AN ANALYSIS OF HIGH AND AVERAGE MILK PRODUCTION DAIRY FARMS

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ABSTRACT

AN ANALYSIS OF HIGH AND AVERAGE MILK PRODUCTION DAIRY FARMS

By

Russel Winton Erickson

Average pounds of milk per cow has been increasing in Michigan over the last decade. There has also been a steady increase in the average pounds of milk per cow for those herds enrolled in the Dairy Herd Improvement Program. The average production of all herds on official test in this program is 12,973 pounds of milk. However, within this group of herds on test there is a wide variation in average production. Some herds produce less than 9,000 pounds of milk per cow and others produce in excess of 19,000 pounds of milk.

The basic question, which this survey of 80 dairy farms attempted to answer, was what are the differences in management practices and other variables between average production herds and top production herds when paired according to herd size and County. The specific objectives of the study were to examine certain management factors known to influence milk production and to try to identify some unknown factors such as motivation.

A personal survey was conducted which included the top 40 herds based on average pounds of milk per cow and their pairmate which had approximately average DHI production. The questionnaire was divided into six sections, demographic data, feeding, breeding, reproduction and herd health, calves and young stock, and motivation. The data were analyzed using a two sample T-test to determine significant differences between strata. The data were then subjected to a multiple regression, by least squares procedures, to circumvent the problem of univariate analysis, since most of the factors involved are essentially multivariate. The procedure of least squares allows one to make specific independent tests of significance on the direct effect of the various factors, however, this also permits one to ascertain which combination of variables is the most reasonable predictor of the dependent variable. The owners of high producing herds when compared to average producing herds would:

1. Not use breeding and dry dates on herd report
2. Be less likely to be a 4-H leader
3. Be less active in lodges and other non-related farm activities
4. Be more likely to have a will
5. Be less likely to rent more land in the future
6. Be less likely to have his children substitute for milking and chores
7. Be more inclined to make a county milk record with a little extra effort
8. Have a dry cow mastitis treatment

9. Vaccinate his calves for Pl3, IBR and BV D
10. Have more of his cows identified by sire number.
11. Have a higher percentage of his cows registered
12. Milk earlier in the morning in the summer
13. Have higher producing cows
14. Have higher low producing cows
15. Would have heavier cows
16. Have a higher single milk weight
17. Feeds more pounds of grain to average cows
18. Have a lower grade protein percent in the hay
19. Feed more grain to his top cow
20. Have more cows with milk fever and a higher veterinary bill
21. Have higher milk production goals, higher percent drop in milk, higher value of product, higher number of cows with sires who have a predicted difference.
22. Have a higher predicted difference of the sires of the cows in his herd

This research project has shown there are significant differences between high producing herds and average production herds of about the same size, located in the same county. It must be impressed upon the dairymen that some of the decisions he makes today will have there effect in six or seven years. This is evident in the difference between the two strata regarding the predicted difference for milk of the sires of the cows in the herd, these decisions were made at a minimum of four years ago.

Time spent using management tools such as the DHI report appear to increase milk production per cow.

Every dairyman is an individual, with certain habits, personal preferences, drives, capabilities, and certain ideas. The dairymen's routine is not always the same from day to day, therefore, it is difficult to establish patterns of behavior. The area of motivation is a very difficult subject on which to question a dairyman, because he may give you what is a sociably acceptable answer to a question rather than his true feeling.

There are many other variables and factors which were not included in this survey which may have an influence on high milk production.

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TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd). . .

LIST OF TABLES

LIST OF TABLES (Cont'd). . .

LIST OF TABLES (Cont'd). . .

APPENDIX LIST OF TABLES

INTRODUCTION

High milk production per cow depends upon many variables within a herd. According to Michigan Dairy Herd Improvement information and Michigan Telefarm data there is considerable variation among Michigan dairy farmers in the average production per cow. At the present time there are herds that have an average production per cow of 20,000 pounds of milk; yet, the average production of all cows in the Michigan Dairy Herd Improvement program in 1971 was 12,973 pounds of milk, and the average for all dairy cows in Michigan in 1971 was 9,700 pounds of milk. Hoglund and McBride (15) in an analysis of Michigan dairy farms state that as the pounds of milk sold per cow increase, there is a positive increase in the gross value of sales from the farm. Therefore, there is not only a difference between pounds of milk per cow produced, but also in the income generated from this increase in production. There continues to be a variation in production per cow on farms of similar size, similar labor supply, similar location, similar feeds and similar breeds of cows. Some production differences are difficult to detect; others are identifiable.

Some of these differences can be assumed to be a function of resources, but even more they may be the result of differences in management abilities and practices.

The success of a dairy farmer is determined by his ability to acquire and use his resources to achieve both monetary and non-monetary objectives. Success is usually measured by monetary objectives since these are quantifiable. Since many of the non-monetary goals cannot be measured accurately, success in dairy farm management is equated with maximizing income.

Management is a part of production which develops within the lives of men. It is a mental process, a concentration of desires and of will power. Dairy management is concerned with the decisions that affect the profitability of the dairy business. Management functions when a farmer is (1) observing and conceiving ideas, (2) analyzing and making further observations, (3) making decisions on the basis of analysis, (4) taking action and (5) accepting responsibilities. Obviously, the decisions that are made are reflected in the process of assembling and coordinating the factors of production: land, labor, cattle, equipment, credit and capital.

A problem of dairy extension specialists and research personnel alike, is the answer to the farmer question of "How can I increase the pounds of milk per cow?" This problem stems from a lack of information on the reasons for some dairymen having high milk production and other

farmers not being able to obtain these high levels. The objectives of this research proposal are to try to identify the differences between high and average producing dairy herds. A second objective would be to single out these variables and factors which have a significant influence on high milk production. A third objective is to relay to the average and below average dairymen the information obtained and to possibly motivate them to higher milk production.

REVIEW OF LITERATURE

Performance of an animal is determined by genetic and environmental circumstances. In the attainment of high milk production per cow there is interplay between heredity and environment. If the only goal is milk production per cow, the environment should provide an opportunity for each cow to produce up to inherited potential. When the goal is profit, then the environment should be one that maximizes profit.

This review will deal with the genetic and management decisions that influence level of production. Even though environmental variation is not transmitted, this should not lessen the breeders' efforts to provide a favorable environment that will permit the attainment of the animals' inherited potential. In many herds there must be animals that have a much higher potential performance than the environment permits them to express. This literature review will be restricted to those items thought to be important and for which information exists about their influence on level of milk production.

GENETIC VARIATIONS

Variation refers to the observable or measurable differences in individuals for a particular trait. If there were no variation between individuals, there would be no need to select and there would be no progress made through selection. All phenotypic variations in dairy cattle are due to heredity, environment, or the interaction of both. Hereditary variation in a dairy animal is due to differences in the kinds of genes with which the individual begins life. Environmental variations are those factors such as disease, feeding, temperature effects, and all external influences which the individual encounters from the time of conception until death. Plowman (31) has stated that genetics accounted for approximately 20 percent of the mean differences between herd averages. Feeding and management account for the other 80 percent. This does not mean that any two specific herds are only 20 percent different genetically. Expectations are that variation between herds should decrease with the increased use of artificial insemination and frozen semen.

Gaunt (12) has stated that in New York D.H.I.A. Al-sired Holsteins' genetic improvement was 103 lbs. and environmental improvement was 283 lbs. per year for the years 1956 to 1962.

There not only exists genetic variations between herds, but also genetic variation within a herd. Most of this variation within a herd is due to low repeatability of

records within cows. Johanson and Rendel (17) state that the variation within cows of age-corrected lactation yield of milk or butterfat is about 60 percent of the total variation within a herd.

Artificial insemination and progeny testing of bulls has had an impact on the genetic improvement which is possible per year. Robertson and Rendel (32) state that by natural service, selection of cows by culling the poorest, and saving sons from only the best cows the maximum possible genetic improvement per year would be one percent of the mean production. Through the use of artificial insemination and progeny testing it is possible to have a maximum improvement per year of 1.69 percent of the mean. This mean increase is obtained by making optimum use of artificial insemination and progeny testing within a population of 2,000 cows. Lush (23) has stated that their value may be too high because improvement possible by using sib-tests and pedigree information other than the records of the dam and paternal granddam with natural service and selection of cows only is omitted from that calculation. The AI industry has the potential of increasing genetic progress per year by intensification of selection. Lush (23) has stated that if one-tenth of one percent of the best bulls are saved, this would make the progress something like twice that by natural service. Artificial insemination can also change the genetic improvement per year through the use of more accurate progeny tests in two ways. A bull can have more

daughters, thereby reducing random errors. Secondly, the bull studs can be sure those daughters are scattered through many herds, thereby reducing environmental correlations.

McDaniels (25) holds that if selection is for milk production then the upper limit of genetic progress is approximately 2.3 percent per year. AI can permit special matings to a greater extent than can be done under natural service, thereby intensifying selection of dams of bulls. However, AI can be detrimental to genetic progress. Lush (23) contends that artificial insemination will tend to lengthen the generation interval from sire to son and from sire to daughter, especially if the proven sires are used for a long length of time.

Johannson and Rendel (17) found when semen of different bulls was largely distributed at random to herds associated with the bull stud variation in the average genotype of the herds almost completely disappeared during the course of a few cow generations. However application of different selection intensities among the females in the different herds is possible, but the possibilities of thereby differentiating the herds is relatively small, since the greater portion of the heifer calves born must be reared for herd replacements. The authors go on to write that after an AI unit has been in operation for some ten years the associated herds are to a large extent genetically similar except from random variation. If certain herds are consistently selected to receive the semen from

the best of the progeny-tested bulls, then the results can be quite different genetically.

If the current estimates of genetic parameters are approximately correct, any breeding system cannot be expected to improve milk production more than two percent a year. Even a much lower rate than this would be highly important in the long run because genetic improvement may be likened to compound interest. McDaniels (25) indicates that during the period 1953 to 1968, the American dairy cow population has been gaining genetically about 0.58 percent of the mean per year.

NON-GENETIC VARIATIONS

Milk production of cows is influenced by many factors, some of which are randomly distributed among different members of the population, whereas others are systematically distributed and so affect certain groups of individuals more than others. Causes of non-genetic variations are the age of cows, calving interval, and length of dry period. The age of the cow is an important non-genetic variation in yield. Production capacity of cows increases at a declining rate until the body is fully developed at six to eight years of age. After this, the capacity decreases at an increasing rate as aging of the body proceeds.

Length of the calving interval as determined by Johannson and Rendel (17) has an influence on milk yield. A shorter calving interval leads to a lower milk yield in

both the current and the succeeding lactations; the longer calving interval operates in the opposite direction. Speicher and Meadows (35) in their study of 4,285 Holstein cows indicate a reduction in daily yield of milk by three pounds as calving interval increased from less than 366 days to over 425 days, when cows were grouped by four productive ability categories. Other factors which affect yield are season of calving, persistency of yield, and management. Johannson (16) states that most of the variation in milk and butterfat yield between herds of the same breed is apparently due to differences in the level of nutrition and management. These changes may be temporary or they may follow a certain trend.

Actual yield of a cow is the manifestation of her genotype under a given set of environmental conditions. Under another set of conditions yield may be more or less. Absolute maximum yield which may be obtained when all environmental factors are present in the correct quantities may be rare.

IMPACT OF ARTIFICIAL INSEMINATION INDUSTRY

One of the management tools available to dairyman is artificial insemination. McDaniel (25) summarized ten different studies on the superiority of cows sired by AI bulls over their naturally-sired herdmates for milk yield and reported a range of from -173 to +536 with most values positive. McDaniel further reviewed five studies that

dealt with the expected daughter superiority from pedigree information on bulls put into AI use. These five studies done in the late 1960's showed an expected daughter superiority ranging from -37 lbs. of milk to a +317. In 1966 only 50 percent of the cows bred were to sires with a plus for daughter's milk. At the same time one cow in nine was bred to bulls that had a minus predicted difference. McDaniel (25) reported over 3.5 million services to Holstein proven bulls, the expected daughter superiority was +257 lbs. of milk and +7 lbs. of fat. Dairymen not now using AI would make initial gains of approximately +500 to +600 lb if he used the best bulls now available to dairymen. Genetic gain possible through AI in five years with selection strictly for milk production in the Holstein breed would be 1,536 lb of milk according to McDaniel, if the increase were 2.3 percent per year.

Thus use of top proven bulls available through an AI unit would be a very important management tool. McDaniel (25) reports that there may be ways to increase the production through AI without using the top proven bulls since the latter may be priced too high for the average dairyman. Substantial improvement can be made through careful selection of sires and dams of young sires. If the sires of the young bulls are +1000 and the dams are in the top one percent of the breed, and if the top ten percent of the young sires are saved, the approximate daughter superiority would be +1925 lbs. If all the young

bulls were saved, the daughter superiority would be +1179 lbs. of milk.

Dickinson (9) has stated that bulls with a range in predicted difference of 0-199 lbs. will increase the dollars change in income over feed cost by $3.74 per cow. However, if the range is +800 to +999 the dollar change in income over feed cost would be $28.85 per lactation. On the other hand, any bull with a negative predicted difference will decrease the dollar change in income over feed cost. The increase in income over feed cost which a dairyman with a 50-cow milking herd, and which the industry as a whole would receive annually from the use of AI bulls under present conditions and the three suggested levels of selection among these bulls were given by Dickinson and are reproduced below.

Level of Selection	Increase Received from a 50 cow Milking Herd in income over feed cost	Received by the Industry as a Whole (6,500,000 Cows)
	Dollars	Dollars
Present condition	243	31.5 million
Not use bulls below -400 lbs. PD for milk	391	50.8 million
Not use bulls with negative PD for milk	641	83.3 million
Not use bulls below +400 PD for milk	1090	141.7 million

PD = predicted difference

HERD MANAGEMENT

Bradford and Johnson (5) list five steps in management; they are:

1. Getting the ideas and making observations.
2. Analysis of observation, including formulation and reformulation of problems and ideas concerning their solution.
3. Decision-making
4. Action
5. Acceptance of responsibility for action

"Management" may be short range or long range depending on the problems involved and may be a daily job or extend over a long period of time.

The animals in a herd at the present time are consequences of previous action and past decision-making. However, the environment in which a cow is performing at the present time is a function of the type of management which is now employed. There are many known management factors that must be considered when herds are being analyzed to determine differences in milk production per cow. These include level of feeding, health of animals, conception rates, and milking systems as well as housing and feeding systems, size of operation labor quality, and availability.

NUTRITIVE REQUIREMENTS

A dairy cow's nutritive requirements must be met, in order to achieve high milk production. The cow must

have the proper balance and supply of energy, protein and other nutrients from the feed materials for maximum production.

According to Foley et al. (10) when feed is restricted, a dairy cow will use the available energy for maintenance and reproduction at the expense of growth and lactation. Cows should have enough protein to adequately supply the necessary amino acids for incorporation into protein that are needed for maintenance, growth, reproduction and lactation. If the energy, protein and other nutrients are not in the correct amounts, production will be suboptimal. Adequate supplies of water must be provided. Recommendations and requirements for dairy cattle are available from the National Research Council and dairymen are kept informed about feeding rates and problems through research and extension activities.

HEALTH

Health of a herd is very important in relation to high milk production, and is a function of the management of the herd. There are many health problems that severely reduce milk production. Probably the most common of these is mastitis and the dollar loss from this problem amounts to from $30 to $50 per cow per year (10). Mastitis reduces milk production per cow and severely affects milk quality. It is one of the most frequent reasons for culling cows and according to Bath and Bratton (3) ranks third behind

low production and infertility as reasons for culling.

Bath and Bratton (3) report the second most important reason for culling cows from herds is infertility. For maximum production per cow, dairymen would like one calf per cow per year. Unfortunately this is not the case. Anatomical, physiological, pathological, and certain management factors affect the efficiency of reproduction.

Management factors which may affect reproduction listed by Foley et al (10) are proper nutrition to eliminate the causes of infertility, breeding cows at the right period in the estrus cycle, observing cows for signs of heat, keeping breeding records, eliminating the chance of infection and the use of artificial insemination. There are many pathological and physiological causes of infertility.

Some of the pathological causes may be eliminated from a herd through vaccination or cleanliness of the maternity areas. In a study by Gangwar et al. (11) environmental factors such as season, temperature, humidity and light interact to affect reproduction. High temperatures shorten the duration and lower the behavioral expression of estrus in the cow. Thus there is more missed heat in summer than during the other seasons of the year (11).

There are also other health and nutritional disorders that should be reduced to increase milk production. Two of the most common disorders are acetonemia and milk fever. Incidence of milk fever may be reduced through certain feeding regime.

MILKING SYSTEMS

Most of the income in a dairy operation is from the sale of milk. Characteristics of good milking according to Foley et al. (10) include milking at regular intervals, fast, gentle, and complete milking, good sanitation procedures, and efficient use of labor. The authors state that persistent use of these procedures will result in increased milk yields, less mastitis, longer life in the herd and, ultimately, more profit per cow estimated. MacLachlan (24) reports that the milking operation requires more labor than any other single chore in the dairy barn. The milking equipment is sometimes badly neglected. MacLachlan (24) states that every milking system should be maintenance checked at least twice a year under a full operating load to assure maximum efficiency. Many times such factors as too many machines, inadequate vacuum, and poor maintenance are the cause of udder problems and reduced milk production.

A system to obtain rapid, efficient removal of milk from the udder should be the goal of every milking program because it is the largest single user of labor on the dairy farm, according to Foley et al. (10)

There are many different types of milking systems available. One of the major management decisions is the choice of a milking system, since the initial investment in either a pipeline system for a stanchion barn or for a milking parlor requires a large amount of capital according

to Foley et al. (10) There are many styles and designs of milking parlors which must be considered--each type has its advantages and disadvantages. However, many of the present dairymen in the Lake States still use a bucket-type milker and carry the milk by hand. Buxton and Hays (7) in their study of the Lake States found that 90 percent of the herds were housed in conventional barns with 80 percent of the operators using 2 or 3 standard milking machines and carrying the milk by hand to the milk room.

HOUSING SYSTEMS

The type of housing for a particular farm are influenced by many factors, such as climate, cost, size of herd, personal preference and the condition and layout of present buildings. The principal functions of any housing system for dairy cattle are to provide good working conditions for the personnel, to comply with sanitary codes, to provide a healthy, comfortable environment for the dairy animals and to integrate the housing facility with the milking, feeding and manure handling systems, according to Light (22).

Most of the housing in the Lake States in 1958 was of the conventional stanchion barns type with only 5 percent being loose housing and less than one percent being a combination, according to Csorba and Butler (8). In Michigan in January 1970, 68.1 percent of the dairy farmers were housing their dairy cattle in stanchion barns, and

5.6 percent had stanchion barns with switch-type milking. This would be considered a stanchion and loose housing or stanchion and free stalls as reported by Hogland and McBride (15). The type of housing is related to the size of the herd. These same authors state that 88 percent of the herds of less than 30 cows were housed in stanchion or stanchion switch barns. This drops to 70 percent when herd size increases from 30 to 49 cows. Open lot and free stalls make up the majority of housing for herds of about 75 cows. Hogland and McBride (15) expect the trends in the future will be toward free stall systems with milking parlors because of the less amount of labor required per cow in these types of operations.

FEEDING SYSTEMS

The objective of any system of feeding dairy cows is to reduce the hours of manual labor required for feeding and to provide the animals with the proper amount of feed at the right time and place, according to Foley et al. (10) The system involves the arrangement of the entire facility, types of storage, physical form of the feed materials, and the farmer's preference for feed materials.

Hogland and McBride (15) indicate a trend away from grazing and hay to harvesting forages as silage and haylage. They state that in the future most dairymen will feed largely corn silage and/or a haylage, as these practices lend themselves to highly mechanized harvesting and feeding

equipment. They indicate that a highly mechanized system will increase overhead expenses and reduce profit. It should further be noted that mechanical devices do fail, so an alternative method of feeding or auxiliary equipment should be available. The feed-handling system should be an integral part of the total dairy facilities in order to reduce the movement of feed from storage to ultimate consumption by the cow.

MANURE HANDLING SYSTEM

According to Light (21) the method of handling manure depends on the size of the herd, the housing system, available labor, and other management factors, as well as the location of the farm and health and sanitary regulations. Buxton and Hays (7) in their study of 567 Michigan dairy farms in 1967 indicate that 43 percent of the farms were hand loading materials on litter-carrier or were loaded directly into the spreader by driving through barns. Forty-eight percent tractor-loaded their manure and 29 percent used gutter cleaners, with one percent having liquid manure. Some farms in the survey had two different types of handling. Presently there is a definite trend toward liquid manure systems as the herds increase in size over 75 cows.

FARM MANAGEMENT

Nielson (28) with reference to management states: "I believe that a set of variables that may explain a large part of the variation in management outcome is managerial behavior or process--how the manager carries out the process

of management." Nielson further states that "we must also give attention to the personal characteristics of the managers, with the characteristics classified under the heading of Drives and Capabilities." Drives include motivation and variables which are likely to be related to it such as needs, goals, interest and attitude. Capabilities include such things as basic intelligence and various skills and abilities. In studying managerial performance we may include elements such as demographic information, drives, capabilities and processes for predicting managerial abilities.

Travis (39) writes that managerial performance appears to be the result of a complex interaction of variables and cannot generally be explained by means of the correlation of a few items of information about the manager with managerial performance.

Boettinger (4) compares managers to artists, and states: "They observe the world, conceive visions of how it can be changed, gather people and resources, develop deployment strategies and inspire their followers to turn their visions into reality." Suter (38) defines a skillful manager as "one who conducts his business, financial, personal and family affairs with economy, making whatever resources he has available go as far as possible toward achieving those ends he most desires." In this respect management abilities could be a very important aspect of obtaining high milk production per cow.

Willett and Albright (40) stated that maintenance of high production per cow is of prime importance in determining the success of a large dairy operation. Albright et al. (1) in a study of 440 large commercial dairy farmers, studied seven management factors. After adjusting for the overall size of the dairy operation, milk production per cow emerges as the most important factor which significantly influences economic performance over a five year period. However Speicher and Lassiter (36) stated "the assumption of a constant relationship between level of production and profits is erroneous." In reference to the 1966 Michigan Telfarm Summary, the range in labor income for milk sold per cow with production at less than 11,500 lbs. of milk was -$6,318 to $14,911. With 13,500 lbs. of milk sold per cow the labor income ranged from $8,416 to $41,683. Speicher further affirmed that the milk sales per cow is one of the important factors influencing income, but that it is only one of several. In a study of dairy farm income (36) Speicher states that milk production per cow is positively correlated to net income. He also found a linear trend between milk produced per cow and net income.

The literature contains many references to milk production per cow and the influence of different sources of variation affecting the milk production. Miller (26) in his analysis of 8,048 Dairy Herd Improvement Associations Holstein herds in 23 states from 1960 to 1964 stated that percent days in milk was a major factor influencing average

production. The variation in percent days in milk can be attributed to at least three sources. First of all, there is an automatic correlation with yield level because high producing cows dry off later than low producers. Secondly, differences in the length of time milk is produced are influenced by the level of breeding efficiency. Herds with a low conception rate will tend to have a larger number of average dry days. Finally, dairymen may vary their drying-off policies with respect to the level of production at which milking is halted. Miller further states that there is a strong relationship between percent days in milk and the level of production of herds.

In analysis of herd average summaries there is an indication of steadily widening margin of return per cow above feed costs as the herd's average production increases. McDaniel (25) found a correlation of .97 between income over feed cost and milk yield with prices constant. Speicher (36) found that differences in amounts of grain fed per cow were associated with 20.4 percent of the variation in milk production per cow.

Knisley (19) in a study of milking time in Michigan DHIA herds found that the high milk production group averaged one more cow milked per hour than the low production group, and that they had more milk per cow per milking than the low group. Knisley, in looking at manufacturers of milking machines, found a difference of 2.2 cow per hour between companies. This may be a factor in the number of

cows milked per man-hour and the amount of milk produced per man-hour.

MOTIVATION

Travis (39) in his study of 14 award-winning farm managers (the top three percent of all Telfarm participants) found that the winner sold 500 pounds of milk more per cow than 14 non-winners, with production of 12,800 and 12,300 lbs. respectively. He concluded there was only a slightly more feed disappearance per cow ($50) for the non-award group. There was a difference in housing between groups, in that the non-award group had more stanchion barns than the award group. This was reversed when it came to free stalls. Travis further stated that the milking system reflected the type of barn utilized. He questioned the two groups on the use of veterinarians for pregnancy examination and post-calving examinations on the reproductive tract; he found no difference. Further in his study, Travis states that there is a tendency for the award group to use some natural service bulls in these herds. In this study there was some tendency for the award winners to use more artificial insemination and to depend less upon the inseminator to select the bulls used. However, the differences between groups was slight. Fifty-seven percent of the non-award group used predicted differences, while 78 percent of the award winners used predicted differences as the main item in selecting sires to use. The remainder of the herds in the two groups left the choice of sires up to the inseminator.

Travis (39) also looked at some other factors, such as size of operation. The non-award groups operated an average of 249 acres and rented 71 acres, while the award-group operated 376 acres and rented an average of 79 acres. The award winners had 2.47 times as many cows as the non-award winners. Travis further studied some efficiency measures, such as milk sold per man, which was 287,100 lbs. for the non-award and 400,700 lbs. for the award winners. The average age of farmers in the Travis study was 46 years for the non-award and 51 years for the award winners. There was a six year difference in the years spent farming, with the winners averaging more. There was a one year difference in formal education with the award winners averaging 13 years. When the farmers were asked the factors contributing to their success as managers a high producing herd ranked third.

In a study by Hess and Miller (13) of 151 farms, 102 of these farms adjusted the protein level of grain ration during the year. These Pennsylvania researchers also studied some sociological factors influencing dairy farmers. They state that a dairyman's concept of a good level of milk production may serve as a source of motivation to improve his herd production. Twenty-eight operators who considered 11,000 lbs. or better to be a good herd had herds averaging over 9,000 pounds of milk per cow while those whose concept of good production was less than 9,500 had an average herd production of 7,700 lbs. This merely shows

that one's version of good production is 2,000 lbs. above present level of production - a level that the operator could achieve.

Hess and Miller in studying motivation found that a dairyman's self-rating of herd production in comparison to his neighbors may serve as a source of motivation to improve his herd's performance. Those operators who seriously underrate their herd's performance were actually operating herds with unusually high production and returns over feed cost. On the other hand, those who tended to overrate their herd performance were operating dairies with lower producing herds which yielded only fair returns above feed costs. To move to a more profitable position, the operator must be motivated to make use of knowledge and capital to improve his economic position. Insofar as motivation is lacking, the removal of capital and knowledge limitations may not produce the expected improvement in the farm's operation. This suggests that the source and nature of farmers' motivation constitutes a general problem area of considerable importance.

METHODS AND PROCEDURES

This survey was designed to personally interview dairymen whose herds were enrolled in the Dairy Herd Improvement Program in Michigan that had the highest average pounds of milk per cow in October 1971. These herds were then matched with a herd of similar size--on DHI--in the same county, with the same breed of cows, and having approximately

the average DHI production of 12,973 pounds of milk. Appendix Table 1 shows the number of cows and the average pounds of milk for each pair of herds. Also shown in this Table is the mean and standard deviation for each of the strata.

Sample Size and Sampling Frame

Sample size was primarily determined by the time available and the financial budget allocation for the survey. Considering these two factors the maximum number of dairy farms that could be visited was set at 80.

A listing of herds enrolled in the Dairy Herd Improvement Program, on official test, was obtained from Michigan DHIA Inc. The herds were listed by milk production in descending order. The 80 herds were then chosen and matched. Information was also obtained on farm location by township and section. There were 19 counties represented in the survey.

The Questionnaire

The questionnaire was designed with a one and one half hour interview time in mind. In the construction of the questionnaire, copies of instruments used by Kucker (20) and Roche (33) were consulted. The guidelines suggested by Backstrom and Hursh (2) and Kerlinger (18) were also followed in designing the questionnaire and in structuring the questions. The questionnaire was divided into six separate sections: demographic data, feeding, breeding,

reproduction and herd health, calves and young stock, and motivation. The initial questionnaire contained 130 questions with some of them having multiple answers. It was then pretested on dairy department faculty members and graduate students, as well as four dairymen with herds on test who were not included in the sampling frame. The questionnaire was then reduced to 123 questions, with the same sections as previously mentioned. A copy of the questionnaire is included in Appendix Table 2.

Interview Procedure

One half day was set aside to interview a dairyman. A letter of introduction was sent to each dairyman, which included a return postcard with which to reply whether the date and time for the interview was satisfactory. County maps, with township and section numbers, were obtained to use in locating the farm. The dairyman was given a copy of the questionnaire and a tape recorder was used to record the answers. This was found to be a most effective tool and no farmer objected to its use. However, each was assured that the material on the tapes would be destroyed after completion of the project. The tapes were reviewed so there was no misinterpretation. The interviews were begun in January 1972 and were completed in April 1972. Of the original 80 farmers chosen, six were dropped for various reasons. The final number of completed questionnaires was 74 or 37 pairs of herds. There were two substitutions to the original

list of herd owners with average production.

Method of Analysis

The collection of data is a very integral part of any research project and is generally very time-consuming. However, only through accurate and appropriate analysis is such data transformed into useful information.

In review of the objectives of this research project and the factors involved in this survey, the data are essentially multi-variate, because many of the factors questioned are interrelated and several may co-vary together. Thus the method chosen for analysis was the multiple linear regression by least squares analysis. However, not all of the variables considered would have a linear relationship. Speicher et al. (36) obtained curvilinear relationship with some management factors as they relate to net income. The model chosen for analysis was, $y = a + b_1x_1 + b_2x_2 + \ldots + b_nx_n$ where y is milk production in pounds, the dependent variable, a is a constant, b_1 is the regression coefficient, and x_1 is the value for a variable. Analysis was done using the least square addition model, where the variables that contribute the most to the total variation is added first; the least square deletion model was used for the final 35 variables. This model removes variables one at a time, starting with the variable that contributes the least to the total variation. Three separate computer outputs for the least squares addition program were necessary because of matrix

capacity of the computer. The variables selected, for each separate output, were those with a high simple correlation. In the least squares addition procedure if two variables are highly correlated only the variable that contributes the most to the multiple regression equation will be included. The variables included in the least squares are those which had 74 observations for each variable. The variables which were significant in the initial computer outputs, were then analyzed in a least squares deletion program. The least squares addition program does not give the regression coefficients or the standard partial regression coefficients as does the deletion procedure.

The procedures for least squares permits a specific independent test of significance on the direct effect of the factors. In this example, this procedure permits one to ascertain which factors or combination of variables are the most reliable predictors of high milk production per cow. There are some limitations to this type of analysis which should not be overlooked. Some variables that may have an influence on milk production may not have been included. Secondly, in multiple regression analysis, there is an assumption that all independent variables are not representative of the population, but are fixed. Most independent variables in this survey are random or representative of the population and thus estimates of partial regression coefficients may be biased and the usual variance-covariance matrix will not be correct.

The mean difference between each of the strata for each variable was analyzed using a two-sample t-test with paired observation according to the procedure shown by Steele and Torrie (37).

Data

The data were transferred from the questionnaires to 80-column computer cards. The first 11 columns of each card contained the card number, herd code number, the strata of the herd and the pair number. There were nine cards necessary for each herd. The variables and card columns are listed in Appendix Table 3. One question asked in the survey was not tabulated or analyzed. There were three questions where the dairymen were asked to rank given answers. When they did not rank all the answers, an average of the unassigned ranks was used for the missing values.

The data for 11 variables obtained from the DHI master file tape on May 1, 1972, were the number of cows, average pounds of milk per cow, average pounds of milk fat, fat test, average percent days in milk, average gross value of product, total cows in herd for past year, the number of cows with sires reported, the sire number of each cow and the number of calves with sires reported, as well as the sire number of these calves. Predicted differences for milk for the sires of the cows was obtained from the U.S.D.A. sire summary approximately one year prior to the birth of the cow. If no information was available at that time, the

earliest proof was used. The same procedure was used to determine the predicted differences for milk for the sires of the calves.

Items on the questionnaire were coded either as a rank, yes and no type answer, or numeric answers. Yes answers were coded as 1 and no answers as 0. If a question was not answered it was coded as blank. Open-ended questions were not analyzed because of the variation in responses. Simple correlations were obtained on variables thought to be associated and were analyzed to determine which variables should be included in the initial least squares addition program.

Herds with high average milk production will be referred to as stratum 1, while those with average production will be referred to as stratum 2.

RESULTS AND DISCUSSION

Demographic Data

This section of the survey dealt with the farm and the farm family in general. There were 56 questions asked, some of which required multiple answers.

There was no significant difference between the age groups in the two strata. The average age being 44.1 years. This does not differ significantly from the 44.4 years obtained by Kucker (20) on production testing adopters in Michigan. A positive simple correlation coefficient of +0.90 was obtained between age and years of farming. Age of the operator did not contribute significantly to the variation in milk production. The average years of education of surveyed dairyman was 11.7 years, with no significant difference between strata. Education was positively correlated with number of acres operated and number of acres owned with coefficients of +0.32 and +0.31 respectively. The respondents had farmed for 21.8 years, with no significant difference between strata. Number of years in farming was positively correlated with years on test and reading the Michigan Farmer magazine, but was negatively correlated with number of children under 16, number of acres rented,

and plans to buy or rent more land. Ninety-five percent of the respondents were married, 18 percent of the wives of dairymen in stratum one worked full time, while 31 percent of the wives in stratum two worked full time.

Years on test averaged 16 and there was no difference between strata. This variable was positively correlated with number of boys over 16, and years of age. Negatively correlated with this variance was renting more land. Years on test did not account for significant variation in the pounds of milk produced per cow.

Information on time spent studying the monthly dairy herd improvement report was obtained. The hypothesis that dairymen having higher average milk production would spend more time studying their report was supported (Table 1) by data obtained.

TABLE 1. Time Spent Studying the Dairy Herd Improvement Report

		Minutes per month	
	N	$\hat{u}$	$\hat{\sigma}$
Stratum 1	37	258.6*	305.6
Stratum 2	37	125.3	129.1

N = Number of observations in each stratum
* Significant at $p < .05$
u = mean
σ = standard deviation

There was a positive simple correlation between this variable and pounds of milk per cow, with a value of 0.28. When the 35 most significant variables were analyzed by a least squares deletion model procedure, time spent studying the report was not included in the final regression equation.

Dairymen were asked to rate four items which appear on the DHI report in order of importance and their rankings are given in Table 2. There was no difference in the ranking between strata.

TABLE 2. Rank of Selected Variables on Dairy Herd Improvement Report

Variable	Rank
Individual cow test day production	1
Rolling herd average production	2
Lactation to date information	3
Herd test day average information	4

Dairymen were asked whether they used the dollar value expected in 305 days, pounds of grain, last bred, and due date and the action needed sections of the Dairy Herd Improvement report and the percentages are given in Table 3. The significant difference in use of last bred and due date may have been due to dairymen in stratum one using another set of records for that purpose. Those dairymen in stratum one use the selected variable less than the respondents in stratum two.

TABLE 3. Percentage Use of Selected Variables on DHI Report

Variable	Stratum 1 Percent Yes	Stratum 2 Percent Yes
Dollar value expected in 305 days	35.1	45.9
Pounds of grain	21.6	24.3
Last bred and due date	32.4	54.1*
Action Needed	29.7	35.1

*Significant at $p < .05$.

Eighty-seven percent and 76 percent of those responding in strata one and two, respectively, were raised on dairy farms.

The number of children on a dairy farm is an important source of additional labor, as well as having an influence on the parent's participation in off-the-farm activities. Number of children had a positive correlation with the operators' activities in church and school, but not with the wives' participation in their off-the-farm activities. The only exception to this was in the case of girls under 16 and the mothers' activity in school affairs, where the simple correlation coefficient was +0.31. If there were boys in the family, there was a positive correlation with the plans to rent more land. If the children participated in the record-keeping program on the farm, there was a high correlation with participation involving finances, consulting and planning, with coefficients of

+0.73, +0.87 and +0.84, respectively. Children participating with chores had a high positive correlation with field work activity, the coefficient being +0.75. These data indicate that in some families children participate in chores and field work while in other families there is participation with records, finances, consulting and planning. There was a positive simple correlation between children's participation with farm activities, the number of children at milking and the pounds of milk per cow.

The hypothesis that farmers with high average milk production would be leaders in 4-H clubs was not supported by the data; actually the reverse was true (Table 4). In the multiple regression, this variable accounted for .48 percent of the total variation in the dependent variable.

TABLE 4. Percentage of Farmers in each Strata that were Leaders in 4-H

	N	Yes	No
Strata 1	37	29.7	70.3*
Strata 2	37	56.8	43.2

*Significant at $p < .05$.

The average number of magazines read was 5.3, with no significant difference between strata. Percent readership of selected magazines by strata is shown in Table 5.

TABLE 5. Percent Readership of Selected Magazines for each Strata

Magazine	Strata 1 % Readership	Strata 2 % Readership
Hoard's Dairyman	97.3	94.6
Farm Journal	83.8	83.8
Successful Farming	56.8	67.6
Dairy Herd Management	27.0	24.3
Michigan Farmer	78.4	81.1
Prairie Farmer	18.9	18.9
Reader's Digest	10.8	13.5
Farmers Advance	5.4	8.1
Holstein World	21.6	21.6
Michigan-Indiana Holstein World	18.9	16.2
Canadian Holstein World	0	2.7
Farm Quarterly	8.1	16.2
Top Operator	24.3	29.7
Big Farmer	8.1	8.1
Other Magazines	35.1	48.6

Number of magazines read was positively correlated with other magazines, with a coefficient of +0.59 and had no significantly influence on pounds of milk produced. There was a slight negative correlation between number of magazines read and pounds of milk produced per cow with a coefficient of -0.04.

There was no significant difference between the two strata for church activity, recreational activity, school and scout activity thus not confirming the hypothesis that farmers with average production were more involved in off-the-farm activities.

TABLE 6. Percentage of Respondents in each Strata that participate in off-the-farm Activities.

	N	Yes Percent	No Percent
		Operators Political Activities	
Stratum 1	37	2.7	97.3*
Stratum 2	37	16.2	83.8
		Operators Lodge Activities	
Stratum 1	37	0	100.0**
Stratum 2	37	19.4	80.6
		Operators Other off-the-farm Activities	
Stratum 1	37	0	100.0 **
Stratum 2	37	16.2	83.8
		Wives' Lodge Activities	
Stratum 1		2.7	97.3*
Stratum 2		21.6	78.4

*Significant at $p < .05$
**Significant at $p < .01$

There were significant differences in percentage of respondents in the two strata that participated in politics, lodge, or off-the-farm activities (Table 6). Wives' activities off-the-farm were not significantly different between the two strata except for the participation in lodge activities (Table 6).

In the initial analysis of the variables, operator's political activities, wives' recreational activities and children's scout activities entered into the multiple regression equation.

Sixty-five percent of the respondents listen to agriculture programs on radio or television. There was no significant difference between strata, and this variable did not significantly influence pounds of milk produced but had a negative simple correlation coefficient of -0.04 with pounds of milk produced.

The question of what would happen to the farm if the operator retired or if something happened was analyzed (Table 7). Many of the dairymen surveyed regarding a will did not have specific plans but indicated that the farm would be transferred to wife or family. There was no legal arrangement.

TABLE 7. What would happen to the farm at retirement or if some catastrophe happened?

Variable	Stratum 1 Percent	Stratum 2 Percent
Sold	8.1	8.1
Estate	2.7	8.1
Will	18.9	2.7*
Wife	16.2	16.2
Family	48.6	43.2
Other	8.5	18.9

*Significant at $p < .05$

On many farms wives are a very important part of the dairy operation. They are often sources of additional labor in peak labor demand periods. These wives are also very involved with record-keeping as well as with other duties. Table 8 gives the extent of wives participation in different areas of the dairy operation.

TABLE 8. Extent of Wives' Participation in Farm Activities

Variable	Stratum 1 Participation %	Stratum 2 Participation %
Records	48.6	54.1
Chores	45.9	59.5
Finances	30.6	40.5
Field Work	32.4	27.0
Planning	40.5	35.1
Consulting	37.8	32.4
Other	2.7	2.7

As can be seen from this table,wives were very involved in records and chores. There was no significant difference between strata. On many farms the wives were involved in the calf-raising program. In this survey, 22 percent of the wives fed the calves both winter and summer. There was no difference between strata. The simple correlation coefficients were small and ranged between -0.08 and +0.06 between wives' different farm activities and the pounds of milk produced.

Children on the farm are an important source of additional labor as previously mentioned. Many times children receive the responsibility of feeding of the calves. In strata one 41 percent of the respondents indicated that children fed the calves in the winter, and 43 percent indicated the children did this chore in the summer. In strata two, 31 percent of the dairymen indicated that the children fed the calves in the winter, while 39 percent indicated this was the children's job in the summer. Heat detection is also one of the responsibilities sometimes given children. In analysis of the data, 19 percent of the dairymen in Strata one indicated their children did this in the winter, while 30 percent of those in strata two indicated this same practice. These percentages are increased somewhat during the summer months to 24 percent for strata one and remain the same for strata two. There was no significant difference between strata for these categories. Children were also cited as a substitute for milking if the need arose.

Michigan dairymen have followed the practice of raising crops and marketing those crops through their livestock, therefore amount of land farmed becomes a very important item. One of the reasons for pairing herds on a county basis was to eliminate the differences which may exist in the quality of land area involved. Herds were paired within a county on the assumption that such herds would have a similar feed supply for the dairy herd. If herds had been assigned randomly, the variation in land quality and quantity as well as feed supplies may have been evident between the two strata. There was no significant difference between strata in the number of acres operated, number of acres owned, (220.5), number of acres rented, sale price per acre of land ($539.40) or investment in the farm ($118,937). Dairymen in strata one rented 99 acres of land, while those in strata two rented 87 acres of land. The number of acres operated, owned and rented had small positive correlations with pounds of milk. Thirty-five percent of the respondents in both strata indicated they plan to buy more land in the future, however, this is not the situation when questioned about plans to rent more land. (Table 9)

Information on amount of gross income from different enterprises on the farm was obtained by the questionnaire. Ninety-six percent of the respondents indicated that they received most of their gross income from the dairy

TABLE 9. Do you plan to rent more land in the future?

	N	Percentage Yes	Percentage No
Stratum one	37	24.3	75.7*
Stratum two	37	51.4	48.6

*Significant at $p < .05$

enterprise. There was a negative simple correlation between pounds of milk per cow and gross income from crop and hogs, with coefficients of -0.13 and -0.12 respectively.

Most of the farms surveyed were either family farms or partnerships, and therefore most of the labor was family labor. Labor hired amounted to 9 percent. This value was slightly lower than the 17 percent obtained by Kucker (20). Labor from wife and children was 24 percent and 67 percent was considered the operator's labor. There was no significant difference between strata. Percentage of labor hired was negatively correlated with pounds of milk (-0.20). Percent of labor from wife and children had a positive correlation coefficient (+0.18) with pounds of milk. Percent labor hired accounted for .88 percent of the total variation in the dependent variable.

An initial hypothesis was that the higher-producing herds housed their dairy animals in stanchion barns but there was no significant difference between the types of housing in the two strata. Table 10 gives the percentage in

each strata by type of housing.

TABLE 10. Types of Dairy Cattle Housing

Variable	Stratum 1 Percent	Stratum 2 Percent
Stanchion barn	64.9	48.6
Open lot-free stalls	5.4	5.4
Cold-covered free stalls	18.9	24.3
Loose housing	0	2.7
Stanchion barn and free stalls	5.4	13.5
Stanchion barn and loose housing	5.4	5.4
	100.0	100.0

Different methods of milk movement from the milking area to the milk house was analyzed. Table 11 gives the percentage in each strata that utilize different methods of movement.

TABLE 11. Percent of each stratum who utilize different methods of milk movement from milking area to milk house

Variable	Stratum 1 Percent	Stratum 2 Percent
Pipeline	52.4	43.2
Portable pipeline	29.3	43.2
Carried	18.5	13.5

There was no significant difference in the various means for the two strata. Portable pipeline milk movement system accounted for 10.1 percent of the total variation in the dependent variable.

Percent of cows registered had a positive correlation with milk produced per cow, with a coefficient of +0.28 and the distribution for the 2 strata is given in Table 12.

TABLE 12. Percent of Cows Registered

	$\underline{N}$	$\underline{\hat{u}}$	$\underline{\hat{\sigma}}$
Stratum one	37	66.3*	36.7
Stratum two	37	40.2	42.2

*Significant at $p < .05$

There is a trend toward dry lot feeding of the dairy cows throughout the year (15). The hypothesis that herds with a higher average level of milk production would have a higher incidence of dry lot feeding during the year than in average herds was not noted in the study with 94 percent of the respondents in both strata feeding their cows in dry lot. Other feeding regimes found in this study were strip-grazing, green-chopping and partial dry lot combined with pasture. Time spent feeding per day in the winter and summer may be used as a measure of feeding practice.

There were no significant differences between the two strata or between summer and winter feeding. Neither dry lot feeding, time spent feeding in the winter nor time spent feeding in the summer had a significant influence on the pounds of milk produced per cow ($r \approx 0.0$).

Milking time was investigated to obtain information on the hypothesis that higher producing herds would milk on a more regular basis than average producing herds. Strata differed significantly between the starting times of milking in the morning both in the summer and winter.

TABLE 13. Starting Time of Milking

	Morning-Winter	Morning-Summer
Stratum one	6:01*	5:43**
Stratum two	6:20	6:18

*Significant at $p < .05$
**Significant at $p < .01$

Milking time in the morning in the winter accounted for 0.40 percent of the total variation in the dependent variable.

Vaccum line size was investigated and the hypothesis was that the average producing herds would have a smaller vacuum line and therefore more problems with udder infection (Table 14). One trend in the dairy industry is toward larger vacuum lines.

TABLE 14. Vacuum line size and percent of respondents with that size

Variable Description	Stratum 1 Percent	Stratum 2 Percent
0.75" line	2.7	10.8
1.0" line	10.8	8.1
1.25" line	45.9	45.9
1.50" line	32.4	29.7
1.75" line	0	0
2" line	8.1	5.4
2.0" line	0	2.7

There was no significant difference in the percentage at any line size between the strata. However there was a difference between strata in the average bacteria count (Table 15).

TABLE 15. Average Bacteria Count for Dairymen in each Stratum

	N	$\hat{u}$	$\hat{\sigma}$
Stratum one	37	9500*	9504
Stratum two	37	14543	14051

*Significant at $p < .05$

The brand of milking machine was determined to ascertain if relationships to milk production or milk produced per cow existed. There was no significant difference detected between strata. The time spent milking per day was not significantly different between the stratum, nor was the time milking per cow with stratum one herds spending 2.1 minutes per cow and strata two herds taking 2.3 minutes per cow. The correlation between pounds of milk produced per cow and the time required to milk had a simple correlation coefficient of +0.19. The average number of men at milking in stratum one was 1.4 and for stratum two this variable was 1.2. When women and children over 16 are included in the milking labor the value for stratum one is 1.78 persons, while for stratum two this value is 1.48 persons. There was no significant difference between the strata for number of men, women or children milking. Number of women at milking accounted for 0.07 percent of the total variation in milk production per cow.

Milking requires more labor on the dairy farm than any other operation. One of the problems which arise on many dairy farms is that of whom the farmer would obtain for a substitute if he were unable to milk. Tabulation of whom farmers would obtain as substitutes is listed in Table 16. There was a significant difference in the mean percentage for children as substitutes between stratum. However, there is not a significant difference in the number of children in each of the strata. In stratum one herds

there is more reliance on other farm labor for substitute. This category may include parents of operator and parents

TABLE 16. The percentage of dairymen in each stratum who would obtain different substitutes for milking and chores

Variable Description	Stratum 1 %	Stratum 2 %
Neighbor	18.9	8.1
Wife	8.1	5.4
Neighbor boy	8.1	13.5
Children	10.8	37.8*
Other farm labor	43.2	29.7
Don't know	18.9	8.1
	100.0	100.0

*Significant at $p < .05$

of wife as well as hired labor. Nineteen percent of the owners of high producing herds do not have anyone they could contact for substitute milkers in case of illness or injury to themselves.

The hypothesis that herds of high producing ability have more problems with their cows than those of average production was tested. There was no significant difference between strata regarding the percentage of dairymen who indicated they had more problems with cows going off feed, reproduction problems, mastitis and udder problems, ketosis

and milk fever. The most noticeable difference was in milk fever problems, with 36 percent of the dairymen in strata one indicating there was more problem in this area, compared to 16 percent of the dairymen in stratum two. This difference was not statistically significant.

Dairymen were questioned concerning the order of importance of items for culling cows. The following table gives the ranking of items used in culling.

TABLE 17. Ranking of items used to cull cows by farmers in each stratum

Variable Description	Strata 1 Rank	Strata 2 Rank
Milk production	1	1
Fat production	5	5
Feet and legs	6	6
Mastitis and udder	3	3
Reproduction	2	2
Type	7	8
Disposition	4	4
Other	8	7

There was no difference in the ranking except for different ranking of the two least important items; type and other criteria.

A herd with a high average of pounds of milk per cow must contain some high producing cows. The respondents were asked to state the production level of their highest

producing cow (305 day-record) in 1971. The highest producing cows in stratum one averaged 24,450 pounds of milk with a standard deviation of 2851 pounds. High cows in stratum two averaged 18,798 pounds of milk with a standard deviation of 1713 pounds. There was a significant difference between strata, $p < .01$. Relationship of milk production of the highest producing cow to other items was studied and found to be positively correlated with lowest producing cow (+0.55) as well as with highest pounds of milk per day (+0.66) and average pounds of milk per cow (0.79). It accounts for the largest amount of total variation in average pounds of milk per cow. The amount of variation contributed by this variable is automatic because of the definition of the strata. In the multiple regression the variable of highest producing cow had a multiple correlation coefficient of 0.852.

Another variable was also investigated--that of the lowest producing cow which completed a 305 day record within each herd. There was a significant difference between strata, $p < .01$. Low producing cows averaged 12,302 pounds in strata one and 9,477 lbs. in strata two. This was the second most important variable accounting for the difference in milk produced per cow. The value for lowest producing cow was positively correlated with that for high producing cows and average pounds of milk produced per cow, with correlation coefficients of 0.55 and 0.73, respectively.

There was a significant difference between strata in the value for highest pounds of milk produced per cow per day ($p < .01$). The average highest one day production in stratum one was 113.1 pounds compared to 93.4 pounds for stratum two. This variable was correlated with average production per cow ($r = +0.67$).

There was a significant difference between strata in the average body weight of the cows, $p < .01$. Cows in stratum one averaged 1,378 pounds, while those in strata two averaged 1,311 pounds. Individual cows were not taped and the value used was the dairyman's estimate of the average weight of cows in his herd. Average body weight had a positive simple correlation with the dependent variable (0.30).

Data were gathered to test the hypothesis that dairyman with a high producing herd would be more interested in making a national, state, or a county milk record than would his pairmate in stratum two. The following table 18 gives the percentage in stratum one and stratum two who would attempt making records with a little effort. The table illustrates that there was a higher percentage for all three variables in stratum one. There was a high simple correlation between these three variables, with coefficients from +0.72 to +0.87. Making national, state and/or county records are all positively correlated with average pounds of milk per cow, with coefficients of 0.25, 0.26 and 0.29, respectively. Correlation measures

TABLE 18. Percentage of each strata who would make a record with a little effort

Variable Description	Stratum 1 Yes %	Stratum 2 Yes %
National record	83.8	62.2*
State record	89.2	70.3*
County record	94.6	73.0*

*Significant at $p < .05$

the degree of association between two variables independent of there units.

The average calving interval was investigated to determine if this variable accounted for any of the variation in milk production. The breeding records were not consulted, so the data represent the dairyman's estimate of his calving interval. There was only one-tenth of a month difference between the means of the two strata, a difference which was not significant. In retrospect, the records of each herd should have been examined to determine the actual calving interval, estimate may have been inaccurate. Oxender (30) in a study of 37 Michigan herds on test, found a calving interval of approximately 13 months which compares to the value of 12.8 months found in this study. This item may have been expected to be different between strata since both strata indicated more problems with reproduction in high producers than in average cows. There is also no

significant difference between strata when the variable, days after calving to breeding, was analyzed. The data presented here indicates that the variables of calving interval or calving to breeding interval had little or no influence on pounds of milk produced per cow. However data from actual breeding records should be used in any subsequent survey to more accurately determine this relationship.

Feeding

The feeds and feeding systems on a dairy farm are very important in obtaining high milk production per cow. The correct qualities, quantities and amount of feed must be delivered to the animals at the proper place and time. Farmers indicate the ingredients used in grain mix in order to determine the percent protein and therms of net energy in the grain mixture being fed. Ingredients were stated in amounts per ton or quantity per batch. To determine the percent protein and the therms of energy, values for feeds were obtained from numerous sources (14),(27), (29). When dairymen were feeding additional supplements proper values were included in the calculations for the protein and energy. The percent of protein and therms of net energy per hundred weight of concentrate did not differ significantly between the strata. Stratum one herds had a 14.5 percent protein and 72.2 therms of net energy per hundred weight of concentrate ration compared to 13.9 percent and 73.8 therms for stratum two. These variables were

not included in the multiple regression model, however, percent protein had a positive correlation with pounds of milk produced. Energy content of grain was negatively correlated with pounds of milk produced per cow (-0.24).

Miller and Hess (13) noted that 67 percent of the dairymen in Pennsylvania changed the protein control of their grain ration during the year. This item was investigated in the present study. There was no significant difference between strata. Thirty-eight percent of the dairymen in stratum one and 49 percent of the dairymen in stratum two changed the protein content of their grain mix during the year. This variable was not included in the least squares multiple regression equation. This variable had a positive correlation coefficient of +0.08 with pounds of milk produced per cow. Supplemental feed was fed by 41 percent of the dairymen in strata one and 32 percent of the respondents in strata two. Most of this supplement was added as a top-dressing as compared to being mixed with the feed or being fed in some other way.

Level of protein in the grain ration should be determined by the protein content of the roughage. Twenty-two percent of the dairymen in stratum one and 14 percent of those herd-owners in stratum two knew the percent crude protein in their corn silage. When asked if their hay had been tested for protein or fiber, 32 percent of the respondents in stratum one and only 14 percent of those in stratum two gave an affirmative answer. There was no significant

difference between strata on the percentage of positive answers. There was a simple correlation between knowing the crude protein of the corn silage and having their hay tested, with a coefficient of +0.51. The correlation between having hay tested and average production per cow was +0.29. The protein percentage of the corn silage and hay is given in Appendix Table 4.

There was no significant difference between strata in the percent protein of the hay for those dairymen who had their hay tested. The averages were 15.0 percent and 15.9 percent for strata one and two, respectively. If first and second cutting tests were taken, an average of the two values was obtained for the herd average. The respondents in both strata indicated that they cut their first cutting of hay approximately on June 1, with a mean difference between strata of 1.1 $\pm$ 0.27 days which was not significant.

Additives to corn silage to increase the protein content have been made available to the dairymen. Twenty-two percent of the dairymen in both strata used some type of additive to their corn silage. Sixty-three percent of those adding material to their silage added urea. The remainder added some commercial mixture.

There was a significant difference between strata on the average of concentrate fed per cow per day.

TABLE 19. Pounds of Concentrate to Average Cow per day by Stratum

	N	$\hat{\mu}$	$\hat{\sigma}$
Stratum one	37	20.6**	5.1
Stratum two	37	17.6	4.3

**Significant at $p < .01$

When included in the final least squares deletion method for multiple regression, it accounted for .07 percent of the total variation in average milk produced per cow. This variable has a positive correlation with milk production per cow (+0.38). The majority of the dairymen in both strata fed according to milk production, however, 8.6 percent of the respondents in stratum one and 19.4 percent of the respondents in stratum two fed all cows alike. The practice of feeding according to milk production had a low positive correlation with average production per cow (+0.16). Dry cows in both strata received an average of 3.7 pounds of grain per day, with no significant difference between strata. Sixty-eight percent of the respondents in stratum one and 60 percent in stratum two increased the pounds of grain prior to freshening. This is not a significant difference. The average cow in both strata received 10.3 pounds of grain prior to freshening, with no significant difference in means between the strata.

A significant difference was detected in the crude protein of the hay fed (17.1 percent vs. 17.7 percent, $p < .05$). If a dairyman had his hay tested, this value was used. If the dairyman did not have his hay tested a constant of 17.7 percent crude protein was used. Those in stratum one had a lower percent protein in the hay and a higher percent had their hay tested. Therefore the difference in means may be related to the number of dairymen who had their hay tested, and to the fact that the actual average was lower than the constant used. None of the variables referring to dry matter, crude protein or energy of corn silage, hay or haylage were used in the least squares analysis since there were unequal observations in each strata.

Over 75 percent of the respondents in both strata indicated that salt and mineral supplements were available free choice. Based on the hypothesis that dairymen with high producing herds were giving their cows a maximum amount of concentrates information on the dairymen's concept of whether their cows would eat more grain was advanced. Forty-six percent of the herd owners in stratum one and 49 percent of the herd owners in stratum two believed their cows would eat more grain. There was no significant difference between strata. The variable had a negative correlation with milk production per cow with a simple coefficient of -0.06. The hypothesis was advanced that dairymen with high producing herds fed their "top" cows more concentrates

than did the average member on DHIA. This hypothesis was supported and the average values for each stratum is given in Table 20.

TABLE 20. Average Pounds of Concentrates Fed to Top Cow in each Stratum

	N	$\hat{u}$	$\hat{\sigma}$
Strata one	37	33.2**	7.9
Strata two	37	26.6	7.0

**Significant at $p < .01$

This variable was positively correlated with average pounds of milk per cow, with a coefficient of +0.47. It was retained as one of the significant variables in the multiple regression equation and had a regression coefficient of +46.074 pounds of milk for each pound of grain.

Breeding

The hypothesis was tested that those dairymen with high producing herds bred their heifers at a later age than did the owners of average production herds, since there is a positive correlation between age and stature and weight up to maturity. In this investigation there was no difference between strata in the breeding age or breeding weight of heifers. However the standard deviation for weight at breeding was about 20 pounds more for stratum two. Average

weight of the heifers at breeding has a very slight negative correlation with average pounds of milk (-0.04).

Artificial insemination and frozen semen have increased the spread of genetic material. As mentioned previously there is a positive correlation between the predicted difference of a sire and the daughter's performance and the assumption is made that any bull not the result of a special mating has a predicted difference of zero. Artificial insemination has been available in Michigan for approximately 30 years. The average respondent in this survey had used A.I. for 17 years. There was no significant difference between strata. An average of 93 percent of the cows included in stratum one and 87 percent of those owned by respondents in stratum two were bred artificially. The value for heifers bred artificially was approximately 30 percent lower for both strata. Only 50.5 percent of the heifers owned by respondents in stratum two were bred artificially, while for stratum one this value was 63.6 percent. Both of these variables had a positive correlation with milk production, but were not included in the multiple regression model.

Sire selection by a dairyman is a very important decision that will affect future production and on an individual basis, the sire and dam are of equal importance. However, when the entire herd is considered, the sire or sires used are most important from a genetic standpoint. There are many different criteria for selection of sires.

The respondents in this survey were questioned on how they would rank ten different criteria in making a decision about what bull to use. The following table gives the criteria and ranking for both strata.

TABLE 21. Rank of Dairymen's Criteria for Selection of Sires

Variable Description	Stratum 1 Rank	Stratum 2 Rank
U.S.D.A. Predicted Difference	1	1
Type traits of the sire's daughters	2	2
Repeatability factor	4	4
Dam's milk and fat production	3	3
Ancestry (pedigree)	5	7
Pleasing color markings	9	9
Price of semen	7	8
Conception rate	6	5
Price of sire	10	10
Other criteria	8	6

As has been previously mentioned, if a farmer did not rank all the variables, an average of the unassigned ranks was used for the missing values. These rankings are different than those obtained by Kucker (20). However, his survey was a sample of all Michigan dairymen not only those on the DHI program. The U.S.D.A. predicted difference

information, which ranked first in this survey is made available by the extension service to herds on test, whereas it may not be available to all dairy herds in Michigan. This may account for some of the difference in rankings between the two investigations. The U.S.D.A. predicted difference is the best estimate available of what a sire's daughters will produce in relation to their herdmates. In this study, U.S.D.A. predicted difference ranked first as a criteria for sire selection, followed by type traits of the sires' daughters, dam's milk and fat production, and the repeatability factor. The other is an estimate of reliability of the predicted difference. There is no difference between strata on the first four rankings. A difference in ranking the use of pedigree information was found and those herd owners in stratum one ranked this variable higher than did those in stratum two. The cause for this may be the higher percentage of registered cows in stratum one.

One goal of herd management is to have one offspring from every cow each year and thus an examination of the reproductive performance seemed important. It was hypothesized that the respondents in stratum one would have a post partum examination by a veterinarian and also a more regular pregnancy check than did dairymen in stratum two. There was no significant difference between strata in either item. However, there was a slightly higher percentage of the dairymen in stratum one who followed the practice of

examination prior to breeding and pregnancy checks (51.4 vs. 43.2 percent and 62.2 vs. 51.4 percent). Both of these variables were positively correlated with average pounds of milk per cow but neither entered the multiple regression equation accounting for any of the variation in the dependent variables.

The decisions and selections which a dairyman makes today regarding the bulls used will not have any effect at the present time. However, they will have an effect in the future performance of his herd. The respondents were asked about the average predicted difference (for milk) of the sires presently used. The average P.D. in stratum one was 870.7 pounds of milk and 751.2 in stratum two and this difference was not significant. In order to ascertain if this value was near what the farmer was actually using, the sires of the calves born in the past year were identified. The information on P.D. for milk of those sires was obtained from the sire summary a year prior to the birth of the calf. The average P.D. for milk of sires of calves in stratum one herds averaged 807.8 pounds of milk. Those in stratum two averaged 694.1 pounds. The estimate given by the herd owner was slightly higher than the P.D. for the sires of calves. Estimates were 60 and 70 pounds higher, respectively. However, owners of herds in both strata may be using bulls at the at the present time which are on the average 60 to 70 pounds higher in P.D. than the bulls used the two previous years.

A hypothesis that the herd owners of high producing herds would be more affirmative in the concept that a breeder with 50-100 cows would be rearing and proving his own bulls was examined. There was no significant difference between strata, with 32 percent and 22 percent of herd owners in strata one and two, respectively, indicating that breeders should be rearing and proving own bulls. This variable had a slight positive correlation with milk production.

Reproduction and Herd Health

To maintain high milk production, cows in the herd must be healthy and able to reproduce on a regular schedule. The number of abortions in a herd can be used as an indication of the health of the herd. Stratum one had an average of 1.56 cows abort, while stratum two had .97 cows per herd abort ($p > .05$). One herd in the stratum one had 12 abortions due to infectious bovine rhinotracheitis. The number of abortions per herd had a small positive correlation with the dependent variable, but did not enter the multiple regression equation.

The detection of estrus is very important for an efficient breeding program. The respondents were asked how many times a day in winter and in summer, were their cows observed for heat and by whom. Cows are observed for heat more frequently in summer than in winter with averages during summer of 3.0 and 3.6 times per day for strata one

and two respectively. Observations were most frequently done by the operator himself as compared to wife, children and/or hired labor. The length of time the cows were observed for heat was questioned but not analyzed. Dairyman found difficulty in stating an exact time interval for this management practice. Most dairymen indicated they observed the cows while doing other chores. Only one dairyman interviewed indicated he spent 15 minutes twice a day doing nothing but observing for signs of estrus. Because of the difficulty of the respondents to answering this question, it was not analyzed.

Other common health-related problems are milk fever and ketosis and herds with higher average production were hypothesized to have a higher incidence of these problems than average producing herds. There was a significant difference between strata in the average number of cows with milk fever.

TABLE 22. Average Number of Cows in each Stratum with Milk Fever

	N	$\hat{u}$	$\hat{\sigma}$
Stratum one	37	6.2*	5.3
Stratum two	37	2.7	2.5

*Significant at $p < .05$

There was a higher average number of cows in both strata with milk fever than with ketosis. Both of these variables were positively correlated with average pounds of milk per cow. The simple correlation coefficient for milk fever was +0.41 and for ketosis was +0.08. The amount of money spent for veterinarian services was hypothesized to be more for dairymen in stratum one than for dairymen in stratum two. This was verified by the use of a two-sample T-test on the difference of two means.

TABLE 23. Average Cost of Veterinary Services by Stratum

	N	$\hat{u}$	$\hat{\sigma}$
Stratum one	35	\$1012**	\$615
Stratum two	36	\$ 488	\$302

**Significant at $p < .01$

This variable was not included in the initial least squares addition model since there was an unequal number of observations in each strata.

The relationship between the dairyman and his veterinarian is very important for a good herd health program. Answers to the question of whether a veterinarian visits a farm at times other than just when he is called gives some indication of the relationship which exists between the individuals. It also may indicate whether the

dairyman has a contract, verbal or written, with the veterinarian about the services to be performed, even though the question was not worded this way. There is no significant difference in the percentage of affirmative answers to this question. Sixteen percent of the respondents in stratum one stated that the veterinarian visited the farm between times called, compared to approximately three percent of those in stratum two. The simple correlation coefficient between this variable and average pounds of milk per cow is +0.11. There appears to be a trend with those dairymen who have high milk production to have a closer relationship with their veterinarians. This variable was not included in the multiple regression equation.

Mastitis control and prevention are very important to herd health and the production of a high quality milk. Some mastitis preventive measures are dry cow treatment and teat dip treatment. The detection of mastitis is also important to ascertain which cows may have abnormal milk. Answers to information about dry cow mastitis treatment, teat dip treatment and use of a strip cup were analyzed. There was a significant difference between strata in the percent of herd owners who used a dry cow mastitis treatment program.

This variable had a positive simple correlation with average production per cow (+0.31). The use of teat dip was not significantly different between strata, nor was

TABLE 24. Percent of Dairymen in each Stratum who use Dry Cow Mastitis Treatment

	N	Yes	No
Stratum one	37	89.2**	10.8
Stratum two	37	56.8	43.2

**Significant at $p < .01$

the use of a strip cup. Only 35 percent and 27 percent of the dairymen in strata one and two respectively used a strip cup.

Another important aspect of herd health is the calfhood vaccination program. Dairymen with high average pounds of milk per cow were hypothesized to vaccinate calves against more diseases than did dairymen with average DHI milk production. There was no significant difference between strata for the vaccination against Brucella; both strata indicated 100 percent vaccination. There was a significant difference in the vaccination program for Infectious Bovine Rhinotrocheitis, and the Virus Diarrhea-Mucosal disease complex and this is shown in Table 25. This practice had a positive correlation with average production per cow (+0.40). The vaccine is usually given in a combined form. There was no difference between strata on vaccination for porterurella and/or leptospirosis, with 24 percent and 14 percent of the respondents in strata one and two vaccinating for these diseases.

TABLE 25. Percent of Dairymen in each Stratum who Vaccinate Calves for IBR-PI_3-BVD

	N	IBR-PI_3-BVD	
		Yes	No
Stratum 1	37	64.9**	35.1
Stratum 2	37	27.0	73.0

**Significant at $p < .01$

Calf mortality is also an indicator of herd health, and it was hypothesized that more calves die at an early age in average producing herds than higher producing herds. The mean number of calf deaths in stratum one was 2.5 calves, while in stratum two the death loss was 5.6 calves ($p > .05$). This variable has a negative correlation with the dependent variable. Calf losses were highest in the first three weeks of age, with 80 percent and 92 percent of the calves which died in strata one and two being lost at this time. The calf mortality rate in stratum two was slightly lower than the estimate obtained by Speicher and Hepp (34) of 13.5 percent in their analysis of 379 Michigan dairy farms. The estimate for stratum one of a 5 percent loss is much lower than the 13.5 percent loss previously mentioned but stillbirths were counted in the 13.5 percent value and not in the present study.

The death loss of cows within a herd is an indication of level of management even though some losses may be accidental, others may be due to lack of sufficient observation. There was no significant difference between the mean death loss in the two strata.

The number of cows sold during the year could have an influence on the average pounds of milk produced per cow as calculated in the DHI program. To obtain the average production per cow the cumulative pounds of milk produced by each cow is divided by the total number of cows, including dry cows. Therefore if the cows sold are removed from the herd before a dry period starts, this would increase the percent days in milk as well as increase the average production of the herd. When the percent days in milk is approximately 85 percent, the average cow milked 305 days and had an average of 60 days dry. If this value increases above 85 percent, then the dairyman may be removing cows from the herd at the end of lactation. There was a significant difference between the strata on the number of cows sold the previous year (Table 26).

TABLE 26. Average Number of Cows Sold per Herd by Stratum

	$\underline{N}$	$\hat{u}$	$\hat{\sigma}$
Stratum one	37	15.4*	10.1
Stratum two	37	11.9	7.5

*Significant at $p < .05$

The number of cows sold has a positive simple correlation with the dependent variable (+0.23). There was a significant difference between strata in the percent days in milk (Table 27).

TABLE 27. Average Percent Days in Milk

	N	$\hat{u}$	$\hat{\sigma}$
Stratum one	37	88.6*	2.3
Stratum two	37	86.5	2.8

*Significant at $p < .05$

The simple correlation between percent days in milk and average production per cow was +0.39. This is in contrast to the previously mentioned work of Miller where it was stated that percent days in milk is a major factor influencing average production. The present study has less variation in the percent days in milk, as well as a much smaller sample size than the previous study by Miller.

Calves and Young Stock

The future of a dairy herd begins with the raising or purchase of the herd replacements. Calves must be properly raised to obtain heifers which are of sufficient size for breeding at the recommended age of 14-16 months. Differences in raising calves and young stock between the two strata were hypothesized. Seventy-six percent and 81

percent of the respondents in strata one and two indicated they fed a milk replacer starting an average of 7.3 and 5.8 days after birth for strata one and two respectively. Neither of these variables entered the multiple regression equation. Most of the feeding of the calves is done by the operator, wife and children, with the children doing a higher percentage of the feeding of calves in stratum one than in stratum two. Table 28 gives the percentage of the respondents and other persons who feed calves at different seasons.

TABLE 28. Percent Distribution by Stratum of Personnel Who Feed Calves

Variable Description	Stratum 1 Percent	Stratum 2 Percent
Operator-winter	37.84	56.76
Operator-summer	35.14	45.95
Wife-winter	21.62	21.62
Wife-summer	21.62	21.62
Children-winter	40.54	30.56
Children-summer	43.24	38.89
Hired labor-winter	5.41	8.33
Hired labor-summer	5.41	11.11
Other-winter	2.70	2.78
Other-summer	2.70	2.78

There is no significant difference in these percentages. Calves are weaned at an average age of 58.5 days by the respondents in stratum one and 57.1 days of age by the respondents in stratum two. Items used to determine time of weaning varied from farm to farm, therefore, factors which may determine weaning were investigated. Table 29 gives the factors and the percentages of owners in stratum one and two who use those factors to determine weaning time.

TABLE 29. Percentage of Dairymen in each Stratum who Indicate the Calves are Weaned by the Various Factors

Variable Description	Stratum one Percentage	Stratum two Percentage
Age	29.7	21.6
Amount of grain and hay consumed	24.3	32.4
Condition of calf	32.4	45.9
Combination of above factors	32.4	24.3

Percentage in each stratum using any one item was not significantly different.

Seventy percent of the farmers in both strata purchased a calf starter; the remainder fed calves herd ration or a special calf ration mixed on the farm.

Contracting to rear heifers is becoming popular in some parts of the country. As a matter of interest, we

investigated how many dairymen would contract their heifer raising from three days of age to the springing heifers stage for $300.00. Eleven percent of the respondents in stratum one and 31 percent of the respondents in stratum two indicated they would. Twenty-two percent and 14 percent of strata one and two respectively indicated they didn't know, or had not thought about it. Sixty-eight percent and 56 percent of owners in strata one and two, respectively, indicated that they were not interested in a contract arrangement.

Most dairymen in both strata sell bull calves rather than rear them. The majority of the bull calves were sold at seven days of age with a range in price from $40.00 to $50.00. Forty-three percent of the dairymen in stratum one indicated they sold an average of five bred heifers a year and received an average of $546.25. The eight respondents in stratum two who sold bred heifers averaged 4.4 heifers and received $478.13 each for these heifers. Four dairymen in each of the strata indicated they sold an average of 2.0 and 3.3 open heifers per year and received an average of $231.25 and $222.50 for owners in stratum one and in stratum two respectively.

Nineteen percent of the dairymen in stratum one indicated they purchased some heifers compared to 30 percent of those respondents in stratum two who indicated they purchased heifers.

Colostrum is the first milk secreted by the mammary gland after parturition. It is higher in energy and other milk constituents than normal milk. The excess colostrum not utilized by the calf can successfully be fed to other calves if diluted with water, rather than being wasted. There was no significant difference between strata in the percentage of owners that utilize the colostrum for feeding other calves.

Supplemental Information

Additional information on each herd in both strata was obtained from the DHI program master file on May 1, 1972. This information was the rolling herd average information, such as average number of cows, average pounds of milk per cow, pounds of milk fat per cow, average percent fat of milk, percent days in milk and gross value of the product. As would be expected, there was a significant difference between strata on the average pounds of milk per cow, the average pounds of milk fat per cow, the percent days in milk and the gross value of the product ($p < .01$). The average pounds of milk per cow was used as the dependent variable. There was a high positive multiple correlation between the variables mentioned and the average pounds of milk per cow. Average pounds of milk fat and gross value of the product were removed from the final least squares addition and deletion models because of the high single correlations obtained.

Information was obtained on the number of cows in the herd with a sire number reported. There was a significant difference between strata in the number of sires so reported (Table 30).

TABLE 30. Percent of Cows in each Stratum with Sire Numbers Reported

	N	Percentage
Stratum one	37	91.6**
Stratum two	37	62.9

**Significant at $p < .01$

The number of cows in a herd with sire reported, who had a predicted difference, was significantly different between strata (Table 31).

TABLE 31. Percent of Cows in each Stratum whose Sire had Predicted Differences Information

	N	Percentage
Stratum one	37	73.8**
Stratum two	37	49.5

**Significant at $p < .01$

This variable was not included in the multiple regression equation because of unequal observations but had a positive

simple correlation with average pounds of milk per cow (+0.38). There was a significant difference between strata in the average predicted difference of the sires of the cows in the herd at the present time (Table 32).

TABLE 32. Average Predicted Difference of Sires of Cows in Herd at Present Time

	N	$\hat{u}$	$\hat{\sigma}$
Stratum one	37	374.6**	189.4
Stratum two	35	215.1	178.1

**Significant at $p < .01$

This variable was not entered into the multiple regression equation because of unequal numbers in each strata.

The number of calves with sires reported was also analyzed. There was no significant difference between strata, nor was there a significant difference in the average predicted difference of the sires of the calves in the two strata.

Motivation

This is the most difficult section of the survey to obtain meaningful data and to analyze because of the lack of quantitative measures. There has been very little research done on the motivations that a farmer has for being in the dairy profession. Many of the questions asked are of an open ended nature giving a wide variety of answers.

The only significant difference detected in analysis of this section of the survey was on the milk production goals of the dairyman ($p < .01$). Those dairymen in stratum one have as their average milk production goal 19,185 pounds of milk, while the dairymen in stratum 2 had a goal of 16,333 pounds of milk produced per cow. Not all the farmers had a goal--only 88 percent of those in stratum one and 81 percent of the respondents in stratum two gave a definite goal. Most dairymen in both strata did not give any other overall goals for the future. They either did not have them formulated in their minds or they did not want to disclose this information.

The farmers in both strata belong to an average of 3.4 organizations, the majority of the dairymen attending over 75 percent of the meetings of these organizations. Most of the respondents in both strata received help from their parents or wives' parents through a partnership arrangement. However, 22 percent of the dairymen in stratum one and 16 percent of those in stratum two did not receive help from anyone.

Most of the decisions on purchases for the farm or house are made between the operator and his wife. The next most important decision-making group is the total family, followed by the operator and another member of the family. The decisions made by the operator and other members of the family are those decisions which are made in partnership-type operations.

Dairymen in both strata were asked which they enjoyed doing the most, field work or dairying. Table 33 gives the percentage in each stratum of the most enjoyed activity.

TABLE 33. Percentage of the most enjoyed activity by stratum

Variable Description	Stratum one Percentage	Stratum two Percentage
Dairy	54.05	29.73
Field work	8.11	29.73
Combination	37.84	40.54

There was no significant difference between strata for either of the three items when analyzed using the two sample t-test.

Most dairymen surveyed indicated that if they were not in the farming business, they would be in a profession which was oriented toward agriculture. The majority of the respondents indicated that they would not be happy working for someone else.

Multiple Correlation

The data were summarized using a CDC 3600 Computer and utilizing the least squares addition of variables to a multiple regression equation. The initial least squares addition of variables was divided into three separate analyses. This was necessary because of the number of

variables and the number of observations involved as well as the limits of the computer. Variables which had a simple correlation greater than .50 were included in the same initial computer output. The least squares addition procedure was used initially since it could not be determined which variables would influence the variation in pounds of milk produced. The variables which were added to the multiple regression equation with the stopping criterion that if a variable, under consideration for addition to the regression, is entered into the regression the probability of type I error for the F statistic for that variable will be less than or equal to .10. This stopping criterion was used throughout the entire analysis. By the method of least squares addition a number of variables were retained from each of the initial analysis for inclusion in a final analysis. There are limitations which are involved in combining variables from three separate results into a final least squares deletion procedure for multiple correlation and regression coefficients. One of the problems involved may be the correlation of variable not in the same computer results. Another problem involved is the number of total observations (74) and the number of variables involved (344). In survey information, an attempt should be made to limit the variable to less than the number of observations. This will help to circumvent some of the problems involved.

Table 34 gives the final ten variables, which are the result of the least squares deletion solution for a multiple regression. The final multiple correlation coefficient for these variables is .9279. This coefficient measures the closeness with which the regression plane fits the observations. Listed in Table 34 is the variable description, regression coefficients and partial correlation coefficients.

TABLE 34. Significant Variables in Multiple Regression Equation with Regression Coefficients and Partial Correlation Coefficients

Variable	Regression Coefficient	Partial Correlation Coefficient
Constant	-6388.65	-
HPC	0.30	0.70
RML	- 440.49	-0.23
PDAYM	128.22	0.34
PPIP	-951.50	-0.45
UN	-1221.50	-0.28
PLH	-30.43	-0.40
TOCG	46.07	0.33
LD4H	-556.22	-0.28
LBSG	46.10	0.21
LPC	0.28	0.42

*See Appendix Table Three for variable description

In analysis of the variables, the two of the three most important variables are high producing cow and low producing cow in the herd for 305 days. These two variables would be quite automatic, when the definition of the stratum was by highest producing herds and average production herds. There was a significant difference between the strata for both these variables. The second variable of importance was having a portable pipeline system. There was not a significant difference between strata, however there were more users of portable pipelines in the average strata. Percent labor hired (PLH) has a negative effect on the average production per cow. There was a difference between stratum for this variable which was not significant (6.8 percent vs. 11.0 percent). The intention of renting more land (RML) in the future was a significant variable. There was also a significant difference ($p < .05$) between the strata for this variable. Twenty-four percent of the dairymen in stratum one and 51.4 percent of the respondents in stratum two indicated they planned to rent more land in the future. The other variables which have a positive effect on average production are the percent days in milk (PDAYM), pounds of grain to top cow (TOCG), and pounds of grain to average cows (LBSG) in the herd. Negative effects not previously mentioned were the use of a universal (UN) milking machine and being a leader in the 4-H program (LD4H). The multiple regression coefficients would be used as the

coefficients of the variables included in the prediction of milk production.

SUMMARY

The dairy business is a very important segment of the Agriculture economy in Michigan. In 1970, the Dairy products sold accounted for 29 percent of the total agriculture farm marketing in the state.

Average pounds of milk per cow has been increasing in Michigan over the last decade. There has also been a steady increase in the average pounds of milk per cow for those herds enrolled in the Dairy Herd Improvement Program. The average production of all herds on official test in this program is 12,973 pounds of milk. However, within this group of herds on test there is a wide variation in average production. Some herds produce less than 9,000 pounds of milk per cow and others produce in excess of 19,000 pounds of milk.

The basic question, which this survey of 80 dairy farms attempted to answer, was what are the differences in management practices and other variables between average production herds and top production herds when paired according to herd size and County. The specific objectives of the study were to examine certain management factors known to influence milk production and to try to

identify some unknown factors such as motivation.

A personal survey was conducted which included the top 40 herds based on average pounds of milk per cow and their pairmate which had approximately average DHI production. The questionnaire was divided into six sections, demographic data, feeding, breeding, reproduction and herd health, calves and young stock, and motivation. The data were analyzed using a two sample T-test to determine significant differences between strata. The data were then subjected to a multiple regression, by least squares procedures, to circumvent the problem of univariate analysis, since most of the factors involved are essentially multivariate. The procedure of least squares allows one to make specific independent tests of significance on the direct effect of the various factors, however, this also permits one to ascertain which combination of variables is the most reasonable predictor of the dependent variable. The owners of high producing herds when compared to average producing herds would:

1. Not use breeding and dry dates on herd report
2. Be less likely to be a 4-H leader
3. Be less active in lodges and other non-related farm activities
4. Be more likely to have a will
5. Be less likely to rent more land in the future
6. Be less likely to have his children substitute for milking and chores

7. Be more inclined to make a county milk record with a little extra effort
8. Have a dry cow mastitis treatment
9. Vaccinate his calves for Pl3, IBR and BVD
10. Have more of his cows identified by sire number
11. Have a higher percentage of his cows registered
12. Milk earlier in the morning in the summer
13. Have higher producing cows
14. Have higher low producing cows
15. Have heavier cows
16. Have a higher single milk weight
17. Feeds more pounds of grain to average cows
18. Have a lower grade protein percent in the hay
19. Feed more grain to his top cow
20. Have more cows with milk fever and a higher veterinary bill
21. Have higher milk production goals, higher percent drop in milk, higher value of product, higher number of cows with sires who have a predicted difference.
22. Have a higher predicted difference of the sires of the cows in his herd.

In the least squares deletion solution to a multiple regression equation, all factors are included in the initial equation and are then deleted one at a time until a specified stopping criterion. The following are the final variables which were included in the equation in order of importance.

1. Highest producing cow
2. Lowest producing cow

3. Use of portable pipeline
4. Percent of labor hired
5. Pounds of grain to top cow
6. Percent days in milk
7. Universal milking machine
8. Leader in 4-H
9. Pounds of grain to average cow
10. Rent more land

The foregoing variables have a final multiple correlation coefficient of .9279.

This research project has shown there are significant differences between high producing herds and average production herds of about the same size, located in the same county. It must be impressed upon the dairymen that some of the decisions he makes today will have their effect in six or seven years. This is evident in the difference between the two strata regarding the predicted difference for milk of the sires of the cows in the herd, these decisions were made at a minimum of four years ago.

Time spent using management tools such as the DHI report appear to increase milk production per cow.

Every dairyman is an individual, with certain habits, personal preferences, drives, capabilities, and certain ideas. The dairymen's routine is not always the same from day to day, therefore, it is difficult to establish patterns of behavior. The area of motivation is a very difficult subject on which to question a dairyman, because he

may give you what is a sociably acceptable answer to a question rather than his true feeling. This area of motivation will require additional research and investigation to determine why a dairyman strives for high milk production per cow, is it prestige, recognition, status symbol, increased income, additional security, a goal or a desire to do the best he is capable of doing or is it to prove something to himself or others. It is evident from this survey that not all dairymen are interested in making or breaking records.

There are many other variables and factors which were not included in this survey which may have an influence on high milk production. I am sure many of these variables are difficult to measure or determine. A more indepth study would be needed to determine all the factors related to milk production.

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APPENDIX

TABLE 1. Herd pairs.

	Strata 1		Strata 2	
Pair	Average No.Cows	Average # Milk	Average No.Cows	Average # Milk
1	90	17,349	78	13,223
2	26	16,917	34	13,016
3	41	18,964	32	12,566
4	47	16,924	58	12,822
5	46	17,859	49	13,018
6	112	16,715	93	12,790
7	24	16,909	25	12,645
8	55	17,066	57	12,341
9	46	16,579	43	12,995
10	53	16,747	45	13,029
11	45	16,618	44	13,021
12	40	16,853	50	12,269
13	50	17,230	47	13,049
14	21	18,353	44	12,725
15	33	16,894	33	12,490
16	24	16,667	43	13,266
17	50	18,847	55	12,742
18	114	17,581	131	13,075
19	34	17,852	32	13,145
20	43	17,879	46	14,404
21	45	17,004	40	12,925
22	59	17,249	42	13,684
23	47	17,387	42	12,769

TABLE 1. Herd pairs (continued)

	Strata 1		Strata 2	
Pair	Average No.Cows	Average # Milk	Average No.Cows	Average # Milk
24	67	16,932	46	13,022
25	40	17,070	31	13,416
26	39	16,962	50	13,351
27	45	18,853	42	12,978
28	83	19,319	69	12,022
29	19	16,900	23	13,369
30	59	17,011	58	13,162
31	50	17,174	51	13,013
32	39	20,429	41	13,516
33	39	16,981	34	13,582
34	36	16,737	30	13,075
35	39	16,836	51	13,223
36	42	16,638	40	12,451
37	36	17,223	38	12,798
u =	48.05	17,392.1	47.75	12,999.6
σ =	21.50	880.4	19.71	435.5

TABLE 2. An analysis of high and average milk production dairy farms, personal interview questionnaire.

Herd code _____

Strata -- High _____ Low _____

A. Demographic data

1. Age of operator _____
2. Years of education of operator after 8th grade _____
3. Years of farming _____
4. Marital status -- 1. married ____ 2. single ____
5. Age of wife ____
6. Wife's education. Is she (or has she) worked for pay, full time ____, part time ____?
7. Years on DHI test _____
8. How much time a month do you spend studying the DHI report?
9. Rate the listed items on DHIA monthly report in order of importance.
    1. Test day average
    2. Rolling herd average
    3. Lactation to date
    4. Test day production
    5. $ value expected in 305 days
    6. Pounds of grain
    7. Last bred and due date
    8. Action ~~needed~~
    9. Other
    10. Other
11. Total number of children at home ____

12. Boys over 16 at home ____

13. Girls over 16 at home ____

14. Boys under 16 at home ____

15. Girls under 16 at home ____

16. Have you ever been a leader or are you presently a leader in 4-H?

17. Were you raised on a dairy farm? 1. Yes ____
2. No ____

18. What magazines do you read regularly?

1. 2.

3. 4.

5. 6.

7. 8.

9. 10.

19. What activities do your children participate in outside of agriculture related activities?

1. School _____ 2. Church _____

3. Scouts _____ 4. Sports _____

5. Other _____

20. What activities do you (the operator) participate in outside of agriculture related activities?

1. Political _____ 2. Church _____

3. Lodges _____ 4. Recreational _____

5. School _____ 6. Scouts _____

7. Other _____

21. What activities do you (the wife) participate in outside of agriculture related activities?

1. Political _____ 2. Church _____

3. Lodges _____ 4. Recreational _____

5. School _____ 6. Scouts _____

7. Other _____

22. Do you listen to agriculture programs on the radio or television?

    1. Yes ____ 2. No ____

23. What would happen to the farm when you retire or if something happened?

    1. Sold _____ 2. Estate _____

    3. Will _____ 4. Wife _____

    5. Family _____ 6. Other _____

24. (Wife) How much do you participate in the dairy farm operation?

    1. Records _____ 2. Chores _____

    3. Finances _____ 4. Field work _____

    5. Other _____ 6. Plan _____

    7. Consult on operation _____

25. (Children) How much do they participate in the dairy farm operation?

    1. Records _____ 2. Chores _____

    3. Finances _____ 4. Field work _____

    5. Other _____ 6. Consult on operation ___

    7. Plan _____

26. Number of acres operated? _____

27. How many tillable acres do you own? _____

28. How many tillable acres do you rent? _____

29. In the future do you plan to buy more land?

    1. Yes ____ 2. No ____

30. In the future do you plan to rent more land?

    1. Yes ____ 2. No ____

31. What would be the sale price per acre for your farm on today's market if it were sold?

32. What enterprise do you think you get the most gross income from on the farm?

1. Dairy _____ 2. Crops _____

3. Hogs _____ 4. Beef cattle _____

5. Other _____

33. What percent of your labor is hired? _____

34. What percent of your labor is wife and children? _____

35. How would you describe your dairy operation-type of facilities?

1. Stanchion barn or tie stalls _____

2. Open lot-free stalls and parlor _____

3. Warm enclosed-free stalls and parlor _____

4. Cold covered-free stalls and parlor _____

5. Loose housing and parlor _____

6. Stanchion barn and parlor _____

7. Stanchion barn and free stalls _____

8. Stanchion barn and loose housing _____

9. Other _____

36. How is milk moved from milking area to milk house?

1. Pipeline _____ 2. Portable pipeline _____

3. Small portable pull tank _____

4. Carried _____ 5. Other _____

37. If you have a parlor, what type of parlor?

1. Side open _____ 2. Herringbone _____

3. Walk thru _____ 4. Home made _____

5. Other _____

38. What percent of your cows are registered? _____

39. Do you feed your cows in dry lot during the summer?

1. Yes ____ 2. No ____

40. What time in the morning do you usually start milking?

Winter _____ Summer _____

41. What time in the afternoon do you usually start milking?

Winter _____ Summer _____

42. What size of vacuum line do you have?

1. 3/4 inch ____ 2. 1 inch ____

3. 1 1/4 inch ____ 4. 1 1/2 inch ____

5. 1 3/4 inch ____ 6. 2 inch ____

7. Over 2 inches ____

43. What brand of milking machine are you using?

1. Surge ____ 2. DeLaval ____

3. Bou-Matic ____ 4. Universal ____

5. Zero ____ 6. Sta-rite ____

7. Jamesway ____ 8. Condi ____

9. Combination ____ 10. Other ____

44. How long does it take to milk -- per milking?

_____. How many cows? _____.

45. How many persons do you have at milking time, washing udders and handling machines?

Men _____ Women _____

Children _____ Ages _____

46. If the need arises for a substitute, who do you have do your milking and chores?

1. Neighbor _____ 2. Wife _____

3. Neighbor boy _____ 4. Children _____

5. Other farm labor ____ 6. Don't know _____

47. How much time do you spend excluding manure handling?

	Summer	Winter
Feeding	_____	_____

48. What was your average bacteria count last month?

_____

49. What problems do you have with your high producing cows that you do not have with your average cows?

1. Going off feed ____ 2. Reproduction problems ____

3. Mastitis and udder problems ____

4. Ketosis ____ 5. Milk fever ____

6. Other ____

50. List the order of importance of the following items for culling cows

1. Milk production ____ 2. Fat production ____

3. Feet and legs ____ 4. Mastitis and udder problems ____

5. Reproduction ____ 6. Type ____

7. Disposition ____ 8. Other ____

51. How many pounds of milk did your highest producing cow give last year in 305 days? ____

52. How many pounds of milk did your lowest producing cow give last year in 305 days? ____

53. What is the average weight of the last 5 cows you sold?

_____

54. What is the highest pounds of milk given by any of your cows in a single day? _____

55. If you had a cow that could make a world record with a little effort, would you do it ?

A state record 1. Yes ____ 2. No ____

A county record 1. Yes ____ 2. No ____

56. What is your average calving interval? _____

FEEDING

57. What has been the composition of your grain mix since January 1?

1. Shelled corn ____ Amount ____ Prot. ____ ENE ____
2. Oats _____ Amount ____ Prot. ____ ENE ____
3. Wheat _____ Amount ____ Prot. ____ ENE ____
4. Beet pulp _____ Amount ____ Prot. ____ ENE ____
5. Protein supple.__ Amount ____ Prot. ____ ENE ____
6. Salt _____ Amount ____
7. Minerals _____ Amount ____
8. Corn & cob _____ Amount ____ Prot. ____ ENE ____
9. H.M. Corn _____ Amount ____ Prot. ____ ENE ____
10. Vit. A _____ Amount ____
11. Barley _____ Amount ____ Prot. ____ ENE ____
12. Molasses _____ Amount ____ Prot. ____ ENE ____
13. Linseed meal ____ Amount ____ Prot. ____ ENE ____
14. Soybean meal ____ Amount ____ Prot. ____ ENE ____
15. Vit. D _____ Amount ____
16. Other _____ Amount ____ Prot. ____ ENE ____
17. _____ Amount ____ Prot. ____ ENE ____
18. _____ Amount ____ Prot. ____ ENE ____

58. Do you change your grain mix composition during the year?

1. Yes ____ 2. No ____

59. If no supplement is included in the ration, is any additional supplement fed?

1. Yes ____ 2. No ____

3. How much? _____ 4. How Fed?

a. Mixed with feed by hand _____

b. Top dressed _____

c. Other _____

60. Do you know the crude protein percent of your corn silage?

1. Yes ____ 2. No ____

3. If yes, what is it? _____

61. Do you add any additive to your corn silage?

1. Yes ____ 2. No ____

If yes, what? 1. Urea ____. 2. Commercial additive ____

3. Anhydrous ammonia ____ 4. Other ____

How much per ton? _____

62. Do you have your hay tested?

1. Yes ____ 2. No ____

If yes, what percent protein? 1st test _____

2nd test _____

63. When do you cut your 1st cutting of hay?

After April 30 _____

64. In your winter feeding program, how many pounds of grain per day was fed to your average producing cows?

_____

65. What is your feeding guide?

1. According to milk production ____

2. According to fat production ____

3. According to cows condition ____

4. Give all the cows the same ____

5. Other ____

66. How many pounds of grain does the average dry cow get? _____

67. Do you increase the pounds of grain to dry cows before calving?

1. Yes ____ 2. No ____

How many pounds of grain are they receiving prior to calving? _____

68. How many pounds of corn silage per day do you feed your milking cows in an average year? _____

69. How many pounds of hay is fed per day to your milking cows in an average year? _____

70. How many pounds of haylage is fed per day to your milking cows in an average year? _____

71. If haylage is fed, what is the percent protein? ____

72. Is salt and mineral available free choice? _____

73. How many pounds of grain a day did your top cow receive last year? _____

74. Do you think your cows would eat more grain?

1. Yes ____ 2. No ____

If yes, why don't you give them more? _____

_____

BREEDING

76. At what age do you breed your heifers? _____

77. At this age, how much do they weigh? _____

78. What percent of the cows are bred artificially? _____

79. What percent of the heifers are bred artificially?

_____

80. In what order do you rank the following in making your decision about what bull to use?

1. Dam's milk and fat production ____
2. Ancestry (pedigree) ____
3. U.S.D.A. predicted difference ____
4. Pleasing color markings ____
5. Type traits of sire's daughters ____
6. Repeatability factor ____
7. Price of sire ____
8. Price of semen ____
9. Conception rate ____
10. Other ____

81. Are cows examined after calving to determine if they are ready to rebreed?

1. Yes ____ 2. No ____

82. Are cows examined for pregnancy after breeding by a veterinarian?

1. Yes ____ 2. No ____

83. How long after calving are your cows bred for the first time? _____

84. How many years have you used A.I.? _____

What is the average predicted difference of bulls used now? _____

85. Do you think the breeder with 50-100 cows should be trying to rear and prove his own bulls?

1. Yes ____ 2. No ____

REPRODUCTION AND HERD HEALTH

86. How many cows aborted in the past year? _____

87. How many times a day are your cows observed for heat in the winter? _____

By whom? 1. Operator ____ 2. Wife ____

3. Children ____ 4. Hired labor ____

88. How many times a day are your cows observed for heat in the summer? _____

By whom? 1. Operator ____ 2. Wife ____

3. Children ____ 4. Hired labor ____

89. How long a time each day are the cows observed for heat? _____

90. How many cows had milk fever last year? _____

91. How many cows had ketosis last year? _____

92. What was your veterinarian bill last year? _____

93. Does the veterinarian visit your farm in between the times you call him?

1. Yes ____ 2. No ____

94. Do you have a dry cow mastitis treatment program?

1. Yes ____ 2. No ____

95. Do you use a teat dip? _____

96. Do you use a strip cup? _____

97. Are your calves vaccinated for

1. Brucella ____ 2. PI_3 (shipping fever)

3. IBR (red nose)____ 4. BVD (virus diarrhea)___

5. Porterurella (shipping fever) ____

6. Leptospirosis ____

98. How many calves died last year? _____

1. Under 3 weeks ____ 2. 3 weeks-3 months ____

3. 3 months-1 year ____

99. How many cows were sold last year? _____

100. How many cows died last year? _____

CALVES AND YOUNG STOCK

101. Do you feed your calves a milk replacer?

1. Yes ____ 2. No ____

If yes, when do you start? _____

102. Who usually does the feeding of the calves?

	Winter	Summer		Winter	Summer
1. Operator	_____	_____	2. Wife	_____	_____
3. Children	_____	_____	4. Hired labor	_____	_____
5. Other	_____	_____			

103. How old are your calves when they are weaned? _____

104. What determines when the calves are weaned?

1. Age ____
2. Amount of grain and hay consumed _____
3. Condition of calf ____
4. Combination ____

105. Do you feed a purchased calf starter?

1. Yes ____
2. No ____

106. If no calf starter, what is fed?

1. herd ration ____
2. special calf ration -- mixed by farmer ____
3. Other ____

107. Would you contract your heifer raising from 3 days of age to springing heifers if someone would do it for $300?

1. Yes ____
2. No ____
3. Undecided ____

108. What do you do with most of your bull calves?

1. Sell ____
2. Raise ____

If sold, at what age _____

How much do you get at this age? _____

109. Do you sell any bred heifers?

1. Yes ____
2. No ____

If yes, how many a year? ____

What do you usually receive? ____

110. Do you sell any open heifers?

1. Yes ____ 2. No ____

How many a year? ____

What do you usually receive? ____

111. Do you feed calves all of your colostrum?

1. Yes ____ 2. No ____

112. Do you purchase any heifers?

1. Yes ____ 2. No ____

MOTIVATION

113. When you started to farm did you receive any help from your parents or your wife's parents such as:

1. Land ____ 2. Cattle ____

3. Money ____ 4. Labor ____

5. Machinery _____

6. Was this a partnership before you became the operator? _____

7. Advise ____ 8. Other ____

114. What organizations are you active in?

	Officer	Pay Dues	On Committee	Attend 75% Meetings
1.	_____	_____	_____	_____
2.	_____	_____	_____	_____
3.	_____	_____	_____	_____
4.	_____	_____	_____	_____

115. Which do you enjoy the most, field work or dairying?

1. Field work ____ 2. Dairying ____

116. What goals regarding milk production do you have for the next five years? _____

117. What overall goals do you have for the future?

Operator _____

Wife _____

118a. Who is involved in making a decision on a purchase?

1. Operator only ____ 2. Wife only ____

3. Operator & wife ____

4. Operator & other member of the family ____

5. Wife and other member of the family ____

6. Total family ____

118b. What criteria do you use for making decisions?

_____

119. From the standpoint of the family, what are the advantages of farm living as compared to city living?

120. What are the disadvantages to farm living?

121. What other profession would you like to be in, if you were not in farming?

122. Do you think you could be happy working for someone else?

123. What do you consider the best possible source of information on:

1. Cropping _____

2. Nutrition of dairy cattle _____

3. Breeding of dairy cattle _____

4. Dairy buildings _____

5. Dairy equipment _____

TABLE 3. Card format.

Variable Name	Variable Number	Variable Description	Card No.	Col.
St.	1	Strata	1	9
PNO	2	Pair Number	1	10-11
Age	3	Age of Dairyman	1	12-13
Ed.	4	Education	1	14-15
YDFM	5	Years of Dairy Farming	1	16-17
MOS	6	Marital Status	1	18
YAge	7	Wife's Age	1	19-20
YWork	8	Wife's Work	1	21-22
YTest	9	Years on Test	1	23-24
TMire	10	Time Spent Studying DHIA Report (Monthly Minutes)	1	25-29
TDA	11	Rank on Test Day Average	1	30
RHA	12	Rank on Rolling Herd Average	1	31
LTD	13	Rank on Lactation to Date	1	32
TDP	14	Rank on Daily Production	1	33
DUAL	15	% Use of Dollar Value	1	34
LBGR	16	% Use of Lbs. of Grain	1	35
BDDA	17	% Use of Breeding and Dry Dates	1	36
ACTN	18	% Use of Action Needed Col.	1	37
O	19	% Use of Other Parts of DHI Report	1	38
OT	20	% Use of Other Parts of DHI Report	1	39
NOCH	21	Number of Children	1	40
BO16	22	Number of Boys Over 16	1	41

TABLE 3. Card format (continued).

Variable Name	Variable Number	Variable Description	Card No.	Col.
GO16	23	Number of Girls Over 16	1	42
BO6	24	Number of Boys Under 16	1	43
GO6	25	Number of Girls Under 16	1	44
LD4H	26	Leader in 4-H Program	1	45
RDF	27	Raised on a Dairy Farm	1	46
MAGR	28	Number of Magazines Read	1	47-48
HD	29	Hoard's Dairyman	1	49
FJ	30	Farm Journal	1	50
SF	31	Successful Farming	1	51
DHM	32	Dairy Herd Management	1	52
MF	33	Michigan Farmer	1	53
PF	34	Prairie Farmer	1	54
RD	35	Reader's Digest	1	55
FA	36	Farmer's Advance	1	56
HW	37	Holstein World	1	57
MIHW	38	Michigan-Indiana Holstein World	1	58
CHW	39	Canadian Holstein World	1	59
FQ	40	Farm Quarterly	1	60
TO	41	Top Operator	1	61
BF	42	Big Farmer	1	62
OTH	43	Other Magazines	1	63
CSC	44	Children-School Activities	1	64
CSH	45	Children-Church Activities	1	65

TABLE 3. Card format (continued).

Variable Name	Variable Number	Variable Description	Card No.	Col.
CSCO	46	Children-Scouts Activities	1	66
CSP	47	Children-Sports Activities	1	67
COT	48	Children-Other Activities	1	68
OPO	49	Operator-Political Activity	1	69
OCH	50	Operator-Church Activity	1	70
OLO	51	Operator-Lodge Activity	1	71
ORE	52	Operator-Recreational Activity	1	72
OSC	53	Operator-School Activity	1	73
OSCO	54	Operator-Scout Activity	1	74
OOT	55	Operator-Other Activities	1	75
WPO	56	Wife-Political Activity	2	12
WCH	57	Wife-Church Activity	2	13
WLO	58	Wife-Lodge Activity	2	14
WRE	59	Wife-Recreational Activity	2	15
WSC	60	Wife-School Activity	2	16
WSCO	61	Wife-Scouts Activity	2	17
WOT	62	Wife-Other Activities	2	18
ROT	63	Listen Radio or TV	2	19
SOL	64	Farm Sold	2	20

TABLE 3. Card format (continued)

Variable Name	Variable Number	Variable Description	Card No.	Col.
EST	65	Estate	2	21
WIL	66	Will	2	22
WIF	67	Wife	2	23
FAM	68	Family	2	24
OTH	69	Other Arrangements	2	25
WPR	70	Wife-Participate Records	2	26
WPC	71	Wife-Participate Chores	2	27
WPF	72	Wife-Participate Finances	2	28
WPFW	73	Wife-Participate Field Work	2	29
WPOT	74	Wife-Participate Other	2	30
WPPL	75	Wife-Participate Planning	2	31
WPCO	76	Wife-Participate Consulting	2	32
CPR	77	Children-Participate Records	2	33
CPC	78	Children-Participate Chores	2	34
CPF	79	Children-Participate Finances	2	35
CPFW	80	Children-Participate Field Work	2	36
CPOT	81	Children-Participate Other	2	37
CPCO	82	Children-Participate Consulting	2	38
CPP	83	Children-Participate Planning	2	39

TABLE 3. Card format (continued).

Variable Name	Variable Number	Variable Description	Card No.	Col.
NAOP	84	Number of Tillable Acres Operated	2	40-43
NAOW	85	Number of Tillable Acres Owned	2	44-47
NAR	86	Number of Tillable Acres Rented	2	48-51
BML	87	Buy More Land	2	52
RML	88	Rent More Land	2	53
SAPA	89	Sale Price Per Acre	2	54-57
DA	90	Gross Income - Dairy	2	58
CR	91	Gross Income - Crops	2	59
HO	92	Gross Income - Hogs	2	60
BC	93	Gross Income - Beef Cattle	2	61
OTHE	94	Gross Income - Other	2	62
PLH	95	Percent Labor Hired	2	63-65
PLWC	96	Percent Labor Wife & Children	2	66-68
PLO	97	Percent Labor Operator	2	69-71
SB	98	Stanchion Barn	2	72
OLFS	99	Open Lot-Free Stalls	2	73
WEFS	100	Warm Enclosed-Free Stalls	2	74
CCFS	101	Cold Covered-Free Stalls	2	75
LH	102	Loose Housing	2	76
SBP	103	Stanchion Barn & Parlor	2	77
SBFS	104	Stanchion Barn & Free Stalls	2	78

TABLE 3. Card format (continued).

Variable Name	Variable Number	Variable Description	Card No.	Col.
SBLH	105	Stanchion Barn & Loose Housing	2	79
Other	106	Other Housing	2	80
PIP	107	Pipeline	3	12
PPIP	108	Portable Pipeline	3	13
SPT	109	Small Pull Tank	3	14
CA	110	Carried	3	15
Ther	111	Other	3	16
PSO	112	Parlor Side Open	3	17
PHE	113	Parlor Herringbone	3	18
PWT	114	Parlor Walk Thru	3	19
PHM	115	Parlor Home Made	3	20
POT	116	Parlor Other	3	21
PGR	117	Percent Cows Registered	3	22-24
DL	118	Feed in Dry Lot	3	25
SG	119	Strip Graze	3	26
PDPP	120	Part Dry Lot-Part Pasture	3	27
GC	121	Green Chop	3	28
DOT	122	Other	3	29
MTMW	123	Milking Time A.M. Winter	3	30-32
MTMS	124	Milking Time A.M. Summer	3	33-35
MTAW	125	Milking Time P.M. Winter	3	36-38
MTAS	126	Milking Time P.M. Summer	3	39-41

TABLE 3. Card format (continued).

Variable Name	Variable Number	Variable Description	Card No.	Col.
VAC1	127	3/4" Vacuum Line	3	42
VAC2	128	1" Vacuum Line	3	43
VAC3	129	1 1/4" Vacuum Line	3	44
VAC4	130	1 1/2" Vacuum Line	3	45
VAC5	131	1 3/4" Vacuum Line	3	46
VAC6	132	2" Vacuum Line	3	47
VAC7	133	2+" Vacuum Line	3	48
SU	134	Surge Machine	3	49
DEL	135	DeLaval Machine	3	50
BM	136	Bou-Matic Machine	3	51
UN	137	Universal Machine	3	52
ZE	138	Zero Machine	3	53
STU	139	Sta-rite Machine	3	54
JA	140	Jamesway Machine	3	55
CON	141	Condi Machine	3	56
COM	142	Combination Machine	3	57
MMO	143	Other Milking Machine	3	58
MMILK	144	Minutes It Takes to Milk	3	59-62
NOCO	145	Number of Cows	3	63-65
NMM	146	Number of Men Milking	3	66
NWM	147	Number of Women Milking	3	67
NCM	148	Number of Children Milking	3	68

TABLE 3. Card Format (continued).

Variable Name	Variable Number	Variable Description	Card No.	Col.
SN	149	Substitute-Neighbor	3	69
SW	150	Substitute-Wife	3	70
SNB	151	Substitute-Neighbor Boy	3	71
SCH	152	Substitute-Children	3	72
SOFL	153	Substitute-Other Farm Labor	3	73
SDN	154	Substitute-Don't Know	3	74
TSFS	155	Time Feeding-Summer (Minutes)	3	75-78
TSFW	156	Time Feeding-Winter (Minutes)	4	12-15
AVBC	157	Average Bacteria Count	4	16-21
HPOF	158	High Producers-Off Feed	4	22
HPRE	159	High Producers-Reproduction	4	23
HPMU	160	High Producers-Mastitis & Udder	4	24
HPKE	161	High Producers-Ketosis	4	25
HPMF	162	High Producers-Milk Fever	4	26
HPOT	163	High Producers-Other	4	27
RIMP	164	Culling-Milk Prod.	4	28-30
RIFP	165	Culling-Fat Prod.	4	31-33
RIFL	166	Culling-Feet & Legs	4	34-36
RIMU	167	Culling-Mastitis & Udder	4	37-39
RIRE	168	Culling-Reproduction	4	40-42

TABLE 3. Card format (continued).

Variable Name	Variable Number	Variable Description	Card No.	Col.
RITY	169	Culling-Type	4	43-45
TIDI	170	Culling-Disposition	4	46-48
RIQ	171	Culling-Other	4	49-51
HPC	172	Highest Producing Cow	4	52-56
LPC	173	Lowest Producing Cow	4	57-61
AWC	174	Average wgt. of Cows	4	62-65
HPM	175	Highest lbs.-Milk Per Day	4	66-70
MWR	176	Make World Record	4	71
MSR	177	Make State Record	4	72
MCR	178	Make County Record	4	73
ACI	179	Average Calving Interval	4	74-77
PPG	180	Percent Protein-Grain	5	12-15
TECWT	181	Therms of Energy-Grain-Cwt.	5	16-19
CGM	182	Change Grain Mix	5	20
ASF	183	Add. Supplemental Feed	5	21
HMPD	184	Amt. of Add. Supplement/ Day	5	22-23
MWFE	185	Suppl. Mixed with Feed	5	24
TD	186	Suppl. Top Dressed	5	25
THERO	187	Suppl.-Fed Other	5	26
CPCS	188	Crude Prot. Corn Silage	5	27
CPCSP	189	Amt. C.P. in Corn Silage	5	28-30
AAA	190	Add. Additive to C. Silage	5	31

TABLE 3. Card format (continued).

Variable Name	Variable Number	Variable Description	Card No.	Col.
UREA	191	Add Urea to C. Silage	5	32
COMM	192	Add Commercial to C. Silage	5	33
AMM	193	Add Ammonia to C. Silage	5	34
HEROT	194	Add Other to C.Silage	5	35
ADPT	195	Additive-How Much Per Ton	5	36-38
WHT	196	Was Hay Tested	5	39
PERPRO	197	Percent Protein-Hay	5	40-43
DAYSH	198	First Cut-Hay-After 4-30 (Days)	5	44-46
LBSG	199	Lbs.-Grain-Average Cow	5	47-48
ATM	200	Feeding-Guide-Milk	5	49
ATF	201	Feeding-Guide-Fat	5	50
ATC	202	Feeding-Guide-Condition	5	51
GACS	203	Give All Cows Same	5	52
LBSGD	204	Lbs.-Grain-Dry Cows	5	53-54
ILBGC	205	Increase-Grain-Freshening	5	55
LBGPC	206	Lbs.-Prior to Freshening	5	56-57
LBCS	207	Lbs.-Corn Silage-Day	5	58-60
DMCS	208	% D.M. of C. Silage	5	61-62
CPCS	209	C.Protein-Corn Silage	5	63-65
ENECS	210	ENE of Corn Silage	5	66-67
LBSH	211	Lbs. of Hay	5	68-69
CPH	212	C.P. of Hay	5	70-73

TABLE 3. Card format (continued).

Variable Name	Variable Number	Variable Description	Card No.	Col.
ENEH	213	ENE of Hay	5	74-75
LBSHA	214	Lbs. of Haylage	5	76-78
DMHA	215	D.M. of Haylage	5	79-80
CPHA	216	C.P. of Haylage	6	12-15
ENEHA	217	ENE of Haylage	6	16-17
SMAF	218	Salt & Mineral-Free Choice	6	18
TOCG	219	Lbs.-Grain-Top Cow	6	19-20
EMG	220	Would Cows Eat More Grain	6	21
AGEH	221	Age to Breed Heifers	6	22-25
AWHF	222	Wgt. of Heifers at Breeding	6	26-29
PCAB	223	Percent of Cows Bred Artificially	6	30-32
PHAB	224	Percent of Heifers Bred Artificially	6	33-35
RBMF	225	Rank-Bulls-Dams M & F	6	36-38
RBA	226	Rank-Bulls-Ancestry	6	39-41
RBPD	227	Rank-Bulls-Predicted Difference	6	42-44
RBCM	228	Rank-Bulls-Color Marking	6	45-47
RBTT	229	Rank-Bulls-Type Traits	6	48-50
RBR	230	Rank-Bulls-Repeatability	6	51-53
RBP	231	Rank-Bulls-Price of Sire	6	54-56
RBPS	232	Rank-Bulls-Price of Semen	6	57-59
RBCR	233	Rank-Bulls-Conception Rate	6	60-62

TABLE 3. Card format (continued).

Variable Name	Variable Number	Variable Description	Card No.	Col.
RBO	234	Rank-Bulls-Other	6	63-65
CETR	235	Cows Examined-Rebred	6	66
CEFP	236	Cows Examined-Pregnancy	6	67
CADTB	237	Days Aft. Calving to Breed	6	68-70
YAI	238	Years in AI	6	71-72
APD	239	Ave. P.D. of Bulls Now	6	73-77
SBRPO	240	Rear & Prove Bulls-Breeder	6	78
CA	241	Cows Aborted	6	79-80
TCOHW	242	Time Cows Observed Heat-Winter	7	12
TCO	243	Heat Observed by Operator	7	13
TCW	244	Heat Observed by Wife	7	14
TCC	245	Heat Observed by Children	7	15
THL	246	Heat Observed by Hired Labor	7	16
TCOHS	247	Time Cows Observed Heat-Summer	7	17
TCOS	248	Heat Observed by Operator	7	18
TCWS	249	Heat Observed by Wife	7	19
TCCS	250	Heat Observed by Children	7	20
THLS	251	Heat Observed by Hired Labor	7	21
NCMF	252	No. Cows-Milk Fever	7	22-23

TABLE 3. Card format (continued).

Variable Name	Variable Number	Variable Description	Card No.	Col.
NCKE	253	No. Cows-Ketosis	7	24-25
VETB	254	Vet. Bill	7	26-29
VVF	255	Does Vet. Visit Farm	7	30
DCMT	256	Dry Cow Mastitis Trt.	7	31
UTD	257	Use Teat Dip	7	32
USC	258	Use Strip Cup	7	33
CVB	259	Calves Vac.for Brucella	7	34
DUPI	260	Calves Vac.for PI_3	7	35
CVIBR	261	Calves Vac.for IBR	7	36
CVBVD	262	Calves Vac.for BVD	7	37
CVSF	263	Calves Vac.for Shipping Fever	7	38
CVLE	264	Calves Vac.for Lepto	7	39
CD	265	Number of Calves Died	7	40-41
CDU3	266	Number under 3 Weeks	7	42-43
CD33	267	Number 3 Weeks-3 Mos.	7	44-45
CD31	268	Number 3 Mos.- 1 Yr.	7	46-47
NCSOL	269	Number Cows Sold	7	48-49
NCDIE	270	Number Cows Died	7	50-51
FMR	271	Feed Milk Replacer	7	52
MRST	272	Start Milk Replacer (Days)	7	53-55
FCWO	273	Feed Calves-Winter-Operator	7	56
FCSO	274	Feed Calves-Summer-Operator	7	57

TABLE 3. Card format (continued).

Variable Name	Variable Number	Variable Description	Card No.	Col.
FCWW	275	Feed Calves-Winter-Wife	7	58
FCSW	276	Feed Calves-Summer-Wife	7	59
FECW	277	Feed Calves-Winter-Children	7	60
FCCS	278	Feed Calves-Summer-Children	7	61
FCHLW	279	Feed Calves-Winter-Hired Labor	7	62
FCHLS	280	Feed Calves-Summer-Hired Labor	7	63
FCSO	281	Feed Calves-Winter-Other	7	64
FCWO	282	Feed Calves-Summer-Other	7	65
CWEA	283	Calves Weaned-Age	7	66-68
WAGE	284	Age Determines Weaning	7	69
WAHG	285	Grain & Hay Determines Weaning	7	70
WCOC	286	Condition of Calf Determines Weaning	7	71
WCOMB	287	Combination Determines Weaning	7	72
DPCST	288	Purchase a Calf Starter	7	73
WIFH	289	Herd Ration Fed Calves	7	74
WIFS	290	Special Calf Ration Fed Calves	7	75
WIFO	291	Other Ration Fed Calves	7	76
WYC	292	Would Contract Calf Raising	7	77-78

TABLE 3. Card format (continued).

Variable Name	Variable Number	Variable Description	Card No.	Col.
SBCA	293	Sell Bull Calves	7	79
RBCA	294	Raise Bull Calves	7	80
BSWA	295	Bulls Sold-What Age	8	12-14
BSRP	296	Price Received-Bulls	8	15-17
SBHEF	297	Sell Bred Heifers	8	18
HOWM	298	How Many a Year	8	19-20
PRICE	299	Price Received-Bred Heifers	8	21-24
SOHEF	300	Sell Open Heifers	8	25
HWM	301	How Many a Year	8	26-27
PREE	302	Price Received-Open Heifers	8	28-31
FCAC	303	Feed Calves All Colostrum	8	32
DYPH	304	Purchase Heifers	8	33
RHLA	305	Receive Help-Land	8	34
RHCAT	306	Receive Help-Cattle	8	35
RHMO	307	Receive Help-Money	8	36
RHLAB	308	Receive Help-Labor	8	37
RHMAC	309	Receive Help-Machinery	8	38
RHPART	310	Receive Help-Partnership	8	39
RHAVE	311	Receive Help-Advice	8	40
RHOTHE	312	Receive Help-Other	8	41
NONE	313	Receive Help-None	8	42
NOFOR	314	Number of Organizations	8	43
ENJOY	315	Enjoy-Dairy-Field Work	8	44-45

TABLE 3. Card format (continued).

Variable Name	Variable Number	Variable Description	Card No.	Col.
GOALS	316	Goals-Milk Production	8	46-50
OO	317	Decisions-Operator Only	8	51
WO	318	Decisions-Wife Only	8	52
OW	319	Decisions-Operator & Wife	8	53
OOM	320	Decisions-Operator & Other	8	54
WOM	321	Decisions-Wife & Other	8	55
TF	322	Decisions-Total Family	8	56
COWS	323	Ave.Number Cows-4-1	8	57-59
MILK	324	Ave. Milk-4-1	8	60-64
FATX	325	Ave. Fat-4-1	8	65-67
TEST	326	Ave. Test-4-1	8	68-70
PDAYM	327	% Days in Milk-4-1	8	71-72
GVP	328	Gross Value Product-4-1	8	73-76
TCOWS	329	Total Cows-Herd-Year-4-1	8	77-79
NCSR	330	No.Cows-Sires Reported-4-1	9	12-14
NCPD	331	No.Cows-Sires P.D.-4-1	9	15-17
NCASR	332	No.Calves-Sires Reported-4-1	9	18-20
NCAPD	333	No.Calves-Sires P.D.-4-1	9	21-23
PDSC	334	Ave.P.D.-Sires-Cows	9	24-28
PDSCA	335	Ave.P.D.-Sires-Calves	9	29-33
SING	336	Single Ownership	9	34
FS	337	Father, Son	9	35
F2S	338	Father, 2 Sons	9	36

TABLE 3. Card format (continued).

Variable Name	Variable Number	Variable Description	Card No.	Col.
BROS2	339	2 Brothers	9	37
B2S1	340	2 Brothers, 1 Son	9	38
B2S2	341	2 Brothers, 2 Sons	9	39
B2N	342	2 Brothers, Nephew	9	40
FSIL	343	Father, Son-In-Law	9	41
REHTO	344	Other Ownership	9	42
330/329	359	% of Cows with Sires Reported	Generated	
323*324/ 146+147+148	361	Lbs. of Milk Per Worker	Generated	
323*328	362	Total Value of Production	Generated	

TABLE 4. Variable u and σ.

Variable Description	Variable Number	Strata 1			Strata 2			T of the Mean
		N	u	σ	N	u	σ	
Age	3	37	43.5	11.6	37	44.8	10.7	0.578
Education	4	37	11.7	2.2	37	11.8	1.8	0.230
Years of Dairy Farming	5	37	22.3	11.7	37	21.3	10.1	-0.409
Wife's Age	7	34	42.7	10.9	36	42.6	10.9	-0.344
Years on Test	9	37	15.8	9.5	37	16.4	9.4	0.274
Time Spent Studying Report (Monthly Minutes)	10	37	258.6	305.6	37	125.3	129.1	-2.417*
Magazines Read	28	37	5.1	2.0	37	5.4	2.1	0.726
No. of Acres Operated	84	37	319.6	157.1	37	307.4	142.4	-0.414
No. of Acres Owned	85	37	220.3	132.1	37	220.8	113.3	0.020
No. of Acres Rented	86	37	99.3	111.8	37	87.2	95.9	-0.556
Sale Price Per Acre	89	37	541.9	203.6	36	$536.80	$252.24	-0.168
Percent Labor Hired	95	37	6.8	11.6	37	11.0	14.4	1.826
Percent Labor Wife & Child	96	37	26.4	23.5	37	21.3	18.8	-0.984
Percent Labor Operator	97	37	66.7	23.0	37	67.6	20.3	0.195
Percent Cows Registered	117	37	66.3	36.7	37	40.2	42.2	6.721*

TABLE 4. Variable u and σ (continued).

Variable Description	Variable Number	Strata 1			Strata 2			T of the Mean
		N	u	σ	N	u	σ	
Milking Time-Morning-Winter	123	37	6:00 AM	59 min.	37	6:20 AM	50 min.	4.915*
Milking Time-Morning-Summer	124	37	5:42 AM	54 min.	37	6:18 AM	50 min.	7.831**
Milking Time-Afternoon-Winter	125	37	5:16 PM	77 min.	37	5:30 PM	62 min.	0.944
Milking Time-Afternoon-Summer	126	37	5:19 PM	75 min.	37	5:37 PM	66 min.	1.515
Minutes Spent Milking	144	37	100.4	34.8	37	91.6	35.1	-1.188
Number of Cows	145	37	47.8	20.9	37	45.0	20.6	-1.142
Number of Men Milking	146	37	1.4	0.6	37	1.2	0.4	-1.357
Time Spent Feeding-Summer	155	37	123 min.	88 min.	37	96 min.	81 min.	-1.504
Time Spent Feeding-Winter	156	37	145 min.	83 min.	37	123 min.	85 min.	-1.209
Ave. Bacteria Count	157	35	9500	9504	35	14542	14051	2.287
Highest Producing Cow	172	37	24450	2851	37	18798	1713	-10.600**
Lowest Producing Cow	173	37	12302	1353	37	9477	1458	-9.629**
Ave. Body Wgt.	174	37	1378	88	37	1311	95	-3.138**

TABLE 4. Variable u and σ (continued)

Variable Description	Variable Number	Strata 1			Strata 2			T of the Mean
		N	u	σ	N	u	σ	
High Pounds Milk	175	37	113.1	10.8	37	93.4	11.8	-7.967**
Ave. Calving Interval	179	37	12.7	0.7	37	12.8	0.7	0.398
Percent Prot. Grain	180	37	14.5	2.9	37	13.9	2.9	-0.833
Therms Energy Grain	181	37	72.2	4.5	37	73.8	2.8	1.785
Amt. of Supple.Add/Day	184	14	3.2	1.5	12	3.7	3.3	0.459
C.P. of C. Silage	189	8	3.6	0.8	5	3.2	0.9	0.000
Commercial Add./Ton	195	8	7.5	4.1	8	10.5	5.5	-1.571
Percent Protein/Hay	197	10	15.0	1.0	4	15.9	2.7	0.882
Days After 4-30 to First Cutting of Hay	198	37	31.6	5.2	36	32.1	6.4	0.269
Lbs. Grain-Ave.Cow	199	37	20.6	5.1	37	17.6	4.3	-2.966**
Lbs. Corn Silage	207	34	40.0	12.5	37	43.3	11.4	1.421
D.M. Corn Silage	208	34	33.2	1.9	37	33.0	0	-0.801
C.P. Corn Silage	209	34	3.1	0.5	37	3.0	0.4	-0.560
ENE Corn Silage	210	34	18.0	0 Constant	37	18.0	0	0.0
Lbs. of Hay	211	35	17.3	8.7	33	14.2	8.0	-1.567
Crude Prot. Hay	212	35	17.1	1.2	33	17.7	0.3	2.668*

TABLE 4. Variable u and σ (continued)

Variable Description	Variable Number	Strata 1			Strata 2			T of the Mean
		N	u	σ	N	u	σ	
ENE of Hay	213	35	45.0	0 Constant	33	45.0	0	0.0
Lbs. of Haylage	214	13	29.7	10.5	12	36.4	13.9	0.234
D.M. of Haylage	215	13	44.5	1.9	12	43.8	4.0	0.0
C.P. of Haylage	216	13	15.3	0.6	12	16.3	1.4	1.00
ENE of Haylage	217	13	30.0	0 Constant	12	30.0	0	0.0
Lbs. of Grain-Top Cow	219	37	33.2	7.9	37	26.6	7.0	-4.632**
Age Breed Heifers	221	37	16.8	2.0	36	17.2	2.1	0.665
Ave. Wgt. Heifers	222	37	831.1	89.2	37	852.7	108.6	0.907
Days After Calving to Breed	237	37	69.6	10.5	37	65.1	12.7	-1.532
Years Using A.I.	238	36	17.1	6.3	37	17.3	7.0	0.103
Ave. P.D. Bull	239	32	870.7	256.6	15	751.2	368.8	-1.611
Ave.# Cows-Milk Fever	252	37	6.2	5.3	37	2.7	2.5	-3.712**
Ave.# Cows-Ketosis	253	37	2.8	4.4	37	1.9	3.0	-1.057
Ave. Vet Bill	254	35	$1012	$615	36	$488	$302	-5.547**
Calves Dies	265	37	2.5	1.8	37	5.6	9.8	1.974
Calves Died 3 Wk.	266	37	2.0	1.6	37	5.2	9.9	1.968

TABLE 4. Variable u and σ (continued)

Variable Description	Variable Number	Strata 1			Strata 2			T of the Mean
		N	u	σ	N	u	σ	
Calves Died 3 Wk.-3 Mo.	267	37	0.3	0.8	37	0.4	1.1	0.580
Calves Died 3 Mo.-1 Yr.	268	37	0.2	0.6	37	0	0	-1.782
No. Cows Sold	269	37	15.4	10.1	37	11.9	7.5	-2.276*
No. Cows Died	270	37	1.1	1.5	37	0.9	0.9	-0.474
Start Milk Replacer	272	37	7.3 Days	11.4 Days	37	5.8	8.8	-0.587
Calves Weaned	283	37	58.5 Days	23.1 Days	36	57.1	17.2	-0.282
Bred Heifers Sold	298	16	5.0	2.7	8	4.4	2.6	0.0
Price for Bred Heifers	299	16	$546.25	$64.87	8	$478.13	$86.02	-4.33
Open Heifers Sold	301	4	2.0	1.6	4	3.25	2.99	0.0
Price for Open Heifers	302	4	$231.25	$159.92	4	$222.50	$241.57	0.0
Milk Production Goals	316	35	19185	1440	30	16333	1037	-10.139**
Cows	323	37	50.0	22.7	37	48.3	20.5	-0.908
Milk/Per Cow	324	37	17694	982.1	37	13397	741.4	-18.060**
Lbs.Fat/Per Cow	325	37	648.6	49.7	37	494.8	38.5	-14.575**
Average Test	326	37	3.67	0.14	37	3.69	0.16	0.964
% Days Milk	327	37	88.6	2.3	37	86.5	2.8	-3.895**

TABLE 4. Variable u and σ (continued)

Variable Description	Variable Number	Strata 1			Strata 2			T of the Mean
		N	u	σ	N	u	σ	
Gross Value Product Per Cow	328	37	$1046.68	$69.39	37	$796.22	$52.34	-15.199**
Total Cows	329	37	53.8	25.7	37	50.0	21.1	-1.581
No.Cows Sires Reported	330	37	45.8	23.1	37	30.1	20.2	-3.915**
No.Cows Sires P.D.	331	37	36.9	18.3	37	23.9	14.4	-3.682**
No. Calves Sires Reported	332	34	22.8	22.1	34	14.6	15.0	-1.853
No. Calves Sires P.D.	333	34	15.5	17.9	34	10.3	10.9	-1.446
P.D. Sires Cows	334	37	374.6	189.4	35	215.1	178.1	-3.513**
P.D. Sires Calves	335	28	807.75	250.2	26	694.1	278.4	-1.943

Level of Significance

** $p < .01$
* $p < .05$

TABLE 5. Percent positive and negative responses by stratum

Variable Description	Variable Number	Strata 1 N	Strata 1 Percent Yes	Strata 1 Percent No	Strata 2 N	Strata 2 Percent Yes	Strata 2 Percent No	T of the Mean
Use of Dollar Value	15	37	35.1	64.9	37	45.9	54.1	1.276
Use Ibs. of Grain	16	37	21.6	78.4	37	24.3	75.7	0.329
Use Breeding and Dry Dates	17	37	32.4	67.6	37	54.1	45.9	2.462*
Use Action Needed	18	37	29.7	70.3	37	35.1	64.9	0.495
Leader in 4-H	26	37	29.7	70.3	37	56.8	43.2	2.522*
Raised on Dairy Farm	27	37	86.5	13.5	37	75.7	24.3	-1.276
Read Hoard's Dairyman	29	37	97.3	2.7	37	94.6	5.4	-0.572
Read Farm Journal	30	37	83.8	16.2	37	83.8	16.2	0.0
Read Successful Farming	31	37	56.8	43.2	37	67.6	32.4	0.941
Read Dairy Herd Management	32	37	27.0	73.0	37	24.3	75.7	-0.274
Read Michigan Farmer	33	37	78.4	21.6	37	81.1	18.9	0.274
Read Prairie Farmer	34	37	18.9	81.1	37	18.9	81.1	0.0
Read Reader's Digest	35	37	10.8	89.2	37	13.5	86.5	0.374
Read Farmer's Advance	36	37	5.4	94.6	37	8.1	91.9	0.442
Read Holstein World	37	37	21.6	78.4	37	21.6	78.4	0.0
Read Michigan-Indiana Holstein World	38	37	18.9	81.1	37	16.2	83.8	-0.329

TABIE 5. Percent positive and negative responses (continued)

Variable Description	Variable Number	Strata 1 N	Strata 1 Percent Yes	Strata 1 Percent No	Strata 2 N	Strata 2 Percent Yes	Strata 2 Percent No	T of the Mean
Read Canadian Holstein World	39	37	0	100.0	37	2.7	97.3	1.00
Read Farm Quarterly	40	37	8.1	91.9	37	16.2	83.8	1.00
Read Top Operator	41	37	24.3	75.7	37	29.7	70.3	0.627
Read Big Farmer	42	37	8.1	91.9	37	8.1	91.9	0.0
Read Other Magazines	43	37	35.1	64.9	37	48.6	51.4	1.094
Children-School Activities	44	37	37.8	62.2	37	43.2	56.8	0.466
Children-Church Activities	45	37	37.8	62.2	37	40.5	59.5	0.215
Children-Scouts	46	37	0	100.0	37	8.1	91.9	1.782
Children-sports	47	37	29.7	70.3	37	40.5	59.5	1.000
Children-Other	48	37	13.5	86.5	37	18.9	81.1	0.572
Operator Political	49	37	2.7	91.3	37	16.2	83.8	2.372*
Operator Church	50	37	48.6	51.4	37	56.8	43.2	0.723
Operator Lodge	51	37	0	100.0	36	19.4	80.6	2.907**
Operator Recreational	52	37	21.6	78.4	37	13.5	86.5	-0.829
Operator School	53	37	27.0	73.0	37	21.6	78.4	-0.529

TABLE 5. Percent positive and negative responses (continued)

Variable Description	Variable Number	Strata 1 N	Strata 1 Percent Yes	Strata 1 Percent No	Strata 2 N	Strata 2 Percent Yes	Strata 2 Percent No	T of the Mean
Operator Scouts	54	37	0	100.0	37	2.7	97.3	1.000
Operator Other Activity	55	37	0	100.0	37	16.2	83.8	2.640*
Wife Political	56	37	0	100.0	37	5.4	94.6	1.434
Wife Church	57	37	54.1	45.9	37	62.2	37.8	0.723
Wife Lodge	58	37	2.7	97.3	37	21.6	78.4	2.492*
Wife Recreational	59	37	8.1	91.9	37	18.9	81.1	1.276
Wife School	60	37	21.6	78.4	37	18.9	81.1	-0.329
Wife Scouts	61	37	0	100.0	37	5.4	94.6	1.434
Wife Other	62	37	27.0	73.0	37	24.3	75.7	-0.239
Listen to Radio or TV	63	37	62.2	37.8	37	67.6	32.4	0.466
Farm Sold	64	37	8.1	91.9	37	8.1	91.9	0.0
Estate	65	37	2.7	97.3	37	8.1	91.9	1.000
Will	66	37	18.9	81.1	37	2.7	97.3	-2.640*
Wife	67	37	16.2	83.8	37	16.2	83.8	0.0
Family	68	37	48.6	51.4	37	43.5	56.8	-0.495
Other Arrangement	69	35	8.6	91.4	37	18.9	81.1	1.276

TABLE 5. Percent positive and negative responses (continued)

Variable Description	Variable Number	Strata 1 N	Strata 1 Percent Yes	Strata 1 Percent No	Strata 2 N	Strata 2 Percent Yes	Strata 2 Percent No	T of the Mean
Wife-Participate Records	70	37	48.6	51.4	37	54.1	45.9	0.529
Wife-Participate Chores	71	37	45.9	54.1	37	59.5	40.5	1.094
Wife-Participate Finances	72	36	30.6	69.4	37	40.5	59.5	0.902
Wife-Participate Field Work	73	37	32.4	67.6	37	27.0	73.0	-0.495
Wife-Participate Other	74	37	2.7	97.3	37	2.7	97.3	0.000
Wife-Participate Planning	75	37	40.5	59.5	37	35.1	64.9	-0.529
Wife-Participate Consulting	76	37	37.8	62.2	37	32.4	67.6	-0.495
Children-Participate Records	77	37	24.3	75.7	37	16.2	83.8	-0.829
Children-Participate Chores	78	37	67.6	32.4	37	70.3	29.7	0.255
Children-Participate Finances	79	37	16.2	83.8	37	13.5	86.5	-0.298
Children-Participate Field Work	80	37	54.1	45.9	37	56.8	43.2	0.227
Children-Participate Other	81	37	0	100.0	37	0	100.0	0.0
Children-Participate Consulting	82	37	21.6	78.4	37	21.6	78.4	0.0
Children-Participate Planning	83	37	21.6	78.4	37	24.3	75.7	0.239

TABLE 5. Percent positive and negative responses (continued)

Variable Description	Variable Number	Strata 1 N	Strata 1 Percent Yes	Strata 1 Percent No	Strata 2 N	Strata 2 Percent Yes	Strata 2 Percent No	T of the Mean
Buy More Land	87	37	35.1	64.9	37	35.1	64.9	0.0
Rent More Land	88	37	24.3	75.7	37	51.4	48.6	2.522*
Most Gross Income-Dairy	90	37	97.3	2.7	37	94.6	5.4	-0.572
Most Gross Income-Crops	91	37	0	100.0	37	2.7	97.3	1.000
Most Gross Income-Hogs	92	37	0	100.0	37	2.7	97.3	1.000
Most Gross Income-Beef	93	37	0	100.0	37	0	100.0	0.0
Most Gross Income-Other	94	37	0	100.0	37	0	100.0	0.0
Stanchion Barn	98	37	64.9	35.1	37	48.6	51.4	-1.527
Open Lot-Free Stalls	99	37	5.4	94.6	37	5.4	94.6	0.0
Warm Enclosed-Free Stalls	100	37	0	100.0	37	0	100.0	0.0
Cold Covered-Free Stalls	101	37	18.9	81.1	37	24.3	75.7	0.627
Loose Housing	102	37	0	100.0	37	2.7	97.3	1.000
Stanchion Barn & Parlor	103	37	0	100.0	37	0	100.0	0.0
Stanchion Barn & Free Stalls	104	37	5.4	94.6	37	13.5	86.5	1.357
Stanchion Barn & Loose Housing	105	37	5.4	94.6	37	5.4	94.6	0.0

TABLE 5. Percent positive and negative responses (continued)

Variable Description	Variable Number	Strata 1 N	Strata 1 Percent Yes	Strata 1 Percent No	Strata 2 N	Strata 2 Percent Yes	Strata 2 Percent No	T of The Mean
Other Housing	106	37	0	100.0	37	0	100.0	0.0
Pipeline	107	36	52.8	47.2	37	43.2	56.8	-0.770
Portable Pipeline	108	37	29.7	70.3	37	43.2	56.8	1.221
Small Pull Tank	109	37	0	100.0	37	0	100.0	0.0
Milk Carried	110	37	18.9	81.1	37	13.5	86.5	-0.627
Other	111	37	0	100.0	37	0	100.0	0.0
Parlor-Side Open	112	37	5.4	94.6	37	8.1	91.9	0.442
Parlor-Herringbone	113	37	13.5	86.5	37	21.6	78.4	1.000
Parlor-Walk Thru	114	37	0	100.0	37	16.4	83.6	1.000
Parlor-Home Made	115	37	5.4	94.6	37	0	100.0	-1.434
Parlor-Other	116	37	0	100.0	37	0	100.0	0.0
Feed in Dry Lot	118	32	93.8	6.2	32	93.8	6.2	0.0
Strip Graze	119	32	3.1	96.9	32	0	100.0	-1.000
Part Dry-Part Pasture	120	32	3.1	96.9	32	3.1	96.9	0.0
Green Chop	121	32	0	100.0	32	3.1	96.9	1.000
Other	122	32	0	100.0	32	0	100.0	0.0
3/4" Vacuum Line	127	37	2.7	97.3	37	10.8	89.2	1.357

TABLE 5. Percent positive and negative responses (continued)

Variable Description	Variable Number	Strata 1 N	Strata 1 Percent Yes	Strata 1 Percent No	Strata 2 N	Strata 2 Percent Yes	Strata 2 Percent No	T of the Mean
1" Vacuum Line	128	37	10.8	89.2	37	8.1	91.9	-0.374
1 1/4" Vacuum Line	129	37	45.9	54.1	37	45.9	54.1	0.0
1 1/2" Vacuum Line	130	37	32.4	67.6	37	29.7	70.3	-0.227
1 3/4" Vacuum Line	131	37	0	100.0	37	0	100.0	0.0
2" Vacuum Line	132	37	8.1	91.9	37	5.4	94.6	-0.572
2+" Vacuum Line	133	37	0	100.0	37	2.7	97.3	1.000
Surge Machine	134	37	51.4	48.6	37	48.6	51.4	-0.255
DeLaval Machine	135	37	35.1	64.9	37	35.1	64.9	0.0
Bou-Matic Machine	136	37	2.7	97.3	37	2.7	97.3	0.0
Universal Machine	137	37	2.7	97.3	37	8.1	91.9	1.000
Zero Machine	138	37	2.7	97.3	37	0	100.0	-1.000
Sta-rite Machine	139	37	0	100.0	37	0	100.0	0.0
Jamesway Machine	140	37	0	100.0	37	0	100.0	0.0
Condi Machine	141	37	2.7	97.3	37	0	100.0	-1.000
Combination Machine	142	37	0	100.0	37	0	100.0	0.0
Other Machine	143	37	2.7	97.3	37	2.7	97.3	0.0
Substitute-Neighbor	149	37	18.9	81.1	37	8.1	91.9	-1.276

TABLE 5. Percent positive and negative responses (continued)

Variable Description	Variable Number	Strata 1 N	Strata 1 Percent Yes	Strata 1 Percent No	Strata 2 N	Strata 2 Percent Yes	Strata 2 Percent No	T of the Mean
Substitute-Wife	150	37	8.1	91.9	37	5.4	94.6	-0.442
Substitute-Neighbor Boy	151	37	8.1	91.9	37	13.5	86.5	0.702
Substitute-Children	152	37	10.8	89.2	37	37.8	62.2	3.235**
Substitute-Other Farm Labor	153	37	43.2	56.8	37	29.7	70.2	-1.303
Substitute-Don't Know	154	37	18.9	81.1	37	8.1	91.9	-1.434
High Producers-Off Feed	158	36	5.6	94.4	36	11.1	88.9	0.813
High Producers-Reproduction	159	37	64.9	35.1	37	62.2	37.8	-0.255
High Producers-Mastitis & Udder	160	36	30.6	69.4	37	10.8	89.2	-2.223*
High Producers-Ketosis	161	37	24.3	75.7	37	18.9	81.1	-0.627
High Producers-Milk Fever	162	36	36.1	63.9	37	16.2	83.8	-2.256*
High Producers-Other Problems	163	36	0	100.0	37	0	100.0	0.0
Make World Record	176	37	83.8	16.2	37	62.2	37.8	-2.089*
Make State Record	177	37	89.2	10.8	37	70.3	29.7	-2.220*
Make County Record	178	37	94.6	5.4	37	73.0	27.0	-2.462*
Change Grain Mix	182	37	37.8	62.2	37	48.6	51.4	0.850

TABLE 5. Percent positive and negative responses (continued)

Variable Description	Variable Number	Strata 1 N	Strata 1 Percent Yes	Strata 1 Percent No	Strata 2 N	Strata 2 Percent Yes	Strata 2 Percent No	T of the Mean
Add. Supplemental Feed	183	37	40.5	59.5	37	32.4	67.6	-0.650
Supplement Mixed with Feed	185	15	6.7	93.3	12	0	100.0	-1.000
Supplement Top Dressed	186	15	80.0	20.0	12	91.7	8.3	1.000
Supplement Fed Other	187	15	13.3	86.7	12	8.3	91.7	0.0
Know C.P. of Corn Silage	188	37	21.6	78.4	37	13.5	86.5	-0.902
Add Additive to C.Silage	190	37	21.6	78.4	37	21.6	78.4	0.0
Add Urea to C. Silage	191	8	62.5	37.5	8	62.5	37.5	0.0
Add Commercial Mix to C. Silage	192	8	37.5	62.5	8	12.5	87.5	-1.110
Add Ammonia to C. Silage	193	8	0	100.0	8	0	100.0	0.0
Other Additive to C. Silage	194	8	0	100.0	8	25.0	75.0	1.000
Was Hay Tested	196	37	32.4	67.6	37	13.5	86.5	-2.220*
Feeding Guide-Milk	200	37	86.5	13.5	37	78.4	21.6	-0.902
Feeding Guide-Fat	201	36	2.8	97.2	35	14.3	85.7	1.676
Feeding Guide-Condition	202	36	33.3	66.7	36	16.7	83.3	-1.537
Give All Cows Same	203	35	8.6	91.4	36	19.4	80.6	1.139
Increase Grain Before Freshening	205	37	67.6	32.4	37	59.5	40.5	-0.650

TABLE 5. Percent positive and negative responses (continued)

Variable Description	Variable Number	Strata 1 N	Strata 1 Percent Yes	Strata 1 Percent No	Strata 2 N	Strata 2 Percent Yes	Strata 2 Percent No	T of the Mean
Salt & Mineral-Free Choice	218	37	91.9	8.1	37	78.4	21.6	-1.535
Would Cows Eat More Grain	220	37	45.9	54.1	37	48.6	51.4	0.227
Cows Examined-Rebred	235	37	51.4	48.6	37	43.2	56.8	-0.770
Cows Examined-Pregnancy	236	37	62.2	37.8	37	51.4	48.6	-1.160
Rear and Prove Bulls-Breeder	240	37	32.4	67.6	37	21.6	78.4	-1.071
Does Vet Visit Farm	255	37	16.2	83.8	37	2.7	97.3	-1.961
Dry Cow Mastitis Trt.	256	37	89.2	10.8	37	56.8	43.2	-3.723**
Use Teat Dip	257	37	54.1	45.9	37	45.9	54.1	-0.683
Use Strip Cup	258	37	35.1	64.9	37	27.0	73.0	-0.683
Calves Vac.for Brucella	259	37	100.0	0.0	37	100.0	0.0	0.0
Calves Vac. for PI_3	260	37	64.9	35.1	37	27.0	73.0	-3.875**
Calves Vac. for IBR	261	37	64.9	35.1	37	27.0	73.0	-3.875**
Calves Vac. for BVD	262	37	64.9	35.1	37	27.0	73.0	-3.875**
Calves Vac. for Shipping Fever	263	37	2.7	97.3	37	2.7	97.3	0.0
Calves Vac. for Lepto	264	37	24.3	75.7	37	13.5	86.5	-1.160

TAELE 5. Percent positive and negative responses (continued)

Variable Description	Variable Number	Strata 1 N	Strata 1 Percent Yes	Strata 1 Percent No	Strata 2 N	Strata 2 Percent Yes	Strata 2 Percent No	T of the Mean
Feed Milk Replacer	271	37	75.7	24.3	37	81.1	18.9	0.572
Age Determines Weaning	284	37	29.7	70.3	37	21.6	78.4	-0.683
Grain & Hay Determines Weaning	285	37	24.3	75.7	37	32.4	67.6	0.723
Condition of Calf Determines Weaning	286	37	32.4	67.6	37	45.9	54.1	1.094
Combination Determines Weaning	287	37	32.4	67.6	37	24.3	75.7	-0.829
Purchase a Calf Starter	288	37	70.3	29.7	37	70.3	29.7	0.0
Herd Ration Fed Calves	289	36	11.1	88.9	36	13.9	86.1	0.702
Special Calf Ration Fed Calves	290	37	16.2	83.8	36	11.1	88.9	-0.627
Other Ration Fed Calves	291	36	2.8	97.2	36	0	100.0	- 1.000
Sell Bull Calves	293	37	83.8	16.2	37	73.0	27.0	-1.160
Raise Bull Calves	294	37	16.2	83.8	37	27.0	73.0	1.160
Sell Bred Heifers	297	37	43.2	56.8	37	21.6	78.4	-1.846
Sell Open Heifers	300	37	8.1	91.9	37	8.1	91.9	0.0
Feed Calves All Colostrum	303	37	59.5	40.5	37	62.2	37.8	0.255
Purchase Heifers	304	37	18.9	81.1	37	29.7	70.3	1.071
Receive Help-Land	305	37	5.4	94.6	37	10.8	89.2	0.813
Receive Help-Cattle	306	37	2.7	97.3	37	10.8	89.2	1.357

TABLE 5. Percent positive and negative responses (continued)

Variable Description	Variable Number	Strata 1 N	Strata 1 Percent Yes	Strata 1 Percent No	Strata 2 N	Strata 2 Percent Yes	Strata 2 Percent No	T of the Mean
Receive Help-Money	307	37	8.1	91.9	37	8.1	91.9	0.0
Receive Help-Labor	308	37	2.7	97.3	37	5.4	94.6	0.572
Receive Help-Machinery	309	37	8.1	91.9	37	5.4	94.6	-0.442
Receive Help-Partnership	310	37	59.5	40.5	37	51.4	48.6	-0.829
Receive Help-Advice	311	37	2.7	97.3	37	2.7	97.3	0.0
Receive Help-Other	312	37	0	100.0	37	5.4	94.6	1.434
None	313	37	21.6	78.4	37	16.2	83.8	-0.572
Decisions-Operator Only	317	37	0	100.0	37	13.5	86.5	2.372
Decisions-Wife Only	318	37	0	100.0	37	0	100.0	0.0
Decisions-Operator & Wife	319	37	51.4	48.6	37	56.8	43.2	0.495
Decisions-Operator & Other	320	37	16.2	83.8	37	5.4	94.6	-1.672
Decisions-Wife & Other	321	37	0	100.0	37	0	100.0	0.0
Decisions-Total Family	322	37	32.4	67.6	37	24.3	75.7	-0.683
Single Ownership	336	37	51.4	48.6	37	59.5	40.5	0.829
Father, Son	337	37	24.3	75.7	37	24.3	75.7	0.0

TABLE 5. Percent positive and negative responses (continued)

Variable Description	Variable Number	Strata 1 N	Strata 1 Percent Yes	Strata 1 Percent No	Strata 2 N	Strata 2 Percent Yes	Strata 2 Percent No	T of the Mean
Father, 2 Sons	338	37	8.1	91.9	37	0	100.0	-1.782
2 Brothers	339	37	10.8	89.2	37	5.4	94.6	-0.813
2 Brothers, 1 Son	340	37	0	100.0	37	5.4	94.6	1.434
2 Brothers, 2 Sons	341	37	2.7	97.3	37	0	100.0	-1.000
2 Brothers, Nephew	342	37	2.7	97.3	37	0	100.0	-1.000
Father, Son-in-law	343	37	0	100.0	37	0	100.0	0.0
Other Ownership	344	35	0	100.0	36	5.5	94.5	1.436
Sires of Cows Reported	359	37	87.0	13.0	37	63.6	36.4	-2.504**

Level of Significance

** $p < .01$
* $p < .05$

TABLE 6. Ranking of selected variable by stratum

Variable Description	Variable Number	Strata 1 Rank	Strata 2 Rank
Rank on Test Day Average	11	4	4
Rank on Rolling Herd Average	12	2	2
Rank on Lactation to Date	13	3	3
Rank on Daily Production	14	1	1
Culling-Milk Production	164	1	1
Culling-Fat Production	165	5	5
Culling-Feet & Legs	166	6	6
Culling-Mastitis & Udder	167	3	3
Culling-Reproduction	168	2	2
Culling-Type	169	7	8
Culling-Disposition	170	4	4
Culling-Other	171	8	7
Rank-Bulls-Dam M & F	225	3	3
Rank-Bulls-Ancestry	226	5	7
Rank-Bulls-Predicted Difference	227	1	1
Rank-Bulls-Color Marking	228	9	9
Rank-Bulls-Type Traits	229	2	2
Rank-Bulls-Repeatability	230	4	4
Rank-Bulls-Price of Sire	231	10	10
Rank-Bulls-Price of Semen	232	7	8
Rank-Bulls-Conception Rate	233	6	5
Rank-Bulls-Other	234	8	6

TABLE 7. Simple correlations $\geq \pm$ 0.50

Variable Name	Variable Number	Variable Name	Variable Number	Correlation
YDFM	5	Age	3	0.90
BO16	22	CPFW	80	0.51
G06	25	CSH	45	0.52
MAGR	28	OTH	43	0.59
HW	37	MIHW	38	0.88
OPO	49	WPO	56	0.52
OCH	50	WCH	57	0.57
ORE	52	WRE	59	0.54
WPC	71	WPCO	76	0.53
WPPL	75	WPCO	76	0.88
CPR	77	CPF	79	0.73
CPR	77	CPCO	82	0.87
CPR	77	CPP	83	0.84
CPC	78	CPFW	80	0.75
CPF	79	CPCO	82	0.61
CPF	79	CPP	83	0.67
CPCO	82	CPP	83	0.88
NAOP	84	NAOW	85	0.72
NAOP	84	NAR	86	0.58
DA	90	CR	91	-0.57
DA	90	HO	92	-0.57
PLH	95	NOCO	145	0.51
PLWC	96	PLO	97	-0.81
SB	98	CCFS	101	-0.60

TABLE 7. (continued)

Variable Name	Variable Number	Variable Name	Variable Number	Correlation
SB	98	PHE	113	-0.53
CCFS	101	PHE	113	0.53
LH	102	NOCO	145	0.48
PHE	113	NOCO	145	0.56
VAC3	129	VAC4	130	-0.62
SU	134	DEL	135	-0.74
MMILK	144	NOCO	145	0.60
TSFS	155	TSFW	156	0.86
HPC	172	LPC	173	0.55
HPC	172	HPM	175	0.66
HPC	172	MILK	325	0.79
LPC	173	MILK	324	0.73
HPM	175	MILK	324	0.67
MWR	176	MSR	177	0.83
MWR	176	MCR	178	0.72
MSR	177	MCR	178	0.87
CPCS	188	WHT	196	0.51
ILBGC	205	LBGPC	206	0.64
RBPD	227	RBMF	225	-0.50
RBCM	228	RBP	231	0.68
RBP	231	RBO	234	0.53
CETR	235	CEFP	236	0.61
TCW	244	TCWS	249	0.95

TABLE 7. (continued)

Variable Name	Variable Number	Variable Name	Variable Number	Correlation
TCCS	250	TCC	245	0.86
THLS	251	THL	246	0.93
NCSR	330	NCMF	252	0.54
DUPI	260	CUIBR	261	1.00
DUPI	260	CUBVD	262	1.00
CUIBR	261	CUBVD	262	1.00
CDU3	266	CD	265	0.99
FCSO	274	FCWO	273	0.87
FCSW	276	FCWW	275	0.92
WCOC	286	WCOMB	287	-0.51
RHPART	310	NONE	313	-0.54
OW	319	SING	336	0.54
OOM	320	BROS2	339	0.53
COWS	323	GUP	328	0.94
MILK	324	FATX	325	0.97
MILK	324	GUP	328	0.98
FATX	325	GUP	328	0.98
TCOWS	329	323*328	362	0.95
NCSR	330	NCPD	331	0.94
NCSR	330	323*328	362	0.55
NCPD	331	323*328	362	0.50

TABLE 8. Simple correlation with average pounds of milk per cow and selected variables.

Variable Name	Variable Number	Correlation Coefficient
Age	3	-.05
Ed	4	-.04
YDFM	5	.04
YTest	9	-0.08
TMIRE	10	0.28
TDA	11	-0.01
RHA	12	-0.10
LTD	13	0.04
TDP	14	0.12
DVAL	15	-0.15
LBGR	16	0.03
BDDA	17	-0.12
ACTN	18	-0.0
NOCH	21	-0.11
BO16	22	0.10
GO16	23	-0.07
BO6	24	-0.18
GO6	25	-0.04
LD4H	26	-0.28
RDF	27	0.11
MAGR	28	-0.04
HD	29	0.12
FJ	30	-0.03

TABLE 8. (continued)

Variable Name	Variable Number	Correlation Coefficient
SF	31	-0.07
DHM	32	-0.02
MF	33	0.01
PF	34	0.03
RD	35	-0.03
FA	36	-0.03
HW	37	-0.03
MIHW	38	0.01
CHW	39	-0.10
FQ	40	-0.15
TO	41	-0.08
BF	42	0.08
OTH	43	-0.13
CSC	44	-0.15
CSH	45	-0.08
CSCO	46	-0.25
CSP	47	-0.09
COT	48	0.02
OPO	49	-0.28
OCH	50	-0.19
ORE	52	0.06
OSC	53	0.02
OSCO	54	-0.09
OOT	55	-0.28
WPO	56	-0.23

TABLE 8 (Continued)

Variable Name	Variable Number	Correlation Coefficient
WCH	57	-0.16
WLO	58	-0.26
WRE	59	-0.15
WSC	60	-0.02
WSCO	61	-0.20
WOT	62	0.08
ROT	63	-0.04
SOL	64	-0.04
EST	65	-0.16
WIL	66	0.19
WIF	67	-0.04
FAM	68	0.12
WPR	70	-0.03
WPC	71	-0.08
WPFW	73	0.0
WPOT	74	-0.05
WPPL	75	0.05
WPCO	76	0.06
CPR	77	0.16
CPC	78	0.04
CPF	79	0.08
CPFW	80	0.02
CPCO	82	0.03
CPP	83	0.02
NAOP	84	0.04
NAOW	85	0.02

TABLE 8. (continued)

Variable Name	Variable Number	Correlation Coefficient
NAR	86	0.02
BML	87	0.01
RML	88	-0.29
DA	90	0.10
CR	91	-0.13
HO	92	-0.12
PLH	95	-0.20
PLWC	96	0.18
PLO	97	-0.06
SB	98	0.14
OLFS	99	0.03
CCFS	101	-0.12
LH	102	-0.10
SBFS	104	-0.09
SBLH	105	0.06
PPIP	108	-0.18
CA	110	0.10
PSO	112	-0.03
PHE	113	-0.15
PWT	114	-0.15
PHM	115	0.16
PGR	117	0.28
MTMW	123	-0.38
MTMS	124	-0.39
MTAW	125	-0.14

TABLE 8. (continued)

Variable Name	Variable Number	Correlation Coefficient
MTAS	126	-0.19
VAC1	127	-0.10
VAC2	128	0.08
VAC3	129	-0.06
VAC4	130	0.02
VAC6	132	0.09
VAC7	133	-0.09
SU	134	-0.02
DEL	135	0.03
BM	136	0.05
UN	137	-0.06
ZE	138	0.02
CON	141	0.08
MMO	143	0.02
MMILK	144	0.19
NOCO	145	0.08
NMM	146	0.17
NWM	147	0.12
NCM	148	0.10
SN	149	0.12
SW	150	0.15
SNB	151	-0.07
SCH	152	-0.26
SOFL	153	0.17
SDN	154	0.07

TABLE 8. (continued)

Variable Name	Variable Number	Correlation Coefficient
TSFS	155	0.16
TSFW	156	0.16
HPRE	159	0.03
HPKE	161	-0.01
RIMP	164	-0.07
RIFP	165	-0.06
RIFL	166	-0.13
RIMU	167	0.05
RIRE	168	0.10
RITY	169	0.07
TIDI	170	-0.05
RIQ	171	0.03
HPC	172	0.79
LPC	173	0.73
AWC	174	0.30
HPM	175	0.67
MWR	176	0.25
MSR	177	0.26
MCR	178	0.29
ACI	179	-0.09
PPG	180	0.03
TECWT	181	-0.24
CGM	182	-0.10
ASF	183	0.08
CPCS	188	0.14

TABLE 8. (continued)

Variable Name	Variable Number	Correlation Coefficient
AAA	190	0.03
WHT	196	0.29
LBSG	199	0.38
ATM	200	0.16
LBSGD	204	-0.07
ILBGC	205	0.08
LBGPC	206	0.08
SMAF	218	0.18
TOCG	219	0.47
EMG	220	-0.06
AWHF	222	-0.04
PCAB	223	0.06
PHAB	224	0.16
CETR	235	0.04
CEFP	236	0.17
CADTB	237	0.22
SBRPO	240	0.12
CA	241	0.16
TCOHW	242	0.02
TCOHS	247	0.19
NCMF	252	0.41
NCKE	253	0.08
VVF	255	0.10
DCMT	256	0.31
VTD	257	0.04
USC	258	0.05

TABLE 8. (continued)

Variable Name	Variable Number	Correlation Coefficient
CVPI	260	0.40
CUIBR	261	0.40
CUBVD	262	0.40
CUSF	263	0.00
CULE	264	0.21
CD	265	-0.22
CDU3	266	-0.23
CD33	267	-0.01
CD31	268	0.18
NCSOL	269	0.23
NCDIE	270	0.04
FMR	271	-0.12
MRST	272	0.05
WAGE	284	0.15
WAHG	285	-0.10
WCOC	286	-0.15
WCOMB	287	0.03
DPCST	288	0.0
SBCA	293	0.16
RBCA	294	-0.16
SBHEF	297	0.19
SOHEF	300	0.10
FCAC	303	-0.02
DYPH	304	-0.17
RHLA	305	-0.05

TABLE 8. (continued)

Variable Name	Variable Number	Correlation Coefficient
RHCAT	306	-0.12
RHMO	307	-0.03
RHLAB	308	-0.09
RHMAC	309	0.01
RHPART	310	0.05
RHAVE	311	0.04
RHOTHE	312	-0.11
NONE	313	0.04
NOFOR	314	-0.22
ENJOY	315	0.26
OO	317	-0.27
OW	319	-0.05
OOM	320	0.10
TF	322	0.13
COWS	323	0.04
FATX	325	0.97
TEST	326	0.03
PDAYM	327	0.39
GVP	328	0.98
TCOW	329	0.09
NCSR	330	0.35
NCPD	331	0.38
SING	336	-0.08
FS	337	0.01

TABLE 8. (continued)

Variable Name	Variable Number	Correlation Coefficient
F2S	338	0.23
BROS2	339	0.02
B2S1	340	-0.14
B2S2	341	0.19
B2N	342	0.07
330/329	359	0.40
323*328	362	0.36