4. Using Appendix Tables 5, find the orbital data of Io and the Moon as

$$\begin{aligned} a_{Io} &= 421.6 \times 10^3\ km \\ P_{Io} &= 1.769\ days \\ a_{Moon} &= 384.4 \times 10^3\ km \\ P_{Moon} &= 27.322\ days. \end{aligned}$$

Now, rescale Io's orbital data with the Moon's data

$$\begin{aligned} a_{Io} &= 1.097 a_{Moon} \\ P_{Io} &= 0.065 P_{Moon}. \end{aligned}$$

For any orbital motion,

$$M \propto \frac{a^3}{P^2}$$

where M is the mass of the planet, a and P is the semimajoy axis and the period of its moon, respectively. Thus,

$$\begin{aligned} \frac{M_{Jupiter}}{M_{Earth}} &= \frac{a_{Io}^3}{P_{Io}^2} \frac{P_{Moon}^2}{a_{Moon}^3} \\ &= \frac{1.097^3}{0.065^2} \\ &= 312.46 \end{aligned}$$

In Appendix Table 3, we find that

$$M_{Jupiter} = 317.9 M_{Earth}$$

,which is the same as the estimate we got from Io's orbital data.