Ay190 – Worksheet 04
Donal O Sullivan
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Note: the formatting is messed up in this but all the work is done!

1 Root Finding: Eccentricity Anomaly

1.1 e = 0.0167

The equation we are given for the eccentricity anomaly is $E = \omega t - e \sin E$. Rearranging this we get $f(x) = E - \omega t - e \sin E$ where $f(x) = 0$ for root values of E.

Differentiating $f(x)$ yields $f'(x) = 1 - e \cos E$ which will be necessary for implementing a Newton-Raphson root finding method.

We are given the period T, semi-major axis a and eccentricity e. We can easily calcilate the angular velocity $\omega = \frac{T}{2\pi}$.

Then, implementing the Newton-Raphson method, we get the following results.

Day	x	y	E	Iterations
91	-1.690e+04	1.496e+06	1.582	3
182	-1.496e+06	1.590e+04	3.131	2
273	-4.921e+04	-1.495e+06	4.679	3

1.2 e = 0.99999

Using the same code and data except with $e = 0.99999$ yields the following results.

Day	x	y	E	Iterations
91	-1.004e06	4.959e03	2.307	45
182	-1.496e06	3.615e01	3.136	33
273	-1.018e06	-4.901e03	3.964	32

The iterations here are a lot higher. I'm not sure how to accelerate convergence but better guesses would be a start.