#not okay to post

#Anusha Nagar, Homework 25, 12.01.2021

Assignment: pages 1-12 all problems

P1 $z^3 + 3z^2 - 11z + 2 = 0$

Is $z = 2$ a solution?

$2^3 + 3 \cdot 2^2 - 11 \cdot 2 + 2 = ?$

$8 + 12 - 22 + 2 = 0$ ✓

Is $z = 3$ a solution?

$3^3 + 3 \cdot 3^2 - 11 \cdot 3 + 2 = 23$ ✗

$z = 2$ is a solution, $z = 3$ is not

P2 $\sin z = 0$

Is $z = \pi$ a solution?

$\sin(\pi) = 0$ ✓

Is $z = \frac{\pi}{2}$ a solution?

$\sin(\frac{\pi}{2}) = 1$ ✗

$z = \pi$ is a solution, $z = \frac{\pi}{2}$ is not

P3 $\sin^2 z + \cos^2 z = 1$

Is $z = \frac{\pi}{3}$ a solution?

$\sin(\frac{\pi}{3})^2 + \cos(\frac{\pi}{3})^2 =$

$= (\frac{\sqrt{3}}{2})^2 + (\frac{1}{2})^2$

$= \frac{3}{4} + \frac{1}{4} = 1$ ✓

Is $z = \frac{\pi}{5}$ a solution?

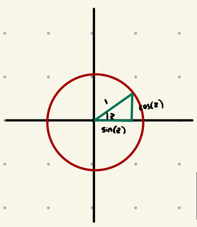
$\sin(\frac{\pi}{5})^2 + \cos(\frac{\pi}{5})^2 =$

⇒ know $\sin^2(x) + \cos^2(x) = 1$

↳ all x are solutions ⇒ $\frac{\pi}{5}$ is solution

$\frac{\pi}{3}$ & $\frac{\pi}{5}$ are solutions

P4 All z are solutions



In a unit circle, if we apply Pythagorean thm., we see $\sin^2(z) + \cos^2(z) = 1^2$

Solution: {all real numbers}

P5 $x(t) = t^4$

$x'(t) = 4t^3$ ⇒ **$x'(2) = 32$**

$x''(t) = 12t^2$ ⇒ **$x'(2) = 48$**

P6 $F(x) = (x-1)(x-2)(x-3) + x$

Fixed points are where $F(a) = a$

$F(1) = 0 + 1 = 1$ ✓

$F(2) = 0 + 2 = 2$ ✓

$F(3) = 0 + 3 = 3$ ✓

$F(-1) = (-2)(-3)(-4) - 1 = -25$ ✗

$x = 1, 2, 3$ are fixed points, $x = -1$ is not a fixed point

P7 $F(x,y) = (x+y+1,\ x-y-2)$

Is $(0,-1)$ a FP?

$F(0,-1) = (0,-1)$ ✓

Is $F(1,1)$ a FP?

$F(1,1) = (3,-2)$ ×

(0,1) is a fixed point, (1,1) is not a fixed point

P8 $F(x) = \frac{1}{x+1}$

(i) $x(0) = 0.5$

$x(1) = \frac{1}{1+0.5} = \frac{2}{3}$

$x(2) = \frac{1}{(2/3)+1} = \frac{3}{5}$

(ii) Orb([(1/(x+1))], [x], [0.5], 1000, 1000) [1];

(iii) 0.6180

P9 $F(x,y,z) = \left(\frac{x}{1+y+z}, \frac{y}{1+x+z}, \frac{z}{1+x+y}\right)$

(i) $(1,1,1) \rightarrow F(1,1,1) = \left(\frac{1}{3}, \frac{1}{3}, \frac{1}{3}\right) \rightarrow F\left(\frac{1}{3}, \frac{1}{3}, \frac{1}{3}\right) = \left(\frac{1}{5}, \frac{1}{5}, \frac{1}{5}\right)$

(ii) Orb([x/(1+y+z), y/(1+x+z), z/(1+x+y)], [x,y,z], [1.0,1.0,1.0], 1000, 100) [1];

(iii) (0.00049975, 0.00049975, 0.00049975)

P10 none in document

P11 $x(n) = x(n-1)^2 - 2x(n-1) + 2$

$F(x) = x^2 - 2x + 2$

$x = x^2 - 2x + 2$

$0 = x^2 - 3x + 2$

$0 = (x-2)(x-1)$

$x(n) = 1$, $x(n) = 2$ are equilibrium solutions

P12 $x(n) = \frac{5}{2}x(n-1)(1-x(n-1))$

$F(x) = \frac{5}{2}x(1-x)$

$x = \frac{5}{2}x(1-x)$

$x = \frac{5}{2}x - \frac{5}{2}x^2$

$\frac{5}{2}x^2 - \frac{3}{2}x = 0$

$x = 0, \frac{3}{5}$

$x(n) = 0$, $x(n) = \frac{3}{5}$ are equilibrium solutions

P13 $x(n) = kx(n-1)(1-x)$

$F(x) = kx(1-x)$

$x = kx(1-x)$

$x = kx - kx^2$

$kx^2 + x(1-k) = 0$

$x(kx + (1-k)) = 0$

$x = 0, \frac{k-1}{k}$

$\frac{\frac{5}{2}+1}{\frac{5}{2}}$

$x(n) = 0$, $x(n) = \frac{k-1}{k}$ are equilibrium solutions

P11' See maple code. 1 is stable, 2 is not

P12' 0 not stable, $\frac{3}{5}$ stable

P11'' $x(n) = x(n-1)^2 - 2x(n-1) + 2$

Eq. points: 1, 2

$F(x) = x^2 - 2x + 2$

$F'(x) = 2x - 2$

$F'(1) = |0| < 1 \Rightarrow$ stable

$F'(2) = |2| > 1 \Rightarrow$ unstable

P12'' $x(n) = \frac{5}{2} x(n-1)(1 - x(n-1))$

$F(x) = \frac{5}{2} x(1-x) = \frac{5}{2}x - \frac{5}{2}x^2$

Eq. pts: $0, \frac{3}{5}$

$F'(x) = \frac{5}{2} - 5x$

$F'(0) = |\frac{5}{2}| > 1 \Rightarrow$ unstable

$F'(\frac{3}{5}) = |-\frac{1}{2}| = \frac{1}{2} < 1 \Rightarrow$ stable

> *#Not okay to post*

> *#Anusha Nagar, Homework 25, 12.02.2021*

>

> **read** "C://Users/an646/Documents/DMB.txt"

First Written: Nov. 2021

This is DMB.txt, A Maple package to explore Dynamical models in Biology (both discrete and continuous)
accompanying the class Dynamical Models in Biology, Rutgers University. Taught by Dr. Z. (Doron Zeilbeger)

The most current version is available on WWW at:
http://sites.math.rutgers.edu/~zeilberg/tokhniot/DMB.txt .
Please report all bugs to: DoronZeil at gmail dot com .

For general help, and a list of the MAIN functions,
type "Help();". For specific help type "Help(procedure_name);"

For a list of the supporting functions type: Help1();
For help with any of them type: Help(ProcedureName);

For a list of the functions that give examples of Discrete-time dynamical systems (some famous), type: HelpDDM();
For help with any of them type: Help(ProcedureName);

For a list of the functions continuous-time dynamical systems (some famous) type: HelpCDM();
For help with any of them type: Help(ProcedureName);

------------------------------ **(1)**

> *#P8*

> $Orb\left(\left[\frac{1}{x+1}\right], [x], [0.5], 1000, 1000\right)[1];$

$$[0.6180339887] \quad \textbf{(2)}$$

> *#P9*

> $Orb\left(\left[\frac{x}{1+y+z}, \frac{y}{1+x+z}, \frac{z}{1+x+y}\right], [x, y, z], [1.0, 1.0, 1.0], 1000, 1000\right)[1];$

[0.0004997501157, 0.0004997501157, 0.0004997501157] **(3)**

> #P11'

> $Orb([x^2 - 2 \cdot x + 2], [x], [1.0], 1000, 1010);$

[[1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000]] **(4)**

> $Orb([x^2 - 2 \cdot x + 2], [x], [1.1], 1000, 1010);$

[[1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000]] **(5)**

> $Orb([x^2 - 2 \cdot x + 2], [x], [0.9], 1000, 1010);$

[[1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000]] **(6)**

> #1 seems stable

> $Orb([x^2 - 2 \cdot x + 2], [x], [2.0], 1000, 1010);$

[[2.], [2.], [2.], [2.], [2.], [2.], [2.], [2.], [2.], [2.], [2.]] **(7)**

> $Orb([x^2 - 2 \cdot x + 2], [x], [2.1], 1000, 1010);$

[[Float(undefined)], [Float(undefined)], [Float(undefined)], [Float(undefined)], [Float(undefined)], [Float(undefined)], [Float(undefined)], [Float(undefined)], [Float(undefined)], [Float(undefined)], [Float(undefined)]] **(8)**

> $Orb([x^2 - 2 \cdot x + 2], [x], [1.9], 1000, 1010);$

[[1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000], [1.000000000]] **(9)**

> #2 is not stable

>

>

> #P12'

> $Orb\left(\left[\frac{5}{2} \cdot x \cdot (1 - x)\right], [x], [0.0], 1000, 1010\right);$

[[0.], [0.], [0.], [0.], [0.], [0.], [0.], [0.], [0.], [0.], [0.]] **(10)**

> $Orb\left(\left[\frac{5}{2} \cdot x \cdot (1 - x)\right], [x], [0.1], 1000, 1010\right);$

[[0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000]] **(11)**

> $Orb\left(\left[\frac{5}{2} \cdot x \cdot (1 - x)\right], [x], [0.2], 1000, 1010\right);$

[[0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000]] **(12)**

> *#0 does not seem to be stable*

> $Orb\left(\left[\frac{5}{2}\cdot x\cdot(1-x)\right], [x], [0.6], 1000, 1010\right);$

[[0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000]] **(13)**

> $Orb\left(\left[\frac{5}{2}\cdot x\cdot(1-x)\right], [x], [0.5], 1000, 1010\right);$

[[0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000]] **(14)**

> $Orb\left(\left[\frac{5}{2}\cdot x\cdot(1-x)\right], [x], [0.7], 1000, 1010\right);$

[[0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000], [0.6000000000]] **(15)**

> *#0.6 seems stable*

>