Capital budgeting involving mutually exclusive alternative and conditional decisions

Capital budgeting involves evaluation of different investment opportunities and select the one which has highest returns. Return can be measured through factors like Return on investments (ROI), Net Present Value (NPV), Time period to make profit. NPV is the most used in the industry. Investment decision sometimes involves exclusive alternative and conditional decisions, i.e. only of the investment must be selected and based on the selected invested a decision is taken which is subject to some conditions. Below mentioned problem involves mutually exclusive alternative and conditional decisions.

**Problem**

Wakanda State University (WSU), is planning for an expansion through opening new a campus and wants to select one location from below given locations. The university is also considering opening a learning center for part time students in the location where it decides to open new campus, but a learning center may not be opened if it is not profitable. The location, NPV and investment required each location is given in below table. Total available fund for investment with the university is 25 million USD. The objective is to find the most appropriate alternatives (investment decisions) which will maximize the total NPV.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Investment Decision No. | Type | Location | NPV (million usd) | Investment (million usd) |
| 1 | College Campus  | Tempy | 10 | 17 |
| 2 | College Campus  | Shandler | 12 | 20 |
| 3 | College Campus  | Tooson | 8 | 15 |
| 4 | College Campus  | Flagstiff | 7 | 12 |
| 5 | Learning Center | Tempy | 3 | 7 |
| 6 | Learning Center | Shandler | 4 | 9 |
| 7 | Learning Center | Tooson | 2 | 4 |
| 8 | Learning Center | Flagstiff | 1.5 | 3 |

**Index:** i, denotes the decision no. such that i = {1, 2,3,4,5,6,7,8}

**Parameter:**

Ni = NPV in million usd for the investment decision i

Ci = Investment required in million usd for the investment decision i

A = Total available fund for investment, 25 million usd in this case

**Decision:** whether to select investment decision i

$$X\_{i} = \left\{\begin{array}{c}1 , if investment decision i is selected \\ 0, if invest decision i is not selected \end{array}\right.$$

**Objective:** To maximize the total NPV from investment, $Max \sum\_{i}^{}Ni\*Xi $

**Constraints:**

1. Total available fund for investment,

 $\sum\_{i}^{}Ci\*Xi\leq A$

1. Mutually exclusive constraint, university want to open only one campus,

 $X\_{1}+X\_{2} +X\_{3} + X\_{4}=1$

1. Mutually exclusive constraint, university want to open only one learning center,

$X\_{5} + X\_{7}+X\_{6} +X\_{8}=1$

1. Contingent constraint, university will consider opening a learning center in the location if the new campus is opened in the location,

$$X\_{5}-X\_{1} \leq 0$$

$$X\_{6}-X\_{2} \leq 0$$

$$X\_{7}-X\_{3} \leq 0$$

$$X\_{8}-X\_{4} \leq 0$$

1. $X\_{i}$ , Binary decision variable