DATA ANALYTICS

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Contents

Module 1

The Orbit of Mars

Describe the background and history briefly: who was Brahe, when what observations did he make, what did Kepler set out to do with these observations?

The Movement of Celestrial Objects

Describe how an observer perceives that objects move in the sky, on a daily basis and against the background of the fixed stars. Describe the zodiac and how the sun moves against the background of the zodiac. Talk of the rising/setting trick. Describe the ecliptic. Describe the analemma and the non-uniform motion of the sun against the zodiac.

Sun or Earth as Center

Describe the observations on Venus which are consistent with Sun as center. Then describe the regressions of Mars and show that a sun-centered universe can explain these regressions, both mathematically and pictorially. For instance, here is the picture. Introduce the notion of oppositions. Also describe the angle of the Mars-Sun plane relative to the ecliptic and show how Kepler determined this angle.
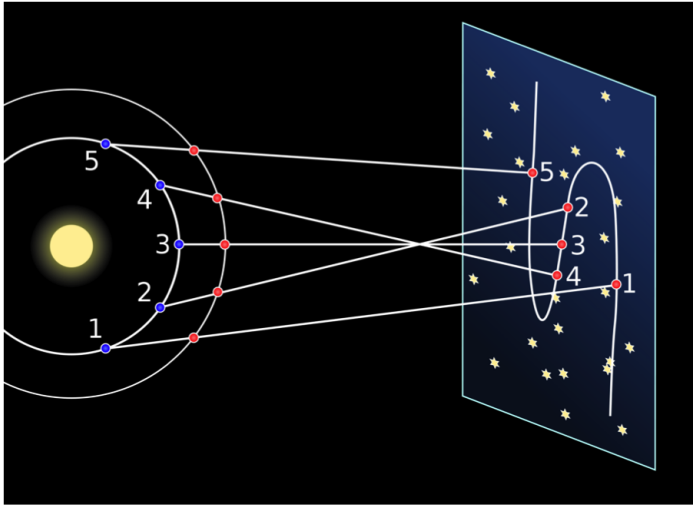
Figure 1.1: Regressions of Mars explained.

Brahe's Observations at Opposition

Describe how Kepler eliminated the Earth via oppositions. Describe Brahe's longitude data and the notion of true longitude, measured on the ecliptic place. Describe how the the period of revolution of Mars was determined and how this can be used to calculate the mean longitude.

Modeling the Orbit of Mars II

Describe the assumptions: circular orbit, average sun etc. Then set up the first regression problem.

Brahe's Observations with Mars in the Same Place

Describe Brahe's data pairs with Mars in the same place but Earth at different places. Again set up the regression problem with this data.

Modeling the Orbit of Mars II

Describe the assumptions: circular orbit, average sun etc. Then set up the second regression problem.

The Linear Regression Algorithm

Outline the algorithm for linear regression.

The Non-Linear Regression Algorithm

Outline the algorithm for the non-linear case.

Results of Regression

Discuss the results of the regression.

Modeling the Orbit of Mars III

Describe Kepler's new model with the ellipse.

Results of Regression with an Elliptical Model

Discuss the results of the regression.

Conclusion

Summarize the final results and any learning that you want to emphasize.