/datasets/shivamb/all-exoplanets-dataset>. The dataset has been provided on the course page (the link above may no longer be active).

Objectives

- *Prepare data for analyses*
- *Generate plots to visualize data*
- *Make inferences from plots*

Deliverables

- *Jupyter Notebook (Python) or R Markdown file (R) with all code and graphs embedded. Files can be rendered to HTML webpages if your instructor requires this. Questions or prompts should be stated and answered within Markdown cells.*

Background Questions

Question 1. Explain how Imaging is used to detect exoplanets. (5 Points)

Question 2. Explain how Microlensing is used to detect exoplanets. (5 Points)

Question 3. Explain how Radial Velocity is used to detect exoplanets. (5 Points)

Question 4. Explain how Transit measurements are used to detect exoplanets. (5 Points)

Questions and Tasks

This assignment can be conducted using either Python or R, whichever you prefer or whichever your instructor requires. Generate code to perform the following tasks and answer the associated questions.

Task 1. Extract out only rows associated with a single planet as opposed to multiple planets ("Num.Planets"). (5 Points)

Task 2. Extract out only records that were detected using one of the following methods ("Discovery.Method"): "Imaging", "Microlensing", "Radial Velocity", "Transit". (5 Points).

Task 3. Create a grouped boxplot showing the distribution of the estimated mass ("Mass") of the planets detected using each of the four methods. On this scale, the Earth has a mass of 1. Does it appear that certain methods are better at detecting smaller planets than others? (5 Points).

Task 4. Create a grouped boxplot showing the distribution of the estimated mass ("Mass") of the planets detected each year. Does it appear that the average sizes or masses of the planets being detected have changed over time? (5 Points)

Task 5. Create a grouped boxplot showing the distribution of the estimated mass ("Mass") of the planets detected each year with the four types broken into separate boxplots per year. Does it appear that the sizes or masses of the planets being detected have changed over time? Is a trend more obvious when the detection methods are differentiated? (5 Points)

Task 6: Create a line graph showing the estimated mass of the least massive planet detected each year. Discuss the trend observed. Note that there are some missing values. (5 Points)

Task 7: Create a line graph showing the estimated mass of the least massive planet detected each year with separate lines for each of the four detection methods. Discuss the trend observed. Note that there are some missing values. (5 Points)

Task 8: Create a grouped bar graph showing the count of planets detected using each of the four methods per year. Discuss the trends observed. (5 Points)