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# Using XPP for simulation and analysis

## Lecture 9

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# Competition model

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$$\dot{u} = u(1 - u - av)$$

$$\dot{v} = v(1 - bu - v)$$

Possible outcomes:

- ◇ Winner depends on initial conditions
- ◇ Superior competitor always wins
- ◇ There exists stable coexistence

# *XPP ode file*

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```
# XPP will disregard lines starting with #
u'=u*(1-u-a*v)
v'=v*(1-b*u-v)
# list the parameters par a=1.2,b=.8
# the rest is not required, can be adjusted
within XPP
# axis boundaries
@ xlo=0,ylo=0,xhi=1.2,yhi=1.2
# axis variables
@ xp=u,yp=v
done
```

# *Initial Analysis*

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## ◇ Display Nullclines

▷ Nullclines → New

# *Initial Analysis*

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## ◇ Display Nullclines

▷ Nullclines → New

## ◇ View scaled/unscaled direction eld

▷ Dir.field/flow → Direct Field

# *Initial Analysis*

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## ◇ Display Nullclines

▷ `Nullclines` → `New`

## ◇ View scaled/unscaled direction eld

▷ `Dir.field/flow` → `Direct Field`

## ◇ Display flows on a grid

▷ `Dir.field/flow` → `Flow`

# Initial Analysis

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## ◇ Display Nullclines

▷ Nullclines → New

## ◇ View scaled/unscaled direction field

▷ Dir.field/flow → Direct Field

## ◇ Display flows on a grid

▷ Dir.field/flow → Flow

## ◇ View stable/unstable invariant sets

▷ Sing pts → Mouse  
press Esc as necessary

# *Displaying data*

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- ◇ Initial Conditions  
On toolbar: [ICs](#)

# *Displaying data*

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- ◇ Initial Conditions  
On toolbar: [ICs](#)
- ◇ Model parameters  
On toolbar: [Param](#)  
or [Parameters](#)

# Displaying data

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- ◇ Initial Conditions  
On toolbar: [ICs](#)
- ◇ Model parameters  
On toolbar: [Param](#)  
or [Parameters](#)
- ◇ Equations  
On toolbar: [Eqn](#)

# Displaying data

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- ◇ Initial Conditions  
On toolbar: [ICs](#)
- ◇ Model parameters  
On toolbar: [Param](#)  
or [Parameters](#)
- ◇ Equations  
On toolbar: [Eqn](#)
- ◇ Simulation Data  
On toolbar: [Data](#)

# *USEful actions*

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◇ Enter initial conditions

`Initialconds`  $\longrightarrow$  `Go, Mouse, MICE, Last`

# *Useful actions*

---

◇ Enter initial conditions

Initialconds → Go, Mouse, MICE, Last

◇ Change Axis

Viewaxis → 2D

or Xi vs t

# *Useful actions*

---

◇ Enter initial conditions

Initialconds → Go, Mouse, MICE, Last

◇ Change Axis

Viewaxis → 2D

or Xi vs t

◇ See multiple graphs

Makewindow → Create

# *USeful actions*

---

- ◇ Enter initial conditions  
Initialconds → Go, Mouse, MICE, Last
- ◇ Change Axis  
Viewaxis → 2D  
or Xi vs t
- ◇ See multiple graphs  
Makewindow → Create
- ◇ Adjust Numerical Parameters  
Numerics → Dt, Method, Bounds

# *Extras*

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- ◇ Assign model parameters to sliders for easier analysis (Three windows in bottom toolbar)

# *Extras*

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- ◇ Assign model parameters to sliders for easier analysis (Three windows in bottom toolbar)
- ◇ Bifurcation Analysis  
`File → Auto`