Programming Assignment 2 (Version 2.0) – MSOE Survivor (SimMSOE)
BE-104, Spring '05, Dr. C. S. Tritt

Programs and presentations due Thursday, May 12

Due to an accident involving a time machine and a '68 Buick, you and about a third of the MSOE student population are transported back in time to 10,000 BCE. Based on your unique combination of intelligence and charm, you have been elected ruler of the group.

Your job now is to maintain control of the group and a stable population in the face of several threats. These threats include starvation, disease, invasion and revolt. You must decide how to allocate your limited resources to minimize these threats. You decide to write an object oriented computer simulation in Java to help you learn how to make these allocations.

You decide on the following goals and specifications for your simulation:

It should simulate 50 years of time.

You will be able to change your resource allocations every 5 years. Total resources are 100 units. You will specify values for 3 needs (food production (*food*), heath care (*health*), defense (*defense*)) of these and the computer will calculate the value for the third (entertainment (*entertainment*)).

It will start with a population (*population*) of 1000.

The fractional annual birthrate (*birthrate*) in the simulation is given by *b*(*food, population*) where *b* is a function to be specified later. Birthrates can never be less than 0.0 or greater than 0.10.

The fractional annual death rate (*deathrate*) is *d*(*food*, *health, weather, population*) where *d* is a function to be specified later. The *weather* represents the severity of a year's weather and is a normally distributed value with a mean of 1.0 and a standard deviation of 0.1. Death rates can never be less than 0.02 or greater than 1.

The annual population change is (*birthrate – deathrate*)**population*. At the end of each year, a new population is calculated.

If you don't provide enough resources for defense, you will increase the risk of an invasion by indigenous people. The annual change in invasion risk is *v*(*defense*, *population*) where *v* is a function to be specified later. The annual risk of invasion starts at 2% and can never be less than 1% or greater than 100%.

If you don't provide enough resources of entertainment, you will increase the risk of revolt. The annual change in risk of revolt is *r*(*food*, *entertainment*, *population*) where *r* is a function to be specified later. The annual risk of revolt starts at 1% and can never be less than 0% or greater than 100%.

At the end of each year, the risks of invasion and revolt are compared to random numbers to determine if the respective events occurred. If so, the simulation ends and you (and all your follow MSOE students) lose. To “win” the game, you must finish your 50 year reign with a population between 4800 and 5200.

The program can have a GUI or console mode user interface. Work in groups of 2 (or at most and with permission 3) on this assignment.

Functions (Version 1.0)

Birthrate

b(food, population) = f(food)·g(population)

food < 25: f = 0.0
25 <= food <50: f = 0.003(food − 25)
50 <= food <75: f = 0.075 + 0.001(food − 50)
food >= 75: f = 0.10

population < 100: g = 0.5 + 0.005(population)
100 <= population < 2000: g = 1.0
2000 <= population < 5000: g = 1.0 − 0.0002(population – 2000)
population >= 5000: g = 0.4

No need to test & restrict calculated value with if statements.

Death rate

d(weather, food, healthcare, population) = weather·f(food) ·h(healthcare)/g(population)

food < 20: f = 1.0 − 0.0375·food
20 <= food <60: f = 0.25 − 0.00575(food − 20.)
food >= 60: f = 0.02

population < 3000: g = 1.0
3000 <= population < 8000: g = 1.0 − 0.00016(population − 3000)
population >= 8000: g = 0.2

h < 10: h = 1.5 − 0.05·health
h >= 10: h = 1.0

Calculated value must be tested & restricted to valid range with if statements.

Invasion Risk

v(population, defense)

Population < 500: $x = \text{defense}/2.$
$500 <=$ population $<= 2000$: $x = \text{defense}$
Population > 2000: $x = 2.\cdot\text{defense}$

$x < 5$: $v = 0.05$
$5 <= x <= 25$: $v = 0.05 - 0.005(x - 5.)$
$x > 25$: $v = -0.05$

No need to test & restrict calculated change value with if statements. However, cumulative value should be restricted to between 0.0 and 1.0.

Revolt

r(food, entertainment)

food < 30: $x = \text{entertainment}/2.$
$30 <=$ food $<= 60$: $x = \text{entertainment}$
food > 60: $x = 2.\cdot\text{entertainment}$

$x < 5$: $r = 0.05$
$5 <= x <= 15$: $r = 0.05 - 0.01(x - 5.)$
$x > 15$: $r = -0.05$

No need to test & restrict calculated change value with if statements. However, cumulative value should be restricted to between 0.0 and 1.0.

Hints and Suggestions

Use a boolean constant called DEBUG and selection statement to generate extra console output during development.

Ask user if they want to change allocations every 5 years (rather than making them change them every time).

Develop the program with “do nothing” birthrate, death rate, invasion risk and risk of revolt functions for testing. Then add equations.

A birthrate of 0.10 and a death rate of 0.02, gave a population of 46,921 after 50 years.

An allocation of 65, 10, 15 & 10, gave a population of 5,301 after 50 years.