Further Analysis III

Objective

Regional study the behaviours of LV equations, and further confirm its behaviours within the region we are concerned.

dX/dt= aX - bXY ----------(1)
dY/dt= cXY - dY ----------(2)

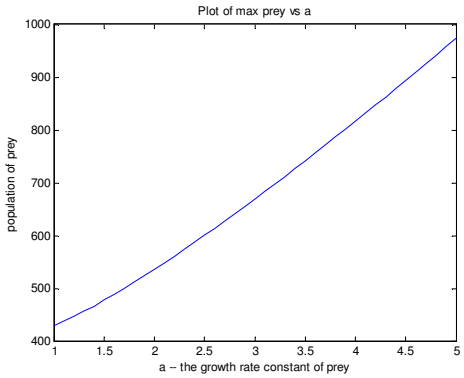
Method

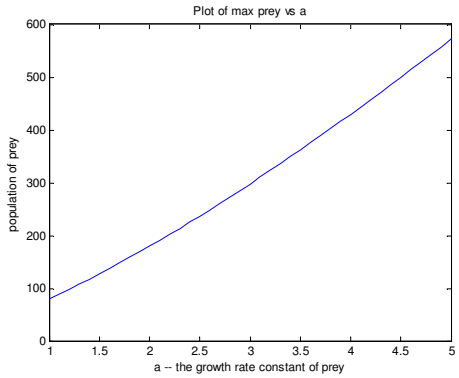
- Increasing "a" from 1 to 5 with 50 steps, at b = 0.1 c = 0.02 d = 2.5 X(0) = 20 Y(0) = 3
- Increasing "a" from 0.7 to 1.3 with 60 steps, at b = 0.1 c = 0.02 d = 0.65 X(0) = 20 Y(0) = 3
- Increasing "b" from 0.07 to 0.13 with 60 steps, at a = 1 c = 0.026 d = 0.5 X(0) = 20 Y(0) = 3

Experiment 6

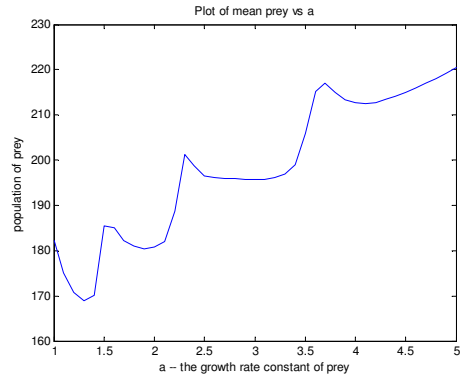
- Increasing "a" from 1 to 5, a –the growth rate of prey

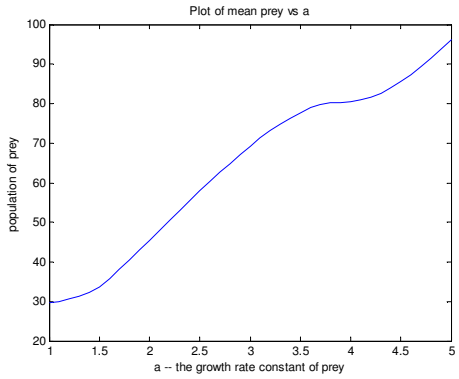
Max prey population vs. a





Mean prey population vs. a

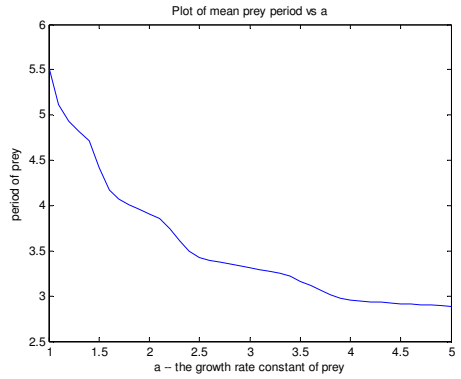


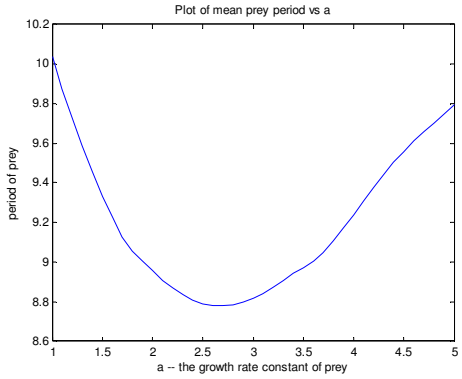


Experiment 6 Experiment 1

- General trend still about the same
- The magnitude is different, and the increasing gradient of Exp 6 is much less than Exp 1

Mean prey period vs. a





Experiment 6 Experiment 1

- The behaviour of period is totally different.

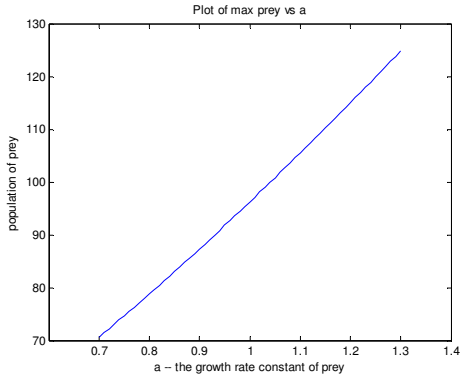
Conclusion from Experiment 6

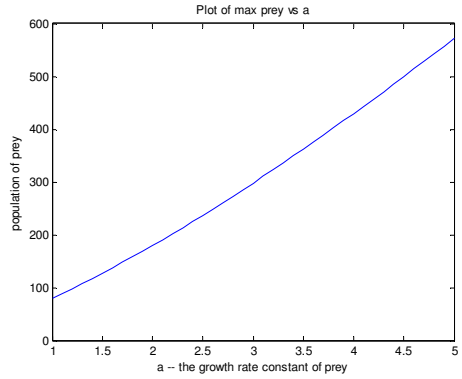
- With large change of other parameters, the behaviours of the changing parameter are not as expected. However, it is still possible to extract a region of interest by confining the region of parameters can vary in the real systems
- To study and confirm the local behaviours, it is better to confine all the interested parameters to a smaller range. In the rest of report, we will be concentration on +- 30%.

Experiment 7

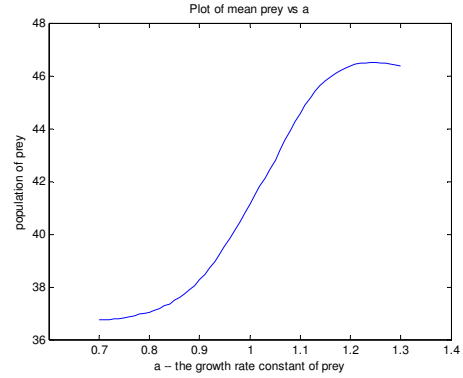
- Increasing "a" from 0.7 to 1.3, a – the growth rate of prey

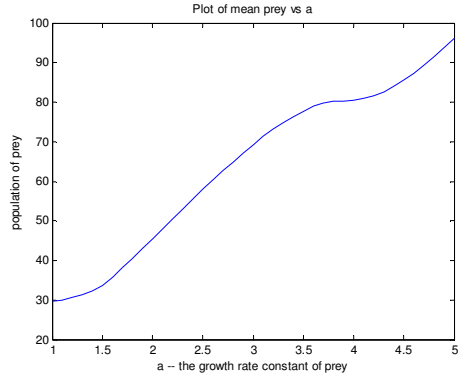
Max Prey population vs. a





Mean Prey population vs. a

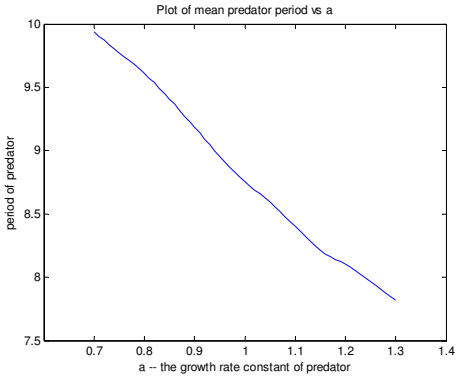


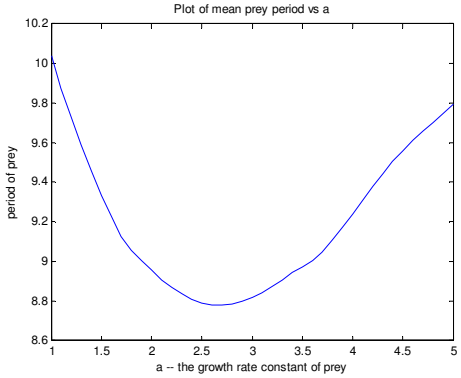


Experiment 7 Experiment 1

- The gradient of the max graph is about the same, 100 population / units of "a"
- The mean graph of prey is generally increasing. We should take range of "a" from 0.9 to 1.1, such that the gradient is about 100 populations / units of "a" as well.

Period of Prey oscillation vs. a





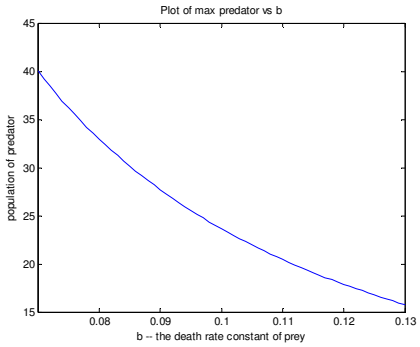
Experiment 7 Experiment 1

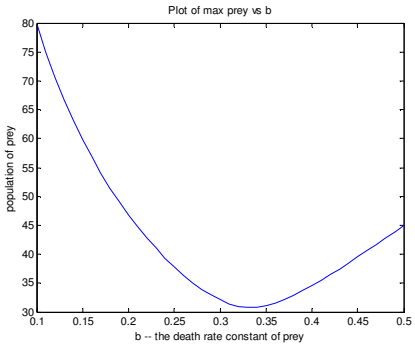
- With the range of "a" being 0.9 to 1.1, we could assume the period are decreasing linearly now with the gradient of -5.

Experiment 8

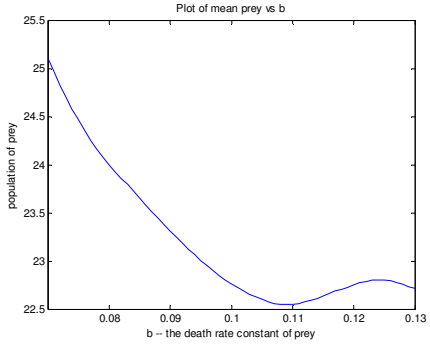
- Increasing "b" from 0.07 to 0.13, b – the death rate of prey

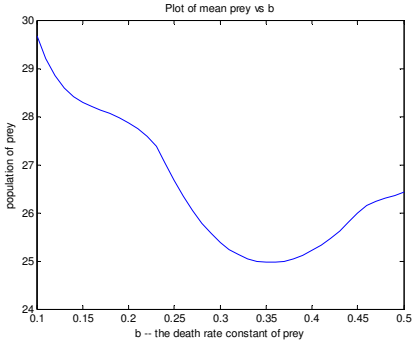
Max Prey population vs. b





Mean Prey population vs. b

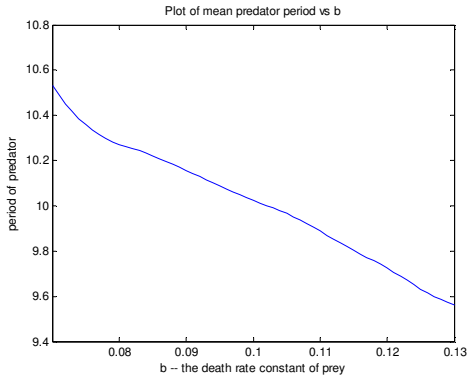


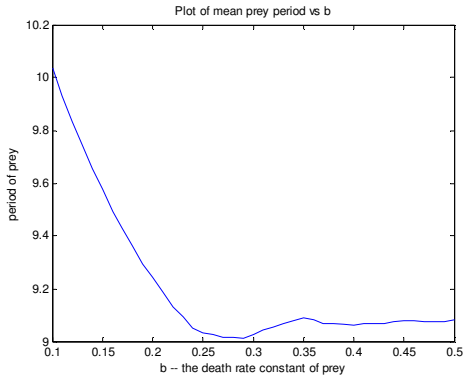


Experiment 8 Experiment 1

- The population is generally decreasing, and we constrain b within the range of 0.07 to 0.11, we could assume the linear relationship, whereas max have a gradient of 500 populations per units of b, and mean have a gradient of 60.

Period of oscillation vs. b





Experiment 8 Experiment 1

- With the range of 0.08 to 0.11, the period is decreasing at a rate of 17 time units / units of b

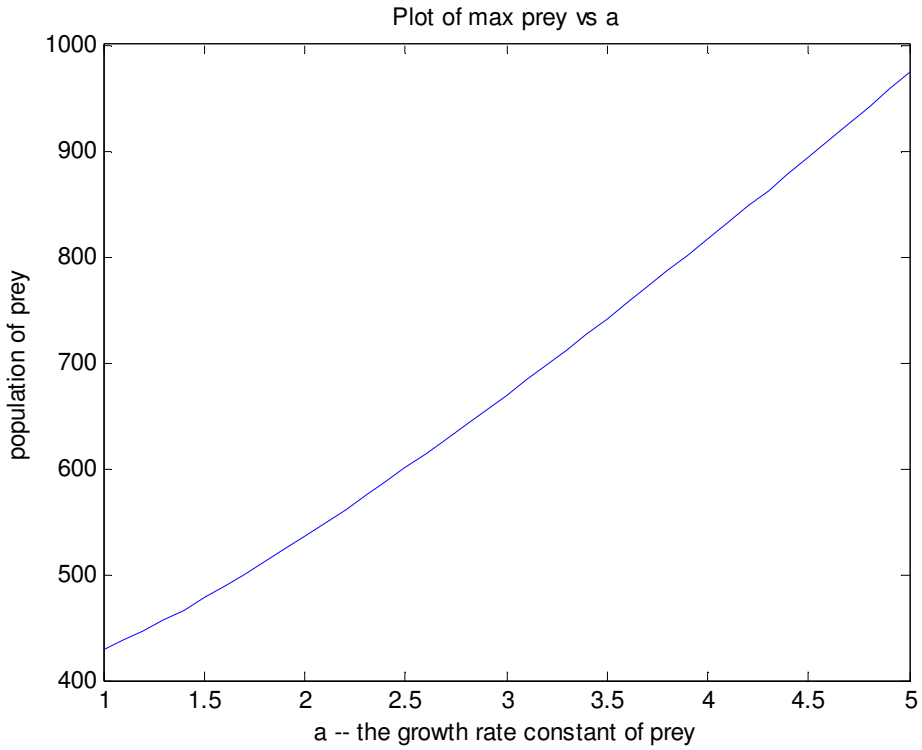
Conclusion

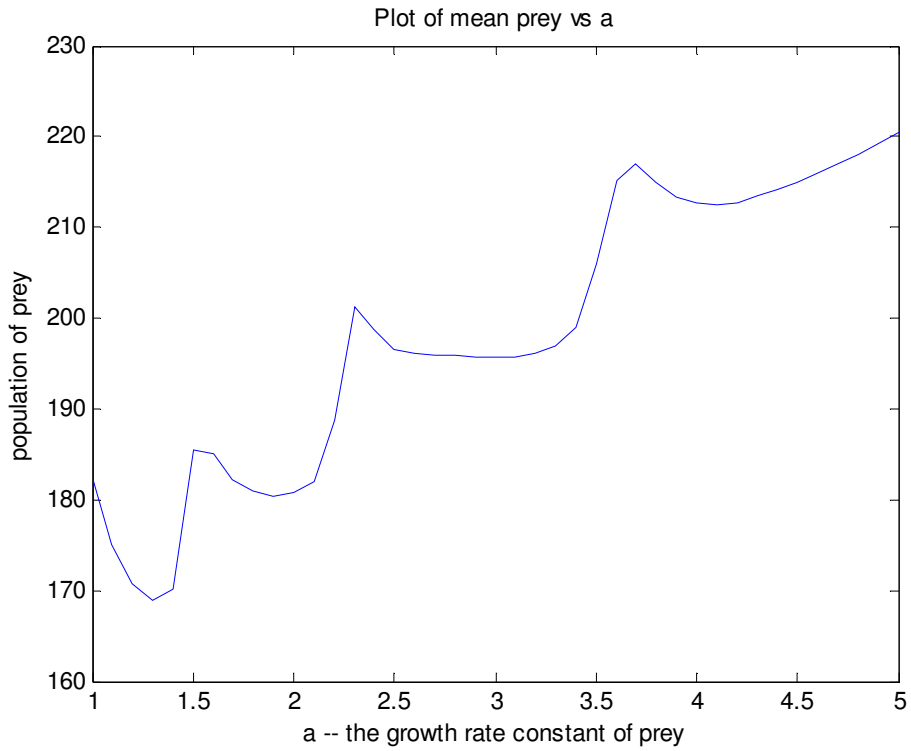
- With a confined range, we have propose the characteristic of parameter a & b, but we have only varied one of the five other parameters, we should change other parameters as well to further confirm our characterization.
- With this approach of analysis, we should be able to understand well on system models, and constrain our range of analysis by experimental limits, and tune our system to a range analysed by our analysis

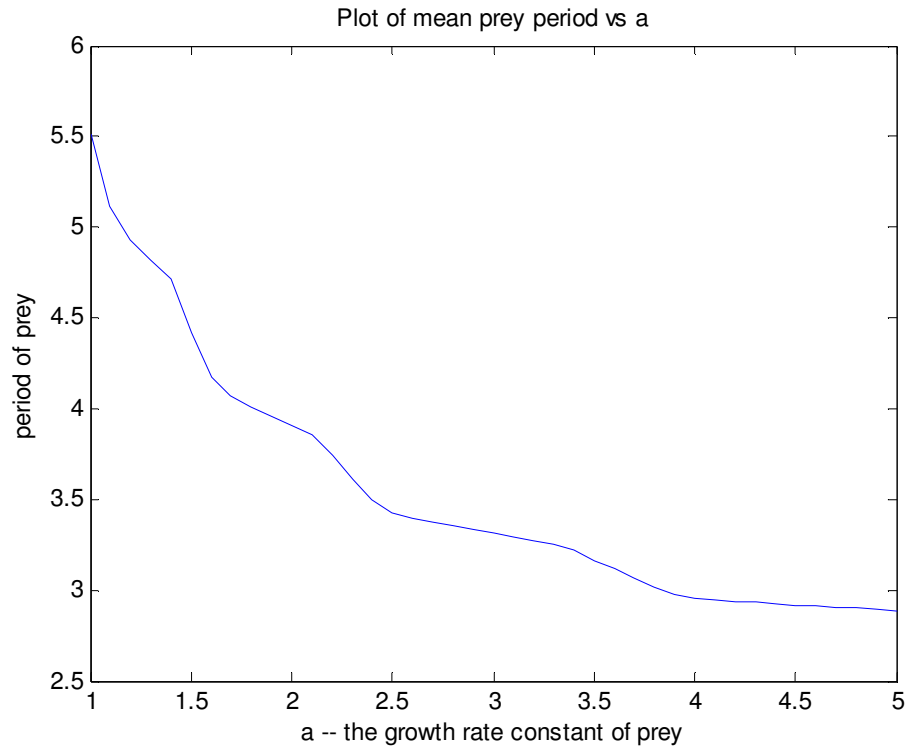
Further work

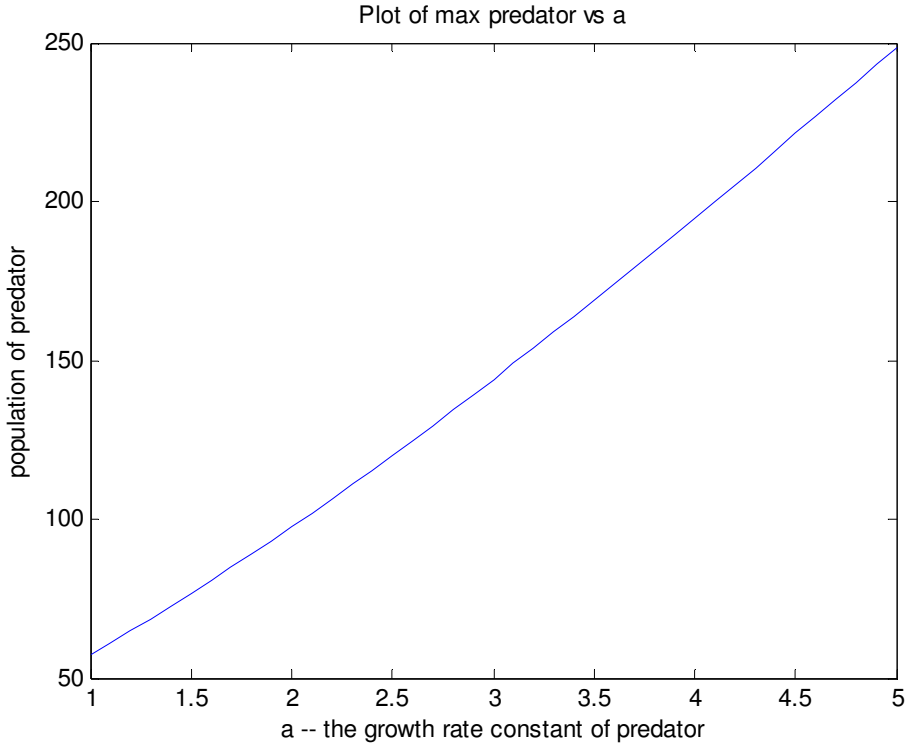
- Further work should be done by Jacobian stability test on more complicated models.
- Then followed by the proposed approach of analysis in last few reports.

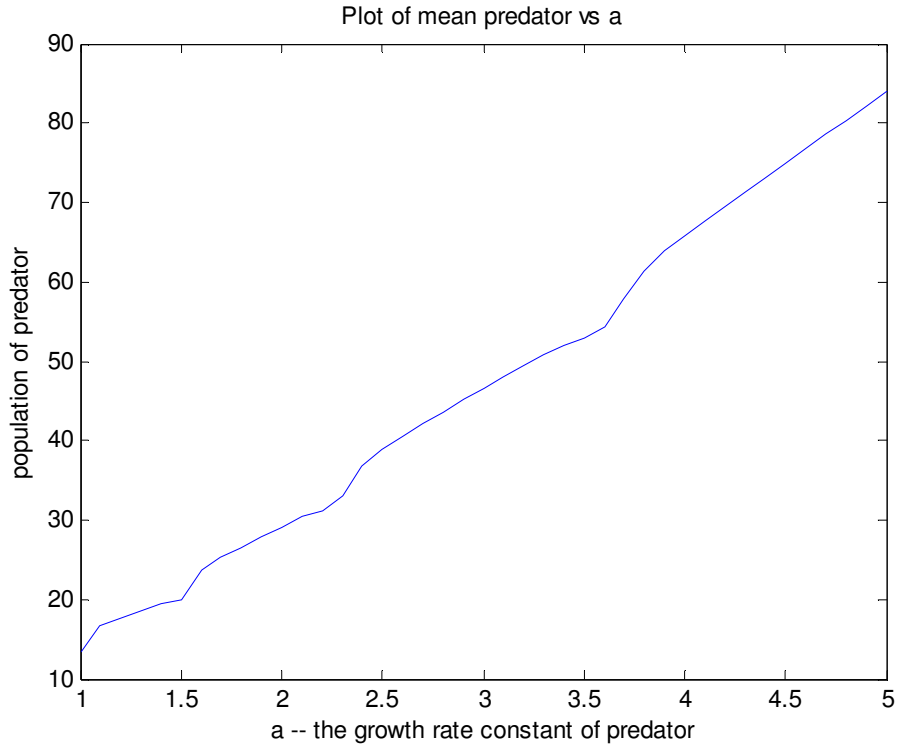
Appendix

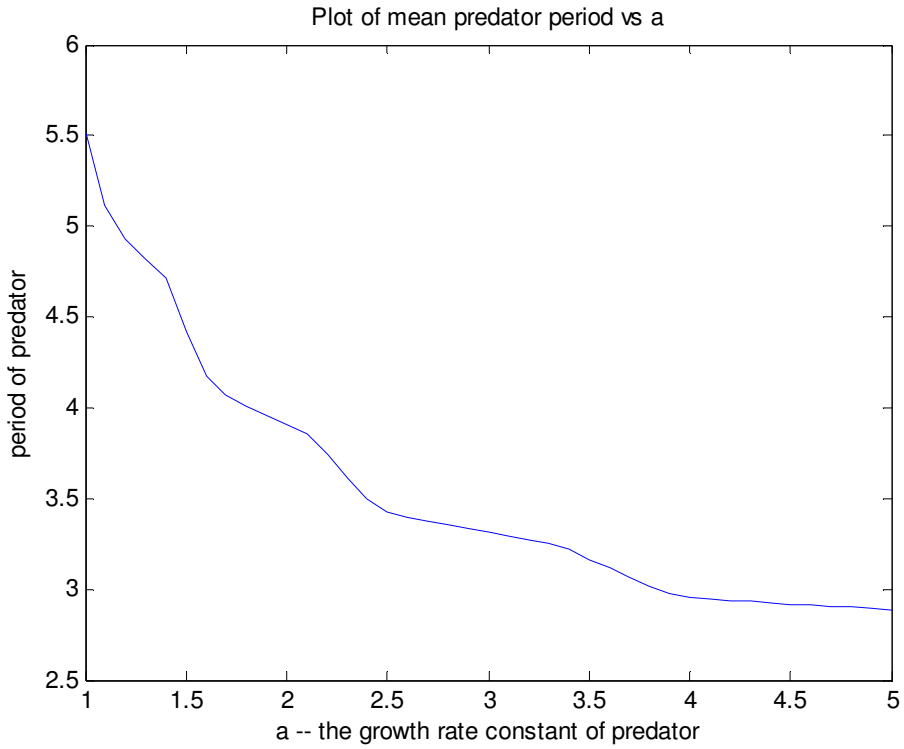

Plot of max prey vs a
population of prey
a -- the growth rate constant of prey
1000
900
800
700
600
500
400
1
1.5
2
2.5
3
3.5
4
4.5
5

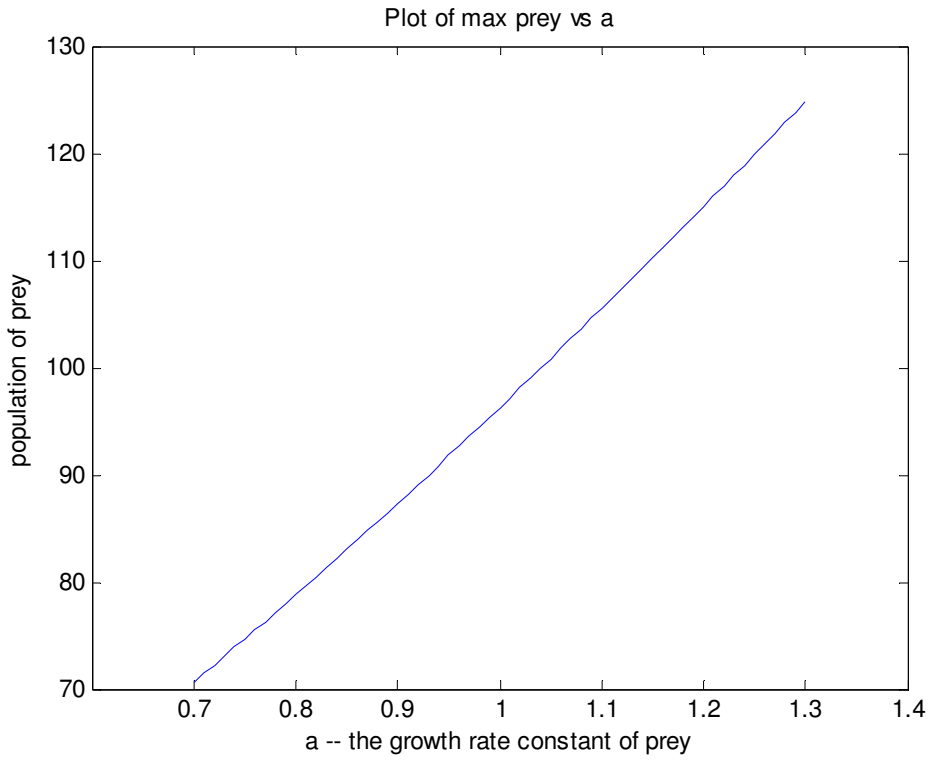

Plot of mean prey vs a
population of prey
a -- the growth rate constant of prey
230
220
210
200
190
180
170
160
1
1.5
2
2.5
3
3.5
4
4.5
5

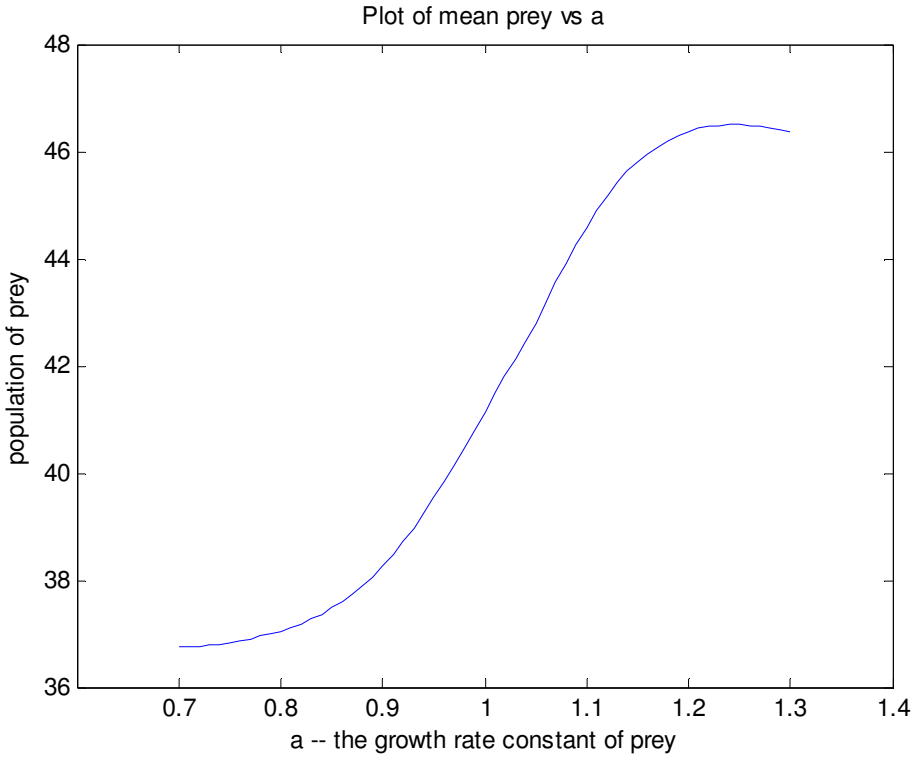

Plot of mean prey period vs a
period of prey
a -- the growth rate constant of prey
6
5.5
5
4.5
4
3.5
3
2.5
1
1.5
2
2.5
3
3.5
4
4.5
5

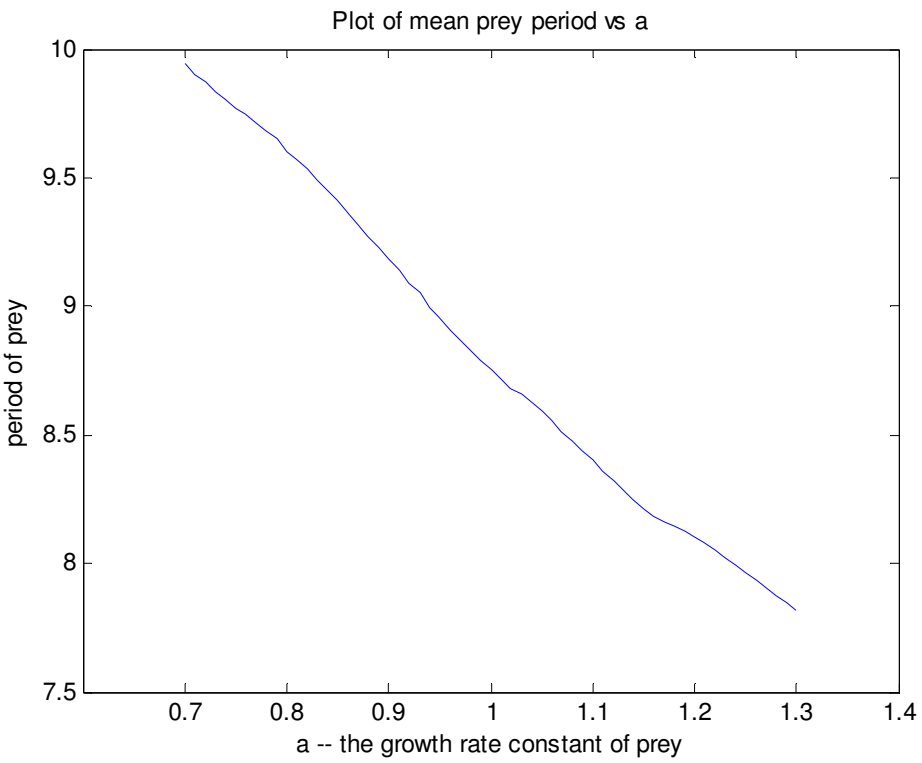

Plot of max predator vs a
population of predator
a -- the growth rate constant of predator
250
200
150
100
50
1
1.5
2
2.5
3
3.5
4
4.5
5

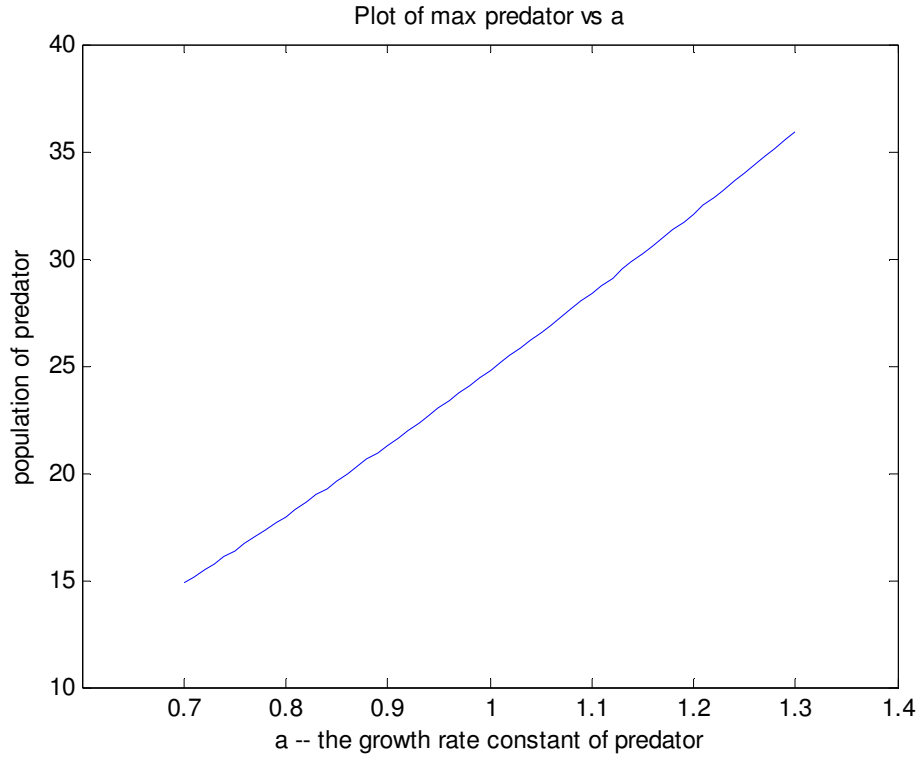

Plot of mean predator vs a
population of predator
a -- the growth rate constant of predator
90
80
70
60
50
40
30
20
10
1
1.5
2
2.5
3
3.5
4
4.5
5

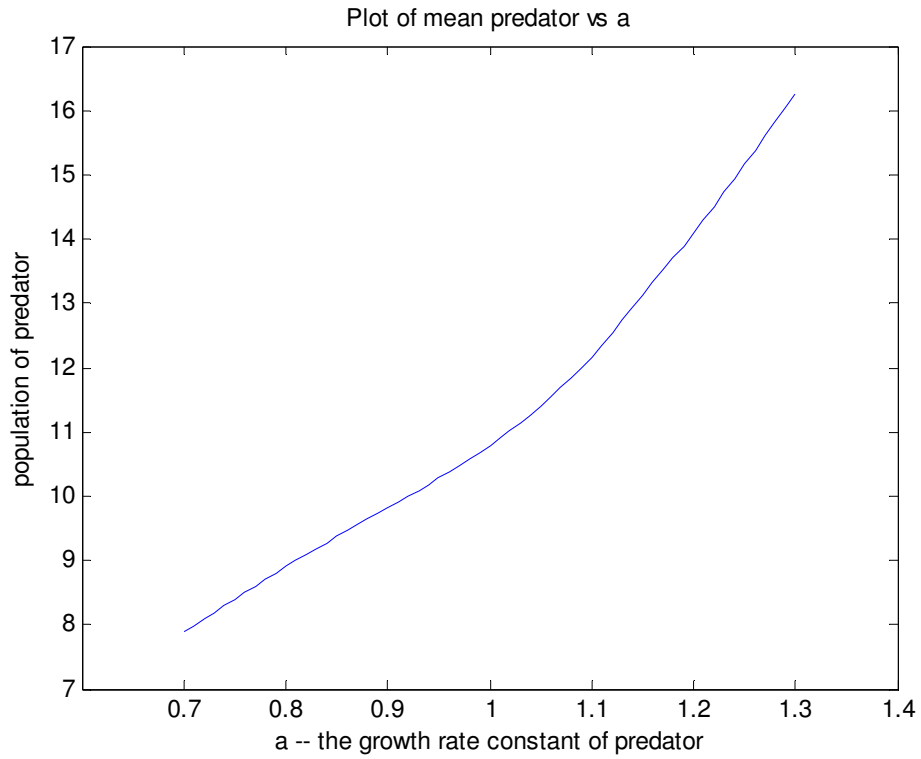

Plot of mean predator period vs a
period of predator
a -- the growth rate constant of predator
6
5.5
5
4.5
4
3.5
3
2.5
1
1.5
2
2.5
3
3.5
4
4.5
5

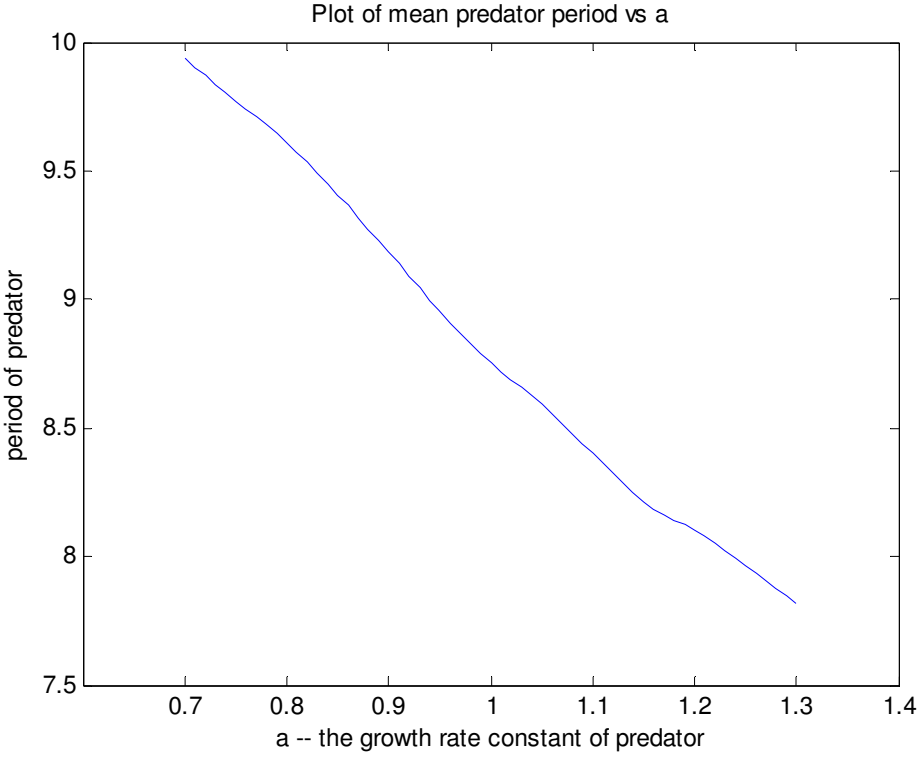

Plot of max prey vs a
population of prey
130
120
110
100
90
80
70
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
a -- the growth rate constant of prey

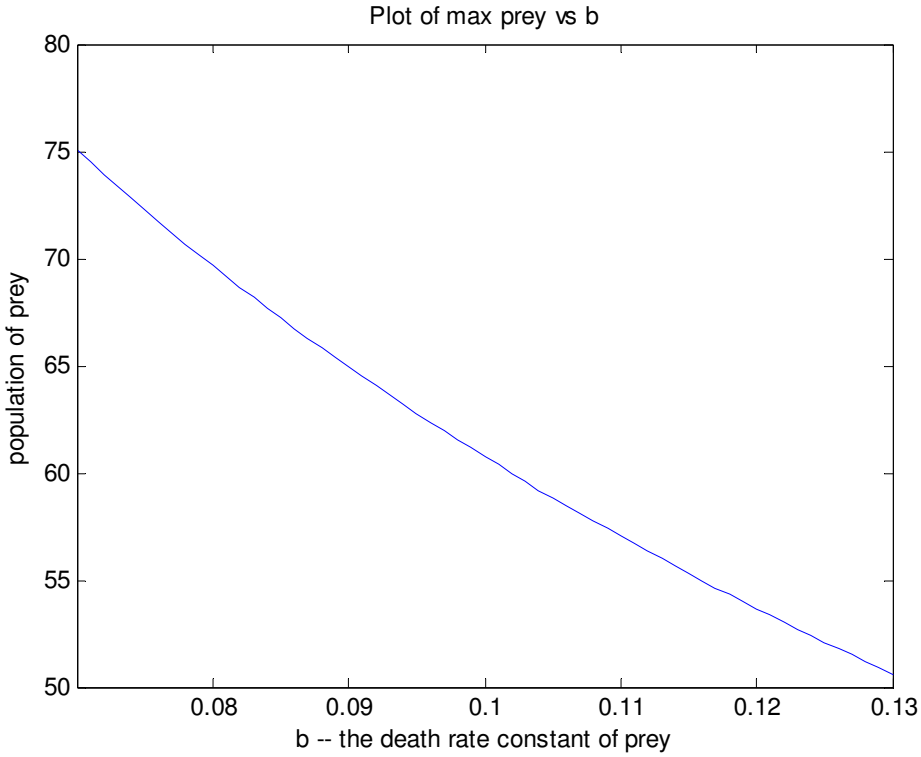

Plot of mean prey vs a
population of prey
48
46
44
42
40
38
36
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
a -- the growth rate constant of prey

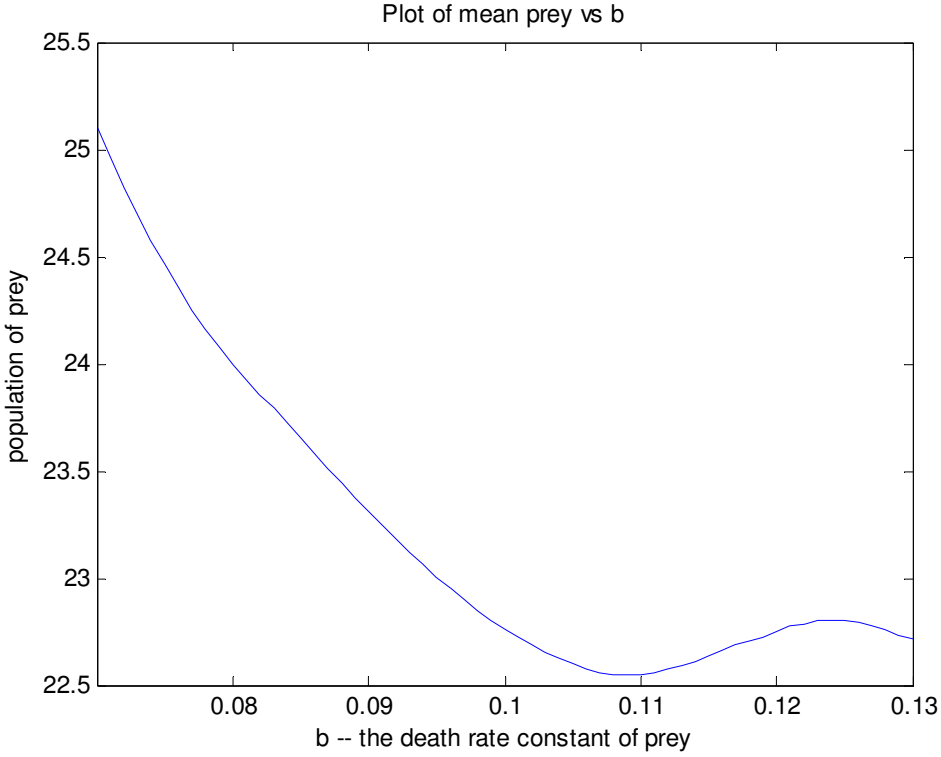

Plot of mean prey period vs a
period of prey
10
9.5
9
8.5
8
7.5
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
a -- the growth rate constant of prey

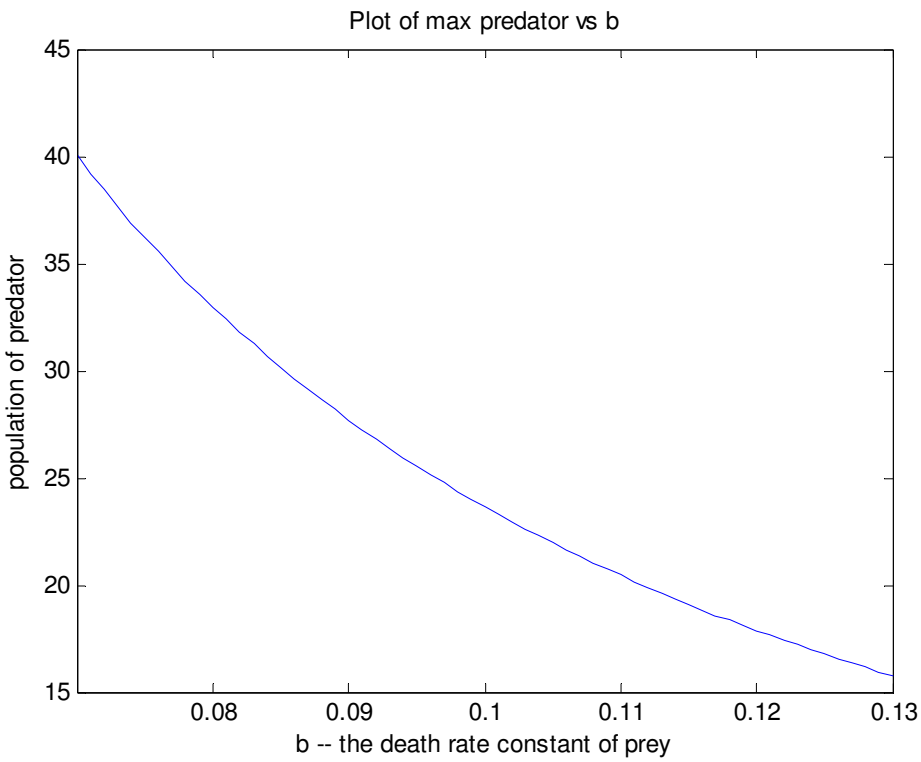

Plot of max predator vs a
population of predator
40
35
30
25
20
15
10
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
a -- the growth rate constant of predator

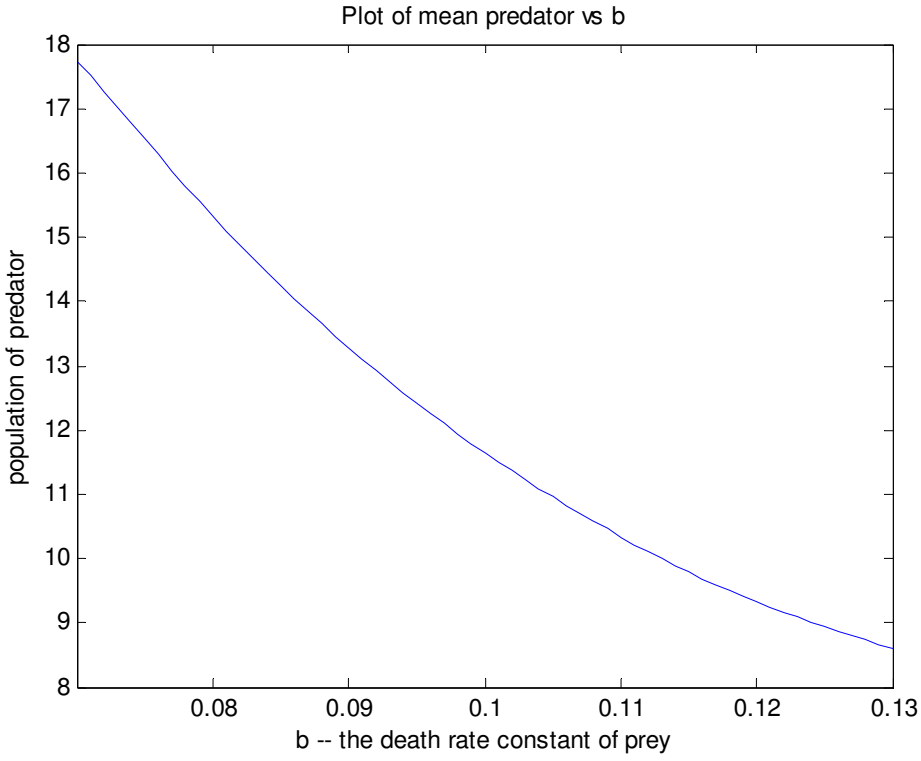

Plot of mean predator vs a
population of predator
17
16
15
14
13
12
11
10
9
8
7
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
a -- the growth rate constant of predator

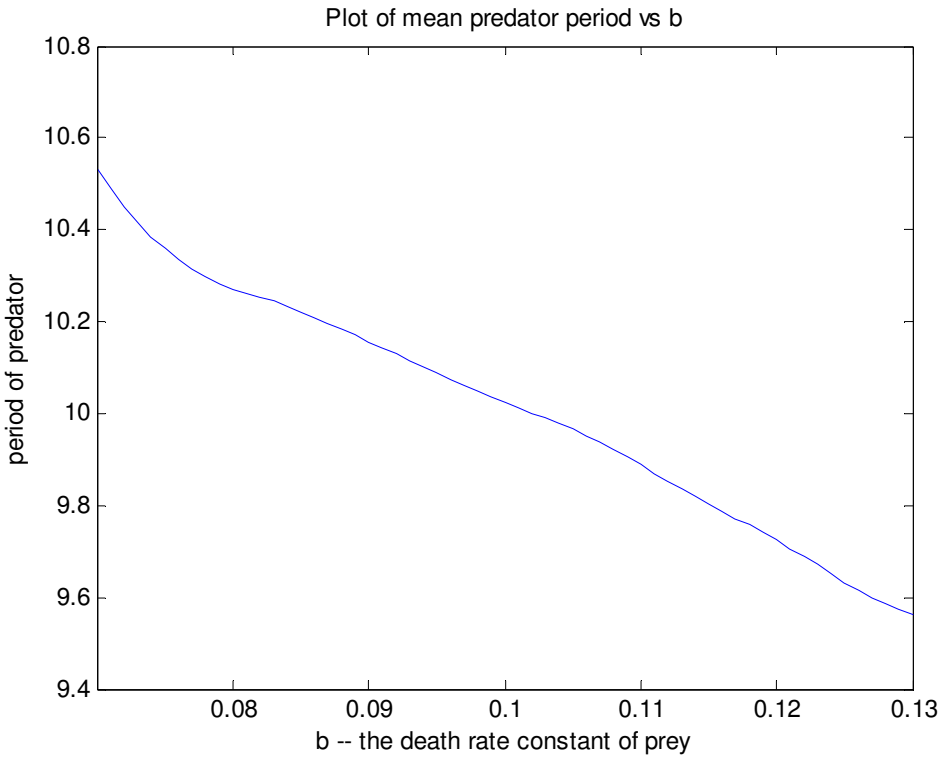

Plot of mean predator period vs a
period of predator
10
9.5
9
8.5
8
7.5
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
a -- the growth rate constant of predator


Plot of max prey vs b
population of prey
80
75
70
65
60
55
50
0.08
0.09
0.1
0.11
0.12
0.13
b -- the death rate constant of prey


Plot of mean prey vs b
population of prey
25.5
25
24.5
24
23.5
23
22.5
0.08
0.09
0.1
0.11
0.12
0.13
b -- the death rate constant of prey


Plot of max predator vs b
population of predator
45
40
35
30
25
20
15
0.08
0.09
0.1
0.11
0.12
0.13
b -- the death rate constant of prey


Plot of mean predator vs b
population of predator
18
17
16
15
14
13
12
11
10
9
8
0.08
0.09
0.1
0.11
0.12
0.13
b -- the death rate constant of prey


Plot of mean predator period vs b
period of predator
10.8
10.6
10.4
10.2
10
9.8
9.6
9.4
0.08
0.09
0.1
0.11
0.12
0.13
b -- the death rate constant of prey