A List-Programmed Solution of ARGESIM Comparison C16 'Restaurant Businesses Dynamics' using Maple

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Simulator. MAPLE has been developed as a symbolic formula manipulation program, and is now also a numerical analysis tool. It has become one of the most used programs in this area.

Model. This comparison aims to simulate and optimize a discrete dynamic system and was programmed directly using MAPLE (version 9.5). At the beginning of the simulation, persons are randomly distributed over a rectangular area.

The people density of each cell is once calculated. The restaurant density is also calculated at the beginning, but updated each time a restaurant closes down or opens a new restaurant. Each time step represents one day. After seven days each restaurant pays a fixed running cost and the weekly tax to the government. According to the profit, restaurants open new restaurants or close down with given probabilities.

As size of Maple lists can be changed, lists have been used to store data about restaurants' coordinates and weekly revenue. Also for persons a Maple list has been stored to keep a list of `restaurants` in range. The algorithm in Table 1 shows how the variable `restaurants` updates when a restaurant opens a new restaurant:

```
While restore> 0 do
Place: =[ uniform[ 0, 20](1),uniform[ 0, 20](1)]:
Restaurants: = [ op (restaurants),
 [ cell index [ 1, opt cell] [ 1] +place [ 1],
  cell index [ 1, opt cell] [ 2] ¡ place [ 2], 0]]:
Restore: =resttoopen¡1:
End does:
```

Table: Update of restaurant number, Maple code using lists

Task a - Time Domain Analysis. The system was simulated for 1, 5 and 10 years, results shown in Figure 1. In the sub-task, multiple (50) simulation runs have been accomplished and got six restaurants as the average value of number of restaurants after the 5th year.

Task b - Maximization of Tax Income. To maximize the tax rate was varied in a loop from 5% to 60% with a step width of 1%, with time domain simulation over three years.

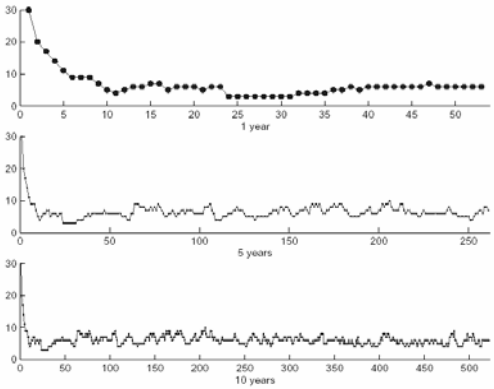

Figure 1: Number of restaurants over time, for an observation period of 1 year (uuper curev), 5 years, and 10 years (lower curve).

The highest tax income for the government is reached by a tax rate of 34%. The highest tax income for the government is reached by a tax rate of 34%. At very low or high tax rates the government reaches less tax income, except some outliers. Results are given in Figure 2

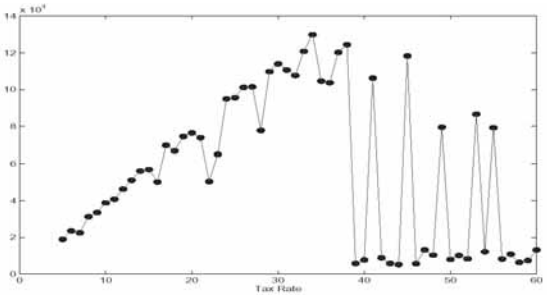

Figure 2: Tax Income over tax rate, observation 3 years

Task c - Maximization Restaurants' Revenue. First the system was simulated over one year, for each value of the parameter *k* (steps of ½). Then this procedure was repeated 3 times, in order to make the stochastic influence smaller. The averages for the revenues are shown in Figure 3 (optimum for k = 1).

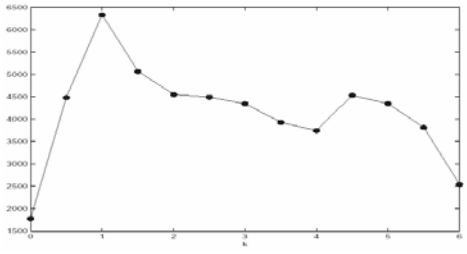

Figure 3: Restaurants' revenues over distance parameter k

C16 Classification: Directly Programmed Solution
Version: Maple 10.1