Short Communication

Error noted in a Case Study on fund allocation using goal programming

Md. Fazle Baki, Niall M. Fraser *

Department of Management Sciences, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1

Received 1 December 1995; accepted 1 June 1996

Abstract

In a recent volume of European Journal of Operational Research a Case Study concerning fund allocation using goal programming was reported [1]. However, the goal program model given was incomplete and the solution provided incorrect. In this short communication we propose a more correct formulation. The correctly formulated problem has multiple solutions. It is demonstrated that at least one solution is better than the solution reported in the original paper.

Keywords: Goal programming; Delphi; Forecasting; Resource allocation

In a recent volume of European Journal of Operational Research a Case Study concerning fund allocation using goal programming was reported [1]. This Case Study well illustrated the use of the Delphi method and a Poisson gravity model for providing qualitative and quantitative forecasting information respectively to a goal programming formulation. However, the goal program model given was incomplete and the solution provided incorrect.

An observation of the goal program given reveals that the trivial solution $X = 0$, $n = 0$, $p = 0$ is optimal. Also, the solution does not follow from the given formulation, suggesting that information is missing. Finally, it can be seen that the reported solution exactly conforms to the reported values of a single criterion, average income. This cannot happen if all the criteria are equally important.

In the following we propose a more correct formulation. There are five retail centres and fund allocation to these centres has to be in direct proportion to the following three criteria: (1) patronization rate, (2) average income, and (3) principal tenants.

Let $c_{i,j}$, $1 \leq i \leq 5$, $1 \leq j \leq 3$ be the percentage of funds to be allocated to retail centre $i$ to satisfy criterion $j$. It can be found from [1] that

$c_{1,1} = 20.46$, $c_{2,1} = 16.29$, $c_{3,1} = 25.34$,
$c_{4,1} = 22.18$, $c_{5,1} = 15.73$,
$c_{1,2} = 30.23$, $c_{2,2} = 11.15$, $c_{3,2} = 28.15$,
$c_{4,2} = 23.87$, $c_{5,2} = 6.60$,
$c_{1,3} = 30.77$, $c_{2,3} = 15.38$, $c_{3,3} = 23.08$,
$c_{4,3} = 23.08$, $c_{5,3} = 7.69$.

Let $X_i$, $1 \leq i \leq 5$ be the percentage of funds allocated to retail centre $i$. Then, for each $i$, $1 \leq i \leq 5$,
we get three goals: $X_i + n_{ij} - p_{ij} = c_{ij}$ for $j = 1, 2, 3$. Also, we have a fund allocation constraint, $\sum X_i = 100$, $i = 1, 2, \ldots, 5$. The objective is to minimize $Z = \sum \sum n_{ij} + p_{ij}$, $i = 1, 2, \ldots, 5$, $j = 1, 2, 3$.

The above problem has multiple solutions. One solution is $X_1 = 29.60$, $X_2 = 15.38$, $X_3 = 25.34$, $X_4 = 23.08$, and $X_5 = 6.60$ with $Z = 33.06$. The solution presented in the paper is $X_1 = 30.24$, $X_2 = 11.15$, $X_3 = 28.15$, $X_4 = 23.86$, and $X_5 = 6.60$. For this solution, $Z = 40.26$, and, therefore, this solution is incorrect.

References