TOPSIS-based OptQuest for strategy selection in Tunisian medical insurance establishment

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Abstract— **Medical insurance refers to a set of mechanisms and institutions whose function is to protect individuals from social risks. This activity deserves to be well studied in order to choose the best strategy that provides good medical coverage. The choice of the best strategy is based on four criteria: waiting time, the number of served insured patients, the rate of resource utilization and the total cost. It obtained from TOPSIS method after determining the importance of performance criteria by optimization via simulation using OptQuest of ARENA: The experimental results show the efficiency of our approach.**

Keywords——**Medical insurance, Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), Optimisation via simulation OptQuest**

I. INTRODUCTION

Insurance is more than a simple answer to the diversity of risks because the developed techniques in insurance have made it possible to set up various types of products trying to meet the concerns of insured.

Medical insurance coverage for workers is provided in Tunisia by two funds: the National Social Security Fund (CNSS) for the private sector (workers in the private sector in the agricultural and non-agricultural sector) and the National Fund for Retirement and Social Welfare (CNRPS) for the public sector (public sector employees). Employers hiring staff are required to affiliate, self-employed workers can voluntarily insure.

These funds offer social benefits to their members except in the field of health coverage: health insurance, maternity, occupational accidents and occupational diseases. Students are systematically affiliated with the CNSS when they register at a university institution, paying the sum of 5 dinars.

The benefits offered by the CNSS are family benefits such as family allowances, the increase of the single salary, the allowance for birth leave, the contribution to nursery fees, ..., family insurance such as allowances and death benefits , old-age, disability and survivors' pensions with the refund of contributions and the supplementary scheme.

The offered benefits by the CNRPS are pensions, survivors' pensions, and death benefits. But it also intervenes in the field of social housing by granting these affiliates credit at low-interest rates.

Medical insurance reimburses only a part of the health costs. Even if the excess fees, free fees, dental and optical care increase the bill, the rest of the sum remains the responsibility of the insured.

Medical insurance institutions are of great importance in our society because all citizens almost today are affiliated with medical insurance funds. So we must direct our research to improve the different services provided by them.

II. DESCRIPTION OF THE MEDICAL INSURANCE

Tunisian medical insurance covers salaried workers against all risks, including unemployment.

A. Structure

The National Health Insurance Fund (CNAM) is a reform of Tunisian health insurance. The CNAM is the product of a reform launched in 2004 and aims to improve the quality and access to care, to master health spending and to provide equitable health coverage system.

This reform has a dual system: The mandatory: managed by social security funds CNSS, this system covers the non-agricultural private sector employees, agricultural sector employees , farmers, independent workers and fishermen and other optional: managed by insurance and mutual companies, these cover health expenses not supported by the basic plan.

It is set up in 2006 as part of the reform to unify the health insurance plans and health benefits previously provided by the National Social Security Fund (CNSS) and the National Pension and Social Insurance (CNRPS), but also to expand health coverage to private providers of care.

B. Affiliate

The CNAM has imposed compulsory health insurance to all CNRPS affiliates who are employee in public sector and to the CNSS affiliates who are semi-state and private sector officials,. There are more than two and a half million affiliates.

C. Administrative Organisation

Under the supervision of the Ministry of Social Affairs, two funds administer the reform:

• The National Social Security Fund (CNSS), which is responsible for old age, invalidity, survivors, death and unemployment insurance, and which provides family benefits,

• The National Health Insurance Fund (CNAM) which manages health, maternity, occupational accidents and occupational diseases insurance.

The compulsory contribution of the work accident and occupational diseases scheme is the responsibility of the employer only; it varies between 0.4% and 4% depending on the sector of activity (this contribution may be, if necessary, adjusted according to employer failures to safety rules, or its prevention efforts).

Basic contributions are paid the full salary. For the supplementary pension, only employees who receive a salary exceeding the ceiling equal to 6 times the SMIG pay contributions. Contributions are paid to the CNSS.

Medical insurance consists of:

• Healthcare,

• Cash benefits in case of sickness, maternity or death.

Entitled to benefits in kind, the insured person:

•Employee,

• Self-employed worker,

• Pensioner

• Social assistance recipient,

Is considered as entitled:

• The spouse,

•The child up to the age of 20 in the case of continuing university studies, or without age limit if he is disabled,

• Dependent ascendant who has no health care coverage.

A dependent is an ascendant at least 60 years of age, to whom the worker provides effective and permanent accommodation, food and clothing.

To benefit from cash and maternity benefits in kind and in cash, the insured employee must have at least 50 days of work during the last 2 calendar quarters or at least 80 days in the last 4 quarters.

Pensioners of the CNSS benefit from sickness cover under the same conditions as salaried employees.

The holder of a Resident's pension and his beneficiaries are entitled to a free care card issued by the competent local services of the health insurance on the basis of a list of beneficiaries established by the National Fund for Retirement and the Social Provident - CNRPS, a public pension fund.

Certain categories of insured persons benefit from a card (valid for one year and renewable) entitling to the treatment at reduced rates:

• The worker dismissed for economic reasons,

• The dependent ascendancy of an affiliate who remains 1 or 2 years before benefiting from the health cover issued at age 55,

• The seasonal or temporary worker,

• The unemployed higher education graduate after the expiry of a full year of graduation without benefit from unemployment benefits.

The poorest families benefit from a free care card granted by a regional commission created at the level of each governorate, as part of the national program to help families in need.

III.   SELECTION OF THE BEST SOLUTION

After generating several alternatives by a simulation tool to improve the current medical insurance system, we use the TOPSIS method to choose the best alternative.

A. TOPSIS method

Founded by Hwan and Yoon 1981, the TOPSIS method is one of the most used methods in multi-criteria decision support whose goal is to rank in order of choice a number of alternatives based on a set of positive or negative criteria.

$$s_{i+} = \left[\sum_{j=1}^{n} (v_{ij} - v_{+j})^2 \right]^{0.5} \quad (1)$$

$$s_{i-} = \left[\sum_{j=1}^{n} (v_{ij} - v_{-j})^2 \right]^{0.5} \quad (2)$$

The relative closeness to the ideal point can be calculated by (3).

$$c_{i+} = \frac{s_{i-}}{s_{i+} + s_{i-}} \quad (3)$$

Where v_{-j} is the weighted standardized criterion value of the ith alternative that is calculated by multiplying standardized criterion value by the corresponding weight, and v_{+j} is the ideal value and v_{-j} is the negative ideal value for the jth criterion.

Despite being simple to apply, the TOPSIS method is sensitive to the weights of the criteria (w_j) which must be fixed a priori. Moreover, poor allocation of magnitudes criteria can lead to a bad choice by this method. In order to adapt the TOPSIS method to the characteristics of the studied problem, we propose to determine the weighting values associated with different criteria by optimization via simulation.

Its principle consists in determining for each alternative a coefficient between 0 and 1 based on the distances between each alternative on the one hand and the favorable or unfavorable solutions on the other hand. The basic concept of this method is that the selected alternative should have the shortest distance to the positive ideal solution and the farthest distance from the negative ideal solution [1].

The TOPSIS method assumes that each criterion tends toward a monotonically increasing or decreasing utility [2]. Therefore it is easy to define the positive ideal and negative ideal solutions. The Euclidean distance approach was proposed to evaluate the relative closeness of the alternatives to the ideal solution. Thus, the preference order of the alternatives can be derived by a series of comparisons of these relative distances. The distance between the ideal point and each alternative can be calculated using. Using the same separation measure, the distance between the negative ideal point and each alternative can be determined [3].

B. Determining the importance of performance criteria by optimization via simulation

Several methods of optimization via simulation can be applied to this type of problem [4][5][6]

The OptQuest add-on is an additional module optionally available with Arena, being a product OptTek. The OptQuest engine integrates into a single method consists of meta-heuristics, mathematical programming, and neural network [7] to identify the search for good solutions to simulated systems optimization problems. This method is not disclosed for commercial reasons.

In this work, OptQuest Arena is used to determine the importance of the criteria. This technique allows the user to specify the upper and lower limits and the suggested values for each variable to be optimized, which represent the optimizing starting point. It helps to use multiple replications. More details about OptQuest can be found in the work. It is used to find the best inputs for the production of the desired simulation output. It finds the combination, the order that produces the highest expected value of earnings, minimum variance or the highest value likely produced using the least amount of resources.

OptQuest lets to define various system inputs and desired system outputs. OptQuest then guides the process of selection of system inputs and then executes the model by

running several scenarios for each set of inputs in order to achieve the desired system outputs.

If you are looking for the best combination of weight values to achieve a certain goal, so the weight must be defined as controls, specifying the range of each weight. Thus OptQuest will test all possible combinations and rank in the descending order of magnitudes according to the goals.

The application of OptQuest with Arena in our model gives us the determination of weights of the four performance indicator's as follows:

TABLE 1. DETERMINATION OF WEIGHTS

Criteria	C_1	C_2	C_3	C_4
w_j	0.21	0.24	0.27	0.28

After running this method, the classification of the five proposed alternatives is represented as follows:

TABLE 2. CLASSIFICATION OF
ALTERNATIVES OBTAINED BY TOPSIS METHOD

Alternatives	0	1	2	3	4	5	6
S*	0.042	0.121	0.212	0.631	0.705	0.625	0.707
Distribution coefficient	1	3	8	21	23	21	23
Rate choice	7	6	5	3	2	4	1

So it is remarkable that the alternative 6 take the greatest importance score. It selected as the best solution to improve the current medical insurance that manifests in the addition of three windows service to the current system with the change of working time of the medical insurance fund Gabes, Tunisia.

IV. CONCLUSIONS AND FUTURE SEARCH

In this work, we have improved the performance of the medical insurance system by exploring the possibilities of adding resources using ARENA software. After generating several alternatives, the application of the TOPSIS multicriteria method suggests choosing the alternative that adds three windows service to the current system with the change of the opening time of the medical insurance fund, instead of 8 am to 7 am. By this strategy, most of the performance measures were improved.

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