OK to post

Anusha Nagar, Homework 18, 11.06.2021

MAPLE code is after handwritten portion

① a chickens lay b eggs in c days ⇒ d chickens lay how many eggs in e days

$C(a,b,c,d,e)$

$\frac{b}{a}$ = # of eggs 1 chickens lays in c days

1.5 chickens 1.5 eggs in 1.5 days

1 chicken lays 1 egg in 1.5 days

$\left(\frac{b}{a}\right)/c$ = # of eggs in 1 day by 1 chicken

$\frac{\left(\frac{b}{a}\right)}{c} * d$ = 1 chicken lays ___ eggs in e days

$\frac{\left(\frac{b}{a}\right)}{c} * d * e$ = d chickens lay ___ eggs in e days

② A + B fill cistern in a hours

A + C fill cistern in b hours

B fills k-times as fast as C

$W(a, b, k)$

$$\begin{cases} a R_A + a R_B = 1 \\ b R_A + b R_C = 1 \\ R_B = k R_C \end{cases}$$

③ $$\begin{cases} x'(t) = x(t)(1 - x(t) - y(t)) \\ y'(t) = x(t)(3 - 2x(t) - y(t)) \end{cases}$$

$f(x) \Rightarrow f(u) = u(1-u-v) = u - u^2 - uv$

$g(y) \Rightarrow g(v) = u(3-2u-v) = 3u - 2u^2 - uv$

(i)
$$\begin{cases} 0 = u - u^2 - uv \\ 0 = 3u - 2u^2 - uv \end{cases}$$

$u - u^2 = 3u - 2u^2$

$u^2 - 2u = 0$

$u(u-2) = 0$

$u = 0, 2 \Rightarrow \{[0,0], [2,-1]\}$

$v = 0, -1$

(ii) $J(x,y) = \begin{bmatrix} -2x-y & -x \\ 3-4x-y & -x \end{bmatrix}$

$J(0,0) = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

$J(2,-1) = \begin{bmatrix} -3 & -2 \\ -6 & -2 \end{bmatrix}$

```
#Okay to Post
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#Problem 1

C := proc(a, b, c, d, e) local f:
f := (b/a)/c*d*e:
end:
```

$$C\left(\frac{3}{2}, \frac{3}{2}, \frac{3}{2}, 3, 3\right)$$

$$6 \tag{1}$$

```
#Problem 2
W := proc(a, b, k) local R_A, R_B, R_C, sys, f:
sys := {a*R_A + a*R_B = 1, b*R_A + b*R_C = 1, R_B = k*R_C}:
f := solve(sys, {R_A, R_B, R_C}): return 1/f[3]
end:
W(4, 5, 2)
```

$$\frac{1}{R\_C} = 20 \tag{2}$$

```
#Problem 3
with(LinearAlgebra):
J_1 := Matrix([[0, 0], [0, 0]]):
Eigenvalues(J_1)
```

$$\begin{bmatrix} 0 \\ 0 \end{bmatrix} \tag{3}$$

```
J_2 := Matrix([[-3, -2], [-6, -2]]):
Eigenvalues(J_2)
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$$\begin{bmatrix} 1 \\ -6 \end{bmatrix} \tag{4}$$

```
#Both are not stable
#Problem 4
read "C://Users/an646/Documents/M18.txt"
L1 := Dis2([x(t)·(1 − x(t) − y(t)), x(t)·(3 − 2·x(t) − y(t))], x(t), y(t), [0.1, 0.1], 0.01,
      10): print([op(nops(L1)-3..nops(L1), L1)]):
```

[[9.98, [0.003127345426, 1.636919647]], [9.99, [0.003107328946, 1.636962080]], [10.00, [0.003087439884, 1.637004241]], [10.01, [0.003067677438, 1.637046132]]] (5)

```
#(0,0) is unstable
L2 := Dis2([x(t)·(1 − x(t) − y(t)), x(t)·(3 − 2·x(t) − y(t))], x(t), y(t), [2.1, -1.1], 0.01,
      10): print([op(nops(L2)-3..nops(L2), L2)]):
```

[[9.98, [Float(-∞), Float(-∞)]], [9.99, [Float(-∞), Float(-∞)]], [10.00, [Float(-∞), (6)

```
    Float( - ∞ ) ]], [10.01, [Float( - ∞ ), Float( - ∞ ) ]]]
> #(2,-1) is also unstable
>
> #Problem 5
> L3 := Dis2(SIRS(x, y, 0.01, 0.5, 1, 50), x, y, [50 − 30, 30], 0.01, 10) : print([op(nops(L3) - 3
      ..nops(L3), L3) ]) :
[[9.98, [49.02886873, 0.06268718805]], [9.99, [49.03310360, 0.06236766436]], [10.00,                (7)
    [49.03732043, 0.06204979573]], [10.01, [49.04151930, 0.06173357334]]]
> #Eradicated
> L4 := Dis2(SIRS(x, y, 0.01, 0.5, 1, 80), x, y, [80 − 30, 30], 0.01, 10) : print([op(nops(L4) - 3
      ..nops(L4), L4) ]) :
[[9.98, [76.27263233, 0.6996929764]], [9.99, [76.28243397, 0.6980327891]], [10.00,                (8)
    [76.29220688, 0.6963772252]], [10.01, [76.30195114, 0.6947262684]]]
>
> L5 := Dis2(SIRS(x, y, 0.01, 0.5, 1, 120), x, y, [120 - 30, 30], 0.01, 10) : print([op(nops(L5) - 3
      ..nops(L5), L5) ]) :
[[9.98, [97.97864061, 6.730335598]], [9.99, [97.98915282, 6.728975155]], [10.00,                (9)
    [97.99962552, 6.727622060]], [10.01, [98.01005884, 6.726276283]]]
> #Above, steady state is approaching infected = gamma(N-nu div beta) over (nu + gamma) for
      gamma =0.5. Numericlly, we are approaching 6.666 in this example (number of individuals
      infected in the long run)
> #When I tried runningthe above code with gamma as a variable, the code would stall
```