**Integer Programming. The Plant company executives held a meeting to make a decision of next year investments. There are four projects are available. The projects require not only cash flow but also raw material. The raw material cost $1 million per ton. It can yield the net present values(in millions) shown below. If the company has $11 million. Find the investment plan that maximizes NPV.**

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| --- |
| Cash outflows (in millions), Required Materials(in tons), and NPVs of projects (in millions) |
| 　 | Project 1 | Project 2 | Project 3 | Project 4 |
| Required Materials | 1 | 2 | 1 | 2 |
| Cash outflow | $3  | $5  | $2  | $4  |
| NPV | $5  | $8  | $3  | $7  |

**Discussion.**

This is an example of an integer programming model. The basic objective if fairly simple, i.e. to maximize the NPV. We must decide choosing which of the investment projects will help us achieve this. We assume that investments to these projects can be made only once. In most Integer programming models, one of the decision variables is always a binary variable, in this case it is the decision whether a project must be chosen. We must ensure that when choosing the projects, the amounts we invest in it do not exceed the capital and raw material available, this will be one of the constraints.

**Model.**

Parameters:

$C\_{i }$: *Cash outflow required by investment* $i$*,* $ where i\in \left(1,2,3,4\right)$

$M\_{i }$: *Required raw material for investment* $i$*,* $ where i\in \left(1,2,3,4\right)$

*U: Unit price for raw material*

$P\_{i}$: *NPV from project* $i $*,*$ where i\in \left(1,2,3,4\right)$

*A: Available capital*

Decisions:

$x\_{i}$: *Whether investment* $i$ *should be chosen,* $ where i\in \left(1,2,3,4\right)$

Objective: *Maximize Revenue*

$max\sum\_{i}^{} $ $x\_{i}$\*$ P\_{i}$

Constraints:

$\sum\_{i}^{} x\_{i}\* (C\_{i}+U\*M\_{i})\leq A \left(1\right)$ Total investments not more than

$ x\_{i} \_{ }\geq 0$ (2) Non - negative amount invested

$x\_{i}\in $ {0,1} (3) Binary decision

**Optimal Solution.** The following is the solution obtained from Excel Solver.

[](Ex37%5BFour%20projects%5D_s.xlsx)

A maximum NPV of $11 million dollars can be attained by choosing a project as shown below.

