Homework-5

0) $6a(n-1) + a(n+3) + 5a(n+1) = 0$

Replace n with $n-3$

$6a(n-4) + a(n) + 5a(n-2) = 0$

$a(n) = -6a(n-4) - 5a(n-2)$

```
read "/Users/rmn74/Downloads/M5.txt"
Help5( )
```

RecToSeq(INI,REC,N), GrowthC(INI,REC,K) , GrowthCe(REC)
LeslieMod(SUR,FER): e.g. LeslieMod([9/10,9/10],[0,1,1]);
LeslieMat(SUR,FER); e.g. LeslieMat([9/10,9/10],[0,1,1]); **(1)**

```
#0)
REC := [0, -5, 0, -6] :
INI := [1, 2, 4, 11] :
L := RecToSeq(INI, REC, 1000) :
L[1000]
```

```
1818014589793496842119263353977165955901169251300081152017301791629030009579197\
4774209925134910767767993350034005595962441714858161276739646642515466061817\
3117628394165055217094548419439974932835130478675973471845469594019041097457\
684403540309
```

(2)

```
#1)
REC2 := [1, 1, 1, 1, 1, 1, 1, 1, 1, 1] :
INI2 := [2, 4, 6, 8, 10, 12, 14, 16, 18, 20] :
GrowthC(INI2, REC2, 100)
```

1.999018633 **(3)**

```
GrowthCe(REC2)
```

1.999018633 **(4)**

```
#2)
SUR := [seq(0.99, i = 1 ..45)] :
FER := [seq(0, i = 1 ..16), seq(1/2, i = 17 ..31), seq(1/4, i = 32 ..46)] :
LeslieMod(SUR, FER)
```

```
[0, 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.4257288856, 0.4214715968, 0.4172568808,
 0.4130843120, 0.4089534689, 0.4048639342, 0.4008152948, 0.3968071419, 0.3928390705,
 0.3889106798, 0.3850215730, 0.3811713572, 0.3773596437, 0.3735860472, 0.3698501868,
 0.1830758425, 0.1812450840, 0.1794326332, 0.1776383069, 0.1758619238, 0.1741033046,
 0.1723622715, 0.1706386488, 0.1689322623, 0.1672429396, 0.1655705102, 0.1639148052,
 0.1622756571, 0.1606529005, 0.1590463715]
```

(5)

```
GrowthCe(%)
```

1.085998871 **(6)**

```
LeslieMat(SUR, FER) :
A := evalf(Eigenvalues(%))
```

$$A := \begin{bmatrix} 1.08599887069177 + 0.\,\mathrm{I} \\ -0.926288253646375 + 0.\,\mathrm{I} \\ 0.992643349539113 + 0.293676142636269\,\mathrm{I} \\ 0.992643349539113 - 0.293676142636269\,\mathrm{I} \\ 0.927041166828259 + 0.192952854567572\,\mathrm{I} \\ 0.927041166828259 - 0.192952854567572\,\mathrm{I} \\ 0.883201079489300 + 0.405407378929534\,\mathrm{I} \\ 0.883201079489300 - 0.405407378929534\,\mathrm{I} \\ 0.773017972650749 + 0.618116809564570\,\mathrm{I} \\ 0.773017972650749 - 0.618116809564570\,\mathrm{I} \\ \vdots \end{bmatrix} \quad \textbf{(7)}$$

46 element Vector[column]

#3)

$RS := [0, 0, 0, 0.16, 0.41]:$

$GrowthCe(RS)$

$$0.8879729192 \quad \textbf{(8)}$$

#4)

```
# Ans-4

PlantGSeq := proc(alpha, beta, gamma, sigma, INI, K) local a, b, i, k, L, newguy, REC :
 if not (type(INI, list) and nops(INI) = 2 and type(K, integer) and K ≥ nops(INI) ) then
 print(`bad innput`) :
 RETURN(FAIL) :
fi:

 a := alpha·sigma·gamma :
 b := beta·(sigma)^2·(1 − alpha)·gamma :
 REC := [a, b] :
k := nops(INI) :

L := INI :

while nops(L) < K do
 newguy := add(REC[i] * L[ -i], i = 1 ..k) :
 L := [op(L), newguy] :
od:
L :
end:

 Ini := [100, 80] :
 PlantGSeq(0.5, 0.25, 2.0, 0.8, Ini, 21)
[100, 80, 80.000000, 76.80000000, 74.24000000, 71.68000000, 69.22240000, 66.84672000,      (1)
    64.55296000, 62.33784320, 60.19874816, 58.13305344, 56.13824246, 54.21188252,
    52.35162481, 50.55520105, 48.82042081, 47.14516882, 45.52740239, 43.96514892,
    42.45650352]
Ini2 := [100, 96] :
 PlantGSeq(0.6, 0.3, 2.0, 0.8, Ini2, 21)
[100, 96, 107.52000, 117.9648000, 129.7612800, 142.6902221, 156.9139458, 172.5546061,      (2)
    189.7544040, 208.6686153, 229.4681472, 252.3409206, 277.4935912, 305.1534130,
    335.5702921, 369.0190446, 405.8018797, 446.2511298, 490.7322533, 539.6471367,
    593.4377253]
#We can see that this method gives us the same answers as the textbook table 1.1

 #Ans-5

 PlantGSeq :=proc(alpha, beta, gamma, sigma) local a, b, REC, x, i :
a := alpha·sigma·gamma :
b := beta·(sigma)^2·(1 − alpha)·gamma :
REC := [a, b] :
evalf([solve(1 - add(REC[i]/x^i, i = 1 ..nops(REC)))])[1] :

 end:

PlantGSeq(0.01, 0.01, 0.1, 0.001)
```

$$0.00003196823796 \tag{3}$$

#These values will evantually lead to extinction

PlantGSeq(0.25, 0.45, 2, 0.95)

$$1.053339292 \tag{4}$$

#This values give us close to stability

PlantGSeq(100, 100, 200, 100)

$$1.990050504\ 10^{6} \tag{5}$$

#These values give us a polulation explosion