A dynamic programming approach to the multiple-choice multi-period knapsack problem and the recursive APL2 code

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Abstract

The multiple-choice multi-period knapsack problem lies on the interface of multiple choice programming and knapsack problems. Previous study of this problem attempted to find its optimal solution through the branch-and-bound procedure using special-ordered-sets. In this paper, we propose another solution approach based on the dynamic programming to locate its optimal solution through recursive evaluation of Bellman’s equation at each period. We also introduce a set of concise computer code written in IBM’s APL2 that solves the problem recursively. Based on this developed APL2 codes, a computational experiment was conducted to further examine the performance of this dynamic programming solution approach.

Keywords and phrases: Knapsack problem, dynamic programming, multiple choice programming, APL2 computing language.

Introduction

Both standard knapsack problem (i.e., maximize $\sum_{j \in N} c_j x_j$ subject to $\sum_{j \in N} c_j x_j \leq b$ where $N = \{1, 2, \ldots, n\}$) and various types of non-standard knapsack problems have been widely studied by researchers leading to numerous publications [13, 17]. In our bibliographical survey on many well-known non-standard knapsack problems [14], a non-standard knapsack problem called the multiple-choice multi-period knapsack problem

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