HG3MCE—Computerised Mathematical Techniques in Engineering

Problem Class 2

Some exercises on equations and differencing for the problem class of 23rd February. Remember to set your calculator to use radians!

- 1. Find to 6dp all real roots of (a) $x^4 = x+10$; (b) $\sin x = x + \frac{1}{2}$.
- 2. Recall that the iteration $x_{n+1} = \tan x_n$ diverges near that root of $\tan x = x$ which is near 4.5. Find this root to 4dp by using the above iteration together with Aitken's Device, starting from $x_0 = 4.5$. [So that

$$x_{1} = \tan x_{0},$$

$$x_{2} = \tan x_{1},$$

$$x_{3} = (x_{1}^{2} - x_{0}x_{2})/(2x_{1} - x_{0} - x_{2}),$$

$$x_{4} = \tan x_{3},$$

$$x_{5} = \tan x_{4},$$

$$x_{6} = (x_{4}^{2} - x_{3}x_{5})/(2x_{4} - x_{3} - x_{5})$$

and so on.] [This is much easier if you have a programmable calculator, and is quite tedious if you don't know how to use 'memory' to access previous results. As noted in lectures, Aitken's Device works better with convergent iterations; you can try here using $x_{n+1} = \tan^{-1} x_n$ —you'll need to add π to the value shown on your calculator to get $\tan^{-1} x_n$ into the range near to 4.5.]

3. According to a text on astronomy, the precession (in minutes of arc) of the earth in various years was:

Year	1700	1750	1800	1850	1900	1950
Precession	494.50	459.77	425.40	390.32	355.58	320.86

Difference these values. Taking account of your findings, estimate the precession in the year 2000.