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THE DEVELOPMENT OF A MODEL DESIGN TO ASSESS INSTRUCTION IN FARM MANAGEMENT IN TERMS OF ECONOMIC RETURNS AND THE UNDERSTANDING OF ECONOMIC PRINCIPLES

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

by

John August Rolloff, B.Sc., M.A.

* * * * * * *

The Ohio State University
1966

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ACKNOWLEDGMENTS

The writer dedicates in total this dissertation to his wonderful wife Ann Louise. There is no one more deserving of recognition than she, who has borne into our union three lovely and understanding daughters; Nina Rebecca, Heidi Marie, and Sara Annette. Moreover, it is she who has given steadfast purpose, inspiration, and encouragement to the writer and she who has forfeited the normalities and amenities of life without complaint. She is my greatest asset, my afflatus -- the writer knows of no greater tribute. Hopefully, the rigors and rewards of organized intellectual inquiry through this stimulating learning experience may be transferred within the family in its pursuit of happiness and service in academic excellence.

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CHAPTER I
INTRODUCTION AND THE PROBLEM

Education is receiving increased attention today as a component of national policy, particularly vocational education. There is a growing public acceptance of the rationale that the viability of the nation is entwined in the matrix of vocational and technical education. The new Vocational Act of 1963 gives evidence of such a movement by an affluent society, as did once the Morrill Act of 1962, to provide the nation's masses with occupational education for the world of work. Antecedents of concern are found in statements such as the following:

Our future progress and strength depend upon a conscious and deliberate concern with our manpower resources. Recognition that our most precious single resource consists of the skills, capacities, and creativeness of people is not enough. For the sake of contributing to the greater well-being of each individual and strengthening the nation as a whole, it is also necessary for us to assure the further development of our manpower resources and their effective utilization. To take such action we must view our human resources as a whole, and not only as they now are, but as they can be developed.¹

There is little question that today's public looks upon human as well as natural resources as the base for national growth. The concept is reflected in the evolving substitution of the term

"investment in education" for that of "expenditures on education."  \(^2\)

As desirable as increasing public expenditure for occupational education may be, it does constitute an increasing financial burden to be shared by the public at all levels of the educational continuum. Generalizations that the returns from investment in education are high, both individually and socially, are becoming less acceptable. The public is now commencing to ask, "How high?" Moreover, as increased funds are expended for occupational education, educators are being asked for greater accountability of its value in tangible terms. Therefore a major problem confronting educators today is that of measuring or establishing the value or worth of instruction.

Agriculture, although referred to as "the poor sector of most economies," \(^3\) is concurrently regarded with high esteem as a model of technological innovations based on research and one which has been characterized by high productivity per worker. Nevertheless, such conceptualizations are based on aggregate output rather than individualized output or efficiency per farm unit. As a consequence, there appears to be a masking effect on the need for and the potential

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returns to education in agriculture. Contingent problems are (1) the high investment and risk bearing within a slow growth industry, (2) the social as well as economic dilemma attendant with migration of farm labor, and (3) the replacement of an estimated 1.5 percent of the approximately three million present farm operators each year.4

Ironically, the shift from human labor in agriculture has not materially altered the lack of exploitation of the human skills in management. The availability of "packaged" agricultural services and technology calls on farm operators to intensify the sophistication of their management. A precursor to intelligent management by farm operators is that of understanding economic principles as applied to agricultural production. Investigationally, managerial ability is still the key to the production process, but as yet a relatively unknown ingredient.

Increases in numbers and quality of agricultural personnel receiving farm management instruction rather than stability are the hallmarks of the times. Here there is a simile with the developments in other sectors of the economy. A graphic illustration is the defense sector wherein the numbers of supportive personnel (e.g., supply and technical areas) have increased tremendously, despite the decrease in the number of combat infantrymen who nevertheless possess increased fire power.

Although great strides have been made in understanding physical relationships in the physical sciences, it is not yet possible to determine optimum combinations or inputs of land, labor, and capital with a given entrepreneur for the attainment of a specific goal, until it is possible to measure the managerial input.

The growing concern for greater accountability and predictability from educational inputs should prompt agricultural educators, in an era of effervescent agriculture, to examine and design means for measuring the micro-economic aspects of intellectual investments in agriculture. This study is in response to the challenge.

**Statement of the Problem**

The axiomatic nature and potential economic return from instruction in farm management for present and future entrepreneurs in agriculture predetermined the writer's investigation into the area of farm business planning and analysis.

The purpose of this study is to develop a model procedure for determining the influence of the farm business analysis phase of instruction in farm management upon factors of economic efficiency and management understanding of economic principles.

**The Specific Objectives**

The overriding objective of this developmental study is singular; namely, to formulate a basic design as a plan for developing procedure to assess the relative degree of effectiveness of instruction in farm management.
The writer believes, however, that it is further desirable to measure the effectiveness of the procedure developed by submitting it to a test. The objectives of the test, being secondary in this study, are delineated as follows:

1. To determine the change in understanding of economic principles achieved by farm operators enrolled for instruction in farm management.

2. To determine changes in selected factors of economic efficiency achieved by farm operators enrolled for instruction in farm management.

3. To determine whether association exists between changes in the understanding of economic principles achieved by farm operators and changes accomplished in factors of economic efficiency.

4. To determine the input costs of the instruction in farm management over the period of instruction defined for the model design.

5. To determine what may be an expected economic ratio between the input costs of farm management instruction and the changes in net farm income accruing to farm operators enrolled for instruction.

For several years many states have offered instruction in farm management. In several states particular emphasis has been laid on instruction based upon the systematic analysis of farm records.

There seems to be every reason for believing that the farm business management acumen of those receiving instruction by teachers of vocational agriculture has been enhanced. Likewise, it appears possible the incomes of many farm businesses were measurably increased.
In light of these circumstances an undeniable opportunity appears to exist for efforts aimed at determining the economic returns which may accrue from certain types of instruction. The problem stated for this study was worded recognizing the unique opportunity represented for some systematic consideration of determining the effects of instruction.

The Logical Base of the Study

In order to formulate a methodological design for the study a logical framework was established with the following statements of rationale:

1. Different sources of information about the relative value and appropriateness of farm management instruction exist.

2. These sources of information influence teachers, administrators, supervisors, teacher trainers, advisory committees, and local citizenry involved in initiating, planning, allocating resources, and maintaining programs of adult farm management instruction.

3. An understanding of economic principles is a precursor to optimum management efficiency.

4. The process of understanding takes place over time.

5. Cost factor analysis has great impact on the motivation of individuals and institutions to adopt or reject programs.

6. The proximity of the analysis to local or area conditions reinforces their perceived value.
7. The primary objective of farm management instruction is to increase the economic efficiency of the participant's farm business.

8. Farmers who voluntarily enroll in farm management instruction programs seek as a result of their participation to increase their management efficiency.

9. It is possible to increase the efficiency of the farm business through more effective and efficient attention to price relationships, size of business, rates of production, labor efficiency, combination of enterprises and capital efficiency.

10. Over a term of instruction in farm management, it is reasonable to expect a positive effect on the understanding of economic principles and on the economic efficiency of farmers voluntarily participating in farm management programs.

Method of Investigation

Although educational input-output ratios as they relate to economic development are outside the confines of this study, they have provided the stimuli for this investigation. The writer's foreign experiences have illuminated for him the need to identify and program the "potent" variables by which micro-economic aspects of intellectual investments in agriculture could be measured. Farm management represents to the writer a logical vehicle, a key avenue for an attack on the problem. Consequently, a considerable amount of study was skewed toward a perusal of the literature in agriculture, economics, education, and sociology as a prelude to the delineation
of the problem. Moreover, consultations were expanded with personnel of The Center of Vocational and Technical Education, and the Department of Agricultural Education at The Ohio State University as well as the Department of Agricultural Education of the University of Minnesota. The results of the aforementioned endeavors gave repeated evidence of a large void in the literature. Also lacking was a well defined professional conceptualization of the methodology which might profitably be employed for developing a procedure to assess the relative degree of effectiveness of instruction in farm management. Cvancara of the University of Minnesota had recently completed a study of the direction and degree to which agricultural production units respond to instruction in farm management received by farmers.\(^5\)

Initially the most appropriate study for Ohio seemed to be a parallel to that recently completed by Cvancara, as it was the only study to date that dealt with the micro-economic aspects of an educational input. However, several deficiencies were noted as limiting its applicability to the Ohio situation.

Following early review of a proposal by instructors and peers in research courses and by the writer's graduate committee, a developmental or procedural study was suggested. It would encompass the development of a model design to assess instruction in terms of economic returns and the understanding of economic principles. It

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was further proposed that the developed procedure be subjected to test with farm operators who were participants in the Ohio Farm Business and Analysis Program. The suggestions were accepted and the proposal was changed accordingly. This was done to increase the potential contribution of the study to other states, while at the same time retaining and broadening its possible impact within the State of Ohio.

As the study crystallized, it became one of this nature:

1. Identifying critical or "potent" variables which would indicate change in the income of a farm business as the result of management by a farm operator.

2. Developing procedures needed for removing influences of economic fluctuations from the measures used to identify change in farm income.

3. Studying the analysis records of a number of farm operators who have participated in the Ohio Farm Business Planning and Analysis Program, which would constitute the test. After making allowance for economic change due to price fluctuations, it was planned to consider the remaining net change in farm income as a reflection of understandings gained from instruction. The relatively limited number of farm operators for whom complete records were available for a period of time made necessary a rather intensive analysis relative to a number of criteria.

The immediate task was then to determine the means of identifying and qualifying the variables to be used in the study. Recognizing the limitations of time and resources available to the investigator
A problem statement was forged which utilized two sets of dependent variables. One set was dealing with economic efficiency factors and the other was measuring the understanding of economic principles.

In selecting the farm management efficiency variables, two considerations were made. First the variable should be considered significant by farm management experts and authors, and secondly it should be commonly used as a measure of efficiency by analysts.

The selection of components of input to be measured of the independent variable was determined to be those (1) normally computed for reports by instructors, (2) considered the most "potent" variable by agricultural educators, and (3) providing a logical base for the assignment of a standardized monetary value per unit of input.

Then the perplexing question arose as to the length of time over which all the variables were to be measured. Literature suggests that many state programs of farm management instruction provided in vocational agricultural programs constitute a three year course of study. Therefore, the ideal minimum testing of the model study should take place over a three year period. However, the Ohio test is delimited to conform with previously administered test measures of management understanding of economic principles. This factor indirectly determined the identity of the farm operators who could be a part of the study.

The investigator accepted an evaluative instrument measuring farm operator understanding of profit maximizing principles developed
by McCormick. The forty-five multiple choice instrument utilizes the following seven basic profit maximizing principles:

1. Diminishing physical returns
2. Diminishing economic returns
3. Fixed-variable costs
4. Substitution
5. Opportunity costs
6. Time relationships (time comparisons)
7. Combination of enterprises

The instrument was tested in 1963 on discriminate groups of efficient and non-efficient farm operators from 158 farmers borrowing from the Farmers Home Administration in Ohio selected on the bases of their management analysis data.

Statistical treatment of the data secured will be subjected to two commonly used parametric techniques of measurement. The relationship between the dependent and independent variables will be determined by analysis of variance. Included with the latter will be the "F" test so as to provide a ratio of variance within and between groups from which the null hypothesis may be accepted or rejected. A multiple correlation and regression analysis will be utilized as a technique to explain any significant differences in the dependent variable when compared to the independent variable. The .05 level was established as the point of significance for the model.

A paradigm of this writer's study design was developed to assist in assessing the task to be undertaken (Figure 1).

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Figure 1. The Relation of Instruction in Farm Management to the Understanding of Economic Principles and Selected Economic Efficiency Factors.

**ECONOMIC EFFICIENCY**

1. Gross Income
2. Net Cash Income
3. Net Farm Income
4. Net Worth
5. Net Margin
6. Overhead Ratio
7. Operating Ratio
8. Gross Income per $1,000 Invested
9. Net Farm Income per $1,000 Invested
10. Gross Income per Man Equivalent
11. PMWU per Man Equivalent

**ECONOMIC UNDERSTANDING**

- Diminishing Physical Returns
- Diminishing Economic Returns
- Fixed-Variable Costs
- Substitution
- Opportunity Costs
- Combination of Enterprises
- Time Relationships (Time Comparisons)

**PROGRAM INPUTS**

- Number of contact hours of instruction (a) Class time + (b) On-farm time
- Monies paid for contact hours

**PROGRAM OUTPUTS**

- Gross Income
- Net Cash Income
- Net Farm Income
- Net Worth
- Net Margin
- Overhead Ratio
- Operating Ratio
- Gross Income per $1,000 Invested
- Net Farm Income per $1,000 Invested
- Gross Income per Man Equivalent
- PMWU per Man Equivalent

**DOLLAR AND RATIO FINDINGS**

- Diminishing Physical Returns
- Diminishing Economic Returns
- Fixed-Variable Costs
- Substitution
- Opportunity Costs
- Combination of Enterprises
- Time Relationships (Time Comparisons)

**ONE TERM OF INSTRUCTION**
Basic Assumptions

The following internal assumptions are accepted by this investigator as fundamental to this study. It is assumed that --

1. The relative degree of effectiveness of instruction in farm management can be assessed through the formulation and use of a design appropriate to all states.

2. An available evaluative instrument is capable of measuring the farm operator's understanding of basic profit-maximizing principles essential for efficient farm business management.

3. Participants enrolled in farm management instruction have the ability to apply to their farm business basic profit maximizing principles which they understand.

4. The participant's records and subsequent analysis will be accurate.

5. The economic efficiency of farm operators can be identified through comparisons of selected economic factors appearing in two or more yearly analyses of their account records.

6. Price changes, affecting participant's cash receipts and expenses, can be adequately factored out of changes in farm business returns.

7. The number of contact hours of instruction constitutes the "potent" educational input variable and when assigned an hourly cost provide a valid cost measure of educational inputs.
The Scope of the Study

The parameters of this developmental study and its testing are tendered as follows.

1. The primary thrust of the study is of a procedural nature. It seeks to ascertain the influence of the farm business analysis phase of instruction in farm management upon selected factors of economic efficiency and farm operator understandings of economic principles.

2. The test of the developed design encompasses the total universe of full-time farm operators participating in farm management instruction having had their records analyzed for the years 1964 and 1965. Twenty-seven farmers constitute this universe. They are among members participating in farm business planning and analysis programs in five Ohio schools; namely, Ashland, Delphos, Germantown, Kenton, and Paint Valley (Figure 2).

Significance of the Study

This study should contribute to the broad and important question of agriculture's ability to absorb intellectual capital. There is a paucity of research concerning farm management's economic input-output relationship stemming from programs of vocational agriculture. Likewise uncertainty exists as to the extent and role of the farm operator's understanding of economic principles as related to his degree of managerial efficiency. The exploration of these questions in this study would hopefully provoke similar studies in other states.
Figure 2. Participating Ohio Schools
The greatest significance of the study is that if school board members, administrators, advisory boards, supervisors, and educators in agriculture can better understand the micro-economic facts of farm management instruction and the impact of the understanding of management principles on managerial efficiency, it should greatly assist them and their institutions in optimum program planning and resource allocations in the area of agricultural education. Moreover, the study seeks to provide a method for a yearly program evaluation and thus may contribute towards a comprehensive evaluation of agricultural education in 1968 and subsequent evaluations under the Vocational Education Act of 1963. A continuation of the study may also provide answers to three important questions: (1) What is the accumulative rate of economic efficiency and understanding of basic profit maximizing principles by year(s) of program enrollment? (2) Is there a point of diminishing returns? (3) Is there a consistent pattern of correlation between measures of economic efficiency and the understanding of economic principles so as to establish norms of relationship between variables?

The majority of states have mobilized only token resources relative to educational programs in farm management for adults at the secondary school level. The investigator perceives that the findings of this study could mobilize and give perspective to program

*Milo J. Peterson, *The Forward Look in Adult Education in Agriculture*, University of Minnesota, 1961, p. 12.*
planners in many states at whatever level they may be involved in agricultural education.

**Definition of Terms**

A specific clarification of terms appearing in this study seems desirable. Below are listed definitions which are important to the proper interpretation of the text of the study. Some have been uniquely formulated while others are commonly found in appropriate references and texts or in studies somewhat related to this study.

**Farm Business Planning and Analysis Program.** -- A program of instruction in farm management which includes the use of the state's farm account book by the farmer, the summarization of the records by an analyst, interpretation of the analyses and instruction in farm management by the vocational agriculture instructors.

**Farm management instruction.** -- The use of farmer-kept records and farm business analysis as a basis for instruction concerned with the evaluation of economic alternatives and the structuring of procedures for the allocation of productive resources, such as land, labor, capital, and management which will maximize the profitability of resources used in the farm business.

**Farm management class.** -- A scheduled series of classes for adult farmers which satisfy prescribed state standards and are organized and taught by a certified instructor of vocational agriculture.

**Farm operator.** -- An operator of a farm who participated in farm business analysis instruction in vocational agriculture.
Term of instruction. -- A continuum of time during which farm management instruction is provided for adult farmers; unless otherwise specified, one calendar year.

Input. -- Expenditures in time, money, and energy to create a product. Input as used in this study is expressed as the number of contact hours of instruction (class time plus on-farm time) multiplied by an hourly rate as calculated and assigned by the investigator as cost of adult education in farm business planning and analysis instruction in a vocational agriculture program.

Output. -- The product in all of its forms. Output as used in this study is in terms of increased or decreased (1) test scores on the composite principles constituting economic understanding and (2) efficiency as expressed in dollars, ratios, and productive man work units per man equivalent.

Economic understanding. -- A composite of seven profit maximizing principles used in farm business management which, as a measure, provide an accepted guideline to sound decision-making, affecting the profitability of the farm business.

Level of understanding. -- A concept developed to express the extent of knowledge (test score) as measured by the evaluative instrument of the composite economic principles possessed by farm operators. The terms degree of and level of understanding are used interchangeably within the study.
Decision-making. — The gathering of relevant data, evaluating alternative plans, determining course of action, and accepting the responsibility for such action.

"Potential" variable. — A concept developed to express the critical or indicative nature and importance of a variable which was particularly useful in assessing benefits of instruction.8

Economic efficiency. — The change shown toward the maximization of the farm business profits, ratios, and productive man work units per man equivalent. The level of managerial ability and economic efficiency are considered as synonymous within the study.

Certain variables constituting economic efficiency in this study are defined as follows:

Gross income. — Cash receipts plus or minus change in inventory values, capital gains or losses minus feeder livestock purchased.

Net cash income. — Total cash receipts minus total cash expenses.

Net farm income. — Gross income minus cash expenses minus depreciation plus feeder livestock purchases.

Net worth. — The difference between the total assets and total liabilities of the farm business.

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Net margin. -- Percent that family labor and management income is of gross income.

Overhead ratio. -- Percent that overhead expenses are of gross income.

Operating ratio. -- Percent that total cash operating expenses are of gross income.

Productive man work unit (PMWU). -- Work accomplished by one man in a ten hour day with typical levels of mechanization.

The profit-maximizing principles forming the components of economic understanding are provided as working definitions:

Diminishing physical returns. -- The application of additional units of variable resources to a unit of fixed resource increases total output but, after a certain point, the amount added to total output by each successive unit of variable resource diminishes.

Diminishing economic returns. -- After a certain point, the economic returns for each successive unit of variable resource added to a unit of fixed resource tends to decline. However, the farm manager, in order to secure maximum profits, should continue adding variable resources to fixed resources as long as marginal returns are greater than marginal costs.

Fixed-variable costs. -- The cost per unit of production can be decreased by spreading fixed costs over more units of production. Therefore, the farm manager should continue using more resources, if capital is available, to increase production as long as variable costs are covered by the marginal returns.
Substitution. -- When one or more types of resource inputs can be used to produce a given amount of output, the value of the resource replaced or displaced by another resource should be greater than the value of the resource added if the farm manager is to secure maximum profits.

Opportunity costs. -- The profit of a farm business will be greatest if each unit of land, labor, and capital is used where it will add the greatest marginal returns to the farm business. Thus, the farm manager cannot change the distribution of a single unit of variable resource input without reducing farm income.

Combination of enterprises. -- The best combination of enterprises is where a farm business is so organized that the farm manager cannot add to or expand the size of one enterprise or delete or contract another enterprise without reducing income of the farm business.

Time relationships (time comparisons). -- Before investing limited capital resources in the farm business, the farm manager should determine the present value of future income in order to make comparisons between alternatives over time; that is, determine the economic feasibility of making capital investments at the present time to obtain income in the future.
CHAPTER II
REVIEW OF LITERATURE

Whether due to the magnitude of the problem of an inquiry into the micro-economic relation of intellectual investment in education or the failure to see its necessity, educators have tended to steer clear of the task. It seems as if by default educators have in the past left such efforts to economists, who were the first to broach the problems of micro-economic measurement in education. Economists have preceded educators in defining and exploring issues in the economics of education as they apply to increased economic growth. Even so, investigators of education as an economic growth factor have been few. Until recently only limited exploration had been accomplished and that was done by Europeans in a European setting. Today interest has become especially intense within the United States in response to a recent re-discovery: the source of economic growth is not only increased labor and machinery, but investment in human capital as well, "A kind of vitamin E (for education) now seems to be a crucial ingredient in any recipe for economic growth."9 One of the recent authors within this subject, whose book, The Economics of

Education, is concerned largely with establishment of economic theory which might pertain to the question. Herein the author discusses the current status of intellectual investments in education. Much of his analysis is in macro-economic terms but he alludes to the need for micro-economic studies.\(^{10}\)

In the United States vast sums of money have been expanded for education with little question of the fact that returns were accruing. While frequently some author has pointed to the benefits, such as hybrid corn or some similar technological change instituted through educational efforts, scant attention has been paid toward gauging educational benefits. An extensive and careful review of related literature revealed that three studies, Cvancara,\(^{11}\) Wharton,\(^{12}\) and Knewtson,\(^{13}\) have sought to inquire into the relationship between investment in education and economic returns at the farm level. However, an additional study entitled, "A Micro-Economic Study of the Investment Effects of Education in Agriculture," was in progress. This research was being conducted by E. Persons in the Department of Agricultural Education of the University of Minnesota.


\(^{11}\)Cvancara, op. cit.


Another focus of this investigation, namely that of ascertaining evaluative instruments which attempt to measure farm operators' managerial competence, was similarly attacked in two recent studies by Edington\textsuperscript{14} and McCormick\textsuperscript{15}.

The foregoing studies have had the greatest contributory impact on the design formulation of this investigation.

**Relation to Economic Returns**

In the most recent and significant study, completed in December of 1964 by Cvancara\textsuperscript{16}, micro-economic investigations were made on the input costs of farm management instruction. These were analyzed to determine whether the increases in farm output for those farmers enrolled in farm management instruction in Minnesota exceeded the community input costs for conducting a farm management program. Cvancara also sought to determine whether there was an accumulative or diminishing effect on increases in cash income which may have been caused by farm management instruction when matched farm units were compared after one, two, or three years. His study indicated significantly that farmers having received farm management instruction had net cash incomes of at least $500 beyond that of those not receiving instruction. If 60 farmers were enrolled in an adult


\textsuperscript{15}McCormick, op. cit.

\textsuperscript{16}Cvancara, op. cit.
management program, he calculated that it would mean $30,000 additional dollars available not only to the farmers but also to the community. This benefit appears to substantiate greatly Hammond's contention that a good teacher of agriculture will be able to secure economic results great enough to pay his salary from ten to thirty times. The study showed that there was an increase in income from year to year with the greatest increase occurring during the second year of the three year experimental study. This writer agrees with Cvancara that it is doubtful that one could conclude from such a short longitudinal study that the point of diminishing returns occurs during the second year of farm management instruction. An implication however is that not less than a three year program of farm management instruction should be organized. Even though the study employs rigorous statistical controls, its application is limited by reason of its use of cash income as the sole criterion variable in determining net effects on farm operators. Perhaps there are other positive returns not revealed by this measure alone.

Wharton, in a 1960 Brazilian case study, provided additional micro-economic research patterns helpful in perceiving avenues for the current study. An attempt was made to measure the quantitative consequences of the deliberate introduction of human capital as "developmental knowledge" in agriculture. Methodologically, Wharton's


18Wharton, op. cit.
study is not as germane to the required stratification of data covering the entry date of the population and the computation of input and output indexes for the comparisons of two local populations with those of the state and nation. The latter suggested to this writer a means of adjustment for price change over a continuum of time.

Knewtson,\(^{19}\) in a 1965 study, sought to determine whether the rate of change in net farm income of young farmers in Kansas was accelerated by instruction received in farm business analysis during 1963 and 1964. A gain in net farm income was found though the rate of gain was not significantly different from that prior to instruction. It could not be determined from the published report if adjustments had been made to account for a yearly price change. The young farmers sampled seemed to have increased their awareness of the financial status of their farm business. This study has relevance to the present effort in that it deals with like groups of people and like kinds of instruction.

The growing body of studies concerned with macro-economics indicates an awareness of education's role in economic development. These studies were precursors to the micro-economic studies cited above. An Englishman, Alfred Marshall, pointed out in principle that the direct returns to education can also be measured by assessing the returns to individuals.\(^{20}\) Neilson,\(^{21}\) in a 1958 study, revealed a

\(^{19}\)Knewtson, op. cit.

\(^{20}\)Vaizey, op. cit., p. 23.

very significant economic advantage for Iowa farmers with high school vocational agriculture in comparison to farmers without it.

Becker and Miller of the United States Bureau of Census prepared individual studies which have been widely referred to in education. Miller\textsuperscript{22} concentrated on estimates of lifetime earnings of individuals with varying years of education, finding that higher levels of education were definitely associated with increased earning power. Becker\textsuperscript{23} compared the rates of return to individuals for investments in higher education as contrasted to the return rates on other capital investment. The latter study provided insight into the desirability of accounting for earnings "foregone" as well as tuition as investment components in the assessment of costs and returns to higher education.

A proponent of the importance of education to economic output has been Schultz, who indicating that comparatively little of the increased productive output can be accounted for by additional inputs, stated:

Our analysis of supply fails because so much of the increase in output in agriculture, and also, in the rest of the economy, cannot be explained by additional inputs of the conventional types. This failure to explain much, and probably most, of the additional output that we have been enjoying is strongly supported by data not at hand.


we can approximate this ideal formulation by introducing two major neglected inputs; namely, the improvements of the quality of the people as productive agents and the raising of the level of the productive arts. . . both of these "neglected inputs" require capital and effort and, therefore, the activities that create them may be analyzed as productive activities.24

Later Schultz25 attempted to measure net investments in education during the period 1929 and 1957. He indicated that the return on investment per year on each dollar spent for elementary education was about 30 percent, for high school 14 percent, and for college 12 percent. Although the college return recognizes increased cost per student and "foregone" earnings, it is beyond that expected from conventional or non-human types of capital.

The literature by educators in agriculture, as evidenced by Byram et al.,26 has largely been concerned with the examination of farm management from an organizational and operational vantage point, while at the same time evaluating programs on scope and approved practices which increased production. Attempts were not made to test program effectiveness in economic terms.


Many other economic researchers, from Adam Smith to his equals of today, have been intrigued with education but only lately has the exploratory tempo quickened toward investigation of education at the micro-economic level. A tacit criticism of the macro-economic nature of the majority of studies lies in the somewhat exclusive concern for direct benefits of education, when hypothetically the indirect benefits of education are so great that the direct benefits are not necessarily the most important aspects.

**Management Education as Economic Input**

There is unanimity among economists and educators in agriculture that the management factor has an important effect on efficiency of the farm business as well as on the social well-being of the farm operator and his family. The admonishments of Heady and Jensen are forcefully directed toward the needs of management today when they state that "the greatest returns in farming are to be had from 'brain activity' rather than 'brawn activity.'"27

It seems prudent to briefly examine what may be the components of "brain power" or knowledge and to what purposes or goals they are directed. The writer subscribes to the belief that knowledge is a summation of things learned and that learning is a process by which a person becomes changed in behavior as a result of his own activity. It involves a modification of the mental, physical, and emotional

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components of the individual. Moreover, these components are expressed in terms of understandings, skills, abilities, attitudes, appreciations, ideals, and interests.

Behavior is expressed by a series of choices as a person goes from one situation to another. It involves a response to a situation. Behavior is modified only in response to needs. Every person has certain basic motives or needs that he strives to satisfy. As long as his present behavior and knowledge is adequate to satisfy these basic drives or needs, he will not change his behavior or acquire new knowledge. 28

Interaction in the process of personal change involves all five senses recognized in humans. The retention of learning and the "depth" of learning is apparently determined by the intensity of the learning experience and the practice involved. Learning is both formal and informal. 29 It is best accomplished by "doing" when there is a need for learning, but the new things learned are in relationship to the old. 30 Learning is also characterized in terms of permanent outcomes. 31


It was with these complex components of learning and behavior that this investigator dealt when seeking to determine a basic measure of use in relating the impact that education may have to economic efficiency in farm management. Johnson and Haver appear to have visualized similar impacts by functionally defining management as the "process of learning and adjusting." This definition is in keeping with the ideas of both Knight and Schultz and the latter's amplification of the functions of management as (1) observation, (2) analysis, (3) decision-making, (4) action taking, and (5) acceptance of economic responsibility. Knight and Schultz were also instrumental in shifting the thinking toward adjustment to goal changes which is well expressed by Chamblis who stated, "The goal of all management, wherever found, is to provide, from the use of the resources employed, the highest degree of total satisfactions for the person or persons concerned."

32Glenn L. Johnson and Cecil B. Haver, Decision Making Principles in Farm Management, Bulletin 593, Kentucky Agricultural Experiment Station, University of Kentucky, Lexington, Kentucky, January, 1953, p. 7.


Although a considerable number of studies demonstrate the importance of non-economic goals to the functions of management, they also indicate that only through increased efficiency in the management of the farm business can operators and their families expect to achieve such goals. Exemplary is Neilson's 1962 study which classified the goals of responding Michigan farm families into six categories. The single category that did not directly rely on increased income was "farming as a way of life."36

Management is an individualized process whereby the entrepreneur makes adjustments within the managerial complex of goals in accord with his cognitive and non-cognitive powers. 37 It is within two facets of the cognitive domain that the current study takes root: namely prior knowledge and decision-making. These two facets rely on understanding of profit maximizing principles and the ability to transform these into practice through decision-making. Accordingly, Castle and Becker state that "economic principles that have been developed over the years constitute important tools to be used in deductive reasoning. They are helpful in telling us what type of information we need to collect and

36James Neilson, The Farm Families...Their Attitudes, Goals and Goal Achievement, Technical Bulletin 287, Michigan State University, Agricultural Experiment Station, East Lansing, Michigan, 1962, p. 16.

study." The writer believes that the same rationale is applicable to the area of farm management instruction. Therefore, as increased understanding is encountered, increases in economic efficiency may be expected as a consequence of management activity, the rationale being that understanding is a necessary requisite to economic output. It would not necessarily follow that increased output would always be a sequence of increased understanding because of intervening factors which might hinder the exercise of understanding. In any event a pattern for the study of economic output would logically give some account to the development of understanding. To answer the question "why" is to give vision to the decision-making process of "how" to most efficiently solve a management problem. For "successful farm management requires the ability not only to make decisions, but to make the right decisions. . .".

The rising levels of education necessary for productive entry into the labor force are testimony to the swift and accelerating movement of technological change and the rapidity of the accumulation

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39 Benjamin C. Willis, "Responsibilities of the Public Schools for Vocational Education," an address delivered to the National Center Seminar on Agricultural Education, The Ohio State University, July 22, 1963.

40 Castle and Becker, op. cit.
of knowledge. Educators have found that certain facts or skills once learned soon become obsolete. These trends have inspired the realization that "the intelligent performer is one who understands 'why' as well as 'how' a certain procedure is to be followed. His understanding of 'why' distinguishes him from the 'rule of thumb' performer." Such statements have spawned an increasing number of investigations into the delineation of principles and the manner or sequence in which they are taught. A study conducted by Sidney S. Sutherland and W. Earl Sams delineated 22 biological principles and tested their effectiveness when taught to students in vocational agriculture. The results of this California study indicated a positive effect on the students receiving instruction based on the understanding of biological principles. Referring to this study, Starling later noted that statistically only a measure of central tendency was employed, thus raising a question as to the significance of the gain. In a near replication of the California project, he also included measurements on agricultural achievement and interest inventory tests while subjecting his data to a more extensive statistical analysis. Conclusions to this study indicated a significantly

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greater understanding of biological principles and greater interest in agriculture and science.\(^3\)

Schwart states that

If we can determine the farm operators understanding or lack of understanding of managerial principles and managerial functions, then researchers and teachers will be assisted in their jobs of providing procedures and information to organize and operate a going farm business.\(^4\)

Edington, in a 1961 study, endeavored to determine relationships between certain abilities and characteristics which young adult dairy farmers possess and their efficiency in farm management. Although a reliability coefficient of the developed Farm Management Test was .89, the test was not confined to principles but also included practices peculiar to dairymen.\(^5\)

In 1963, McCormick took up Schwart's challenge and expanded Edington's by developing "an instrument for measuring the understanding of basic profit maximizing principles essential for efficient operation and management of a farm business with implications for vocational education in agriculture."\(^6\) He identified, developed, and refined seven principles into a forty-five multiple choice

\(^3\)John T. Starling, "Integrating Biological Principles with Instruction in Vocational Agriculture," Ph.D. dissertation, The Ohio State University, Columbus, Ohio, 1964, p. 8.


\(^5\)Edington, op. cit., p. 21.

\(^6\)McCormick, op. cit., p. 4.
instrument to measure the understanding of basic profit maximizing principles. He used the Mann-Whitney U test to identify the nineteen questions which discriminated between managerial competence levels and the understanding of principles. However, it should be noted that had the investigator rationalized his findings in accordance with Gerberick, Greene and Jorgensen, the authors of *Measurement and Evaluation in the Modern School*, twenty-four questions could have been considered as showing positive significant relationships.

Nevertheless, the nineteen questions did encompass six of the seven profit maximizing principles. McCormick's study shows no relationship between understanding of profit maximizing principles and the application of these principles in the farm business. However, his study does provide an instrument which demonstrates a profound and current insight into the associations of understanding of economic principles to efficiency of farm operators at the farm level.

Several of McCormick's recommendations are to be found in the design of this writer's study. Briefly they are: (1) to develop a procedure or criteria to determine further association between the two groups of variables, (2) to further validate the evaluative instrument by administering it to another group of selected farm operators, and (3) to compare the understanding of profit maximizing principles against other management criteria.

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Although a paucity of research exists on the micro-economic aspects of instruction in farm management, several studies have endeavored to give direction in this area. Equally important have been recent studies directed toward the understanding of principles as they apply to the many facets of agriculture. Particularly germane to this study have been those investigations exploring farm operator's understanding of economic principles in association with his management efficiency of the farm business. These initial inquiries form the basis of this writer's study.

It can be hypothesized that whatever the associations between the understanding of economic principles and farm operator's economic efficiency may be, they are important to the social and economic welfare of the nation. Hence this investigator, as will many others to come, attempts to light a candle rather than to curse the darkness.
CHAPTER III
THE MODEL DESIGN

The primary thrust of this research was for the purpose of developing a systematic means whereby the association or relation of instruction in farm management to the entrepreneur's economic efficiency and understanding of economic principles might better be assessed.

Methodologically, the writer draws on the theoretical base of this study in answer to the question, "What needs to be done?" The ensuing questions of (1) what to measure? and (2) how to measure? became the crux of deliberations as the design of the study advanced. The heterotonic attitudes and value judgments of human beings are in themselves compounding elements in the measurement of any educational program. In addition, we live in a dynamic society in which change is both rapid and inevitable. Schultz, by pointing out that "...the success of the firm must be determined within a framework that allows for 'time' and 'change'" emphasizes the dilemma of measurement. The comparative vacuum of micro-economic inquiry in the area of farm business planning and analysis was thought to afford a unique opportunity for study. There appears to be a need for the

48 Schultz, op. cit., p. 574.
determination of increased understanding of economic principles and economic returns which may accrue from instruction in farm management. At the same time, the limited work that has previously been done makes this investigation the more difficult.

Nature of the Design

An overriding consideration in the model design was the desire for a suitable methodology, which could be applicable to farm businesses in all states. Moreover, there was a need for a design which could be implemented at various stages of programming farm business planning and analysis instruction. The basic framework of analysis instruction within which the measurement of variables may take place became the parameter of the model design.

Program rationale

Since the model concerned the measurement of outcomes of instruction in farm business planning and analysis provided by departments of vocational agriculture, it is wise to describe briefly at this point the general nature of such instructional programs. An instructional program in farm management generally begins with the development of understanding and skills in the keeping of farm account records. Subsequently, instruction will deal with the analysis of farm records and the interpretation thereof as a basis for decision making in light of understandings of certain basic economic principles.
Programs are usually initiated on a new school year basis with the first instructional meeting held in late September or early October. Approximately the first three months of instruction (through December 31 of the first year) are denoted to preparing the participants in the keeping of the standard farm account book of the state.

Until the new calendar year, there is little or no instruction given which deals with the economic principles with the exception of their use for inspirational support to exemplify the necessity for keeping good farm records. Much of the ensuing calendar year is often utilized for in-depth or detailed instruction in record keeping as well as for the participants' initial and limited exposure to economic principles. Instruction during subsequent years is more apt to be directed towards developing an operational understanding of profit maximizing principles of farm management as a precursor to sound decision making. The analyzed records of the participants' previous years of farm business management provide the basic individual and collective instructional data. Yearly records for the previous calendar year are generally summarized and analyzed by March.

**Period of instruction**

Increasing numbers of instructional programs are being conducted on a calendar year basis corresponding to the farm record year rather than the traditional school year. The evolving patterns of organized instruction in farm business analysis suggest a minimum
instructional program of three or more years.\textsuperscript{49} There are indications that a point of diminishing returns to educational investment in farm management instruction tends to be reached around the third year of instruction.

Selecting the Variable Factors

In the development of a model framework thought was given to the output variables which might be significant indicators of the benefits of instruction. The educational components were considered first because the concern was with the relation of the instruction in farm management to the development of understanding, a prerequisite to sound decision making.

Economic understanding

Instruction in farm management centers upon the decision-making process. This involves the collection of facts on which to evaluate alternative courses of action and is the precursor to making a decision directed toward optimizing the profits of the farm business. Deliberations not only involve monetary and physical values, but also economic relationships commonly known as principles. If this is true, it is logical to assume that an understanding of basic economic principles is a prerequisite to sound decision making. The ultimate instructional objective however is not the understanding of economic

principles per se, but the application of these directed to the optimal management efficiency of the farm business. Thus, "the more nearly a farmer succeeds in applying the economic principles, the greater will be his financial success." Moreover, one should note that instruction in farm business planning and analysis involves the application of economic principles to the entire business rather than just a separate enterprise. Heady and Jenson support the above when they state that, "there is not a separate principle or rule for each single part of the business--each principle applies to all parts."^51

A determination of a farm operator's understanding of profit maximizing principles was considered a "potent" variable.

To determine understanding of economic principles the instrument should have certain characteristics such as being readable and easily understood by typical, rural, educated farm operators when administered by a local instructor. McCormick's instrument provides a vehicle by which to measure farm operators' understanding of profit maximizing principles essential for efficient operation and management of a farm business.^52

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51 Heady and Jenson, *op. cit.* p. 54.

52 McCormick, *op. cit.*
**Economic efficiency**

The second major concern in the development of a model procedure was to examine the business income consequences of an instructional program in farm business planning and analysis. Specifically, the question arose, are there common variables which indicate economic efficiency at the farm business level and if so, to what extent may they be measurable?

The following considerations were used in selecting the components of farm management efficiency variables:

1. The variables are commonly used by analysts as a measure of farm management efficiency.

2. The variables are considered significant by various farm management experts and authors.

The criterion variables selected for use as measures of the economic success of farm operators are described here. Each one provides a slightly different insight into the economic rationale of the operator's farm business.

**Gross income** reflects the total scale of the farm business and because definite sales figures are available, is usually one of the more accurately computed measures. Its calculation provides a sound base on which to relate several other measures.

**Net cash income** as a criterion variable has utility in terms of its ease of computation and accessibility, but its usefulness in this procedure is limited in determining net efficiency in the farm
business. The reasons for its limitation is that it is based solely on cash transactions and ignores inventories and liabilities. Nevertheless, the variable is included as a means of comparison to the previously sole study of education's income effect on the farm business, namely, that of Cvancara.53

Net farm income, compared to net cash income, is a more useful measure due to its greater definitiveness in the measure of the farm business because it adjusts for capital purchases, inventory changes, and farm produce used in the household. Thus, it was included as a variable.

The most useful measure of financial progress may be a net worth statement of the farm operator's business. Such a measure reflects the disposition of the spendable income either in capital formation through increased savings or in debt retirement.

In selecting criterion variables indicative of management acumen consideration was first given to the operator's labor earnings or family labor and management income as this reflects the true return to operator labor and management. At the same time, it compensates for differences in the size of business as measured in capital invested and in family labor supply. However, such a variable does not illuminate the internal factors responsible as would the ratios of net margin, overhead ratio, and operating ratio as used in this study.

53Cvancara, op. cit.
Net margin represents the efficiency of both operating and overhead ratios and constitutes the remainder of gross income which is available for disposition by the farm business. Operating ratio represents the cost of production to the farm business. A low operating ratio is indicative of efficient management practices. Overhead ratio is used as an indicator of the extent to which the farmer may be overcapitalized in buildings and equipment, which may be unnecessary for efficient production.

Two variables were selected as being indicative measures of the relative role which capital plays in the operation of a farm business. Gross income per $1,000 invested relates the capital required by the specific farm operator to the total volume of his business. Net farm income per $1,000 invested conversely provides a more definitive measure of the capital required by the entrepreneur to generate the specific level of net farm income as shown in his analysis.

Economic efficiency of the farm business must also take into account the efficiency in use of labor management input. Therefore, man equivalents of labor was deemed a logical common denominator. Gross income per man equivalent when selected as a criterion variable, makes it possible to measure the gross economic response of the business to a given labor input.

Productive man work units per man equivalent was the last variable selected. It is considered best equated as mean work units per individual operator, regardless of other labor supply.
Record systems providing the above variables are generally found only among farm operators receiving technical assistance in keeping complete farm accounts. Such records include income, expense and inventory change preliminary to and including an analysis and interpretation at the end of a calendar year. Technical and educational assistance programs are provided by either the county agricultural extension service or departments of vocational agriculture at the secondary school level.

The model procedures described within this chapter are more specifically designed for the micro-economic measurement of adult farm management programs of vocational agricultural departments. Although the writer visualizes that the procedures of this study may possess some utility for the measurement of extension programs in farm management, program inputs may be more nebulous to ascertain.

Program inputs

Heretofore, in the model design, procedural attention has been given the assessment of outputs which may in part accrue to instruction in farm management. There is to date no empirical evidence of the appropriateness of various investment criteria at either the macro or micro level. Therefore, operational criteria to determine the components of input to be measured were deemed necessary. The criteria selected numbered three, namely:

1. The input constituents should logically be those regularly computed by teachers of vocational agriculture for the preparation of
State reports, thereby minimizing additional tasks which might limit participation.

2. The inputs are considered the most "potent" variables by agricultural educators and authors.

3. The inputs should be equitable to a common denominator so as to assign a standardized monetary value per unit of input.

Rationale for inputs

Report forms from several states were reviewed in an effort to synthesize those instructional input data which were commonly recorded by the local instructors as a basis for regularly submitted reports to their State Department of Education. In practice it was found that only the number of class hours and on-farm hours of instruction per participant were commonly computed. In light of the above review, both the number of class and on-farm hours of instruction participated in by the farm operator were deemed as being the most "potent" variables. Thus, the common denominator of the criterion variable employed in this study became the number of contact hours of instruction per farm operator.

Attention is drawn to the fact that the instructional input is computed on the basis of each individual farm operator and not on the total number of class hours of instruction presented by the instructor. It would be correct to assume that the total number of class hours of instruction offered represents one measure of the cost of the program. However, the primary purpose of this model procedure is to determine
what may be the expected economic ratio between the individual input costs of instruction and the change in economic position accruing to individual farmers enrolled for instruction. In brief, the procedure would be to measure each increment of input rather than aggregate instructional input. The writer believes the aforementioned step is important to the study's precision while still permitting cost assignments to be applied on the basis of total local programs.

The procedure prescribes no stipulated hourly rate cost per contact hour of instruction. However, it does demand the computation of an hourly cost rate reflecting the level of instructional costs within a school district, state, or inter-state consortium over the continuum of time which may be construed as a three year period. The diversity of salaries, proportion of time given by individual instructors to the farm management program, variances in preparation time, and overhead costs are composite indicators of the inappropriateness of establishing a rigid cost assignment. Instead, the writer suggests that the cost assignment be calculated in accordance with the above considerations of instructional costs to the sample situation.

Data Collection

Economic understanding

To ascertain the growth of participants' understanding of basic economic principles, two measures of economic understanding were thought desirable. They were the farm operator's (1) level of
understanding of economic principles and (2) the change in level of understanding over a term of instruction.

To secure a valid pre-test for the assessment of initial level of understanding of economic principles, the first test would be administered at the initial meeting of the participants or shortly following the organizational meeting of the instructional series. The organizational pattern of instruction would seem to indicate a post-test administered during the January meeting following the close of each calendar year of instruction. The procedural format to be discussed under sample selection dictates the collection of post-test data on a randomized third of the population each January for a three year period.

The importance of operational procedure in testing cannot be overlooked. The potential national scale necessitates the cooperation and assistance of the local teachers of vocational agriculture in the administration of the test because of its identification by the nomenclature assigned the participants for the duration of the instructional program and the department's permanent file.

Initial and subsequent instructions to the administrators of the test should emphasize the necessity of withholding any mention of the test per se and the department's involvement in the research project. In short, the examinations are to be totally unannounced and the instructor is further urged to minimize any discussion of any questions pertaining to the test questions following the examination.
Under no circumstance should he intimate the possibility of a post-test. Adherence to the foregoing instructions should minimize a possible "Hawthorn Effect" of influence which might skew observed measurements individually or collectively. In the event that one or more participants were absent when the test was administered, sufficient time should be allocated for an on-farm administration of the instrument so as to secure a total measurement of the group. The cooperating teachers should also be asked to return all examination instruments whether completed or not within a two week period.

**Economic efficiency**

Economic efficiency data is to be secured from the participant's year end farm business record analysis reports of which examples are displayed in the Appendix. Analysis reports should normally be available to the local cooperating instructors during the month of March covering the preceding year's farm operation. Those compiling the analysis, whether the local vocational agriculture instructor, an analyst of an area vocational school or personnel at the state level, should prepare facsimile copies for inclusion in a state archive of analyzed farm business records. Such a ready reservoir could greatly expedite investigations such as the plan for this study suggests.

In the development of a procedure to measure changes of a farm operator's economic efficiency, there is first a need for determining a basic reference point from whence to measure economic
changes. Secondly, there is a determination of means by which price fluctuations in the farm business could be factored so as to present a true measure of change which might be attributed to the instruction in farm management.

Comparatively few, if any, records are available from farm businesses which provide sufficient input data necessary for a comprehensive analysis. Only those farm operators participating in an organized program of instruction in farm management have sufficiently detailed records for the purpose of a meaningful analysis from which sound decision making may result. Consequently, the program participants are the only logical normative base for the purpose of comparison.

Hypothetically, the principal decisions reached by farm operators concerning the management of their farms are not based on understanding resulting from the first year of management instruction, which primarily consists of detailed record keeping. Such rationale is in concert with the nature of the farm business in that major decisions most often precede action by a considerable span of months and specifically are made prior to the farmer's participation in the management program. Therefore, the determination of economic changes resulting from instruction in farm management are to be measured by relative changes in efficiency variables of the sampled participants in the years following the initial analysis of their farm business records.
Changes occurring during the first year of instruction are assumed by this investigator to be based largely on general business acumen in deference to the lack of an analysis of their business records for the first year of instruction. The assumption is made that changes do occur during the initial year and may be expected as an outgrowth of interaction with his peer group, the instructor, and others with a concomitant self-evaluation of his present farm business position.

Having established the analysis of the first year's records as a reference base is only a partial solution to the measurement of changes in economic efficiency from year to year. The problem of price change within and between years when subsequent record analysis are compared to the first analysis still remains.

Any procedure for the computation of meaningful price or cost adjustments must be applied to the volume of goods and services rendered or received by the farm business. Therefore, a decision was made to adjust all items of receipts and expenses shown on the individual's farm business analysis forms by a correction factor for any subsequent year to that of the initial analysis year. The desirability of uniform factor corrections necessitates the compilation of data from a singular source in which the raw data is refined by a common methodology for all states. The Economic Research Service of the United States Department of Agriculture provides such raw data. Moreover,

the data securable from this source is computed on a state basis, thereby allowing further definitly to the economic change and further facilitates meaningful comparisons of inter-state sample populations.

Program input

The components of instructional program inputs were at first thought to be readily available from those reported to the vocational agricultural supervisory section of the State Department of Education. Further reflection by the writer on the use of such records suggested that there could be considerable variance due to state reporting policy, thereby possibly negating a major portion of a micro-economic study which this procedure is designed to test. A basic alternative was to request the necessary information directly from local instructors conducting programs in farm management. Ideally, the actual number of contact hours including class time, farm management consultation time at the school, and the number of contact hours of on-farm instruction should be provided to the person responsible for the yearly analysis of the farm operator's business.

The aforementioned procedure will simplify and facilitate an accurate collection of program input data through its inclusion on the yearly analysis form.

Population Selection

A sound procedure for sampling a population is always important but particularly so when developing a sampling technique as a base
for a longitudinal investigation. The population parameters for this model procedural study would be farm operators, voluntarily enrolled in a state vocational agricultural farm management instructional program at the secondary level, having their farm records summarized and analyzed. The basic sampling unit of the population would be the farm operator. Each unit sampled would be listed and assigned a number code. The numbers assigned to the farm operators of the universe would be consecutive. The numerical code would further record the state and local school.

In order that the sampling and subsequent statistical inference be valid, samples must be chosen so as to be representative of the population.\(^5^5\) A random sampling technique was designed to accomplish the foregoing criteria and is thus prescribed for this study as a procedure. The scope of the investigation will determine the sample size.\(^5^6\) This writer concludes that the relatively small number of states providing continuing programs of instruction in farm management necessitates the inclusion of all of them in any current national investigation. Therefore, within each state a random sample would be taken of local departments of vocational agriculture providing continuing programs in farm business planning and analysis, followed by the random selection of the farm operators participating in a local program.


The writer suggests that the proportion of basic units of the population to be sampled should rest between 20 to 30 percent. The rationale for a relatively large sample is that as state or local programs may be extracted for application of program input costs or additional statistical treatment a sizeable enough population would remain so as to represent a true sample. Moreover, a longitudinal study of this type is subjected to a natural shrinkage of its original unit sample due to death, mobility, and other causes. Although such shrinkage is assumed to affect the sum of the universe in the same manner, it could bias a small sample. The most crucial aspect however is that of the procedural design itself. It stipulates that at the conclusion of the first analysis year following the pre-test of the universe for participants' level of understanding of economic principles, only one-third of the universe would be administered a post-test. Two subsequent post-tests would be administered to each of the remaining thirds of the universe, one after the second analysis year and the other following the third year of analysis. The random sampling of farm operators into thirds would be accomplished by using a table of random numbers to facilitate an equal and independent chance of selection for each farm operator.

**Statistical Design**

Investigations are often designed to discuss and evaluate differences between effects rather than the effects themselves. In this study it is the possible differences produced by the farm business
analysis phase of instruction in farm management, as it affects understanding of profit maximizing economic principles and selected economic efficiency factors of the farm business, which are being tested.

The major hypotheses to be tested by the procedures as given in this study are framed in the null form as follows:

\[ H_0: \text{Changed levels of understanding of profit maximizing economic principles result in no parallel change in the efficiency of the farm business, as indicated by selected factors.} \]

\[ H_1: \text{Changed levels of understanding of profit maximizing economic principles result in parallel change in the efficiency of the farm business, as indicated by selected factors.} \]

The statistical techniques

Two basic parametric statistical techniques are deemed appropriate for use in determining the procedure's relative degree of effectiveness in measuring the test objectives of the model as defined in this study.

The analysis of variance technique will most efficiently determine the relationship between the dependent and independent variables within two broad areas of objective concern, namely, (1) the economic understanding of profit maximizing principles and (2) economic efficiency directed toward optimum returns to the farm business.

The appropriateness of the "F" test used lies in contrasting the variations within a group or groups with the variation between
the groups so as to provide a ratio of variances from which to accept or reject the null hypothesis. The latter stipulates that no difference exists between or among the samples which could not reasonably be attributed to sampling fluctuation or chance.

The other major statistical technique used by this model is the standard multiple correlation and regression analysis. Essentially, the technique is one of predicting dominant or dependent variables, singularly from any number of independent variables and is used as a means of explaining any significant differences in the dependent variable.

The developer of this model procedure perceives that the level of significance, although arbitrary, should be established at the .05 level. Consideration may be given to determining significance at the .10 level with a relatively small sample size or considering the fact that a project may be an initial investiga- tive effort.

Purposely no attempt is made to describe the derivation of statistical theory or formulas as the techniques used in the analysis of data as outlined for this study are well known among statisticians and research workers. Hence, the writer desires to avoid the redundant as the techniques have been widely written in standard statistical texts as well as in the related literature. Nevertheless, the writer wishes to point out for those persons first ac- quainting themselves with research, that Mathis, in a study entitled
"Managerial Perception and Success in Farming," has excellently explained the basic techniques used in this study.\(^{57}\)

Two additional mathematical calculations should be mentioned. First is the necessity to adjust changes in price levels between one analysis year and the next. In this study all yearly price changes would be equated to prices of the initial analysis year.

All changes in cash receipts would be determined by dividing the average state price of the change year into the average state price of the base year. The correction factor would then be multiplied by the financial volume of goods or services to obtain an adjusted figure for each item. All adjusted cash receipts items would be totaled, the sum being the adjusted gross in cash receipts. Although the same procedure would be desirable to follow concerning the adjustment of cash expenses, procuring them via a farmer interview, does not appear to be feasible. An equally good alternative to this investigator would be to adjust the total cash operating expense through the use of the same procedure as described above but on a composite or total basis.

A second series of calculations are needed to determine what might be the expected ratio between successive yearly increments of instructional program inputs and change in net farm income individually and collectively. Assessment per unit of instruction is

\(^{57}\)Gilbert L. Mathis, "Managerial Perception and Success in Farming," Ph.D. dissertation, The Ohio State University, Columbus, Ohio, 1966, pp. 54-56, 69-70.
constructed to be based on a percentage of the total number of contact class hours attended by each farm operator.

The computational procedures are as follows: The total class hours attended divided by the total offered. The resulting percentage is then multiplied by the mean hours of instruction offered for the program group. On-farm instructional hours are then added giving the total number of contact hours of instruction received per farm operator. The latter figure is then multiplied by the stipulated assessment arrived at by the investigator, thus providing the total assessed cost per program participant. The dollar input cost of instruction is then divided into the dollar output of change in net farm income to arrive at the computed ratio.

The statistical techniques used in this model design are also conducive to practitioner interpretation and thus provide a knowledgeable base for the dissemination of findings.

**Summary of Model Procedures**

A systematic model procedure for assessing the association of instruction in farm management to entrepreneurs' economic efficiency and understanding of economic principles is presented in this chapter. This investigation is in response to a relative void of micro-economic inquiry into instruction in farm management. The intended scope of the design is adaptive within and between states as well as longitudinal in nature. The latter is perceived as a minimal period of three calendar or analysis years.
The procedural rationale is based on the assumption that record keeping is the primary concern from autumn enrollment through the following calendar year. Measurements of economic understanding are to be taken for all farm operators upon enrollment and for a randomly selected third of the total sample population each of three consecutive calendar years.

The first record analysis year provides a base record for subsequent economic efficiency changes in the participant's farm business. The base is compatible with successive record analysis data and influenced only slightly by initial participation in the program.

The variables selected by groups are (1) a composite understanding of economic profit maximizing principles; (2) eleven measures of the economic success of farm operators; namely, gross income, net cash income, net farm income, net worth, net margin, overhead ratio, operating ratio, gross income per $1,000 invested, net farm income per $1,000 invested, gross income per man equivalent, and productive man work units per man equivalent; (3) program input consisting of the number of contact hours of instruction (class and on-farm) in farm management, times an investigator's assigned monetary value per hour of instruction.

Source data affecting the dependent variable's levels and changes over time in response to the number of contact hours of farm management instruction received by the participants necessitates the cooperation of vocational agriculture teachers. Assistance would be
requested to administer pre- and post-tests of economic understanding while transcribing the intent of the investigation into as unbiased action and reporting as may be humanly possible. Program input tabulations for each farm operator will be called for on the summary forms of farm business recorded by participants in their standard farm account book of the state. In compiling the analysis facsimile copies will be made for inclusion in a state archive of analyzed farm business records. Thus, both the economic efficiency and program input variables may be secured through the state archive.

The initial analysis year was established as the normative base for factors of economic efficiency. Average state price changes between successive analysis years will be items recorded and equated by fiscal volume to the base year, utilizing regularly published data of the Economic Research Service of the United States Department of Agriculture.

A random sampling technique is required utilizing about 20 to 30 percent of the population of farm operators voluntarily enrolled in a state vocational agricultural farm management instructional program and having their records summarized and analyzed.

Two basic parametric techniques are used; namely, analysis of variance including an "F" test and a multiple correlation and regression analysis. The intensity and relationship of variables provide a basis from which to accept or reject the null hypothesis. The level of significance was established at the .05 level. The statistical techniques used are perceived by the writer to provide a practical dissemination base for findings of the model.
CHAPTER IV

DESIGN OF AN OHIO PILOT STUDY

The preceding chapter explains the procedures which this writer believes are important to accomplish the specified objectives. Actual situations as well as time and resources often necessitate the use of adaptive techniques by the investigator if inquiry into a problem is to be made.

This chapter presents procedural techniques for immediate trial use in Ohio. These techniques were thought germane and indicative enough to provide direction with varying degrees of thrust to evaluate the effect that the model procedure may have as a means of ascertaining the micro-economic value of instruction in farm management.

Procedures for Evaluation

The problem is one of evaluating a pilot trial of the model to assess the relative degree of effectiveness of instruction in farm management in Ohio.

As an adapted resume of the sub-objectives of the model, the procedure seeks to objectively determine the following:

1. To determine the change in understanding of economic principles, during the period April 1965 to June 1966, achieved by farm operators enrolled for instruction in farm business analysis.
2. To determine changes in selected factors of economic efficiency achieved during 1965 by farm operators enrolled for instruction in farm business analysis.

3. To determine whether association exists between changes in the understanding of economic principles achieved by farm operators between April 1965 and June 1966 and changes in factors of economic efficiency accomplished by them in 1965.

4. To determine the input costs of the instruction in farm management between the analysis years of 1964 and 1965.

5. To determine what may be an expected economic ratio between the input costs of farm business analysis instruction and the changes in net farm income accruing in 1965 to farm operators enrolled for instruction.

6. To determine from the pilot findings inferences relative to the acceptance, rejection, or refinement of the model procedure.

The primary modification of the model, required for the pilot study, was the limited time span over which samplings of accrued changes in the variables were to be assessed. All of the variables are identified in the model procedure, except the economic efficiency factor net worth, which was unobtainable, were measured for the Ohio universe. The association which may exist between the resultant changes in variables over the time period of the pilot study was summarized and analyzed as delineated later when discussing the treatment of data.
Population and Sample

The Ohio procedure is based on an identifiable population of twenty-seven farm operators voluntarily enrolled for farm management instruction in the state's Farm Business Planning and Analysis Program. A randomization, as provided in the procedural model, of the Ohio population of farm operators enrolled in the program could not be accomplished due to the comparatively small initial population.

The participants were found within five local schools, shown on page 15, that conducted vocational agricultural programs. Furthermore, the participants had completed the instrument designed to measure the understanding of profit maximizing economic principles in April of 1965. They were likewise enrolled in the farm business analysis program during 1964 and 1965 with subsequent summarization and analysis of their farm business records. The population did not include other farmers who were enrolled in the program but who did not have their farm business records summarized for the purposes of analysis.

Thus the test population was not characterized as the finite population of farm operators but was assumed to be a sample similar in character to other future samples of Ohio farm operators meeting the qualifications of the model.

Source and Methods of Data Collection

Economic understanding

In the model the investigator conjectured that the understanding of profit maximizing principles should increase from the
first through approximately the third calendar or analysis year as a result of instruction in farm management. In the pilot study, however, an assessment was made as to the individual and mean test scores of the population, measuring changes in understanding of profit maximizing principles of farm management between April 1965 and June 1966.

The Ohio test design secured data relative to the understanding of profit maximizing principles as measured by a forty-five question instrument entitled, "Multiple Choice Questions on Farming," which is found in the Appendix. This pre-test instrument was administered in April 1965 by local instructors of vocational agriculture to the participating farm operators who had completed a 1964 Farm Business Summary Form,\(^{58}\) which was analyzed and filed by the Department of Agricultural Education. All test scores were tabulated according to questions answered correctly. The same procedure was used for the post-test, administered in June 1966 following the completion of the participant's 1965 Farm Business Summary forms and their analysis.

A code for each farm operator was assigned by the local instructor and maintained for all tests and analysis. In accordance with the model, all the individuals of the universe were also consecutively numbered and filed.

\(^{58}\)Department of Agricultural Education, Farm Business Summary - Form 7557, no date. The form is completed by the farm operator with the cooperation of his vocational agriculture instructor and sent for analysis to the Department of Agricultural Education, The Ohio State University.
Economic efficiency

Raw data from the Ohio Farm Account Records Books of the participants was summarized with the assistance of the local instructor and analyzed by the Department of Agricultural Education. From this analysis came the data concerning the variables of economic efficiency for the years 1964 and 1965. The analysis reports were available through the Department of Agricultural Education, The Ohio State University.

The 1964 data for each farm operator was directly transferable to a "master" sheet for the purpose of key punching. These data provided the base to which yearly price changes were adjusted. Consequently, the data as recorded on the participant's 1965 Farm Business Summary and Analysis Form\(^{59}\) was subjected to a corrective computation to adjust yearly, for changes in price from that of the base year. The mathematical methodology adhered to was that specified on page 58 in the discussion of the model procedure. Basically, the procedure is one of applying 1964 prices to the business volume of 1965. The facilitating data for the computation of correction factors was drawn from Ohio data provided by the Economic Research Service of the United States Department of Agriculture.\(^{60}\)

\(^{59}\)Department of Agricultural Education, Farm Business Summary and Analysis (mimeographed), no date, pp. 1-4.

The variable, productive man work units per man equivalent, has been rounded to the nearest whole number while the variables net margin, overhead ratio and operating ratio are recorded as a percentage figure rounded to the nearest tenth. All other variables of economic efficiency are recorded to the nearest dollar.

Program inputs

The program input data for the purpose of the pilot study was determined according to the model and calculated as the number of contact hours of farm management instruction received by each program participant during 1965. The constituents of the independent variable are the number of contact hours of class time and on-farm time hours of instruction. The summary report form concerning continuing education of the year 1965 requested information of the instructor as to the "Hours of Instruction Received by This Farmer; Class ___ Hours; On-Farm ___ Hours." This information for each farm operator facilitated a comparison of program inputs. It provided a base for the measure of changes in economic outputs over the same time span.

A program cost assignment per contact hour was made for each hour of on-farm instruction received by the farm operators. The same rate but on a percentage basis of class attendance was applied to the number of contact hours of class instruction received by each participant. The sum of the two cost assignments provided the program

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61 Department of Agricultural Education, Farm Business Summary - Form 7557, op. cit., p. 1.
input costs for each individual farm operator. The cost assignment per contact hour was computed in accordance with the model procedure found on page 59.

The State of Ohio School Foundation Law and The Criteria for the Approval of Units as approved by the State Board of Education concomitantly provide the formula and provisions for partial fiscal reimbursement to local schools. It is germane to this study that the reimbursement rate applicable for approved adult programs in vocational education and hence farm management is $2.50 per instructional hour. The matching of state with local school funds for adult instruction in farm management was common throughout Ohio during the 1964-65 school year. Therefore, the assigned cost of $5.00 per unit of input was assumed for this study.

Treatment of Data

The nature of the population for the pilot study procedure indirectly determined the selection of variables which could be used, their source and method of data collection, and the treatment of the data. Attention is concentrated at this time on the latter task, not because of the often assumed aura of statistical providence, but as a means of mathematically clarifying the relevance of the data collected to the objectives of the stated problem. Barnes evidences a

similar belief by stating that, "no amount of statistical sophistica-
tion can substitute for good judgement." Therefore, the antecedents
to statistical treatment provide an important foundation upon which to
face the problem of selecting an appropriate analysis technique.

The trial procedure also differs from that of the model procedure in the statistical method utilized. The model procedure employs
the parametric technique. Its appropriateness is primarily due to the
assumed random sample of a normally distributed population. This study
of a more limited population utilizes non-parametric or distribution-
free techniques which permit fewer qualifications and assumptions
relative to the sample of the population.

The resulting differences between the techniques in measures of
variable relationships is not so much in kind as in the degree of power
from which inferences may be drawn. A stronger power for inference
increases the predictability of the variables in rejecting the null
hypothesis when the alternate or operational hypothesis is true.

The importance of the foregoing lies in that both techniques
are "product moment" correlations and that although the Pearson
parametric correlation coefficient is stronger and more difficult to
employ, the Spearman non-parametric rank order correlation coefficient
used, provided indicative direction as to the relationship of the
variables measured.

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63 Fred P. Barnes, Research for the Practitioner in Education
(Washington, D.C.: Department of Elementary School Principals, National
Education Association), 1964, p. 107.
Liberty has been taken by the writer in additionally subjecting the trial data to the parametric technique. The data was hypothetically considered as if meeting the requirements for such an analysis. The intent of such treatment by the investigator was to examine a partial comparison of coefficients between the two methods briefly mentioned above. Such a comparison may be somewhat indicative for other researchers in further hypothesizing what inferences could be made, were in fact the data a random sample.

The interpretation of correlation coefficients is a relative matter as they are not on a linear scale of equal units such as a percentage relationship. Therefore, the following classification is presented as a generalized means of describing the strengths of correlative relationships.

<table>
<thead>
<tr>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than .20</td>
<td>Slight; almost negligible relationship</td>
</tr>
<tr>
<td>.20 to .40</td>
<td>Low correlation; definite but small relationship</td>
</tr>
<tr>
<td>.40 to .70</td>
<td>Moderate correlation; substantial relationship</td>
</tr>
<tr>
<td>.70 to .90</td>
<td>High correlation; marked relationship</td>
</tr>
<tr>
<td>.90 to 1.00</td>
<td>Very high correlation; very dependable relationship</td>
</tr>
</tbody>
</table>

The treatment of other data not previously delineated for the model, consisted of routine mathematical calculations, namely the determination of arithmetic means and simple ratios.

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Summary

The evaluative design for the trial Ohio data is an adaptation from the model as presented in the preceding chapter. Procedural differences and data treatment were construed as logical outgrowths of the population sample being the universe of farm operators. The variable net worth, although important, was unobtainable for this evaluation.

The basic source of data was from a local level. However, the majority of the data was transmitted to and secured from the Department of Agricultural Education, The Ohio State University.

The Spearman rank order correlation, a non-parametric measure, was utilized as a treatment technique. A parallel but disparate parametric treatment, the Pearsonian r, was also applied to the data as a possibility for further hypothesis formation. A framework for describing the strength of correlative relationships was presented to ascertain rationale for the rejection of the null hypothesis.
CHAPTER V
ANALYSIS OF THE OHIO DATA

This chapter focuses upon possible associations between three sets of variables: (1) the understanding of profit maximizing economic principles by farm operators, (2) the economic performance of farm operators in respect to certain efficiency factors, and (3) the instructional program inputs as assembled for the pilot project. Such examination is necessary to measure the relative degree of effectiveness, in micro-economic terms, of instruction in farm management received by this population of Ohio farm operators.

Assessment of Economic Understanding

Objective 1: To determine the change in understanding of economic principles, during the period April 1965 - June 1966, achieved by farm operators enrolled for instruction in farm business analysis.

Table 1 gives the mean of the April 1965 pre-test and the June 1966 post-test and the change of the 27 farm operators used in this study. The mean for the pre-test was 31.18 or 69.29 percent and for the post-test 33.74 or 74.97 percent, thus showing the change as an increase in the mean of 2.56 or 5.2 percent. It is interesting to note that a slight decrease or no change in the test score was shown for seven of the 27 participants. Based upon the proportion of
TABLE 1


<table>
<thead>
<tr>
<th>Individual Code Number</th>
<th>Number of Correct Responses&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Change</th>
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</table>

Mean 31.18  Mean 33.74  Mean 2.56
σ 6.48   σ 6.51   σ 0.03

<sup>a</sup>The test instrument consisted of forty-five multiple choice questions on seven profit maximizing economic principles of farm management.
correct answers, it was apparent that relatively high levels of understanding were evidenced in the mean scores.

There was also a considerable clustering around the mean of both test scores as indicated by the low standard deviations. Moreover, the slight change in standard deviation indicates that the variability of the population had not appreciatively changed over the time of instruction; those individuals who scored high on the pre-test also scored higher on the post-test.

The mean correct responses expressed in percentages are included here for comparative purposes. The 140 farm operators tested by McCormick in 1963 correctly answered an average of 59.5 percent of the questions using the same instrument.65 Thus, the consecutive percentage point change between the years 1963, 1964 and 1965 were 9.39 and 5.68 or a percentage increase of 15.6 and 8.2 percent respectively.

In summary, the data presented in Table 1 indicates that farm operators in the pilot study, after receiving instruction in farm management, did as a group achieve increased scores on understanding of profit maximizing principles between assessments.

Objective 2: To determine changes in selected factors of economic efficiency achieved during 1965 by farm operators enrolled for instruction in farm business analysis.

The gross economic efficiency achieved by farm operators compared over a one year period from 1964 to 1965 during which they received instruction in farm management is displayed in Table 2.

---

### Table 2

**The Change in Economic Efficiency Achieved by 27 Farm Operators Participating in Farm Management Instruction, 1964-65**

<table>
<thead>
<tr>
<th>Economic Efficiency Factors</th>
<th>Means for Record Year 1964</th>
<th>Means for Record Year 1965&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Change in Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross income</td>
<td>$18,161.</td>
<td>$24,617.</td>
<td>$6,456.</td>
</tr>
<tr>
<td>Net cash income</td>
<td>$8,163.</td>
<td>$6,754.</td>
<td>-$1,409.</td>
</tr>
<tr>
<td>Net farm income</td>
<td>$6,096.</td>
<td>$10,817.</td>
<td>$4,722.</td>
</tr>
<tr>
<td>Net margin</td>
<td>21.2%</td>
<td>30.4%</td>
<td>9.2</td>
</tr>
<tr>
<td>Overhead ratio</td>
<td>33.5%</td>
<td>30.0%</td>
<td>-3.5</td>
</tr>
<tr>
<td>Operating ratio</td>
<td>45.3%</td>
<td>39.6%</td>
<td>-5.7</td>
</tr>
<tr>
<td>Gross income per $1,000 invested</td>
<td>$550.</td>
<td>$518.</td>
<td>-$32.</td>
</tr>
<tr>
<td>Net farm income per $1,000 invested</td>
<td>$197.</td>
<td>$213.</td>
<td>$16.</td>
</tr>
<tr>
<td>Gross income per man equivalent</td>
<td>$12,112.</td>
<td>$18,319.</td>
<td>$6,207.</td>
</tr>
<tr>
<td>PMWU per man equivalent</td>
<td>202.</td>
<td>255.</td>
<td>53.</td>
</tr>
</tbody>
</table>

<sup>a</sup>Raw data adjusted to 1964 price level.
An increased volume of farm business between 1964 and 1965 was evidenced by increases in both gross income and net farm income. There was also an overall increase in economic efficiency as indicated by decreases in both overhead and operating ratios. The mean figures as expressed in terms of percentage change (net change in percentage points) for net margin increased 43.4 percent, while desirable decreases of 10.5 percent for overhead ratio and 12.6 percent for operating ratio were found. It is likewise apparent that there was an increase in total capital investment between 1964 and 1965 as shown by the decrease of $32 in gross income per $1,000 invested. However, net farm income per $1,000 invested increased from $197 to $213 or an increase of $16 per $1,000 invested. Labor efficiency also showed an increase between the two years since both gross income per man equivalent and productive man work units (PMWU) per man equivalent increased.

Table 2 data indicate that farm operators compositively increased their volume of business and farm net income although they show a decrease in net cash income. Moreover, increases in overall economic efficiency are evident in (1) the efficiency of the farm business, (2) return to capital per $1,000 invested even though a decrease was found when compared to gross income and (3) labor efficiency. Therefore, the data shows that the group of farm operators did achieve aggregate increases, in terms of the selected economic efficiency factors between 1964 and 1965 when adjusted to the former for price change.
Objective 3: To determine whether association exists between changes in the understanding of economic principles achieved by farm operators between April 1965 and June 1966 and changes in factors of economic efficiency accomplished by them in 1965.

In order to investigate this objective the Spearman rank order correlation was used to determine the association between the post-test levels of economic understanding and the selected economic efficiency factors.

Table 3 data indicate a definite but small relationship between the mean post-test level of economic understanding and the efficiency factor of gross income. The variables, gross income per $1,000 invested, net cash income, overhead ratio, and PMWU per man equivalent show decidedly lower but slight positive correlations in descending order. A negative correlation was found for net margin. The variable operating ratio was negative to the same degree as gross income was positive. All other variables were considered as non-discriminant in their associations. While the above directions and relative amounts of association are of interest, it should be noted that no significant correlation was found when subjected to test against the criterial value of .323 at the .10 level of significance.

The data presented in Table 3 show a general pattern of relatively low and equal association both negative and positive when correlating the post-test level of economic understanding to the 1965 level of economic efficiency.

A further investigation of the third objective, which was to determine if the economic efficiency of farm operators changed with their understanding of economic principles, was made.
### TABLE 3

ASSOCIATION OF 1965 LEVEL OF ECONOMIC EFFICIENCY ACHIEVED BY 27 FARM OPERATORS WITH THE POST-TEST LEVEL OF ECONOMIC UNDERSTANDING, DETERMINED BY SPEARMAN RANK ORDER CORRELATIONS

<table>
<thead>
<tr>
<th>Economic Efficiency Factors</th>
<th>Correlation (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross income</td>
<td>.25</td>
</tr>
<tr>
<td>Net cash income</td>
<td>.15</td>
</tr>
<tr>
<td>Net farm income</td>
<td>-.05</td>
</tr>
<tr>
<td>Net margin</td>
<td>-.16</td>
</tr>
<tr>
<td>Overhead ratio</td>
<td>.14</td>
</tr>
<tr>
<td>Operating ratio</td>
<td>-.26</td>
</tr>
<tr>
<td>Gross income per $1,000 invested</td>
<td>.19</td>
</tr>
<tr>
<td>Net farm income per $1,000 invested</td>
<td>.07</td>
</tr>
<tr>
<td>Gross income per man equivalent</td>
<td>-.06</td>
</tr>
<tr>
<td>PMIU per man equivalent</td>
<td>.12</td>
</tr>
</tbody>
</table>
Table 4 shows the correlation between post-test level of economic understanding and changes in the efficiency factors between 1964 and 1965. Positive correlations appeared between the level of understanding and gross income, net cash income, net farm income, while there were negative correlations for the other economic efficiency factors.

The difference in net cash income in Table 4 was shown to be within .013 of meeting the critical value of .323 to be significant at the .10 level. Gross income evidenced only slight association with the post level of economic understanding. Other variables indicated relatively negligible relationships with the exception of net farm income per $1,000 invested and gross income per man equivalent, which showed a marginally low to slight association.

In the aggregate a slight negative association was found in Table 4 between the change in 1964 and 1965 economic efficiency factors with the post-test level of economic understanding. However, the variables, net cash income and gross income, show rather moderate positive correlation with the post-test level of understanding.

An additional correlation addressed to the third objective was presented in Table 5. The data therein concern the association between the change in pre-test and post-test mean scores in economic understanding and 1965 levels of economic efficiency of the 27 farm operators.

The table shows that PMWU per man equivalent was within .003 of the critical value of .323 to be considered as significant at the
<table>
<thead>
<tr>
<th>Economic Efficiency Factors</th>
<th>Correlation (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross income</td>
<td>.17</td>
</tr>
<tr>
<td>Net cash income</td>
<td>.31</td>
</tr>
<tr>
<td>Net farm income</td>
<td>.02</td>
</tr>
<tr>
<td>Net margin</td>
<td>-.07</td>
</tr>
<tr>
<td>Overhead ratio</td>
<td>-.11</td>
</tr>
<tr>
<td>Operating ratio</td>
<td>-.15</td>
</tr>
<tr>
<td>Gross income per $1,000 invested</td>
<td>-.04</td>
</tr>
<tr>
<td>Net farm income per $1,000 invested</td>
<td>-.20</td>
</tr>
<tr>
<td>Gross income per man equivalent</td>
<td>-.20</td>
</tr>
<tr>
<td>PMWU per man equivalent</td>
<td>-.11</td>
</tr>
</tbody>
</table>
.10 level. Both gross and net cash income evidenced definite but small association with the change in economic understanding at approximately the same degree. With the exception of gross income per man equivalent, which was barely negative, all remaining variables shown in Table 5 indicated a moderately slight positive correlation.

There was an overall moderate positive correlation evidenced between mean score change in economic understanding and all 1965 variables but gross income per man equivalent.

**TABLE 5**

**ASSOCIATION OF CHANGE IN ECONOMIC UNDERSTANDING BETWEEN PRE-TEST AND POST-TEST MEAN SCORES BY 27 FARM OPERATORS WITH THE 1965 LEVEL OF ECONOMIC EFFICIENCY, DETERMINED BY SPEARMAN RANK ORDER CORRELATIONS**

<table>
<thead>
<tr>
<th>Economic Efficiency Factors</th>
<th>Correlation (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross income</td>
<td>.26</td>
</tr>
<tr>
<td>Net cash income</td>
<td>.29</td>
</tr>
<tr>
<td>Net farm income</td>
<td>.16</td>
</tr>
<tr>
<td>Net margin</td>
<td>.18</td>
</tr>
<tr>
<td>Overhead ratio</td>
<td>.17</td>
</tr>
<tr>
<td>Operating ratio</td>
<td>.10</td>
</tr>
<tr>
<td>Gross income per $1,000 invested</td>
<td>.16</td>
</tr>
<tr>
<td>Net farm income per $1,000 invested</td>
<td>.18</td>
</tr>
<tr>
<td>Gross income per man equivalent</td>
<td>-.06</td>
</tr>
<tr>
<td>PMWU per man equivalent</td>
<td>.32</td>
</tr>
</tbody>
</table>
Table 6 specifically illuminates the possibility of correlations showing association existing between the change in economic understanding and change in economic efficiency as found in Table 1 and 2 respectively. Moreover, Table 6 was in exact reference to objective three by correlating "change" to "change".

**Table 6**

ASSOCIATION OF CHANGE IN ECONOMIC UNDERSTANDING ACHIEVED BY 27 FARM OPERATORS BETWEEN PRE-TEST AND POST-TEST MEAN SCORES WITH THE CHANGE BETWEEN 1964-65 LEVEL OF ECONOMIC EFFICIENCY, DETERMINED BY SPEARMAN RANK ORDER CORRELATIONS

<table>
<thead>
<tr>
<th>Economic Efficiency Factors</th>
<th>Correlation (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross income</td>
<td>.22</td>
</tr>
<tr>
<td>Net cash income</td>
<td>.60(^a)</td>
</tr>
<tr>
<td>Net farm income</td>
<td>.34(^a)</td>
</tr>
<tr>
<td>Net margin</td>
<td>.33(^a)</td>
</tr>
<tr>
<td>Overhead ratio</td>
<td>.36(^a)</td>
</tr>
<tr>
<td>Operating ratio</td>
<td>.31</td>
</tr>
<tr>
<td>Gross income per $1,000 invested</td>
<td>.36(^a)</td>
</tr>
<tr>
<td>Net farm income per $1,000 invested</td>
<td>.35(^a)</td>
</tr>
<tr>
<td>Gross income per man equivalent</td>
<td>-.03</td>
</tr>
<tr>
<td>PMNU per man equivalent</td>
<td>.09</td>
</tr>
</tbody>
</table>

\(^a\)Statistically significant at the .10 level of significance (.323 = critical value).
The data in Table 6 reveal a substantially positive association to net cash income. Net cash income was .271 points beyond that required by the critical value of .323 at the .10 level of significance. Gross income of Table 6 evidenced a small decrease as compared to the same factor in Table 5 which dealt with the 1965 level of economic efficiency. Variables utilizing per man equivalencies as a common denominator in Table 6 were found to possess an almost negligible relationship. Table 6 also shows five of the remaining six variables to be significant at the .10 level. The last variable, operating ratio, while not significant at the above level, was within .013 points of the critical value.

In the aggregate the groups of variables representing income, efficiency ratios and capital investment, show a definite association in Table 6 although all were not significant at the .10 level. Only the per man equivalents of PMWU and gross income as indicators of labor efficiency indicated marginal correlative relationships.

It seems apparent that a strong overall association exists between the change in pre-test and post-test mean scores of economic understanding and change in economic efficiency between 1964-65.

Objective 4: To determine the input costs of the instruction in farm management between the analysis years of 1964 and 1965.

Objective 5: To determine what may be an expected economic ratio between the input costs of farm business analysis instruction and the changes in net farm income accruing in 1965 to farm operators enrolled for instruction.
Objective four of this pilot study was realized by the mathematical rationale shown on page 68, resulting in an input cost of $5.00 per contact hour of instruction in farm management between the analysis years of 1964 and 1965.

As a preliminary step towards the determination of ratios, it was desirable to show whether association existed. Thus, the association between 1965 program inputs and two measures of economic understanding is shown in the Table 7 data.

**TABLE 7**

ASSOCIATION ACHIEVED BY 27 FARM OPERATORS BETWEEN 1965 PROGRAM INPUTS, AS MEASURED BY THE TOTAL NUMBER OF CONTACT HOURS, AND SELECTED MEASURES OF ECONOMIC UNDERSTANDING, DETERMINED BY SPEARMAN RANK ORDER CORRELATION

<table>
<thead>
<tr>
<th>Measures of Economic Understanding</th>
<th>Correlation (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-test level</td>
<td>-.06</td>
</tr>
<tr>
<td>Change between pre-test and post-test level</td>
<td>.17</td>
</tr>
</tbody>
</table>

In Table 7, a very slight negative association is indicated between the post-test level of economic understanding and the 1965 program inputs. The change in economic understanding recorded between the pre-test and post-test mean score indicated a moderately slight positive correlation which nevertheless provides a negligible relationship with the 1965 program inputs. Table 7 corroborates
Table 3 in that the measures of the understanding of economic profit maximizing principles did not reveal a substantial degree of association with the variables correlated.

The data of Table 7 show that the 1965 program inputs when correlated to the post-test level of economic understanding were slightly negative in association. However, a considerably stronger positive association exists between 1965 program inputs when correlated with changes between pre-test and post-test mean score level of economic understanding. The latter association alludes to the possibility of a slight positive ratio regarding objective five between the input costs of instruction and the changes accruing to farm operators having been enrolled for instruction.

The data found in Table 8 show the correlation coefficients for 1965 program inputs compared to the 1965 level of economic efficiency to determine association between the variables.

In Table 8 a substantial association is shown to exist between the 1965 program inputs and the economic efficiency variables, net farm income per $1,000 invested, PMWU per man equivalent, net margin, overhead ratio and gross income per man equivalent. These five variables exceeded the .10 level of significance. Moreover, the variables gross income and net farm income also evidenced a definite although smaller relationship to 1965 program inputs as shown in Table 8. They lacked only .023 and .033 points from the critical value of .323 for significance at the .10 level. Gross income per $1,000 invested was found to possess only a slight relationship to
# TABLE 8

ASSOCIATION ACHIEVED BY 27 FARM OPERATORS BETWEEN 1965 PROGRAM INPUTS, AS MEASURED BY TOTAL NUMBER OF CONTACT HOURS, AND 1965 LEVEL OF ECONOMIC EFFICIENCY, DETERMINED BY SPEARMAN RANK ORDER CORRELATIONS

<table>
<thead>
<tr>
<th>Economic Efficiency Factor</th>
<th>Correlation (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross income</td>
<td>.30</td>
</tr>
<tr>
<td>Net cash income</td>
<td>-.06</td>
</tr>
<tr>
<td>Net farm income</td>
<td>.29</td>
</tr>
<tr>
<td>Net margin</td>
<td>.41&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Overhead ratio</td>
<td>.41&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Operating ratio</td>
<td>.01</td>
</tr>
<tr>
<td>Gross income per $1,000 invested</td>
<td>.12</td>
</tr>
<tr>
<td>Net farm income per $1,000 invested</td>
<td>.46&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Gross income per man equivalent</td>
<td>.38&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>PMWU per man equivalent</td>
<td>.42&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup>Statistically significant at the .10 level of significance (.323 - critical value).
1965 program inputs while operating ratio and net cash income were negligible in their association, the latter being negative.

Table 8 data show that the 1965 economic efficiency variables as a group were positive and moderately responsive to 1965 program inputs. Exceptions were noted however for the variables net cash income and operating ratio which were negligible in their relationship to 1965 program inputs.

Since the level of economic efficiency between 1964-65 showed an increase in Table 2, the 1965 level may be construed as the end result of change. Thus, the data of Table 8 was indicative of the positive direction of the ratio which might be, in partial response to objective five, expected for 1965 program inputs to changes in economic efficiency.

The association between 1965 program inputs and change between 1964 and 1965 measures of economic efficiency is shown by the data in Table 9.

This data directly provide a base for objective five to determine what might be the expected economic ratio between input costs of instruction and changes accruing from farm management instruction.

All but two correlations exceeded the critical value established by the .10 level of significance in Table 9. The first of two variables not meeting the level of significance was gross income per $1,000 invested which lacked .023 of exceeding the critical value. The second of the aforementioned variables, net cash income, is low in comparison to other variable correlation coefficients found in
TABLE 9

ASSOCIATION ACHIEVED BY 27 FARM OPERATORS BETWEEN 1965 PROGRAM INPUTS, AS MEASURED BY TOTAL NUMBER OF CONTACT HOURS, WITH THE CHANGE BETWEEN 1964-65 LEVEL OF ECONOMIC EFFICIENCY, DETERMINED BY SPEARMAN RANK ORDER CORRELATIONS

<table>
<thead>
<tr>
<th>Economic Efficiency Factor</th>
<th>Correlation (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross income</td>
<td>.45&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Net cash income</td>
<td>.13</td>
</tr>
<tr>
<td>Net farm income</td>
<td>.52&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Net margin</td>
<td>.51&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Overhead ratio</td>
<td>.33&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Operating ratio</td>
<td>.38&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Gross income per $1,000 invested</td>
<td>.30</td>
</tr>
<tr>
<td>Net farm income per $1,000 invested</td>
<td>.50&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Gross income per man equivalent</td>
<td>.57&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>PMWU per man equivalent</td>
<td>.52&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup>Statistically significant at the .10 level of significance (.323 = critical value).
Table 9; yet it evidences a moderately slight positive relation. Moreover, had the level of significance been established at the .02 level, only two additional variables, operating and overhead ratio, would not have met the critical value of .456 for that level.

Table 9 establishes as a whole that there was a positive and substantial association between 1965 program inputs and change between 1964 and 1965 measures of economic efficiency. This degree of association definitely projects the positive value of instructional inputs to the success of the farm business.

Table 10 presents data showing the ratio of 1965 input costs of instruction to change in net farm income between 1964 and 1965 for each of the 27 farm operators and a mean ratio. With these ratios, objective five was realized.

The input costs were assessed at $5.00 per contact hour of instruction for each participant in the Ohio pilot study. The column of dollar input-output ratio in Table 10 represents the number of plus or minus dollars returned to each farm operator for each dollar of input expended.

The data of Table 10 indicate that a positive mean dollar ratio of 1 to 53.16 existed for the group between the 1965 input costs of instruction and change in net farm income between 1964 and 1965. In other words, the farm operators realized an average of $53.16 net farm income for every $1.00 cost of the instructional program.
TABLE 10

RATIO OF INDIVIDUAL INPUT COSTS OF INSTRUCTION IN 1965 TO CHANGE IN NET FARM INCOME BETWEEN 1964-65

<table>
<thead>
<tr>
<th>Individual Code Number</th>
<th>Dollar Input Cost of Program</th>
<th>Dollar Output as Net Farm Income</th>
<th>Dollar Input-Output Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$ 93.</td>
<td>- $ 1,364.</td>
<td>- 14.6</td>
</tr>
<tr>
<td>2</td>
<td>82.</td>
<td>19,277</td>
<td>235.1</td>
</tr>
<tr>
<td>3</td>
<td>82.</td>
<td>4,694</td>
<td>57.2</td>
</tr>
<tr>
<td>4</td>
<td>63.</td>
<td>4,579</td>
<td>72.7</td>
</tr>
<tr>
<td>5</td>
<td>72.</td>
<td>3,771</td>
<td>52.4</td>
</tr>
<tr>
<td>6</td>
<td>67.</td>
<td>- 3,656.</td>
<td>- 54.6</td>
</tr>
<tr>
<td>7</td>
<td>67.</td>
<td>3,441</td>
<td>51.4</td>
</tr>
<tr>
<td>8</td>
<td>77.</td>
<td>282</td>
<td>3.6</td>
</tr>
<tr>
<td>9</td>
<td>82.</td>
<td>1,923</td>
<td>23.5</td>
</tr>
<tr>
<td>10</td>
<td>82.</td>
<td>7,789</td>
<td>95.0</td>
</tr>
<tr>
<td>11</td>
<td>72.</td>
<td>4,064</td>
<td>56.4</td>
</tr>
<tr>
<td>12</td>
<td>107.</td>
<td>11,144</td>
<td>104.1</td>
</tr>
<tr>
<td>13</td>
<td>92.</td>
<td>13,269</td>
<td>144.2</td>
</tr>
<tr>
<td>14</td>
<td>117.</td>
<td>5,989</td>
<td>51.2</td>
</tr>
<tr>
<td>15</td>
<td>82.</td>
<td>14,758</td>
<td>180.0</td>
</tr>
<tr>
<td>16</td>
<td>87.</td>
<td>6,826</td>
<td>78.5</td>
</tr>
<tr>
<td>17</td>
<td>97.</td>
<td>8,372</td>
<td>86.3</td>
</tr>
<tr>
<td>18</td>
<td>72.</td>
<td>-12,670</td>
<td>-176.0</td>
</tr>
<tr>
<td>19</td>
<td>67.</td>
<td>- 492</td>
<td>- 7.3</td>
</tr>
<tr>
<td>20</td>
<td>57.</td>
<td>7,873</td>
<td>148.1</td>
</tr>
<tr>
<td>21</td>
<td>33.</td>
<td>2,014</td>
<td>61.0</td>
</tr>
<tr>
<td>22</td>
<td>104.</td>
<td>9,252</td>
<td>89.0</td>
</tr>
<tr>
<td>23</td>
<td>74.</td>
<td>- 1,013</td>
<td>- 13.7</td>
</tr>
<tr>
<td>24</td>
<td>84.</td>
<td>1,775</td>
<td>22.4</td>
</tr>
<tr>
<td>25</td>
<td>164.</td>
<td>12,880</td>
<td>78.5</td>
</tr>
<tr>
<td>26</td>
<td>92.</td>
<td>5,563</td>
<td>60.5</td>
</tr>
<tr>
<td>27</td>
<td>75.</td>
<td>- 2,965</td>
<td>- 39.5</td>
</tr>
</tbody>
</table>

Mean $ 83. Mean $ 4,722. Mean 53.16
Table 10 also reveals that six of 27 farm operators had a negative output thereby resulting in a negative ratio. When the 22.2 percent observed to have negative ratios were computed as a mean, a mean ratio of minus 50.9 was observed. Conversely, the remaining 77.8 percent of the universe when likewise treated as a mean revealed a positive mean ratio of 82.9, the difference in ratios being a positive 32.

The pilot study data in Table 10 show a strong and positive ratio favorable to the farm operator's economic efficiency as evidenced in dollar earnings accruing from farm management instruction.

Objective 6: To determine from the pilot findings inferences relative to the acceptance, rejection, or refinement of the model procedure.

In testing the findings of the pilot study to determine relevance to the model procedure, a partial comparison between the parametric and non-parametric techniques was examined. This was done to determine possible similarities or differences in indicating the degree and direction of association between the variables measured.

To examine what this association might be, the Spearman non-parametric technique and the Pearson parametric technique of product moment coefficients of correlation, assuming the latter's requirements for the data were met, were computed for 1965 program inputs and other selected variables as shown in Table 11.

Both techniques were similar regarding the positive or negative results of the selected variables correlated. Numerically, the
### TABLE 11

**Spearman Rank Order Coefficients of Correlation and Pearson Product Moment Coefficients of Correlation Computed Between 1965 Program Inputs and Other Selected Variables**

<table>
<thead>
<tr>
<th>Selected Variables</th>
<th>Spearman (p)</th>
<th>Pearson (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-test level, economic understanding</td>
<td>-.06</td>
<td>-.18</td>
</tr>
<tr>
<td>Change between pre- and post-test level, economic understanding</td>
<td>.17</td>
<td>.13</td>
</tr>
<tr>
<td>Gross income 1965</td>
<td>.30</td>
<td>.19</td>
</tr>
<tr>
<td>Net cash income 1965</td>
<td>-.06</td>
<td>-.22</td>
</tr>
<tr>
<td>Net farm income 1965</td>
<td>.29</td>
<td>.19</td>
</tr>
<tr>
<td>Net margin 1965</td>
<td>.41</td>
<td>.25</td>
</tr>
<tr>
<td>Overhead ratio 1965</td>
<td>.41</td>
<td>.42</td>
</tr>
<tr>
<td>Operating ratio 1965</td>
<td>.01</td>
<td>-.07</td>
</tr>
<tr>
<td>Gross income/$1,000 invested 1965</td>
<td>.12</td>
<td>.44</td>
</tr>
<tr>
<td>Net farm income/$1,000 invested 1965</td>
<td>.46</td>
<td>.40</td>
</tr>
<tr>
<td>Gross income per man equivalent</td>
<td>.38</td>
<td>.39</td>
</tr>
<tr>
<td>PMWU per man equivalent 1965</td>
<td>.42</td>
<td>.48</td>
</tr>
<tr>
<td>Change gross income</td>
<td>.45</td>
<td>.38</td>
</tr>
<tr>
<td>Change net cash income</td>
<td>.13</td>
<td>.03</td>
</tr>
<tr>
<td>Change net farm income</td>
<td>.52</td>
<td>.39</td>
</tr>
<tr>
<td>Change net margin</td>
<td>.51</td>
<td>.49</td>
</tr>
<tr>
<td>Change overhead ratio</td>
<td>.33</td>
<td>.46</td>
</tr>
<tr>
<td>Change operating ratio</td>
<td>.38</td>
<td>.27</td>
</tr>
<tr>
<td>Change gross income per $1,000 invested</td>
<td>.30</td>
<td>.56</td>
</tr>
<tr>
<td>Selected Variables</td>
<td>Correlation with 1965 Program Inputs</td>
<td></td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-------------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spearman (p)</td>
<td>Pearson (r)</td>
</tr>
<tr>
<td>Change net farm income per $1,000 invested</td>
<td>.50</td>
<td>.61</td>
</tr>
<tr>
<td>Change gross income per man equivalent</td>
<td>.57</td>
<td>.54</td>
</tr>
<tr>
<td>Change PMWU per man equivalent</td>
<td>.52</td>
<td>.46</td>
</tr>
</tbody>
</table>
coefficients of correlation for all but two variables between the two techniques ranged from 0.01 to 0.16 in Table 11. The two variables which exceeded the foregoing range were "gross income per $1,000 invested" and "change in gross income per $1,000 invested" for which the divergence was 0.32 and 0.26 respectively.

In total, the data of Table 11 evidence a relatively close parallel between the resulting coefficients of correlation using the two techniques. Thus, if the requirements necessary to rightfully employ the parametric technique could not be met it appeared from the comparison in this pilot test that the non-parametric may be equally effective in showing degree and direction of association even though it would not be inferable to a larger population.

In the aggregate the analyzed data of the pilot trial determined that change as an increase in the level of understanding of economic profit maximizing principles for the sample of 27 farm operators did occur with a resultant parallel change in the efficiency of their farm business. Therefore, the null hypothesis was rejected.

**Summary**

The analysis of the Ohio pilot study data concerning the group of 27 farm operators, showed associations within and between the variables of the study.

1. There was an increase of 8.2 percent in correct scores on the understanding of profit maximizing economic principles
between the pre-test and post-test after instruction in farm management.

2. There were increases in the volume and composite efficiency of the farm businesses, measured by the mean change in economic efficiency, between the record years of 1964 and 1965.

3. The association between the post-test level of economic understanding and the variables of economic efficiency were inconclusive. However, the variable gross income did possess the most positive degree of correlation with the economic understanding of profit maximizing principles.

4. The post-test level of economic understanding when correlated with changes in economic efficiency variables between 1964 and 1965 showed a slight negative association. Exceptions were the variables, net cash income and gross income, which were moderately positive.

5. Changes in economic understanding between pre-test and post-test mean scores when compared with the 1965 level of economic efficiency variables, showed an overall moderately positive association, but not significant at the established .10 level.

6. The association between changes in economic understanding between pre-test and post-test mean scores with the change between the 1964-65 level of economic efficiency variables as groups representing income, efficiency ratios and capital investment were significant at the .10 level. The variables constituting labor efficiency showed a negligible association.
7. The change in economic understanding between the pre-test and post-test mean score showed a slight positive relation with 1965 program inputs. A slightly negative association between 1965 program inputs and the post-test level of economic understanding was evident.

8. A correlation of 1965 levels of economic efficiency variables as a group with 1965 program inputs showed a moderately positive association. Individually the variables net farm income per $1,000 invested, PMWU per man equivalent, net margin, overhead ratio and gross income per man equivalent exceeded the .10 level of significance. Conversely, net cash income and operating ratio were low and indiscriminate in their relation to 1965 program inputs.

9. In the aggregate, the strongest and most significant of all associations were found for the change between 1964 and 1965 measures of economic efficiency when correlated with 1965 program inputs. This degree of association definitely associates the positive value of instructional inputs with the success of the farm business.

10. A positive mean dollar ratio of 1 to 53.16 existed between the 1965 input costs of instruction and change in net farm income between 1964 and 1965. Thus a strong positive ratio favorable to the farm operator's economic efficiency as evidenced in dollar earnings accruing from instruction in farm management was shown.

11. The comparison of the product-moment correlation coefficient techniques of Spearman (non-parametric) with the Pearson (parametric) indicated that the Spearman rank order correlation
technique might be equally effective in showing degree and direction of association. Caution would be exercised to assure a random sample if generalizations were to be made relative to general populations.

12. With increases in the understanding of economic profit maximizing principles, there were increases in the economic efficiency of the farm operators sampled; therefore the null hypothesis was rejected.
CHAPTER VI

SUMMARY, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

Increased public attention is focused on the expanding scope and mounting investment in education. A consequent problem is that of measuring the value of instruction for the purpose of accountability. Educators in agriculture must respond to this challenge by examining and designing means for measuring the micro-economic aspects of intellectual investments in agriculture. Instruction in farm management was selected for this investigation as the vehicle through which meaningful measurements might be assessed.

The purpose of this study was to develop a model procedure for determining the influence of the farm business analysis phase of instruction in farm management upon selected factors of economic efficiency and management understanding of economic principles.

Objectives of the Study

The primary objective was to formulate a basic design as a plan or procedure to assess the relative degree of effectiveness of instruction in farm management.

Secondary objectives were --

1. To determine the change in understanding of economic principles achieved by farm operators enrolled for instruction in farm management.

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2. To determine changes in selected factors of economic efficiency achieved by farm operators enrolled for instruction in farm management.

3. To determine whether association exists between changes in the understanding of economic principles achieved by farm operators and changes accomplished in factors of economic efficiency.

4. To determine the input costs of the instruction in farm management over the period of instruction defined for the model design.

5. To determine what may be an expected economic ratio between the input costs of farm management instruction and the changes in net farm income accruing to farm operators enrolled for instruction.

Rationale of the Study

Society has long assumed that education contributes to the general economic well being of the nation and through those individuals receiving instruction. Hence it was assumed in this study that instruction in farm management should increase the economic efficiency of farm operators resulting in a financial gain for the farm business. Many farmers receive instruction based on the analysis of farm records through adult programs of vocational agricultural departments in the secondary schools of the nation.

Cvancara was the first to investigate the micro-economic effects of adult instruction in farm management in 1964. Using cash

66 Cvancara, op. cit.
income as the criterion variable, he found that farmers receiving
instruction had increased farm incomes by at least $500 or more when
compared to farmers receiving no instruction. Projecting his finding
he estimated that 60 farmers enrolled in an adult management program
would mean an additional $30,000 available to farmers of the com-
munity.

A Brazilian case study by Wharton67 also provided procedural
insight for micro-economic research in regard to the adjustment for
price change occurring over a span of time.

The criterion variable, net farm income, was later used by
Knewtson68 in 1965 to determine whether the rate of change of young
farmers in Kansas was accelerated by instruction received in farm
business analysis during 1963 and 1964. A gain in net farm income
was found though the rate of gain was not significantly different
from that prior to instruction. It could not be determined from the
published report if adjustments had been made to account for a yearly
price change.

At the time of this study a Minnesota study by E. Pearsons was
in progress, broadening the base of the aforementioned studies by
increases in (1) the number of farm records, (2) measurement span, and
(3) the number of dependent variables namely, labor earnings, return
to capital and family labor, and change in net worth.

67Wharton, op. cit.
68Knewtson, op. cit.
Evaluative instruments which attempted to measure farm operators' managerial competence via an understanding of economic principles became another locus of attention. In 1961 Edington developed an instrument which in addition to regard for the understanding of principles also included determination of practices peculiar to young dairymen. Two years later McCormick developed an instrument to measure the understanding of basic profit maximizing principles essential for efficient operation and management of a farm business.

The Model Design

The methodology of this study was based on the concept that a sequence of events for the optimum management of a farm business is one of understanding, decision making and application. Moreover, this process should be within a framework that allows for "change" over "time" and the application of commonly used measures for instructional inputs, economic understanding and efficiency, thereby enabling wide application of the model design within and among states.

Tasks dealt with in the development of the model were (1) the identification of "potent" dependent variables or instruments which would indicate change in the economic understanding of farm management principles and change in the income for the farm business as the

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69 Edington, op. cit.
70 McCormick, op. cit.
result of management by a farm operator; (2) the identification of the "potent" variable for program unit inputs, normally computed for reports by vocational agricultural instructors and readily assigned a monetary value per unit of instructional input; (3) the establishment of procedures by which the variables were to be measured; (4) the development of a technique for removing influences of price fluctuations from the measures used to identify change in farm income; (5) the development of a rationale for assigning a monetary cost per unit of instructional input; (6) the determination of the method of sampling the population of farm operators enrolled for instruction based upon their farm business records; (7) the delineation of procedures to be used for collecting the data required; (8) the selection of suitable statistical techniques for the assessment of change within and between the variables to be measured, and (9) the determination of ratios between the input costs of instruction and the economic changes accruing to farm operators enrolled for instruction. The paradigm of the study design is portrayed on page 103.

The Pilot Trial

A series of trial tests of the procedures of the model design would be desirable. Inadequate finances and the longitudinal nature of the model design precluded for this investigator the use of an adaptive procedure for the initial pilot test.

The Ohio Farm Business Planning and Analysis program provided an accessible and timely opportunity for a pilot study. The major
Figure 1. The Relation of Instruction in Farm Management to the Understanding of Economic Principles and Selected Economic Efficiency Factors.

<table>
<thead>
<tr>
<th>ECONOMIC EFFICIENCY</th>
<th>PROGRAM INPUTS</th>
<th>ECONOMIC EFFICIENCY</th>
<th>PROGRAM OUTPUTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gross Income</td>
<td>Number of contact hours of instruction</td>
<td>1. Gross Income</td>
<td></td>
</tr>
<tr>
<td>2. Net Cash Income</td>
<td>(a) Class time + (b) On-farm time</td>
<td>2. Net Cash Income</td>
<td></td>
</tr>
<tr>
<td>7. Operating Ratio</td>
<td></td>
<td>7. Operating Ratio</td>
<td></td>
</tr>
<tr>
<td>8. Gross Income per</td>
<td></td>
<td>8. Gross Income per $1,000</td>
<td></td>
</tr>
<tr>
<td>$1,000 Invested</td>
<td></td>
<td>Invested</td>
<td></td>
</tr>
<tr>
<td>9. Net Farm Income per</td>
<td></td>
<td>9. Net Farm Income per $1,000</td>
<td></td>
</tr>
<tr>
<td>$1,000 Invested</td>
<td></td>
<td>Invested</td>
<td></td>
</tr>
<tr>
<td>10. Gross Income per Man Equivalent</td>
<td>Monies paid for contact hours</td>
<td>10. Gross Income per Man Equivalent</td>
<td></td>
</tr>
<tr>
<td>11. PMWU per Man Equivalent</td>
<td></td>
<td>11. PMWU per Man Equivalent</td>
<td></td>
</tr>
</tbody>
</table>

ECONOMIC UNDERSTANDING

Diminishing Physical Returns
Diminishing Economic Returns
Fixed-Variable Costs
Substitution
Opportunity Costs
Combination of Enterprises
Time Relationships
(Time Comparisons)

PROGRAM INPUTS

DOLLAR AND RATIO FINDINGS

TEST SCORES FINDINGS

ONE TERM OF INSTRUCTION
assets of the Ohio programs were (1) an established and continuing program utilizing the record keeping, analysis, and programming sequence approach to instruction; (2) the utilization of a uniform farm account record book; (3) the availability of summarized records analyzed by the Department of Agricultural Education of The Ohio State University; (4) the availability of resource persons familiar with the scope of the program and the development and use of an instrument to measure economic understanding; (5) an established policy on reimbursement for approved adult instruction; (6) potential program expansion poised on the question of the micro-economic returns accruing to adult instruction in farm management.

Modification for the Pilot Trial

The pilot study test met all but the following points of procedure as established by the model --

1. The sample. — The population for the pilot trial constituted 27 farm operators participating in the farm business analysis programs of five local Ohio schools. They had all completed a 1964 analysis of the farm business, a pre-test on economic understanding, and were currently enrolled for the 1965 analysis year.

2. Period of measurement. — Change in the understanding of profit maximizing economic principles were established for the trial by the change in scores between a pre-test in April 1965 and a post-test in June 1966. Changes between 1964 and 1965 in factors of economic efficiency were measured by analysis of the farm business records of the participants.
3. **The variables.** -- The only variable of the original model which was unobtainable for the trial was net worth.

4. **The statistical technique.** -- The nature of the population precluded meeting the requirements called for by the parametric techniques. Therefore, the non-parametric Spearman rank order correlation technique was used to assess direction and degree of association between the variables measured. However, the Pearsonian r, a parametric technique, was also used but only for estimating the possibility of further hypothesis formation.

**The Collection of Data**

**Economic understanding**

This investigator utilized data on the understanding of basic profit maximizing economic principles as measured by a 45 multiple choice instrument developed by McCormick. The data was collected from a pre-test administered in April 1965 by local instructors of vocational agriculture to participating farm operators. These participants had also completed a 1964 Farm Business Summary form which was analyzed by the Department of Agricultural Education, The Ohio State University. All test scores were tabulated according to questions answered correctly. A code for each farm operator, assigned by the local instructor at the time of the pre-test, was maintained for all tests and analysis. In addition the individuals of the universe

71McCormick, *op. cit.*
were coded by using consecutive numbers according to the model procedure. The same procedure was used for the post-test, administered in June 1966 following the completion of the participant's 1965 Farm Business Summary forms and their analysis.

**Economic efficiency**

Summarized and analyzed data from the participant's farm account record book provided data on the variables of economic efficiency for the years 1964 and 1965. This data was on file in the Department of Agricultural Education, The Ohio State University. The 1965 analysis data was subjected to corrective computations to adjust for yearly price changes of goods and services to the price levels of 1964. Data for the determination of price corrective factors were drawn from yearly reports of the Economic Research Service of the United States Department of Agriculture.

**Program inputs**

The "potent" variable of the model design was the number of hours of instruction. The number of contact hours of farm business analysis instruction, as the sum of "in class" and "on-farm" hours, for each of 27 farm operators constituted program inputs which was the basic variable of this study. Such information was directly transferable from the 1965 farm record summary reports as recorded by the instructor for each participant. The total class hours offered for each farm operator's class was reported directly by his instructor.
The rate of $5.00 per unit of instructional input was established by this investigator for this pilot study only. The rate was assigned on the base of a state reimbursement policy of $2.50 for approved adult programs which was commonly matched by local school districts during the 1964-65 school year.

The Analysis of Data

The analysis of the trial data focused on determining the association between three sets of variables: (1) the understanding of profit maximizing economic principles, (2) economic efficiency factors, and (3) instructional program input, the latter being the independent variable.

The treatment of the data to ascertain those associations was determined by the nature of the population sample. Hence, the Spearman non-parametric rank order correlation coefficient technique was used. It was felt that this procedure would discriminate between the measures used in determining the relative direction and degree of effectiveness of farm management instruction received by the 27 farm operators used in the pilot study.

Two additional mathematical calculations were made. First, corrective computations were made to adjust yearly price changes occurring in 1965 to 1964 price levels. This was accomplished by dividing the average state price of 1965 into the average price of 1964, the base year. Correction factors for all cash receipts were then multiplied individually by the financial volume of goods or
services to obtain an adjusted figure for each item. The sum of these became the adjusted gross cash receipts. The same procedure was used for adjusting the total cash expenses but on a composite basis.

The second series of calculations were made to determine ratios between the economic value of program inputs and changes in dollars of net farm income, individually and collectively. The procedure used was to divide the total class hours attended individually by the total offered; multiply the result by the mean hours of instruction offered; add the number of individual on-farm instructional hours, the result being the total number of contact hours of instruction received per farm operator. This sum multiplied by the cost per unit of instruction ($5.00) equals the total assessed cost per participant. Ratios were then computed between program costs and changes in net farm income.

Major Findings of the Trial Study

In the aggregate changes in the variables measuring the understanding of economic principles and economic efficiency were desirable. It is prudent, however, to note that the measures were not always positively or negatively desirable nor did all variables meet the critical level of .323 to be statistically significant at the .10 level. Nevertheless, the direction and the degree of change and level show important associations upon which to gauge the micro-economic results of instruction in farm management accruing to the 27 farm operators of this study.
Economic understanding

The investigator reasoned that if an increase in the mean score measuring understanding was found to exist between two tests interspersed by a program of instruction in farm management, it might be construed as accruing to the program inputs. Importance was not only attached to the change but also to the level of understanding. The positions of change and level of understanding provided valuable indices from which to gauge the response to and continuance of the economic value resulting from instruction in farm management.

The data determined that the farm operators achieved an increase of 8.2 percent in mean score on the instrument measuring the understanding of profit maximizing economic principles between the pre-test and the post-test.

Based upon the proportion of correct answers, 69.25 percent on the pre-test and 74.97 on the post-test, it is apparent that relatively high levels of understanding were evidenced in the mean scores. The high initial level might have been the result of a higher than average clientele which alluded to previous learning either formal or informal. Attention is drawn to the foregoing as a means of qualifying the inappropriateness of predicting from the data at hand the effect that farm management instruction would have on the total population of Ohio farm operators.

Assuming the writer's rationale to be correct, the level of understanding should provide a better base for decision making, thereby increasing the operator's efficiency and hence increasing
the economic returns to the farm business. The data of Table 5, dealing with the association between change in understanding and the 1965 level of efficiency, and more significantly Table 6, relative to the association between change in understanding to change in the level of efficiency, lend considerable support to the reasoning that increases in understanding led to increases in economic efficiency and financial return to the farm business.

**Economic efficiency**

The change in means observed in the data measuring the variables of economic efficiency between the analysis years of 1964 and 1965 are shown in column (2) of Table 12. These means were assumed to be the result of decisions made, based on the level and increase in understanding as previously described. Table 12 shows an accumulation of data from the study which deal with the variables of economic efficiency. It is presented as an aid in the overall assessment of change in economic efficiency when viewed with correlations of association between other variables of the pilot study. Each factor of economic efficiency was analyzed separately and with others of a group dealing with income, ratios, capital and labor. Among the ten variables, gross income, net cash income and net farm income dealt with income efficiency; net margin, overhead ratio and operating ratio were concerned with management efficiency; gross income per $1,000 invested and net farm income per $1,000 invested
<table>
<thead>
<tr>
<th>Economic Efficiency Factors</th>
<th>Change in Eff. to 1965 Level</th>
<th>Change in Understdg. to 1965 Level</th>
<th>Change in Efficiency</th>
<th>1965 Prog. Input to Change in Efficiency</th>
<th>1965 Prog. Input to Change in Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Gross income</td>
<td>$ 6,456</td>
<td>.25</td>
<td>.17</td>
<td>.26</td>
<td>.22</td>
</tr>
<tr>
<td>Net cash income</td>
<td>$-1,409</td>
<td>.15</td>
<td>.31</td>
<td>.29</td>
<td>.60d</td>
</tr>
<tr>
<td>Net farm income</td>
<td>$ 4,721</td>
<td>-.05</td>
<td>.02</td>
<td>.16</td>
<td>.34d</td>
</tr>
<tr>
<td>Net marginc</td>
<td>43.4</td>
<td>-.16</td>
<td>-.07</td>
<td>.18</td>
<td>.33d</td>
</tr>
<tr>
<td>Overhead ratioc</td>
<td>-.10.5</td>
<td>.14</td>
<td>.11</td>
<td>.17</td>
<td>.36d</td>
</tr>
<tr>
<td>Operating ratioc</td>
<td>-.12.6</td>
<td>-.26</td>
<td>-.15</td>
<td>.10</td>
<td>.31</td>
</tr>
<tr>
<td>Gross income per $1,000 invested</td>
<td>$ -32</td>
<td>.19</td>
<td>-.04</td>
<td>.16</td>
<td>.36d</td>
</tr>
<tr>
<td>Net farm income per $1,000 invested</td>
<td>16</td>
<td>.07</td>
<td>-.20</td>
<td>.18</td>
<td>.35d</td>
</tr>
<tr>
<td>Gross income per man equivalent</td>
<td>$ 6,207</td>
<td>-.06</td>
<td>-.20</td>
<td>-.06</td>
<td>-.03</td>
</tr>
<tr>
<td>PMU/man equiv.</td>
<td>53</td>
<td>.12</td>
<td>-.11</td>
<td>.32</td>
<td>.09</td>
</tr>
</tbody>
</table>

a Column (2) shows the actual change in economic efficiency between 1964-65. It enables one to relate the degree and direction of association to the actual change in economic efficiency.

b Post-test level.

c Percent.

d Statistically significant at the .10 level of significance (.323 = critical value).
dealt with capital efficiency; and gross income per man equivalent and PMWU per man equivalent constituted labor efficiency.

Gross income shows an increase in business volume. The mean change of $6,456 in gross farm income may in part be explained by the increase in productive man work units. Since farm operators were accomplishing more work (more man work units), one would consequently expect an increase in gross income. Yet when the factor was further refined by equating the mean change between gross income to a per man equivalent basis, a differential decrease of only $249 is noted. It was apparent to this investigator that the change in gross income was largely the result of increased business efficiency.

The correlations between gross income and the measures of economic understanding, efficiency and program inputs, as indicated in columns 3 to 8 in Table 12, showed a rather constant and positive association. As level of understanding and program inputs increased, farm operators realized an increase in gross income. A significant association was found when change in gross income was correlated to 1965 program inputs. In the light of the mean change and its pattern of association with the other sets of variables, gross income remains a "potent" variable for the measurement of farm operators business efficiency. Therefore it should remain a part of the model design.

Net cash income data, column 2, evidenced a decline in the mean of $1,409 per operating unit which accounts for the slightly negative association found between program inputs and 1965 level of efficiency.
It is important to understand that of all the variables, net cash income is one of the most elusive measures to determine farm business efficiency. This is particularly so over a short term, due to possible investments designed to increase efficiency in the long run, but which mask net cash income over one or a few analysis years. Therefore the writer suggests, relative to the data of this pilot study, that the negative change shown may in fact be revealing a positive reaction as a result of instruction in the understanding of profit maximizing economic principles. In any event, because of the tendency of this measure to mask or confuse the evidence of change, it seems of dubious value to the model design.

Net farm income was used in the pilot trial to determine the ratio between the input costs of the instructional program and economic returns accruing to the farm business. Net farm income data showed a sizeable increase between 1964 and 1965. This would be expected since there was an increase of $6,406 in gross income between the two analysis years, which indicated increased efficiency and volume of business.

The correlation between change in understanding with 1965 level of efficiency indicated a relatively strong association. A positive and significant association existed beyond the .10 level between the change in understanding and change in economic efficiency. The latter association when compared to correlations concerning level might suggest that a current and timely awareness of
the principles of economic understanding may play a larger role than heretofore considered as a precursor to increased economic efficiency. Since change in understanding and change in efficiency as measured by net farm income was significant at the .10 level, it seemed desirable to have year-round enrollment of farm operators in programs of farm management analysis instruction.

Correlations of the program inputs for 1965 with change in efficiency were substantially beyond the .10 level of significance. The same inputs when correlated to the 1965 level of efficiency were within .033 of the critical value to be significant at the .10 level. Such associations were indicative of a positive mean dollar input-output ratio. It was inferred that as the hours of instruction received by farm operators increased there was a significant increase in their economic efficiency.

Net farm income was considered a more definitive measure of efficiency than net cash income. It also is subject to possible distortion as a result of income tax management whereby cash expenditures and depreciation allowance might be increased or additional capital assets purchased or held over for the measured year. Nevertheless, the writer assumed that differences resulting from income tax management would be off-set among individuals within the population from year to year. Net farm income is considered a useful measure of efficiency and should be retained in the model.

In summary, income efficiency comprising data on the variables gross income, net cash income and net farm income show increased
volume and efficiency for the farmers in the study as a group. The actual decrease which occurred in net cash income was construed as a short term reflection of increased investments carrying potential for long term efficiency benefits. Associations were basically positive, showing significance beyond the .10 level between change in economic understanding and change in economic efficiency. The 1965 program inputs when correlated with economic efficiency also showed significance above the .10 level of confidence.

**Net margin** data indicated a 43.4 percent increase in its proportion to gross income between the 1964 and 1965 analysis years. This meant a 9.2 percentage point increase in the percent that family labor and management income constituted of gross income for the year 1965. Three correlations in columns (6), (7) and (8) of Table 12 showed significance above the .10 level. These indicated that the mean number of contact hours of instruction and the increased mean score on understanding of principles might be important to increases in economic efficiency as measured by net margin.

**Overhead ratio** data showed a decrease of 10.5 percent in proportion to gross income of 1965, when compared to the corresponding figure for 1964. Therefore, by spending 10.5 percent less, while increasing gross and net farm income, these farm operators had increased the efficiency of their business operation.

**Operating ratio** was revealed by the data to have decreased in the same manner as the overhead ratio to the extent of 12.6 percent. Therefore it may be reasoned that the total cash operating expenses
were kept constant or that the efficiency improved while the volume of the farm business increased.

The pattern of association shown by the correlations were not particularly discernable. Yet the 1965 program inputs correlated significantly at the .10 level with the change in economic efficiency as measured by net margin and overhead ratios.

Compositely, data on the three management efficiency ratios illuminated the intimacy of the variable's relation to the efficiency of the farm business and as such should be retained in the model. To the investigator these ratios were important as they provided insight as to the position of gross income absorbed by costs of production including both variable and fixed cost.

Relatively strong and significant associations found in columns (6), (7) and (8) of Table 12 were indicative of the value of programs of instruction in farm management analysis to (1) increased understanding of economic principles and (2) increased levels of farm business efficiency. In summary, the three variables were considered "potent" measures to be used in the model.

Gross income per $1,000 invested decreased according to the data of column (2) of Table 12 between 1964 and 1965. This was not surprising in the light of the previously analyzed data which suggested that there was an apparent increase in total capital invested during 1965. Again the decrease could be masking a desirable and efficient allocation of capital which could be discernable in a future analysis.
The sole correlation for this factor which was significant at the .10 level was the association between changes in understanding and changes in efficiency. It is inferred that as a result of the instructional program there was increased understanding of economic principles and a resultant increase in economic efficiency which was significant at the .10 level.

Net farm income per $1,000 invested exhibited a small increase between 1964 and 1965 (Table 12, column 2). This brought into focus an occurrence in which the variables of capital investment ran conversely to the position of their comparable income efficiency variable. Increased capital investment appeared to have been the catalyst to that dichotomy in this pilot trial.

The two variables, gross income per $1,000 invested and net farm income per $1,000 invested, comprising the measures of capital efficiency in this pilot trial, evidence increased investment in the farm business and as such their continued use in the model were recommended. The strongest series of significant correlations beyond the .10 level in the trial were shown for net farm income per $1,000 invested in columns (6), (7) and (8) of Table 12. These associations alluded in part to a possible cause and effect relation between "timely" change in the understanding of economic principles and change in economic efficiency and likewise between 1965 program inputs and the 1965 level as well as change in economic efficiency.

Gross income per man equivalent as a labor efficiency variable indicates that a close parallel exists between this factor and gross
income (Table 12, column 2). It seemed logical to assume that labor
efficiency had increased measurably since the mean difference in the
variables between 1964 and 1965 was only $249 in spite of the increased
volume of the farm business.

PITU per man equivalent data in Table 12 also supported the
assumption that larger amounts of work were accomplished by individual
operators in 1965 when compared to 1964. Based upon these associa-
tions it was inferred that more effective utilization of labor
resources was realized.

Correlative data for these two variables in relation to labor
efficiency show significant associations beyond the .10 level between
1965 program inputs and 1965 levels. They showed little or no asso-
ciation with change in the understanding of principles when this was
correlated with change in economic efficiency. This was contrary to
the association found when correlated to the other factors of economic
efficiency. Further analysis and research need to be conducted to
determine the relation between understanding and application. In-
creases might be attributed to greater operator production through
mechanization. Nevertheless, the variables of gross income per man
equivalent and PITU per man equivalent were considered "potent"
indicators of economic efficiency and should be retained in the model.

Program inputs

The overriding purpose of this micro-economic pilot study was
to determine the economic returns accruing to the participants as a
result of instruction in farm management analysis. These microeconomic returns were measured as ratios between 1965 program inputs as determined by hours of instruction and outputs as determined by change in net farm income for individual farmers and the mean of the group.

Collectively, the data show that a positive mean dollar ratio of 1 to 53.16 existed between the 1965 input costs of instruction and the change in net farm income between 1964 and 1965. This means that participants in this group realized an average of $53.16 net farm income for every $1.00 cost of their instructional program. Individual ratios showed that 21 of 27 or 77.8 percent of the farm operators had a positive mean ratio of 82.9. However, a negative mean ratio of 50.9 was shown for the six remaining farmers or 22.2 percent of the population. This evidence of strong and positive dollar earnings accruing to farm management instruction should incite the inquisitive activity of persons concerned with education in production agriculture.

Conclusions, Implications and Recommendations

The pilot trial of the basic design to assess the micro-economic returns to investment in farm management instruction seems to warrant several conclusions and implications. They grow out of the findings and are grouped according to the pilot study objectives.

Change in understanding of economic principles

Instruction in the Ohio Farm Business Planning and Analysis Program provided participants in the five departments of vocational
agriculture was effective in improving the mean understanding of profit maximizing economic principles.

**Change in economic efficiency**

Farm operators who had participated in farm business analysis instruction, as a group, increased their mean net margin indicating greater efficiency or control over the fixed and variable costs of the farm business.

There was increased investment either as reinvested capital or increased inventory in the average farm business over the one year span of the trial.

Farm operators utilized their labor resources more efficiently after instruction in farm business analysis.

**Association between economic understanding and efficiency**

There was in the aggregate a positive association between changes accruing to farm operators in their understanding of profit maximizing economic principles and the changes in their economic efficiency.

**Ratio between inputs and outputs**

Study of the mean ratio of cost of program inputs to outputs expressed as change in net farm income over one year revealed a $53.16 increase in average net farm income for each $1.00 expended on instruction.
Refinement of the model procedure

Several changes in the model design appear warranted as a consequence of the trial.

Net cash income was not a suitable indicator of farm business efficiency and thus it should no longer remain in the group of measures used in the model. It was evident that a one year span of study provided a limited base period for valid analysis and a period of three or more years appears highly desirable.

It is suggested that yearly analysis data and test scores be transferred to computer cards as standard procedure, thereby further automating the procedure of the model. A PST (Program Evaluation Review Technique) could profitably be applied to this model particularly when used in state or national assessment of the micro-economic value of instructional programs in farm business analysis.

Recommendations for Further Study

As a consequence of the pilot trial of the model design several recommendations for study are offered.

1. Further research should be conducted to determine the micro-economic returns to investment in farm business analysis instruction. Investigations suggested are --

a. The measurement of the effect of quality and depth of instruction upon the net farm income of operators.

b. The further refinement of efforts to measure understanding.
c. The importance to farm income of an understanding of farm business analysis and economic principles by the wife of the farm operator.

d. The development of a management attitude inventory to be administered in conjunction with pre-test and post-tests of the understanding of economic principles.

2. Studies of micro-economic instruction concerning production technology should be undertaken utilizing similar procedural design.

3. A study should seek to determine the best policies relative to the administration, supervision and reimbursement of farm business analysis instruction.
APPENDIX A

The Test

"Multiple Choice Questions on Farming"
MULTIPLE CHOICE QUESTIONS ON FARMING

Please check ( ) the one answer for each question which you think is most nearly correct. Check only one answer for each question. Answer all questions even if you have to guess. Read each question carefully, then study all of the choices before making your decision. You do not need to sign your name.

EXAMPLE: ( ) Check one

Question: For a farm operator who is heavily in debt, the most important factor to consider in choosing enterprises to combine into a farm business is:

   ___a. personal preference
   ___b. labor distribution
   ___c. relative profit per unit of investment as compared with competing enterprises.
   ___d. capital necessary to begin new enterprises.

Please fill in the following blanks before starting.

1. Age ____________

2. Years of schooling ____________

3. Are you a high school graduate? (yes or no) ____________

4. Are you a college graduate? (yes or no) ____________ If yes, what was your major field? ___________________________________________________________________

5. Give years of experience as a farm operator ____________

6. Give years of vocational agriculture completed in high school ____________
QUESTION: A farmer is told that he can obtain an increase in daily gain of feeder pigs by the addition of one-half pound of protein supplement placed in the daily ration. He thinks this is good and, therefore, adds 1/2 of protein supplement to the daily ration. Which of the following results is most likely to occur?

   a. daily gain per head will be doubled.
   b. daily gain per head will remain the same.
   c. daily gain per head will increase but not double.
   d. daily gain will actually decrease.

QUESTION: A farmer is able to produce 70 bushels of oats per acre with the application of 100# commercial fertilizer per acre. By varying only one factor of production, in this case, the amount of fertilizer applied, he can receive a yield increase of 12 bushels per acre with the application of 200# of additional commercial fertilizer. A 300# increase in fertilizer would result in an additional yield increase of 6 bushels per acre and a 400# increase in an additional yield of 2 bushels per acre. If oats will sell for 80¢ per bushel and the fertilizer costs $4.00 per hundred, how much fertilizer should be applied to maximize his net income?

   a. 100#
   b. 300#
   c. 400#
   d. 500#

QUESTION: Purchasing a larger piece of machinery in order to reduce the cost required to complete a particular operation is feasible if:

   a. the savings in labor is less than the cost of owning the larger machine.
   b. there is sufficient capital available.
   c. the savings in labor is equal to the cost of owning the larger machine.
   d. the value of labor saved is greater than the cost of owning the larger machine.

QUESTION: Up to harvest time a farmer has spent $10 per acre for labor, seed, and machine costs on oats. Price of oats has fallen, and a severe local drought has reduced his yields. With an anticipated price of 70¢ per bushel on an expected yield of 10 bushels per acre, the farmer cannot expect to make a profit on this crop. Assuming that the oats crop can be harvested for $3 per acre, the farmer should:

   a. assume his $10 loss for the year and leave the oats in the field.
   b. harvest the oats crop.
   c. sell the oats crop as pasture for $2 per acre.
   d. sell the oats crop for hay at $3 per acre.
QUESTION: Assuming a farmer with limited capital can get $4 return for each $1 invested in protein supplement for hogs, he should invest his limited funds in a new crop variety if:

a. net profit on the crop is increased.
b. investments in new varieties return at least $4 for $1 of added costs.
c. investments in new varieties return more to net profit than investments in protein for hogs.
d. investments in new varieties increase yields per acre, crop quality and total farm gross income.

QUESTION: On a large cash grain and hay farm where summer labor is limited, which one of the following enterprises would fit in the best, providing adequate facilities and equipment exist?

a. sheep
b. cattle feeding
c. hog feeding
d. laying hens

QUESTION: Referring to the table below, which level of fertilizer application would yield the most return to the farmer per $1 invested in fertilizer:

<table>
<thead>
<tr>
<th>Quantity of Fertilizer Added</th>
<th>Total Yield</th>
<th>Cost of Added Fertilizer</th>
<th>Value of Added Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>60 bushels</td>
<td>$-</td>
<td>$-</td>
</tr>
<tr>
<td>10%</td>
<td>65 bushels</td>
<td>1.50</td>
<td>4.50</td>
</tr>
<tr>
<td>20%</td>
<td>68 bushels</td>
<td>1.50</td>
<td>2.70</td>
</tr>
<tr>
<td>30%</td>
<td>70 bushels</td>
<td>1.50</td>
<td>1.80</td>
</tr>
<tr>
<td>40%</td>
<td>71 bushels</td>
<td>1.50</td>
<td>.90</td>
</tr>
</tbody>
</table>

a. 10%
b. 20%
c. 30%
d. 40%

QUESTION: Assuming that 100% of pork can be produced either with 340# corn and 15# soybean meal or with 270# corn and 40# soybean meal, which item below would be the most important for the farmer to consider before he makes the decision regarding which combination to feed?

a. the price of soybean meal per pound.
b. the price of corn per pound.
c. the price of hogs per hundredweight.
d. the price of corn and soybean meal per pound.
QUESTION: Referring to fixed costs such as insurance and taxes and variable costs such as seed, feed, and fertilizer as they relate to the farm business, which of the following costs must be paid by the farmer even if nothing is produced?

a. both variable and fixed costs.
b. variable cost.
c. fixed costs.
d. neither variable nor fixed costs.

QUESTION: Based on the "Return Per $100 Investment" table below, a farmer with $1000 capital to invest in his farm business should invest the most in:

<table>
<thead>
<tr>
<th>Capital</th>
<th>Bonds</th>
<th>Building</th>
<th>Machinery</th>
<th>Dairy Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st $100</td>
<td>$104</td>
<td>$155</td>
<td>$158</td>
<td>$170</td>
</tr>
<tr>
<td>2nd $100</td>
<td>104</td>
<td>148</td>
<td>143</td>
<td>160</td>
</tr>
<tr>
<td>3rd $100</td>
<td>104</td>
<td>136</td>
<td>139</td>
<td>151</td>
</tr>
<tr>
<td>4th $100</td>
<td>104</td>
<td>115</td>
<td>135</td>
<td>140</td>
</tr>
<tr>
<td>5th $100</td>
<td>104</td>
<td>100</td>
<td>130</td>
<td>136</td>
</tr>
</tbody>
</table>

a. bonds.
b. buildings.
c. machinery.
d. dairy equipment.

QUESTION: A dairyman is milking an average of 40 head of dairy cows monthly and is not utilizing his good hired man efficiently during the winter. He has a large poultry house which is not being used presently and has, also, a surplus of corn. What should he do?

a. expand his dairy herd.
b. custom hire his corn production.
c. buy 50 to 100 feeder pigs in late fall to feed out each winter.
d. sell the surplus corn and let the hired man rest some in the winter.

QUESTION: With limited capital, a farm operator would tend to invest his available capital in:

a. long-term land improvements.
b. quick turnover operations.
c. new machinery and equipment.
d. labor saving equipment.
QUESTION: With a capital investment of $5000, a farmer could install an automatic feeding system for his dairy cows. It is estimated that this system would save approximately 300 hours of chore labor per year. In order for the farmer to make a sound decision on whether or not to invest in this system, he would need to consider which of the following:

___ a. the possible return on the $5000 if invested elsewhere in the farm business.
___ b. whether the labor saved could be profitably utilized elsewhere in the farm business.
___ c. the annual fixed and variable costs for operating and maintaining the new feeding system.
___ d. all of the above.

QUESTION: A farmer has an average fixed cost of $12 per acre on land planted to corn. Assuming that the variable cost required to produce 1 bushel of corn remains the same, if the farmer increases corn production per acre, he will:

___ a. lower the per bushel cost of producing corn.
___ b. increase the per bushel cost of producing corn.
___ c. not affect the per bushel cost of producing corn.
___ d. decrease the variable costs per bushel of corn.

QUESTION: A farmer has $1600 to invest in his farm business. He is presently raising 100 acres of small grain and has been harvesting with his own combine but the combine needs to be replaced. The cost of harvesting with his own combine is $3 per acre while custom combining costs $4 per acre. He can save $100 each year by doing his own combining. If the present combine can be replaced for $1600, the $100 saved by doing his own harvesting is about 6½% return on his investment. If the $1600 were invested in dairy cows, it would return $200 above costs, what should the farmer do?

___ a. replace the combine and continue harvesting small grain because he saves $100 per year.
___ b. invest the money in dairy cows and hire the combining done.
___ c. plant more acres of small grain in order to reduce fixed costs on the combine.
___ d. invest in a smaller combine which would still get the harvesting done efficiently.
QUESTION: A supplementary enterprise such as hogs following steers in a feed lot does:

__a. compete with another enterprise but also adds directly to the production of that enterprise.
__b. compete with other enterprises without adding to their production.
__c. add directly to the productivity of another enterprise.
__d. neither compete with nor add to the production of another enterprise, yet increases the net farm income.

QUESTION: Whether or not a farm operator should adopt a soil improvement plan requiring an immediate large outlay of capital in order to insure a higher income in 5 years will depend upon:

__a. the present need for income.
__b. the current rate of interest on borrowed money.
__c. the potential for increasing his farm output.
__d. all of the above.

QUESTION: Feeding trials have indicated that the first 50# of pork can be produced with 150# of feed; the second 50# of pork with 200# of feed; and the third 50# of pork with 275# of feed. Therefore, a farmer who feeds out hogs:

__a. can expect less added gain from each additional pound of feed fed to hogs being fattened.
__b. can expect more feed efficiency as hogs approach market weight.
__c. can produce the fourth 50# of pork for 300# of feed.
__d. can expect all of the above.

QUESTION: When a farmer increases his investment in land, buildings, and equipment without increasing the total units of production, the cost per unit of production:

__a. decreases.
__b. increases.
__c. remains the same.
__d. varies with the operator.
QUESTION: (20) Based on the "Return to Investment" table below, if a farmer had $400 to invest in his present farming business, how much should he invest in machinery for maximum net farm income?

<table>
<thead>
<tr>
<th>Capital</th>
<th>Hog Equipment</th>
<th>Machinery</th>
<th>Dairy Cows</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st $100</td>
<td>$155</td>
<td>$158</td>
<td>$170</td>
</tr>
<tr>
<td>2nd $100</td>
<td>148</td>
<td>143</td>
<td>160</td>
</tr>
<tr>
<td>3rd $100</td>
<td>136</td>
<td>139</td>
<td>151</td>
</tr>
<tr>
<td>4th $100</td>
<td>115</td>
<td>135</td>
<td>140</td>
</tr>
</tbody>
</table>

____ a. $100
____ b. $200
____ c. $300
____ d. $400

QUESTION: (21) Competing enterprises are those which compete with one another for the use of a farmer's resources; if one enterprise is increased, the other enterprise decreases. Therefore, all enterprises:

____ a. become competitive at some point.
____ b. never become completely competitive.
____ c. become helpful to each other at some point.
____ d. should be considered as separate business ventures.

QUESTION: (22) A particular farm has a 25-acre woodlot with a good stand of young trees. To insure optimum growth, a capital investment of $20 per acre is required to improve the woodlot. Which of the following operators should invest the necessary capital in this enterprise?

____ a. an elderly operator with ample capital.
____ b. a fairly young operator with ample capital.
____ c. an operator with other enterprises which will pay 10% return on investment.
____ d. a young operator with a need for a quick return.

QUESTION: (23) An 8% ration of cracked corn and sufficient roughage and protein supplement fed daily to an 800# steer will yield a 2% daily gain in weight. If the amount of cracked corn is increased to 16% per day with sufficient roughage and protein supplement added to balance the ration, the daily gain will now most likely be:

____ a. twice that of the 8% ration of cracked corn.
____ b. less than the 8% ration of cracked corn.
____ c. more than the 8% ration of cracked corn.
____ d. more than twice that of the 8% ration of cracked corn.
To secure maximum profit through increased milk production, a dairyman should increase the daily ration fed dairy cows until the cost of the additional feed is:

a. greater than the value of the increased milk production.
b. less than the value of the increased milk production.
c. equal to the value of the increased milk production.
d. one-half the value of the increased milk production.

If 1.2% of soybean meal will substitute for 1.2% of linseed meal of equal nutritional value and soybean meal sells for 5.2¢ per pound and linseed meal sells for 4¢ per pound, the livestock farmer who wishes to make the largest net income should:

a. feed 68% soybean meal and 32% linseed meal.
b. feed all soybean meal.
c. feed 20% soybean meal and 80% linseed meal.
d. feed all linseed meal.

A farmer's profit will be greatest if each unit of land, labor, and capital is used:

a. in such a manner that it will add the most to gross returns of the farm business.
b. on the enterprise in which the farmer has the greatest interest and ability.
c. on the enterprises where he will realize the greatest yield per acre or animal unit.
d. in such a manner that will add the most to net returns of the farm business.

Combining crop enterprises to reduce uncertainty is advantageous particularly for:

a. the beginning farmer with ample capital.
b. a tenant farmer with specialized machinery.
c. a farmer with unlimited capital.
d. a farmer with limited capital.

A 4-plow gasoline tractor burns 4 gallons of fuel per hour, and a 4-plow diesel tractor burns 3 gallons of fuel per hour. A farmer should consider purchasing a diesel tractor if:

a. the annual fuel costs are less for the diesel.
b. the annual savings in fuel costs will be more than the additional annual cost of owning the diesel tractor.
c. the annual savings in fuel costs will equal the total costs incurred in owning the gasoline tractor.
d. the rate of operation per acre is the same with the diesel as the rate for the gasoline tractor.
A farmer has been feeding cattle on his 300-acre farm since 1955 with the help of an up-to-date set of machinery and a good full-time hired man. He has always fed out 75 head of calves and 50 head of yearlings per year. Over the last 5 years he has invested $15,000 in his cattle feeding operation for buildings and modern feeding equipment. His net income has decreased even with the addition of efficient feeding facilities and he cannot understand why. Can you explain the reason?

___ a. cattle feeders can expect losses for several years in a row.
___ b. he should have fed out all yearlings.
___ c. he has increased overhead costs without changing his volume of business.
___ d. he made the wrong choice of enterprises as dairying is a better enterprise.

By diversifying crop enterprises rather than specializing in one major crop, the crop farmer will:

___ a. reduce risk and uncertainty.
___ b. decrease annual labor efficiency.
___ c. facilitate the use of more labor saving equipment.
___ d. concentrate production knowledge.

In your judgment, which of the following farm operators would be more inclined to invest in a long-range soil conservation plan?

___ a. a beginning farmer who is short on capital.
___ b. a tenant with a long-term lease.
___ c. an owner-operator with money in a savings account.
___ d. an owner-operator who is heavily in debt.

Assuming all other production factors are of no influence, the fertility of a given field is sufficient to produce 80 bushels of corn per acre without additional nitrogen. The addition of 10% of available nitrogen to one acre of the above land will increase the yield 10 bushels per acre. If a second 10% of available nitrogen is applied to the same land, the yield per acre will most likely:

___ a. increase the same number of bushels per acre as the first 10% of available nitrogen applied.
___ b. increase less bushels per acre than the first 10% of available nitrogen applied.
___ c. increase more bushels per acre than the first 10% of available nitrogen applied.
___ d. not be affected by the additional 10% of available nitrogen applied.
QUESTION: A beginning farmer with limited capital in the amount of $3000 has had to make a choice between the following two alternatives: (1) purchase a new combine (estimated life 10 years) for $3000 or (2) purchase a used combine for $1600 (estimated life 6-7 years) and have $1400 to invest in needed lime and fertilizer. He decided to buy the used combine and have the $1400 for other production uses on the farm. He made the correct decision. Why did he make the correct decision?

a. the annual savings in fixed costs on the used combine will be enough to replace the machine when it wears out.

b. the added net return from the expenditure for lime and fertilizer will provide sufficient money to replace the machine when it wears out.

c. the return on investment is higher on the used combine than on the new combine.

d. beginning farmers have the tendency to "over invest" in machinery and "under invest" in other production resources.

QUESTION: Based on the table below showing the yield at different levels of nitrogen used per acre of wheat, which statement is most nearly correct?

<table>
<thead>
<tr>
<th>No. of Lbs. of Nitrogen Added</th>
<th>Total Yield Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>30 bushels</td>
</tr>
<tr>
<td>10</td>
<td>38 bushels</td>
</tr>
<tr>
<td>20</td>
<td>42 bushels</td>
</tr>
<tr>
<td>30</td>
<td>44 bushels</td>
</tr>
<tr>
<td>40</td>
<td>45 bushels</td>
</tr>
</tbody>
</table>

a. the bushels added to the total yield by each successive 10% of additional nitrogen increases at a uniform rate.

b. the bushels added to the total yield by each successive 10% of additional nitrogen increases at a diminishing rate.

c. the bushels added to the total yield are greatest at the 20% level.

d. the 40% rate will yield the best return on a farmer's investment in fertilizer.

QUESTION: Commercial fertilizer should be applied to crops as long as:

a. the added production returns increase gross farm income.

b. the added fertilizer maintains soil productivity.

c. the added production returns are more than the added cost of the fertilizer.

d. the added fertilizer increases crop yields per acre.
QUESTION: An approved practice for increasing the per acre yield of soybeans has been discovered and tested at the State Experimental Station. A farmer should adopt the new practice if:

___ a. it will improve the quality of soybeans.
___ b. it will increase soybean receipts more than expenses.
___ c. it will increase the size or volume of the farm business.
___ d. it will increase gross farm income.

QUESTION: For maximum net returns, a farmer should substitute machinery for labor when:

___ a. the annual cost of machine use is equal to the cost of labor.
___ b. the value of labor saved is more than the annual cost of machine use.
___ c. there is a limited supply of labor.
___ d. the additional machine will increase labor efficiency.

QUESTION: In analyzing the farm business, depreciation should be considered as:

___ a. a variable cost.
___ b. a fixed cost.
___ c. an opportunity cost.
___ d. an operating cost.

QUESTION: A farmer can borrow only $400 for chemicals to control weeds on 100 acres of corn, 100 acres of wheat, and 100 acres of barley. Previous weed control trials have indicated that he can expect the following returns per $1 invested in chemicals:

<table>
<thead>
<tr>
<th></th>
<th>Corn</th>
<th>Wheat</th>
<th>Barley</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>$100</td>
<td>$2.50</td>
<td>$1.50</td>
</tr>
<tr>
<td>2nd</td>
<td>$100</td>
<td>2.25</td>
<td>1.25</td>
</tr>
<tr>
<td>3rd</td>
<td>$100</td>
<td>1.75</td>
<td>.75</td>
</tr>
<tr>
<td>4th</td>
<td>$100</td>
<td>1.25</td>
<td>.50</td>
</tr>
</tbody>
</table>

He should:

___ a. put all $400 worth on corn.
___ b. put $300 on corn and $100 on wheat.
___ c. put $200 on corn and $200 on wheat.
___ d. distribute it evenly over all these crops.
QUESTION: A dairyman is milking 50 Holstein cows with a yearly milk production record of 8000 lb per cow. He has $10,000 capital to invest in his dairy enterprise. He has had to make a choice between the following alternatives: (1) invest $10,000 in an ultra-modern feeding system, or (2) invest $6000 in a "conventional type" feeding system and have $4000 to invest in higher producing cows. He decided to invest the $10,000 in the modern feeding system. He made the wrong decision. Why?
   a. the annual depreciation charge is more than he can profitably afford.
   b. $10,000 is too much to invest in buildings and equipment for 50 cows.
   c. the added returns from the investment in high producing cows would have yielded more profit to the farmer in the long run than the new feeding system.
   d. his neighbors think he made a mistake.

QUESTION: The normal seeding rate for barley is 90 lb per acre. Two fields with comparable capability and fertility levels are seeded to barley. Field "A" is seeded at the rate of 115 lb per acre and Field "B" is seeded at the rate of 140 lb per acre. Assuming that growing conditions were identical for each field, we might predict that the yield per acre of Field "B" would be:
   a. twice the yield of Field "A".
   b. the same yield as Field "A".
   c. less than the yield of Field "A".
   d. more than the yield of Field "A".

QUESTION: It is profitable for a farmer to borrow money to expand his farm business when the borrowed money:
   a. returns more than the cost of borrowing money.
   b. can be secured at a low interest rate.
   c. can improve the level of production.
   d. will increase volume of business.

QUESTION: A hog raiser should substitute barley for corn in a ration as long as:
   a. barley is 80% per bushel and corn is $1 per bushel.
   b. barley and corn substitute at the same rate of total digestible nutrients.
   c. the value of the corn replaced is less than the cost of the barley added.
   d. the value of the corn replaced is more than the cost of the barley added.
QUESTION: In the long run, usually 15-20 years, all costs encountered in operating a farm business become:
  ___ a. variable costs.
  ___ b. fixed costs.
  ___ c. submarginal.
  ___ d. capital costs.

QUESTION: Assuming that a farmer is efficiently managing his farm business, the last dollar spent on a factor of production, such as seed, fertilizer, machinery, or buildings, will yield a marginal or added return:
  ___ a. greater than the last dollar earned from all other factors of production.
  ___ b. exactly equal to the last dollar earned from all other factors of production.
  ___ c. less than the last dollar earned from all other factors of production.
  ___ d. twice as large as the last dollar earned from all other factors of production.
APPENDIX B

Farm Business Summary
**FARM BUSINESS SUMMARY**

**NAME OR NO.**

**COUNTY**

**DEPARTMENT**

**YEAR**

**INVENTORIES**

<table>
<thead>
<tr>
<th>KIND</th>
<th>PAGE NO.</th>
<th>BEGINNING</th>
<th>CLOSING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk and Cream*</td>
<td>L-EE</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Poultry and Eggs</td>
<td>D-K</td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>General Crops</td>
<td>FF-GG</td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Special Crops</td>
<td>B-C</td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Cash Rent and Royalties</td>
<td>I</td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Labor Off Farm</td>
<td>67</td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Custom Work</td>
<td>GQ</td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Wool</td>
<td>Land</td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Other Livestock Prod.</td>
<td>67</td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Tax Refund</td>
<td>67</td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Patronage Dividend</td>
<td>D-K</td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Breeding Fees Received</td>
<td>L-EE</td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous Receipts</td>
<td>TT-UU</td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Government Payments</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Market Livestock Both Raised and Purchased</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Swine</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Cattle</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Veal Calves</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>Lambs</td>
<td></td>
<td>$</td>
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**CASH RECEIPTS**

<table>
<thead>
<tr>
<th>KIND</th>
<th>P. 52 COL.</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk and Cream*</td>
<td>2 $</td>
<td></td>
</tr>
<tr>
<td>Poultry and Eggs</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>General Crops</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Special Crops</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Cash Rent and Royalties</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Labor Off Farm</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Custom Work</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Wool</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Other Livestock Prod.</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Tax Refund</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Patronage Dividend</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Breeding Fees Received</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous Receipts</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Government Payments</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Market Livestock Both Raised and Purchased</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swine</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Cattle</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Veal Calves</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Lambs</td>
<td>19</td>
<td></td>
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</table>

**CASH EXPENSES**

<table>
<thead>
<tr>
<th>KIND</th>
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<th>AMOUNT</th>
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<tbody>
<tr>
<td>Hired Labor</td>
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<td>$</td>
</tr>
<tr>
<td>Feed Purchased</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Farm Supplies</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Machinery Repairs</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Bldg., Fence, etc., Repairs</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Fuel, Oil, Grease</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Electricity (Farm Share)</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Telephone (Farm Share)</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous Expenses</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Seeds and Plants</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Fertilizer and Lime</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Mach. Hire and Trucking</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Auto Exp. (Farm Share)</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Interest on Notes and Mort.</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Veterinary and Medicine</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Breeding Fees and Regs.</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Feeder Livestock Purch.*</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Taxes</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Cash Rent</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Insurance</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

* NOTE: Indicate Total Receipts from Milk and Cream. For Feeder Livestock Purchases, include only Purchases made during this Record Year.

Complete this form with the cooperation of your vocational agriculture teacher and forward to Room 204, Department of Agricultural Education, The Ohio State University.
### CROP PRODUCTION AND USE

<table>
<thead>
<tr>
<th>Crop</th>
<th>Acres</th>
<th>Total Prod.</th>
<th>Beginning Inventory</th>
<th>Closing Inventory</th>
<th>Sold or To Landlord</th>
<th>Fed on Farm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other (Specify)</td>
<td></td>
<td></td>
<td>Labor Used (P. 60)</td>
<td>MONTHS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Special Crops</th>
<th>Labor Used (P. 60)</th>
<th>MONTHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diverted Acres</td>
<td>Operator</td>
<td></td>
</tr>
<tr>
<td>Rotation Land Pasture</td>
<td>Hired</td>
<td></td>
</tr>
<tr>
<td>Permanent Pasture</td>
<td>Son Under 12</td>
<td></td>
</tr>
<tr>
<td>Woodland</td>
<td>Son 12-15</td>
<td></td>
</tr>
<tr>
<td>Other Land</td>
<td>Son 16 and Over</td>
<td></td>
</tr>
<tr>
<td>Total Land</td>
<td>Wife</td>
<td></td>
</tr>
<tr>
<td>Crop Acres Owned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crop Acres Rented</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### LIVESTOCK PRODUCTION

<table>
<thead>
<tr>
<th>Dairy Cows, Average Number for Year</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Lbs. Milk Sold</td>
<td>lbs.</td>
</tr>
<tr>
<td>Average Test</td>
<td>%</td>
</tr>
<tr>
<td>Beef Cows, Average Number for Year</td>
<td>No.</td>
</tr>
<tr>
<td>Calves Weaned</td>
<td>No.</td>
</tr>
<tr>
<td>Average Weight at Weaning</td>
<td>lbs.</td>
</tr>
<tr>
<td>Beef Fattening, Total for Year</td>
<td>No.</td>
</tr>
<tr>
<td>Total Lbs. Gain</td>
<td>lbs.</td>
</tr>
<tr>
<td>Feeding Period, Days</td>
<td>days</td>
</tr>
<tr>
<td>Sows and Gilts, Average Number for Year</td>
<td>No.</td>
</tr>
<tr>
<td>Litters Farrowed</td>
<td>No.</td>
</tr>
<tr>
<td>Pigs Weaned</td>
<td>No.</td>
</tr>
<tr>
<td>Feeder Pigs Sold</td>
<td>No.</td>
</tr>
<tr>
<td>Market Hogs Sold</td>
<td>No.</td>
</tr>
<tr>
<td>Market Hogs Sold</td>
<td>lbs.</td>
</tr>
<tr>
<td>Ewes, Average Number for Year</td>
<td>No.</td>
</tr>
<tr>
<td>Ewes Lambing</td>
<td>No.</td>
</tr>
<tr>
<td>Lambs Weaned</td>
<td>No.</td>
</tr>
<tr>
<td>Lambs Fattened</td>
<td>No.</td>
</tr>
<tr>
<td>Lambs Sold</td>
<td>lbs.</td>
</tr>
<tr>
<td>Wool Sold</td>
<td>lbs.</td>
</tr>
<tr>
<td>Laying Hens, Average Number for Year</td>
<td>No.</td>
</tr>
<tr>
<td>Eggs Sold</td>
<td>Doz.</td>
</tr>
<tr>
<td>Broilers, Number Sold</td>
<td>No.</td>
</tr>
<tr>
<td>Broilers, Lbs. Sold</td>
<td>lbs.</td>
</tr>
<tr>
<td>Turkeys, Number Sold</td>
<td>No.</td>
</tr>
<tr>
<td>Turkeys, Lbs. Sold</td>
<td>lbs.</td>
</tr>
</tbody>
</table>

*NOTE: Total Production plus Beginning Inventory minus Closing Inventory minus Quantity Sold or to Landlord should equal Fed on Farm.*
APPENDIX C

Farm Business Summary and Analysis
### FARM BUSINESS SUMMARY AND ANALYSIS

#### CASH RECEIPTS

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Dairy Products</td>
<td>$</td>
</tr>
<tr>
<td>Eggs</td>
<td>$</td>
</tr>
<tr>
<td>Poultry</td>
<td>$</td>
</tr>
<tr>
<td>General Crops</td>
<td>$</td>
</tr>
<tr>
<td>Special Crops</td>
<td>$</td>
</tr>
<tr>
<td>Cash Rent and Royalties</td>
<td>$</td>
</tr>
<tr>
<td>Labor Off Farm</td>
<td>$</td>
</tr>
<tr>
<td>Custom Work</td>
<td>$</td>
</tr>
<tr>
<td>Wool</td>
<td>$</td>
</tr>
<tr>
<td>Other Livestock Products</td>
<td>$</td>
</tr>
<tr>
<td>Patronage Dividend</td>
<td>$</td>
</tr>
<tr>
<td>Tax Refund</td>
<td>$</td>
</tr>
<tr>
<td>Breeding Fees Received</td>
<td>$</td>
</tr>
<tr>
<td>Miscellaneous Receipts</td>
<td>$</td>
</tr>
<tr>
<td>Government Payments</td>
<td>$</td>
</tr>
<tr>
<td>Market Livestock—Swine</td>
<td>$</td>
</tr>
<tr>
<td>Cattle</td>
<td>$</td>
</tr>
<tr>
<td>Veal Calves</td>
<td>$</td>
</tr>
<tr>
<td>Lambs</td>
<td>$</td>
</tr>
<tr>
<td>TOTAL CASH RECEIPTS</td>
<td>$</td>
</tr>
</tbody>
</table>

#### CASH EXPENSES

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hired Labor</td>
<td>$</td>
</tr>
<tr>
<td>Feed Purchased</td>
<td>$</td>
</tr>
<tr>
<td>Farm Supplies</td>
<td>$</td>
</tr>
<tr>
<td>Machinery Repairs</td>
<td>$</td>
</tr>
<tr>
<td>3ldg., Fence, Tile, etc., Repairs</td>
<td>$</td>
</tr>
<tr>
<td>Fuel, Oil, Grease</td>
<td>$</td>
</tr>
<tr>
<td>Electricity (Farm Share)</td>
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</tr>
<tr>
<td>Telephone (Farm Share)</td>
<td>$</td>
</tr>
<tr>
<td>Miscellaneous Expenses</td>
<td>$</td>
</tr>
<tr>
<td>Seeds and Plants</td>
<td>$</td>
</tr>
<tr>
<td>Fertilizer and Lime</td>
<td>$</td>
</tr>
<tr>
<td>Machine Hire and Trucking</td>
<td>$</td>
</tr>
<tr>
<td>Auto Expense (Farm Share)</td>
<td>$</td>
</tr>
<tr>
<td>Interest on Notes &amp; Mortgage</td>
<td>$</td>
</tr>
<tr>
<td>Taxes</td>
<td>$</td>
</tr>
<tr>
<td>Cash Rent</td>
<td>$</td>
</tr>
<tr>
<td>Insurance</td>
<td>$</td>
</tr>
<tr>
<td>Veterinary and Medicine</td>
<td>$</td>
</tr>
<tr>
<td>Breeding Fees &amp; Registration</td>
<td>$</td>
</tr>
<tr>
<td>Feeder Livestock Purchase</td>
<td>$</td>
</tr>
<tr>
<td>TOTAL CASH EXPENSES</td>
<td>$</td>
</tr>
<tr>
<td>TOTAL CASH OPERATING EXPENSES</td>
<td>$</td>
</tr>
</tbody>
</table>

OPERATING RATIO

141
### CAPITAL GAIN
- Raised Breeding Stock $_________ $_________
- Purchased Breeding Stock
- Machinery and Equipment

### NET INVENTORY CHANGE
- Raised Breeding Livestock
- Purchased Breeding Livestock
- Market Livestock
- Grain, Hay, and Supplies
- Power and Machinery
- Building and Improvements

### DEPRECIATION
- Buildings, Fence, etc. $_________
- Machinery and Equipment
- Purchased Breeding Stock

### CAPITAL EFFICIENCY
- Capital Investment
  - Purchased Breeding Stock $_________
  - Raised Breeding Stock
  - Market Livestock
  - Grain, Hay, and Supplies
  - Machinery and Equipment
  - Buildings, Fence, etc.
  - Land

### INCOME
- Gross Income $_________
- Net Cash Income $_________
- Farm Income
- Family Labor and Management Income

### TOTAL
- AS PERCENT OF GROSS INCOME

### INTEREST ON CAPITAL (5 percent)

### OVERHEAD EXPENSES

### TOTAL
- $_________

### AS PERCENT OF GROSS INCOME

### NET MARGIN

### TOTAL
- PER FULL TIME OPERATOR
- $_________

### NET MARGIN
### CROP SUMMARY

<table>
<thead>
<tr>
<th>Crop Production</th>
<th>Acres</th>
<th>Yield Per Acre</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Soybeans</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Oats</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Wheat</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Alfalfa Hay</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Clover and Mixed Hay</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Corn Silage</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Grass Silage</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Other General Crops</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Special Crops</td>
<td>_____</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td><strong>TOTAL CROPLAND ACRES</strong></td>
<td>_____</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Value of Crops**
- Fed on Farm $______
- Cash Sales $______
- Change in inventory Grain, Hay, & Supplies $______

**GROSS VALUE OF CROPS** $______

**Gross Income per Crop Acre** $______

**Machinery Investment per Cropland Acre** $______

**Power and Machinery Costs**
- Total $______
- Per Harvested Crop Acre $______

### LIVESTOCK SUMMARY

**Value of Feed Fed**
- Crops Fed $______
- Purchased Feed $______
- Pasture $______
- Total Value of Feed $______

**Value of Net Livestock Increase**
- Total $______
- Returns per $1.00 $______

**Feed Cost per 100** $______

### DAIRY SUMMARY

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Cows</td>
<td>_____</td>
</tr>
<tr>
<td>Pounds of 3.5% Milk Sold</td>
<td>_____</td>
</tr>
<tr>
<td>Total</td>
<td>_____</td>
</tr>
<tr>
<td>Per Cow</td>
<td>_____</td>
</tr>
<tr>
<td>Dairy Products Sold Per Cow</td>
<td>$______</td>
</tr>
<tr>
<td>Purchased Feed per Cow</td>
<td>$______</td>
</tr>
<tr>
<td>Milk Sold per Cow</td>
<td>_____</td>
</tr>
</tbody>
</table>
### LABOR EFFICIENCY

**Productive Man Work Units**
- Crops
- Dairy
- Swine
- Beef Cows
- Cattle Fattened
- Chickens
- Sheep
- M & M Labor
- TOTAL

<table>
<thead>
<tr>
<th>Months of Operator Labor</th>
<th>Man-Year Equivalents of Labor</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
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### SWINE SUMMARY

- No. Litters Farrowed
- Pigs Weaned Per Litter
- Pounds Pork Produced Per Litter Sold Per Man
- Average Weight Sold
  - Told Pounds Pork Sold Per Man
  - Feed Costs per 100% Pork
  - Returns per $100 Feed Fed

### POULTRY SUMMARY

- No. Layers
- Eggs per Hen (Doz.)
- Egg Sales Per Hen

### BEEF FATTENING SUMMARY

- No. Fed Out
- Pound of Gain Total
  - Per Head
- Dairy Rate of Gain
APPENDIX D

The Variables
THE VARIABLES OF THE STUDY

$X_1 = \text{Program inputs, 1965}$
$X_2 = \text{Program inputs, 1964}$
$X_3 = \text{Economic understanding, 1965}$
$X_4 = \text{Average economic understanding between 1964 and 1965}$
$X_5 = \text{Difference in economic understanding between 1964 and 1965}$

$Y_1 = \text{Gross income, 1965}$
$Y_2 = \text{Gross income, 1964}$
$Y_3 = \text{Net cash income, 1965}$
$Y_4 = \text{Net cash income, 1964}$
$Y_5 = \text{Farm net income, 1965}$
$Y_6 = \text{Farm net income, 1964}$
$Y_7 = \text{Farm labor and management income, 1965}$
$Y_8 = \text{Farm labor and management income, 1964}$
$Y_9 = \text{Net margin, 1965}$
$Y_{10} = \text{Net margin, 1964}$
$Y_{11} = \text{Operating ratio, 1965}$
$Y_{12} = \text{Operating ratio, 1964}$
$Y_{13} = \text{Overhead ratio, 1965}$
$Y_{14} = \text{Overhead ratio, 1964}$
$Y_{15} = \text{Gross income per $1,000 invested, 1965}$
$Y_{16} = \text{Gross income per $1,000 invested, 1964}$
$Y_{17} = \text{Farm net income per $1,000 invested, 1965}$
$Y_{18} = \text{Farm net income per $1,000 invested, 1964}$
$Y_{19} = \text{Gross income per man equivalent, 1965}$
$Y_{20} = \text{Gross income per man equivalent, 1964}$
$Y_{21} = \text{Productive man work units (PMWU) per man equivalent, 1965}$
$Y_{22} = \text{Productive man work units (PMWU) per man equivalent, 1964}$
$Y_{23} = \text{Difference in gross income between 1964 and 1965}$
$Y_{24} = \text{Difference in net income between 1964 and 1965}$
$Y_{25} = \text{Difference in farm net income between 1964 and 1965}$
$Y_{26} = \text{Difference in net margin between 1964 and 1965}$
$Y_{27} = \text{Difference in operating ratio between 1964 and 1965}$
$Y_{28} = \text{Difference in overhead ratio between 1964 and 1965}$
$Y_{29} = \text{Difference in gross income per $1,000 invested between 1964 and 1965}$
$Y_{30} = \text{Difference in farm net income per $1,000 invested between 1964 and 1965}$
$Y_{31} = \text{Difference in gross income per man equivalent between 1964 and 1965}$
$Y_{32} = \text{Difference in PMWU per man equivalent between 1964 and 1965}$

*The variables are referred to in the matrixs found in Appendix E and F.*
APPENDIX E

Spearman Rank Order

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Pearson Product Moment Correlation

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