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ABSTRACT

This paper describes the characteristics and circumstances defining nine decision cases in an effort to provide methodological assistance for practitioners. Each case is examined according to its objectives (single or multiple), resource level (limited or unlimited), time frame (a priori or evaluative), and the nature of desired decisions. In cases 1, 2, and 3, the decision-maker considers activity-designs. The complexity of cases 4, 5, and 6 mandates more detailed analysis. Here the notions of tasks and program-packages (sets of tasks) are introduced. In cases 7, 8, and 9, the term activity is used to connote the same overall meaning as program-package. These distinctions are necessitated by analytic complexities arising out of a need to derive an optimal decision-variable for each case. Decisions made by the decision-maker are at the level of activity-design for cases 1 and 2, program-package for cases 4 and 5, and activity for cases 7 and 8. The case discussion is preceded by an introductory exhibit showing the evolutionary structure of the nine cases. (Author)

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METHODOLOGICAL IMPLICATIONS DERIVING FROM NINE DECISION CASES*

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Administering for Change Program
Research for Better Schools, Inc.

A large number of recent studies in educational decision-making have embraced economic analysis in one form or another. Methodological descriptions for these studies have included benefit-cost analysis, cost-effectiveness analysis; programming-planning-budgeting systems (PPBS), operations analysis, operations research, and cost-utility analysis.

As one examines these studies, two important inadequacies become evident:

1) Theoretical bases for these analyses are absent.

   - Theory, in the domain of decision-making, should provide not only a basis for description and explanation, but explicit statements of assumptions underlying the proposed rationale and methodology.

2) Little help is offered to the individual who wishes to select from the various economic based approaches an appropriate method to apply to a practical problem.

This paper describes the characteristics and circumstances defining nine decision cases in an effort to provide methodological assistance for practitioners.[1]

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*This paper was prepared for American Educational Research Association Convention, March, 1970, Minneapolis, Minnesota.

[1]The analysis presented in this paper of case models is based on a somewhat rigorous theory whose development was suggested by the first above mentioned inadequacy. See -- Temkin, Sanford. A Theory of Cost-Effectiveness (Philadelphia: Research for Better Schools, Inc.) March, 1970.

Each case is examined according to its objectives (single or multiple), resource level (limited or unlimited), time frame (a priori or evaluative), and the nature of desired decisions.

In Cases 1, 2 and 3 the decision-maker considers activity-designs. An activity-design is a plan developed by an engineer. Some plans are complex. In Cases 4, 5 and 6 complexity mandates more detailed analysis. Here the notion of task is introduced. A set of tasks comprises a program-package. Assessment of program packages is complicated by the fact that some task performances are independent of outcomes from preceding tasks ("in parallel"), while other task performances are dependent on outcomes from prior tasks ("in series"). Finally, in Cases 7, 8 and 9, the term activity is used to connote the same overall meaning as program-package. These distinctions are necessitated by analytic complexities arising out of a need to derive an optimal decision-variable for each case.

Decisions made by the decision-maker are at the level of activity-design for Cases 1 and 2, program-package for Cases 4 and 5, and activity for Cases 7 and 8.

The case discussion is preceded by an introductory exhibit (see following page), showing the evolutionary structure of the nine cases.

Case 1 serves as a logical point of entry into the overall case structure. In this instance the decision-maker has one objective with an unconstrained level of resources. His problem is to make the optimal selection, a priori, from among the alternatives presented to him by his engineers.

Since Case 1 imposes no constraints, the decision-maker is pleasantly faced with a utopian research and development problem.

Case 2 introduces a cost constraint. A single objective is still being pursued. The only complication that results from the introduction of costs is

CASE	STRUCTURE	DECISION FRAMEWORK	RESOURCE LEVEL	COMMENT
1.	Single objective with set of proposed plans (activity-designs); one to be selected.	A <u>priori</u>	Unlimited	A utopian research and development problem.
2.	Single objective with set of activity-designs; one to be selected.	A <u>priori</u>	Limited	The constraint limits admissible alternatives; but still no incentive to economize.
3.	Evaluation of Cases 1 and 2.	A <u>posteriori</u>	Known	A performance evaluation involving a partition of outcome space.
4.	Single objective with set of tasks; several to be selected as a package.	A <u>priori</u>	Unlimited	A more complex version of Case 1; still utopian.
5.	Single objective with set of tasks; several to be selected as a package.	A <u>priori</u>	Limited	The constraint limits admissible alternatives as in Case 2;still no incentive for decision-maker to economize.
6.	Evaluation of Cases 4 and 5.	A <u>posteriori</u>	Known	A more compex version of Case 3.
7.	Multiple objectives with sets of activities; several to be selected.	A <u>priori</u>	Unlimited	A much more complex version of Cases 1 & 4; the relative weight of objectives becomes important.
8.	Multiple objectives with sets of activities; several to be selected.	A <u>priori</u>	Limited	The general cost-effectiveness case; the only case meeting the necessary and sufficient conditions for A <u>priori</u> cost-effectiveness analysis.
9.	Evaluation of Case 8.	A <u>posteriori</u>	Known	The general program evaluation case; provides cost-effectiveness evaluations for present year and inputs for next year's budget.

that some proposed activities are eliminated from consideration because they exceed budget limitations. There is still, however, no reason for the decision-maker to be "efficient" since there is only one outlet (objective) for expenditures.

Case 3 considers the evaluation of the first two cases. In cases 1 and 2 the preferred value of the decision-variable was found by selecting the proposed activity with the highest admissible certainty-equivalent.[2] The evaluation of these situations involves comparison of the certainty-equivalent with the implemented activity's actual performance outcome. Here the engineer's *a priori* distribution of the performance variable is also introduced. Case 3 is predicated on the belief that evaluation is undertaken to improve methods for 1) *designing* future activities; 2) *estimating* performances for activities to be designed in the future; and 3) *implementing* future activities as specified in their design.

Case 4 treats multiple activities aimed at a single shared objective. The need for assigning weights to outcomes in accordance with their potential worth to the decision-maker is incorporated into the methodology.

Case 5 reintroduces cost constraints, this time into a more complex situation. The decision-maker considers the advisability of allocating the budget among tasks of the preferred program package. Allocation of the budget among tasks is, however, in the domain of the implementor since he, alone, has responsibility for implementation. The implementor's major problem

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[2] A certainty-equivalent allows the decision-maker to consider trade-offs among alternative combinations of the mean and variance (the variance being taken as an index of uncertainty). The concept is discussed fully in: Markowitz, Harry. "Portfolio Selection," *Journal of Finance* (March, 1952).

along these lines is one of accounting and control. It is also true that he has a problem of allocating his budget among tasks.

A special instance of Case 5 is found in situations where the decision-maker pursues a single objective and the various tasks are capable of producing a homogeneous output. For example, consider a planning problem in which the decision-maker wants "to maximize the number of high school graduates" subject to a budgetary constraint and side conditions. He will consider alternative institutions which produce high school graduates. This problem lends itself to linear programming solution.[3]

What we see, in the special instance, is the engineer using linear programming to sort among alternative packages to display for the decision-maker. The decision-maker, on the other hand, at a higher order level of decision-making sees only his single objective and the constraint. The higher order problem is solved without recourse to linear programming or any other form of economic analysis.

Case 6, which provides an apparatus for the evaluation of Cases 4 and 5, is similar to Case 3. Again, the evaluation emphasis is on future improvement in the engineering, decision-making, and implementation processes.

Case 7 introduces a set of overall objectives into the decision-structure. The decision-variable in this case becomes a composite quantity reflecting value potential (a utility index) as well as relative performance (an index ranging from 0-1.0).

Case 8 introduces cost limitations on the structure of Case 7. <u>This is</u>

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[3]James McNamara, Pennsylvania Department of Education, pointed out the relevance of the linear programming model.

the first instance requiring economic analysis, and necessitates the formulation of two methodologies. These are applicable to the following distinctions:

1) If the decision-structure is suitable to the design of a totally new system with a remote time horizon, then "benefit-cost analysis" is appropriate.[4]

2) If the decision-structure is suitable to planned and incremental improvement of an existing system with a time dimension weighted heavily toward the present and the immediate future, then "cost-effectiveness analysis" is appropriate. This choice is mainly justified by the superior ability of cost-effectiveness methods to handle intangibles and incommensurables, and the trade-off of the future for the near present.

Case 9 is a model for the decision-maker who must evaluate the existing system in order to propose changes. These evaluations are based on variables that encompass not only educational criteria (effectiveness), but also economic criteria (effectiveness-cost).

The most interesting point about Cases 8 and 9 is that the effectiveness variable, combining value assignments and performance, allows for optimal decisions in that consideration of trade-offs among objectives is possible by virtue of the common denominator of value.

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[4] Benefit-cost analysis is applicable to the selection of projects from among a set of alternatives when investment is clearly the spirit of the decision, and when inputs and outputs can be fairly well measured by dollar units. This method derives from the criterion of present value of net benefits as a basis for comparing proposed alternatives. The method is generally conceded to be inapplicable to the intangible and incommensurable outcomes of education.

Clear statements of alternative benefit-cost criteria may be found in:

McKean, Roland N. Efficiency in Government through Systems Analysis (New York: John Wiley & Sons, Inc., 1958).

A few comments of a clarifying nature are in order. One point deserving mention is that budget problems do enter into Case 5. These problems, however, are accommodated as part of the implementation effort itself. Another point deserving emphasis is that it is not until Case 8 that a true economic problem is encountered. The simple introduction of a budgetary constraint upon decision situations does not constitute a true economic problem. The conditions for economic analysis, then, are:

1) At least two objectives are being pursued (since if only one is pursued there is no expenditure alternative available); and
2) The level of resources has prevented at least one activity (for if this is not the case, then the project budget is adequate to perform all the tasks desired and is not in any sense restrictive) from being chosen for implementation.

Parenthetically, it can be pointed out that a method of comprehensive planning is being developed based on a deterministic model of Cases 8 and 9. The method has been fully operationalized and is being tested in schools.

This paper has tried to provide a basis for assessing methodological suggestions for educational decision-making.

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