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> #OK to post homework
> #Anusha Nagar, 9.6.2021, Assignment 1
>
> #Problem 1
> #Assumptions: (1) Only one-year-old, two-year-old, and three-
    year-old females are fertile, (2) the probability that a one-
    year-old, two-year-old, or three-year-old female gives birth
    to a female are p1, p2, and p3 (respectively), (3) there were
    c0 females born at n=0, c1 females born at n=1, and c2 females
    born at n=2
> #Recurrance: R(n, p1, p2, p3, c0, c1, c2) = p1·R(n-1, p1, p2, p3,
    c0, c1, c2)+p2·R(n-2, p1, p2, p3, c0, c1, c2)+p3·R(n-3, p1,
     p2, p3, c0, c1, c2) with initial conditions R(0)=c0, R(1)=c1,
      R(2)=c2
> #At n=4, expected number of females born is p1·R(3)+p2·R(2)+p3·R
    (1)
> #R(3) = p1·R(2)+p2·R(1)+p3·R(0) = p1·c2+p2·c1+p3·c0
> #Therefore, at n=4, R(4)=p1·(p1·c2+p2·c1+p3·c0)+p2·c2+p3·c1
>
> #Problem 2
> #Assumptions: (1) Only one-year-old, two-year-old, and three-
    year-old females are fertile, (2) the probability that a one-
    year-old, two-year-old, or three-year-old female gives birth
    to a female are p1, p2, and p3 (respectively), (3) there were
    c0 females born at n=0, c1 females born at n=1, and c2 females
    born at n=2
> #Initial Conditions: Rg(0)=c0, Rg(1)=c1, Rg(2)=c2
> #Rg(n, p1, p2, p3, c0, c1, c2):
     THE EXPECTED NUMBER OF FEMALES BORN AT YEAR n
> Rg:=proc(n, p1, p2, p3, c0, c1, c2) option remember:
  if n=0 then
   c0:
  elif n=1 then
   c1:
  elif n= 2 then
   c2:
  else
  expand(p1*Rg(n-1, p1, p2, p3, c0, c1, c2)+p2*Rg(n-2, p1, p2, p3,
      c0, c1, c2) + p3·Rg(n-3, p1, p2, p3, c0, c1, c2)): #Recurrence
  fi:
  end:
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> #Problem 3
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> seq(evalf(Rg(i, .3333333, .3333333, .3333333, 1, 1, 1)), i = 1 ..100);
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(1)

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1., 1., 0.9999999, 0.9999998667, 0.9999998223, 0.9999997631,
   0.9999997174, 0.9999996676, 0.9999996160, 0.9999995670,
   0.9999995169, 0.9999994667, 0.9999994169, 0.9999993668,
   0.9999993167, 0.9999992667, 0.9999992167, 0.9999991667,
   0.9999991167, 0.9999990667, 0.9999990167, 0.9999989667,
   0.9999989167, 0.9999988667, 0.9999988167, 0.9999987667,
   0.9999987167, 0.9999986667, 0.9999986167, 0.9999985667,
   0.9999985167, 0.9999984667, 0.9999984167, 0.9999983667,
   0.9999983167, 0.9999982667, 0.9999982167, 0.9999981667,
   0.9999981167, 0.9999980667, 0.9999980167, 0.9999979667,
   0.9999979167, 0.9999978667, 0.9999978167, 0.9999977667,
   0.9999977167, 0.9999976667, 0.9999976167, 0.9999975667,
   0.9999975167, 0.9999974667, 0.9999974167, 0.9999973667,
   0.9999973167, 0.9999972667, 0.9999972167, 0.9999971667,
   0.9999971167, 0.9999970667, 0.9999970167, 0.9999969667,
   0.9999969167, 0.9999968667, 0.9999968167, 0.9999967667,
   0.9999967167, 0.9999966667, 0.9999966167, 0.9999965667,
   0.9999965167, 0.9999964667, 0.9999964167, 0.9999963667,
   0.9999963167, 0.9999962667, 0.9999962167, 0.9999961667,
   0.9999961167, 0.9999960667, 0.9999960167, 0.9999959667,
   0.9999959167, 0.9999958667, 0.9999958167, 0.9999957667,
   0.9999957167, 0.9999956667, 0.9999956167, 0.9999955667,
   0.9999955167, 0.9999954667, 0.9999954167, 0.9999953667,
   0.9999953167, 0.9999952667, 0.9999952167, 0.9999951667,
   0.9999951167, 0.9999950667
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> # (i) Extinction values: p1=p2=p3=0.2 led to extinction
> # (ii) Stable Population values: p1=p2=p3 = .3333 leads to stable
    population
> # (iii) Population Explosion Values: p1 = p2 = p3 = 0.9 led to
    population explosion
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