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**New Technologies
and
Innovations
in
Agricultural Economics
Instruction**

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Benefit/Cost and Internal Rate of Return Lessons: Computer-To-Videotape Transfer

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In this paper, a computer software developed for teaching investment project analysis is presented. The examples chosen are first the calculation of the B/C ratio using a time period of three years. Net incremental benefits are derived and the IRR is calculated and interpreted. Second, a design for a session addressing shadow exchange rates is presented at the end of the paper to illustrate the use of these materials.

These are examples from a series of lectures on investment analysis comprising lessons in the form of computer-generated slide shows on Financial Analysis, Economic Analysis (shadow pricing) and Monitoring and Evaluation of Agricultural and Non-agricultural Investments.

Lessons include examples and a series of exercises and answers. The materials are easy to use, yet flexible and provide for interaction between the instructor and student. (Appendix 1). Computer diskettes with accompanying manuals have been developed using the screen show features of Harvard Graphics. An IBM compatible computer with a color EGA or VGA monitor is needed. Videotapes of the material are also available.

These lessons contain all the necessary information for an introductory presentation in investment project analysis and their use or misuse depends on the understanding and application of the experiential approach in designing the use teaching sessions utilizing these materials. The audio-visual approach with its increased student retention advantages provides an additional experience for the student. Given educational goals to be achieved, the best use of these audio-visuals will be determined.

The content of the audio-visual materials on investment project analysis will first be characterized in terms of the educational approach followed in their development¹. Second, the proper use of these materials will be investigated within a experiential learning model and an example of a design for a session which uses these audio-visuals will be developed.

Characterization of the Educational Material

Student's level of preparation, learning style and preconceived ideas regarding the economic environment are main concerns in introductory courses in agricultural economics (Wetzstein). Among the objectives of an agricultural economics course are to teach students to conceptualize with varying degrees of abstraction and acquire the self-discipline to study and learn with others throughout their lifetimes (Solow).

To provide students with an interest in economic questions and policies they must be directly involved in the educational process by modifying student learning styles (Miller and Weil, Wolfe). Charkin, O'Toole and Wetzl define a dependent learner a student who generally prefers a highly directed and structured instruction. The collaborative learner prefers a discussion class with as much interaction as possible, while the independent learner wants some influence on the content and structure of the course. If students are to be taught to continue to question and learn, then a teaching approach focusing on collaborative and independent learning is required. (Wetzstein).

These audio-visual materials can be characterized as following the method of programmed instruction supplemented with the

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modern problems approach but mainly aphoristic in nature. They fit programmed instructions because the audio-visuals (accompanied by a work book) can be made available to individual students or "small groups" of students, and allow for "self paced" instruction. This material further fits programmed instruction in that there is repetition to reinforce learning of important concepts. The student has the correct answers immediately available after the exercises, which encourages the student to go on (Siegfried and Fels). Effectiveness is further increased by omitting everything else in the presentation other than the exact subject to be taught. The audio and visual parts enhance student's retention. Evidence suggests that learning and retention improve when a combination of sensory inputs are utilized to convey information (Nelson and Harris)².

The materials focus, to a large extent, on describing contemporary economic problems and institutions and therefore add to the realism and relevance of the lessons. One shortcoming of the contemporary economic problems approach is that it lacks the historical and theoretical base in analyzing economic problems (Wetzstein).

The nature of the content of these materials mainly follows the aphoristic approach. It stresses the use of rules and principles as the primary tools for competence (Clark). As a result, this teaching technique (material) can stifle imaginative zest and limit cognitive economic learning. It assumes that content and expression are separable and does not give the students the opportunity to think for themselves in order to obtain a better understanding (Crowe and Youga, McCloskey).

Organic and Experiential Approaches

The organonic approach presents economics in terms of values as well as principles. Thus it provides the organon for the discovery of truth. Economic analysis leads to the understanding of an integrated system of principles about what an economy can and ought to do (Wetzstein). Economic education under this approach, should not be limited to a body of concrete truths. The aphoristic approach, and therefore to a large extent the educational

materials on investment analysis, limits the content to concrete truths. This simply means that the aphoristic lectures contained in the audio-visual should not be used alone or as the main educational material. Rather, they should be blended possibly with organonic lectures, case studies, written reports, critiques of research, problem sets and empirical exercises which by providing a meaningful environment enhance student's ability to formulate and test hypothesis. (Wetzstein).

The experiential approach to teaching is learner-centered and allows the participants to manage and share responsibility for their own learning with their instructors. It is consistent with and follows the organonic approach. Climate setting and goal clarification provide the rationale for the importance and usefulness of the subject to the participants. Figure 1. Goal clarification further contributes to explain the intent and purpose of the activities to follow and allows the students to participate by seeking clarity on goals, add issues or raise concerns. (Kolb, TRG).

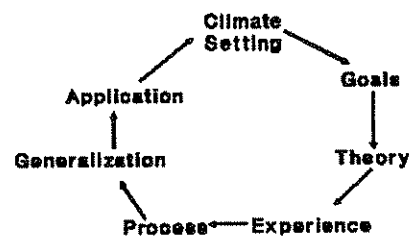


Figure 1. Experiential Approach to Teaching

Goal clarification stems from a needs assessment as well as an entry level skills determination performed at the beginning of the course. A climate setting introduction by the instructor is always necessary to stimulate the needs assessment and goal clarification. Goal clarification from additional needs assessments can proceed at the beginning of every session dealing with a new subject. If individuals are to share responsibility for their own learning, their goal expectations should be accounted for in the course design. Furthermore, entry level skills determination should also be accounted during the goal clarification and needs assessment process. Small group formation necessitates

information on entry level skills in order to provide some uniformity in programmed (self paced) instruction.

The experience phase is where the student is exposed to the knowledge relevant to the goals of the session (course). This phase includes a wide range of techniques such as: lectures, assignments, case studies; role plays, simulations; games; review exercises, computer games; film and slide shows, etc. The choice of the combination of teaching techniques depends largely on the lessons goals. Lectures consistent with the organonic approach and enhanced by the modern problems approach, provide a basis of knowledge. Such knowledge is largely theoretical and although necessary, requires the selection of additional teaching techniques to complete the experiential phase. Case studies, role plays, simulations, etc., become the way to test the theory or try out the validity of the concepts implied by it. The materials developed on investment analysis provide some of this additional exposure through the examples incorporated in the text and independent review exercises. The main purpose of these materials however, remains an audio-visual enhancement and review of main points contained in the organonic lectures for a programmed approach to learning.

The processing and generalization phase is where the class reflects on the activities undertaken during the experiential phase. The instructor, through structured feedback guides the class into sharing both their cognitive and affective reactions as they identify key generalizations and conclusions.

A variation in the experiential approach is that the theory if not presented through a lecture or other means at the beginning of the experience phase, then the theory is "developed" by the class through the structured feedback interwoven into the generalization phase. (Fig.1)

The experiential learning approach is completed by coaching for application. How can we use what we learned and what are the linkages back to the session goals and the rest of the course, especially upcoming sessions.

A Session Design

Effective teaching strategies which incorporate experiential learning require special attention to the design components of an experiential session. Following the experiential approach to teaching a session on "Shadow Exchange Rates" is designed to illustrate the suggested use of audio-visual materials on investment analysis of projects. The session has an approximate duration of two hours and some adaption would be needed to fit the structured fifty or seventy-five minute time allocated to many courses. The design is presented in Appendix 2.

Conclusions

Examples of the audio-visuals developed as an aid to teaching investment project analysis were presented to the participants of this conference. In the paper, an example on the calculation of the B/C ratio and the IRR is reproduced in Appendix 1.

The audio visuals with accompanying work manuals were developed consistent with an aphoristic approach to teaching. Their combination of sensory inputs, hearing, reading, writing and their contemporary economic problem content provide for improved learning and retention. They aid in the transfer of reasoning ability by providing representative examples. The possibility of individual or small group reviewing of the video tapes allows for programmed and "self paced" instruction.

The drawbacks, based on general educational objectives, of this aphoristic approach are remedied when these audio visuals are used as an additional review experience within the experiential approach to teaching. The design of a session was developed in this paper, to illustrate an example of the use of these audio-visuals. A teaching session that is organonic in the approach can receive the most benefit from the use of audio visuals. Any other use would be inconsistent with the intent of the author in developing these materials.

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Appendix 1

Ranking Investments With B/C and IRR

Problems and Issues

Benefit Cost analysis and IRR have become the required criteria for justifying large public and private investments, and the use of these two criteria have sometimes been confused. This display illustrates some of the new computer software we have developed for using the B/C ratio and the IRR for ranking alternative investment projects. The example chosen is the calculation of the B/C ratio using a time period of three years. Net incremental benefits are derived and the IRR is calculated and interpreted.

The lessons are suitable for undergraduate students, extension agents, vocational agriculture teachers, farmers and others who must make intertemporal investment decisions. These lessons can also be used interactively, and include exercises, questions and answers to assist in the training process.

Outcomes and Results

The slide show begins with a brief statement of the theoretical rules governing the use of Benefit/Cost Ratios and the Internal Rate of Return. A simple example is used to illustrate the determination of incremental benefits and costs (using "with" and "without" investment budgets). The next sequence of slides shows how the B/C ratio is calculated from discounted incremental benefits and costs.

The Internal Rate or Return rule is illustrated in a number of ways. First, discounted net incremental benefits vary with the discount rate. Then, a tabular presentation illustrates the discount rate at which the net incremental benefits are zero. Simple arithmetic is used to perform the same calculation. A graph is used to illustrate the IRR rule. Then the algebraic formula for the calculation is presented.

Four projects of varying sizes with different intertemporal cash flows are compared. One of the projects is selected based on the IRR and the Net Present Value.

Topics include:

Part A--Financial Analysis

Introduction to Compounding and Discounting

Choice of the Discount Rate

Annuity Factors

Measures of Project Worth

Net Present Value

Benefit/Cost Ratio

Internal Rate of Return

Part B--Economic Analysis

Aggregation

Shadow Prices for Traded and Non-Traded Items

Transfer Payments

Inflation

Contingency Allowances

Sensitivity Analysis

Indirect Effects and Tradeoffs

Part C--Investment Evaluation

Identification

Planning

Logical Framework

PERT

Monitoring and Evaluation (Congruence Diagrams)

Introduction to Surveys (Sampling)

Appendix 2: Session Design
Shadow Exchange Rates in Economic Analysis

Total time: 2 hours

Independent Reading: Gittinger "Economic Analysis of Agricultural Projects" pp. 243-254.
USDA Manual "Agricultural Project Analysis" pp. EA-13, pp 18-33
"Economic Analysis" TMI, Lexington, KY

Rationale: Undervaluation of official exchange rates requires, in many instances, the calculation of shadow exchange rates for the economic analysis of projects. This session focuses on the determination of foreign exchange premiums in order to adjust the prices of traded and non-traded items. Shadow exchange rates allow for the correction of "distortions" and the determination of the real worth of project inputs and outputs.

Objectives: At the completion of this unit, participants will be able to:

- * explain the economic policy considerations for fixing exchange rates with a "basket" of currencies with floating exchange rates.
- * Explain the resulting impacts to the economy from undervaluation or overvaluation of exchange rates.
- * Identify which input and output prices need to be adjusted by the foreign exchange premium in order to obtain shadow exchange rates.
- * Calculate shadow exchange rates for traded and non-traded items in the economic analysis of projects.

- A. Climate Setting
Introduction - An introduction by the instructor to stimulate interest, have participants think about the subject and provide goals for the discussions to follow. Participants talk about own experiences and difficulties faced with the subject.
- Discussion - Instructor asks questions and leads discussion on "home country" exchange rates. Through paraphrasing, summarizing and probing the information generated is written on charts. (The concepts written on the charts become additional goals).
- B. Experience
Short lecture - A lecturette that draws on the information from the charts, explains the determination of official exchange rates, distortions in prices, need for adjustment, foreign exchange premium and shadow exchange rates.
- Audio Visual - A videotape that follows the independent reading shows the steps in the calculation of shadow exchange rates using the foreign exchange premium. (individually or in small groups.)
- Review Exercises - A set of independent review exercises referring to case studies allow the participants to experience the calculation of shadow exchange rates.
- C. Process - Generalization
Discussion - A discussion follows on the solution of the exercises with conclusions and generalizations. Charts are used to record the meaning and use of shadow prices for traded and non-traded items in the economic analysis of projects.
- D. Application - Closure
Lecturette-Discussion Drawing upon insights and conclusions from previous stages, a plan is developed for adjusting official exchange rates and calculating shadow prices for inputs and outputs of projects. Linkage with rest of course and upcoming sessions.



RANKING INVESTMENTS WITH B/C AND IRR.



The Benefit/Cost ratio for an investment is calculated as the ratio of incremental benefits and costs discounted at a given discount rate. The lower the Benefit/Cost ratio to 1, and vice versa, "mutually exclusive" investments, based on the size of the cost.

The Internal rate of return allows us to rank investments that are not "mutually exclusive". The lowest value the IRR = r. The IRR is the discount rate at which the Present and Incremental benefits are zero.

Discounting net incremental benefits at different discount rates:

Year	NET INCREMENTAL BENEFITS	Discount Rate	Discounted net incremental benefits
0		0	225.20
1	10	10	92.91
2	10	20	67.91
3	10	30	50.00
4	10	40	37.69
5	10	50	27.47
6	10	60	19.71
7	10	70	13.96
8	10	80	9.91
9	10	90	6.71
10	10	100	4.69

If there are no negative figures in the net incremental benefits the IRR is 0%

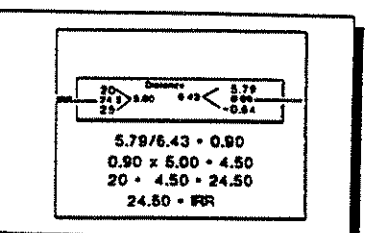
The formula to use for the interpolation is:

Lower IRR = Discount Rate	Benefit/Cost Ratio	NPV of Investment
Higher IRR = Discount Rate	Benefit/Cost Ratio	NPV of Investment

$$IRR = 20 + \frac{0.79}{0.79 - 0.84} \times 10 = 24.5$$

The B/C ratio of an investment with an economic life of 3 years, discount rate 10%.

Year	Benefit	Cost	Discount Factor	Discounted Benefit	Discounted Cost
1	1150	1100	0.91	1046.50	1000.00
2	870	1100	0.83	726.90	913.00
3	870	1100	0.75	652.50	825.00
Total				2425.90	2738.00



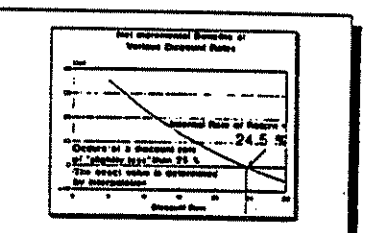
For example, we have the following 4 project results all calculated with a 12% discount rate.

Project	NPV	IRR
Project A	NPV = 28,479	IRR = 63%
Project B	NPV = 1,785	IRR = 95%
Project C	NPV = 14,321	IRR = 41%
Project D	NPV = 13,085	IRR = 41%

CALCULATION OF THE B/C RATIO:

Year	Discounted Net Incremental Benefits	Discounted Incremental Costs
1	543.45	1100.00
2	87.99	913.00
3	112.83	825.00
Total	744.27	2738.00

The Benefit/Cost Ratio = 744.27 / 2738.00 = 0.27



Choose between projects A, B, C, D.
 Then choose between the "mutually exclusive" C and D.

ANSWER
 Between A, B, C, we choose B.
 Between C and D we choose C.

Endnotes

1. The computer diskettes do not qualify as audio-visual materials and they are viewed only as a necessary step in the production of the video-tapes.

2. Phillips reports that when telling is used alone, 70% of the information can be recalled three hours later, but three days later only 10% can be recalled. When showing is used alone, 72% is retained after three hours, 20% after three days. When an reinforcing mixture of telling and showing is employed, 85% of the information is recalled after three hours, and 65% is retained three days later.