Introducing a Mathematical Model to Determine the Optimum Combination for the Customers of Tejarat Bank to Minimize the Cost of Outstanding Claims

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Abstract

Outstanding claims are the very underlying resource of banks, but their occurrence creates many problems and leads to the banks’ losses, because the process of outstanding claims collection is costly and time consuming. The objective of this paper is to determine the optimum combination of banking facilities to minimize the cost of outstanding claims for Tejarat Bank using a multi-objective model and applying it for Zanjan Tejarat Bank during a period of 5 years. A list of 6 questions was designed for the purpose of the research, answering which the desired results were obtained. The customers were categorized in 4 groups (Mine & Industry, Agriculture, Housing & Construction, and Commerce, Services, and miscellaneous) and 3 types (Natural, legal, Duty). Customers cause the outstanding claims, based on the type and nature of the economic sector they receive facilities for. 4 types of major costs that lead to the bank’s loss were identified and prioritized by 6 bank experts, including opportunity cost, benefit reduction cost, liquidity reduction cost, and the claims collection cost. Regarding the methods given for reduction of claims, some strategies were proposed according which banks may considerably reduce the claims. In this research we prioritized the economic sectors for resource allocation using FTOPSIS method, resulting in a preference order such as: Housing & Construction, Mine & Industry, Commerce and Services, and Agriculture. Linear multi-objective model to determine the optimum combination for the customers to minimize the cost of outstanding claims was presented. Based on the model solution for a period of 4 years, the maximum and minimum values were calculated for the payment of each group. The ways for reduction of the cost of outstanding claims used in the model are: participation contracts, getting easy collaterals, selecting the most qualified customers, using short-term facilities, and increasing the number of committed customers.
Keywords: Outstanding claims, Linear Multi-Objective Programming, Cost of Outstanding claims, FTOPSIS

Introduction

The banking system is recognized with two major responsibilities: collection of resources (deposit gathering) and allocation of resources (giving facility). Outstanding claims may be defined as the risk of the allocation of resources.

In recent years, the growth of claims and its endogenous problems have caused the banks’ risk increase. The lack of easy return on the banks’ resources leads to a limited profitability, and the collection of this type of claims is associated with exorbitant costs for them. The standard for the outstanding claims is 2% of the total bank resources, while this proportion for developed countries is about 1%, and from the viewpoint of their managers, a more than 5% ratio of outstanding claims to the total given facilities makes a whole country face an economic crisis.

The phenomenon of outstanding claims is a deep dysfunction that has impeded the bank from fulfilling its main role in development of the country during long periods of time. The existence of outstanding claims means that the recipients of banking facilities do not (or cannot) return their facilities’ principal and the discount before it is due, or even afterward. The reasons for the occurrence of outstanding claims can be divided into two types: internal (intra-organizational) factors such as: lack of credit hygiene, Lack of acting in accordance with regulations and instructions, lack of reliable collaterals, lack of capacity assessment, and improper analysis; and external (extra-organizational) factors such as: natural factors, lack of deterrent laws, low discount rate, the government’s failing to fulfill its debts, the need for a long time to investigate the cases by judicial institutions, and obliging the banks to give duty facilities.

From economic point of view, massive outstanding claims mean less profit due to less revenue for the bank. On one hand, it is part of the bank’s non-earned revenue, and on the other hand this has given the borrower a portion of the bank’s capital that he/she has not returned principal and the discount. The resulted inefficiency index practically increases the total cost of bank’s services and consequently mitigates its efficiency and level of servicing. The important point is the waste of citizens’ resources. The bank’s profit must be divided between the bank and investor on the basis of participation in the profit and loss, so when the bank does not recover the outstanding claims, the profit to be divided among investors and shareholders will practically diminish. These costs are increasing on a daily basis, and the specialists in this area believe that it has reasons such as: lack of accordane with the outstanding claims collection experts, absence of required capability to perform analyses and planning in the bank’s structure and being boss-oriented instead of planning and expert orientation, regional and national political pressures to impede the outstanding claims collection, lack of employing the expert labor in collection of outstanding claims, and the lack of independence in line (non-staff) units in collection of outstanding claims. (Shabahang, 2006)

The importance of outstanding claims has attracted particular attention from politicians and the media. Implementing the traditional methods of credit risk management, and using tools such as credit policy making, evaluating the economic, technical, and financial aspects of the project, getting precious and easy collaterals, and also establishing databases and creating customer's credit rating system that has been of special interest to the banking system in recent years, all have not been able to adjust the trend of outstanding claims to its standard level. Now the question is how can we mitigate the outstanding claims and minimize their cost?

One way is to determine the optimum combination of customers. The objective of this paper is to identify the combination of customers in different economic sectors (manufacturing, commerce, services, and housing and construction) and in different types of Islamic contracts (Savings accounts, Investor-agent partnership, civil contribution, installment sales, lease-option, futures, and unilateral contracts) and their role in occurrence of outstanding claims, and to calculate the costs imposed to the
bank in each sector, and finally determine the optimum combination to minimize the cost of outstanding claims via mathematical models.

For the mentioned purpose of the research, a list of 6 questions was designed and distributed in groups of customers. The research’s questions are as follows:

1. How should be the grouping of customers to minimize the cost of outstanding claims?
2. How much is the cost of outstanding claims in each group?
3. By what methods can we reduce the cost of outstanding claims in each group?
4. How much does each method contribute in reduction of the cost of outstanding claims?
5. Which economic sector is the best choice for the bank to allocate resources?
6. How is the combination of customers who receive banking facilities, in order to minimize the cost of outstanding claims?

**Literature and Background**

The facilities in Islamic banking system can be divided into 4 branches: loaning, participation, commercial exchange, and commitment, implementing in one or more economic sectors according to the law of interest-free banking system (Jamshidi, 1994).

The first branch is similar to lending, and the bank does not intend to get back any additional amount. The second branch including Investor-agent partnership, Mozare’a, Musaqat, Direct investment, Rights partnership, and Civil partnership, has a participation aspect. The third branch has a commercial exchange aspect, and associates with the transfer of ownership on the basis of the relevant laws and regulations approved by the Islamic jurisprudence. The fourth branch includes either a kind of a wage agreement for performing a certain work or project such as unilateral contracts, or a commitment agreement on the request of applicant such as personal bonds contracts, and with getting collateral and paying wage according to the relevant regulations. Based on the nature and form of the job, the donated facilities can be categorized as follows: donated facilities in the form of loans, donated facilities in the form of participation, donated facilities in the form of exchanges or transactions, and donated facilities in the form of performing a work or project. The outstanding claims of the national banking system are classified in 3 categories: the first category includes the past due claims up to 6 months that impose the least collection cost to the bank. The second category includes the past due claims over 6 and up to 18 months that cause more collection cost. The third category includes the past due claims over 18 months or bad debts that lead to the upmost negative score and collection cost.(Bahmani, 2007)

Iranian Central Bank and other banks, in addition to giving explicit warnings to the individuals with outstanding debts, classify all of them. Banks themselves are the main responsible for the collection of outstanding claims for reasons such as: lack of project evaluation and economic justifiability assessment, not ranking the bank customers and not properly identifying them, not getting adequate collaterals, lack of enough inspection and supervision, lack of sufficient incentive in the employees to collect the claims, poor economic conditions, weak economic reports, and absence of credit insurance Kobayashi examined the relation between increased outstanding claims in banks, and the specific risk in commerce sector in Japan, and introduced some models. He explained how the banks’ specific and systematic risks can increase the level of outstanding claims. His findings for the Japanese market imply that outstanding claims may reduce by the banks’ pragmatic supervision (Norozi, 2002).

McIver (2005) studied the claims of government commercial banks, and assessment of reluctance to give facilities, and showed that the main reason for occurrence of outstanding claims is the non-profitability of government banks due to their style of asset management. (Jamshidi, 1994).

Panyagomreh and Roberts (2009) studied the loaning policy of mandatory relative in donating probable loans and also in reduction of banks’ bankruptcy, and concluded that this policy is suitable
only for some developed countries and financial markets, and large environments; while it is not likely to be a useful policy for developing countries.

Hashemi (2008) in his thesis studied the occurrence of outstanding claims and past due loans in Maskan bank facilities concluded that provided the adequate budget allocated to recover the outstanding claims and past due loans, it is possible to overcome the bank’s lack of resources. Ranked after the amount of facilities, variables like the number of branches, the branches’ employees per capita, and the authorities’ average years of service were measured to be significantly effective on the claims’ changes. Other variables of the research (the market discount rate, various interest rates for facilities, and the delay penalty in non-consistent monetary market) were also effective, but these effects were not significant (Hashemi, M.Sc. final thesis, 2008).

Ahadian (2006) in his paper focused on the factors effecting the occurrence of outstanding claims in Bank Melli Iran, has tried to answer the fundamental question of what are the effective factors in occurrence of outstanding claims in this bank? Based on the research model that introduces the outstanding claims as a function of the amount of credits and donated facilities, Gross Domestic Product, inflation rate, exchange rate, and price index of goods and services, the paper examines the relations among these variables. The results are as follows: During the periods of high GDP and economic boom, the banks carelessly donate facilities to increase their market share, and this leads to an increase in outstanding claims. If the interest rate lies between the banking facilities interest rate and banking facilities interest rate plus the delay penalty, then one can observe that the inflation rate is inversely related to the amount of outstanding claims. (Jamshidi, 1994).

Movasseghi (2007) has introduced a model for the banks to find the different combinations of donating facilities in order to maximize their profitability regarding the existing constraints. The data are derived from Karafarin Bank database for fiscal year 2003. Decision variables include different types of donated facilities in the form of Islamic contracts that are made in accordance with the laws of interest-free banking system. The paper has used linear programming methods.

Fallahzadeh (2005) in studying the proper portfolio for Saderat Bank examined the different ways of donating facilities (On installment, all at once, and different deadlines for payback dues) and concluded that donating short-term facilities is the upmost efficient approach for the bank. The importance of this study is that optimum donating of facilities maximizes the bank’s profitability and it results in attraction of more investors; On the other hand it increases the resources and these are positively associated with the bank’s market share among competitors.

Hoseini Hashemi (2010) concluded that the bank’s carefulness in donating the facilities and refusing to donate the mandatory facilities from the side of management can reduce the amount of outstanding claims. It implies that banks must close every way to occurrence of outstanding claims. This is the only way of donating banking facilities in accordance with expert procedures and legitimate authority (Jamshidi, 1994).

Mark and Crouhy (2006) in the study of outstanding claims management, write that:
“Getting familiar with procedures in the world’s modern banking systems can be the first step of establishing an efficient risk management system in domestic banks in the short-term; and it can contribute to mitigating the amount of outstanding claims.”

**Method**
This is an applied research: all collected and categorized information of the present paper can be used for different purposes such as comparison of the bank branches, and the amount of outstanding claims in each economic sector. The model introduced to minimize the cost of outstanding claims is applicable for other banks and financial institutions, by replacing the required data. Methodologically this is a descriptive research. The domain of the research project includes 31 branches of Tejarat Bank.
Data are collected using field method and library method. Library method was used to integrate the theoretical foundations of the study. Information and statistics were collected from bureau of accounting and credit department of Zanjan, Tejarat bank’s central management of funds. Statistics include the amount of donated facilities, and their deferment time period, and also the bank’s status among working banks in Iran. We used a questionnaire to collect data. These data were later used in the calculation of the effect of each method in mitigating the outstanding claims, and the order of preference for the methods.(cormen,2002 Khaki,2006).

Data Analysis
Multi-criteria decision making methods (FTOPSIS for the ranking of the choices) and operational research methods (Fuzzy multi-objective linear programming (FMOLP) to formulate the problem) were used for analyzing the data, and the model was solved using GAMS software (Mehregan, 2009).

Fuzzy Multi-Objective Linear Programming
Linear programming is one of the efficient models in various areas and real problems (Mehregan, 2009). Since the model used in this study has more than one objective function, we used a multi-objective mathematical model, by the general form:
Max(min) \[ Z = [Z_1, Z_2, ..., Z_p] \]
St:
\[ \sum_{i=1}^{n} a_{ij} x_{ij} \forall i, j \]
\[ x_{ij} \geq 0 \forall i, j \]

The modeling requires 3 processes as follows: introducing the decision variables, defining the cost variable, and determining the objective function and constraints (Mehregan, 2009).

In classical TOPSIS (Technique for Order Preference by Similarity to Ideal Situation) the weights of the criteria and the ratings of alternatives are known precisely and crisp values are used in the evaluation process. However, under many conditions crisp data are inadequate to model real-life decision problems. Uncertainty is an endogenous part of human thinking, and this uncertainty affects the decision making processes. Therefore, the fuzzy TOPSIS method is proposed, in which the weights of criteria and ratings of alternatives are evaluated by linguistic variables represented by fuzzy numbers to deal with the deficiency in the traditional TOPSIS.(Attaii,2009)

Chen and Huang (2009) have presented an algorithm for using FTOPSIS in a multi-criteria decision making problem, with n criteria and m alternatives:(Attaii,2010)

**Forming the Decision matrix:** A MCDM problem can be concisely expressed in matrix format as
\[
D = \begin{bmatrix}
\tilde{x}_{11} & \tilde{x}_{12} & \cdots & x_{1n} \\
\tilde{x}_{21} & \tilde{x}_{22} & \cdots & x_{2n} \\
\vdots & \vdots & \ddots & \vdots \\
\tilde{x}_{m1} & \tilde{x}_{m2} & \cdots & x_{mn}
\end{bmatrix}
\]

Where using the triangular fuzzy number \( \tilde{x}_{ij} = (a_{ij}, b_{ij}, c_{ij}) \) is the fuzzy evaluation value of each alternative \((i = 1, 2, ..., m)\) for each criterion \((j = 1, 2, ..., m)\). If the decision committee consists of \( k \) members, and the fuzzy ranking of the \( k \) th decision maker is \( \tilde{x}_{ij} = (a_{ij}, b_{ij}, c_{ij}) \) for \( i = 1, 2, ..., m \)
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and \( j = 1, 2, \ldots, n \), then regarding the criteria, one can obtain the combined fuzzy ranking of the alternatives, using the following relations:

\[
a_{ij} = \min_k \{ a_{ijk} \}
\]

\[
b_{ij} = \frac{\sum_{k=1}^{k} b_{ijk}}{k}
\]

\[
c_{ij} = \max_k \{ c_{ijk} \}
\]

**Determining the Weight Matrix of criteria:** In this step, the importance weight of different criteria is defined as \( W = [\tilde{w}_1, \tilde{w}_2, \ldots, \tilde{w}_n] \). Using the triangular fuzzy numbers, each component of \( w_j \) (the weight of each criterion) is defined as \( w_j = (\tilde{w}_{j1}, \tilde{w}_{j2}, \tilde{w}_{j3}) \).

**Establishing the Normalized Fuzzy Performance Matrix:** To avoid the complicated normalization formula used in classical TOPSIS, the linear scale transformation is used here to transform the various criteria scales into a comparable scale. Therefore, we can obtain the normalized fuzzy decision matrix. The elements of normalized decision matrix for positive (benefit) and negative (cost) criteria can be determined using the following relations (Killir, 2001, Lodwick, 2005, Nanda, 2006, Manas, 2005):

\[
r = \begin{pmatrix} a_{ij}, b_{ij}, c_{ij} \\ c_j^-, c_j^+, c_j \end{pmatrix}
\]

\[
r = \begin{pmatrix} a_{ij}^-, b_{ij}^-, c_{ij}^- \\ c_j^-, b_j^-, a_j \end{pmatrix}
\]

Where:

\[
c_j^+ = \max_i c_{ij}
\]

\[
a_j^- = \min_i a_{ij}
\]

**Obtaining the weighted fuzzy decision matrix:** Considering the different importance of each criterion, we can construct the weighted normalized fuzzy decision matrix as:

\[
\tilde{V} = \begin{bmatrix} \tilde{v}_{ij} \end{bmatrix}_{m \times n} \quad i = 1, 2, \ldots, m \quad j = 1, 2, \ldots, n
\]

Where:

\[
\tilde{v}_{ij} = \tilde{r}_{ij} \tilde{w}_j
\]

Using the triangular fuzzy numbers for positive (benefit) and negative (cost) criteria, we have:

\[
\tilde{v}_{ij} = \tilde{r}_{ij} \tilde{w}_j = \begin{pmatrix} a_{ij}, b_{ij}, c_{ij} \\ c_j^-, c_j^+, c_j \end{pmatrix} \begin{pmatrix} w_{j1}, w_{j2}, w_{j3} \end{pmatrix} = \begin{pmatrix} a_{ij} w_{j1}, b_{ij} w_{j2}, c_{ij} w_{j3} \end{pmatrix}
\]

And:

\[
\tilde{v}_{ij} = \tilde{r}_{ij} \tilde{w}_j = \begin{pmatrix} a_{ij}^-, b_{ij}^-, c_{ij}^- \\ c_j^-, c_j^+, c_j \end{pmatrix} \begin{pmatrix} w_{j1}, w_{j2}, w_{j3} \end{pmatrix} = \begin{pmatrix} a_{ij}^- w_{j1}, b_{ij}^- w_{j2}, c_{ij}^- w_{j3} \end{pmatrix}
\]

Finding the Fuzzy Positive Ideal Solution (FPIS) and the Fuzzy Negative Ideal Solution (FNIS): The distance of each criterion from FPIS and FNIS can be currently calculated as:
\[ S_i^* = \sum_{j=1}^{n} d(\tilde{v}_{ij}, \tilde{v}_{j}^*) , \ i = 1, 2, ..., m \]

\[ S_i^- = \sum_{j=1}^{n} d(\tilde{v}_{ij}, \tilde{v}_{j}^-) , \ i = 1, 2, ..., m \]

Where \( d(\ldots) \) is the distance measurement between two fuzzy numbers \((a_1, b_1, c_1)\) and \((a_2, b_2, c_2)\), given as:

\[ d_i(\tilde{M}_1, \tilde{M}_2) = \sqrt[3]{\frac{1}{3} \left[ (a_1 - a_2)^2 + (b_1 - b_2)^2 + (c_1 - c_2)^2 \right]} \]

**Calculating the Closeness Coefficient:** The closeness coefficient of each alternative is calculated as:

\[ CC_i = \frac{S_i^-}{S_i^* + S_i^-} , \ i = 1, 2, ..., m \]

**Ranking of the Alternatives:** Regarding the closeness coefficient we can determine the ranking order of all alternatives and select the best one from among a set of feasible alternatives. The alternatives with greater closeness coefficient are more preferred.(Attaii, 2010)

**Analysis**

For the purpose of the research, the customers were grouped based on their role in the occurrence of outstanding claims. Also the cost of each claim was calculated and then using mathematical models, the optimum combination of customers in order to minimize the cost of outstanding claims was proposed.(Manas, 2005)

**1. How should be the Grouping of Customers to Minimize the Cost of Outstanding Claims?**

Three groups of customers receive facilities: facilities to natural persons, facilities to legal persons, and the state's duty facilities to the customers. Regarding the recipients, financial facilities are presented in four groups (Mine & Industry, Agriculture, Housing & Construction, and Commerce, Services, and miscellaneous) and through Islamic contracts (exchange contracts, participation contracts, unilateral contracts, and savings accounts). The customers and their type in each economic sector were classified and their problems prior to receiving facilities - which are sometimes the cause of outstanding claims - along with their reasons were separately examined. After the problems prior to receiving facilities and their reasons were identified, the legal, intra- and extra-organizational problems of each customer were separately examined by means of a 3 by 3 matrix.

**Table 1:** Customer classification for making outstanding claims in industry and mine sector

<table>
<thead>
<tr>
<th>The cause of outstanding claims</th>
<th>The problems prior to receiving facilities</th>
<th>Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluctuation in interest rate, spending facilities in other sectors, importing goods and having no incentive for producing domestic products, bankruptcy</td>
<td>Lack of suitable place for implementing the plan, expenses like insuring the proforma invoice, lack of required permissions to present to the bank</td>
<td>Natural</td>
</tr>
<tr>
<td>Replacement of previous managers, new managers' unawareness about previous managers' work, fluctuation of exchange rate-profit, inability in quick transformation of production to cash, lengthiness of plan turnover</td>
<td>Lack of reliable people to make promissory notes, no justification for the plan by bank expert, previous liabilities and bounced checks</td>
<td>Legal</td>
</tr>
<tr>
<td>Getting relational facilities, no careful capacity assessment, political forces for offering facilities</td>
<td>Not fulfilling bank requirements, no sufficient justification to receive loans, not having the required credentials to receive facilities</td>
<td>duty</td>
</tr>
</tbody>
</table>
Table 2: Customer classification in making outstanding claims in agriculture sector

<table>
<thead>
<tr>
<th>The cause of outstanding claims</th>
<th>The problems prior to receiving facilities</th>
<th>Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damage in the product, disasters (such as flood, hailstone, etc.), no suitable conditions to sell the product, lower facility price compared to the market disasters (such as flood, hailstone, etc.), no suitable conditions to sell the product, lower facility price relative to the market Damage in the product</td>
<td>Lack of necessary credentials, farmers' low turnover accounts, lack of supportive facilities to buy pesticide and fertilizers in the midway Lack of necessary permissions for implementing the plan, need for natural persons as makers of promissory notes, company's previous liabilities, no justification from company expert Not being able to fulfill bank requirements, lack of complete justification to receive facilities, lack of necessary credentials required to receive facilities</td>
<td>natural legal duty</td>
</tr>
</tbody>
</table>

Table 3: Customer classification in making outstanding claims in the section of housing and urban development

<table>
<thead>
<tr>
<th>The cause of outstanding claims</th>
<th>The problems prior to receiving facilities</th>
<th>Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in the price of construction materials in the middle of the work and the constructor's bad planning, fluctuation in the facility interest rate Fluctuation of facility interest rate, attraction of real estate market and unfulfilling bank liabilities, lengthy procedure of enforcing estate collaterals by law firms, contractors' wrong policies Getting relational facilities, no careful capacity assessment, political pressures to provide facilities</td>
<td>Getting permission from housing and urban development organization, 20% capital stock at the beginning of the work, bank participation in mass construction No confirmation for plan justification by bank expert, company's unfulfilled liabilities and bounced checks, part payment of the bank of its shares and the company's lack of liquidity to pay its share Failure in meeting bank requirements, no sufficient justification to receive the loan, banks' lack of trust in customers</td>
<td>Natural Legal duty</td>
</tr>
</tbody>
</table>

Table 4: Customer classification in making outstanding claims in Commerce-services and other sector

<table>
<thead>
<tr>
<th>The cause of outstanding claims</th>
<th>The problems prior to receiving facilities</th>
<th>Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>High facility interest rate, recession of trade sector in some occupations, importing goods from countries like China Lack of careful capacity assessment by the bank, economic sanctions, high interest rates</td>
<td>Not having permission to receive facilities, insuring the proforma invoice, not having trade card and customer's insistence on receiving trade facilities Lack of required permissions to receive facilities, no agreement with counterparties from other countries, no confirmation from bank expert Failure in meeting bank requirements, no sufficient justification to receive facilities, not having required credentials for receiving facilities</td>
<td>Natural Legal duty</td>
</tr>
</tbody>
</table>

Ignoring the origins of these problems causes the banks to have outstanding claims. The problems encountered by natural, legal and duty customers at the time of receiving facilities and also when using bank resources are as follows:

1. Legal problems: These problems concern the limitations and deficits in the business laws of the country which the customers encounter with when they begin to receive facilities.
2. Intra-organizational problems: The problems imposed to the customers by the bank and the banking system.
Table 5: Example of different types of problems faced by customers (natural, legal and duty)

<table>
<thead>
<tr>
<th>External factors</th>
<th>Internal factors</th>
<th>Legal factors</th>
<th>customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Society's cultural, economical, and political factors, fluctuation in interest rate, failure of the state to repay its liabilities to the banks in the lead time</td>
<td>Ostensible transactions in order to extend facilities, expenses like insuring the proforma invoice, not allocating the resources to the bank program framework</td>
<td>Not having legal permissions, lack of supportive facilities in the middle of plan implementation, lengthiness of organizational hierarchy, prior liabilities</td>
<td>natural</td>
</tr>
<tr>
<td>Fluctuation in interest rate, importing goods from countries like China, lack of suitable conditions for selling products, bankruptcy, manager replacements, new managers' confusion</td>
<td>Failure of the state in paying its liabilities to the bank in a timely manner, society's economical and political factors</td>
<td>Economical and political boycotts, no legal permissions to implement the plan, company's prior liabilities</td>
<td>legal</td>
</tr>
<tr>
<td>Failure of the state in paying its liabilities to the bank in a timely manner, society's economical and political factors</td>
<td>No capacity assessment, no confirmation for the plan by the bank experts, need for natural persons as makers of promissory notes, paying the customer's share which is usually a considerable amount</td>
<td>Failing to meet bank legal requirements, problems of insurance companies</td>
<td>duty</td>
</tr>
</tbody>
</table>

2. How Much is the Cost of Outstanding Claims in Each Group?

Outstanding claims force huge costs upon banks and would even lead them to the point of bankruptcy. In this section, 4 categories of costs which are the most important costs due to outstanding claims are examined. Bank experts rank these costs in order of having the most negative effect on the bank: opportunity cost 0.4, benefit reduction cost 0.3, liquidity reduction cost 0.2, charge of claim collection 0.1 (the coefficients assigned to each cost has been based on the experts' viewpoints). According to the values given to each cost and based on the statistics taken from the loan and financial departments of Zanjan province branches, the cost of outstanding claims, consisting 20% of the whole outstanding claims, is calculated separately for different economic sections:

Table 6: Calculating the outstanding claims in each economic sector from 2006 to 2010

<table>
<thead>
<tr>
<th>Economic Sector</th>
<th>Sum of outstanding claims</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mine &amp; Industry</td>
<td>1791017</td>
<td>1791017×%20=358203</td>
</tr>
<tr>
<td>Housing &amp; Construction</td>
<td>41928</td>
<td>41928×%20=8386</td>
</tr>
<tr>
<td>Agriculture</td>
<td>112992</td>
<td>112992×%20=22598</td>
</tr>
<tr>
<td>Commerce, services and miscellaneous</td>
<td>248089</td>
<td>248089×%20=49618</td>
</tr>
</tbody>
</table>

Source: credit department of Tejarat Banks in Zanjan Province

Table 7: Costs incurred due to outstanding claims from 2006 to 2010

<table>
<thead>
<tr>
<th>Economic Sectors</th>
<th>Cost of profit reduction</th>
<th>Cost of liquidity reduction</th>
<th>Opportunity Cost</th>
<th>Claim collection charge</th>
<th>Weighted Means of the Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mine &amp; Industry</td>
<td>107461</td>
<td>71641</td>
<td>143281</td>
<td>35820</td>
<td>89551</td>
</tr>
<tr>
<td>Housing &amp; Construction</td>
<td>2516</td>
<td>1677</td>
<td>3354</td>
<td>839</td>
<td>2096</td>
</tr>
<tr>
<td>Agriculture</td>
<td>6779</td>
<td>4520</td>
<td>9039</td>
<td>2260</td>
<td>5650</td>
</tr>
<tr>
<td>Commerce, services and miscellaneous</td>
<td>14885</td>
<td>9924</td>
<td>19847</td>
<td>4962</td>
<td>12404</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>131642</strong></td>
<td><strong>87761</strong></td>
<td><strong>175522</strong></td>
<td><strong>43881</strong></td>
<td><strong>109701</strong></td>
</tr>
</tbody>
</table>

Source: credit department of Tejarat Banks in Zanjan Province

3. By What Methods can we Reduce the Cost of Outstanding Claims in Each Group?

The cost of outstanding claims in each cost type (benefit reduction cost, liquidity reduction cost, opportunity cost, and claim collection cost) is calculated and each group's share in every cost type is
determined. Then the relevant scenarios for each cost type are prepared and presented according to the experts' opinions.

1. Benefit reduction cost: Based on the calculation of benefit reduction cost in Table 8, the percentage of benefit reduction cost in each economic sector was calculated from the total benefit reduction cost and the total outstanding claims cost.

### Table 8: Percentage of Benefit reduction Cost in Different Economic Sectors

<table>
<thead>
<tr>
<th>Economic Sectors</th>
<th>Benefit reduction Cost</th>
<th>Cost Percentage from the Total of Benefit reduction Cost</th>
<th>Percentage from the Total Cost of Outstanding claims</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mine &amp; Industry</td>
<td>107461</td>
<td>81%</td>
<td>24%</td>
</tr>
<tr>
<td>Housing &amp; Construction</td>
<td>2516</td>
<td>2%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>6779</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>Commerce, services and miscellaneous</td>
<td>14885</td>
<td>12%</td>
<td>3.4%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>131642</strong></td>
<td><strong>100%</strong></td>
<td><strong>30%</strong></td>
</tr>
</tbody>
</table>

Increase in the benefit reduction cost puts the banks’ work into question because banks are profit organizations which operate according to the general economic policies of the country, and use monetary and credit tools in order to collect or mobilize people's deposits and allocate resources and make efficient use of them (Jamshidi, 2000; p4). Therefore, if there are outstanding claims and the cost of benefit reduction is increased, the bank is being weak in fulfilling its duties. In the present conditions where banks are moving toward privatization, this would push the bank into bankruptcy. As illustrated in table 8, the cost of benefit reduction in the four economic sectors is 131642 billion Rials which contains 30% of the total costs incurred from outstanding claims. To understand how these costs were incurred, a number of scenarios were written and some strategies were developed to cut down on these costs.

### Table 9: Scenarios and Strategies

<table>
<thead>
<tr>
<th>Scenario 1:</th>
<th>Strategy 1:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The facilities offered by the bank are provided from the bank’s deposits, so the bank needs to pay interest on them. Therefore, deferred collection of facilities will result in a gain or loss for the bank.</td>
<td>Bank's use of deposits and other low cost resources like &quot;savings accounts&quot; can alleviate the loss of its profit if outstanding claims occur. The bank should increase its promissory note makers (following credit hygiene precautions) to lower the risk of offering facilities and mitigate the cost of benefit reduction.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario 2:</th>
<th>Strategy 2:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term facilities take the bank’s resources away for a long time and the profit earned by the return on these facilities is slow. However, before the facilities' repay time is due and they are accounted as bad debts (which may take several years), the outstanding claims of these facilities will cause gain or loss to the bank, since these facilities are provided from costly deposit resources.</td>
<td>The bank should use short term -instead of long term- facilities so that if the facilities are converted into outstanding claims, it can quickly put the legal actions in process and lower the cost of benefit reduction.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario 3:</th>
<th>Strategy 3:</th>
</tr>
</thead>
<tbody>
<tr>
<td>As for the facilities given as exchange contracts like selling machineries on installment basis, the ill-intentioned customers do not repay them in due time. Since the rate of these facilities is less than other contracts, the customers invest them in secondary markets. This will bring about outstanding claims which (since the rate of these facilities are low) even when collected, cannot compensate for the bank’s loss of profit.</td>
<td>Instead of offering facilities as exchange contracts, the bank should use participation contracts so that the ill-intentioned customers can not misuse the low profit of the exchange contracts. Also it is much better to use estate collaterals or plan site collaterals instead of promissory notes.</td>
</tr>
</tbody>
</table>
As it is seen above, opportunity cost, liquidity reduction cost and claim collection cost were calculated and the scenarios and strategies were developed. This shows the method of action in each of these conditions.

4. How Much Does each Method Contribute in Reduction of the Cost of Outstanding Claims?

According to the planned scenarios that are developed and the leading strategies, and also based on the experience, 5 methods were derived and presented to the banks’ experts to determine the degree of each method’s impact on outstanding claims reduction and conducting pair-comparison on the methods to reduce outstanding claims. The results of experts’ calculations are as follows:

Table 10: The result of experts’ opinions about the effect of each method on the reduction of outstanding claims

<table>
<thead>
<tr>
<th>Priority Method</th>
<th>Weight</th>
<th>Priority Method</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Using Participation Contracts</td>
<td>0.351</td>
<td>4th Using short-term facilities</td>
<td>0.145</td>
</tr>
<tr>
<td>2nd Getting easy collaterals</td>
<td>0.215</td>
<td>5th Increasing the number of bailers</td>
<td>0.135</td>
</tr>
<tr>
<td>3rd Selecting reliable customers</td>
<td>0.154</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

After calculating the impact factors, these values were given to the experts to calculate the percentage of cost reduction of the outstanding claims due to each of the ranked methods using fuzzy numbers.

Table 11: Mean of the impact on reducing the cost of outstanding claims

<table>
<thead>
<tr>
<th>Method</th>
<th>Average impact on the reduction of outstanding claims</th>
<th>Method</th>
<th>Average impact on the reduction of outstanding claims</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increasing the number of bailers</td>
<td>(3, 5, 7)</td>
<td>Getting easy collaterals</td>
<td>(3, 5, 7)</td>
</tr>
<tr>
<td>Using short-term facilities</td>
<td>(5, 7, 9)</td>
<td>Using Participation Contracts</td>
<td>(5, 7, 9)</td>
</tr>
<tr>
<td>Selecting reliable customers</td>
<td>(5, 7, 9)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Considering the bank experts’ opinions, one can say that the degree of reduction in the costs of outstanding claims due to the implementation of the methods in each group and sub-group (consisting of high-risk, average-risk and low-risk customers) would be as follows:

Table 12: The degree of impact on reducing the cost of outstanding claims

<table>
<thead>
<tr>
<th>Sector</th>
<th>Customer Subsector</th>
<th>Degree of impact on the reduction of outstanding claims</th>
<th>Sector</th>
<th>Customer Subsector</th>
<th>Degree of impact on the reduction of outstanding claims</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mine &amp; Industry</td>
<td>Low Risk</td>
<td>(3, 5, 7)</td>
<td>Commerce, services and miscellaneous</td>
<td>Low Risk</td>
<td>(3, 5, 7)</td>
</tr>
<tr>
<td>Average Risk</td>
<td>(5, 7, 9)</td>
<td></td>
<td>Average Risk</td>
<td>(5, 7, 9)</td>
<td></td>
</tr>
<tr>
<td>High Risk</td>
<td>(7, 9, 10)</td>
<td></td>
<td>High Risk</td>
<td>(7, 9, 10)</td>
<td></td>
</tr>
<tr>
<td>Low Risk</td>
<td>(1, 3, 5)</td>
<td></td>
<td>Low Risk</td>
<td>(1, 3, 5)</td>
<td></td>
</tr>
<tr>
<td>Average Risk</td>
<td>(3, 5, 7)</td>
<td>Agriculture</td>
<td>Average Risk</td>
<td>(3, 5, 7)</td>
<td></td>
</tr>
<tr>
<td>High Risk</td>
<td>(3, 5, 7)</td>
<td></td>
<td>High Risk</td>
<td>(3, 5, 7)</td>
<td></td>
</tr>
</tbody>
</table>
5. Which Economic Sector is the Best Choice for the Bank to Allocate Resources?

Based on the index for cost reduction in the outstanding claims costs, it can be understood that in which sectors and in what order the resources would be applied to. But, obviously there are other indices that the banks need to consider:

Step 1: Consistent with bank ideals, some other indices were determined by bank expert:

Table 13: Indices and their weights taken from bank ideals

<table>
<thead>
<tr>
<th>Index</th>
<th>Relative Frequency</th>
<th>Index</th>
<th>Relative Frequency</th>
<th>Index</th>
<th>Relative Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>State obligation</td>
<td>0.5</td>
<td>Emphasis of the political institutions in the province</td>
<td>0.15</td>
<td>Domestic Policy of the bank</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Legal requirements</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Step 2- Paired-comparison analysis was conducted on the indices in order to determine their weights. The results are as follows:

Table 14: Indices taken from bank ideals and their weights

<table>
<thead>
<tr>
<th>Index</th>
<th>Final weight</th>
<th>Index</th>
<th>Final weight</th>
<th>Index</th>
<th>Final weight</th>
<th>Index</th>
<th>Final weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>State obligation</td>
<td>0.438</td>
<td>Emphasis of the political institutions in the province</td>
<td>0.175</td>
<td>Bank internal Policy</td>
<td>0.155</td>
<td>Legal Requirements</td>
<td>0.232</td>
</tr>
</tbody>
</table>

Step 3- The economic sectors using the resources were ranked through Fuzzy TOPSIS analysis. After ranking the choices, the verbal variables were used to categorize them (Atayi, 2010).

Then the options were ranked according to four criteria: the decision matrix and criteria weight vector, the normalized fuzzy decision matrix and normalized fuzzy weighted decision matrix were established, and finally, fuzzy positive and negative ideal solutions were presented:

\[ A^+ = [(1,1,1),(1,1,1),(1,1,1),(1,1,1)] \]
\[ A^- = [(0.033,0.033,0.033),(0,0,0),(0.175,0.175,0.175),(0.003,0.003,0.003)] \]

Then the distance of each option from the positive and negative ideal solutions \((S^-_1, S^+_1)\) and the closeness coefficient were calculated. The result was the ranking of options as \(A_2 > A_4 > A_3 > A_1\).

6. How is the Combination of Customers who Receive Banking Facilities, in Order to Minimize the Cost of Outstanding Claims?

In this step, based on the results of Fuzzy TOPSIS analysis, a mathematical model was presented to find the optimum composition of resource allocation in a way to minimize the cost of outstanding claims. In this model:

\[ X_{ij} = 0-1 \text{ variable which shows the facilities donated (1) or not donated (0) to the group (i) from the sector (j).} \]

\[ Y_{ij} = \text{the variable showing the amount of facilities to donate to the group i from the sector j.} \]

\[ i_{ij} = \text{the Fuzzy parameter shows the outstanding claims coefficient of the group i from sector j.} \]

It is a parametric and triangular fuzzy number.

Here, the customers of each sector are assigned to three sub-groups of low risk in repayment \((i=1)\), average risk \((i=2)\) and high risk \((i=3)\) customers. Therefore, the objective function is as follows:

\[ \text{Min } z = \sum_{j=1}^{4} \sum_{i=1}^{3} i_{ij} y_{ij} \]

To complete the model, there is a need for defining some constraints, as follows:
The upper limit of the bank’s facilities

\[ \sum_{j=1}^{4} \left( \sum_{i=1}^{3} y_{ij} \right) \leq N \]

\( N \) = the upper limit of the bank’s facilities.

The upper limit of the facilities for each sector

\[ \sum_{i=1}^{3} y_{ij} \leq N_j \]

The upper limits of the facilities for each group

\[ \sum_{j=1}^{4} y_{ij} \leq p_i \]
\[ \sum_{i=1}^{3} p_i = N \]

Constraints of mandatory donating the facilities

\[ \sum_{i=1}^{3} y_{ij} \geq k_j \]
\[ \sum_{j=1}^{4} y_{ij} \geq T_i \]

The share limit of every sector according to the bank’s policy

\( \lambda = \beta = \alpha = \Theta \)

\( \Theta, \beta, \alpha, \lambda \) are coefficients considered by the bank for the normality of the facilities.

The formulated programming 0-1 model using the data collected during the period 2007 to 2010 of Tejarat Bank in Zanjan province was solved by GAMS software. The findings are seen in the table below (Toloai, 2011)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Sub-group</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mine &amp; Industry</td>
<td>Low risk customers</td>
<td>210</td>
<td>156</td>
<td>201</td>
<td>222</td>
</tr>
<tr>
<td></td>
<td>Average risk customers</td>
<td>256</td>
<td>208</td>
<td>220</td>
<td>261</td>
</tr>
<tr>
<td></td>
<td>High risk customers</td>
<td>152</td>
<td>131</td>
<td>131</td>
<td>158</td>
</tr>
<tr>
<td>Housing &amp; Construction</td>
<td>Low risk customers</td>
<td>78</td>
<td>54</td>
<td>75</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>Average risk customers</td>
<td>92</td>
<td>63</td>
<td>71</td>
<td>106</td>
</tr>
<tr>
<td></td>
<td>High risk customers</td>
<td>68</td>
<td>36</td>
<td>36</td>
<td>75</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Low risk customers</td>
<td>112</td>
<td>88</td>
<td>110</td>
<td>121</td>
</tr>
<tr>
<td></td>
<td>Average risk customers</td>
<td>123</td>
<td>102</td>
<td>115</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>High risk customers</td>
<td>85</td>
<td>69</td>
<td>69</td>
<td>91</td>
</tr>
<tr>
<td>Commerce, services</td>
<td>Low risk customers</td>
<td>112</td>
<td>88</td>
<td>110</td>
<td>142</td>
</tr>
<tr>
<td></td>
<td>Average risk customers</td>
<td>155</td>
<td>115</td>
<td>133</td>
<td>178</td>
</tr>
<tr>
<td></td>
<td>High risk customers</td>
<td>98</td>
<td>73</td>
<td>73</td>
<td>115</td>
</tr>
</tbody>
</table>

Obviously the optimum combination is different depending on the upper and lower limits of the facilities. In the above table the first column shows the upper limit, the second column shows the lower limit, and the third column illustrates the optimum amount of donated facilities in each year. Therefore, the optimum amount of \( z \) or the cost of outstanding claims is calculated. This model reaches the best solution by replacing the values of the formula with the corresponding values of each year.
Introducing a Mathematical Model to Determine the Optimum Combination for the Customers of Tejarat Bank to Minimize the Cost of Outstanding Claims

Discussion
Regarding the customer classification in 4 groups (Mine & Industry, Agriculture, Housing & Construction, and Commerce, Services, and miscellaneous) and assigning each group to 3 types (natural, legal and duty) in can be concluded that customers can make outstanding claims depending on the nature and type of economic sector they take facilities for. Four types of costs which cause the highest amount of loss to the bank were identified regarding the type of costs they brought about by their outstanding claims. These costs were classified according to their importance: opportunity cost, benefit reduction cost, liquidity reduction cost, and claim collection cost.

Opportunity cost is the most important cost, regarding that the bank could invest the donated facilities taken from its resources (which in itself has been very costly to the bank) in other sectors and considerably mitigate the outstanding claims. According to the methods presented to reduce the cost of outstanding claims, some strategies were introduced which can remarkably reduce the amount of outstanding claims if performed by the bank. Allocating the bank’s resources in sectors which produce the least amount of outstanding claims implies that (depending on the cost of providing resources that the bank has to pay according to how it has received them) the bank should allocate resources in sectors which would cause the highest gain and lowest loss or deferment. In this study the economic sectors to use the resources were ranked using FTOPSIS analysis. The results are as follows:

Agriculture < Commerce and Services < Mine & Industry < Housing & Construction

Among these economic sectors, housing & construction has the least degree of risk, agriculture the most and "commerce, services and miscellaneous" sector has an average risk degree for repaying the facilities. Considering the presented model and its solution and analysis, we concluded that it is possible to present a model for having the best customer combination in order to reduce the cost of outstanding claims. There are different methods for reducing the cost of outstanding claims: using participation contracts, getting easy collaterals, selecting reliable customers, using short-term facilities and increasing the number of bailers.

References