**InsightMaker exercise -- World War Z**

Human Population : Friday Jan 20

**Stage 1 -- Zombies wipe-out humans.**

Create a stock "Humans".
   Set it to 7.5 billion.

Create a stock "Zombies".
   Set it to 1.

Create a flow from Humans to Zombies, "Conversion".

Create a variable, "Success rate".
   Set it to 1. One zombie converts one human per day to a zombie.
   Link to Conversion.

Set Conversion to [Zombies]*[Success rate]

Simulation Time Settings.
   Set to Days.
   Range 0 to 365.

Hit Simulate!

-- How long do humans last? Not long, right? --

Does changing [Success Rate] to a lower value change the outcome?

**Stage 2 -- Weaker zombies, still wipe out humans.**

Create a flow from [Zombies], "Death" (really dead this time!).

Create a variable "Zombie Lifetime".
   Set it to 20 days.
   Link it to [Death].

Edit [Death]. (click the = sign to edit)
   Set to Delay([Zombies],[Zombie Lifetime], 0)

--- Look up Delay function to see what it does. ---

Add a comment using the # sign: "# Zombies die after [Zombie Lifetime] days"

Simulate.

Edit [Success Rate]. Make it a slider, from 0 to 1.
Edit [Zombie Lifetime]. Make it a slider from 1 to 100.
Simulate.

-- Is Humanity any safer with self-expiring zombies? --

Create variable "Log zombies" and "Log humans"
   Link [Zombies] to [Log Zombies]
   Link [Humans] to [Log Humans]
   Set [Log Zombies] to Log([Zombies]+1)
      Adding 1 assures that [Log Zombies] does encounter a log-zero error.
   Set [Log Humans] to Log([Humans]+1)

Simulate.
   In simulation window: Add Display.
      Select [Log Zombies] and [Log Humans]

-- Note "linear" changes in log space. Exponential growth! --

Stage 3 -- Humans hide, survive.

-- Add Hollings response function, type 2. Humans are harder to find. --

Create a variable "Population density"
Create a variable "World"
   Set it to 2e9
Create a variable "Hiding ability"
   Edit [Hiding ability]. Make it a slider from 1 to 10.
   Link [Humans] to [Population density].
   Link [World] to [Population density].
   Link [Population density] to [Success Rate].
   Link [Hiding ability] to [Success rate].

Edit [Success rate]. Turn off slider. Edit Value/Equation. Add the lines
   holling2 <- ([Population density])/([Hiding ability] + [Population density])
   return holling2  # Holling's type 2

Simulate. Try many settings for Hiding ability.

-- How well do we need to hide to avoid extermination? --

Edit [Hiding ability].
   Set Equation/Value to
      Rand(1,10)  # selects a random value between 1 and 10

-- Add Hollings response function, type 3. Humans cooperate! --

Create a variable "Cooperation".
   Link it to [Success rate]
   Edit it. Make it a slider from 1 to 5.
Edit [Success rate]. Edit Value/Equation. Remove "return holling2"
Add the lines
    holling3 <- ([Population density]^[Cooperation])/([Hiding ability]^[Cooperation] + [Population density]^[Cooperation])
    return holling3  # Holling's type 3

Simulate. Try different values of [Cooperation].

--- SENSITIVITY TESTING ---

Edit [Cooperation]. Set Value/Equation =
    Rand(1,5)

Tools | Sensitivity Testing...
    Set confidence regions to 50, 70, 90
    Set runs to 50
    Check Plot Each Run.
    Monitor: [log Humans], [log Zombies]
    Ran analysis.

Stage 4 -- Humans sound the alarm.

--- Use PAUSE function to change parameters on the fly ---

Settings
    Set Pause interval to 5 days

Edit [Cooperation]. Make it a slider from 1 to 5.

Edit [Hiding ability]. Make it a slider from 1 to 10.

Start sliders at lowest levels. (DefCon "Green")

Simulate!
    Simulation will pause.
    Hit Play until [Zombies] have reached a dangerous level. (DefCon "Red")
    Adjust sliders to increase [Hiding ability] and [Cooperation].

--- What happens? Can humanity be saved if we delay? ---