Deer Population

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Introduction

- NC deer population is about 1,000,000
- Current population can be modeled by:

$$N_{t+1} = N_t + 0.12(1 - \frac{N_t}{1{,}200{,}000})N_t$$

- growth rate: 12% carrying capacity: 1,200,000
- Population is nearing its carrying capacity

Introduction Continued

- If the state introduces a predator, populations can be modeled by:

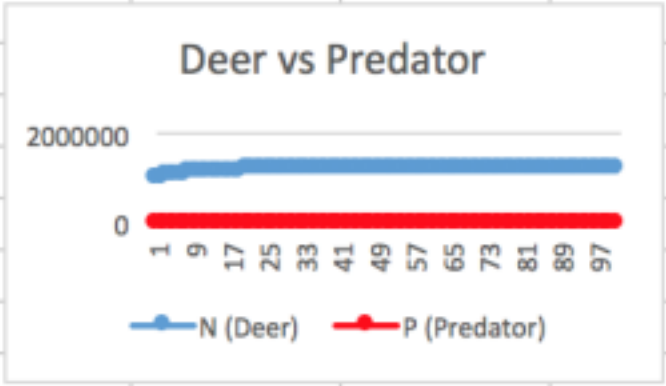
$$N_{t+1} = N_t + 0.12(1 - \frac{N_t}{1{,}200{,}000})N_t - \frac{cN_tP_t}{a + N_t}$$

$$P_{t+1} = P_t + \frac{bN_tP_t}{a + N_t} - mP_t$$

- a, b, and c can be values larger than 1
- m must be a value between 0 and 1 because it's a mortality rate

Excel

A	B	C	D	E	F	G	H
t (Time)	N (Deer)	P (Predator)		a	b	c	m
0	1000000	1000		0.1	0.1	0.1	0.1
1	1019900	999.99999					
2	1038168.4	999.99998					
3	1054869.24	999.999971					
4	1070078.64	999.999961					
5	1083881.25	999.999952					
6	1096367.14	999.999943					
7	1107629.11	999.999933					
8	1117760.38	999.999924					

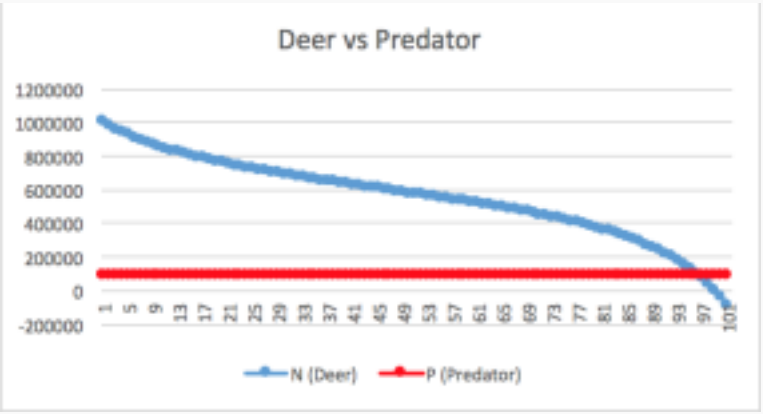


fx =B2+(0.12*(1-(B2/1200000))*B2)-(G2*B2*C2/(E2+B2))

fx =C2+(F2*B2*C2/(E2+B2))-(H2*C2)

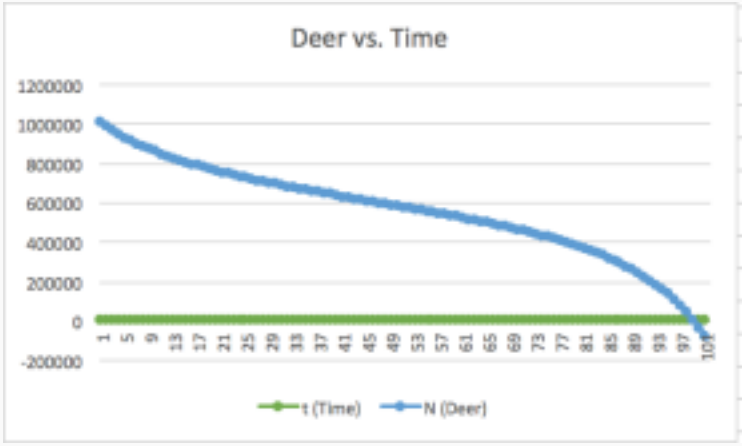
- N(0)=1,000,000
- 100-year time frame

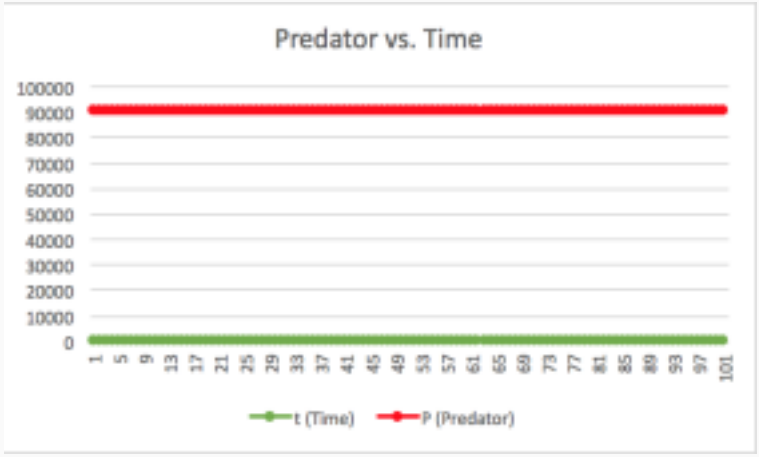
Population Goes Extinct



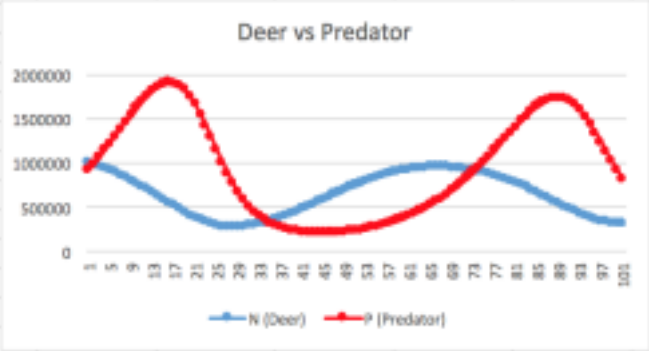
t (Time)	N (Deer)	P (Predator)		a	b	c	m
0	1000000	90000		0.001	0.9	0.459	0.9

- a doesn't matter
- b & m are the same value while c is relatively smaller

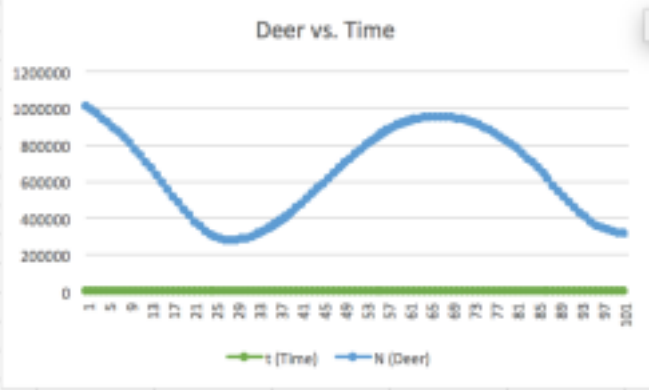


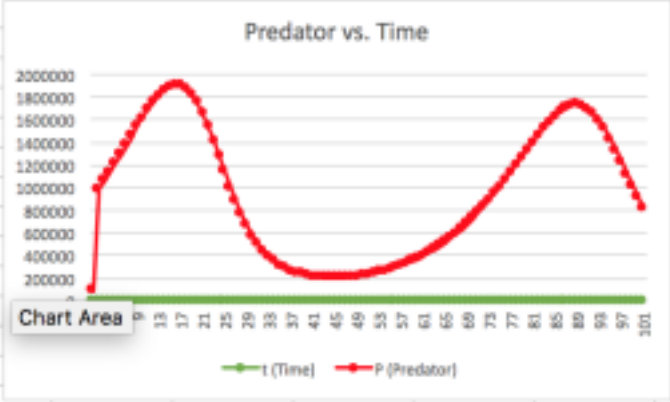


Cycling Population

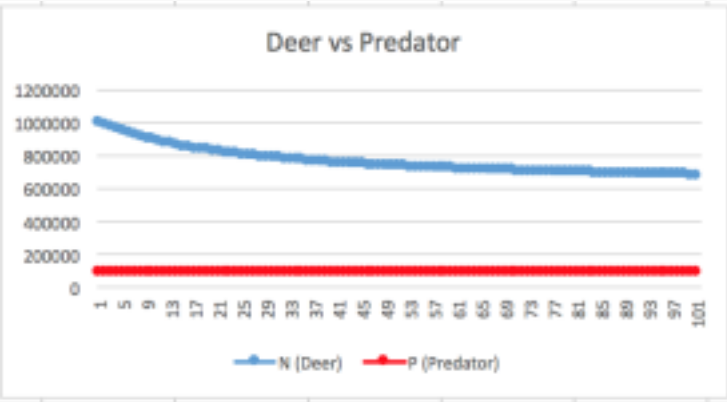


t (Time)	N (Deer)	P (Predator)		a	b	c	m
0	1000000	917847		160000	0.9	0.05	0.7



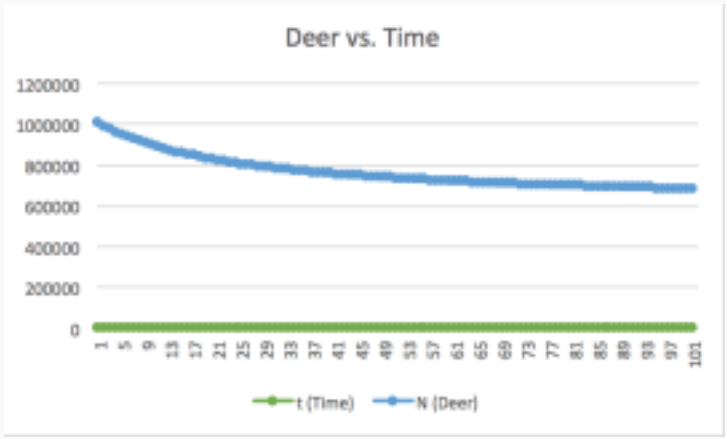


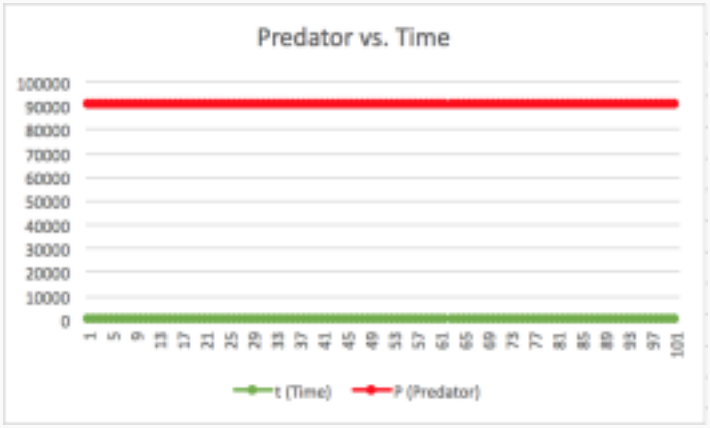
Population Kept Under 700,000 Deer



t (Time)	N (Deer)	P (Predator)		a	b	c	m
0	1000000	90000		0.001	0.2	0.4	0.2

- a doesn't matter
- b & m are the same values (small) while c is relatively larger

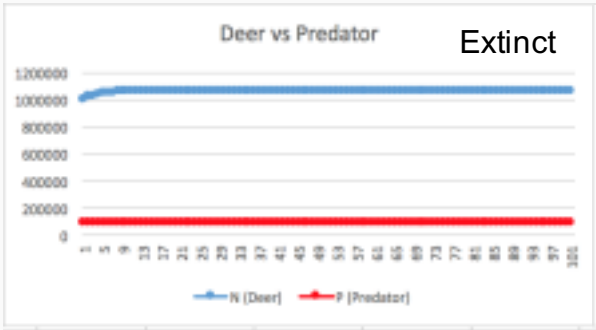


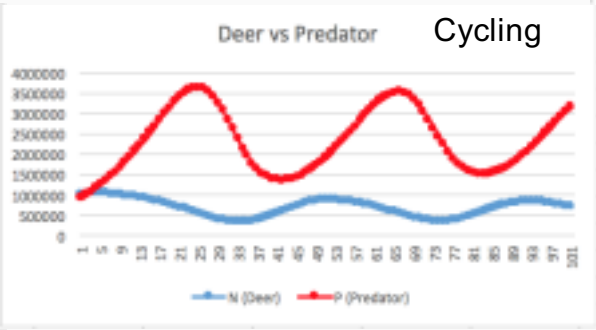


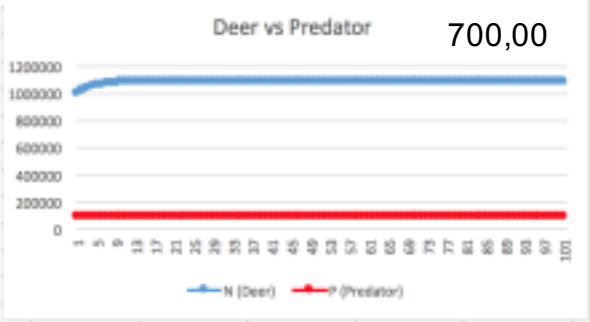
Stochastic Deer Growth Rate Changes

Change growth rate to equally likely values: Hi = 0.34, Mid = 0.12 (the same), Lo = -0.1

Hi:







Lo: