



## An Activity-Sanning Approach to AR-GESIM Comparison C16 “Restaurant Business Dynamics” in MATLAB

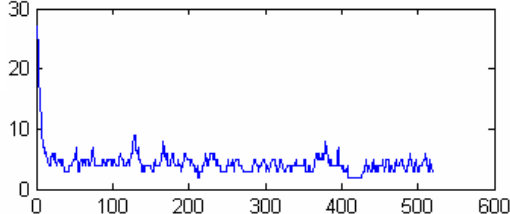
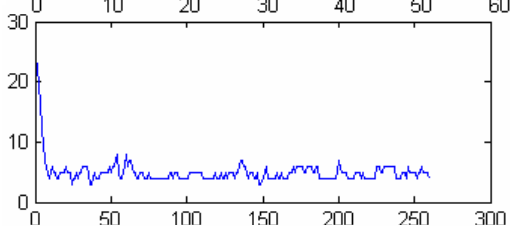
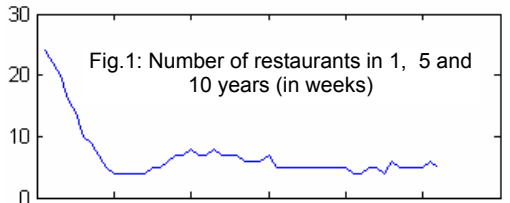
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**Simulator:** MATLAB one of the most powerful numerical tools at the time. Although its capabilities are further enhanced by the Simulink modelling and simulation toolbox, those functions were not used.

**Task a - Modelling & Simulation of the System.** As MATLAB is no discrete event simulator, the time honoured approach of activity scanning had to be used, made much easier by the fact that the behaviour of people as well as restaurants was based on the fixed time steps of days and weeks. Also the complex randomness of the problem - restaurants can open at arbitrary points on the grid and close down as well – can be managed by standard features of MATLAB.

As size of MATLAB arrays can vary, arrays can be used as a list to store data about the restaurants. The algorithm for the update loop shows efficient but hard-to-read MATLAB code (results in Figure1):

```
For i=1:365*5; ... ; For j=1:3000
Reach=sort ((restaurants (: 1)-people (j, 1)).
^2+
(Restaurants (: 2)-people (j, 2)). ^2)-100;
For k=1: length (restaurants (: 1))
If reach (k) <0 count=count+1; end;
Count=ceil (rand (1)*count);
For k=1: length (restaurants (: 1))
If reach (k) <0 count=count-1;
If count==0 money (k) =money (k) +1; end;
```



The other sub-task, simulating the model 50 times and computing statistical data was easily done by adding an outer loop for the repeated modelling and a variable to store the statistical data. Calculation of the mean value (4.48 Restaurants) and the variance (2.25) again are basic MATLAB features.

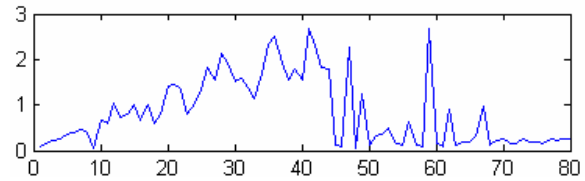


Fig 2: Tax income vs. Tax rate

**Task b – Tax Income Maximisation.** Figure 2 shows a variation of tax level between one and eighty percent of the income after the running costs (scaled at  $10^5$ ). The statistical data gathered at task a, together with the simulation for ten years, shows us that at 20 percent then number of restaurants oscillates between 3 and seven restaurant once the start up phase has ended. When the tax rate is increased, tax income rises up to a certain point where the maximum is gathered. Then restaurants in less populated areas are unable to survive any more, so tax income drops as there are less restaurants. But those restaurants now attract more people, so the tax rate can be raised again. Figure 3 shows the average of the maximum number of restaurants which can reach the profit threshold at certain tax rates. This also is an explanation for the drastical drop in tax income at the really high rates: Here, restaurants can no longer survive in the smaller cities, and therefore the people there do not contribute to the pool of possible guest any more.

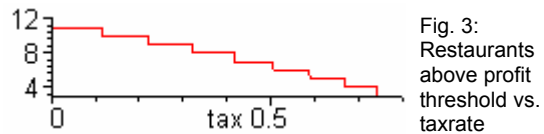


Fig. 3: Restaurants above profit threshold vs. taxrate

**Task c - Restaurants’ Revenue Analysis.** The restaurant density parameter is used to determine how much other restaurants in the area are considered when choosing the spot for a new restaurant. Also achieved with simple loops and arrays to carry the data, the average lifetime of a restaurant in days and its variance do not differ much significantly.

Value	1	2	3	4	5	6
Mean	48.3	45.6	47.3	42.1	46.5	43.9
StdDev	53.1	52.1	54	44.5	59.7	48

**C16 Classification: Activity Orient., Programmed Simulator: MATLAB 6.5**