A SIMPLE QUEUING STATISTICAL MODEL FOR THE BANKING SYSTEM IN MACEDONIA

Project conducted by the students’ from the Integrated Business Faculty Skopje
Supervision: Professor Marjan Nikolov

Abstract

We try to set up a statistical model to measure the queuing system at the banking system in Macedonia. The illustrative statistical model shows possible not viable queuing systems in the biggest Macedonian banks that lead on one side toward short term cost savings for the banks in terms of fewer employees for the service points but in long run it builds customer’s dissatisfaction and social and transactional costs. This research sets up a base for more in depth research about the bank’s operations with households operations as customers and might increase the awareness about the customers and banks to improve the existing situation.

Key words: exponential distribution, Poisson distribution, banking system, statistical model, customer’s satisfaction.

The banking system in Macedonia

Macedonian banking system comprises 18 banks structured by the Macedonian central bank into three groups by its assets (see more at the Central Bank banking indicators for the third quarter 2007). Macedonia experienced two periods of credit expansion - first in 1997-1998, and second in 2003 and continuing. In between, the country was exposed to the 1999 Kosovo crisis, and to 2001 security crisis with the later having substantial effects for macroeconomic stability (see more at CEA 2006).

The banking system in Macedonia continued to expand their activity measured with the total assets to guarantee capital (see IMF 2008) while the ratio of nonperforming loans has fallen. The banks have strengthened their profitability (rate of return over average assets) and their cost efficiency has continued to rise (operating expenses to grow income). Denar deposits are projected to grow faster than euro deposits and Macedonian banks are optimistic about credit growth. They plan to finance this with deposit growth, drawing down foreign assets held abroad and retained earnings.

1) Team leaders: Ivana Joksimovik, Ivana Ilovska, Dean Mandicevski. Team members: Dimitar Damjanovski, Igor Dojcinovski, Aleksandar Apostolski, Ana Buzarovska, Darko Arsovski, Slobodan Levkovski.
Defining the queuing statistical model for the banking system in Macedonia

The credit expansion and other factors have implication on the queuing system in business operations of the banks that have a direct impact to customer's satisfaction, operating expenses of banks, transaction costs and indirectly to capital expenses of banks, social costs etc.

For the purpose of this research we make assumptions that all banks are operating with the same efficiency and that they are all physically accessible. For the purpose of homogeneity (how big the banks are) we test only three banks at a specified period of time for a period of one hour.

The main point of our queuing statistical model is to provide us with information about the operation of the queuing system specifically the average waiting time and the average length time of queuing and thus, the viability of the queuing.

We assume that individuals join the queue according to the Poisson distribution and that the service times are exponentially distributed (see more at Buglear 2006). We shall study only one service point and by service point here being one service officer per branch for each of the three banks.

The exponential distribution is used to analyse service times in our queuing statistical model. The probability that an exponential random variable takes a particular value can be worked out by:

\[ P(X = x) = \frac{e^{-\mu x}}{\mu} \] where \( \mu \) is the mean of the distribution and \( x \) is the value of interest.

The Poisson distribution \( P(X = x) = \frac{e^{-\lambda} \lambda^x}{x!} \) (where \( \lambda \) is the mean of the distribution and \( x \) is the value of interest) is used to analyse the incidents that are unpredictable and in our case this is the number of people that will join the queue in expectation to be served by the bank at the service point.

Methodology and data

Given the basic assumptions of exponentially distributed service time with the \( \mu \) as the main parameter and that the individuals are joining the queue in the banks with the \( \lambda \) as main parameter, the ratio of the two parameters: \( \rho = \frac{\lambda}{\mu} \) will show us the traffic intensity in the banking queuing system. For the banking queuing system to be viable the traffic intensity must be less than 1 meaning that the mean arrival rate must be less than the mean service rate, otherwise the queue will "bubble".

The three measurements were done for three bank's branches in The City of Skopje. Two for the hour period from 11:00 to 12:00 and one for the hour period from 15:00 to 16:00 on 6th and 8th of May 2008.

The results

The results from the three measurements are illustrated in the next table.

<table>
<thead>
<tr>
<th>Methodology and data</th>
<th>First bank's branch</th>
<th>Second bank's branch</th>
<th>Third bank's branch</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11:00 - 12:00 hours</td>
<td>11:00 - 12:00 hours</td>
<td>15:00 - 16:00 hours</td>
</tr>
<tr>
<td></td>
<td>One service point</td>
<td>One service point</td>
<td>One service point</td>
</tr>
</tbody>
</table>
Let us assume that each household in Macedonia (around 500000) is visiting banks once in a week thus, 4 times in a month. Given the traffic congestion in the city and parking problems it takes at least half an hour to get to the bank.

The mean waiting time in the queue in the bank is: $W_s = \frac{\rho}{(\mu - \lambda)}$ or: $W_s = \frac{1.2}{(23 - 20)} = 0.4$ thus, 24 minutes from our measurement on the field (with the worst measured case with traffic intensity of $\rho = \lambda / \mu = 1,2$).

Thus, if we assume that all the banks in Macedonia are operating under same efficiency around Macedonia and given the above assumptions, it turns out that it takes for household at least one hour to deal with the banks in a week (to get there and to do the job) or 4 hours in a month. Four hours is half working day and given that the average net paid wage in Macedonia for February 2008 (see State Statistical Office: www.stat.gov.mk) is 15207 denars (246 euros) it turns that half working day in Macedonia (20 working days in a month assumption) is worth 380 denars (6 euros) per household. For a year this results in 4562 denars (74 euros) and for total Macedonia (500000 households) it results in 37 million euros.

This, really rough calculation illustrates that around 15 million euros (24 minutes average waiting) in a year are paid to Macedonians just to queue in the banks and are the transactional costs in Macedonia caused by the (non)viability of the banking sector. Just one minute improvement in the average waiting time will improve the transaction cost for a bit more than 600000 euros per year.

In the next table it is illustrated a sensitivity analyses of the transactional costs if the Macedonian households are visiting banks once, twice, three times or four times a month.

Table 2. Simulation analyses of yearly transaction costs in euros (1 euro=61,7 denars) from queuing in the banks in Macedonia and transaction gain for one minute improvement of average waiting time.

<table>
<thead>
<tr>
<th>Visiting frequency</th>
<th>Transaction costs for net paid wage</th>
<th>One minute improvement of average waiting time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once a month</td>
<td>3,75 million</td>
<td>150000</td>
</tr>
<tr>
<td>Twice a month</td>
<td>7,5 million</td>
<td>300000</td>
</tr>
<tr>
<td>Three times a month</td>
<td>11,25 million</td>
<td>450000</td>
</tr>
<tr>
<td>Four times a month</td>
<td>15 million</td>
<td>600000</td>
</tr>
</tbody>
</table>

Conclusion and Limitations

Increasing banking operations in Macedonia and the credit expansion, especially for households, brings also on higher profile the discussion about the viability of the queuing system in the banks, customer's
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satisfaction, transaction and social costs. Our simple model (with limited monitoring and measurement) illus-
trates the intuitive and anecdotic evidence of the low viability and quality of banking service in Macedonia for
households as customers and aims at increasing awareness about this potential problem. A further more in
depth and thorough research is needed to empirically test this hypothesis and to bring bank's management
to a level of awareness about customer's satisfaction.

References