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Multiple Projects and Constraints

In the existing environment, an organization cannot consider a capital investment project individually without first considering certain pre-conditions.

Constraints

Project dependence, capital rationing and project indivisibility are factors that restrict isolated project selection. If the acceptance or rejection of one influences the cash flow stream of the other or affects the acceptance and rejection of the other, then the two projects are said to be economically dependent. The three types of economic dependency are as follows:

1. Mutual exclusiveness
2. Negative dependency
3. Positive dependency (complementariness)

Capital rationing occurs when funds available are not adequate to undertake all the projects that are otherwise acceptable. It also arises because of internal limitations or an external constraint.

A project cannot be accepted or rejected partially - it is indivisible, and has to be accepted or rejected in totality.

Methods for comparison

Factors like economic dependency, capital rationing and project indivisibility emphasize the need for comparison of projects. The methods used for comparing projects are:

- 1. Method of ranking.** The method of ranking, originally proposed by Joel Dean, consists of two steps:
 - (i) Ranking all the projects in decreasing order of the NPV's, IRR's, or BCR's.
Assumptions in these 4 methods are:
 - *NPV method.* The intermediate cash flow is re-invested at a rate of return equal to the cost of capital of the firm.
 - *IRR method.* Cash flow is re-invested at a rate of return equal to or greater than the Fisherian rate of return.
 - *BCR criterion.* The intermediate funds are reinvested at a rate of return greater than the Fisherian rate of return.

- Projects are accepted according to their rank until the capital budget is exhausted.
- (ii) All combination of feasible projects should be defined given the capital rationing constraint and project dependencies. Then, choose the combination that has the highest NPV. This is known as the feasible combination procedure.

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Problems: There are two major problems related to this method. Because of the discounted cash flow criteria, conflict arises when performing the ranking. Also, the indivisibility of the project can cause some difficulties.

2. **Mathematical programming approach.** Two broad categories of equations are considered for formulations in the mathematical programming approach - the objective function and the constraint equations.

The following two models are commonly used:

- (i) Linear programming model. This assumes that the objective function and the constraint equation are linear, while the decision variables are continuous.
- (ii) Integer linear programming model. It is presupposed that decision variables assume a value of 0 or 1.

Advantages of this method include:

- It overcomes the problem of partial projects which besets the linear programming model
- It is capable of handling virtually any kind of project interdependency, such as mutual exclusiveness, contingency and complementary.