ECONOMIES OF SCALE IN MICHIGAN LIVESTOCK AUCTIONS

By

Richard Dean Gibb

A THESIS

Submitted to the School for Advanced Graduate Studies of
Michigan State University of Agriculture and
Applied Science in partial fulfillment of
the requirements for the degree of

DOCTOR OF PHILOSOPHY

Department of Agricultural Economics

1959

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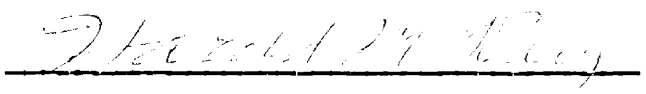
Approved 

ABSTRACT

This investigation was conducted in an attempt to determine the relationship between costs and volume of operation at Michigan livestock auctions. Previous livestock auction studies conducted in other areas of the country, have been largely descriptive of auction operations or based upon cost accounting studies which sometimes included time studies. The cost accounting type of study has certain limitations and it was considered desirable to employ the synthetic approach in this study.

The basic information for this study was obtained from data collected at eight Michigan livestock auctions. These data were in the form of time study results and cost accounting information. Cost records of the eight auctions studied indicated that there were large differences in average total costs of operation incurred by the auctions. Labor constituted nearly 60 percent of all costs.

The time studies indicated that there were large differences between auctions in the man-minutes required to handle different species of livestock. These differences may be primarily attributed to lot-size, number of workers, and method of handling. Cattle required more labor, per head, than any other species of livestock, followed by calves, then sheep and hogs. On the basis of the time studies and direct observation it was recommended that livestock auctions designed so as to make possible a relatively efficient handling of livestock would incorporate the following features: (1) calf and hog pens located adjacent to the

unloading area, (2) a "feed" chute for bringing-up cattle, (3) double tagging chutes with an elevated platform between for the tag man, (4) scales opening directly into the sales ring, (5) separate buyer pens for hogs, cattle, and sheep, and (6) write-up operations performed in a structure separate from the main building.

On the basis of the time studies, cost records, and other information, costs of operations were estimated for 24 auctions, which were similar except for size. These auctions represented six different size groups, and four livestock mixes within each. The size groups ranged from 10,000 animals handled per year up to 110,000. The mixes varied according to the relative importance of each species of livestock. All auctions for which costs were estimated were designed so as to incorporate the most efficient methods of handling livestock, as determined by the time studies and direct observations.

Eleven different cost components were estimated. These included labor, transportation, repair and maintenance, utilities, supplies, advertising, insurance, taxes, depreciation, interest and "other."

The results of the cost synthesis indicated that "economies of scale" are possible in Michigan livestock auctions. Average costs per head of livestock handled ranged from approximately $.60 at the largest auction to about $1.50 at the smallest. Average costs continued to decline through the largest auction. However, most of the economies of scale were realized when a volume of 35,000 animals yearly had been attained. Average costs declined approximately $.50 in moving from 10,000 to 20,000 animals yearly, $.20 from 20,000 to 35,000, but only

about $.05 from 80,000 to 110,000. Average total costs also tended to decline as the proportion of hogs increased.

Although average total costs continued to decline up through the largest auction synthesized, it does not necessarily follow that this tendency will continue with increases in livestock numbers over 110,000.

One item of expense not directly a part of the auction operations but which may exert considerable influence on the average costs incurred in marketing livestock is that of transportation costs other than those incurred by the auction owner. These costs include (1) those incurred in shipping livestock from the producer to the auction, (2) those incurred by livestock buyers in (a) driving from auction to auction when buying livestock and (b) transporting the livestock from the place of purchase to the slaughtering plant, and (3) those incurred in moving the meat and meat products from the slaughtering plant to the ultimate consumer.

Although no attempt was made to arrive at an aggregate transportation cost function it was illustrated that if average transportation costs increase as auction size increases, the lowest point on the long-run average total cost curve which includes both auction costs and transportation costs will always be achieved at a lower volume of operation than is true when the long-run average total cost curve includes only those costs incurred by the auction. If average transportation costs decline as auction size increases, then the reverse would be true and the lowest point on the long-run average cost curve would be achieved at a larger volume than when only auction costs are considered.

As additional information concerning transportation costs is obtained one may appropriately consider this problem of "optimum" size and location of Michigan livestock auctions.

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CHAPTER I

INTRODUCTION

Michigan Livestock Auctions

The first livestock auction sale in Michigan was held in May, 1933.[1] Since that time auctions have increased considerably in importance as a market outlet for producers' livestock, and in 1956 they received over one-half of the total dollar volume of livestock sold in Michigan.[2]

Livestock auction owners act as selling agents between buyers and sellers. They provide facilities to the producer for receiving, selling, and loading the livestock after it is sold. The cost of handling the livestock may be high or low at one auction in comparison with another, depending upon the facilities, methods employed, and number of livestock handled. The auction owner charges a fee to the producer for providing facilities at which his livestock may be sold, and in the long-run, the revenue from these fees must be at least equal to the costs incurred if the auction owner is to remain in business. This thesis presents the results of an analysis of the costs associated with livestock auction operations.

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[1]Stanton Parry, "An Analysis of Michigan's Livestock Auction Industry," M. S. Thesis, Michigan State University, East Lansing, Michigan, 1953.

[2]Richard Gibb and Harold Riley, Changing Market Patterns for Slaughter Livestock in Southern Michigan. Quarterly Bulletin, Michigan Agricultural Experiment Station, Michigan State University, East Lansing, Michigan, Vol. 40, No. 3, Feb. 1958, pp. 446-459.

Objectives of the Study

The first objective of this study was to determine if differences exist between auctions as to methods of handling livestock and, if so, which methods permit handling the livestock at lowest average cost.

The second and primary objective was to determine the relationship between costs of operation and volume of livestock handled by the auctions.

The final objective was to show how transportation costs, other than those incurred by the auction owner, may have considerable effect upon the average costs incurred in marketing livestock and thus may influence the conclusions one arrives at concerning economies of scale in livestock auctions.

Need for the Study

Several "economies of scale" studies have been conducted by various researchers in an effort to determine the relationship between cost and volume of operation. French, Bressler and Sammett conducted an investigation of pear packing plants in California and observed that average cost per unit packed declined as volume of output increased.[3] This decline continued from the smallest up through the largest plant for which costs were estimated. Bressler, in a synthesis of costs of operation of country milk plants in New England, indicated that economies of scale

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[3]B. C. French, L. L. Sammett, and R. G. Bressler, "Economic Efficiency in Plant Operations with Special Reference to the Marketing of California Pears," Hilgardia, Vol. 24, No. 19, July, 1956.

existed in those plants.[4]

Several studies have been conducted at livestock auctions in various areas of the country in an effort to determine the nature of the long-run average total cost curves. Most of the investigations have indicated that average total costs tend to decline with increasing volume. Almost all of these investigations, however, involved the cost accounting records[5] procedure of analysis, which has definite limitations when used to estimate the nature of the long-run average total cost curve.

Assuming the conclusions arrived at in other studies were valid, Michigan auctions may be sufficiently different from those in other states that the results of studies in other areas may not be applicable. Only a careful study of Michigan auctions can determine this.[6]

It has been implied in several previous studies that auction owners should increase their volume of operations and thereby achieve lower average total costs. This implication may be challenged on the basis that although it may be desirable from the auction owners view to expand his volume of operations, it may not be desirable from other viewpoints. For example, transportation costs incurred in transporting the livestock from the producer to the auction were not considered in these studies.

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[4]R. C. Bressler, Economies of Scale in the Operation of Country Milk Plants with Special Reference to New England, New England Research Council on Marketing and Food Supply, Boston, Massachusetts, June, 1942.

[5]A discussion of this procedure is given in Chapter III.

[6]Two Michigan auctions were included in one of the cost studies. However, these auctions operated six days per week and therefore were not directly comparable with other Michigan auctions.

If it is necessary to expand the territory from which an auction receives its livestock in order to achieve a higher volume of operations, the higher average transportation cost per head may more than offset any reduction in costs achieved through an increased volume of operation. This problem has been considered in this dissertation.

Usefulness of the Results

The livestock auction owner can use the results to assist him in determining if his auction facilities can be changed so as to lower his cost of operation. If it is apparent to him that a different method of handling the livestock at a given stage can result in lower average costs he will then be in a position to decide if the change should be effected. Although the owner is the one who must decide as to whether a change in technology employed at his auction is desirable, information obtained in this study will provide him with additional information in making the decision. The results of this study will also provide the owner with an indication of the changes in cost he can expect as he receives different volumes of livestock.

The livestock producers, ever desirous of having more efficient methods of marketing established, could benefit in the long-run through a reduction in marketing charges or through improved services for the same charge.

Those people empowered with making legislative decisions may find the results useful in deciding the nature of restrictions, if any, which should be placed on livestock auction operations in the state. One state, Montana, considers livestock auctions similar to public

utilities and requires that an individual who contemplates the construction of an auction show cause as to why an additional action is needed. The chapter in this thesis concerning transportation costs should be of some value to those who must make a decision of this nature. The section which discusses the amount of losses incurred by auction owners through "bad checks" of buyers should be of interest to legislative groups which may be considering the question of requiring livestock buyers to be bonded.

Finally, the consumer of livestock products may benefit if average marketing costs are reduced.[7] In the final analysis it is the consumer who often pays the marketing costs. If these can be reduced, the consumer will benefit, the amount depending upon how much of the cost reduction is passed on to him.

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[7]The cost reduction may be in the form of lower costs for a given marketing service or additional marketing services at a given cost.

CHAPTER II

PREVIOUS INVESTIGATIONS OF LIVESTOCK AUCTION OPERATIONS

Investigations Largely Descriptive in Nature

Several investigations of a descriptive nature have been conducted with reference to livestock auctions. Although this type study does not in itself contribute greatly to a future reduction in auction operating costs, it does provide insights into the nature of auction operations and thus can serve as a basis for additional research directed toward reducing marketing costs.

One of the most comprehensive studies of this nature was conducted by the United States Department of Agriculture during 1956.[1] This was a mail survey in which questionnaires were mailed to all auction operators in the United States who were listed as operating in 1955. The questionnaire was designed so as to provide general information concerning such things as number and type of buyers and sellers at the auctions, numbers of livestock received, selling charges, and distances from which the livestock were received. It was observed that auctions were commonly a relatively small operation with over one-half of the total number responding to the questionnaire indicating they handled less than 10,000

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[1]Gerald Engleman and B. S. Pence, Livestock Auction Markets in the United States. Marketing Research, Report No. 223, Agricultural Marketing Service, USDA, Washington, D. C., 1958.

marketing units per year.[2] In addition to this it was estimated that over 60 percent of the livestock originated from within a 25 mile radius of the auction.

McNeely and others conducted a study similar in nature to the United States Department of Agriculture study previously mentioned, but this study encompassed auctions located only in the state of Texas.[3] Results of this study indicated that average size of consignments was rather small, averaging less than three head, except for sheep. As was true in the United States Department of Agriculture study, most of the livestock came from an area close to the auction with almost one-half of the cattle and more than one-half the other classes of livestock originating from less than 25 miles away.

A descriptive study of livestock auctions conducted in the Northeastern States in 1954 indicated that livestock auctions received over 50 percent of the livestock sold in that area.[4] Most of the livestock was received from within a radius of 50 miles of the auction but some came from distances of 100 miles or more. It was indicated that some auction operators had a tendency to over-build in terms of seating capacity for buyers, sellers, and spectators. In addition it was pointed out that some auction owners had suffered heavily through "bad check" losses. One operator was facing a write-off in losses of

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[2]One marketing unit was equivalent to one head of cattle, three calves, four hogs, or ten sheep and lambs.

[3]J. G. McNeely, C. B. Brotherton, and T. M. McKenzie, Livestock Auctions in Texas. Bulletin 732, Texas Agricultural Experiment Station, College Station, Texas, 1951.

[4]C. G. Randell, Livestock Auctions in the Northeastern States, PCS Bulletin 8, Farmer Cooperative Service, USDA, Washington, D. C., 1956.

approximately $50,000 which would probably result in liquidation of the agency.

Results of a Western Regional study of livestock auctions indicated that the number of workers used to operate an auction ranged from seven to 59 with an average of 21.[5] Although large auctions required more workers than small ones, the number of workers required did not increase proportionally with the size of the auction. In addition it was observed that livestock, except sheep, was sold in rather small groups (average size of lot sold for cattle 2.2, sheep 21.3, and hogs 3.0) and that most of the livestock was received from a radius of 25 miles or less.

Investigations Based Upon Cost Accounting Records

Several investigations of livestock auctions have been conducted in which an effort was made to determine the relationship between cost and volume. These studies have been largely based upon information obtained from the cost records maintained by the auctions.

Cox and Blum of Purdue University studied the costs of operating selected Indiana livestock markets for the year July, 1949 to June, 1950.[6] They divided costs into five categories; (1) all wages and salaries; (2) advertising and public relations; (3) office expenses; (4) yard or barn expense; and (5) other expenses. They then showed cost

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[5]Harold Abel and D. A. Broadbent, Trade in Western Livestock at Auctions--Development, Relative Importance, Operations. Bulletin 352, Utah Agricultural Experiment Station, Logan, Utah, 1952.

[6]C. B. Cox and M. A. Blum, Cost of Operating Selected Indiana Livestock Markets. Station Bulletin 618, Purdue University Agricultural Experiment Station, Lafayette, Indiana, 1955.

per marketing unit for different types of livestock markets (dealers, auctions, and packers) of various sizes. A marketing unit was considered as one hog. One cow was considered 3.375 marketing units, one calf equaled 1.875 marketing units and one sheep represented 0.750 marketing units. The measure of an animal unit was arrived at by consulting market operators as to what they thought would be a close approximation of the relative costs of marketing the different types of livestock.

The average total costs of the auctions varied from 48.1 cents to 73.1 cents per marketing unit. The auction with the highest average costs was also the one with the lowest volume; conversely the auction with lowest average costs was the largest auction in terms of marketing units. Except for the high and low volume auction markets differences in operating expenses between auctions were relatively small. It should be noted, however, that only five auctions were included in this study. According to the authors the important cost determinants were volume handled, physical layout of the market, work routine followed by labor, wage rates, and equipment used. The largest expense category for auctions was wages and salaries, which constituted about two-thirds of all expenses.

Cox and Blum concluded that considerable opportunity existed for reducing costs of operating livestock markets by increasing volume. They indicated that one of the markets studied had reached or passed the optimum size from a cost standpoint, and that unit costs could be reduced from 10 to 50 percent if volume could be increased by about 1,000 marketing units per month.

The Indiana study, which emphasized the relative importance of labor as a cost component, tended to confirm results of an Ohio study published at an earlier date in which it was indicated that labor costs constituted approximately two-thirds of all costs ranging from 59.2 percent at small auctions up to 71.0 percent at the large auctions.[7] This study also indicated that expenses incurred per dollar value of livestock sold were lower at large auctions than small ones.

One of the most recent cost accounting studies was made by Lindberg and Judge of Oklahoma State University.[8] Auctions of different sizes were studied, and in order to place these auctions on a comparable basis for the purpose of cost analysis, the amount of livestock received at each auction was converted to an animal unit base. One horse, one head of cattle over 400 pounds, two calves, 400 pounds or less, two hogs, and five sheep were each considered as one animal unit. Justification for this was not given.

As was true in the Indiana and Ohio studies labor was the most important item of expense, accounting for approximately 50 percent of all expenses in this study. For the lowest volume auctions it represented 56.4 percent of the expenses and for the highest volume auctions it accounted for 49.4 percent. This was in contrast to the Ohio study in which labor constituted a larger percentage of the total costs at

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[7]George Henning and Merrill Evans, Livestock Auction Markets in Ohio, Research Bulletin 743, Ohio Agricultural Experiment Station, Wooster, Ohio, 1954.

[8]R. C. Lindberg and G. G. Judge, Estimated Cost Functions for Oklahoma Livestock Auctions, Bulletin B-502, Agricultural Experiment Station, Oklahoma State University, Stillwater, Oklahoma, 1958.

large auctions than at small ones.

Results of the Oklahoma study indicated that average hired labor costs per animal unit declined sharply up to about 35,000 animal units and then started leveling off. Economies of scale were largely realized before this volume was attained. It was concluded that average costs per animal unit would decrease 25 cents in going from an annual volume of 10,000 to 35,000 but that an increase in volume from 35,000 to 70,000 animal units would make possible only a five cent saving per unit.

Investigations Which Included Time Studies

Several studies have been conducted at auctions in which time studies were included as part of the investigation. The purpose of the time studies was to compare auctions as to the time required to handle livestock when different methods were employed.

A study of this nature was conducted at four auctions in Maryland during an eight-week period in the summer of 1954.[9] Time studies were conducted at the unloading stage and during the selling operation.

The average amount of time required to unload pickup trucks at the four markets was 5.2 minutes and large trucks, 6.3 minutes. Most of the trucks carried relatively few animals with an average load size of cattle of 2.0, calves 2.0, hogs 5.7, and sheep 8.1.

Table 2.1 indicates that there was considerable variation in the selling speed of livestock at the four auctions.

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[9]H. H. Harp and H. D. Smith, Efficiency of Livestock Auction Markets in Maryland, Bulletin 457, University of Maryland Agricultural Experiment Station, College Park, Maryland, 1956.

Table 2.1. Number of Animals Sold Per Hour, Maryland, 1954.

Class	Market Designation A	B	C	D	Average Weighted by Number of Animals
	(Number sold per hour)				
Market hogs	462	133	118	158	333
Lambs	353	353	163	24	300
Dairy calves	300	188	125	162	200
All livestock	169	147	112	68	132

Harp and Smith indicated that the principal cause of variation in selling rate was the extent to which animals were sold in groups. In market A where considerable grouping was done, calves sold in lots moved at the rate of 300 per hour whereas when sold singly as in markets B and C, they averaged 188 and 125, respectively. A similar relationship was found with other classes of livestock.

Although the time studies conducted in the Maryland study represent an effort to obtain some basis of comparing different methods of handling livestock, the opinion is held by this author that the results of this part of the study are open to rather serious criticism. At the unloading stage of operations the number of workers involved and the number of livestock per load was not disclosed. Inasmuch as these influence average costs it is difficult if not impossible to make reliable comparisons of different methods of handling livestock without this information.

Time studies were conducted in connection with a rather detailed investigation of 20 livestock auctions in the Southeastern States.[10]

[10] G. E. Turner and C. F. Brasington, Livestock Auction Markets in the Southeast--Methods and Facilities. Marketing Research Report No. 141, USDA, Washington, D. C., 1956.

An effort was made to obtain information so as to enable the investigator to design improved livestock auction facilities and to develop more efficient methods for receiving, selling and loading livestock at auctions. Costs of construction, amount of land needed for the market site, and yard labor requirements were estimated for three methods of handling livestock. It was estimated that three or four fewer yard workers would be required at each of the auctions under the recommended plan than were normally required. Assuming a savings of 40 hours per week, 50 sales per year, and $1.00 per hour wage rate, an annual saving of $2,000 in labor cost would result.

Time study results were presented for only the unloading stage of operations. The results were given in number of truckloads unloaded per man-hour as opposed to the number of trucks unloaded per hour in the Maryland study. Although the including of number of workers involved contributed much to this study no mention was made as to the number of livestock handled per man-hour.

A United States Department of Agriculture study of nine cooperative auctions in Ohio, Indiana, and Michigan was conducted in 1955 and early 1956.[11] Most of the material presented as a result of this study was obtained through a cost accounting analysis of each of the nine auctions, and some time studies were conducted.

A rather detailed breakdown of costs was made and the markets were then compared with each other. The largest item of expense was labor

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[11] I. M. Stevens and R. L. Fox, Improving Livestock Marketing Efficiency; A Study of Nine Cooperative Livestock Markets in Ohio, Indiana, and Michigan. General Report 39, Farmer Cooperative Service, USDA, Washington, D. C., 1958.

which averaged 83 cents per animal unit for the nine markets. In this study one animal unit was either one head of cattle, two calves, four hogs, or five sheep. No justification was presented in the study relative to the measuring of an animal unit. The range on labor expense was from 47 cents to $1.05 per animal unit. In general the largest markets showed lowest costs and greatest efficiency, but this was not always the case. The market with the highest labor cost per animal unit was also the one with the greatest volume. Total expense per animal unit varied from $1.61 to $3.07, but revenue showed less variation, ranging from $1.98 to $2.52 per animal unit. The three markets with smallest volume incurred losses during the year.

The only time study results presented were those conducted during the selling operation. The time, in seconds, was recorded for three phases of the selling process. These phases were work-out time, between-lot time, and total time. Wide differences were noted both in work-out time and between-lot time among auctions. A comparison of time in seconds per head for cattle, hogs, and sheep when sold individually and in groups is presented in Table 2.2.

Table 2.2. Time in Seconds Per Head Required to Auction Livestock in Different Size Lots.*

Size of Lot	Cattle	Hogs	Sheep
1 head	32	35	46
2 to 5 head	21	17	18
6 to 10 head	13	7	8
11 or more	9	2	2

*I. M. Stevens, and R. L. Fox, Improving Livestock Marketing Efficiency: A Study of Nine Cooperative Livestock Markets in Ohio, Indiana, and Michigan. General Report 39, Farmer Cooperative Service, USDA, Washington, D. C., 1958, p. 32.

It is apparent from Table 2.2 that selling time per head declined as lot size increased.

A study by Turner, McNeely, and others tended to confirm the findings of Stevens and Fox relative to the selling time requirements per head as lot size increased.[12] Although actual selling time requirements increased as lot size increased, the minutes per head decreased. Time requirements were also given in this study for unloading, bringing up, weighing, bringing back, and loading out. In some instances the number of man-minutes required per head was given but, in general, information as to the number of workers employed or the number of livestock handled was not given.

A somewhat later report on the Texas study was concerned primarily with operating costs and returns.[13] McNeely and Turner estimated the costs for each of twelve different expense components for auctions of four different sizes. These synthetic costs were in the authors' words "based on optimum conditions at auctions of different sizes."

Labor expense was the most important cost item for auctions regardless of size. Although actual labor expense increased with auction size, the expense per animal unit declined. However, McNeely and Turner believed that the labor expense per unit at the auction falling in the

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[12]George H. Turner, J. G. McNeely, C. V. Wooton, and S. W. Burt, Texas Livestock Auction Market-Methods and Facilities. Miscellaneous Publication 93, Texas Agricultural Experiment Station, College Station, Texas, 1953.

[13]J. G. McNeely and G. E. Turner, Texas Livestock Auction Markets--Operating Costs and Returns. Miscellaneous Publication 118, Texas Agricultural Experiment Station, College Station, Texas, 1954.

largest volume bracket would be greater than that of the auction falling in the second largest volume bracket. They arrived at this conclusion because they felt that it would be necessary to pay a higher wage rate at the largest auction because they were located in larger cities where labor was commonly paid a higher wage rate. It was not indicated as to whether or not the actual labor expense incurred by the auctions studied corroborated their beliefs concerning estimated labor expenses at auctions falling in the highest volume group.

Summary of Previous Investigations

In this chapter livestock auction studies were classified into three main categories. These were (1) those largely descriptive in nature, (2) those based upon cost accounting records, and (3) those which included time studies.

Those falling into the first category may be of considerable value in that they enable one to gain insight into the nature of the problem and consequently serve as a basis for additional research which may be directed toward increased efficiency in livestock handling.

The second type study can show rather clearly the magnitude of the various cost components and thereby indicate which cost areas should be investigated further in order to result in the largest potential cost reductions. When combined with observations of the auction operations, they may also, with careful interpretation, serve as a basis for making inter-auction comparisons as to methods of handling livestock.

The time studies can add materially to the value of other studies in that they can indicate which methods of handling livestock result in lowest labor requirements per head.

The previous studies showed that most livestock came from a relatively short distance away and was received in relatively small loads. In addition to this it was observed that labor was the most important cost component in auction operations, with most of the studies indicating that it constituted from one-half to over two-thirds of the total costs of operation. Rather large differences were observed between auctions in average labor cost per head of livestock handled. This implies that research directed toward this area may result in rather substantial reduction in average handling costs per head of livestock.

Most of the research indicated that average total costs tended to decline as volume increased but exceptions to this were noted. The conclusions arrived at in some of the studies were based on a very limited number of observations. In order to ascertain the nature of the relationship existing between costs and volume the researchers found it necessary to arrive at some measure of size of auctions, and it was generally realized that numbers of animals handled, in itself, was not a reliable indicator of size. In attempting to overcome this problem most of the investigators arrived at an "animal unit" for measuring size. With one exception no justification was given for deciding what constituted an animal unit. Inasmuch as size was measured in animal units, this measure is of paramount importance in determining the relationship between costs and volume of operation (or size). Since justifications were not given in determining an animal unit, one can seriously question

conclusions concerning the relationship between cost and volume which were arrived at in studies using animal units as a measure of size.

Some of the time studies presented are also open to questioning. In most of the investigations time studies were conducted at only one or two stages of the auction operations. These cannot serve as a basis for making comparisons as to methods used at other stages of the operations. In addition to this, it is this author's opinion that those time studies which present only the number of minutes per head or the number of man-minutes per lot are incomplete. These figures are rather meaningless unless one knows the time required to perform the operation, the number of workers involved, and the number of head of livestock. As an example, let us consider the Texas study in which the minutes required, per truck, to unload cattle using three different methods of operation was shown as was the number of workers. The resulting figures disclosed the man-minutes required to unload a truck, but did not show the labor requirements per head of livestock. If the trucks which were being unloaded contained about the same numbers of livestock, then the comparisons of methods of unloading could be accepted as reliable indicators of the relative efficiency of each method. However the numbers of livestock, per truck, were not given and it is conceivable that the technology which required the highest number of man-minutes to unload a truck might be the one with the lowest man-minutes per head of cattle and, assuming the same wage rate, lowest average costs. For this reason it is felt that the results of many of the time studies conducted in previous livestock auction studies are inconclusive. Although many of the studies reviewed do provide

considerable insight into the nature of livestock auction operations the conclusions concerning methods of handling and relationship between cost and volume are open to questioning because of the reasons indicated.

CHAPTER III

METHODOLOGY AND PROCEDURE

Most of the previous studies designed to determine the relationship between cost and volume may be separated into two groups. One group consists of the cost accounting records studies and the other consists of the "synthetic" studies. The primary distinction between the two methods is that in the former the investigator studies plant records, observes the plant operations and compares plants that actually exist. Using the synthetic approach the researcher estimates costs of operating plants that do not actually exist and then compares these "synthetic" plants.

Cost Accounting Records Method

This method uses as basic information the cost records of existing plants. Consequently, if the study which is to be conducted achieves the intended results the plant records must be accurate and complete. The usual procedure in conducting a study of this nature is to study a sample of firms representing different volumes of output. Costs of operation for each of these firms are computed; the total cost incurred by each firm is considered as a single observation, and a regression equation is fitted to the data.

One of the major limitations to this method is that the total cost arrived at for each plant does not indicate at what point on the short-run

average total cost curve a plant was operating. The result may not be the correct estimate of the long-run average total cost curve. As Lindberg and Judge[1] indicated the long-run, average cost curve will be correctly estimated only when the short-run average cost functions are tangent to the long-run average total cost curve.

Figure 3.1. Erroneous and Actual Long-Run Average Total Cost Curves.

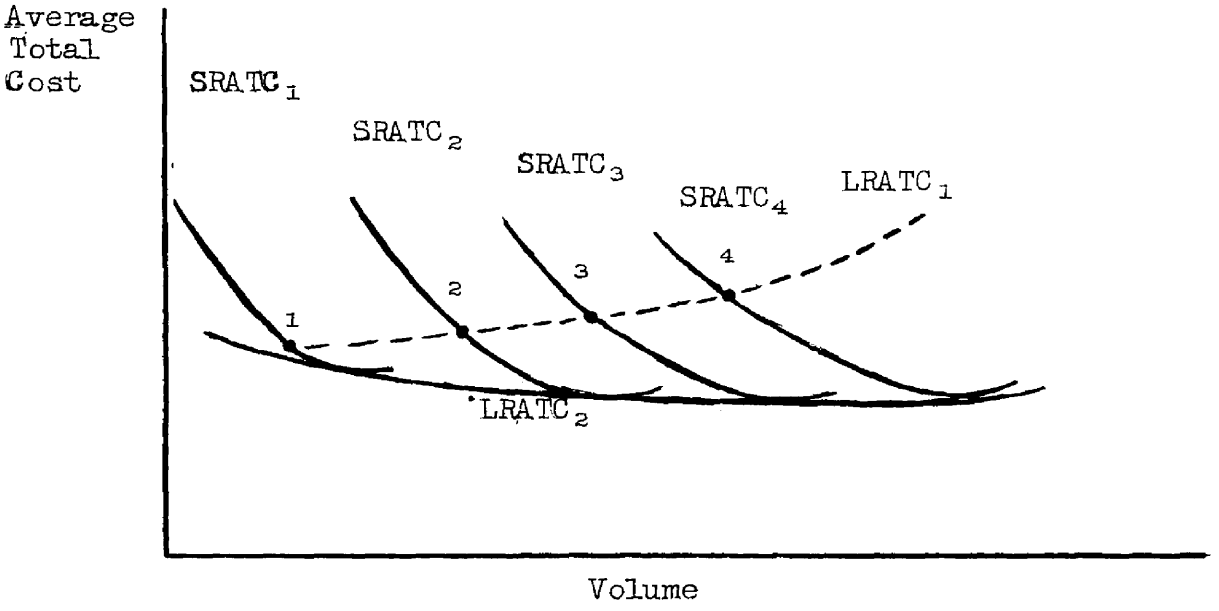

Figure 3.1 depicts a hypothetical case in which four plants are observed and the total operating costs incurred by each for a given period are obtained. These costs are indicated by numbers 1 through 4. If one accepted these points as defining the long-run average cost curve, this curve would follow the path indicated by the broken line ($LRATC_1$).

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[1]R. C. Lindberg and G. G. Judge. Estimated Cost Functions for Oklahoma Livestock Auctions, Bulletin B 502, Agricultural Experiment Station, Oklahoma State University, Stillwater, Oklahoma, 1958.

This would indicate that small plants in this industry achieve lower average costs than large ones. There would be a dis-economy to scale.

The true nature of the relationship between cost and volume, however, might be represented by the short-run average total cost curves and the solid long-run average total cost curve, ($LRATC_2$). The reason that it appeared that a dis-economy to scale existed is that the smaller plants were operating on a relatively low point on their short-run average total cost curve and the larger ones were operating at a relatively high point.

One may eliminate, or reduce the magnitude of the possible error of failing to determine the correct long-run average total cost curve by obtaining the costs of operation from each plant while they are operating at different points on their average total cost curve. This may be very time consuming, if not impossible, however, because a given plant may operate at a fairly uniform volume of output for several months or years.

A second rather basic disadvantage in using the cost accounting records approach is that they do not provide a basis for comparing the relative efficiency of alternative methods of operation. Relatively small plants may achieve lower average total costs than large ones not because of a dis-economy of scale but because the small firms are using more efficient methods of operation. The cost records, by themselves, do not disclose this.

Other disadvantages of using the cost accounting records approach are:[2] (1) information taken from plant records contain many arbitrary

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[2]Ibid., p. 21.

valuations and allocations, and (2) reported fixed costs reflect variation in such items as purchase date of plant and equipment and rates and methods of depreciation.

The main advantage attributed to the cost accounting records approach is that this method enables one to obtain considerable information concerning costs in a relatively small amount of time and at a relatively low cost. This is especially true with certain relatively unimportant cost components such as utilities and supplies. Estimating the cost of these components without cost records would require a very large amount of time. The cost records also may be of considerable value in determining the wage rates to use. In addition, they may be the only source of data for some items of cost such as administrative and miscellaneous expenses.

Synthetic Method

The synthetic method is used to determine cost relationships among "synthetic" plants when all variables are held constant except volume of output. It is difficult, if not impossible, to compare actual existing plants that differ from each other only in size. According to Black[3] this technique of cost determination has been derived largely from the workshop of the industrial engineer. It employs a combination of tools of economics, statistics, accounting, engineering, and other technical subjects.

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[3]Guy Black, "Synthetic Method of Cost Analysis in Agriculturel Marketing Firms," Journal of Farm Economics, Vol. 37, 1955, p. 270.

In attempting to make cost comparisons of synthetic plants all costs of plant operation must be estimated. The sources of data for these estimates may be plant records, direct observations, equipment manufacturers, engineering estimates of building costs and technical data from the physical and biological sciences.[4]

Direct observation may consist of work sampling, job description, motion study, time study and several other activities. Each is primarily directed towards obtaining information concerning the amount of labor necessary to perform a given function.

The equipment manufacturers provide the primary source of data on price of the equipment which is to be utilized in the synthetic plants.

Engineering estimates of the building construction costs require specifications of the physical quantities of materials and labor used in constructing the building. Estimates of building life may be obtained from engineering experience, contractors and from plant records.

It may be necessary to obtain some information from workers in the physical and biological sciences. "The content of the information obtained will depend upon the type and function of the plant being synthesized and may involve consideration of factors such as the import of production techniques upon quality, physiological aspects of storage, and the nature of chemical or other technical processes and their relation to costs and output."[5]

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[4]J. F. Herrick, et al., "Assembling and Packing Operations at Country Plants," Marketing Efficiency In a Changing Economy, USDA Agricultural Marketing Service, 1955, p. 194.

[5]Ibid., p. 197.

In general, when the synthetic approach is used operations within a given plant are divided into separate phases or "stages" for purposes of cost measurement. In this manner, the cost measurements yield input-output functions that provide a fundamental basis for comparing the costs of alternative technologies and for developing total plant cost curves.[6] Once the input-output relationships of individual operations have been developed, the costs of hypothetical plants may be determined as readily as those of existing plants.

One of the major advantages of the synthetic approach over the cost accounting records approach is that it can be applied in an industry where data are not adequate for statistical analysis, where price changes or new technologies have destroyed the usefulness of historical records, or where it is not possible to find a sample of plants operating under comparable conditions at a given time.

This approach does have some disadvantages, however. One difficulty is that the input-output relationship may depend on other factors in addition to plant size. Plants which appear similar in design may exhibit rather marked differences in efficiency because of differences in management.

A second disadvantage is that the researcher in adding the costs of each stage of operations may fail to realize that there may be a dependency between stages which necessitates that if the lowest cost technology is used at one stage one of the higher cost technologies must be employed at the next stage.

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[6]Guy Black, op. cit., p. 194.

A third disadvantage often attributed to the synthetic approach is that it may be expensive. Although it may be correct that the cost accounting approach often requires less time and money it may be that the type of information desired is obtainable only through the synthetic approach. If so, it may be a question, then, of obtaining the information through the relatively expensive approach or not obtaining it at all.

Procedure Employed in This Study

Inasmuch as the primary objective was to determine the relationship between cost and volume of livestock auctions, and realizing that the cost accounting approach can provide this information only under certain conditions, it was decided that primary emphasis should be given the synthetic approach in this study.

The results of this study are based upon information received from eight livestock auctions in Michigan plus visits to several others. The auctions were selected on the basis of numbers of livestock sold, gross dollar volume of livestock sales, geographic location, and method of handling the livestock.

Initial contact was made with the owners or managers of the auctions included in this study by telephone, and a follow-up personal visit was made at which time an explanation was given as to the nature and purpose of the study. Most of the owners were very cooperative, and arrangements were made at this time to visit the auction and conduct the study.

Table 3.1 shows that the auctions exhibited marked differences with respect to numbers of livestock handled, total dollar sales and square footage of building area.

Table 3.1. Total Dollar Sales, Area of Building, and Number of Livestock Sold at Eight Michigan Auctions in 1957.

Auction	Dollar Sales	Livestock Sold				Area of Building (Sq. Ft.)
		Cattle	Calves	Hogs	Sheep	
		(No. of Head)				
A	$5,074,574.78	17,311	11,084	39,464	26,465	31,860
B	3,421,975.31	19,162	12,003	23,234	1,792	26,856
C	3,000,000.00	18,700	9,900	15,500	7,220	26,128
D	2,927,262.21	10,167	11,175	31,970	3,613	27,242
E	2,122,352.00	8,600	11,981	25,355	4,848	14,058
F	1,406,465.00	5,600	3,014	14,525	803	20,648
G	767,929.47	4,002	3,431	3,713	60	10,800
H	746,084.89	3,926	2,428	6,959	638	14,400

An effort was made to visit the auction prior to the sale in order to obtain cost records, discuss auction operations with the owner or manager, and observe the general lay-out of the facilities. By observing the facilities prior to sale day one could learn how the livestock was handled and then determine how the time studies should be conducted during the sale.

Detailed cost records were obtained at all auctions, and these were considered to be especially useful in serving as a basis for estimating variable costs such as utilities, supplies and advertising. These cost components normally constitute a relatively small percent of the total amount of cost, and the cost records reveal approximately what percent one could ordinarily expect this to be. Although this information could also be estimated in other ways, to do so would require

extreme amounts of time and money. Cost records were also valuable in providing an indication of wage rates and salaries paid to all employees.

Diagrams of floor plans of each auction were made, and these were used to help determine the reasons for differences between auctions in time requirements to handle livestock.

Livestock auction operations were separated into six stages,[7] and time studies were conducted at each of these at all auctions in order to compare different methods of handling the livestock. Appendix A shows the form used in conducting the time studies.

Most of the study was conducted during the three-month period--June, July, and August, 1958. Although this is a period of relatively light receipts of livestock, the nature of the auction operations nevertheless remain essentially the same throughout the year. All auction operators indicated that they do not voluntarily alter the number of workers employed as livestock receipts rise or decline although the length of time the personnel work will be somewhat less during days of relatively light runs. The procedure used in handling the livestock, both in the office and in the yard is essentially the same regardless of the season.

The information obtained from the cost records, through discussions with auction owners, and through the time studies was utilized in estimating costs of operation for 24 synthetic auctions. Chapter IV provides the results of the cost studies conducted at each auction; Chapter V

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[7]A description of each stage is given in Chapter V.

provides a description of the livestock auction stages; Chapter VI gives the results of the time studies, and Chapter VII presents the results of the actual synthesis of the auctions.

CHAPTER IV

OPERATING COSTS INCURRED BY EIGHT MICHIGAN LIVESTOCK AUCTIONS

Introduction

Detailed cost records were obtained at each auction included in this study for several reasons. First, the records were considered a good source of information concerning wage rates and salaries of auction employees. These were needed in synthesizing auction costs. Secondly they may be used to estimate certain cost components, such as utilities, advertising, and supplies, which constitute a relatively small proportion of the total but which would be difficult to estimate otherwise. Finally the author considered it desirable to include the actual costs incurred by the auction so that a comparison of these with the synthetic auctions might be made.

Classification of Costs

The costs were separated into ten component parts which corresponded closely to those listed by the auctions although some variations in classifying costs were found at all auctions studied. The cost components were:

1. Labor
2. Transportation
3. Maintenance and Repair
4. Utilities
5. Supplies

6. Advertising
7. Losses
8. Insurance and Bond
9. Taxes
10. Other

One of the largest problems encountered while obtaining these figures was that in a few auctions the owner was also a livestock dealer. In most cases, separate records were kept for each enterprise, but this was not always true nor was it true for all cost components. For example, at one auction, all expenses incurred due to truck operation were listed as auction expense even though this truck was used for other purposes as well. In this case an estimate was made as to the percent of the total transportation expense which could be attributed to the auction. This problem arose primarily in connection with the transportation cost component but not exclusively. It was true to a lesser degree with labor costs. In all cases where a problem of this kind arose, an estimate was made from the best information available as to the proportion which should be allocated to the livestock auction.

Labor cost was separated into four categories--yard, office, auctioneer, and management. This classification made it possible to make more accurate labor cost comparisons between auctions.

Transportation costs included any trucking expense incurred by the auction in addition to automobile expense which arose as part of the auction operations.

Maintenance and repair expenses consisted of costs resulting from such things as replacing gates, fixing pens, and re-roofing.

Utilities included cost items such as electricity, heat, and telephone. No problem arose in obtaining these figures. Telephone

expenses were sometimes quite high as a result of non-auction personnel making long distance calls. Often, however, the management was reimbursed for these. In such cases the telephone expense which was included in the utilities was the net amount.

Supplies included items used both in the office and in the yard. This cost component included items such as hip and ear tags, glue, stationery, pencils, buyer sheets, consignment sheets, and scale tickets. No breakdown was made between office supplies and yard supplies because some auctions listed a given item as yard supply whereas others considered it as an office supply.

Advertising expense included costs incurred in advertising through newspapers, on the radio, handbills, or any other method.

Losses included such items as bad checks, animal injury or death, and trading losses which were incurred as the result of an auction owner buying livestock at his auction and reselling in the same manner. The latter may be considered as a price supporting activity.

Insurance costs covered all types of insurance which the auction owner carried in connection with the auction operations. Among these were fire and comprehensive insurance on the building and its contents, livestock insurance, workman's liability insurance and unemployment insurance compensation. All Michigan auction operators are required by law to be bonded. The amount of the bond is based upon the average weekly dollar volume of sales for the previous year.

Taxes included social security taxes, property taxes, and any other taxes which the organization paid.

The "other" category accounted for all other expense items. It was not listed as a cost component in some auctions but was necessary in this study because there were many cost items which were rather important at some auctions but negligible or non-existent at others. It included such things as donations, snow removal, legal fees, Christmas gifts, and director's fees.

Depreciation was not included as an expense item in this phase of the study. Methods used in depreciating facilities varied so greatly between auctions that comparison between them were virtually impossible. One possible solution to this is to estimate the replacement cost of each building and then use a standard measure for depreciating the facilities. This introduces a bias, however, in favor of the auction with a relatively new building which may have efficient pen arrangement for handling the livestock.

It may be possible that some auction owners are aware that with the design of their old buildings, labor costs will be relatively high. However, the owners may be willing to, in effect, trade low labor costs for low fixed building costs. If these older buildings were depreciated on the basis of their replacement cost the auction owners would be penalized on their combined depreciation and labor costs. If the owner were to replace his building he would, if facilities are such that labor costs are high, construct it so that labor costs would be reduced, assuming that it would cost no more to build this building than a new one which is not arranged to utilize labor efficiently.

For these reasons depreciation costs are not given for the eight auctions. It should be pointed out, however, that if one were estimating

the costs of livestock auction operations, depreciation costs would have to be considered.

Cost Relationships Among Auctions

Total Cost and Average Cost

Table 4.1 shows that total costs of operation ranged from about $14,000 up to about $68,000. Average total cost per animal ranged from 66 cents at auction E up to $1.37 at auction G. Auction G was the smallest auction in terms of number of livestock handled in 1957, but auction E, with lowest average cost, ranked only fifth in total number of livestock handled in that same year. There are certain limitations to making these cost comparisons. First, auctions A, C, D, and E were owned by people who did some of the auctioneering and who did not pay themselves for this service. If the owners paid someone else to do this, this item of expense would be approximately doubled at auctions C, D, and E, and increased about one-third at auction A. This would result in somewhat higher average costs incurred at those auctions than are shown. Similar comments are applicable for the management cost component at auctions E, G, and H.

In addition one must keep in mind that the proportion of each species of livestock handled varied between auctions. Auction E, for example, received relatively few cattle and many hogs which would tend to reduce average costs.[1] In effect the auctions were handling somewhat

[1]The differences in labor requirements to handle different species of livestock are shown in Chapter VI.

Table 4.1. Costs of Operation of Eight Livestock Auctions in Michigan, 1957.

	A		B		C		D		E		F		G		F		Total	Percent
	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Cost	of Cost
	Dollars		Dollars		Dollars		Dollars		Dollars		Dollars		Dollars		Dollars		Dollars	
Labor	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Office	7,385.40	10.9	7,641.65	17.4	4,732.00	10.8	2,629.99	6.1	4,783.93	14.3	4,493.00	17.2	1,200.00	8.6	2,334.42	13.2	35,200.41	12.1
Yard	18,782.89	27.7	15,766.15	35.9	12,024.00	27.4	13,796.92	32.9	12,995.70	38.8	8,598.43	33.0	7,765.09	55.8	5,485.82	31.0	95,215.00	32.8
Auctioneer	5,265.50	7.8	4,186.50	9.5	1,845.00	4.2	2,120.00	4.9	1.820.00	5.4	1,530.00	5.9	1,500.00	10.8	1,640.00	9.3	19,907.00	6.9
Manager	6,256.72	9.2	6,000.00	13.7	2,500.00	5.7	3.975.00	9.2	--	--	2,151.00	8.2	--	--	--	--	20,882.72	7.2
Total Labor	37,690.51	55.6	33,594.30	76.5	21,101.00	48.1	22,521.91	52.2	19,599.65	58.5	6,772.43	64.3	10,465.09	75.2	9,460.24	53.5	171,205.13	59.0
Transportation	1,854.84	2.7	--	--	4,000.00	9.1	934.00	2.2	752.16	2.2	--	--	--	--	1,159.76	6.5	8,700.76	3.0
Maint. and Repairs	1,404.43	2.1	1,513.59	3.4	2,295.00	5.2	661.87	1.5	3,274.54	9.8	1,932.39	11.2	278.20	2.0	403.91	2.3	12.764.53	4.4
Utilities	2,537.09	3.7	1,375.31	3.1	1,200.00	2.7	1,257.06	2.9	1,211.25	3.6	1,372.72	5.8	343.49	2.5	1,236.46	7.0	10,533.38	3.6
Supplies	2,495.80	3.7	2,068.76	4.7	2,300.00	5.2	1,656.45	3.8	1,495.95	4.5	1,039.02	4.0	754.46	5.4	1,899.46	10.7	13,709.90	4.7
Advertising	2,651.16	3.9	150.00	.3	1,000.00	2.3	1,278.00	3.0	1,512.10	4.5	1,205.20	4.6	355.00	2.6	1,860.67	10.5	10,012.13	3.5
Losses	7,746.76	11.4	348.51	.8	2,200.00	5.0	9,258.06	21.5	238.33	.7	188.60	.7	45.68	.3	62.25	.4	20.088.19	6.9
Insurance	1,041.01	1.5	1,405.99	3.2	1,000.00	2.3	1,671.00	3.9	855.04	2.6	1,550.32	5.9	570.54	4.1	823.58	4.6	8,917.56	3.1
Taxes	2,491.65	3.7	1,575.26	3.6	1,750.00	4.0	1,520.18	3.6	1,126.36	3.4	827.03	3.2	982.84	7.1	806.03	4.6	11,079.35	3.8
Other	7,986.92	11.8	1,868.41	4.3	7,000.00	16.0	2,339.02	5.4	3,415.81	10.2	197.40	.8	125.60	.9	--	--	22,933.16	7.9
Total Cost	67,900.17	100.0	43,900.13	100.0	43,846.00	100.0	43,097.63	100.0	33,481.19	100.0	6,085.11	100.0	13,921.50	100.0	17,712.36	100.0	289,944.09	100.0
Total No. Animals	94,324		56,191		51,320		57,125		50,784		3,942		11,206		13,951		358,843.00	
Average Total Cost Per Head	.72		.78		.85		.75		.66		1.09		1.37		1.27		.81	
Average Labor Cost Per Head	.40		.60		.41		.39		.39		.70		.93		.68		.48	

different products insofar as the proportion of each species of livestock received by the auctions was not the same. One is not justified in concluding that auction E handled livestock more efficiently than auction B even though the average cost per head was lower at E. Auction B handled relatively more cattle and relatively fewer hogs than E, and cattle required more labor, per head, than did hogs.

One could, however, reasonably conclude, on the basis of the costs presented in Table 4.1, that auction B was handling livestock somewhat more efficiently, than auction F. Average cost per head at auction B was 78 cents as compared with a cost of $1.09 at F. This is true despite the fact that cattle constituted a higher percent of the total number of livestock received at B than at F.

Individual Cost Components

Labor. When considering all auctions together, labor constituted 59 percent of the total costs. There was, however, a considerable variation with these costs ranging from 48 percent at auction C to 76 percent at auction B. It should be noted, however, that it does not necessarily follow that auction B, in which labor accounted for 76 percent of all costs, will also exhibit the highest average labor cost per head of livestock handled. Actually the average labor cost per head at auction B (60 cents) was lower than that at three other auctions. The average labor cost per head ranged from 39 cents up to 93 cents with a tendency for the smaller auctions to have higher average labor costs.

The relatively high proportion of total expenses which labor constituted at auction B may be explained in two ways. First, this

percentage may have been high because other costs were quite low and they constituted a small percentage of the total. However, one might also be led to believe that the labor costs were high simply because an inefficient use was being made of labor. In attempting to determine the reason for this high labor cost comparisons of actual labor costs for the different auctions may be made, keeping in mind the number of livestock handled and the relative proportion of each.

Keeping these things in mind it appears that office labor expense was definitely high for auction B in comparison with other auctions except F and H. This auction (B) handled almost exactly the same number of calves but far fewer cattle, hogs, and sheep in 1957 than auction A, but its office labor expense was somewhat greater than that of A's. In sharp contrast with auction B was auction D which handled approximately the same number of livestock, although D did handle relatively fewer cattle and more hogs which would tend to decrease its labor costs. Office expense at D was only about 35 percent as great as that of B. In visiting these auctions it was immediately apparent that office labor expense would be relatively high at auction B because ten people worked in that office as compared with six at auction D and only four in auction C. However, the number of workers employed, in itself, does not indicate that labor costs will be high or low. One must also consider the wage rate and the number of hours worked. Office employee wage rates at B and D were almost identical but employees at B worked a greater number of hours which would make the discrepancy in office labor expense even greater. Auction C employed what was perhaps the most efficient method of utilizing its office help. Four workers ran

the office, and each worker had a definite task assigned to him. The employees in this office worked about the same length of time as those in auction D and there were two fewer employees, but the office labor expense was nevertheless greater because of the wages paid. Auction C utilized office personnel who also had full-time duties during the week with that auction or with another auction owned by the same corporation. These employees were trained and highly specialized and their wage rate was much higher than that usually paid office personnel at other auctions. It should be pointed out, however, that it would not be necessary in order to operate the auction office with only four employees to pay wages as high as those paid at C. Since the office workers at C were employed full-time, using them to work in the office on sale day was a method of eliminating additional expenses. The type of work done in the office is such that most people would be quite capable of doing it.

Yard labor expense showed somewhat more uniformity than did office labor expense, tending to be fairly close to 30 percent of the total expenses with the exception of auction G. This auction showed relatively high yard labor costs in relation to total costs both because the actual labor costs were somewhat high and some of the other cost components were relatively low and thus constituted a small percentage of the total cost.

Auctioneer expenses were not directly comparable inasmuch as the expenses shown were only those actually incurred by the auction. Auctions A, D, C, and E were owned by people who did some of the auctioneering and who did not pay themselves for this service. If those people did none of the auctioneering and if they paid someone else to

do this, this expense would be approximately doubled at auctions C, D, and E and would be increased about one-third at auction A. Even so, however, it appears that auctioneer expense did not rise as rapidly, percentagewise, as did the volume of livestock handled.

The same comment holds true for the management cost component where three of the owners did not hire a manager and did not pay themselves for this task. The other five auctions were either corporations which hired a full-time manager or private enterprises in which the owner hired a manager and devoted part of his own time to other activities. Table 4.2 shows the number of workers at each of the eight auctions.

Table 4.2. Number of Workers, By Type, Employed at Each of Eight Michigan Livestock Auctions.

Auction	Type of Worker				Total
	Office	Yard	Manager	Auctioneer	
A	6	21	1	3	31
B	10	19	1	2	32
C	4	15	1	2	22
D	6	16	1	2	25
E	7	16	0	2	25
F	6	15	1	1	23
G	4	9	0	1	14
H	3	8	0	2	13

The number of office workers ranged from three at one of the smallest auctions to ten at one of the larger ones, whereas the number of yard workers ranged from eight to twenty-one with a tendency for the number of workers used to increase with numbers of livestock handled.

Transportation. Transportation costs varied from zero up to about $4,000 and constituted from zero percent to nine percent of the total

costs. This latter figure was quite high because this auction was one of several owned by the corporation and several of the employees at this auction, including the business manager, lived at a location considerably distant from the auction itself. This resulted in a high transportation charge assessed to this auction. Auctions B and F were corporations and did no trucking for consignors nor did they use automobiles to drive around in an effort to persuade additional livestock producers to sell at their auction. Auction G, likewise, did not engage in this activity. H had relatively high transportation expenses which could be largely explained through the fact that this was a small auction which had not been operating long, and the owner was making a concentrated effort to increase the number of livestock received at his auction. In order to do this, he did considerable traveling around the countryside calling on livestock producers, and he also provided trucking services sometimes at little or no cost to the producer.

Maintenance and Repair. Maintenance and repair costs constituted from 1.5 percent to 11.2 percent of the total costs. The amount of maintenance and repair cost may be expected to vary for at least three reasons. First, other things being equal, large buildings will require more maintenance and repair than small buildings. Secondly, new buildings will require less maintenance and repair than old buildings, and, finally, the owner may postpone doing certain kinds of repairs. When he does make these repairs they will be costly but as long as some of them are postponed this cost component may be abnormally low during a given year. Auctions F and E showed heavy maintenance and repair expenses because considerable repairing was done at these two auctions

in 1957. Normally one would not expect these two auctions to have this heavy repair expense. Actual repair and maintenance expense at auctions G and H was quite low (although on a percentage basis no lower than several others) because these two were small auctions, and the facilities at H were almost new.

Utilities. With two exceptions the actual cost of utilities was quite similar between auctions. One would have expected auction A to have had somewhat higher actual utility expenses because the facilities were relatively large, and this required additional electricity for lighting. The sales arena, however, was no larger than many others and heating should have been higher only insofar as the sale lasted longer. Telephone expenses at this auction were quite heavy, however, and this accounted for much of the added expense. Auction G had very low utility expense, both in terms of actual cost and percent. This was a very small building and one would have expected heat, water and electricity costs to have been low. Auction H had somewhat higher utility expenses than one would have expected. This building was larger than that of auction G and one would have expected heating, light and other utilities to have been somewhat higher but not as much as shown in Table 4.1. The most likely explanation is that the owner permitted some buyers and sellers to make long distance calls on his telephone at little or no cost to them.

Supplies. Supplies constituted from 3.7 to 10.7 percent of the total costs. This variation was not completely unexpected. Some auctions used hip tags on the animals; some used ear tags; some marked the hogs and some did not. Another reason for the variation was that

different types of buyer sheets and consignor sheets were used, and these varied considerably in cost. Some auctions used write-up sheets which needed no carbon paper but which were relatively expensive. Others used buyer sheets and consignor sheets which had no carbon paper but which required that the employees had to insert carbon paper into. This required more labor but would help decrease supply costs. With one exception, however, a rather distinct pattern could be detected in which the larger auctions had greater absolute supply expenses than the small ones. There was not a great deal of variation percentagewise at these auctions other than the exception mentioned earlier. This exception was auction H and one of the main reasons for the high amount here was that this auction used two hip tags on each animal and this almost doubled this item of expense.

Advertising. Advertising costs accounted for a fairly uniform percent of the total except for one unusually low and one unusually high figure. Auction B did practically no advertising through any media whereas auction H had heavy advertising expenses. As mentioned previously, auction H was a recently formed, small auction whose owner was attempting to increase his volume of business. One method used in this attempt was through advertising and the owner in this case apparently was convinced that it was well worth the cost. One can only assume that the owners of auction B felt that it would not pay them to advertise heavily. This was somewhat surprising in view of the fact that there were two other livestock auctions approximately 10 miles away.

Losses. One rather important item of expense for two auctions was that of losses. These may occur in the form of buyer adjustments,

seller adjustments, or bad debts. The latter was the one which most operators were chiefly concerned with. It was difficult to make reliable comparison of losses suffered by auctions on the basis of one year's observations. Most of the operators indicated that they might go two or three years without suffering a major bad debt loss. This being the case, it was quite possible that some of the auctions showing little loss through bad debts during 1957 might have suffered them in 1956 or 1958. It should be emphasized that if the relatively large losses suffered by auctions A and D had not occurred, the relative importance of the remaining cost components would have been increased considerably. In the case of auction D, one bad check of about $7,500 resulted in a very high loss cost component. If this auction had not suffered this loss labor would have constituted about 63 percent of the total cost instead of 52 percent and the total cost per animal handled would have been about 15 cents per head less and lower than that of any other auction. Auction A also suffered rather heavily through losses. Both this auction and auction D were fairly large auctions but one cannot justifiably conclude that large auctions suffer far greater losses through bad debts because auction B, which was also a rather large auction suffered almost no losses during the year. The problem did not appear to be one of size. It is true, however, that large auctions have buyers who buy in larger quantities than those at small auctions, and if one of these buyers does write a "bad" check, it is more likely to be a large one.

Insurance, Bond and Taxes. Insurance showed no definite pattern, ranging in percent from 1.5 to 5.9 percent of all costs. Auction F had

higher insurance costs than any other auction except one although this was not one of the larger auctions. Auction A had actual insurance costs only slightly higher than auctions G and H which were much smaller in size. The insurance costs were determined in large part by the auction owners and the extent which they wanted to transfer the risks to someone else. Some owners may want to insure the building for its estimated replacement cost while others insure for only its depreciated value or some fraction of it. Some may insure heavily on livestock and others may not insure at all. Similarly with other types of insurance. The bonding fee, being based upon the previous year's average weekly gross dollar sales, was somewhat higher for large auctions than small ones.

Taxes, including social security, varied for several reasons. Social Security varied, of course, with the number of employees and their wages. Property tax varied considerably from school district to school district, and the business activities tax, which auction owners pay was based upon the revenue received by the auction, auctions with large revenues paying higher taxes. The tax rate, however, was not progressive.

Other. The "other" category varied considerably between auctions for several reasons. All expenses which were not generally a part of each auction were put into this category. Included here were directors' fees, legal expenses, bank charges, donations, snow removal, and Christmas gifts. In some instances, notably auction A, these expenses were relatively high. Auction A had a very high legal fee included in this cost component, and this would not normally be expected. Auction C

also had high costs in this category, primarily because, as mentioned previously, this was only one of several auctions owned by this corporation, and the nature of the expenses incurred were somewhat different than those of the other auctions. The smaller auctions without exception had a very low amount shown in this category.

Summary of the Costs

The operating costs incurred by eight Michigan auctions have been presented in this chapter. Costs were separated into ten component parts and the relative importance of each was shown.

Average cost per head of livestock varied from 66 cents at auction E to $1.37 at auction G. There was a tendency for average total costs to decline as the number of livestock handled increased, but exceptions were noted. The two smallest auctions showed highest average costs and the largest auction showed second-lowest average costs.

Labor was the most important cost component and constituted about 59 percent of the total costs. Considerable variation was observed, however, in the relative importance of this expense item which ranged from 48 percent of the total at auction C to 76 percent at auction B.

Most of the remaining cost components constituted no more than five percent of the total costs at any auction. An important exception to this was that of losses which constituted over 20 percent of the total costs at auction D.

It should be re-emphasized that the costs presented herein show no depreciation, no interest, and in some cases no wages paid for management or auctioneering services. If these were shown the average costs would,

of course, be higher, and other cost components would constitute a relatively smaller proportion of the total.

Although there was a tendency for the auctions handling relatively large numbers of livestock to achieve lower average total costs than those handling relatively small numbers, extreme caution must be observed in arriving at conclusions of this nature for at least two reasons. First, the proportion that each livestock species constituted of the total number of livestock handled varied between auctions, and this may influence costs considerably. Secondly, exceptions were noted to the tendency toward lower average costs with increasing volume and this indicates that factors other than volume of livestock handled may be very important in determining costs of operation. One of the possible factors was the method of handling livestock. The time study results which are presented in Chapter VI provide insight as to the relative efficiency of different methods of handling livestock.

CHAPTER V

STAGES OF A LIVESTOCK AUCTION OPERATION

Introduction

Operations conducted within an auction consists of several types of activities which are sufficiently different from each other that they lend themselves to being separated into distinct phases or "stages." According to French[1] a stage consists of all productive services--durable or nondurable--that cooperate in performing a single operation or a group of minor but closely related operations.

For purposes of this study it was deemed desirable to separate livestock auction activities into stages in order to obtain a more detailed comparison of the auction operations. If one does not classify the operations into stages he may observe that one auction is handling a given amount of livestock with less labor than another, but it may be difficult for him to determine why this is so. By classifying according to stage, one can compare auctions as to the amount of labor necessary to handle a given number of livestock at each stage of operation, and if there is a "bottleneck" in the auction operations this classification of stages facilitates locating it.

In this study, auction operations were divided into six stages. These were:

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[1]B. C. French, op. cit., p. 545.

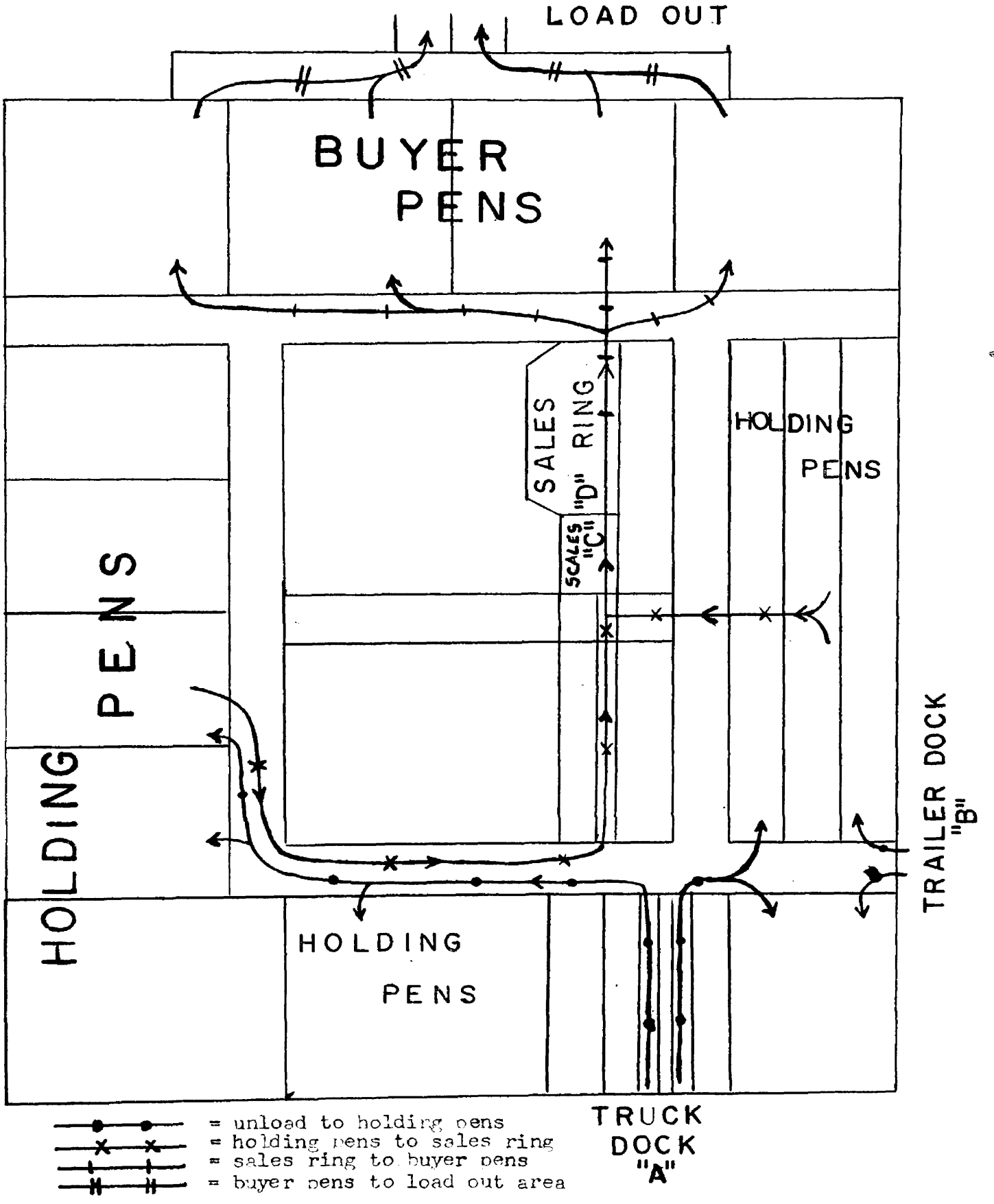
1. Unloading
2. Bringing-up to be weighed
3. Weighing
4. Selling
5. Bringing-back to buyers' pens
6. Loading out

Figure 5.1 illustrates the flow of livestock through the auction. The livestock is unloaded at "A" or "B" and put into holding pens where they are held until the sale begins. They are then taken from the pens and driven to the scales at point "C" where they are weighed. After they are wieghed they are driven into the sales ring "D" and sold. They are then driven into the buyers pens where they are held until they are loaded out.

All auctions included in this study had many common features. All had an area for unloading large trucks and all had a trailer dock where cars, trailers, and pickup trucks were unloaded. In addition, pens for holding the livestock, alleys for driving the livestock to and from the sales ring, scales, sales arena, office, and restaurant were a part of all auctions studied.

Although similarities were noted among auctions, differences in methods of handling livestock at each stage were also observed. A description of the operations carried on at each stage and differences in methods of handling livestock at each provides insights into auction operations and some of the problems which may arise in estimating their costs.

Figure 5.1. Flow of Livestock Through a Livestock Auction



Stage I--Unloading

General Description

The unloading stage began at the time a truck backed into the truck dock or a trailer was ready for unloading at the trailer dock and ended when a given vehicle departed from the unloading area or when the pen-back men returned for further duties after they had penned back a consignment. The latter criteria was used when there was no line-up of vehicles waiting to be unloaded and when the truck (or trailer) driver was visiting with auction personnel.

As soon as a vehicle was ready for unloading an auction write-up man prepared a consignors' ticket which indicated the sellers' name, address, number, species, and description of livestock, the tag number or pen number of the livestock, trucking fees, if any to be deducted from the sellers' check, and any special selling instructions which the seller desired.

If the livestock was injured or if other peculiarities were associated with a consignment (such as hogs being over-heated), a note was often made of this on the consignor sheet. Generally, one copy of the consignor sheet was given to the trucker, one copy remained with the write-up man, and two copies were forwarded to the office. If only three copies were used, however, the write-up man did not retain a copy. The write-ups were delivered to the office by a yard worker, office worker, or a mechanical device such as a vacuum tube.

As the write-up man was recording the necessary information, the yard men were unloading the livestock, marking them, and driving them back to the holding pens.

From two to five trucks could be unloaded at a time at the truck docks of the auctions observed, and the trailer dock could accommodate one or two trailers simultaneously.

One of the major differences found at the unloading stage was the location of the write-up office. Some auctions had only one central write-up office for both trailer dock write-ups and truck dock write-ups; some had a separate write-up station for the trailer dock and truck dock, and one had a write-up office structure entirely separate from the main auction building. In the latter instance all vehicles drove by this office, received their consignor slips and tags, and then drove to the unloading area. When they reached this area they gave their tags to the yard men who put them on the animals and unloaded them.

Hogs and Sheep

All auctions studied handled hogs in about the same manner as they handled sheep. One major difference between auctions was noted in the procedure employed to unload these two species of livestock. All auctions studied, except one, did not mark hogs and sheep but instead assigned the animals to a given pen and recorded the pen number on the consignor sheet. Although this resulted in a slight reduction in labor costs care was necessary in order to avoid assigning the same pen to two different consignments. If a running account of pens was not kept, the yard men might drive animals to an assigned pen and find that the pen was already filled. If this happened the workers had to return to the write-up man to get a different pen number.

The problem was dealt with by one of three methods. Two of the auctions used blackboards showing all the pens in the yard. As a pen was filled a worker recorded with chalk the nature of the consignment in that pen. As long as a notation was made on the blackboard when each pen was filled no trouble arose. A second method of coping with this matter consisted of using a printed form which listed all the auction pens and had space to indicate if they were filled and if so how many animals were contained therein. One auction using this method employed two write-up people both of whom worked in the same dock office. The yard sheet was passed back and forth between them as they did their write-ups and each recorded the pen numbers as he filled them. Seldom was a pen assigned that was already in use.

The third procedure was that in which a yard worker determined by visual inspection which pens were not filled and then cried this pen number out to the write-up man. A difficulty here was that a worker at the truck dock may have seen a pen open, and relayed its number to the write-up man who assigned certain animals to it, but before the animals arrived a worker at the trailer dock had done the same thing for one of his consignments. This was less likely to happen if the trailer docks and truck docks were adjacent to each other, but such was not always the case. Two of the auctions studied had the trailer and truck docks a considerable distance apart and one of these, using the visual inspection method of assigning pen numbers, often had two consignments of hogs for the same pen.

If the animals were marked as they were at one auction studied, the marking was accomplished by using marking irons which were dipped

in paint and then applied to the animal's back.

Sheep were placed in pens under the bleachers in the sales arena at all auctions. Hog pens were usually located close to the unloading area.

Cattle and Calves

Cattle and calves were assigned a tag number by the write-up man, and the other workers put the tags on the animals. Most of the calves were unloaded at the trailer dock, tagged, and then placed in pens immediately adjacent to the unloading area. Cattle were tagged in the truck or trailer, in the unloading chute or in a tagging chute. Large consignments of cattle were usually driven into a tagging chute to be tagged. The three most important differences observed in unloading calves and cattle were in the type of tag used, the location of the pens used to hold the livestock, and the design of the tagging chutes. Five auctions used hip tags and three used ear tags. The cattle holding pens at some auctions were located close to the unloading area and were a considerable distance away at others. Some of the auctions utilized a single tagging chute and others used two. If a single one was used, a worker moved along outside this chute and placed the tag on the animal. If two chutes were used, a raised platform was located between them, and the worker operated from this platform.

Stage II--Bringing Up

General Description.

This stage began when the yard men started to drive animals out of a pen and towards the scales to be weighed (or to the sales ring if

selling occurred first). The stage ended as soon as the gate was closed on the scales. The most important difference observed at this stage was in the number of personnel used for a given bring-up operation at the various auctions and in the method employed to bring up cattle. Some auctions used twice as many personnel to move up a given number of animals as others. The two major determining factors here were (1) selling speed, and (2) yard layout. If animals were sold rapidly, other things being equal, more personnel were required to bring the animals up fast enough to keep the auctioneer busy. If the approach to the scales from the holding pens was not direct additional personnel were needed. The auctions varied, of course, considerably in the distance which the animals had to travel from the holding pen to the scales (or sales ring). If the distance was great, three people may have been required to handle a given number of livestock in a certain time period whereas if this distance was somewhat less perhaps two people would have ample time to perform the work required at this stage.

Hogs and Sheep

If hogs and sheep were unmarked, considerable care had to be observed as the hogs were driven to the scales so as to insure that two pens did not become mixed.[2] This was usually accomplished by having a worker open and close alley gates so that there was always one gate closed between different groups of hogs.

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[2]This was less true for sheep because they were usually located in pens under the seats in the sales arena and had to be driven only a very short distance to the scales.

The hog selling operation were sometimes very rapid and there were as many as six groups of hogs moving simultaneously--two moving up, one weighing, one selling, and two moving back. If hogs and sheep, after being sold, were put in the same pen from which they originated, it was customary for a worker to move through the complete cycle with the same group of animals. He would get them from a pen, move them through the scales and sale ring, and back to the original pen. Actually, since a gate was almost always closed between groups, it was a very rare occurrence when two pens of animals became mixed.

When a worker got a pen of unmarked animals he removed the paper slip from the pen gate, took it with him, and handed it to the clerk or weighmaster when he entered the ring. The clerk or weighmaster then was able to put the pen number, number of head, and description of the animals on the scale ticket. This was necessary since no other identification was used. After the information was recorded on the scale ticket the recorder handed the slip back to the yard man who brought up the hogs and this man brought it back, and attached it to the pen as he penned the livestock back. If hogs were put in separate buyer pens after they were sold the worker instead of accompanying the hogs through the weighing, selling, and pen-back cycle, returned to obtain additional hogs as soon as he had finished putting a group on the scales.

Cattle and Calves

Aside from the numbers of workers used, two distinct methods of bringing up cattle were observed. In the first method one worker got several cattle (usually from four to ten) from a holding pen and moved them up to a pen close to the scales. A second man then drove these

animals from this pen one at a time onto the scales. However, two workers may have been used to put the animals on the scales and two may have been used to get them from the distant pens, or another man may have been employed between the far pens and the scales to insure that the man next to the scales always had livestock ready to drive onto the scales.

In the second method, which was observed at one auction, a long chute was employed to bring up cattle onto the scales. Two workers were used here. One got cattle from a holding pen and drove them one at a time onto the scales. The chute was narrow so that the animals could not turn around in it.

Two phases were usually involved in the bringing-up stage for calves. The first phase occurred prior to the time the calves were being sold. This involved driving the calves from the holding pen adjacent to the unloading area to a holding pen next to the scales. All auctions employed this phase except one. At this auction the calves were placed in the pen next to the scales immediately upon being unloaded. The second phase of the stage consisted of putting the calves onto the scales to be weighed. The chief difference observed in the bringing-up process for calves was in the number of workers employed to perform the task.

Stage III--Weighing

The third stage in auction operations involved the actual weighing of livestock. In this study all auctions except two weighed the livestock before it entered the ring. The remaining two weighed cattle and

sheep after they were sold and hogs and calves before they were sold. The weighing operation began when the scales gates were closed after incoming livestock was driven on the scales and was finished when the weighmaster hand-recorded the weight on the scale ticket. By recording the watch readings for consecutive weighings, one could also obtain the delay time between weighings.

When the weigher was finished weighing a given lot of animals, he signaled this to the worker in the sales ring by pushing a button which sounded a buzzer. Nearly all auctions observed had this buzzer system. To facilitate the weigher's work, as an animal (or animals) was placed on the scales, the yard man driving it there cried out the tag number to the weigher. Most auctions had a simple tube or pipe arrangement leading from the scale entrance to the weighmaster's booth and the worker cried the number into this tube or pipe. When it was called to the weigher, he recorded it on the scale ticket. After he had recorded the weight on the scale ticket he passed the ticket to the clerk. This conveying of the ticket was accomplished by means of a vacuum tube, an endless belt, or by hand carrying. If the weigher and clerk were located quite close to each other it was easy for one to hand the ticket to the other.

Ordinarily only one man was used to perform the actual weighing operations, but at one auction two men were involved in this operation for certain species of livestock. In this case one man recorded the tag number, and species of livestock, and the other performed the actual weighing. Cattle and calves were almost always weighed individually but hogs and sheep were weighed in groups.

Most scales were of the beam, hand-recorded type and had a capacity of 10,000 pounds with five pound gradations. Most auctions had the scales located within the sales arena, and the weighing operations were visible to all spectators. Some, however, were located adjacent to the ring. In the former case when the animals were driven from the scales they were in the sales ring. Three of the auctions studied did not have the scales located within the sales arena although one of these did have the scales exit opening directly into the ring. Since at the other two the scale exits did not lead directly into the ring, an additional man was used to open the scale exit gate, drive the animals into the sales ring, and close the entrance gate to the sales ring.

If hogs and sheep were returned to the same pen from which they originated two workers were associated with the weighing stage--the weighmaster and the worker driving the animals. This worker was idle during the weighing operations, but his time was, nevertheless, allocated to that stage.

Stage IV--Selling

General Description

The fourth stage of plant operation was that of selling the livestock. This operation began when the auctioneer started selling one consignment and ended when he began selling the next lot. The ringworkers, clerk, and auctioneer were all considered as part of the selling stage. Generally, from four to five people were involved in this stage. The ring workers drove the animals around the ring in order that buyers could observe them closely. They also opened gates leading from the

scales and from the sales ring to the pen-back area. Although most animals walked from the scales without being prodded, it was sometimes necessary for one of the ring workers to drive the animals off the scales--especially deacon calves.

The clerk, after receiving the scale ticket from the weighmaster recorded the selling price and buyer's name on the ticket and then forwarded this to the office where the tickets were posted to buyer and seller sheets. In all auctions observed except three, the scale tickets were forwarded to the office by vacuum tube. At one sale one of the office personnel hand carried them, and at a second they were relayed to the office, which was only a few feet away (and upstairs), by a clothespin and string arrangement. The clerk put the tickets inside the clothespin, and an office worker pulled them up to the office. After removing them the clothespin was thrown back down to the auctioneer's booth. The two auctions which did not use a vacuum tube were the two smallest auctions observed. A third auction used an endless belt for conveying tickets from the clerk to the office.

Hogs and Sheep

Hogs and sheep were sold by consignment which ranged in size from one animal to twenty or more. If hogs and sheep were not marked at the unloading stage, and the worker who drove them from the holding pen to the sales arena also drove them back to the same pen, then this worker was considered as part of the selling operation when the animals were sold.

Cattle and Calves

Cattle and calves were generally sold individually. The primary difference noted between auctions during the selling stage was in the number of workers involved at this stage.

Stage V--Bringing-Back

General Description

The bringing-back stage began when an animal emerged from the sales ring and ended when the workers finished penning it back and were available to pen back the next animal. Differences were observed in the number of workers involved and method used to pen back the animals.

Hogs and Sheep

Sheep were usually returned to the pen from which they came. One auction selling relatively large numbers of sheep had separate buyer pens for those animals after they were sold.

Hogs were handled in two distinct ways at this stage. At six of the auctions included in this study the hogs were taken back to the same pen from which they came. Those were not, of course, buyer's pens. At two of the auctions the hogs, after being sold, were put in separate buyer pens. One of those auctions was the one that marked its hogs. The other did not mark the hogs. If hogs were put in buyer pens, and if they were not marked, extreme care was necessary to insure that hogs were assigned to the correct buyer. If the auctioneer relayed the buyer's name incorrectly or if the workers confused the buyers' pens, unmarked hogs could be put in the wrong pens with other unmarked hogs

and identification would be almost impossible. This problem did not occur, of course, if the hogs were marked. If hogs were driven back to the original pens after being sold, it was necessary that workers be stationed along the alley to insure that different lots of hogs did not become mixed as they were being penned back. No mix-ups of this nature were observed during this study, and it was believed by the author that this was, as mentioned previously, a very rare occurrence.

Cattle and Calves

At all auctions, except one, cattle were put into buyers' pens where they usually remained until they were loaded out. At most auctions, there were several major buyers who had pens assigned to hold their cattle. There was always a "mixed" pen which held cattle of several buyers who bought only a few during the sale. After the animals were sold the auctioneer announced the buyer's name, and the pen-back man closest to the ring relayed this to workers farther down the alleys who then put the animals in the proper pens.

With respect to the above procedure, there was one important exception. One small auction did not have separate buyer pens for cattle. Here the cattle were penned back into large, holding pens regardless of the identity of the buyer. As the animals were sold they were driven out into an alley where they remained until fifteen or twenty had accumulated at which time a worker drove them all back to a large holding pen. This auction operator indicated that he planned to construct individual buyer pens in the future.

As the cattle pens were filled, the cattle were often moved back farther in the yards, again to buyer pens, so that the pens close to the sale arena could be used for another species of livestock or additional livestock of the same species. This additional moving back was necessary more often in large auctions than in small ones.

Calves were handled in the same manner as cattle except at one auction. At this auction there was no bringing-back stage for calves. Gates leading to the calf buyer pens were located within the sales ring. The ring workers opened these gates and put the calves in them as part of the selling operation. This was possible at this auction because there were only two or three buyers who bought calves regularly and only two or three pens were needed as buyer pens.

Stage VI--Loading Out

This stage consisted of the trucker giving the release slip to a yard worker who then found the animals and assisted in loading them out. The stage began when a trucker backed his truck up against the loading dock and gave the release slip to the yard worker. It ended when the truck left the dock (or when the truck was completely loaded in the event the truck driver remained to visit). If the trucker was picking up cattle for a buyer who had a separate pen for his cattle, the worker went to that buyers' pen and got the cattle. Similarly for calves, sheep and hogs if hogs were put in buyers' pens after they were sold. If the truck was hauling cattle for several small buyers, it was necessary for the worker to go to the "mixed" pens and sort out the cattle by tag number.

If hogs were returned to the pen where they were originally penned, the worker got the hogs from the individual pens and brought them to the truck.

The load-out time was affected to a certain extent by the distance which the animals had to be driven from the buyer's pens to the loading dock. Another factor influencing load-out time was the design of the chutes. At one auction, it was observed that the chute was about ten inches lower then the truck bed, and it was extremely time-consuming to drive hogs into the trucks.

Most trucks hauled more than one species of livestock from a given auction.

As the animals were loaded, the yard worker checked off the tag and/or pen numbers shown on the release slip. When loading was completed, the trucker signed the release and left. Usually the auction kept one copy of the release slip and the trucker kept one.

Functions Not Associated with a Given Stage

Two types of activities which were carried on at all auctions but which were not directly associated with any single stage were the office operations, including managerial functions, and clean-up operations.

Office

A separate operation at the auctions and one in which no time studies were done was that of office procedure. The number of personnel used in the office during sale day varied considerably between auctions.

The office workers obtained the write-up sheets from the write-up man, computed the gross dollar value of a sale, posted this information on sellers' sheets and buyers' sheets, deducted selling charges, transportation, etc., from sellers' gross amount, wrote out checks to the sellers, received money from the buyers, and paid the auction employees. The scale tickets arrived in the office in duplicate. The worker receiving the tickets usually computed the product of the price and weight and handed this to a second worker. This worker gave one copy of the ticket to a third worker and kept one herself. One worker then recorded the information contained on the scale ticket onto the seller's sheet and another worker transferred this information to the buyer's sheet. It was not difficult to match up the scale ticket with a seller's sheet because the sellers' sheets were placed in chronological order according to tag or pen number by species. The worker posting to the seller sheet, usually determined the selling charges to be deducted and calculated the net amount to be given the seller but this was sometimes done by a fourth person. This fourth person, when used, also wrote out the checks to the seller, put them through a check protector, and handed out checks to sellers. A fifth person sometimes acted as cashier. The checks were usually put in alphabetical order according to sellers name and given the seller when he asked for it or else it was mailed to him the following day. The buyers' sheets were also put in alphabetical order according to the buyers' names.

Variations from the above procedure was only found in the number of workers employed to perform these functions.

It was necessary that the office procedure run smoothly if a seller was to receive his check within a few minutes after an animal is sold. Most auctions claimed that the seller could pick up his check within ten to fifteen minutes after his consignment was sold, but one indicated that it sometimes took as much as thirty minutes.

Usually four major items of equipment were needed in the office--a typewriter, adding machine, check writer, and a computer. The computer was necessary for the person receiving the scale tickets to calculate the value of animals sold by the pound. The typewriter was used in writing up the buyer accounts and addressing envelopes, the adding machine was used to total amounts on both seller and buyer sheets, and the check writer was used primarily as a safeguard against anyone altering the amount for which the check was written. This check writer was operated similarly to an adding machine. The amount of the check was punched on the machine and this in turn was recorded on the check when it was inserted in the machine. These machines could be purchased or rented according to the auction owner's preferences.

An office task which also had to be performed was that of ordering and receiving supplies. In the smaller auctions this was usually done by the owner, but in larger ones it was done by the manager or bookkeeper. In addition to this records had to be kept of expenses and receipts. This was sometimes turned over to an accounting firm separate from the office personnel, but one or more of the office personnel often did it. In addition to this, auction owners or managers often checked on buyer credit during the week as well as called on livestock producers in the area.

The offices were invariably located towards the front of the building and with one exception, it was necessary to climb stairs to get to them. Depending upon the size of the building the office might or might not have been located close to the sales arena.

Clean-Up Operations

Separate from any of the six stages discussed was the task of cleaning the yards after sale day and doing maintenance and repair work on the building. This must be considered, of course, when one attempts to estimate the costs of conducting the livestock auction operation.

Dependency Between Stages

One of the things which was brought out sharply during the time studies was that stages often were not independent of each other. More specifically, the method of handling at one stage quite often influenced the time requirements at another stage. An auction which unloaded its cattle in pens directly adjacent to the unloading docks, because of the short distance involved, might have relatively low man-minute requirements. However, since the cattle were unloaded and driven to pens close to the unloading area, they might have to be driven a considerable distance in bringing up to be weighed. This would increase the labor requirements at this stage.

There was not only dependency between stages but also among species of livestock. One auction may show up well in labor requirements in bringing hogs back to the pens because the hogs were placed in buyers' pens immediately outside the sales ring. In this case, because of short

transportation distances, a minimum of workers could keep up with the selling speed. However, if hogs were allowed to remain in these pens after they were sold and cattle were sold immediately thereafter, the cattle may have to be driven a considerable distance after being sold resulting in higher labor requirements because of additional workers needed to pen cattle back long distances as rapidly as they were sold. This applied, or course, to other species of livestock as well.

CHAPTER VI

RESULTS OF TIME STUDIES

Introduction

It was indicated in Chapter V that although there was a tendency for average costs to decline as volume of livestock received at the auction increased, there were exceptions to this. It was obvious, then, that average costs were influenced by factors other than volume. One of the factors which could influence costs was that of methods of handling the livestock. In order to compare the relative efficiency of different methods of handling livestock time studies were conducted at each auction included in this investigation.

Time requirements for all stages except loading out are shown. The time studies were also conducted at this stage at each auction but the results are not comparable. Almost all vehicles upon which livestock were loaded were used to haul several species of livestock simultaneously. It was very seldom that a truck was loaded with only cattle, or calves, or hogs, or sheep. This being the case one could not determine what percent of the time of the loading operations could be allocated to each species. To say that one truckload of 100 animals took 2.50 man-minutes per head at auction A but 3.50 man-minutes per head at auction B is misleading. The 100 head at auction B may consist of 20 cattle, 40 calves and 40 sheep whereas the load may consist of 90 sheep and 10 hogs at

auction A. For this reason, time results for loading out at the various auctions are not given.

However, one could determine, on the basis of observation, that certain procedures used in loading out were more efficient than others. For example, it was not difficult to ascertain that a given number of cattle could be loaded out quicker when the cattle were in pens assigned to a single buyer than when the cattle were put in a pen containing the purchases of several buyers. Hogs, too, could be loaded out quicker when they were put in relatively large buyers' pens than when they were returned to the small, individual pens from which they originated.

Inasmuch as the primary objectives in this time study was to compare different technologies of handling livestock at different stages, it was decided that the average number of livestock per observation should be kept as uniform as possible for each auction. For example on all observations on bringing up hogs at auction D, there was an average number of hogs of seven, and 0.566 man-minutes of time were required per head. This figure was lower than for auction B where 0.630 man-minutes were required per head. One might conclude on the basis of this that the method of bringing up hogs was more efficient at D than B, but additional insight indicates this to be erroneous. When the average number per head at D is reduced to 5.44 per observation the time requirement goes up to 0.666 man-minutes per head which is somewhat greater than at auction B.[1] The reason for lower man-minute requirements

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[1]The reduction in average lot size was accomplished by eliminating one or more observations of relatively large lot size from the computations.

at one auction than another might be due to a more efficient method of handling or because larger numbers per observation were observed at one auction than the other. In order to ascertain whether or not man-minute requirements per head declined as lot size increased a statistical test was carried out, and it was observed that the labor requirements per head did decline as lot size increased. This difference was significant with $\alpha = .05$.[2]

Although it was deemed desirable to have lot size adjusted so as to be comparable between auctions, it was not always possible to do this. In some instances during the period of observations when the time studies were conducted, the observed lot sizes were so small as to make impossible the raising of them up to approximately the same as for other auctions. Such was the case at auction G for hogs. If all observations except those which showed lot sizes of four or five were eliminated, there would be so few observations remaining at this auction that the results would not be conclusive.

Although for purposes of comparing technologies it was considered desirable to have fairly even lot sizes between auctions, it should be noted that lot sizes at different auctions did vary somewhat. A good indication as to average lot size received at the various auctions was obtained by going through a sample of the consignor sheets for the calendar year 1957 and recording the number and species of livestock for several hundred consignments. On the basis of this a regression analysis was run to determine the relationship between numbers of livestock

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[2]Students "T" test.

handled by an auction and the average lot size. It was observed that lot size tended to increase as the number of livestock received by an auction increased, and the slope of this regression line was significantly different from zero with $\alpha = .05$ in the case of cattle, hogs and sheep. The slope was not significantly different from zero for calves. Table 6.1 shows lot size, by species, for each auction.

Table 6.1. Lot Size, by Species, for Eight Michigan Livestock Auctions.

Auction	Species			
	Hogs	Calves	Cattle	Sheep
	(Number of Head)			
A	6.63	1.47	2.55	13.42
B	4.77	1.39	2.39	4.96
C	5.06	1.45	2.09	10.57
D	4.84	1.62	1.84	9.14
E	5.62	1.47	1.96	8.5
F	6.11	1.54	1.83	4.4
G	3.56	1.17	1.81	7.5
H	5.03	1.40	1.65	4.17

It is quite likely that one of the economies of scale for large auctions may be in handling livestock in larger lot sizes than small auctions. This is true primarily in the case of hogs and sheep which are handled in groups at all stages whereas calves and cattle, except for loading and unloading, are handled individually regardless of the sizes of consignment except for auction A where some cattle of the higher grades were sold in groups.

The results of the time studies are given for each species of livestock.

Hogs

Total Labor Requirements

A comparison of time requirements for handling hogs at the eight auctions included in this study is shown in Table 6.2.

Total man-minutes required per hog ranged from 3.4 at auction F to 7.0 at auction G. Although some auctions required relatively low total man-minute requirements none showed lowest labor requirements at all stages. Auction A which showed relatively low total man-minute requirements for handling hogs ranked no better than fifth among auctions in bringing hogs up to be weighed. One of the reasons for this was that an auction may handle the animals in a manner that resulted in low labor requirements at one stage but required a relatively high amount of labor at the next.

Unloading. All times were considered productive at the unloading stage even though this was not correct because of a delay time between unloadings. This delay time may be several hours in the early morning or only a few seconds a short time prior to the actual selling. Since the delay times may be so large they were not computed at this stage. Man-minute requirements per head in unloading hogs ranged from 1.24 up to 3.99. The low figure, achieved by auction C was due to two main reasons. First, relatively few people were used in unloading the hogs and secondly, the hog pens were located immediately adjacent to the trailer dock where most of the hogs were unloaded. This pen arrangement was also observed at auction A which also showed relatively low time requirements at this stage. Auction H had the hog pens located a

Table 6.2. Time Requirements in Minutes to Handle Hogs at Eight Michigan Auctions.

Auction	Item	Unloading	Weighing	Selling	Bringing Up	Bringing Back	Total
A	Average number of head	5.21	4.44	4.35	6.75	6.0	
	Minutes per head	.59	.16	.19	.21	.19	
	Prod. time	.59	.05	.09	.07	.10	
	Delay time	--	.11	.10	.14	.09	
	Number of men used	2.57	1.00	4.10	4.00	2.80	
	Man-minutes per head	1.51	.16	.79	.83	.60	3.89
B	Average number of head	4.92	4.60	4.95	4.27	6.67	
	Minutes per head	.52	.19	.16	.18	.16	
	Prod. time	.52	.05	.08	.14	.10	
	Delay time	--	.14	.08	.04	.06	
	Number of men used	3.92	2.00	4.00	3.80	2.00	
	Man-minutes per head	2.03	.39	.64	.63	.20	4.16
C	Average number of head	4.58	2.90	2.57	4.85	5.00	
	Minutes per head	.69	.24	.30	.30	.22	
	Prod. time	.69	.08	.19	.11	.11	
	Delay time	--	.16	.11	.19	.11	
	Number of men used	1-3	1.00	4.00	5.00	3.00	
	Man-minutes per head	1.24	.24	1.18	1.50	.65	4.82
D	Average number of head	4.27	4.37	5.00	5.44	6.36	
	Minutes per head	.75	.20	.24	.22	.14	
	Prod. time	.75	.04	.09	.19	.14	
	Delay time	--	.16	.15	.03	--	
	Number of men used	4.82	2.00	5.00	3.00	2.00	
	Man-minutes per head	3.55	.40	1.18	.67	.28	6.08
E	Average number of head	5.25	4.50	4.50	5.00	5.86	
	Minutes per head	.52	.20	.24	.24	.24	
	Prod. time	.52	.08	.08	.10	.15	
	Delay time	--	.12	.16	.14	.09	
	Number of men used	4.00	2.00	5.00	4.00	2.43	
	Man-minutes per head	2.08	.40	1.19	.95	.58	5.20
F	Average number of head	4.89	5.10	4.76	4.76	6.67	
	Minutes per head	.45	.21	.16	.16	.16	
	Prod. time	.45	.06	.07	.10	.10	
	Delay time	--	.15	.08	.06	.06	
	Number of men used	3.77	2.00	4.00	3.00	2.00	
	Man-minutes per head	1.70	.43	.62	.47	.20	3.42
G	Average number of head	3.75	2.80	2.83	3.00	2.57	
	Minutes per head	.58	.47	.60	.52	.51	
	Prod. time	.58	.21	.24	.20	.17	
	Delay time	--	.27	.36	.32	.34	
	Number of men used	3.50	1.00	3.83	2.00	2.00	
	Man-minutes per head	2.18	.47	2.31	1.03	1.03	7.03
H	Average number of head	4.40	4.67	4.67	5.70	5.81	
	Minutes per head	1.13	.33	.34	.33	.33	
	Prod. time	1.13	.18	.11	.17	.08	
	Delay time	--	.15	.23	--	--	
	Number of men used	3.40	2.50	4.83	1.50	1.50	
	Man-minutes per head	3.99	.76	1.62	.27	.11	6.75

considerable distance from the unloading area, and this was the main reason for its relatively high labor requirements at this stage. The time requirements in man-minutes per head were relatively high at auction D because the holding pens were not located adjacent to the unloading area and the number of men employed at this stage was relatively high.

Bringing Up. Man-minute requirements per head to bring hogs up varied from 0.27 at auction H up to 1.50 at auction C. The low figure was achieved primarily at the expense of a high figure for unloading at this auction. It was mentioned earlier that unloading time for hogs was slow at auction H because the hogs were moved back a considerable distance from the unloading area. By so doing, however, the hogs were placed rather close to the sales arena and few workers were needed to perform the bringing-up operation. Actually only three workers were used to bring up and bring back at this auction with an average of 1.5 workers at each stage. There was no delay time in bringing up hogs at auction H. The relatively high time requirements at auction C resulted primarily from five workers being used even though selling speed was rather slow. One can see from the table that considerable delay time occurred at that auction at that stage. This indicates that more workers were being used than need be. There was also some hog sorting done at that auction, and this tended to increase the time requirements.

Weighing. In weighing hogs, only one weighmaster was used but most auctions showed two people involved in the hog weighing operations. This was because those auctions handled hogs by having a worker get them out of a pen and drive them to the scales, through the ring, and

back to the original pens. While the weighmaster was weighing the hogs, the driver was waiting outside the scales, and his time was allocated to the weighing operation. Auctions A, C, and G handled their hogs differently and as soon as a driver drove the hogs on the scales, he returned to the holding pens to get more hogs; thus only one man was involved in the weighing operations for hogs at these three auctions. This being the case, time requirements for weighing should have been lower at these three auctions than the others. This was true for auctions A and C which had man-minute requirements of 0.16 and 0.24, respectively, but less so for G primarily because lot size was small at G. Except for the already mentioned difference, weighing times were largely a function of the weighmaster and/or the auctioneer and his rate of selling. If the weighmaster was slow the auctioneer would have to wait on him and vice versa. Certainly the weighmaster could not weigh animals faster than they were being sold. A good indication as to the speed of the weighmaster may be obtained by comparing his productive time with the delay time. If delay time was high, it meant the weigher was waiting on the auctioneer or workers bringing up the livestock. If the delay time was relatively a low proportion of the total, it meant that the weighman was not waiting long for the yardmen or auctioneer. Normally it was observed that the weigher could keep up with the auctioneer, although this was not true at auction H which showed man-minute requirements of 0.76 which was higher than at any other auction. The weighmaster at that auction took considerable time to compute the average weight of hogs.

Selling. Selling time depended largely on the auctioneer, delay in weighing, delays in bringing up the livestock, and lot size. Man-minutes per head was determined by selling time plus number of people involved in the selling operation. These labor requirements ranged from 0.62 man-minutes per lead at auction F to 2.31 at G. The relatively low figure achieved at F was due primarily to the fact that the actual selling speed was relatively fast. The number of people involved at this stage at F was about the same as at other auctions. Auction G had relatively high labor requirements because of a relatively slow selling speed. Actual selling times in minutes per head were fastest at auctions A, B, and F but, as in the case of weighing, to get a truer picture of this operation one should also look at the productive and delay times. A rather good example to consider here is a comparison between auctions B and E. Man-minute requirements at E were considerably higher than B because the selling time in minutes was slower and because one additional man was used at this stage. The actual productive selling time, however, was the same at each auction. Productive time was considered to be that time elapsed from the initial weight announcement on the animals until the auctioneer cried "sold." This means in this case that the auctioneer was waiting on the weigher or the yard workers. In this case one can see that the actual productive weighing time was almost exactly the same as the productive selling time which means the auctioneer had to wait while the scale gates were opened and closed and the animals were driven from the scales.

There appears to be no real reason why five workers should be used in the selling operation instead of four. The usual explanation as to

why five were used was that normally two ringmen plus a clerk and auctioneer were used and when hogs were sold the worker getting a pen of hogs moved through the ring with them bringing up the total number of workers at this stage to five. This could be avoided, however, by assigning one of the ringmen to another task, such as unloading late arrivals, during the hog selling operation.

Bringing Back. Bringing back times ranged from 0.11 man-minutes per head at auction H up to 1.03 at auction G. Auction H used only an average of 1.5 workers for this operation and penned the hogs back in an area close to the sales arena. Although this reduced the man-minute requirements at the bringing-back stage, it would increase them during the loading out operations because the hogs had to be driven further to the truck dock than they would if they were penned back farther from the sales ring. Auction G labor requirements were relatively large at this stage even though only two men were used in the operation because the selling rate was relatively slow and these men were idle much of the time. In addition, the average lot size at this auction was relatively small during the time studies.

Calves

Total Labor Requirements

Time requirements for handling calves are shown in Table 6.3.

Total man-minute requirements per calf ranged from 6.02 at auction A to 12.82 at auction H. These differences, from a percentage standpoint, were about the same as were observed for hogs. As was also the

Table 6.3. Time Requirements in Minutes to Handle Calves at Eight Michigan Auctions.

Auction	Item	Unloading	Weighing	Selling	Bringing Up	Bringing Back	Total
A	Average number of head	1.83	1.00	1.00	1.00	1.00	
	Minutes per head	1.28	.27	.33	.62	.50	
	Prod. time	1.28	.19	.25	.30	.32	
	Delay time	--	.08	.07	.32	.18	
	Number of men used	1.58	1.80	4.00	2-3	2.00	
	Man-minutes per head	1.89	.39	1.31	1.42	1.01	6.02
B	Average number of head	2.00	1.00	1.00	1.00	1.00	
	Minutes per head	1.31	.39	.37	.57	.45	
	Prod. time	1.31	.18	.28	.26	.31	
	Delay time	--	.21	.09	.31	.41	
	Number of men used	4.41	1.00	4.00	1-2	2-3	
	Man-minutes per head	5.68	.39	1.48	.71	.95	9.21
C	Average number of head	2.00	1.00	1.00	1.00	1.00	
	Minutes per head	1.60	.44	.54	.53	.52	
	Prod. time	1.60	.21	.36	.22	.35	
	Delay time	--	.23	.10	.31	.17	
	Number of men used	4.36	1.00	4.00	1.00	1-2	
	Man-minutes per head	3.36	.44	1.82	.53	.97	7.08
D	Average number of head	2.10	1.00	1.00	1.00	1.00	
	Minutes per head	.89	.44	.35	.52	.41	
	Prod. time	.89	.15	.31	.24	.24	
	Delay time	--	.29	.04	.28	.17	
	Number of men used	4.50	1.00	4.00	2-3	2.00	
	Man-minutes per head	4.04	.44	1.40	1.44	.82	8.14
E	Average number of head	2.00	1.00	1.00	1.00	1.00	
	Minutes per head	.74	.50	.44	.58	.37	
	Prod. time	.74	.30	.30	.41	.11	
	Delay time	--	.20	.14	.16	.26	
	Number of men used	4.08	1.00	4.00	1.00	3.00	
	Man-minutes per head	3.04	.50	1.77	.58	1.11	6.99
F	Average number of head	1.07	1.00	1.00	1.00	1.00	
	Minutes per head	.79	.46	.47	.67	.55	
	Prod. time	.79	.24	.23	.37	.12	
	Delay time	--	.21	.24	.29	.43	
	Number of men used	3.25	1.00	4.00	2.00	4.00	
	Man-minutes per head	2.58	.46	1.90	1.34	2.22	8.50
G	Average number of head	1.72	1.00	1.00	1.00		
	Minutes per head	1.19	.98	.80	.59	Combined	
	Prod. time	1.19	.50	.42	.09	with	
	Delay time	--	.49	.38	.49	selling	
	Number of men used	3.11	1.00	4.64	1-2		
	Man-minutes per head	3.69	.98	3.71	1.09		9.47
H	Average number of head	1.86	1.00	1.00	1.00	1.00	
	Minutes per head	1.57	.71	.79	1.01	.73	
	Prod. time	1.57	.50	.31	.43	.21	
	Delay time	--	.21	.47	.59	.53	
	Number of men used	3.57	1.00	5.40	2-4	1.00	
	Man-minutes per head	4.70	.71	4.24	2.44	.73	12.82

case with hogs, no auction had lowest or highest labor requirements at all stages of handling calves.

Unloading. The most important differences observed in methods of unloading calves were in the holding pen arrangement and number of workers used. Man-minute requirements ranged from 1.89 auction A to 5.68 at auction B. At auction A most of the calves were unloaded at the trailer dock where only one or two employees were working. Despite the fact that only one to two employees were working at this location, they were nevertheless able to handle the calves quickly and without undue delay. Auction B used four to five men to unload calves, and this resulted in a rather high labor requirement. If the use of additional employees resulted in handling the calves quicker, the resulting man-minute requirements might be no greater than where fewer workers work for a longer period of time. It appears, though, that using additional workers at auction B to unload calves did not result in appreciably lower actual minutes required to accomplish the task. In fact only two other auctions required more minutes per head than did auction B. The actual number of minutes required to unload the calves was relatively high at auction H because the holding pen was not located directly adjacent to the unloading area. The man-minutes per head were also relatively high at that auction.

Bringing Up. The time required per head to bring up calves ranged from 0.53 man-minutes at auction C to 2.44 man-minutes at auction H. The minutes required per head to bring up were somewhat greater than the minutes required in selling because part of the bringing up stage was done before the calves were sold. This part of the stage involved bringing up

the calves from the holding area which was usually immediately adjacent to the unloading area to a pen directly outside the entrance to the scales. The times reported in Table 6.3 include both the time required to bring calves from the holding pens to the scales and the time required to put the calves on the scales. Auction G eliminated the first part of the stage by bringing the calves directly to a pen adjacent to the scales as they were unloaded. Although this tended to result in higher labor costs for the unloading stage, it did reduce the labor cost at the bringing-up stage.

Although the actual number of minutes required per head in bringing up was approximately 0.60 at seven of the auctions, the number of man-minutes required varied considerably because of differences in the number of personnel employed to perform this activity. Some of the auctions used only one man at this stage for calves but others used as many as three. It did not appear that any method of bringing up calves should require more than two workers except possibly when driving from the holding area near the unloading area to the pens adjacent to the scales.

Auction H showed rather high labor requirements in bringing up calves primarily because a relatively large number of workers was utilized at this stage despite a relatively slow selling speed. Auctions D and A showed somewhat higher man-minutes used at the bringing-up stage than one would expect. This was due to the fact that one additional worker was used at this stage because the scales did not open directly into the sales ring. Because of this a worker was needed to remove the calves from the scales and then drive them a few feet into the sales ring.

At the other auctions the need for this man was eliminated because with the scales opening directly into the sales ring, one of the ringmen could perform this duty.

Weighing. Weighing times for calves did not vary greatly except for the two smaller auctions. The weighing times at auctions G and H were relatively high because calves can be weighed at a speed no faster than the selling speed, which was relatively slow at these auctions. Upon closer inspection, however, one can see the actual productive weighing time was also greater at these two auctions. This may, have been because the weighmasters were slower at these two auctions, or it may be that inasmuch as they had plenty of time because of the slow selling speed they could take their time about the actual weighing operation.

Only one auction, A, used more than one person during the calf-weighing operation. The second person, who was not always present at this stage, sat in one corner of the weighmaster's booth and shouted the hip tag number of the calf as it entered the scales. The weighmaster then recorded this number. The scales at the auction were of such design that it was somewhat difficult for the weighmaster to see the tag number from his seating position behind the scale beam.

Selling. Selling time for calves ranged from 1.31 man-minutes at auction A to 4.24 man-minutes at auction H. Except for the two small auctions, these times averaged between about 1.3 man-minutes per head and 1.9 man-minutes per head. The owners of auctions G and H indicated that because of their relatively small size and relatively few buyers they liked to give the calves considerable time in the ring while they were being sold. It was their opinion that the consignors preferred it

that way. It should be noted however that there was considerable delay time in selling the calves at auctions G and H. One of the reasons for this was that the workers taking calves from the scales and removing them from the ring after they were sold worked in a rather leisurely manner. At all auctions except G and H four workers were involved in the selling operation whereas at G and H usually five and sometimes six people were involved. It is rather easy to see why, then, that man-minute requirements were greater at those two auctions. The greater number of workers combined with a slower selling speed must result in greater man-minutes per head.

Bringing Back. Bringing-back times, in terms of man-minutes, show little variation except for auction G which showed no time expended for this stage and auction F which showed relatively large time requirements. Auction G was a rather small auction, and the calves were put into pens located immediately at the rear of the sales arena. The two ringmen at this auction performed the pen-back operation as part of the selling operation, and all of their time was allocated to the selling stage. Only two or three major calf buyers were present at this auction and only two or three pens were needed for the calves as they were sold. The doors to these pens were located inside the sales ring near the auctioneer's booth and the calves were handled quickly in this manner.

At auction F, the calves were moved one of two different directions to pens. Regardless of which way they went, two men were needed at each location thereby requiring four men at this stage. This tended to increase the man-minute requirements.

The actual minutes required to pen the calves back was somewhat higher than the selling speed at some auctions. This was because the operation was sometimes divided into two parts. The calves were first penned back in pens near the sales ring exit and then after the calf-selling operation was over, the calves were moved back to holding pens near the loading-out area where they awaited being loaded out. At auctions E and H, however, the pen-back stage was not divided into two parts, and the bringing-back times should correspond rather closely to the selling times. Auction H showed relatively low man-minute requirements in penning back calves largely because only one man was used for this task. This man stood in the alley and put the calves as they were sold into separate buyer pens which were located immediately adjacent to the sales arena. Were it not for the fact that the selling speed on calves was relatively slow at auction H, one man would not have been able to perform this duty.

Cattle

Total Labor Requirements

The results of the time studies for cattle are shown on Table 6.4.

The total man-minutes per head required to handle cattle ranged from 10.92 at auction C up to 17.07 at auction G. In the eight auctions studied, cattle required more man-minutes per head to handle than the other species of livestock. This was to be expected inasmuch as they were handled individually except for loading and unloading. Although calves were also handled individually, it usually took somewhat less time to handle one calf than one head of cattle. An exception to this

Table 6.4. Time Requirements in Minutes to Handle Cattle at Eight Michigan Auctions.

Auction	Item	Unloading	Weighing	Selling	Bringing Up	Bringing Back	Total
A	Average number of head	2.37	1.00	1.00	--	1.87	
	Minutes per head	2.09	.41	.46	.46	.36	
	Prod. time	2.09	.20	.33	.28	.22	
	Delay time	--	.21	.14	.19	.14	
	Number of men used	2.62	1.00	4.00	4.00	2-6	
	Man-minutes per head	5.43	.41	1.88	1.88	1.66	11.27
B	Average number of head	2.23	1.00	1.00	--	1.00	
	Minutes per head	1.96	.66	.62	.62	.62	
	Prod. time	1.96	.29	.47	.20	.27	
	Delay time	--	.36	.15	.42	.35	
	Number of men used	4.06	1.00	4.00	3.00	1-2	
	Man-minutes per head	8.79	.65	2.47	1.86	.92	14.70
C	Average number of head	2.68	1.00	1.00	--	1.00	
	Minutes per head	1.95	.56	.57	.57	.85	
	Prod. time	1.95	.23	.41	.24	.54	
	Delay time	--	.34	.16	.33	.31	
	Number of men used	4.06	1.00	4.00	2.00	3.26	
	Man-minutes per head	4.45	.56	2.27	1.14	2.50	10.92
D	Average number of head	2.60	1.00	1.00	--	1.00	
	Minutes per head	1.74	.71	.78	.73	.61	
	Prod. time	1.74	.28	.54	.22	.41	
	Delay time	--	.43	.24	.51	.19	
	Number of men used	4.40	1.00	4.00	4.00	4.00	
	Man-minutes per head	7.75	.71	3.14	2.91	2.44	16.95
E	Average number of head	2.00	1.00	1.00	--	1.00	
	Minutes per head	1.88	.68	.80	.80	.61	
	Prod. time	1.88	.29	.61	.19	.14	
	Delay time	--	.39	.19	.61	.46	
	Number of men used	3.70	1.00	4.00	4.00	4.00	
	Man-minutes per head	6.75	.68	3.20	3.20	2.44	16.27
F	Average number of head	2.00	1.00	1.00	--	1.00	
	Minutes per head	1.55	.59	.75	.71	.57	
	Prod. time	1.55	.30	.43	.29	.28	
	Delay time	--	.29	.31	.43	.28	
	Number of men used	2.83	1.00	4.00	1-2	4.00	
	Man-minutes per head	4.39	.59	2.99	1.08	2.27	11.32
G	Average number of head	2.00	1.00	1.00	--	1.00	
	Minutes per head	2.07	1.14	1.15	1.12	.99	
	Prod. time	2.07	.49	.71	.29	.28	
	Delay time	--	.66	.43	.83	.70	
	Number of men used	3.44	1.00	4.00	2.00	2.00	
	Man-minutes per head	7.16	1.14	4.59	2.24	1.94	17.07
H	Average number of head	2.2	1.00	1.00	--	12.33	
	Minutes per head	1.57	.94	.93	.93	.14	
	Prod. time	1.57	.42	.70	.25	.14	
	Delay time	--	.52	.23	.68	None	
	Number of men used	3.9	1.00	4.00	1-2	1-2	
	Man-minutes per head	6.09	.94	3.73	1.39	.22	12.28

statement worth mentioning was that of auction H. This auction handled cattle with slightly fewer man-minutes than it used on calves. Although auction H showed up relatively poorly in its labor requirements for calves, the same thing was not true for cattle. This auction used an entirely different method of bringing up and taking back cattle than any other auction.

Unloading. Unloading time in man-minutes ranged from 4.39 at auction F to 8.79 at auction B. The relatively low times of F were achieved through having the cattle holding pens located very close to the unloading area. This permitted the use of fewer employees at this stage and despite the lower number of employees utilized, the actual minutes used to unload the cattle was fairly low in comparison with other auctions.

Closely behind auction F in this respect was auction C with 4.45 man-minutes required per head to unload. This last figure was all the more important in view of the fact that auction C used ear tags to mark cattle instead of hip tags. Ear tags require more time to attach to the animal than do hip tags. In addition to this, auction C had holding pens for cattle located not directly adjacent to the unloading area. Despite these handicaps G showed up well at this stage, and the primary reason appears to be that the auction had the write-up station located in a small structure separate from the main building. The write-ups were performed quickly and efficiently under this arrangement and this tended to eliminate workers standing around doing nothing while the write-up man was performing his duties. At this auction the yard men

were engaged in unloading activities while the write-up man was doing the write-ups.

Auction B had relatively high-man-minutes requirements in unloading cattle. There were two main reasons for this. First this auction was using from four to six workers for this task which was more than most of the others (and, it appeared, more than were needed) and secondly, it was ear tagging cattle. The tagging chute design was not very good at this auction, and the workers sometimes found it difficult to perform their tasks because of cattle trying to jump out the chutes.

Auction D showed rather high labor requirements at this stage despite the fact it hip-tagged the cattle. It was observed that several workers, although associated with this stage, were idle much of the time the cattle were being unloaded. Nonetheless, they were considered as part of this stage and the result was that the average number of workers at this stage was relatively high even though the number of minutes actually used per head was not as low as it was in the case of some other auctions.

Bringing Up. The average number of cattle per lot during the bringing-up stage is not given because this stage consisted of getting several animals from the holding pen, driving them to a pen near the scales, and then putting them onto the scales one at a time. The number of animals during the first phase may be five or ten but only one at the last phase.

Labor requirements in bringing cattle up ranged from 1.08 to 2.91 man-minutes per head. The low figure at auction F was achieved because only one to two men were used for this operation even though the selling

speed was reasonably fast. The pen arrangement which permitted the use of only one to two men at this selling speed appeared to be somewhat more desirable than the arrangement for handling cattle at all other auctions with the exception of auctions H and G. Closely connected with this was the fact that auction F was not as large in area as some of the others and the cattle were required to move a somewhat shorter distance. The pen layout at auction G appeared to be favorable to an efficient bringing-up process, but this desirable arrangement is useful only if its advantages are utilized, and when the selling speed is relatively slow, this arrangement loses most of its merit. In order to attempt to ascertain whether or not a given auction could bring up the cattle at the same speed but with fewer people, it is desirable to observe the columns showing productive minutes and delay minutes. In so doing it becomes apparent that auctions D, E, G, and H all had a relatively high amount of delay time in relation to productive time. Auctions D and E could probably have brought up cattle at the speed shown in Table 6.4 with fewer people. It takes two men to bring up cattle regardless of the arrangement. When only two men are employed to perform the task, and where delay time is still excessive, the only solution is to increase the selling rate or have the workers assist with some other task during their delay time.

Auction H employed a method of bringing up cattle distinctly different from any other studied. In this instance a chute about 50 feet long and 30 inches wide leading into the scales was used. Cattle were removed from the holding pens and were driven into this chute, whereupon the gate to the chute was closed. The animals were then driven single

file onto the scales, and only one employee was needed to do this. In order to keep animals from backing up as the chute became empty, notches were cut into the chute so as to provide a place in which the worker could insert a 2" x 4" piece of lumber behind each animal. Under this arrangement one man got cattle from the holding pen and drove them into the chute while the other man was feeding the animals onto the scales individually. The bringing-up times at auction H were very good in comparison with other auctions despite the fact that the selling speed was relatively slow. The delay time in minutes per head in bringing up cattle was relatively high in proportion to the productive time which indicates that two workers could bring up cattle using this method at a much faster selling rate.

Auction C also used only two men for this operation despite the relatively fast selling speed. In fact the actual productive time in minutes per head was slightly lower for auction C than for auction H. It is this author's opinion, however, that the workers in auction H could have done the same task in considerably fewer productive minutes had they so desired, but inasmuch as the selling rate was relatively slow there was little need for the workers to extend themselves.

Weighing. Cattle were weighed individually except on certain occasions at auction A. Man-minute requirements ranged from 0.41 at auction A to 1.14 at auction G. As with other livestock, the weighing operations could not proceed at a pace faster or slower then the selling speed. As was true for calves and hogs auctions H and G had slower weighing times than the other auctions, and, as before, the main reason was that the selling speed at these auctions was relatively slow.

It is obvious from Table 6.4 that the weighmaster at auctions C and H were capable of weighing cattle faster than the auctioneers were selling. This is reflected in the columns showing the productive minutes and delay minutes per head for weighing and selling. One could safely conclude from this table that at all auctions the weigher was not slowing down the selling speed of cattle.

Selling. Man-minutes used in selling ranged from 1.88 at auction A to 4.59 at G. Four men were used for this stage at all auctions and one must look elsewhere for reasons as to the wide variation in man-minute requirements. The main reason for this variation was that the number of minutes used in selling was much greater at auctions G and H than it was for the other auctions. This was the result of decisions by these auction owners to give the cattle a lengthy workout in the ring before they were sold. The high minute requirements resulted both from relatively high productive time in selling and high delay time. The latter is the result of the ringmen moving the cattle from the scales and out of the ring rather slowly.

Bringing Back. Bringing-back times ranged from 0.22 man-minutes per head at auction H up to 2.50 at auction C. The low figure for auction H was arrived at at the expense of rapid loading out. As the cattle were sold at H, they were driven into an alley by one of the ringmen. The cattle stayed in this alley until 20 or 25 were there at which time a worker (the one who is driving cattle into the feed chute prior to selling) drove them all to a large holding pen where they were kept until loaded out. No separate buyers' pens were used. This method was quick but when the animals were loaded, a worker had to go into the

pen and sort out each animal individually according to tag number. This was a very time-consuming process. The owner indicated he would build some separate buyer pens in the future.

The bringing-back times were reasonably close between the other auctions except for auction B which showed relatively low labor requirements. The explanation of relatively low man-minute requirements at this auction was that the buyers' pens were located quite close to the sales ring and only one to two men were used to perform the penning back task. Actually the arrangement for penning back cattle at auction B was not greatly different from auctions A, C, E, and F. This indicates that fewer people might have been used for this operation at those auctions.

Despite the fact that the average lot size in bringing back cattle was 1.87 for auction A as opposed to 1.0 for other auctions, the labor requirements in terms of man-minutes per head were not especially low. This is due primarily to the fact that this was a large auction in terms of area, and the cattle were driven a considerable distance to the buyer pens where they were held until loaded out.

Load-out time should not vary much between auctions except in the case of auction H. Inasmuch as the cattle were not put into separate buyers' pens at that auction, the time requirements per head to load out would be considerably greater than at the other auctions. Variations in time requirements between the other auctions would be due to differences in the number of personnel used and in the distance the animals were penned from the loading area.

Sheep

Observations on sheep were made at only two auctions. This species of livestock was relatively unimportant at all auctions except A, and very few sheep were sold at any other auction during the period the time studies were conducted. All auctions handled sheep in approximately the same manner. As they were unloaded they were driven to holding pens which were below the bleachers in the sales arena. The animals were driven out one side of the arena, onto the scales, sold, and driven back to the pens from which they came. Differences in time requirements at various auctions would not be due to different methods of handling but instead to different lot sizes. Large auctions tend to handle sheep in relatively large lot sizes, and this would result in somewhat lower time requirements for the larger auctions.

The labor requirements per head should be approximately the same for sheep as for hogs. Sheep are somewhat more difficult to drive than hogs but they are handled in somewhat larger lot sizes which tends to offset their slower driving habits. Table 6.5 shows the labor requirements for sheep at all stages at one auction and three stages at another.

Table 6.5. Labor Requirements in Minutes to Handle Sheep at Two Michigan Auctions.

Auction	Item	Unloading	Weighing	Selling	Bringing Up	Bringing Back	Total
A	Average number of head	15.57	5.43	9.00	--	22.67	
	Minutes per head	.34	.17	.23	.23	.23	
	Prod. Time	.34	.07	.09	.06	.04	
	Delay Time	--	.10	.14	.17	.19	
	Number of men used	2.29	1.00	6.00	3.00	2.33	
	Man-minutes per head	.70	1.69	1.39	.70	.54	3.50
D	Average number of head			6.58	6.58	6.58	
	Minutes per head			.28			
	Prod. Time			.08			
	Delay Time			.19			
	Number of men used			4.00	5.00	3.00	
	Man-minutes per head			1.12	1.33	.80	

Summary of Time Requirements

Table 6.6 provides a summary of the time studies conducted at eight Michigan livestock auctions.

It can be seen that man-minutes per head were highest for cattle, followed by calves and then hogs and sheep. Rather wide variations may be observed both between species of livestock and between auctions. Differences between auctions in man-minutes used to handle the livestock at the various stages were primarily the result of (1) differences in yard layout and methods of handling the livestock, (2) differences in the selling speed of the auctioneers, (3) differences in the number of employees used at each stage, and (4) differences in lot size. It was

Table 6.6. Labor Requirements to Handle Livestock, by Species, At Eight Auctions.

	Auction							
	A	B	C	D	E	F	G	H
	(Man-Minutes per Head)							
Hogs								
Unloading	1.50	2.03	1.24	3.55	2.08	1.70	2.18	3.99
Weighing	.16	.39	.24	.40	.40	.43	.47	.76
Selling	.79	.64	1.18	1.18	1.19	.62	2.31	1.62
Bringing Up	.83	.63	1.50	.67	.95	.47	1.03	.27
Bringing Back	.60	.48	.65	.28	.58	.20	1.03	.11
Total	3.88	4.17	4.82	6.08	5.20	3.42	7.03	6.75
Calves								
Unloading	1.89	5.68	3.36	4.04	3.04	2.58	3.69	4.70
Weighing	.39	.39	.44	.44	.50	.46	.98	.71
Selling	1.31	1.48	1.82	1.40	1.77	1.90	3.71	4.29
Bringing Up	1.43	.71	.53	1.44	.58	1.34	1.09	2.44
Bringing Back	1.01	.95	.94	.82	1.11	2.22	*	.73
Total	6.03	9.21	7.08	8.14	7.00	8.50	9.47	12.82
Cattle								
Unloading	5.43	8.79	4.45	7.75	6.75	4.39	7.16	6.09
Weighing	.41	.66	.57	.71	.68	.59	1.14	.94
Selling	1.88	2.48	2.27	3.14	3.20	2.99	4.59	3.73
Bringing Up	1.88	1.86	1.14	2.91	3.20	1.08	2.24	1.39
Bringing Back	1.66	.92	2.50	2.44	2.44	2.27	1.94	.22
Total	11.27	14.70	10.93	16.95	16.27	11.32	17.07	12.28
Sheep								
Unloading	.70							
Weighing	.17							
Selling	1.39							
Bringing Up	.70							
Bringing Back	.54							
Total	3.50							

*Combined with selling stage.

pointed out that low labor requirements at one stage may result in high labor requirements at another stage. Inasmuch as this was often the case, when one attempts to determine the optimum method of handling the livestock he must consider this inter-dependency of stages.

The differences in labor requirements between species merit some additional comment. Several studies have been conducted, as indicated in Chapter II, in which an "animal unit" was used as a measure of size of an auction. The number of livestock of each species required to constitute an animal unit differed between studies. With one exception no justifications were given as to the criteria for determining what constituted an animal unit. The time study results presented in this chapter provide one with some basis for determining an animal unit. They must be interpreted carefully, however, and it must be realized that the time studies show only labor requirements and thus cannot serve as an indicator of other cost components such as depreciation and supplies.

The differences between species of livestock in time requirements varied considerably between auctions. At auction H cattle required about the same amount of labor per head as calves and about twice as much labor as hogs. One might conclude from this, insofar as labor costs are concerned, that a measure of an animal unit should be one head of cattle, one calf or two hogs. At auction A it would more likely be one head of cattle, two calves, or three hogs. Auction H's relative efficiency in handling cattle, in comparison with auction A, was much greater than it was for hogs. In attempting to reduce average labor costs per head at auction H one would likely obtain more tangible results

by observing the handling of hogs at that auction than he would by observing the method employed to handle cattle.

If the intent of the auction operators is to base their selling charges, to the livestock producer, upon costs incurred by them in handling the livestock they should be able to use these time study results to assist them in deciding upon the selling rates to charge.

No claim is made that the figures presented in Table 6.6 represent a perfect picture of the labor requirements for a given auction during a given year. The lot sizes may have been larger or smaller when the time study was conducted than they are during most of the year. Information gained from 1957 consignor sheets indicates, however, that the lot sizes shown in Table 6.1 are not greatly different from the average for the year.

In some instances it would appear that more laborers were being utilized at a given stage than were needed. In defense of this, however, it should be noted that there is a minimum number of personnel required to operate an auction during the peak of its activities. This may be when selling hogs, cattle or sheep. Since a certain number must be available to handle the "peak" load, these men at other times may be used to assist at a given stage even though their services at this stage could be dispensed with. In these instances the owner is faced with three alternatives. He may elect to hire the men to come in only during the peak of activities, permit the "extra" men to loaf during the times when they are not needed, or use these men at stages to assist others even though it is not imperative that they assist during these stages. The first alternative must be rejected on the grounds that the

peak load lasts only for a relatively short time, perhaps two hours, and it would be virtually impossible to hire personnel to be available for this short time period. Few, if any, people would be willing to commit themselves to a job lasting only two hours per week. In addition to this the peak labor requirements may occur at different hours from week to week which would make it quite difficult for the workers to know the exact time they should report for work.

The second alternative would be rejected by most auction owners in preference for the third. Most of them would not be in favor of having several men around loafing for extended time periods while others were working. The third alternative appears best.

On the other hand, it appeared to this observer that even during the peak labor requirement periods that several auctions had "excess" workers. This is the situation which might need additional attention from the auction owners.

On the basis of actual observation and the time studies presented herein, it was concluded that a livestock auction facility, designed so as to make possible a relatively efficient handling of livestock would incorporate the following features:

(1) Calves and hogs placed in pens immediately adjacent to the unloading area after they are unloaded.

(2) A "feed" chute with which one could introduce cattle onto the scales for weighing would be utilized at all auctions except very small ones handling few cattle.

(3) Tagging chutes for cattle constructed so that a worker could work on a platform between two tagging chutes without

fear of injury to himself. This platform would be elevated sufficiently to permit the worker to reach the animals quickly and easily.

(4) Scales opening directly into the sales ring and having gates that either slide open or roll up so as to eliminate animals getting behind the gates when they are opened.

(5) Buyer pens available for hogs, calves and cattle. Hogs would be put into separate buyers' pens instead of being returned to the pens from which they came.

(6) Write-up operations performed in a small structure located separate from but close to the main auction building.

These recommendations are made with the realization that labor is not the only cost component which should be considered in designing the sales barn. However, none of the recommendations, except number five, would involve a much greater expense of costs other than labor, and the labor savings would be rather substantial. Recommendation number five would require substantially more outlay in the form of fixed costs, but this recommendation is based upon the indicated preferences of livestock buyers and auction owners. Loading-out operations, for which time-studies were not presented, would be accomplished much quicker when separate buyer pens are present.

Under a different cost structure, in which labor is relatively inexpensive and other costs are relatively large, these recommendations might not be appropriate.

CHAPTER VII

SYNTHESIS OF TWENTY-FOUR LIVESTOCK AUCTIONS

Introduction

In Chapter I it was pointed out that the first objective of this study was to determine if differences exist in methods of handling livestock at livestock auctions, and if so which methods were most efficient. To achieve this objective time studies were conducted at each auction, included in this study, and the results were presented in Chapter VI.

The second and primary objective was to determine the relationship between costs of operation and volume of livestock handled at livestock auctions. In Chapter III two methods of conducting this type study were discussed, and some of the advantages and disadvantages of each were presented. It was concluded that the synthetic approach to cost measurement was more appropriate for this investigation. Detailed cost records were obtained from each of the eight auctions included in this study and the results of this were presented in Chapter IV.

In this chapter material presented in Chapter IV on costs, and that given in Chapter VI on time studies are combined with additional information in order to estimate, or synthesize, the total costs of operation for 24 livestock auctions in Michigan. These auctions represent a wide range in size and each is designed to incorporate the most efficient methods of handling livestock that were observed at the eight auctions studied.

The numbers of livestock handled per year by each auction is presented and then the component cost items for each is given. The first item of cost estimated was labor and this was divided into four categories--yard, office, auctioneer, and management. Other cost components considered, in order, are: depreciation, repair and maintenance, insurance and bond, taxes, interest, transportation, utilities, supplies, advertising and "other."

Before synthesizing the costs, however, it is considered desirable to comment on the so-called rate-time dimension which has been incorporated in certain synthetic cost studies.

French and others pointed out rather clearly in their study of pear packing plants[1] that one of the basic weaknesses of much previous research in marketing was that the researchers had not considered the rate-time dimension problem. For example, at many plants, including pear packing plants, the owner of the plant could increase his plant's rate of operation and reduce the number of hours worked or he could reduce the rate and increase the amount of time, or he could employ any one of many combination of rates and times. Depending upon the nature of the plant itself there should be some unique combination of rate and time which would result in lowest costs to handle a given output. Barring certain institutional factors, such as labor unions, the manager is free to make the decision concerning rate of output and hours

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[1]B. C. French, L. L. Sammett, and R. G. Bressler, "Economic Efficiency in Plant Operations with Special Reference to the Marketing of California Pears," Hilgardia, Vol. 24, No. 19, July, 1956.

of operation. It is believed by this author that French and others have made a genuine contribution to our economic analysis used in attempting to reduce costs of operation.

Livestock auctions, however, are a different type of plant than, say, a pear packing plant or a milk processing plant. There is no doubt that with no institutional restrictions placed upon him, an auction owner could vary the rate-time dimension to where he could operate at lowest cost. However there are some very genuine restrictions placed upon the auction owner that are not placed on operators of many other types of plants. These restrictions are twofold. First, the livestock buyers insist upon a relatively rapid rate of selling. They want to purchase the livestock which they need and then move on. If the auction owner does not consider their preferences he stands a serious chance of losing some of his buyers which he does not often want to do. Secondly, the livestock producers who consign the livestock have a strong interest in the rate of selling. In many cases they are in agreement with the buyers in desiring a rapid selling rate--especially at the larger auctions. They feel that a rapid selling rate at relatively large auctions where relatively large numbers of buyers are present tends to keep the buyers' interest and "keep them on their toes." It is the sellers impression that a relatively rapid rate of sale results in relatively strong buyer interest and a higher price than would be realized if a slower selling rate were used. At the smaller auctions, however, the livestock consignors prefer a relatively slow rate of selling because relatively few buyers are available and the consignors feel that when buyer competition is somewhat limited a somewhat higher

selling price will be realized if the animals are given a longer "workout" in the sales ring.

The views held by the consignors may or may not be correct. However, as long as the consignors do hold these views, their preferences cannot be ignored by the auction owner if he wants to retain their business. The auction owner must consider rather carefully both the preferences of the buyers and sellers in electing a selling rate. Even though a different selling rate might theoretically result in lower operating costs, if this changed rate resulted in the auction owner losing either or both buyers and sellers his operating costs in the long run might go up sharply because of a reduced volume of business. For this reason, the author assumes that the selling rates shown in Chapter VI reflect both the desires of buyers and sellers and that the auction owner would be reluctant to change this rate appreciably. With this in mind the selling rates for each species of livestock at all twenty-four auctions were determined.

Numbers of Livestock Handled Yearly By Twenty-Four Auctions

Costs of operating auctions of six different basic sizes were computed. In addition to this costs were computed for four variations within each size group. Table 7.1 shows the number of livestock handled by each of the twenty-four auctions.

Auction size in terms of numbers of livestock ranges from 10,000 animals per year to 110,000 animals per year. Costs were synthesized for four different "mixes" of livestock inasmuch as Michigan livestock

Table 7.1. Livestock Handled Yearly by 24 Different Synthetic Livestock Auctions in Michigan.

Mix	Species	Auction Size 1	2	3	4	5	6
		(Number of Head)					
1	Hogs	2,500	5,000	8,750	13,750	20,000	27,500
	Calves	3,000	6,000	10,500	16,500	24,000	33,000
	Cattle	4,000	8,000	14,000	22,000	32,000	44,000
	Sheep	500	1,000	1,750	2,750	4,000	5,500
	Total	10,000	20,000	35,000	55,000	80,000	110,000
2	Hogs	3,500	7,000	12,250	19,250	28,000	38,500
	Calves	2,500	5,000	8,750	13,750	20,000	27,500
	Cattle	3,000	6,000	10,500	16,500	24,000	33,000
	Sheep	1,000	2,000	3,500	5,500	8,000	11,000
	Total	10,000	20,000	35,000	55,000	80,000	110,000
3	Hogs	4,500	9,000	15,750	24,750	36,000	49,500
	Calves	1,500	3,000	5,250	8,250	12,000	16,500
	Cattle	2,000	4,000	7,000	11,000	16,000	22,000
	sheep	2,000	4,000	7,000	11,000	16,000	22,000
	Total	10,000	20,000	35,000	55,000	80,000	110,000
4	Hogs	6,000	12,000	21,000	33,000	48,000	66,000
	Calves	1,000	2,000	3,500	5,500	8,000	11,000
	Cattle	1,500	3,000	5,250	8,250	12,000	16,500
	Sheep	15,000	3,000	5,250	8,250	12,000	16,500
	Total	10,000	20,000	35,000	55,000	80,000	110,000

auctions vary considerably in the percent of the total each class of livestock accounts for at a given auction. Table 7.2 shows the percent of the total for each species of livestock for each mix. As can be seen from Table 7.2 in moving from mix 1 through mix 4, hogs constitute an increasing percent of the total and cattle and calves become relatively less important. Hereafter all auctions synthesized will be assigned a code number such as 1-1, 2-4, or 3-6. These mean, in their

Table 7.2. Percent of Total Each Species of Livestock Constitutes in Four Different Mixes.

Mix	Percent of Total				
	Hogs	Calves	Cattle	Sheep	Total
1	25	30	40	5	100
2	35	25	30	10	100
3	45	15	20	20	100
4	60	10	15	15	100

respective order, auctions in mix 1, size 1; mix 2, size 4; and mix 3, size 6. The first number indicates the mix, and the second number indicates the size group.

Labor Costs

Selling Rates

The chief basis of estimating labor costs was the time study presented in Chapter VI. It is assumed that all auctions will operate one day per week, 50 weeks per year. This permits weekly operation except for two weeks per year at which time the sale day may fall on a legal holiday. Most auctions in Michigan hold about 50 sales per year.

The first step involved was to determine the speed at which each species of livestock would be sold in each auction.

In estimating the selling rates careful consideration was given to the numbers of livestock involved. For example, in the case of auction 1-1, 2,500 hogs per year are sold. This is somewhat fewer hogs than were sold in 1957 at any of the auctions studied. Closest to this, in terms of number of hogs handled was auction G. The selling speed at auction G was 0.60 minutes per hog. However, the actual minutes

productive time per head was 0.24 with 0.36 minutes delay time. Although auction G handled more hogs in 1957 than are intended for synthetic auction 1-1, and, as a rule, the auctions handling larger numbers of a given species sell at a faster speed, it was believed that 0.35 minutes per head was an appropriate figure to use as selling speed for hogs at this auction. This was arrived at by using a selling speed in productive minutes of 0.25 and a delay time of 0.10 minutes per head. The productive time of 0.25 minutes per head is close to the 0.24 of auction G, and there is no reason that the delay should be greater than 0.10 minutes per head.

All other rates of selling were arrived at in the same manner. The total minutes per head, productive minutes per head, delay minutes per head, and size of the auction were all utilized in establishing the selling speeds.

The selling rates arrived at are shown in Table 7.3.

After arriving at the selling rate the amount of time required to sell all the livestock at a given sale was then determined. The average total time per sale required to sell each species, the delay time, and the total time required to complete the sale are shown for all twenty-four auctions in Table 7.4. The number of livestock per sale was arrived at by dividing the number per year by the number of sales. Actually, some sales will be larger than others, but one does not know exactly how large each sale will be and can only arrive at an average amount.

Table 7.3. Selling Speed, by Species of Livestock, for Each of Twenty-Four Livestock Auctions.

Auction Code	Species of Livestock			
	Hogs	Calves	Cattle	Sheep
	(Minutes per Head)			
1-1	.35	.50	.80	1.00
1-2	.29	.40	.60	.60
1-3	.23	.30	.54	.40
1-4	.17	.27	.40	.30
1-5	.16	.25	.32	.25
1-6	.15	.24	.25	.24
2-1	.32	.55	.85	.60
2-2	.25	.43	.70	.37
2-3	.19	.34	.58	.25
2-4	.16	.28	.50	.24
2-5	.15	.26	.38	.23
2-6	.14	.25	.32	.22
3-1	.30	.60	.90	.37
3-2	.23	.50	.80	.25
3-3	.17	.43	.65	.23
3-4	.15	.35	.57	.22
3-5	.14	.29	.51	.21
3-6	.13	.27	.40	.20
4-1	.27	.65	1.00	.45
4-2	.19	.57	.85	.29
4-3	.18	.40	.76	.24
4-4	.14	.43	.60	.23
4-5	.13	.35	.56	.22
4-6	.12	.30	.50	.21

Table 7.4. Average Total Time Per Sale Required to Sell Each Species of Livestock at Twenty-Four Synthetic Livestock Auctions.

Auction Code	Hogs	Calves	Cattle	Sheep	Delay Time	Total
			(Minutes)			
1-1	17.5	30.0	64.0	10.0	21.0	142.5
1-2	29.0	48.0	96.0	12.0	25.0	210.0
1-3	40.25	63.0	151.2	14.0	26.0	294.45
1-4	46.75	89.1	176.0	16.5	27.0	355.35
1-5	64.0	120.0	204.8	20.0	28.0	436.80
1-6	82.5	158.4	220.0	26.4	30.0	517.30
2-1	22.4	27.5	51.0	12.0	21.0	133.9
2-2	35.0	43.0	84.0	14.8	24.0	200.8
2-3	46.55	59.5	121.8	17.5	25.0	270.35
2-4	61.6	77.0	165.0	26.4	26.0	356.00
2-5	84.0	104.0	182.4	36.8	27.0	434.20
2-6	107.8	137.5	211.2	48.4	28.0	532.90
3-1	27.0	18.0	36.0	14.8	21.0	116.80
3-2	41.4	30.0	64.0	20.0	23.0	178.40
3-3	53.55	45.15	91.0	32.2	24.0	245.90
3-4	74.25	57.75	125.4	48.4	25.0	330.80
3-5	100.8	69.6	163.2	67.2	26.0	426.80
3-6	128.7	89.1	176.0	88.0	27.0	508.80
4-1	32.4	13.0	30.0	13.5	21.0	109.9
4-2	45.6	22.8	51.0	17.4	22.0	158.8
4-3	67.2	33.6	79.8	25.2	23.0	228.8
4-4	92.4	47.3	99.0	37.95	24.0	300.65
4-5	124.8	56.0	134.4	52.80	25.0	393.00
4-6	158.4	66.0	165.0	69.3	26.0	484.70

Yard Labor

In determining the number of workers required at each stage of operations at all synthetic auctions careful consideration was given the man-minute labor requirements, number of workers, selling speed, and productive and delay time shown in Chapter VI. However, the time study results presented in Chapter VI, valuable as they are, do not in themselves tell the exact number of workers that must be employed at each stage. For example, if 4.20 man-minutes per head are required to perform a given task this does not mean one can employ one man for 4.20 minutes, two men for 2.10 minutes, three men for 1.40 minutes or four men for 1.05 minutes. The nature of some tasks are such that it may take a minimum of two men to perform it almost without regard to rate of sale. Two men can perform some tasks in considerably less than one-half the time required for one man to do it. Except for this restriction little variance in man-minutes required was permitted from those shown in Chapter VI unless the table also showed considerable delay time or unless a different method of handling the livestock was being used.

As an example consider auction B in which hogs were brought up at the rate of 0.18 minutes per head. Three to four men were used resulting in labor requirements of 0.63 man-minutes per head. Delay time was only 0.04 minutes per head. In the synthetic auction in which a selling rate, and consequently a bringing-up rate, of 0.17 minutes per head was used it would be unrealistic to assume only two workers would be needed, unless an entirely different, and more efficient method was used.

To help further illustrate the procedure used in estimating the number of workers required at a given stage let us consider some examples.

Auction H used 1.39 man-minutes per head to bring up cattle. One to two men were used. Much of the time was delay time. The actual productive time was 0.25 minutes per head. Adding 0.20 minutes per head for delay time and assuming that two men were working gives a minute per head time of 0.45 and a man-minute per head time of 0.90. This last figure is considered to be the man-minute requirements. By looking at the rate of sale arrived at in Table 7.3 of this chapter, the number of workers required for bringing up cattle can quickly be ascertained. At a selling rate of 0.80 minutes per head, 1.12 workers are required, or, since workers are indivisible, two workers. Two workers are also required for selling all rates slower than 0.45 minutes per head. If the selling rate is 0.44 minutes per head, three workers will be required. If the selling speed is faster than 0.30 minutes per head, four workers will be required. It should be noted, however, that the man-minute requirement per head of 0.90 can be used only as a guide. Actually this requirement will increase or decrease somewhat as the distance which the animals must be driven from their pen to the feed-chute increases or decreases, i.e., if the pens are relatively far from the feed-chute, the time requirements will be somewhat greater.

Using this procedure the number of yard workers was estimated, and the results are shown in Table 7.5.

In addition to the yard labor requirements during the actual selling operation one must also consider the labor needed to unload livestock prior to the sale and the labor requirements of loading livestock after the sale. These requirements are shown in Tables 7.6 and 7.7.

Table 7.5. Number of Yard Workers Required Classified According to Species of Livestock, Auction Size, Auction Mix, and Stage of Operations, at Twenty-four Synthetic Auctions.

Auction Size	Species	Ring-Workers	Bringing-Up Workers				Bringing-Back Workers				Other Workers *
			Mix				Mix				
			1	2	3	4	1	2	3	4	
1	Hogs	2 ring workers	2	2	2	2	2	2	2	2	1 for all
	Calves	for all mixes	1	1	1	1	0	0	0	0	species and
	Cattle	and all	2	2	2	2	2	2	2	2	mixes.
	Sheep	species.	2	2	2	2	2	2	2	2	
2	Hogs	Same as size	2	2	2	3	2	2	2	3	1 for all
	Calves	1	1	1	1	1	2	2	0	0	mixes and
	Cattle		2	2	2	2	2	2	2	2	species.
	Sheep		2	2	3	3	2	2	3	3	
3	Hogs	Same as size	3	3	3	3	3	3	3	3	None
	Calves	1	1	1	1	1	3	3	2	2	
	Cattle		2	2	2	2	2	2	2	2	
	Sheep		2	3	3	3	2	3	3	3	
4	Hogs	Same as size	3	3	3	4	3	3	3	3	2 for all
	Calves	1	1	1	1	1	3	3	3	2	mixes.
	Cattle		3	2	2	2	3	2	2	2	
	Sheep		3	3	3	3	3	3	3	3	
5	Hogs	Same as size	3	3	4	4	3	3	3	4	2 for all
	Calves	1.	2	2	1	1	3	3	3	3	mixes.
	Cattle		3	3	2	2	4	3	2	2	
	Sheep		3	3	4	3	3	3	3	3	
6	Hogs	Same as size	3	4	4	4	3	3	4	4	2 for all
	Calves	1.	2	2	2	1	3	3	3	3	mixes.
	Cattle		4	3	3	2	4	4	3	2	
	Sheep		3	3	4	4	3	3	4	3	

*Needed to help unload late arrivals when all other workers are busy and to help load out while sale is in progress.

Table 7.6. Hours Worked Before Sale, Per Sale, According to Mix, Auction Size, and Worker.

Worker	Mix 1 Auction Size 1	2	3	4	5	6	Mix 2 Auction Size 1	2	3	4	5	6
1	5.0[1]	5.0[1]	6.0[2]	6.0[3]	6.0[3]	6.0[3]	5.0[1]	5.0[1]	6.0[2]	6.0[3]	6.0[3]	6.0[3]
2	3.0	3.0	4.0	5.0	5.0	6.0	3.0	3.0	4.0	5.0	5.0	6.0
3	2.0	2.0	3.0	4.0	4.0	4.0	2.0	2.0	3.0	4.0	4.0	4.0
4	2.0	2.0	3.0	4.0	4.0	4.0	2.0	2.0	3.0	4.0	4.0	4.0
5	2.0	2.0	3.0	3.0	3.0	3.0	2.0	2.0	3.0	3.0	3.0	3.0
6	2.0	2.0	2.0	3.0	3.0	3.0	2.0	2.0	2.0	3.0	3.0	3.0
7	2.0	2.0	2.0	3.0	3.0	3.0	2.0	2.0	2.0	3.0	3.0	3.0
8			2.0	2.0	2.0	3.0			2.0	2.0	2.0	3.0
9				2.0	2.0	2.0			2.0	2.0	2.0	2.0
10				2.0	2.0	2.0				2.0	2.0	2.0
11					2.0	2.0						2.0
12						2.0						2.0
13						2.0						

	Mix 3						Mix 4					
1	5.0[1]	5.0[1]	6.0[2]	6.0[3]	6.0[3]	6.0[3]	5.0[1]	5.0[1]	6.0[2]	6.0[3]	6.0[3]	6.0[3]
2	3.0	3.0	4.0	5.0	5.0	6.0	3.0	3.0	4.0	5.0	5.0	6.0
3	2.0	2.0	3.0	4.0	4.0	4.0	2.0	2.0	3.0	4.0	4.0	4.0
4	2.0	2.0	3.0	4.0	4.0	4.0	2.0	2.0	3.0	4.0	4.0	4.0
5	2.0	2.0	3.0	3.0	3.0	3.0	2.0	2.0	3.0	3.0	3.0	3.0
6	2.0	2.0	2.0	3.0	3.0	3.0	2.0	2.0	2.0	3.0	3.0	3.0
7	2.0	2.0	2.0	3.0	3.0	3.0	2.0	2.0	2.0	3.0	3.0	3.0
8		2.0	2.0	2.0	2.0	3.0		2.0	2.0	2.0	2.0	3.0
9			2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0
10				2.0	2.0	2.0				2.0	2.0	2.0
11					2.0	2.0					2.0	2.0
12						2.0					2.0	2.0
13						2.0						2.0

[1]Works eight hours, day after sale, cleaning up and repairing.

[2]Works two days after sale cleaning up and repairing.

[3]Works by week.

Table 7.7. Hours Worked after Sale Ends, Loading Out, Per Sale, According to Mix, Auction Size, and Workers.

Worker	Mix 1 Auction Size 1	2	3	4	5	6	Mix 2 Auction Size 1	2	3	4	5	6
	(Hours)						(Hours)					
1	2.5	2.5	(All night			)	2.25	2.25	(All night			)
2	1.5	2.5	2.5	2.5	3.0	3.0	1.25	2.25	2.25	2.25	3.0	
3			2.5	2.5	3.0	3.0			2.25	2.25	3.0	
4				2.5	3.0	3.0				2.25	3.0	
5						3.0				2.25		
	Mix 3						Mix 4					
	(Hours)						(Hours)					
1	3.0	2.0	(All night)			)	1.83	1.67	(All night			)
2	1.0	2.0	2.0	2.0	2.0	2.5	.83	1.67	1.83	1.83	2.0	2.25
3			2.0	2.0	2.5	2.5			1.83	1.83	2.0	2.25
4				2.0	2.5	2.5				1.83	2.0	2.25
5						2.5						2.25

Auctioneers, Ring Clerk, and Weighmaster

Time studies cannot serve as a basis for determining the number of auctioneers, ring clerks, and weighmasters needed. The number of workers needed for these functions was estimated on the basis of observations of other auctions and these estimates are shown in Table 7.8 on the following page.

One ring clerk is sufficient at all auctions. This clerk will need relief for rest periods and to eat at all auctions of size three or larger. This relief is furnished by one of the auctioneers who is idle at that time.

One weighmaster is adequate for all auctions except the largest. Auctions falling in the size six group will employ two weighers.

Table 7.8. Number of Auctioneers, Ring Clerks, and Weighmaster Personnel at Twenty-Four Synthetic Auctions

Worker	Mix 1 Auction Size 1	2	3	4	5	6	Mix 2 Auction Size 1	2	3	4	5	6
Auctioneer	1	2	2	2	3	3	1	2	2	2	3	3
Ring Clerk	1	1	1	1	1	1	1	1	1	1	1	1
Weighmaster	1	1	1	1	1	1	1	1	1	1	1	2
	Mix 3						Mix 4					
Auctioneer	1	2	2	2	3	3	1	1	2	2	2	3
Ring Clerk	1	1	1	1	1	1	1	1	1	1	1	1
Weighmaster	1	1	1	1	1	2	1	1	1	1	1	2

Actually only one weigher was observed at each of the eight auctions included in the study, but relief was provided the weighmaster at the larger ones. The weighmasters in auctions size three, four, and five, will need a rest period and will be relieved by the manager or one of the yard workers.

The number of auctioneers required is the same for all mixes except mix four. Since it does not require as long to sell the animals in this mix only one auctioneer is required at auction 4-2 and only two are required at auction 4-5. Although this is one less auctioneer in each case, the total auctioneer's wages will not decrease as much because the wage of each of those remaining will have to be increased some.

Office Labor

The number of office employees varies from three at the smallest auction up to five at the larger ones. Table 7.9 summarizes the number of office workers used at each auction.

Table 7.9. Number of Office Workers Employed at Twenty-Four Synthetic Auctions.

Mix	Auction Size					
	1	2	3	4	5	6
1	3	4	4	4	5	5
2	3	4	4	4	5	5
3	3	4	4	4	5	5
4	3	4	4	4	5	5

At auctions of size 1, one office worker will take the scale tickets and compute the gross amount of the sale. One copy of the tickets, which is in duplicate, will be given to worker number two who posts these tickets to the consignor sheets, and the other ticket will be given to worker number three who posts the tickets to the buyer sheets. Worker number two also prepares the checks for the consignors and hands them out as the consignors ask for them. Worker number three also waits on buyers as they pay for the livestock which they purchased.

Procedure in auctions of sizes 2, 3, and 4 is similar to that of size 1. In this case, however, worker four writes checks to the consignors and dispenses them, relieving worker two of this duty. When five workers are used in the office the procedure is the same as when four are used except that the fifth worker waits on buyers as they pay their bills, thereby relieving worker number three of this task.

The office workers must arrive some time before the sale begins in order to prepare for the sale itself. This work consists primarily of taking the write-up sheets and classifying them by tag or pen number and species of livestock. It also involves getting supplies such as

blank checks ready for processing and arranging the office machines. Table 7.10 shows the number of minutes each office worker works before and after the sale.

Table 7.10. Number of Minutes Per Sale Worked by Office Workers Before Sale and After Sale.

Auction Size	Mix 1 Worker 1	2	3	4	5	Mix 2 Worker 1	2	3	4	5
	Minutes					Minutes				
1 Before Sale	120.0	60.0	60.0			120.0	60.0	60.0		
After Sale	37.5	37.5	37.5			35.0	35.0	35.0		
2 Before Sale	120.0	60.0	60.0	60.0		120.0	60.0	60.0	60.0	
After Sale	40.0	40.0	40.0	40.0		37.0	37.0	37.0	37.0	
3 Before Sale	120.0	60.0	60.0	60.0		120.0	60.0	60.0	60.0	
After Sale	45.0	45.0	45.0	45.0		41.5	41.5	41.5	41.5	
4 Before Sale	120.0	120.0	60.0	60.0		120.0	120.0	60.0	60.0	
After Sale	52.5	52.5	52.5	52.5		48.5	48.5	48.5	48.5	
5 Before Sale	120.0	120.0	60.0	60.0	60.0	120.0	120.0	60.0	60.0	60.0
After Sale	60.0	60.0	60.0	60.0	60.0	55.5	55.5	55.5	55.5	55.5
6 Before Sale	120.0	120.0	120.0	60.0	60.0	120.0	120.0	120.0	60.0	60.0
After Sale	70.0	70.0	70.0	70.0	70.0	65.0	65.0	65.0	65.0	65.0
	Mix 3					Mix 4				
1 Before Sale	120.0	60.0	60.0			120.0	60.0	60.0		
After Sale	32.5	32.5	32.5			30.0	30.0	30.0		
2 Before Sale	120.0	60.0	60.0	60.0		120.0	60.0	60.0	60.0	
After Sale	34.0	34.0	34.0	34.0		31.0	31.0	31.0	31.0	
3 Before Sale	120.0	60.0	60.0	60.0		120.0	60.0	60.0	60.0	
After Sale	38.0	38.0	38.0	38.0		34.5	34.5	34.5	34.5	
4 Before Sale	120.0	120.0	60.0	60.0		120.0	120.0	60.0	60.0	
After Sale	44.5	44.5	44.5	44.5		40.5	40.5	40.5	40.5	
5 Before Sale	120.0	120.0	60.0	60.0		120.0	120.0	60.0	60.0	60.0
After Sale	51.0	51.0	51.0	51.0	51.0	46.5	46.5	46.5	46.5	46.5
6 Before Sale	120.0	120.0	120.0	60.0	60.0	120.0	120.0	120.0	60.0	60.0
After Sale	60.0	60.0	60.0	60.0	60.0	55.0	55.0	55.0	55.0	55.0

Wage Rates

Having determined the number of workers and the length of time each works, it is necessary to establish a wage rate in order to obtain total labor costs for each auction. Table 7.11, on the following page, shows the wage rates used in this synthesis.

Auctioneer wages ranged from $25.00 each up to $40.00 each at the eight auctions included in this study. This was used as a criteria in determining this item of expense.

Weighmasters averaged about $2.00 per hour, ring clerks averaged $1.50 per hour, and the wage rate for yard workers and office workers ranged from $1.00 per hour up to $1.50 per hour. Six of the auctions studied paid $1.25 per hour, and this figure was used.

The method used in estimating management wages is, admittedly subjective for the smaller auctions. The rates arrived at were estimated on the basis of the time, and responsibility involved in performing managerial duties at each of the smaller auctions. Management was a direct cost at five of the eight auctions studied and these costs were used in estimating management costs at the auctions.

Total Labor Costs

After making all these considerations, the number of workers, time worked, and wage rate or salary were used to arrive at a total labor cost. Labor cost per year is shown for each auction in Table 7.12 on page 117.

Table 7.11. Wage Rates of Auction Personnel

Auction Code	Management (per sale)	Auctioneer* (per sale)	Yard Foreman (per sale)	Weighmaster (per hr.)	Ring Clerk (per hr.)	Yard Worker (per hr.)	Bookkeeper (per hr.)	Office Worker (per hr.)
1-1	$40.00	$25.00	--	$2.00 at all auctions	$1.50 at all auctions	$1.25 at all auctions	$1.50 at all auctions	$1.25 at all auctions
1-2	50.00	20.00	--					
1-3	65.00	30.00	--					
1-4	85.00	40.00	$75.00					
1-5	120.00	35.00	80.00					
1-6	150.00	40.00	85.00					
2	Wage rates and salaries are the same at all mixes except mix 4 where auctioneer salaries are somewhat different.							
3								
4-1		$25.00						
4-2		35.00						
4-3		30.00						
4-4		40.00						
4-5		30.00						
4-6		40.00						

*Wages for each auctioneer.

Table 7.12. Labor Cost Per Year for Twenty-Four Different Livestock Auctions.

Auction Code	Type of Labor				Total
	Yard	Office	Auctioneer	Management	
1-1	$ 3,439.50	$1,325.00	$1,250.00	$2,000.00	$ 8,014.50
1-2	4,190.00	1,958.50	2,000.00	2,500.00	10,648.50
1-3	6,427.00	2,424.00	3,000.00	3,250.00	15,101.00
1-4	10,463.00	2,935.00	4,000.00	4,250.00	21,648.00
1-5	12,153.50	4,053.50	5,250.00	6,000.00	27,457.00
1-6	15,380.50	4,907.50	6,000.00	7,500.00	33,788.00
2-1	3,315.50	1,289.50	1,250.00	2,000.00	7,857.00
2-2	4,064.50	1,902.00	2,000.00	2,500,00	10,466.50
2-3	6,572.50	2,302.50	3,000.00	3,250.00	15,125.00
2-4	10,421.00	2,920.00	4,000.00	4,250.00	21,591.00
2-5	11,915.50	4,014.50	5.250.00	6,000.00	27,180.00
2-6	14,926.00	4,967.00	6,000.00	7,500.00	33,393.00
3-1	3,113.50	1,224.00	1,250.00	2,000.00	7,587.50
3-2	4,130.50	1,792.50	2,000.00	2,500.00	10,423.00
3-3	6,267.50	2,180.50	3.000.00	3,250.00	14,698.00
3-4	10,062.50	2,794.00	4,000.00	4,250.00	21,106.50
3-5	11,922.00	3,949.50	5,250.00	6,000.00	27,121.50
3-6	15,128.00	4,806.00	6,000.00	7.500.00	33,434.00
4-1	3,021.50	1,192.00	1,250.00	2,000.00	7,463.50
4-2	4,176.50	1,692.00	1,750.00	2,500.00	9,868.50
4-3	6,082.50	2,090.50	3,000.00	3,250.00	14,393.00
4-4	9,663.00	2,645.00	4,000.00	4,250.00	20,558.00
4-5	11,929.50	3,746.50	4,500.00	6,000.00	26,176.00
4-6	14,690.50	4,650.00	6,000.00	7,500.00	32,840.50

When put on an average cost per head basis the labor cost is as shown in Table 7.13. As can be seen from Table 7.13, average labor cost per head tends to decline both as the size increases and also as the percent of hogs increases. This, of course, is in agreement with the time studies presented in Chapter VI. The decline in labor costs is quite rapid through the first three size increments but the rate of decline is much slower after that point. The decline is about $0.25 per

Table 7.13. Average Labor Cost Per Year Per Head of Livestock for Twenty-Four Different Livestock Auctions.

Auction Code	Average Cost Per Head: Yard Labor	Office Labor	Auctioneer	Management	Total
			(dollars)		
1-1	.344	.133	.125	.200	.801
1-2	.210	.098	.100	.125	.532
1-3	.184	.069	.086	.093	.431
1-4	.190	.053	.073	.077	.394
1-5	.152	.051	.066	.075	.343
1-6	.140	.045	.055	.068	.307
2-1	.332	.129	.125	.200	.786
2-2	.203	.095	.100	.125	.523
2-3	.188	.066	.086	.093	.432
2-4	.189	.053	.073	.077	.393
2-5	.149	.050	.066	.075	.340
2-6	.136	.045	.055	.068	.304
3-1	.311	.122	.125	.200	.759
3-2	.207	.089	.100	.125	.521
3-3	.179	.062	.086	.093	.420
3-4	.183	.051	.073	.077	.384
3-5	.149	.049	.066	.075	.339
3-6	.138	.044	.055	.068	.304
4-1	.302	.119	.125	.200	.746
4-2	.209	.085	.088	.125	.493
4-3	.173	.060	.086	.093	.411
4-4	.176	.048	.073	.077	.374
4-5	.149	.047	.056	.075	.327
4-6	.134	.042	.055	.068	.299

head in moving from size 1 to size 2 but only about $0.03 in moving from size 5 to size 6. There are exceptions to the trend toward lower average costs as the proportion of hogs increases, however, and these should be noted. Let us use auctions 1-3 and 2-3 as an example. Despite the fact that the percent of hogs and sheep increased and the relative proportion of cattle and calves declined, labor costs advanced slightly.

The reason for this is that for auction 1-3 only two men were needed to bring up the sheep whereas at auction 2-3 three men were necessary. This increase in number of employees needed to bring up sheep was not accompanied by a decrease in the number of employees needed to handle cattle and calves. The reverse may also be true, however, in which case when moving from a mix relatively light in hogs and heavy in cattle to a mix where the reverse is true one finds that no additional workers are needed to handle the hogs and one less man is needed in handling cattle. In cases such as this, where fewer workers are needed, and these workers work fewer hours (because of faster selling speeds for hogs than cattle), there may be a substantial saving in labor costs.

Depreciation

In order to obtain depreciation costs it was first necessary to estimate the cost of the building including the heating equipment, office equipment, plumbing, and restaurant equipment. To do this a plan for each of the twenty-four auctions was made. A floor plan is shown in Appendix B. This plan was designed so as to be large enough to accommodate the numbers of livestock shown earlier in this chapter. If the auction is of a size such that it can handle 10,000 animals per year, this means it must accommodate 200 animals, on the average, per sale. One cannot use average figures here, however, because more animals than this will be received on some sale days and fewer animals on other days. The auction must be large enough to accommodate what one would expect to be the maximum number of livestock during a given sale, given a certain number handled per year. Having determined the maximum numbers

of each species expected during a given sale, one can then determine the pen space needed by multiplying the number of head of each species times the number of square feet required for each. By doing this and then adding the space requirements for each species one will obtain the total square feet requirements. To this must be added the alley space, space for unloading, and space for the sales arena. It was assumed that owners of all auctions, regardless of size will want separate pens for cattle, calves, and hogs after they are sold. Sheep will be returned to the pens from which they came. Since additional pen space will be needed for the livestock after it is sold, the space requirements will be increased over and above that necessary to accommodate the animals when they are received.

All buildings are of pole type construction with concrete floors throughout and a galvanized metal roof. Each building has one scales, 8' x 14' of 8,000 pound capacity, two toilets, an office and a restaurant. In addition each has a public address system and a vacuum tube for dispatching scale tickets and other paper items from the auctioneers' booth to the office. The office, toilets, and restaurant are located on the second floor above the unloading docks. A catwalk leads from a passageway between the office and restaurant to the sales arena. Catwalks are in each building so that prospective buyers may see the livestock without entering the alleys. The amount of catwalk depends upon the size and shape of the auction.

All the buildings are of similar design with the size increasing with the number of livestock handled. Auctions in the various mixes vary from each other only in space requirements and number of pens.

Auction 3-1, for example, which receives more hogs and fewer cattle than auction 1-1 will substitute hog pen space for cattle pen space. Although auctions receiving a high percentage of hogs will normally require somewhat less total area than those receiving relatively more cattle the actual building cost may be greater because the "hog" auctions will require greater amounts of fencing and gates.

Table 7.14 shows the dimensions and area of each auction building, the number of docks, and the dimensions and area of each sales arena.

Table 7.14. Characteristics of Twenty-Four Synthetic Livestock Auction Building.

Auction Code	Building Dimensions	Building Area	Sales Arena Dimensions	Sales Arena Area	Number of Chutes
		(Sq. Ft.)		(Sq. Ft.)	
1-1	64' x 132'	8,448	34' x 36'	1,222	2
1-2	92 x 140	12,880	36 x 36	1,296	2
1-3	112 x 166	18,592	36 x 36	1,296	4
1-4	140 x 204	28,560	40 x 40	1,600	5
1-5	180 x 227	39,860	44 x 45	1,980	6
1-6	222 x 242	53,724	44 x 48	2,112	6
2-1	64 x 128	8,192	34 x 36	1,222	2
2-2	88 x 140	11,520	36 x 36	1,296	2
2-3	114 x 158	18,012	36 x 36	1,296	4
2-4	136 x 196	26,656	40 x 40	1,600	5
2-5	170 x 223	37,910	44 x 44	1,936	6
2-6	212 x 224	49,608	22 x 48	2,112	6
3-1	76 x 97	7,372	36 x 36	1,296	2
3-2	84 x 142	11,928	36 x 36	1,296	2
3-3	108 x 156	16,848	36 x 36	1,296	4
3-4	138 x 156	26,220	40 x 40	1,600	5
3-5	176 x 209	36,784	44 x 45	1,980	6
3-6	182 x 240	43,680	44 x 48	2,112	6
4-1	76 x 98	7,448	36 x 36	1,296	2
4-2	84 x 140	11,760	36 x 36	1,296	2
4-3	106 x 140	16,748	36 x 36	1,296	4
4-4	138 x 196	27,048	40 x 40	1,600	5
4-5	166 x 200	34,694	44 x 48	1,980	6
4-6	178 x 244	43,352	44 x 48	2,112	6

Costs of restaurant equipment, office equipment, public address system, plumbing system, and heating systems were all obtained from local agencies specializing in selling and installing this type equipment. While variations from these figures may be obtained, they are, nonetheless, believed to provide a reasonably reliable guide to what one would expect to pay for this equipment at 1958 prices.

The agricultural engineers supplied information concerning how to estimate building costs and wiring costs.[2] As a basis for this it was determined that there should be three watts per square foot in the restaurant and sales arena, ten watts per square foot directly above the sales ring and in the kitchen, five watts per square foot in the office and one watt per square foot in the animal holding areas. In addition to this one convenience outlet per four feet wall space was provided in the kitchen and auctioneers' booth plus one per ten feet of wall space in the restaurant and office and several located in other parts of the building. A figure of $4.00 per outlet was used throughout.

Inasmuch as the expected life of the building may differ from that of the office equipment, and restaurant equipment, depreciation must be computed for each and then added together for a total depreciation cost per year. Table 7.15 shows the original cost of each, the expected life, and the depreciation per year.

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[2]Dr. James Boyd and Dr. Frederick Buelow.

Table 7.15. Original Cost, Expected Life, and Depreciation of Component Parts of Twenty-Four Synthetic Livestock Auctions.

Auction Code	Buildings[1]		Restaurant Equipment[2]		Office Equipment[3]		Total Depreciation
	Cost	Depreciation	Cost	Depreciation	Cost	Depreciation	
1-1	$ 30,276.94	$1,211.08	$1,060.00	$106.08	$ 574.00	$ 57.40	$1,374.48
1-2	40,721.57	1,628.86	1,285.00	128.50	584.00	58.40	1,815.77
1-3	54,955.03	2,198.20	1,887.00	188.70	649.00	64.90	2,451.81
1-4	78,708.20	3,148.33	2,297.00	229.70	1,710.00	171.00	3,549.03
1-5	106,728.29	4,269.13	2,670.00	267.00	1,870.00	187.00	4,723.14
1-6	141,164.30	5,646.57	3,000.00	300.00	1,870.00	187.00	6,133.57
2-1	29,858.04	1,194.32	1,060.00	106.00	574.00	57.40	1,357.72
2-2	38,319.57	1,532.78	1,285.00	128.50	584.00	58.40	1,719.69
2-3	53,985.53	2,159.42	1,887.00	188.70	649.00	64.90	2,413.03
2-4	75,181.70	3,007.27	2,297.00	229.70	1,710.00	171.00	3,407.97
2-5	103,801.14	4,152.05	2,670.00	267.00	1,870.00	187.00	4,606.01
2-6	134,051.90	5,362.08	3,000.00	300.00	1,870.00	187.00	5,849.07
3-1	28,335.12	1,133.40	1,060.00	106.00	574.00	57.40	1,296.80
3-2	39,103.17	1,564.13	1,285.00	128.50	584.00	58.40	1,751.02
3-3	52,190.03	2,087.60	1,887.00	188.70	649.00	64.90	2,341.20
3-4	75,214.20	3,008.57	2,297.00	229.70	1,710.00	171.00	3,409.27
3-5	98,474.49	3,938.98	2,670.00	267.00	1,870.00	187.00	4,392.98
3-6	121,397.20	4,855.89	3,000.00	300.00	1,870.00	187.00	5,342.89
4-1	28,436.52	1,137.46	1,060.00	106.00	574.00	57.40	1,300.86
4-2	39,109.36	1,564.37	1,285.00	128.50	584.00	58.40	1,751.27
4-3	52,102.23	2,084.09	1,887.00	188.70	649.00	64,90	2,337.69
4-4	77,366.20	3,094.65	2,297.00	229.70	1,710.00	171.00	3,495.35
4-5	98,210.99	3,928.44	2,670.00	267.00	1,870.00	187.00	4,382.44
4-6	122,149.70	4,885.99	3,000.00	300.00	1,870.00	187.00	5,372.99

[1]Includes heating, plumbing, wiring, scales, safe, and P. A. system. Expected life is 25 years.

[2]Expected life is 10 years.

[3]Expected life is 10 years.

Repair and Maintenance

Repair and maintenance costs were computed on the basis of one percent of the cost of the building. This figure is one used by agricultural engineers in estimating this expense for buildings of this type.

Insurance and Bond

Insurance costs may amount to a fairly sizeable amount for a livestock auction. These costs were estimated for each auction through discussions with insurance agencies. The four chief types of insurance carried by the auctions were: (1) Fire and comprehensive insurance on the building and its contents; (2) insurance on the livestock; (2) liability and compensation insurance on employees in case of accident, and (4) unemployment insurance compensation.

The insurance costs arrived at are somewhat higher than those actually incurred by the eight auctions studied primarily because it was assumed in this study that the owner would insure the building and contents for their full estimated value. These estimated values are considerably higher for the newly constructed synthetic auctions than for most of the auctions actually observed. With insurance on the building and contents costing approximately $3.25 per $100 of building valuation an increase in coverage of $10,000 would increase the insurance costs by about $325.00. The insurance costs will vary, of course, depending upon the location of the structure, area in which the auction is located, and other such things. In this estimation of costs, all auctions were assumed to be of similar construction and located where rates would be the same.

All livestock auction owners in Michigan must be bonded. The bond is computed on the basis of the average weekly sales per auction. The owner must be bonded dollar for dollar up to $25,000 average weekly sale. Over that amount the owner must be bonded at the rate of $1.00 for each $5.00.

Taxes

These costs were arrived at by discussing tax costs with state tax officials and others who have a rather comprehensive knowledge of the state tax structure. One of the taxes, the business activities tax, is based upon gross revenue received. In order to compute this cost it was necessary to establish commission rates and service charges for all auctions and then determine the revenue received by each auction.[3] This tax is computed by taking 50 percent of the total revenue, subtracting $10,000 from the balance and multiplying $6.50 times each $1,000 of the remainder. Thus an auction obtaining $50,000 in revenue would pay tax on $15,000 or $97.50.

Social security was considered as a tax in this study and these costs were arrived at on the basis of the labor payroll. Rates of two and one-half percent of the payroll, effective on 1 January 1959 were used. Social security must be paid up to amounts of $4,800 per year salary effective on 1 January 1959, and this figure was also used.

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[3]The revenue received from commission and service charges, per head, was estimated to be: $0.60 for hogs, $1.10 for calves, $3.00 for cattle, and $0.60 for sheep.

A fairly important item of tax expense was that of property tax. Since assessment methods and property tax rates vary so widely in different areas an average tax rate was arrived at and used in the estimates. The tax levy rate was 0.20 mill and the assessment rate used was 40 percent. The same rate of assessment and the same tax rate was used for each auction.

Interest

Whether a person invests his own money in the plant or borrows it, interest is a real cost. In this study it was assumed that the money would be borrowed and that the average interest rate to use would be three percent. Borrowing money at 5.75 percent interest on the unpaid balance averages out to about three percent per year on the total amount. Although the actual interest rate may vary considerably from this the same relationship between auctions would still hold.

Other Variable Costs

The estimated cost of five variable cost components were arrived at by assigning a given percent of the total cost to them. These percentages were arrived at by considering the type of auction and the cost of the component parts at the auctions actually studied. In addition, consideration was given to other livestock auction studies and the percent of the total which each cost component constituted.[4]

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[4]It should again be pointed out that had certain cost items been included in the total costs presented in Chapter IV (depreciation, wages to management, etc.) certain cost components would have constituted a lower proportion of the total. For example, utilities might

Table 7.16 shows the percentage of the total five different cost components accounted for at the twenty-four auctions.

Table 7.16. Percent of Total Expenses Various Cost Components Constitute at Twenty-Four Auctions.

Auction Code	Cost Components				
	Transportation	Utilities	Supplies	Advertising	Other
			(percent)		
1-1	3.0	3.2	4.2	4.0	5.0
1-2	3.0	3.2	4.2	3.9	5.0
1-3	3.0	3.2	4.2	3.8	5.0
1-4	3.0	3.2	4.2	3.7	5.0
1-5	3.0	3.2	4.2	3.6	5.0
1-6	3.0	3.2	4.2	3.5	5.0
2-1	3.0	3.0	4.0	4.0	5.0
2-2	3.0	3.0	4.0	3.9	5.0
2-3	3.0	3.0	4.0	3.8	5.0
2-4	3.0	3.0	4.0	3.7	5.0
2-5	3.0	3.0	4.0	3.6	5.0
2-6	3.0	3.0	4.0	3.5	5.0
3-1	3.0	2.8	3.8	4.0	5.0
3-2	3.0	2.8	3.8	3.9	5.0
3-3	3.0	2.8	3.8	3.8	5.0
3-4	3.0	2.8	3.8	3.7	5.0
3-5	3.0	2.8	3.8	3.6	5.0
3-6	3.0	2.8	3.8	3.5	5.0
4-1	3.0	2.6	3.6	4.0	5.0
4-2	3.0	2.6	3.6	3.9	5.0
4-3	3.0	2.6	3.6	3.8	5.0
4-4	3.0	2.6	3.6	3.7	5.0
4-5	3.0	2.6	3.6	3.6	5.0
4-6	3.0	2.6	3.6	3.5	5.0

have constituted only 3.0 percent of the total instead of 3.6 percent. On the other hand certain cost components, such as labor and repair and maintenance constitute a much lower proportion of the total costs for the synthetic auction than for those actually observed. The overall effect is that several cost components will constitute about the same proportion of the total for the synthetic auctions as they did for those actually observed.

There is little reason to believe that transportation costs will vary, percentagewise, with type or size of auction. Transportation costs constituted three percent of the total cost of operations for the eight auctions studied, and this figure corresponds rather closely with those found in other studies.

Utilities averaged 3.6 percent of the total cost for those auctions studied. This amount was reduced somewhat for the synthetic auctions primarily because auction H showed abnormally high utilities cost due to a peculiarity existing at that auction. Normally one would not expect this high figure. If this figure is discarded the average percent is approximately 3.1. The utilities cost should decline somewhat as the proportion of hogs handled increases because the sale is finished somewhat quicker, thereby requiring heat and lights a somewhat shorter duration of time.

Cost of supplies averaged 4.7 percent at the eight auctions studied, but this figure was reduced for the synthetic auctions. Three of the eight auctions observed used ear tags for marking cattle instead of hip tags and this increases the cost slightly. It is assumed that only hip tags will be used at the synthetic auctions and only one of these per animal. This should result in the cost of supplies in terms of percent being somewhat lower for the synthetic auctions than the average of those actually observed. Supply costs will decline somewhat in terms of percent as the proportion of hogs handled by an auction increases. This is true because no tags are needed to mark the hogs and, since hogs are received in somewhat larger lot sizes than cattle, the number of consignor sheets required will be reduced somewhat.

Advertising costs for the eight auctions studied accounted for 3.5 percent of the total and this amount is largely unchanged for the synthetic auctions. Smaller auctions will advertise more, percentagewise, than large ones in an effort to increase their volume of business.

Remaining variable costs were classified as "other" and a flat amount of five percent was allocated to each auction for this category. This is somewhat less than the average for the eight auctions actually observed, but in those auctions, two auctions showed rather heavy costs that one would not normally expect to be there.

One item of possible expense not shown is that of losses. This is a cost that is difficult, if not impossible to estimate. There is no reason to believe that it would constitute a greater or less percent for large auctions than small ones. Including it as a cost component would probably not alter the shape of the average cost curve but would change its position to a certain extent.

Summary of Costs

Table 7.17 presents a summary of all costs associated with each auction for a period of one year.

Using these costs a regression analysis was run and the following linear equation was arrived at:

$$\hat{Y} = \$10,547.60 + .445\ X_1 + .526\ X_2 + .597\ X_3 + .486\ X_4$$

Where $\hat{Y}$ = estimated total cost
X_1 = number of hogs
X_2 = number of calves
X_3 = number of cattle
X_4 = number of sheep

With $R^2 = 0.995$

Table 7.17. Yearly Costs of Operating Twenty-Four Synthetic Livestock Auctions.

Auction Code	Labor	Trans-portation	Repairs and Maintenance	Utilities	Supplies	Adver-tising	Insurance	Taxes	Depre-ciation	Interest	Other	Total
1-1	$ 8,014.50	$ 466.68	$ 264.70	$ 497.79	$ 653.35	$ 622.24	$1,480.35	$ 413.65	$1,314.48	$ 987.33	$ 777.80	$15,552.87
1-2	10,648.50	622.95	361.15	664.48	872.13	809.84	2,013.70	611.08	1,815.77	1,307.72	1,038.25	20,765.57
1-3	15,101.00	872.28	503.15	930.43	1,221.19	1,104.89	2,770.45	897.56	2,451.81	1,769.76	1,453.80	29,076.32
1-4	21,648.00	1,252.56	737.29	1,336.06	1,753.58	1,544.82	3,970.19	1,349.33	3,549.03	2,526.46	2,087.60	41,754.92
1-5	27,457.00	1,616.91	1,008.33	1,724.70	2,263.67	1,940.29	5,246.43	1,822.18	4,723.14	3,398.05	2,694.85	53,895.55
1-6	33,788.00	2,030.52	1,352.49	2,165.89	2,842.73	2,368.94	6,771.73	2,391.80	6,133.57	4,456.03	3,384.20	67,685.90
2-1	7,857.00	455.55	260.51	455.55	607.40	607.40	1,443.18	406.37	1,357.72	974.76	759.25	15,184.69
2-2	10,466.50	600.60	337.13	600.60	800.80	780.78	1,920.05	557.59	1,719.69	1,235.66	1,001.00	20,020.40
2-3	15,125.00	863.13	493.46	863.13	1,150.84	1,093.30	2,730.31	860.42	2,413.03	1,740.65	1,438.55	28,771.82
2-4	21,591.00	1,226.07	702.03	1,226.07	1,634.76	1,512.15	3,832.68	1,272.34	3,407.97	2,420.66	2,043.45	40,869.18
2-5	27,180.00	1,581.24	979.05	1,581.24	2,108.32	1,897.49	5,106.35	1,722.92	4,606.01	3,310.20	2,635.40	52,708.22
2-6	33,393.00	1,968.48	1,281.37	1,968.48	2,624.64	2,296.56	6,484.48	2,230.30	5,849.07	4,242.65	3,280.80	65,619.83
3-1	7,587.50	435.12	245.28	406.11	551.15	580.16	1,339.91	387.44	1,296.80	929.07	725.00	14,503.54
3-2	10,423.00	598.41	344.96	558.52	757.99	773.93	1.938.21	543.94	1,751.02	1,257.17	997.35	19,948.50
3-3	14,698.00	832.38	475.50	776.89	1,054.35	1,054.35	2,638.33	802.40	2,341.20	1,686.78	1,387.30	27,747.48
3-4	21,106.50	1,198.50	702.35	1,118.60	1,518.10	1,478.15	3,793.11	1,208.64	3,409.27	2,421.64	1,997.50	39,952.50
3-5	27,121.50	1,543.86	925.79	1,440.90	1,955.56	1,852.63	4,905.39	1,603.46	4,392.98	3,150.43	2,573.10	51,465.60
3-6	33,434.00	1,899.72	1,154.82	1,773.07	2,406.31	2,216.34	6,041.20	2,026.40	5,342.89	3,863.02	3,166.20	63,323.95
4-1	7,563.50	428.31	246.30	371.20	513.97	571.08	1,351.44	385.15	1,300.86	932.12	713.85	14,277.78
4-2	9,868.50	573.00	345.02	496.60	687.60	744.90	1,898.19	520.69	1,751.27	1,259.35	955.00	19,100.12
4-3	14,393.00	815.16	474.62	706.47	978.19	1,032.54	2,614.32	777.58	2,337.69	1,684.15	1,358.00	27,171.72
4-4	20,558.00	1,178.82	723.87	1,021.64	1,414.58	1,453.88	3,823.03	1,174.23	3,495.35	2,486.20	1,964.70	39,294.30
4-5	26,176.00	1,496.25	923.16	1,296.75	1,795.50	1,795.50	4,834.92	1,540.00	4,382.44	3,142.53	2,493.75	49,876.80
4-6	32,840.50	1,867.89	1,162.34	1,618.84	2,241.47	2,179.21	6,018.42	1,965.75	5,372.99	3,885.59	3,113.15	62,266.15

The above equation indicates that cattle require more expense to handle than the other classes of livestock, followed by calves, sheep and hogs in that order. On the basis of the time studies alone, however, one would have thought the differences in costs between species would have been somewhat larger than is indicated by the regression equation. One possible explanation for this is that the relatively wide differences observed in labor requirements between species may not exist for other cost components, i.e., transportation expense per head may be about the same for all species of livestock. A second explanation may be that relatively large labor cost reductions have been brought about in this synthesis for cattle (due primarily to the method of bringing cattle up) and labor savings, as large as this, were not achieved with the other species of livestock.

Table 7.18 shows the average total cost per head for each of the 24 auctions.

Table 7.18. Average Total Cost per Head of Livestock Handled at Each of Twenty-Four Livestock Auctions.

Mix	Auction Size (Head Per Year)					
	10,000	20,000	35,000	55,000	80,000	110,000
1	1.56	1.04	.83	.76	.67	.62
2	1.52	1.00	.82	.74	.66	.60
3	1.45	1.00	.79	.73	.64	.58
4	1.43	.96	.78	.71	.62	.57

Table 7.18 indicates that there are real economies of scale to be realized with respect to livestock auctions. Average costs decline as volume of livestock handled increases even up through the largest size

auction which is larger than any auction in Michigan. The decline is quite large when moving from size 1 to size 2, amounting to approximately $0.50. The average cost reduction in moving from size 2 to size 3 amounts to roughly $0.20 and has diminished to about $0.05 when moving from size 5 to size 6.

The average total cost per head declines as the proportion of hogs increases as was the case for average labor costs per head. Reasons for this are that labor requirements are somewhat lower and building costs are usually somewhat lower which results in lower depreciation, taxes, insurance, and interest costs. In addition the cost of utilities will be lower because of shorter operating hours and usually, a somewhat smaller building.

Although increasing average costs do not exhibit themselves at any time, even for auctions handling 110,000 head of livestock, it is readily apparent that most of the economies of scale are largely realized somewhere between 35,000 animals and 55,000 animals. Nonetheless even a savings of five cents per head in handling costs is well worth the auction owner's consideration. It is possible that even this relatively small amount might represent the difference between profit and loss.

The economies arise with almost all cost components. Labor costs decline per head of livestock as volume increases for several reasons. One is that on some activities it takes a given number of people to do the job whether they handle 50 or 100 animals. Another is that at least one worker must be present early on sale day to receive early arrivals. If these arrivals are slow coming in it means that the worker(s) have much idle time on their hands. Auctioneers do not require twice as much

salary to sell 100 animals as 50. One of the reasons for this is that the auctioneer's expenses in traveling to the sale and return are the same regardless of the volume sold. Office workers do not receive twice as much pay for working while 200 animals are being sold as when 100 are being sold because they get paid by the hour and it doesn't take twice as many minutes to sell twice as many animals.

Depreciation costs per head decline as volume goes up because the building and equipment costs do not increase proportionately, with the volume of livestock handled. One of the reasons for this is that the cost of certain equipment, such as the public address system, scales, and heating units are almost constant regardless of volume handled. The cost of the building itself does not increase as rapidly percentage-wise as the volume of livestock handled. The size of the sales arena needed will not increase much with increase in volume although it will need to be somewhat larger. The office space needed will not be much larger for the 110,000 animal auction than for the 10,000 animal auction.

Inasmuch as the costs of insurance, taxes, utilities, repairs, and interest are based to a considerable extent upon the building costs, these items will also show declining average costs per head of livestock. Although the cost of certain items of supply such as hip tags for cattle and calves will vary almost directly with volume, other items such as consignor sheets, buyer sheets, and checks will not increase in direct ratio with volume because the livestock will be consigned in larger lots. Transportation costs will not increase as rapidly as volume in terms of percent. It may cost little more for the large auction owner to visit three producers than it does for the small one to visit with one because

the three may all be located close together. In addition there are certain fixed charges associated with transportation costs such as automobile insurance and depreciation. These will remain almost constant whether the owner travels 1,000 miles in connection with his business or 5,000.

Patrons who advertise heavily usually get reduced advertising rates. In addition, the smaller auctions may want to advertise heavily in order to increase their volume of business.

Not everything, however, associated with the larger auctions results in economies of scale. The larger auctions have pens for the animals more distant from the sales arena than small auctions, and there may be times when an auction only 25 percent larger in terms of animal numbers would require perhaps 50 percent more workers. Although average labor costs at certain stages may actually increase it would be highly unlikely that average labor costs per head would rise for the entire operation.

A diseconomy arises in connection with the construction costs of the 24 auctions included in this chapter. This is due to the fact that the buildings are of pole type structure and the cost per square foot actually increases after a certain size is reached. This diseconomy is more than offset, however, because the square foot requirements do not increase proportionately with volume of livestock handled.

A diseconomy may arise because of the extended duration of the sale as volume of livestock is increased. This may manifest itself in reduced worker efficiency as time "drags" on. In addition to this, buyer interest may decline and the relative prices might decline.

This could result in consignor dissatisfaction and a reduced volume of operation which in turn would increase the average total costs.

Although the evidence indicates that economies of scale are possible up through the largest auction synthesized one cannot conclude that the average costs would continue to decline regardless of the size of auction. It could very well be possible that an auction handling 125,000 animals yearly might have higher average costs than one handling 110,000 animals.

Despite the fact that evidence presented in this chapter indicates that economies of scale are possible in Michigan livestock auctions, it does not necessarily follow that auctions in this state should be fewer in number and larger in size. This is so because there are still other costs in addition to those actually incurred at the auction, which must be considered. These are discussed in the next chapter.

CHAPTER VIII

"OPTIMUM" NUMBER OF LIVESTOCK AUCTIONS

Evidence was presented in the previous chapter indicating that average costs of handling livestock decline as the volume increases. On the basis of this alone one might conclude that inasmuch as lowest average costs were incurred by the largest auction, which is larger than any currently operating in Michigan, then marketing efficiency would be increased if there were fewer livestock auctions. This does not necessarily hold true, however, because one important cost component which is not directly a part of auction costs was not considered. That cost is the transportation costs other than those incurred by the auction owner. This cost includes (1) expenses incurred in shipping livestock from the producer to the auction, (2) expenses incurred by livestock buyers in (a) driving from auction to auction when buying livestock, and (b) transporting the livestock from the place of purchase to the slaughtering plant, and (3) expenses incurred in moving the meat and meat products from the slaughtering plant to the ultimate consumer.

From the auction owner's standpoint the optimum size of auction might be as large as the largest one synthesized in Chapter VII.

From the producers' viewpoint, it may be desirable to have more auctions (perhaps smaller in size) so that the costs of transporting the animals to the producer would be reduced.

The livestock buyers, such as order buyers and packers, might prefer to have auctions of a larger size so that they could obtain the desired number of livestock at one place thereby eliminating the need to travel from one auction to another to make their purchases.

When these additional transportation costs[1] are considered and added to the average costs incurred by the auctions, the lowest average costs may be achieved at a different volume of operation than when only the auction costs are considered. These costs will be influenced by many different factors. Among these are (1) density of livestock production, (2) terrain, and (3) road network. Inasmuch as these will vary greatly between areas no effort is made to arrive at a transportation cost function. One may conclude, however, that average transportation costs incurred in shipping the livestock from the farmer to the auction will increase as distance from the auction increases.

Figure 8.1 illustrates the effect transportation costs incurred in shipping the livestock from the producer to the auction may have upon the shape of the average total cost curve incurred by the auction operator. In this illustration average total costs incurred by the auction decline as volume of livestock handled increases. It is assumed that in order to obtain an increased volume, the radius of the territory from which the livestock is received will also increase. As this distance increases average transportation costs will increase, i.e., it will cost

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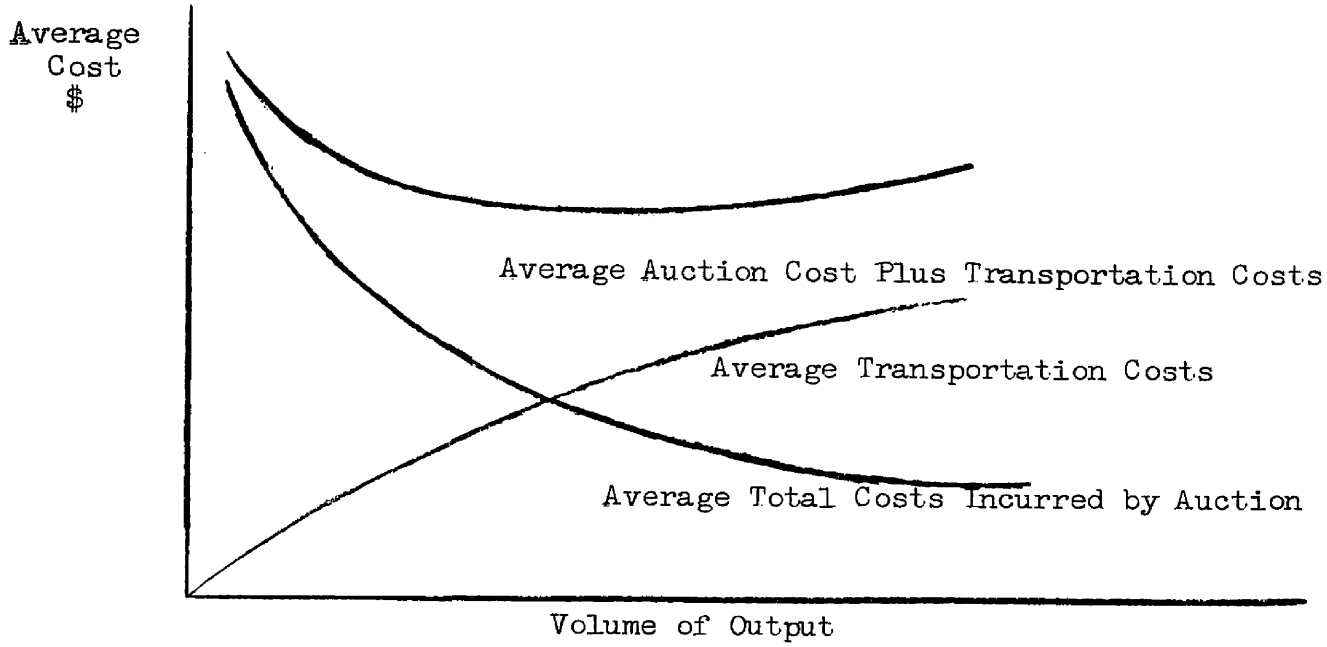
[1]Hereafter in this chapter, unless specified otherwise, when transportation costs are referred to it means transportation costs other than those actually incurred by the auction operator.

Figure 8.1. Effect of Transportation Costs Incurred by Producers Upon Average Total Costs.

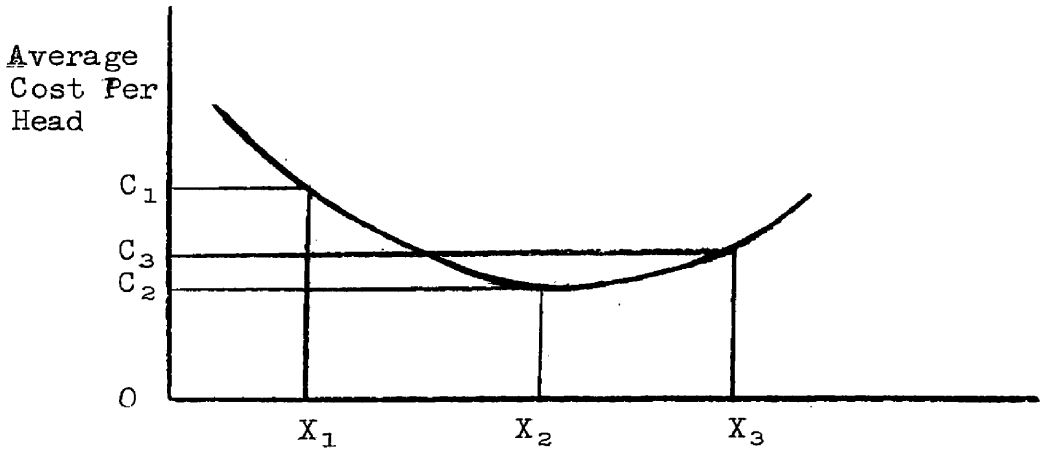


more to move an animal ten miles than it will to ship it five miles. This is illustrated by the average transportation cost curve. If the average transportation costs are added to the average costs incurred by the auction the total average costs will be as indicated by the average auction cost plus average transportation cost curve. It should be noted that the lowest point on this curve is achieved at a smaller volume than the lowest point on the average total cost curve of the auction. As long as average transportation costs increase with distance, the lowest point on the combined curves will always be at a smaller volume than for the auction curve alone.

It should be emphasized that in the preceding illustration the only transportation costs considered were those arising from transporting the livestock from the farm to the auction market.

Transportation costs of buyers include those incurred in (1) driving from one auction to another to buy livestock and (2) those incurred in transporting the livestock from the auctions to the slaughtering plant. If livestock buyers find it necessary to drive from one auction to another in order to purchase the desired number of livestock, then the average costs per head in doing this would most likely tend to decline as auction size increased. This is indicated in Figure 8.2 by going from OX_1 to OX_2 with a cost reduction of OC_1 minus OC_2.

Figure 8.2. Hypothetical Cost Curve of Livestock Buyers



This cost reduction might be achieved because the buyer would be able to obtain the needed livestock at perhaps only one or two auctions instead of a larger number with a resultant reduction in labor and transportation expense. This average cost reduction might hold true, however, only up to a certain point beyond which average costs would increase. This increase in average costs could be brought about because a buyer who was purchasing all the livestock he needed at one auction

might have to drive a greater distance to get this livestock if auctions became still larger in size but fewer in number. This is illustrated in Figure 8.2 by moving from OX_2 to OX_3 with a resultant average cost increase of OC_3 minus OC_2.

Figure 8.2 could also be applicable for costs incurred in shipping the livestock from the auction to the slaughtering plant. Average transportation costs incurred in transporting the livestock from the auction to the slaughtering plant might decline as auction size increased up to the point where all the livestock slaughtered by one plant was being received from one auction. This decline in average cost could be brought about because the total distance required to travel between auction and slaughtering plant might be less, and the trucks used to transport the livestock could be used more nearly to capacity, i.e., the frequency of hauling only "part-loads" would be reduced.

As auctions continued to increase in size, however, and became fewer in number (and further apart), then the average costs incurred in transporting livestock from the auction to the slaughtering plant would likely begin to increase because of the additional distance from the auction to the slaughtering plant.[2]

No attempt was made in this thesis to study the costs incurred in moving the meat and meat-products from the slaughtering plant to the ultimate consumer. However, in attempting to arrive at a total average transportation cost curve this cost would have to be considered.

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[2]The diseconomy associated with increased distance from auction to slaughtering plant would not be as great as one might think because the cost per cwt. per mile would tend to decline somewhat as distance increased.

The information assembled for this study was not sufficient to permit an estimate of the effect on average total transportation costs associated with changes in the number and size of auction markets. Additional information concerning such factors as the density of livestock production, movement of livestock after it is sold at the auction, presence of alternative market outlets, and the meat consumption pattern must be obtained before the problem of determining optimum auction size and location can be solved.

CHAPTER IX

SUMMARY AND CONCLUSIONS

This study was concerned with certain aspects of livestock auction operations in Michigan. The first objective of this study was to determine if differences exist between auctions as to methods of handling livestock and if so which methods permit handling the livestock at lowest average cost. The second, and primary objective was to determine the relationship between costs and volume of livestock handled at Michigan livestock auctions. The final objective was to show how transportation costs, other than those incurred by the auction owner, may have considerable effect upon the average costs incurred in marketing livestock and thus may influence the conclusion one arrives at concerning economies of scale in livestock auctions.

Studies of livestock auctions have been conducted in other parts of the country. Some of these were descriptive in nature and others represented attempts to determine the relationship between average total costs and volume of livestock handled. Most of the studies indicated that average costs do decline as volume increases but these conclusions may not be applicable to Michigan auctions for at least two reasons. First the research methods employed in conducting many of the studies are open to question and, secondly, Michigan auctions may differ sufficiently from those in other parts of the country that the results of other studies are not applicable to auctions in this state.

The results of this study are based upon cost accounting records and time studies conducted at eight Michigan auctions. In determining the procedure to follow in conducting this investigation the merits and weaknesses of various methods were considered. Most other studies directed toward determining the relationship between cost and volume have employed either the cost accounting approach or the synthetic approach. Primary emphasis in this study was given the synthetic approach because of certain limitations to the cost accounting method. Cost records of the eight auctions included in the study were utilized, however, in estimating certain cost components. The cost records indicated that there were rather wide differences between auctions in average cost per head of livestock handled. There was a tendency for average costs to decline as volume of livestock increased, but there were exceptions to this. The two smallest auctions, in terms of number of animals handled and gross dollar sales, incurred highest average costs. Lowest average costs were achieved by the auction ranking fifth in size, and the largest auction achieved second lowest average costs.

There were certain limitations to making inter-auction cost comparisons, however. Certain items of expense were either not included or incomplete at some auctions and this could influence the results. In addition the auctions did not handle the same proportion of each species of livestock, i.e., some handled relatively large amounts of one species but relatively small amounts of others. Inasmuch as the different species require different amounts of labor and other expense items, a direct comparison of costs was somewhat difficult.

Labor was the most important item of expense incurred by the eight auctions included in the study, constituting nearly 60 percent of the total costs. Most of the other cost components constituted no more than five percent of total costs.

The livestock auction operations were separated into six stages. These stages were: unloading, bringing up, weighing, selling, bringing back, and loading out. Time studies were conducted at each stage at all auctions. Large differences were observed in the amount of labor utilized per head of livestock at the various auctions. These differences may be attributed to (1) species of livestock, (2) number of livestock per lot, (3) number of workers and (4) method of handling the livestock.

On the basis of the time studies and direct observation it was concluded that an auction designed to handle livestock most efficiently would incorporate the following features:

1. Separate structure for doing write-ups.
2. Calf and hog pens close to unloading area.
3. A "feed" chute for bringing-up cattle.
4. Separate buyer pens for cattle, hogs, and calves.
5. Double tag chute for tagging cattle. There would be an elevated platform between the two chutes so that a worker could stand on it and mark the cattle easily.
6. Scales opening directly into the sales ring.
7. Scale gates that roll sideways or upwards so that animals could not get lodged behind them.

Costs of operating twenty-four synthetic auctions, each employing similar methods of handling livestock, were estimated. These cost estimates were for auctions of six basic sizes ranging from 10,000 animals handled yearly up to 110,000 animals yearly with four variations of each. The variations were in the relative proportion of the total that each species of livestock constituted.

The amount of labor required for each auction was estimated from the time study results, and the wage rate was obtained from the cost records of the eight auctions studied. The two together provided the total labor costs for each auction. Labor constituted slightly over one-half of all costs and as such was the major cost component.

Transportation, utilities, supplies, advertising and "other" cost components were estimated on the basis of costs incurred by the eight auctions included in this study as well as those incurred by livestock auctions in other studies. Staff members in the Agricultural Engineering Department assisted in estimating building costs, including wiring, and repair and maintenance expense. All other costs were estimated with the assistance of local businessmen and state insurance and tax officials.

Average total costs per animal handled ranged from about $0.60 at the largest auction up to about $1.50 at the smallest. Most of the reduction in average costs was achieved as soon as a volume of 35,000 animals yearly was attained. In moving from size 1 to size 2 the reduction in average total cost amounted to approximately $0.50. In moving from size 2 to size 3 the reduction amounted to about $0.20 and had diminished to about $0.05 when moving from size 5 to size 6. Even the relatively small average cost reduction achieved in moving from size 5 to size 6 should, however, be well worth the auction owner's consideration. This amount might represent the difference between profit and loss. The average total costs declined somewhat as the proportion of hogs increased and the proportion of cattle decreased.

The linear regression equation arrived at on the basis of the synthesized costs was:

$$\hat{Y} = \$10,547.60 + .445\ X_1 + .526\ X_2 + 597\ X_3 + .4861\ X_4$$

Where $\hat{Y}$ = estimated total cost
X_1 = number of hogs
X_2 = number of calves
X_3 = number of cattle
X_4 = number of sheep

$R^2 = .995$

It is obvious that hogs are handled at lowest cost followed by sheep, calves, and cattle in that order. However, the differences in cost of handling the different species of livestock are not as large as one might have believed on the basis of the time study results. There are at least two reasons for this. First, the time studies showed only labor requirements. Other cost components may show relatively small differences between species. Secondly, in the synthesis of auction costs, the largest labor reductions, as compared with actual auctions, were achieved with cattle. This resulted in the difference in auction handling costs between species being much less than existed at the eight auctions studied.

Although average costs tended to decline as volume increased, for the synthetic auctions, it does not necessarily hold that these costs will continue to decline as volume exceeds 110,000 animals per year. Diseconomies may arise if more than 110,000 animals are handled yearly. The increasing costs might arise because as a larger building is constructed, it may be necessary to use other than the pole-type construction and this other type construction may be far more expensive. As the building becomes larger it will be necessary to drive the livestock additional distances and average labor costs may increase considerably.

Selling additional numbers of livestock will take additional time and worker efficiency may decline as a result. The buyers may get restless and want to have a "break period." This "break period" will extend the duration of the sale and consequently increase the labor costs. Other diseconomies may also arise which are unforeseen at the present time.

Assuming that lower average total costs can be achieved, both by using more efficient methods of handling the livestock and by increasing the volume of livestock handled, what will be the effects of this?

If the auction operator succeeds in reducing his average total costs he will increase his net revenue in the short run if the lower average total costs are retained by him and no reduction in the selling charges is given the producer. On the basis of limited information it appears that auction owners are very reluctant to reduce their announced selling charges. One of the reasons for this may be that the auction operator is afraid that his competition will retaliate.

If an average total cost reduction is realized and if none of the reduction is passed on to the producer, others may decide that there are very good profits to be obtained in the auction business and will start up their own auction sale. This would result in the other auctions losing some of their livestock volume which would be accompanied by a rise in the average total costs and profit might be no greater than they were prior to the original cost reduction. The long-run effect, in this case, of a cost reduction through either an improved method of handling or increased volume, would be larger numbers of auctions.

If the auction owner fears both retaliation from competitors if he reduces his selling charges and the entry of newcomers if he does not he may engage in some non-price competiton which will tend to benefit the producers. This non-price competition may come in the form of free trucking of the livestock from the producer to the auction, free meals at the auction or any of many other favors of this nature. The owner may also maintain his original quoted selling charges but offer a private discount to the sellers if he sells his livestock at the auction owners place of business. The latter practice occurs regularly in Michigan livestock auctions.

The auction industry may benefit from this study in that if they achieve lower average total costs and pass these on to the producer it is likely that, in the short run, they will increase their volume of business at the expense of other types of market outlets. If they do not pass the lower costs on to the producer, in the short run their profits will be higher, but if newcomers enter into the business, their long run profits may remain unchanged.

Producers may profit from the auctions' achieving lower average costs depending upon the reaction of the auction owners to the cost reduction. If no cost reduction in any form is given to the producer, he may not profit from the increased efficiency. It is the author's opinion, however, that in the long run some concessions, price or non-price, will be offered the producer in an effort to persuade him to sell his livestock at a given auction.

Society, which pays the marketing costs, may profit by being able to obtain the livestock products at a somewhat lower cost if a method

is found whereby auctions can achieve lower costs. These lower costs are theoretically possible because if they are passed on to the livestock producer, the total costs of producing and selling the livestock have been lowered and the price necessary for the buyer to obtain a given volume of livestock is now lower than before. Since the buyers' costs in obtaining the livestock is lower than before, the price necessary to be paid him in order to receive a given volume of livestock is also lower.

The amount society may actually benefit will depend in large measure upon the extent to which the lower average total costs are passed on by the auction owner to the producer, from the producer to the buyer, and from the buyer to the consumer.

Although average total costs declined with increasing volume, it does not necessarily follow that marketing efficiency in Michigan would increase if there were fewer auctions but of a larger size. In considering marketing efficiency from a general viewpoint one must consider all marketing costs incurred in moving the livestock from the producer to the marketing outlet and finally to the ultimate consumer. The only costs estimated in this dissertation were those actually incurred by the auctions.

From the auction owners standpoint the "optimum" size auction might be 110,000 animals yearly as shown in Chapter VII. This, however, might conflict with the producers' interests. They might prefer having larger numbers of auctions so that they would have only a short distance to haul their livestock to market.

Packer buyers and order buyers might prefer fewer and larger auctions so that they could purchase all the livestock they needed at one source. This would eliminate the necessity of their traveling from one small auction to another in order to obtain the numbers of livestock they desire.

From the more general viewpoint when all livestock marketing costs are considered--those in shipping from the farmer to the market outlet, from there to the slaughter, from there to the consumer--maximum marketing efficiency will be achieved when the costs are lowest for marketing a given amount of livestock, or, in somewhat different terms, when the maximum amount of marketing services are provided at a given cost.

This investigation was concerned primarily with ascertaining the nature of the relationship between costs and volume of livestock handled by Michigan livestock auctions. Several areas for future study should merit attention. One of these is the problem concerned with the advisability of an auction operator conducting a sale on more than one day per week. If this could be accomplished, and if the total volume of livestock handled was increased, costs might be lowered because of a reduction in average fixed costs. In addition to this, it would be easier for the auction owner to hire more capable workers if he could guarantee them a full week's pay each week. On the other hand the total number of livestock handled might be no greater than when the auction sale was conducted weekly and, since the daily sales would be smaller, the average variable costs would probably increase considerably. In addition to this one would have to consider the number of buyers available and the resulting effect on the price of the livestock.

A second area of research might be that of prices paid for livestock at Michigan auctions. Although this dissertation was concerned with costs of auction operations, there is no doubt that livestock producers are interested both in the costs incurred by them in selling their livestock at the auction and in the prices that they receive for the livestock. A slightly higher price for the livestock may more than offset any cost reduction achieved through increased marketing efficiency.

A very, broad, general area of research is that mentioned previously of determining the flow of livestock from the producer to the ultimate consumer and combining this with information on livestock shrinkage in transportation, density of livestock production, and the presence and location of other market outlets in an effort to determine the "optimum" number and location of livestock markets. As additional information is received in these areas it may be possible to solve this problem.

BIBLIOGRAPHY

Abel, Harold, and D. A. Broadbent. Trade in Western Livestock at Auctions--Development, Relative Importance, Operations. Bulletin 352, Utah Agricultural Experiment Station, Logan, Utah, 1952.

Black, Guy. "Synthetic Method of Cost Analysis in Agricultural Marketing Firms," Journal of Farm Economics, Vol. 37, 1955.

Cox, C. B., and M. A. Blum. Cost of Operating Selected Indiana Livestock Markets, Station Bulletin 618, Purdue University Agricultural Experiment Station, Lafayette, Indiana, 1955.

Craxton, F. E., and D. J. Cowden. Applied General Statistics, Prentice-Hall, Inc., New York, 1949.

Engelman, Gerald, and B. S. Pence. Livestock Auction Markets in the United States, Marketing Research Report No. 223, Agricultural Marketing Service, U.S.D.A., Washington, D. C., 1958.

Ezekiel, M. Methods of Correlation Analysis, John Wiley and Sons, Inc., New York, 1947.

French, B. C., L. L. Sammett, and R. G. Bressler. "Economic Efficiency in Plant Operations with Special Reference to the Marketing of California Pears," Hilgardia, Vol. 24, No. 19, July, 1956.

Harp, H. H., and H. D. Smith. Efficiency of Livestock Auction Markets in Maryland, Bulletin 457, University of Maryland Agricultural Experiment Station, College Park, Maryland, 1956.

Harston, C. R., and E. C. Voorhies. Trade in Western Livestock At Auctions--Analysis of Livestock Marketing, Bulletin 537, Washington Agricultural Experiment Station, Pullman, Washington, 1952.

Henning, G. F., and M. B. Evans. Livestock Auctions Markets in Ohio, Research Bulletin 743, Ohio Agricultural Experiment Station, Wooster, Ohio, 1954.

Keynes, J. M., The General Theory of Employment--Interest and Money, Harcourt, Brace and Company, New York, 1935.

Lindberg, R. C., and G. G. Judge. Estimated Cost Functions for Oklahoma Livestock Auctions, Bulletin B-502, Agricultural Experiment Station, Oklahoma State University, Stillwater, Oklahoma, 1958.

McNeely, J. G., C. B. Brotherton, and T. M. McKenzie. Livestock Auctions in Texas. Bulletin 732, Texas Agricultural Experiment Station, College Station, Texas, 1951.

McNeely, J. G., and G. E. Turner. Texas Livestock Auction Markets--Operating Costs and Returns, Miscellaneous Publication 118, Texas Agricultural Experiment Station, College Station, Texas, 1954.

Phillips, V. B., and Gerald Engleman. Market Outlets for Livestock Producers, Marketing Research Report No. 216, U.S.D.A., Washington, D. C., 1958.

Purcell, J. C. Comparative Analysis of Cattle Prices on Georgia Auctions and Midwest Terminal Markets, Bulletin N. S. 26, Georgia Agricultural Experiment Station, Athens, Georgia, 1956.

Randell, C. G. Livestock Auctions in the Northeastern States, FCS Bulletin 8, Farmer Cooperative Service, U.S.D.A., Washington, D. C., 1956.

Smith, H. D., and H. H. Harp. Marketing Procedures of Livestock Producers, Dealers, and Auction Markets in Maryland. Misc. Publication No. 268, Maryland Agricultural Experiment Station, College Park, Maryland, 1956.

Stevens, I. M., and R. L. Fox. Improving Livestock Marketing Efficiency; A Study of Nine Cooperative Livestock Markets in Ohio, Indiana, and Michigan. General Report 39, Farmer Cooperative Service, U.S.D.A., Washington, D. C., 1958.

Thomsen, Frederick L. Agricultural Marketing, McGraw-Hill Book Company, Inc., New York, 1951.

Turner, G. E., and C. F. Brasington. Livestock Auction Markets in the Southeast--Methods and Facilities. Marketing Research Report No. 141, U.S.D.A., Washington, D. C., 1956.

Turner, G. E., J. G. McNeely, C. V. Wooston, and S. W. Burt. Texas Livestock Auction Markets--Methods and Facilities. Misc. Publication 93, Texas Agricultural Experiment Station, College Station, Texas, 1953.

United States Department of Agriculture. Marketing Efficiency in a Changing Economy. A Report of the National Workshop on Agricultural Marketing, AMS-60, United States Printing Office, Washington, D. C., 1955.

Voorhies, E. C. Trade in Western Livestock at Auctions--Some Factors Affecting Producers' Choice of Marketing Agencies. Bulletin 740, California Agricultural Experiment Station, Berkeley, California, 1954.

Walker, H. M., and Joseph Lev. Statistical Inference, Henry Holt and Company, Inc., New York, 1953.

APPENDIX A

FORM USED IN CONDUCTING TIME STUDIES

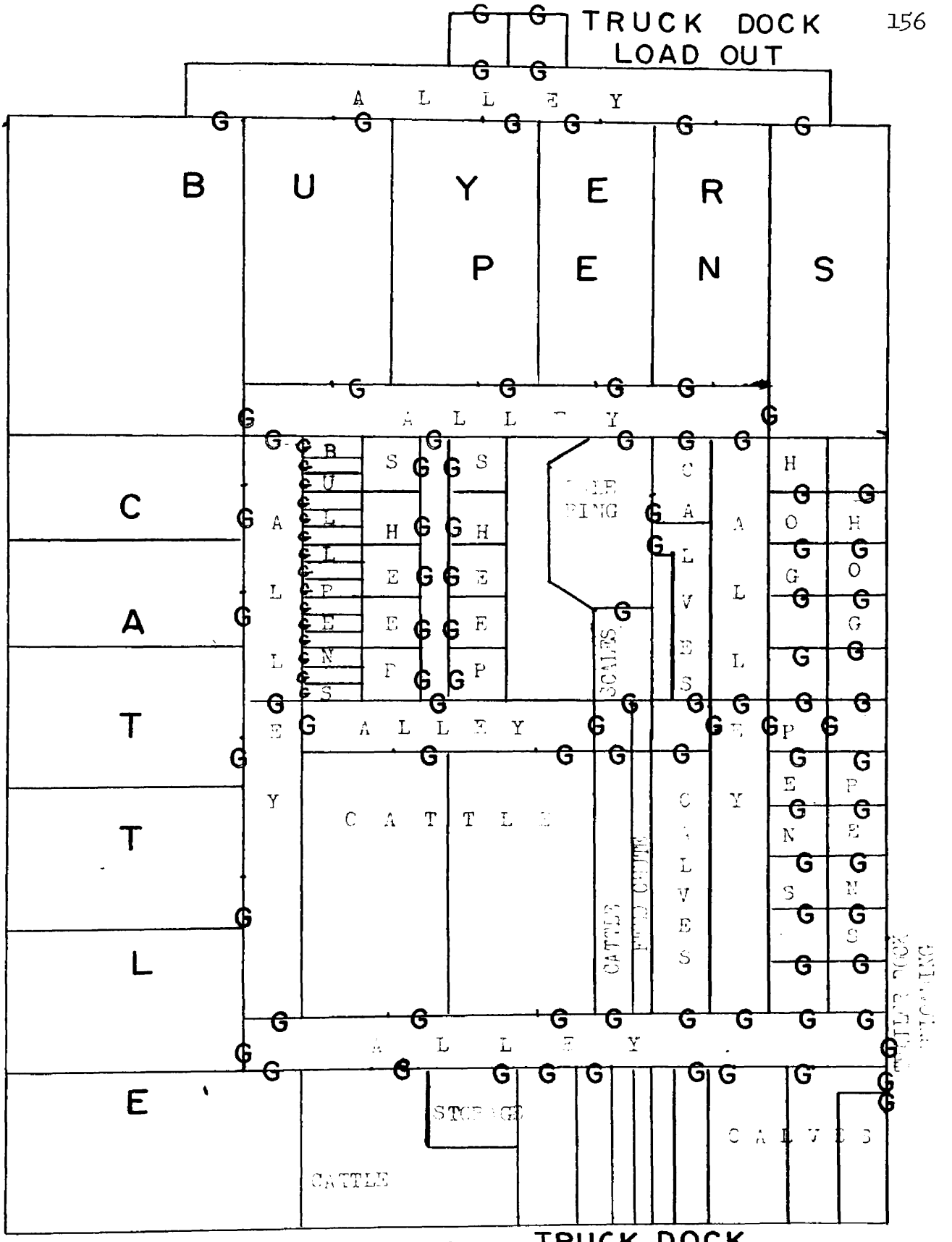
AUCTION_____

STAGE_____

Species	Number of Head	Number of Minutes	Time in Minutes	
			Start	Stop

APPENDIX B

FLOOR PLAN OF LIVESTOCK AUCTION



Scale: 1" = 21'
G = Gate

Floor Plan of Livestock Auction

TRUCK DOCK UNLOADING