# Practice 2

**Nian.Liu**

## Practice 2-1

- **The differential equation model**

$$\frac{dx(t)}{dt} = \rho(1 - \frac{x(t)}{K}) \bullet x(t)$$

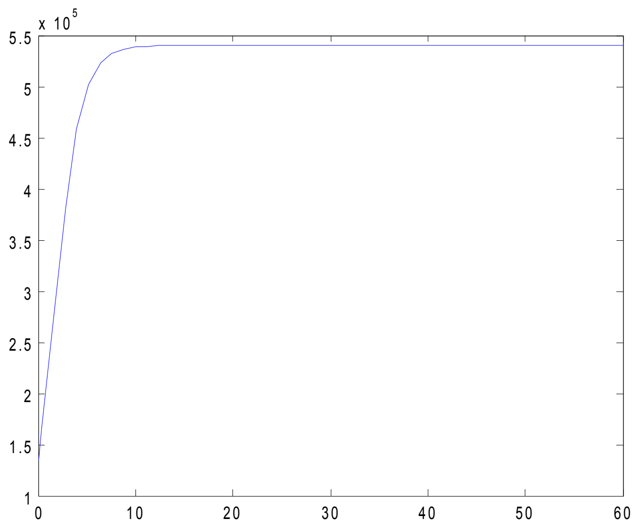
- **Table of all model parameters:**

| $\rho$ | K |
|---|---|
| Growth rate | Capacity of the environment |
| 0.71 | 54*10^4 |
| \. | individuals |

- **Table of all state variables of the model:**

| x(t) |
|---|
| Number of individuals via time |
| x(0)=(1/4)*K=(1/4)*54*10^4 |
| individuals |

- **Calculation:**




**Population size after the first year:<u>2.184*10^5</u>**

**Time when population reaches half capacity of the environment: <u>1.58</u>**

# Practice 2-2

**Logistic model with delay**

- **The differential equation model**

$$\frac{dx(t)}{dt} = \rho \bullet x(t) \bullet \left[1 - \frac{x(t-\tau)}{K}\right]$$

- **Table of all model parameters:**

| $\rho$ | K | $\tau$ |
|---|---|---|
| Growth rate | Capacity of the environment | Time delay |
| 0.71 | 54*10^4 | 1/6 |
| \. | individuals | year |

- **Table of all state variables of the model:**

| x(t) |
|---|
| Number of individuals via time |
| x(0)=(1/4)*K=(1/4)*54*10^4 |
| individuals |

**Population size after the first year:<u>2.262*10^5</u>**

**Time when population reaches half capacity of the environment: <u>1.37</u>**

**Logistic model with variable parameters:**

- **The differential equation model**

$$\frac{dx(t)}{dt} = \rho(t) \bullet x(t) \bullet \left[1 - \frac{x(t)}{K}\right]$$

$$p(t) = arctg(1/t) + 1$$

- **Table of all model parameters:**

| K |
|---|
| Capacity of the environment |
| 54*10^4 |
| individuals |

- **Table of all state variables of the model:**

| x(t) | $\rho(t)$ |
|---|---|
| Number of individuals via time | Growth rate |
| x(0)=(1/4)*K=(1/4)*54*10^4 | $p(t) = arctg(1/t) + 1$ |
| individuals | \. |

**Population size after the first year:<u>2.75*10^5</u>**

**Time when population reaches half capacity of the environment: <u>1.07</u>**

**<u>Logistic model with harvesting</u>**

- **Table of all model parameters:**

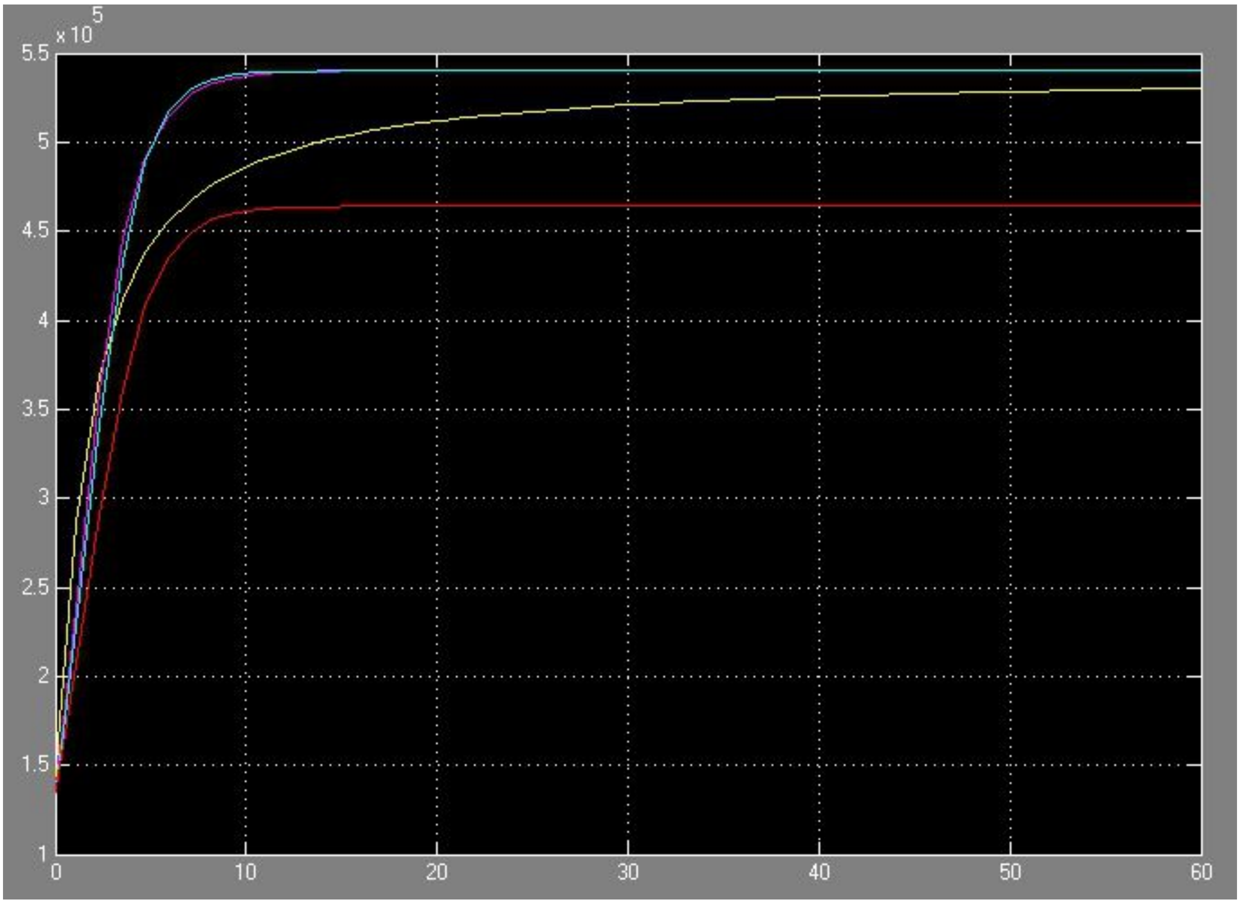
| $\rho$ | K | c |
|---|---|---|
| Growth rate | Capacity of the environment | Model capture |
| 0.71 | 54*10^4 | 0.1 |
| \. | individuals | \. |

- **Table of all state variables of the model:**

| x(t) |
|---|
| Number of individuals via time |
| x(0)=(1/4)*K=(1/4)*54*10^4 |
| individuals |

**Population size after the first year:<u>1.99*10^5</u>**

**Time when population reaches half capacity of the environment:<u>2.05</u>**


x 10^5
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0
10
20
30
40
50
60