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Customer loyalty programs to sustain consumer fidelity in mobile telecommunication market

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ABSTRACT

Companies realized the importance of well-managing their relationships with their customers. Customer Relationship Management (CRM) allows companies to manage their marketing strategies and deliver specific services to clients with different values. The mobile telecommunication market is a very competitive market where the customers are tended to move from one company to another easily. Mobile telecommunication companies should carry on specific programs and services to their customers in order to keep them satisfied and thus ensure their fidelity with the company. In this article our objective is to provide companies a model that facilitates to decide what kind of customer loyalty programs they should address to their clients from different segments. In order to do that we present a fuzzy based Hungarian method that allow assigning different loyalty programs to customers with different characteristics.

1. Introduction

In mobile telecommunication market, the companies should invert remarkable effort to look for solutions to keep their customers satisfied and thus loyal with the company. Some specific services may be delivered to clients in order to keep them content. In practice there are many loyalty programs being conducted to customers but we believe that a precise type of a loyalty program cannot be applied to all clients as clients with different characteristics are going to be satisfied with different kind of loyalty programs. In this article our objective is to provide companies a model that facilitates to decide what kind of customer loyalty programs they should deliver to their clients who have different characteristics. A fuzzy based Hungarian method is being presented which allows us to assign different loyalty programs to customers with different characteristics whom belong to different segments.

2. Customer Relationship Management

Companies realized the importance of well-managing their relationships with their customers. Customer Relationship Management (CRM) allows companies to manage their marketing strategies and deliver specific services to clients with different values. Customers with higher values may deserve better service while less service should be delivered to customers with lower value for the company.

Customer Relationship Management (CRM) is a term that has been first proposed by Varadarajan (1986). According to Varadarajan, "CRM is a joint-transaction model, which is an alignment of product and donation through the partnership between company and non-profit organization, and ultimately gains interests for both parties." Varadarajan and Menon (1988) supposed that CRM helps companies to achieve many of their substantial benefits, such as helping them to improve performance, strengthen corporate and brand image and expand the target market.

According to Peppers, Rogers, and Dorf (1999) CRM is the management of relationships between companies and individual customers with the aid of (customer) databases and interactive and mass customization technologies.

Swift (2001) defines CRM as "an enterprise approach to understanding and influencing customer behavior through meaningful communications in order to improve customer acquisition, customer retention, customer loyalty, and customer profitability."

According to Kincaid (2003) CRM is "the strategic use of information, processes, technology, and people to manage the customer's relationship with the company across the whole customer life cycle." Ko, Lee, and Woo (2004) defines CRM as an integration of customer management strategy of firms that allows them to manage customers efficiently by supplying customized goods and services and maximizing the lifetime value of customers.

As Kincaid (2003) and other authors emphasize in their studies, CRM approach firstly started to take place in company's agenda when they had discovered that all the customers did not have the same value and profitability. Then, companies realized that it would be more effective to deliver distinct services and develop

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specific strategies for customers who have different importance for the company instead of treating them all equally. The basic goal of Customer Relationship Management is to achieve a competitive advantage in customer management and as a result increase profit levels of the customers.

Today companies use CRM to obtain some useful information of current and prospective customers. Through this relevant information they can improve the service that they offer to their customers, give more attention to better customers, may abandon unprofitable customers and attract some new good potential clients.

CRM is known as the new basis of marketing strategies which companies should well-manage and maintain its sustainability. On the other hand, as Peppers et al. (1999) indicate, it is widely known as a software-based approach which allows companies to supply information about customers and manage this information to develop and improve their marketing processes. Among the most important goals of CRM are to offer better services to customers, increase profitability and use customer contact information to manage marketing processes more efficiently.

By using customer information contained in databases, companies can invest in the customers that are potentially valuable for the company, but also minimize their investments in non-valuable customers. Figures on the turnover of each customer or customer profitability are often used as segmentation variables to distinguish between valuable and non-valuable customers (Donkers, Verhoef, & Jong, 2007).

Customer value is an important topic to consider within CRM as customers with different values for the company should not enjoy the same services. Neap and Celik (1999) define value concept as the owner's/buyer's desire to retain or obtain a product. Kelly and Male (1993) define the value concept as a measure expressed in currency, effort, exchange, or on a comparative scale which reflects the desire to obtain or retain an item, service or ideal. According to Dell'Isola (1982), value can be defined as the fair equivalent in service or commodities that an owner/buyer receives in exchange for money. Murphy, William, Paula, and Zigarmi (1997) define values in terms of environmental interactions, choices, and preferences that emphasize the person holding values.

Ravald and Grönroos (1996), point in their previous studies that marketing is facing a new concept, which is named relationship marketing and they underline the evolution from the activity of attracting customers to activities which concern of having customers and taking care of them in marketing. According to Ravald and Grönroos (1996), the main basis of relationship marketing are relations, maintenance of relations between the company and the customers, suppliers, market intermediaries, the public, etc. These authors define the value concept as an important element of relationship marketing which enables companies to provide superior services to its customers.

Customer satisfaction is one of the key objectives of marketing. To increase the satisfaction level of customers and maintain it, customer behavior should be well-known by the firm.

Customer behavior is related to customer loyalty issue. With that reason, Jackson (1985) divided industrial buyers into two major categories: lost-for-good and always-a-share. The lost-for-good category assumes that a customer is either totally committed to the company or totally lost and committed to some other company. The second category, always-a-share includes the buyers which can easily switch their vendor to another one. We can say that customers who are in the lost-for-good category are satisfied, loyal and will remain in the company. But the customers who are in always-a-share category would easily go to another company and would not retain its products for long terms. So customer behavior should be well-known in order to measure their retention correctly.

Marketing is seemed to be the art of attracting and keeping the profitable customers. Ultimately, companies tend to retain more profitable customers for them instead of trying to satisfy and retain all customers. According to Kotler and Armstrong (1996) a profitable customer is "a person, household, or company whose revenues over time exceed, by an acceptable amount, the company costs of attracting, selling and servicing that customer." In order to attract and keep these profitable customers companies give more importance to marketing processes, Customer Relationship Management, customer value and customer lifetime value (CLV).

Donkers et al. (2007) considered the prediction of customer lifetime value in multi-service industries, in particular in the insurance industry, where purchase behavior is complex. They assume that in multi-service industries, customer behavior is multi-dimensional: the most important components of customer behavior are related to customer retention, cross-buying and service usage. The authors consider both relationship-level and service-level models. The relationship-level models focus on customer retention and profits aggregated across services. The service-models take a disaggregated perspective, and can also account for cross-buying of services. For the service-models with explanatory variables, they use a Markov model to predict more than a single period ahead (Pfeifer & Carraway, 2000; Rust, Lemon, & Zeithaml, 2004).

3. Customer loyalty

Loyalty marketing is an approach to marketing, based on strategic management, in which a company focuses on growing and retaining existing customers through incentives. Branding, product marketing and loyalty marketing all form part of the customer proposition – the subjective assessment by the customer of whether to purchase a brand or not based on the integrated combination of the value they receive from each of these marketing disciplines (Evans, 2007). It is very important to keep customers satisfied for companies, especially in the focus sector of this study – the mobile telecommunication as the competition in this sector is very elevated and customers are inclined to move easily from one to another company when there is a better service or price in the competitor. The effort and money should be inverted to existing clients in many cases as it is done to capture new clients in order to have loyal customers as they are the important income generators for the company (Lam, Shankar, Erramilli, & Murthy, 2004).

4. Fuzzy logic

Zadeh (1965) has published first fuzzy set theory. Zimmermann (1991) explained fuzzy set theory as a strict mathematical framework in which vague conceptual phenomena was precisely and rigorously studied. The theory can also be thought as a modeling language which suited well for situations that were containing fuzzy relations, criteria and phenomena. Afterwards, Rowe and Boulgarides (1994) have proved the portfolio matrix and 3Cs model which were enabling companies to analyze their strategic business units and projects, and providing strategic directions in an efficient way. This has not worked very well. Certain values in the decisions making are not always correct. Because there are always vague processes and it is difficult to estimate decision making processes with an exact numerical value. Pap, Bosnjak, and Bosnjak (2000) defined the main problem of using the classical portfolio matrix as the precise determination of the numerical value for the criteria. As a result, it would be useful to use the linguistic assessments which have been introduced by Zadeh (1965) and Bellman and Zadeh (1970) instead of numerical indicators.

4.1. Fuzzy number and linguistic variable

Dubois and Prade (1978) have defined the fuzzy numbers. They have described its meaning and features. A fuzzy number $\widetilde{N}$ is a fuzzy set which membership function is $\mu_{\widetilde{N}}(y) : R \to [0,1]$. A triangular fuzzy number $\widetilde{N} = (a,b,c)$ can conform to different set of a, b, c characteristics. If we explain those characteristics in management terms, a value is the optimistic estimate, when everything goes great. The value b is the most likely estimate, which implies to the situation not very good either very bad. The c value is a pessimistic estimate, when everything goes badly.

Bellman and Zadeh (1970) defines a linguistic variable as a variable whose values are not numbers but words or phrases in a natural or synthetic language. In a problem when we are working on linguistic variables we can present their means. At that moment, we can rate and weight the various conditions by using the fuzzy numbers and linguistic variables. Linguistic variables represent the relative importance and appropriateness of each ranking method that simultaneously considers the metric distance and fuzzy mean value is proposed. The distance from the ideal solution and the fuzzy mean value are usual criteria for ranking fuzzy numbers.

Moon, Lee, and Lim (2009) defines fuzzy numbers as if Y is a collection of objects represented of generated of y's, then a fuzzy set $\widetilde{N}$ in Y is a set of ordered pairs:

$$\widetilde{N} = \{(x, \mu_{\widetilde{N}}(y)) | y \in Y\}$$

$\mu_{\widetilde{N}}(y)$ is the membership function or grade of membership of y in $\widetilde{N}$ that maps Y to the membership space N (when N contains only the two points 0 and 1, $\widetilde{N}$ is no fuzzy and $\mu_{\widetilde{N}}(y)$ is identical to the characteristic function of a no fuzzy set). The range of the membership function is a subset of the nonnegative real numbers whose supreme is finite. Elements with a membership of zero degrees are normally not listed. The authors characterize a linguistic variable by a quintuple $(y, F(y), A, B, \widetilde{N})$ in which y is the name of the variable; $F(y)$ denotes the term of y set; for example the set of names of linguistic values of y, with each value being a fuzzy variable denoted generically by Y and ranging over a universe of discourse A that is associated with the base variable a; B is a syntactic rule for generation of the name, Y, of values of y; and $\widetilde{N}$ is a semantic rule for associating with each Y its meaning $\widetilde{N}(y)$ which is a fuzzy subset of A (Merigo, Gil-Lafuente, & Martorell, 2012).

When it comes to take objective decisions we know the hardness to evaluate them by binary definite numbers 0s and 1s. Therefore in this study we use transform linguistic expressions which can be transformed to numerical values easier (Keropyan & Gil-Lafuente, 2011). This approach facilitates us to value easier the correlations between loyalty programs and customer characteristics, and also the correlations between customer characteristics and customer segments as it is hard to link them in an objective way. The following semantics are proposed in this study:

We use triangular fuzzy numbers and therefore we present the following semantics in Fig. 1:

5. The Hungarian method for the assignment problem

In this study the objective is to assign the most adequate loyalty program to each segment of clients. The Hungarian method is going to be used for assigning the most appropriate campaign action that is going to be carried to a specific group of clients.

5.1. The theorem

The Hungarian method is an algorithm which finds an optimal assignment for a given loyalty programs matrix. In order to find the proper assignment it is essential for us to know the Hungarian method. This method is dependent upon two vital theorems, stated as below (Kuhn, 2005).

Theorem 1. *If a constant is added (or subtracted) to every element of any row (or column) of the loyalty programs matrix $[c_{ij}]$ in an assignment problem then an assignment which minimizes the total programs for the new matrix.*

Theorem 2. *If all $c_{ij} \geqslant 0$ and there exists a solution $x_{ij} = X_{ij}$ such that*

$$\sum_i c_{ij} \quad \text{and } x_{ij} = 0.$$

then this solution is an optimal solution, i.e., minimizes z. And the matrix of that solution:

$$C = \begin{pmatrix} c_{11} & c_{12} & c_{13} & \dots & c_{1n} \\ c_{21} & c_{22} & c_{23} & \dots & c_{2n} \\ \dots & \dots & \dots & \dots & \dots \\ c_{31} & c_{32} & c_{33} & \dots & c_{3n} \end{pmatrix}$$

5.2. The Hungarian algorithm

The Hungarian algorithm is an algorithm for solving a matching problem or more generally an assignment linear programming problem. The Hungarian algorithm is actually a special case of the Primal–Dual Algorithm. It takes a bipartite graph and produces a maximal matching.

According to Hungarian algorithm we can handle our customer loyalty decision making problem easier. In order to do that all the variables should be reduced to the matrices and the following steps should be followed as given by Kuhn.

For customer loyalty we assume different customer loyalty programs. Let us consider that there are n "customer segments" and n "customer loyalty programs".

(A) If necessary, the problem should be converted from a maximum assignment into a minimum assignment. This operation is done by assigning C = maximum value in the assignment matrix. From here, each c_{ij} should be replaced with $C - c_{ij}$.

(B) After the replacement from each row the row min, and from each column the row column min has to be subtracted.
After steps A and B we suppose that we are using k lines.
If $k < n$, m has to be let as minimum uncovered number. From every uncovered number m has to be subtracted and then it has to be added to every number covered with two lines. If $k = n$, then;

(C) Starting with the top row, work your way downwards as you make assignments.
An assignment can be (uniquely) made when there is exactly one zero in a row. Once the assignment is made, that row has to deleted and columned from the matrix.

The operation between row assignments and column assignments have to be repeated until a unique assignment remains. If still there is no unique assignment either with rows or columns, one arbitrary cell with a zero in it should be selected.

The matrix interpretation of the technique is presented below, so that the case can be explained easier.

Given n customer and customer programs, and an $n \times n$ matrix containing the loyalty action of assigning each program to a customer, the objective is to find the most adequate loyalty program for each segment of customer minimizing the assignments. First the problem is written in the form of a matrix. To start, the row operations on the matrix should be performed. To do this, the

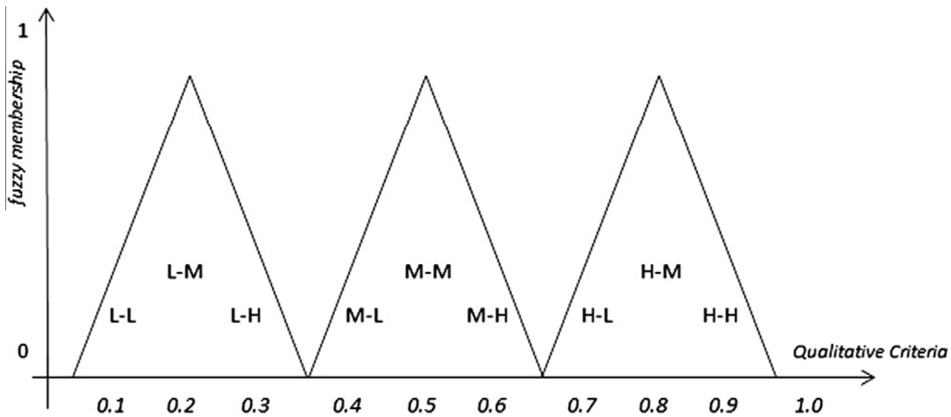

Fig. 1. The membership functions for fuzzy numbers according to the depending qualitative criteria.

lowest of all $p_i(i = 1,2,\ldots,4)$ is taken and is subtracted from each element in that row. This will lead to at least one zero in that row (We get multiple zeros when there are two equal elements which also happen to be the lowest in that row). This procedure is repeated for all rows. We now have a matrix with at least one zero per row. Now we try to assign programs to customer segments. This is illustrated below:

$$Q = \begin{bmatrix} 0 & p_2 & 0 & p_4 \\ q_1 & q_2 & 0 & q_4 \\ r_1 & 0 & r_3 & r_4 \\ 0 & s_2 & s_3 & s_4 \end{bmatrix}$$

The zeros that are indicated are the assigned programs.

Sometimes it may turn out that the matrix at this stage cannot be used for assigning, as is the case in for the matrix below:

$$Q = \begin{bmatrix} 0 & p_2 & p_3 & p_4 \\ q_1 & q_2 & 0 & q_4 \\ r_1 & 0 & r_3 & r_4 \\ 0 & s_2 & s_3 & s_4 \end{bmatrix}$$

In cases as the matrix above it is not possible to make any assignments, there wise both *a* and *c* cannot be assigned to the same program. To overcome this, we repeat the above procedure for all columns (i.e. the minimum element in each column is subtracted from all the elements in that column) and then check if an assignment is possible.

In most situations this will give the result, but if it is still not possible to assign then the procedure described below must be followed.

After here all rows having no assignments should be indicated (row 1) and all columns having zeros in that row(s) should be marked (column 1). Then all rows having assignments in the given column (row 3) have to be marked until a closed loop is obtained and drawn lines through all marked columns and unmarked rows.

$$Q = \begin{bmatrix} 0 & p_2 & p_3 & p_4 \\ q_1 & q_2 & 0 & q_4 \\ r_1 & 0 & r_3 & r_4 \\ 0 & s_2 & s_3 & s_4 \end{bmatrix}$$

From the elements that are left, the lowest value should be found. After that, the lowest value should be subtracted from every unmarked element and added to every element covered by two lines.

The all steps should be repeated until an assignment is possible; this is when the minimum number of lines used to cover all the 0s is equal to the max (number of programs, number of assignments), assuming dummy variables are used to fill in when the number of programs is greater than the number of assignments.

6. Application

In this study, our objective is to address the most adequate customer loyalty programs to consumers with different characteristics in order to maintain their fidelity in mobile telecommunication market. We are taking into account companies from mobile business that carries services to huge amount of customers. There is a big competition between those companies and they have to carry specific services to their customers in order to be able to keep them satisfied, thus loyal to the company (Kim & Lee, 2010).

In this study, six different loyalty programs are being taken into account with the objective to deliver them to the most adequate customer segments and hence to ensure that each client from different segment receives the most suitable service in mobile telecommunication business (Karjaluoto & Leppäniemi, 2005):

(P1) Rewards: Mobile phones and tablet PCs.
(P2) Bonus program: Points, free vouchers and reduced calls.
(P3) Low-priced weekend rates.
(P4) Free SMS's.
(P5) Free Mobile Applications.
(P6) Two hours free mobile internet.

Each of those loyalty programs are going to be related to different customer characteristics according to their:

(C1) Economic level.
(C2) Gender.
(C3) Age range.
(C4) District.

From here the objective is to provide results to mobile telecommunication companies that would help them to take easier decisions when it comes to decide what kind of loyalty programs would be carried to what kind of customers with different characteristics. In order to be able to that we are going to reduce all these variables to matrices and try to assign the most appropriate program to each client using the fuzzy based Hungarian algorithm. We are benefiting from linguistic variables and fuzzy numbers because when there is objectivity it is not easy to reflect them with definite 0 and 1s. Therefore in this study we are using linguistic expressions which are being transformed to numerical values in order to show the objective interactions and estimations (see Table 1).

Beginning with the first loyalty program, all loyalty programs are going to be linked to each customer characteristic that is taken into account in this study:

$$P_i = [C_1 \quad C_2 \quad C_3 \quad C_4] \quad \text{where} \quad i = 1, 2, \ldots, 6.$$

When the first loyalty program's (Rewards: Mobile phones and tablet PCs) importance and value is calculated on different customer characteristics, it is believed that it is almost very important (0.8) to consider different age ranges. It is also important to consider the economic level and district of the customers so they are shown by 0.7. Regarding to gender, although it is not considered as important as other characteristics when the first loyalty program's conjunct matrix value generated it is contemplated that it may have an important impact so it is represented by 0.6. Same, the other matrices are generated for all customer loyalty programs and they are shown below:

$$\left.\begin{array}{l} P_1 = [0.7 \quad 0.6 \quad 0.8 \quad 0.7] \\ P_2 = [0.9 \quad 0.1 \quad 0.7 \quad 0.8] \\ P_3 = [0.9 \quad 0.3 \quad 0.8 \quad 0.5] \\ P_4 = [0.6 \quad 0.3 \quad 0.9 \quad 0.2] \\ P_5 = [0.6 \quad 0.4 \quad 0.7 \quad 0.2] \\ P_6 = [0.4 \quad 0.2 \quad 0.7 \quad 0.4] \end{array}\right\} = [P]$$

In order to be able to find the correlations between loyalty programs and different customer segments, the customer characteristics are being correlated with different customer segments. Following, every customer loyalty program is going to be linked to each customer segment by fuzzy numbers and shown in a matrix.

In this study, for the mobile market the following customer segmentation is considered:

(S1) Upper-class (Higher managerial and professional occupations).
(S2) Lower-middle class (clerical, sales, service occupations).
(S3) Women.
(S4) Adolescents.
(S5) Pensioners – Housewives.
(S6) Zone – Upper Area of the City.
(S7) Zone – Suburbs.

From here, the correlations between each characteristic and customer segmentation are going to be shown. Here we take into account the objective opinions and estimations. This relation matrix is going to be shown by C.

$$C_i = [S_1 \quad S_2 \quad S_3 \quad S_4 \quad S_5 \quad S_6 \quad S_7] \quad \text{where} \quad i = 1, 2, 3, 4.$$

In order to find the C_1 matrix, the correlations between customer characteristics and customer segments have to be shown. It is supposed that economic level characteristic has very important correlation with the suburb customer segment (0.8). It is considered that economic level is also much related to upper-class, lower-middle class and adolescents segments and there wise they are represented by 0.7. Economic level characteristic is also quite related to women segmentation, but with less importance. The segment that is expected to have the less correlation with the economic level is considered to be the zone – upper area of the city segment. For that reason it is shown by 0.3. Same, the correlations are being found and shown with the following matrices for all four customer characteristics below:

$$\left.\begin{array}{l} C_1 = [0.7 \quad 0.7 \quad 0.5 \quad 0.7 \quad 0.6 \quad 0.3 \quad 0.8] \\ C_2 = [0.2 \quad 0.3 \quad 0.9 \quad 0.2 \quad 0.3 \quad 0.1 \quad 0.2] \\ C_3 = [0.4 \quad 0.5 \quad 0.7 \quad 0.1 \quad 0.2 \quad 0.4 \quad 0.3] \\ C_4 = [0.4 \quad 0.1 \quad 0.3 \quad 0.7 \quad 0.6 \quad 0.2 \quad 0.2] \end{array}\right\} = [C]$$

As [P] and [C] matrices are built, subsequently they are being multiplied in order to get the final matrix on which the Hungarian algorithm is going to be applied.

[P] =

0.7	0.6	0.8	0.7
0.9	0.1	0.7	0.8
0.9	0.3	0.8	0.5
0.6	0.3	0.9	0.2
0.6	0.4	0.7	0.2
0.4	0.2	0.7	0.4

[C] =

0.7	0.7	0.5	0.7	0.6	0.3	0.8
0.2	0.3	0.9	0.2	0.3	0.1	0.2
0.4	0.5	0.7	0.1	0.2	0.4	0.3
0.4	0.1	0.3	0.7	0.6	0.2	0.2

When the two matrices are multiplied the following matrix is obtained:

[P]*[C] =

	S1	S2	S3	S4	S5	S6	S7
P1	1.21	1.14	1.66	1.18	1.18	0.73	1.06
P2	1.25	1.09	1.27	1.28	1.19	0.72	1.11
P3	1.21	1.17	1.43	1.12	1.09	0.72	1.12
P4	0.92	0.98	1.26	0.71	0.75	0.61	0.85
P5	0.86	0.91	1.21	0.71	0.74	0.54	0.81
P6	0.76	0.73	0.99	0.67	0.68	0.5	0.65

Once the final relation matrix obtained, the Hungarian algorithm should be applied on it to assign each loyalty program to different segment of clients. According to the theorem, the number of columns and rows should be the same so we consider an additional row which consists of zero values. The Algorithm is starting by identifying the minimum values of rows and columns, and consequently their subtraction from each cell as it was explained above.

	S1	S2	S3	S4	S5	S6	S7	MIN
P1	1.21	1.14	1.66	1.18	1.18	0.73	1.06	0.73
P2	1.25	1.09	1.27	1.28	1.19	0.72	1.11	0.72
P3	1.21	1.17	1.43	1.12	1.09	0.72	1.12	0.72
P4	0.92	0.98	1.26	0.71	0.75	0.61	0.85	0.61
P5	0.86	0.91	1.21	0.71	0.74	0.54	0.81	0.54
P6	0.76	0.73	0.99	0.67	0.68	0.5	0.65	0.5
F	0	0	0	0	0	0	0	0

Once the minimum values subtracted and the reduced matrix is obtained, the following steps of the algorithm should be applied on the matrix:

	S1	S2	S3	S4	S5	S6	S7
P1	0.48	0.41	0.93	0.45	0.45	0	0.33
P2	0.53	0.37	0.55	0.56	0.47	0	0.39
P3	0.49	0.45	0.71	0.4	0.37	0	0.4
P4	0.31	0.37	0.65	0.1	0.14	0	0.24
P5	0.32	0.37	0.67	0.17	0.2	0	0.27
P6	0.26	0.23	0.49	0.17	0.18	0	0.15
F	0	0	0	0	0	0	0

Consequently, the following steps of the Hungarian algorithm are being applied on the reduced matrix. The zeros represent the assignment programs. According to the algorithm all zeros have

Table 1
Linguistic semantics and their corresponding numeric numbers.

High–High	H–H	0.9	Very high
High–Medium	H–M	0.8	High
High–Low	H–L	0.7	Pretty high
Medium–High	M–H	0.6	Rather high
Medium–Medium	M–M	0.5	Regular
Medium–Low	M–L	0.4	Rather low
Low–High	L–H	0.3	Pretty low
Low–Medium	L–M	0.2	Low
Low–Low	L–L	0.1	Very low

to be assigned and all rows and columns of the matrices have to be covered.

	S1	S2	S3	S4	S5	S6	S7
P1	0.38	0.31	0.83	0.35	0.35	0	0.23
P2	0.43	0.27	0.45	0.46	0.37	0	0.29
P3	0.39	0.35	0.61	0.3	0.27	0	0.3
P4	0.21	0.27	0.55	0	0.04	0	0.14
P5	0.22	0.27	0.57	0.07	0.1	0	0.17
P6	0.16	0.13	0.39	0.07	0.08	0	0.05
F	0	0	0	0	0	0.10	0

As all rows and columns of the matrix above are not covered and the assignment is not possible, the minimum element in each column is subtracted from all the elements in that column.

	S1	S2	S3	S4	S5	S6	S7
P1	0.33	0.26	0.78	0.30	0.30	0.00	0.18
P2	0.38	0.22	0.40	0.41	0.32	0.00	0.24
P3	0.34	0.30	0.56	0.25	0.22	0.00	0.25
P4	0.21	0.27	0.55	0.00	0.04	0.05	0.14
P5	0.17	0.22	0.52	0.02	0.05	0.00	0.12
P6	0.11	0.08	0.34	0.02	0.03	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.15	0.00

From here new zeros have to be created and then all zeros have to be covered with the minimum number of (row/column) lines. The value of the smallest uncovered value is subtracted from all the uncovered values and added to all the values that are double-covered.

	S1	S2	S3	S4	S5	S6	S7
P1	0.14	0.07	0.59	0.27	0.23	0	0.07
P2	0.19	0.03	0.21	0.38	0.25	0	0.13
P3	0.15	0.11	0.37	0.22	0.15	0	0.14
P4	0.05	0.11	0.39	0	0	0.08	0.06
P5	0	0.05	0.35	0.01	0	0.02	0.03
P6	0.03	0	0.26	0.1	0.07	0.11	0
F	0	0	0	0.16	0.12	0.34	0.08

The all steps of Hungarian algorithm are applied to our reduced matrix and the final resolution matrix is obtained as shown in the following table:

	S1	S2	S3	S4	S5	S6	S7
P1	0	0.04	0.49	0.17	0.13	0.01	0.03
P2	0.09	0	0.11	0.28	0.15	0.01	0.06
P3	0.05	0.08	0.27	0.12	0.05	0	0.07
P4	0.05	0.18	0.39	0	0	0.18	0.09
P5	0.07	0.12	0.35	0.01	0.02	0.12	0.06
P6	0.01	0.04	0.23	0.07	0.04	0.18	0
F	0	0.07	0	0.16	0.12	0.44	0.11

The algorithm is proceeded 11 times to get to the final matrix that is shown above although all those steps are not shown in this study. From the last matrix obtained we are capable of making assignments as all zeros are all the rows and columns of the matrix are covered and as a result every program is assigned to a customer segment. The results obtained from the resolution matrix can be interpreted as following:

(*P*1) Rewards: Mobile phones and tablet PCs. The first program is assigned to the 1st customer segment; which includes the upper-class clients. The clients from the higher social class who are supposed to have higher incomes appreciate most big rewards such as mobile phones and tablet pc's.

(*P*2) Bonus program: Points, free vouchers and reduced calls: the second loyalty program is assigned to the lower-middle class. This result can be interpreted as the second segment appreciates most the vouchers or some programs that would allow them to accumulate points and acquire reduced rates.

(*P*3) Low-priced weekend rates: This program is assigned to the segment that includes customers who live in the upper part of a city.

(*P*4) Free SMS's program: Assigned to segments those include adolescents and housewives/pensioners.

(*P*5) Free Mobile Applications: This program is also should be assigned to the young customers as expected.

(*P*6) Two hours free mobile internet has to be carried to the zone – suburbs segmentation. The clients that are living in suburbs are the clients who usually have less income so they might appreciate a free mobile internet service.

7. Conclusions, limitations and further research

The results obtained in this study are quite coherent with the real life cases. Beginning with the first program, we find it quite natural that clients who belong to the upper-class appreciate more if they are provided free mobile phones or tablet pc's. These expensive rewards should be addressed to clients who generate higher income for the company and it is very attractive for the mobile telecommunication provider to keep them. Regarding to the second loyalty program, we think that it is also rational to deliver this program to the lower-middle class as the customers from this segment are going to be stay satisfied if they are introduced with a points program or offered some free vouchers, reduced calls and low-priced weekend rates. The result of the third loyalty program is quite surprising. We were expecting to address it to a segment which includes lower-profile clients but in the end according to the final resolution matrix it should be assigned to the customer segment that consists of clients who live in upper areas of a city. The fourth loyalty program examined in this study; the Free SMS's program should be directed to customers that they are between 13 and 19 years old. It is not a surprising result as the adolescents are inclined to use more SMS's and they are the segment that would mostly appreciate to be conceded free SMS's. Surprisingly, customer segment that includes pensioners and housewives also consider very positively to be set out free SMS service/program. The fifth loyalty program is assigned to the adolescents segment. This result confirms us that young customers are more tended to use mobile applications and they would be very satisfied to be introduced with such kind of a program. Finally, according to the final matrix obtained, the last loyalty program should be assigned to the segment that includes clients from suburbs zone. We think that these are the customers with less income and they might be glad to be provided a free mobile internet service. We believe that delivering this program to them may help the company to keep them pleased and loyal. For women we can't assign any specific program because there is no significant result for this group in the matrix but if a program has to be assigned to them it should be the bonus program as it gives the lowest value in the final resolution matrix.

We had some limitations on this article. We did not dispose real data and some correlations may only reflect our objective opinions and estimations. We hope to obtain real data from mobile telecommunication companies and apply them to the model that we present. On the other hand, it would be useful to send some questionnaires to managers from mobile business in order to determine the correlations between customer loyalty programs and customer characteristics. In further studies we are hoping to obtain all those information throughout questionnaires, interviews or company visits. On the other hand our study is going to be extended to other sectors and to a wider variety of customer segments. Lastly, it is considered to take into account the customer values while the model present is improved as we think that customers with higher values may deserve better service while less service should be delivered to customers with lower value for the company.

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