

Math 2280 - Maple Project 3 Writeup

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In this project we modeled the fox and rabbit populations in a wildlife conservation preserve according to the system of differential equations:

$$\begin{aligned}\frac{dR}{dt} &= (0.01)pR - (0.0001)aRF, \\ \frac{dF}{dt} &= -(0.01)qF + (0.0001)bRF,\end{aligned}$$

where p and q are the largest digits (with $p < q$) and a and b are the smallest nonzero digits (with $a < b$) in my student ID number. Here t is measured in months, and we say that January, 2007 is $t = 0$.

My student ID number is 00075213, and so my corresponding differential equation is:

$$\begin{aligned}\frac{dR}{dt} &= (0.05)R - (0.0001)RF, \\ \frac{dF}{dt} &= -(0.07)F + (0.0002)RF.\end{aligned}$$

We use Maple to graph the solution to this differential equation in the RF , tR , and tF planes. We take as our initial values $F(0) = 400$ and $R(0) = 100$.

The Maple code for creating these graphs, along with the graphs themselves, are attached. Judging from these graphs we estimate that:

The period of oscillation for both the rabbits and the foxes is approximately 115 months, or 9 years and 7 months.

The maximum value of the rabbit population is approximately 860 rabbits and first occurs after approximately 75 months, which would be April, 2013.

The minimum value of the rabbit population is approximately 100 rabbits, and first occurs at the initial value, which would be January, 2007.

The maximum value of the fox population is approximately 1400 foxes, and first occurs after approximately 83 months, which would be December, 2013.

The minimum value of the fox population is approximately 100 foxes, and first occurs after approximately 40 months, which would be May, 2010.

We see that the fox population tends to lag behind the rabbit population, having its maximas and minimas a bit after the respective rabbit maximas and minimas. This is to be expected, as the foxes feed on the rabbits. On the other hand, the fox population tends to have greater maximums than the rabbit population, which probably wouldn't happen in real life.

with(DEtools);

[AreSimilar, DENormal, DEplot, DEplot3d, DEplot_polygon, DFactor, DFactorLCLM, DFactorsols, Dchangevar, FunctionDecomposition, GCRD, Gosper, Heunsols, Homomorphisms, IsHyperexponential, LCLM, MeijerGsols, MultiplicativeDecomposition, ODEInvariants, PDEchangecoords, PolynomialNormalForm, RationalCanonicalForm, ReduceHyperexp, RiemannPsols, Xchange, Xcommutator, Xgauge, Zeilberger. abelsol, adjoint, autonomous, bernoullisol, buildsol, buildsym, canoni, caseplot, casesplit, checkrank, chinisol, clairautsol, constcoeffsols, convertAlg, convertsys, dalembertsol, dcoeffs, de2diffop, dfieldplot, diff_table, diffop2de, dperiodic_sols, dpolyform, dsubs, eigenring, endomorphism_charpoly, equinv, eta_k, eulersols, exactsol, expsols, exterior_power, firint, firtest, formal_sol, gen_exp, generate_ic, genhomosol, gensys, hamilton_eqs, hypergeomsols, hyperode, indicialeq, infgen, initialdata, integrate_sols, infactor, invariants, kovacicols, leftdivision, liesol, line_int, linearsol, matrixDE, matrix_riccati, maxdimsystems, moser_reduce, muchange, mult, mutest, newton_polygon, normalG2, ode_int_y, ode_y1, odeadvisor, odepde, parametricsol, particularsol, phaseportrait, poincare, polysols, power_equivalent, rational_equivalent, ratsols, redode, reduceOrder, reduce_order, regular_parts, regularsp, remove_RootOf, riccati_system, riccatisol, rifread, rifsimp, rightdivision, rtaylor, separablesol, singularities, solve_group, super_reduce, symgen, symmetric_power, symmetric_product, symtest, transinv, translate, untranslate, varparam, zoom]

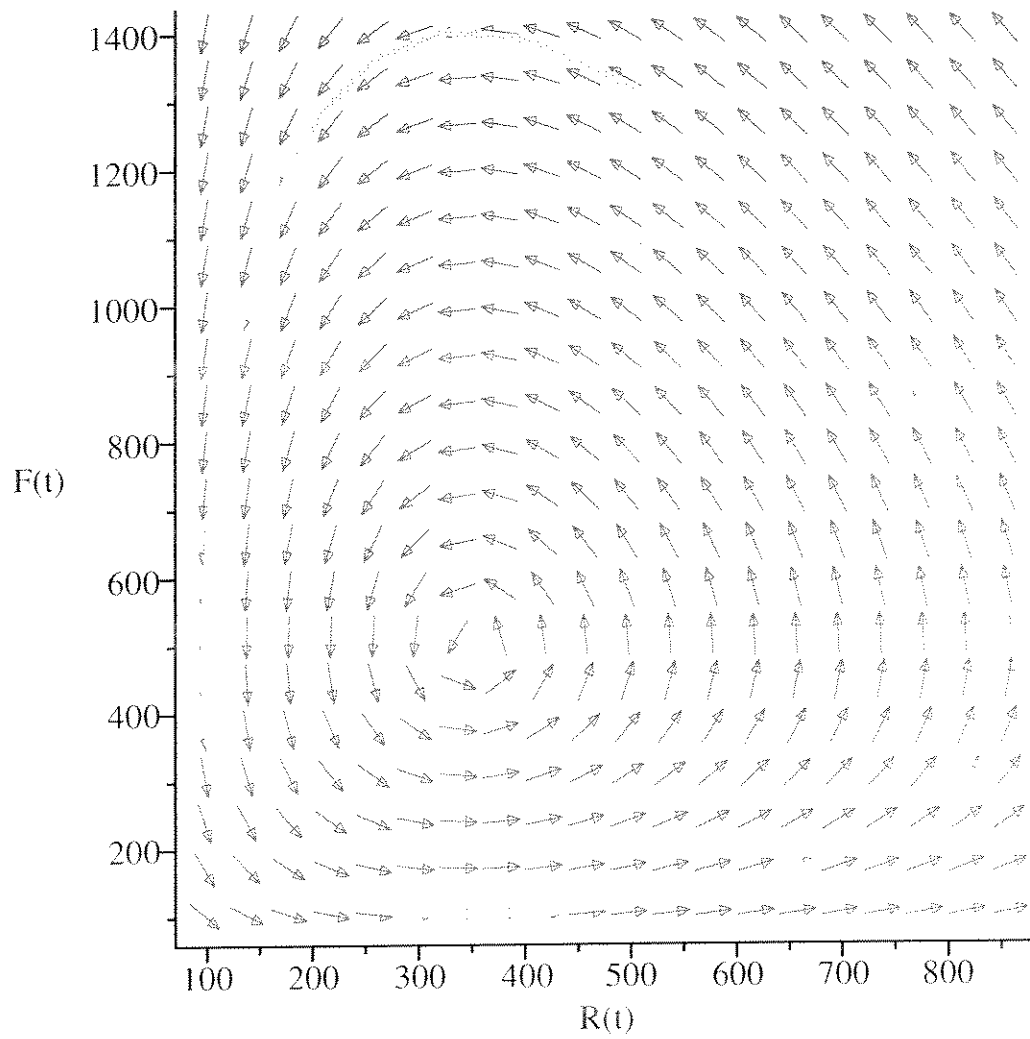
Rab := diff (R(t), t) = (0.05) · R(t) - (0.0001) · R(t) · F(t);

$$\frac{d}{dt} R(t) = 0.05 R(t) - 0.0001 R(t) F(t) \quad (2)$$

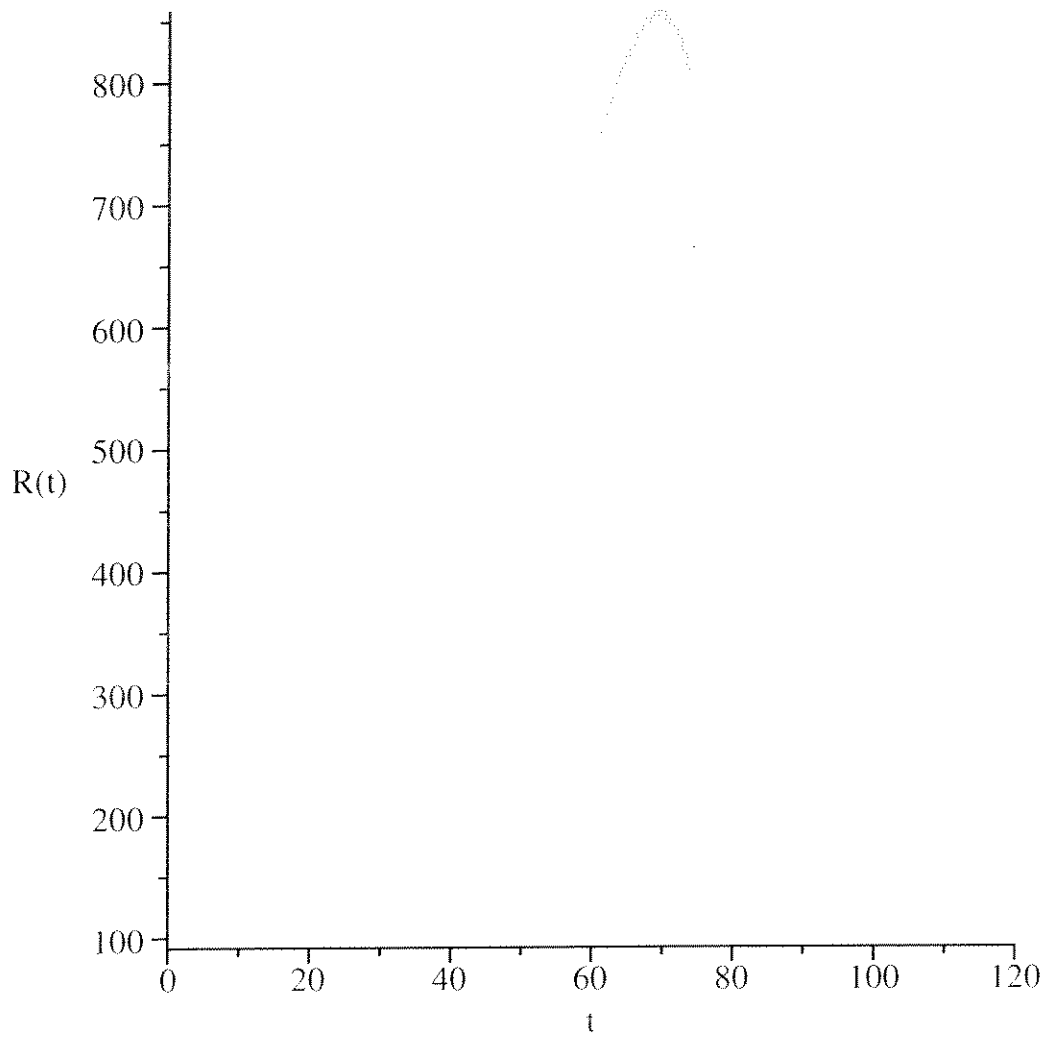
Fox := diff (F(t), t) = - (0.07) · F(t) + (0.0002) · R(t) · F(t);

$$\frac{d}{dt} F(t) = -0.07 F(t) + 0.0002 R(t) F(t) \quad (3)$$

DEplot([Rab, Fox], [R(t), F(t)], t=0..120, [[R(0) = 100, F(0) = 400]], scene = [R(t), F(t)], arrows = medium);



*DEplot([Rab, Fox], [R(t), F(t)], t=0..120, [[R(0)=100, F(0)=400]], scene=[t, R(t)], arrows
=medium);*



DEplot([Rab, Fox], [R(t), F(t)], t=0..120, [[R(0) = 100, F(0) = 400]], scene = [t, F(t)], arrows = medium);

