Kepler's Law of Harmonies

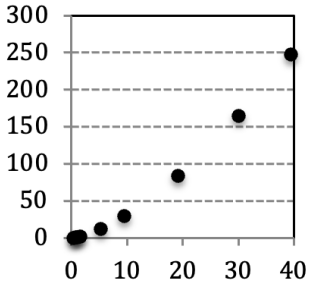
In the late 1600s, Johannes Kepler acquired the carefully collected planetary data of Danish astronomer Tycho Brahe. Kepler attempted to analyze the known planetary information of that day. Kepler attempted to identify the mathematical relationship between the **period** (time for a complete orbit) of each planet and its average distance from the sun. **Table 1** shows a *more polished* form of the data that resulted from his analysis.

Table 1

Planet	Ave. Distance from Sun (au)	Period (year)
Mercury	0.39	0.241
Venus	0.72	0.615
Earth	1	1
Mars	1.52	1.88
Jupiter	5.2	11.8
Saturn	9.54	29.5
Uranus	19.18	84
Neptune	30.06	165
Pluto	39.44	248

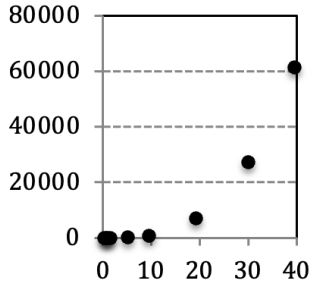
Some physics students plotted the values of period (**T**) and distance (**R**) raised to various powers. Their goal was to find a linear relationship between the two quantities so that they could use the slope-intercept equation to relate them mathematically. They performed a linear regression analysis for each plot; the slope (**m**), and correlation coefficient (**COR**) are reported below.

Figure 1
T vs. R



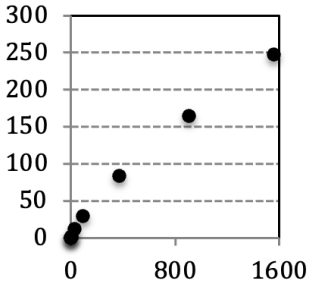
m = 6.12
COR = 0.9777

Figure 2
T^2 vs. R



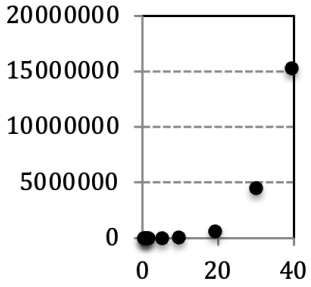
m = 1.34E+3
COR = 0.845

Figure 3
T vs. R^2



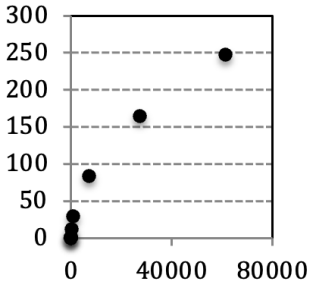
m = 0.162
COR = 0.988

Figure 4
T^3 vs. R



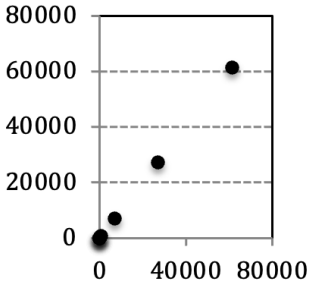
m = 3.02E+5
COR = 0.738

Figure 5
T vs. R^3



m = 4.12E-3
COR = 0.932

Figure 6
T^2 vs. R^3



m = 1.00
COR = 1.000