**PROTOCOL**

**PREDATOR-PREY**

**POPULATIONS DYNAMIC MODEL**

**DATE:** 22.04.2018

**SOFTWARE:** SIMILE

**OBJECTIVE:** Run a model to observe the changes in the population of a two species, according different rates of birth and death.

**MODEL:** The Predator-Prey model will be used for this experiment. This model describes the dynamics of biological systems in which two species interact, one as a predator and the other as prey. The populations change through time according to the rates of Birth and Death and other factors like damage and nutrition of each species. The Figure 1. illustrates the model.

Figure 1. Predator-Prey model



Where, A is the first specie and B is the other one.

**INITIAL VALUES:**

The following initial values and formulas must be set:

**A=**1

**dA\_i=** BirthRateA\*A+Meet\*Nutrition\_factor

**Nutrition\_factor=**0.2

**dA\_d=** DeathRateA\*A

**B=**1

**dB\_i=** BirthRateB\*B

**dB\_d=** DeathRateB\*B+Meet\*Damage\_factor

**Damage\_factor=**0.15

**Meet\_factor=**0.15

**Meet=** A\*B\*Meet\_factor

**SIMULATIONS**

Five simulations will be done adjusting the parameters of Birth and Death rate according to the following conditions:

1. **BirthRateA < DeathRateA and BirthRateB > DeathRateB**

In order to accomplish the condition for this simulation, let us assume the following rates:

BirthRateA=0.3

DeathRateA=0.4

BirthRateB=0.3

DeathRateB=0.2

*Run control and settings:* For the execution of the model, it will start from t0=0 and calculate for T=300 with time step 0.05. The Euler integration method must be used.

*Execution:* we should create a table in the page 1 and a plotter in the page 2 and add the variable A and B in each page in order to simulate the growth of both populations.

After running the model, there is the following observation:



The table has to be saved as a CSV file with the name: *tableCon1.csv*

1. **BirthRateA < DeathRateA and BirthRateB < DeathRateB**

In order to accomplish the condition for this simulation, let us assume the following rates:

BirthRateA=0.3

DeathRateA=0.4

BirthRateB=0.2

DeathRateB=0.3

*Run control and settings:* For the execution of the model, it will start from t0=0 and calculate for T=300 with time step 0.05. The Euler integration method must be used.

*Execution:* we should create a table in the page 1 and a plotter in the page 2 and add the variable A and B in each page in order to simulate the growth of both populations.

After running the model, there is the following observation:



The table has to be saved as a CSV file with the name: *tableCon2.csv*

1. **BirthRateA > DeathRateA and BirthRateB < DeathRateB**

In order to accomplish the condition for this simulation, let us assume the following rates:

BirthRateA=0.4

DeathRateA=0.3

BirthRateB=0.2

DeathRateB=0.3

*Run control and settings:* For the execution of the model, it will start from t0=0 and calculate for T=300 with time step 0.05. The Euler integration method must be used.

*Execution:* we should create a table in the page 1 and a plotter in the page 2 and add the variable A and B in each page in order to simulate the growth of both populations.

After running the model, there is the following observation:



The table has to be saved as a CSV file with the name: *tableCon3.csv*

1. **BirthRateA > DeathRateA and BirthRateB > DeathRateB**

In order to accomplish the condition for this simulation, let us assume the following rates:

BirthRateA=0.4

DeathRateA=0.3

BirthRateB=0.3

DeathRateB=0.2

*Run control and settings:* For the execution of the model, it will start from t0=0 and calculate for T=300 with time step 0.05. The Euler integration method must be used.

*Execution:* we should create a table in the page 1 and a plotter in the page 2 and add the variable A and B in each page in order to simulate the growth of both populations.

After running the model, there is the following observation:



The table has to be saved as a CSV file with the name: *tableCon4.csv*

1. **BirthRateA < DeathRateA and BirthRateB > DeathRateB with integration method Runge-Kutta**

In order to accomplish the condition for this simulation, let us assume the following rates:

BirthRateA=0.3

DeathRateA=0.4

BirthRateB=0.3

DeathRateB=0.2

*Run control and settings:* For the execution of the model, it will start from t0=0 and calculate for T=300 with time step 0.05. The **Runge-Kutta** integration method must be used.

*Execution:* we should create a table in the page 1 and a plotter in the page 2 and add the variable A and B in each page in order to simulate the growth of both populations.

After running the model, there is the following observation:



The table has to be saved as a CSV file with the name: *tableCon5.csv*