AN EVALUATION OF ENUMERATION TECHNIQUES AND ASSOCIATED RESPONSE ERRORS AND BIASES

Sample Survey Research Branch
Research Division
Statistical Reporting Service
U. S. Department of Agriculture
Washington, D. C.

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CONTENTS

INTRODUCTION

The Statistical Reporting Service is implementing probability sampling for an increasing number of surveys. The Multiple Frame Livestock surveys, the Quarterly Farm Labor surveys and the Quarterly Grain Stocks surveys in the North Central States are examples. These surveys cost more than the traditional mail surveys because of the need for non-response followup interviews. Telephone interviewing is being used rather than personal visitation in an effort to reduce probability survey costs. Due to the increased use of the telephone, this research project was initiated to investigate the adequacy of telephone enumeration. The Wisconsin State Statistical Office (SSO) cooperated with the Sample Survey Research Branch in conducting this study.

OBJECTIVES OF PROJECT

The primary purpose of this research project was to determine the effectiveness of telephone interviewing compared to personal interviewing. The specific objectives were to:

1. determine refusal rates for telephone and personal interview;
2. determine incompleteness resulting from no telephone at the address on the list or no telephone number available;
3. determine magnitude and direction of bias from a "true value" for both telephone and personal interviews;
4. test enumerator effects for significance;
5. test difference between personal and telephone interviews for significance;
6. test difference between various telephone calling methods for significance;
7. obtain enumerators' opinions of various enumerating techniques;
8. look at statist estimates for refusals.

SUMMARY

This study was based on a sample of dairy farmers in Wisconsin for which the actual pounds of whole milk sold in one month could be obtained. Questionnaires were completed by telephone and personal enumeration. A copy of the survey questionnaire is presented in Appendix A. Since the actual number of pounds of whole milk sold was on record for each farmer in the sample, the difference between "true" and reported sales was computed and defined as reporter bias.

The results of the survey are summarized below.

(1) The overall refusal rate was 4.93 percent. The refusal rate for telephone interviews at 5.26 percent compares with 4.26 percent for personal interviews. The refusal rate appears to be independent of enumerator effect and interview technique in this survey.

(2) Incompleteness due to no telephone or no telephone number available was 2.16 percent.

(3) The overall reporter bias was 1.55 percent in reported pounds of whole milk sold for one month. This is a statistically-significant upward bias at the $\alpha = 0.05$ level. Response bias by telephone was 1.98 percent compared to 0.68 percent bias with personal interview. The telephone bias is significantly different from zero while the bias which resulted from the personal interviews is not significant.

(4) The enumerator effects were significant for reported acres owned and operated and for pounds of milk fed to livestock. Enumerator effect on reporter bias of milk sold was not statistically significant.

(5) There was no statistically significant difference between the telephone and personal interview mean results for any of the questionnaire items. However, as indicated in (3), the difference between true sales and telephone response was significant and is nearly three times greater than the reporter bias from personal interviews which was not significant.

(6) There was no significant difference between means for any questionnaire items when enumerators called from home versus calling from the SSO. The reporter bias was much higher when calling from the SSO at 3.08 percent than from home with 0.87 percent reporter error. This resulted from a 7.69 percent response bias in one treatment, i.e. calling from the SSO with no presurvey contact.

(7) Enumerators felt that presurvey contact made their work flow much smoother. The difference in bias between presurvey and no presurvey contact was also statistically significant for SSO telephoning though not for personal interviews or home telephoning. The enumerators favored personal interview over the telephone interview because of better public relations.

(8) The bias created when a statistician used historical data to estimate for refusals was -6.9 percent, or over four times larger than the average bias of the respondents and in the opposite direction.

THE SURVEY

Dairy farmers in 31 counties in the southern portion of Wisconsin are serviced by the Chicago Regional Milk Marketing Order of the Consumer and Marketing Service (CRMMO). This area is shown in Appendix B. A list containing the names of approximately 10,637 farmers who sell milk in this area was obtained from CRMMO from which a random sample of 660 farmers was selected. The sampling unit was defined as the entire farm operated by the individuals selected. Therefore, data were collected for all the land operated by the selected dairy farmers.

The survey design called for a total of 540 completed interviews. The sample size of 660 provided 120 extra dairymen for use as possible replacements for non-respondents. Each of six enumerators were to complete 90 interviews. The 90 interviews were distributed evenly among nine different enumeration techniques or treatments. Thus, the ultimate design consisted of 54 cells created by six enumerators and nine enumeration techniques with each cell containing ten interviews. In addition, each enumerator was assigned twenty replacement sample units. The nine enumeration techniques or treatments tested were:

T_1 - Telephone interview from home with no presurvey contact

T_2 - Telephone interview from home following a presurvey mail contact

T_3 - Telephone interview from home following a presurvey personal visit

T_4 - Telephone interview from the Wisconsin SSO with no presurvey contact

T_5 - Telephone interview from the Wisconsin SSO following a presurvey mail contact

T_6 - Telephone interview from the Wisconsin SSO following a presurvey personal visit

T_7 - Personal interview with no presurvey contact

T_8 - Personal interview following a presurvey mail contact

T_9 - Personal interview following a presurvey telephone contact

Presurvey contacts were made February 22-28 with enumeration taking place March 1-15. Data were collected for the month of February 1971.

The questionnaire contained a message from the Statistician in Charge of the Wisconsin SSO explaining the farmer's part in the survey and asking that the questionnaire "not be returned" by mail. The first section was designed to define the total land operated. The second section contained questions on milk production and disposition (see Appendix A). Question 8 (a) asked for the amount of whole milk sold during the month of February 1971, and served as the key variable for use in this study.

The "true value" or actual number of pounds of whole milk sold during February by the sample dairymen was obtained from the records of CRMMO.

The presurvey mail contact consisted of mailing a copy of the questionnaire to the dairymen selected in T_2, T_5, and T_8. Five of the twenty replacement samples assigned to each enumerator also received the questionnaire.

T_3 and T_6 called for a personal visit prior to the survey. During these visits, the enumerators gave the farmers a copy of the questionnaire. The enumerators were able to explain the survey more fully, answer any questions, and ask that the farmers have the questionnaires filled out when the enumerators telephone later for the information.

The reverse procedure was used for T_9. The enumerator telephoned the respondent, explained the survey and tried to make an appointment for a personal interview.

ANALYSIS OF SURVEY DATA

To test for differences in response due to a particular enumerator or enumeration technique (treatment), an analysis of variance was performed on each item in the questionnaire and on the computed reporter bias. To test specific objectives, orthogonal comparisons (contrasts) were made among the means of the various treatments used. These orthogonal comparisons (L_1 through L_3) are listed and explained below:

(1) Telephone versus personal interview

$$L_1 = T_1 + T_2 + T_3 + T_4 + T_5 + T_6 - T_7 - 2T_8 - 2T_9$$

(2) Telephone at home versus telephone from SSO

$$L_2 = T_1 + T_2 + T_3 - T_4 - T_5 - T_6$$

(3) Personal interview: No presurvey contact versus a presurvey contact

$$L_3 = 2T_7 - T_8 - T_9$$

(4) Personal interview: Presurvey mail contact versus a presurvey telephone contact

$$L_4 = T_8 - T_9$$

(5) Telephone from home: No presurvey contact versus a presurvey contact

$$L_5 = 2T_1 - T_2 - T_3$$

(6) Telephone from home: Presurvey mail contact versus a presurvey personal contact

$$L_6 = T_2 - T_3$$

(7) Telephone from SSO: No presurvey contact versus a presurvey contact

$$L_7 = 2T_4 - T_5 - T_6$$

(8) Telephone from SSO: Presurvey mail contact versus a presurvey personal contact

$$L_8 = T_5 - T_6$$

Analysis of variance tables, including the orthogonal comparisons, for each individual question in the survey are presented in Appendix C. Significant differences between enumerators were indicated for the questions on acres owned and operated and on the quantity of milk fed to livestock. No overall significant difference was detected among the individual treatments. Certain contrasts between combinations of treatments did show statistical significance: no presurvey contact versus a presurvey contact in personal interviews (L_3) for acres managed; presurvey mail contact versus a presurvey personal contact in telephoning from home (L_6) for milk used for food and drink and milk fed to livestock; and a presurvey mail contact versus a presurvey personal contact in telephoning from the SSO (L_8) for number of cows milked. No consistent difference across questions between enumerators or survey procedures is demonstrated by the analysis on the items in this survey.

MAGNITUDE AND DIRECTION OF BIAS

A specific objective of this project was to determine the magnitude and direction of bias from a "true value" for both telephone and personal enumeration. Data used for the bias analysis were the differences between sales of whole milk as reported by the respondent and the true value.

Individual reports ranged from a difference of -39,681 pounds to +38,394 pounds between reported and true quantity of milk sold. The positive differences totaled 993,373 pounds from 285 reports for an average positive difference of 3,486 pounds. There were 210 reports with negative differences totaling 661,925 pounds for an average of 3,152 pounds. There were only 45 reports out of the 540 reports which had no difference at all between the reported and true pounds of milk sold (including 10 zero reports).

This gives an absolute difference of 1,655,298 pounds of milk or an absolute error of 7.76 percent of the true quantity. The net difference is 331,448 pounds. Any changes in procedure which would affect only the negative bias or the positive bias could increase the error between the reported and true means.

There were 13 reports with differences of more than 20,000 pounds of milk. Two zero reports were received when the true quantities sold were 28,856 pounds and 39,681 pounds. One report of 37,900 pounds was received when the CRMMO records showed no milk sales during the survey period. These differences point up problems in matching the sampling unit with the reporting unit and/or lack of communication between enumerator and respondent.

Listed in Table 1 are the reported and true pounds of whole milk sold and the bias for each treatment or technique in percent and pounds of whole milk sold. The bias was positive (reported pounds > true pounds) for all treatments except T_3 (telephone interview from home following a presurvey personal visit) and T_8 (personal interview following a presurvey mail contact). For the individual treatments the biases ranged in absolute value from 0.257 percent or 6,237 pounds for T_3 to 7.686 percent or 168,339 pounds to T_4 (telephone interview from the Wisconsin SSO with no presurvey contact). Only the bias in treatment 4 (T_4) was significantly different from zero among the individual treatments with $\alpha = 0.05$.

The average bias for all reports was +1.552 percent or 331,448 pounds. This overall average difference in the reported and true pounds of milk sold is significantly different from zero for $\alpha = 0.05$ (see Table 6). For telephone interviews the average bias was +1.976 percent compared with 0.676 percent for personal interviews.

When a presurvey contact of any kind was used, the bias was +0.686 percent or 100,745 pounds as compared with +3.458 percent or 230,705 pounds for interviews without presurvey contacts. It appears that a presurvey contact may be a useful device.

The large reporter bias obtained under T_4 causes both telephone bias and no presurvey contact bias to be significantly greater than zero.

Table 1.--Reported and true pounds of whole milk sold by treatment and bias in percent and in pounds of whole milk sold

Treatment	Pounds of whole milk sold		Bias	
			Pounds of whole milk sold	Percent
	Reported	True	Reported-True	$(\frac{\text{Reported-True}}{\text{True}})$ X 100
T_1	2,272,653	2,241,957	30,696	1.369
T_2	2,565,395	2,527,231	38,164	1.510
T_3	2,423,520	2,429,757	-6,237	-0.257
T_4	2,358,680	2,190,341	168,339	7.686*
T_5	2,763,042	2,749,326	13,716	0.499
T_6	2,292,423	2,252,747	39,676	1.761
T_7	2,270,955	2,239,285	31,670	1.414
T_8	2,329,721	2,363,922	-34,201	-1.447
T_9	2,410,541	2,360,916	49,625	2.102
Telephone interview	14,675,713	14,391,359	284,354	1.976*
Personal interview	7,011,217	6,964,123	47,094	0.676
Total	21,686,930	21,355,482	331,448	1.552*

* Significantly different from zero at $\alpha = .05$.

The analysis of variance on the differences in reported pounds of whole milk sold and the true value is shown in Table 2.

The enumerator means were not significantly different at the five percent level. Therefore, the enumerators had little affect upon the number of pounds of milk reported in this study.

Similarly, the enumeration techniques or treatment means were not significantly different at the five percent level. Thus, the means were independent of the various enumeration techniques used.

The interaction between enumerators and treatments was not significant at the five percent level. Thus, the enumerators effects were nearly constant for all the enumeration techniques or treatments studied.

Table 2.--Analysis of variance of differences in reported pounds of whole milk sold and the true value

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F ratios
Enumerator	5	46,552,059	9,310,412	0.258
Treatment	8	416,114,772	52,014,346	1.439
Interaction	40	1,820,954,681	45,523,867	1.259
Error	486	17,569,143,919	36,150,502	
Total	539	19,852,765,431		

No results significant with $\alpha = 0.05$.

Results of orthogonal comparisons on reporter biases are presented in Table 3. The first comparison tested was telephone versus personal interviews (L_1). The F value of 0.926 for this comparison was not statistically significant. It may be recalled that T_1 through T_6 involved obtaining data by phone and that T_7 through T_9 involved personal interviews.

Thus, no difference in bias was detected by this contrast between telephone and personal interviews. However, examination of paired observations between reported and "true" data reveals that telephone interviews result in a bias which was significantly different from zero while personal interview bias was not significant. This indicates that the reported average milk sales by telephone differed significantly from the true sales but was not enough different from the mean obtained by personal interviews to be detected by the F test.

Table 3.--Orthogonal comparisons of means of differences in reported pounds of whole milk sold and true value

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F ratios
Enumerator	5	46,552,059	9,310,412	0.258
Treatment				
L_1	1	33,484,359	33,484,359	0.926
L_2	1	70,320,433	70,320,433	1.945
L_3	1	6,377,620	6,377,620	0.176
L_4	1	58,556,652	58,566,652	1.620
L_5	1	2,411,628	2,411,628	0.067
L_6	1	16,428,740	16,428,740	0.454
L_7	1	222,919,327	222,919,327	6.166*
L_8	1	5,616,013	5,616,013	0.155
Interaction	40	1,820,954,681	45,510,958	1.259
Error	486	17,569,143,919	36,150,502	
Total	539	19,852,765,431		

* significant with $\alpha = 0.05$

$F_{1,486} = 3.86$ with $\alpha = 0.05$

$F_{1,486} = 6.70$ with $\alpha = 0.01$

There were two types of telephone interviews involved in the survey: the enumerator calling from his home and from the SSO under supervision. The bias for all telephone techniques except T_3 was positive. The comparison between home and office calling (L_2) showed the second highest F value (1.945) but was not significant at the five percent level.

As previously mentioned, there were several types of presurvey contacts involved in the project. These may be listed as a presurvey mail contact (used for all types of interviews), a presurvey phone contact (used for personal interview), a presurvey personal visit (used for the telephone interview), and no presurvey contact at all. The comparison L_3 tested presurvey contact versus no presurvey contact for the personal interview technique. There was no significant difference between these two. It is interesting to note the biases, however, with +1.414 percent for personal interview with no presurvey contact, -1.447 percent for personal interview with a presurvey mail contact and +2.102 percent for personal interview with a presurvey telephone contact. The difference between the means obtained from a personal interview following a presurvey mail contact and a presurvey phone contact was larger than most (F for L_4 is 1.620) but still not significant.

Similar results were obtained when enumerators telephoned from home. The difference in the reported pounds of whole milk sold and the true value following a presurvey contact and no presurvey contact (L_5) did not vary significantly. Neither was there a significant difference following a presurvey mail contact and a presurvey personal visit (L_6).

The same did not hold true with telephone interviews from the SSO. The bias for no presurvey contact was 7.868 percent as compared with 0.499 percent for the presurvey mail contact and 1.761 percent for the presurvey personal contact. The F value for this comparison (L_7) was 6.166 and is significant at the five percent level but not at the one percent level. Hence, for this survey the presurvey contact was beneficial when the enumerators telephoned from the SSO. L_8 indicates there was no significant difference in the reported pounds of whole milk sold and the true value following a presurvey mail contact and presurvey personal visit when enumerators telephoned from the SSO.

ENUMERATORS' EVALUATIONS

The six enumerators were asked to complete questionnaires (see Appendix D) stating their opinions and farmers' reactions to various enumeration techniques used in the survey. This provided insight into some possible long range effects different enumeration techniques might create.

Enumerators were asked to record the farmers' reception to the presurvey telephone and presurvey personal contacts. Two enumerators indicated they generally had good reception with both. The other four, however, said they received a better reception with the presurvey personal contact. They felt that with the personal visit it was easier to gain the farmer's confidence, the farmer became more interested in the survey and answered more freely.

Although preferring the personal interview, the enumerators thought that telephone enumeration was also effective when preceded by a personal visit or mail contact. There was some problem explaining the purpose of

the survey in the absence of a prior contact, but the data were generally easily obtained by telephone. Only two of the telephone refusals said they would have cooperated if they had been contacted personally.

NON-RESPONSE RATE

The sample design called for interviews with 540 dairymen. Due to refusals, no telephones, etc., it was necessary to replace a total of 47 of these to maintain the complete set of balance treatments. The replacements have been divided into three categories. Dairymen who refused to answer any questions, those replaced because they didn't have a phone or their correct phone number could not be obtained, and those replaced for all other reasons. Table 4 is a summary of the categories of replacements by treatments.

A total of 568 farmers were contacted and 28 of these refused to answer the questions. This represents an overall refusal rate of 4.93 percent. The refusal rate for telephone interviews was 5.26 percent while the rate for personal interviews was 4.26 percent. This difference was not significant as shown later in this section.

A total of 464 telephone interviews were attempted. Only 10 of these could not be completed because there was no phone or the phone number wasn't available. This gives a non-response rate due to telephone problems of about 2.16 percent.

Table 4 shows that the non-response rate due to problems other than refusals and no phone or number listed was 1.56 percent.

With the presurvey telephone contact it seemed harder to explain the purpose of the survey. It was often necessary for the enumerators to repeat their names, organization, and purpose, and thus perhaps easier for the farmer to refuse.

All of the enumerators indicated that any type of presurvey contact was helpful. Almost all of the farmers would admit to receiving the mail questionnaire and many had the report filled in. This enabled the enumerators to obtain the data from the farmers' wives when the farmers were not at home. It should be noted that farmers who completed the questionnaire before the telephone contact had an unknown effect on the bias analysis. One can surmise, however, that this would serve to reduce the total bias.

Most of the enumerators thought it was faster and easier to telephone from the SSO than to call from home because direct dialing was possible and supervisors were available to help when difficult respondents were encountered. They noted that the best time to reach the farmers was during meals and more call backs were required when calling during standard office hours. One additional point brought up was that many

farmers kept their records in the dairy barn and as a result often gave estimates over the phone rather than referring to the records as they did on personal interviews.

The interviewing technique preferred by most enumerators was a personal interview preceded by a contact. The presurvey telephone contact was favored over the presurvey mail contact.

The respondents attached more importance to a phone call and it enabled the enumerator to make an appointment and obtain directions to the farmer's house.

Table 4.--Summary of sample replacements by treatment code and reason for non-response

Treatment	Categories of sample replacements			Total
	Refusals	No phone or number listed	Other	
1	5	1	1	7
2	4	2	0	6
3	3	2	0	5
4	1	0	2	3
5	3	5	2	10
6	4	0	1	5
7	1	0	1	2
8	1	0	0	1
9	6	0	2	8
Total	28	10	9	47
Percent	4.93	2.16	1.56	-

The number of refusals are shown by enumerator and treatment in Table 5. A chi-square test was completed on the 54 cells • $\chi^2 = 38.129$ with 40 degrees of freedom. This value was not significant at the 10 percent level, so for this survey the refusal rate was independent of the treatments and enumerators.

Table 5.--Refusals by treatment and enumerator

Treatment	Enumerator						Total
	E_1	E_2	E_3	E_4	E_5	E_6	
T_1	1	1	0	3	0	0	5
T_2	0	0	1	1	1	1	4
T_3	0	1	0	0	0	2	3
T_4	0	0	1	0	0	0	1
T_5	0	1	0	1	0	1	3
T_6	0	0	0	2	1	1	4
T_7	0	0	0	0	1	0	1
T_8	0	1	0	0	0	0	1
T_9	1	1	1	2	1	0	6
Total	2	5	3	9	4	5	28

OFFICE ESTIMATING FOR NON-RESPONDENTS

An important aspect of probability surveys in SRS is estimating data for the non-respondents. The usual procedure is to obtain data for the non-respondent from some other source, if possible. The sources include field observation, the State Farm Census, other SRS surveys, the previous reporting period for the particular survey in question, or any other source available to the statistician. Sometimes it is not possible to find helpful indications for a particular operator, so a blind type of estimate based on district or county averages, etc. must be made.

As another phase of this project, estimates were made for the 47 non-respondents. These estimates were made by the dairy statistician in the Wisconsin SSO. Two estimates were made for each non-respondent. The first was a blind estimate made with only the name and address of the operator known to the statistician. In making the second estimate, called a refined estimate, the statistician was allowed to utilize any data concerning the operator available in the SSO 1/. Results of these estimates are shown in Table 6.

Table 6.--Comparison of data obtained from survey with blind and refined statistical estimates

	Survey	Blind estimate	Refined estimate
n	540	47	47
$\Sigma(R-T)$	331,448	-305,552	-102,909
$\Sigma(R-T)/\Sigma T$	0.0155	-0.2073	-0.0693
$\bar{X}$	613.79	-6,501.11	-2,172.13
Var X	36,832,004	344,729,013	574,525,382
S. E.$_{\bar{x}}$	261.14	2,708	3,496
$\bar{X}$ ± 1.96 S.E.$_{\bar{x}}$	(101.97 , 1,125.63)*	(-11,809 , -1,193)*	(-9,024 , 4,680)

Where X = R - T = (reported value - true value)

* Significant with $\alpha = 0.05$

1/ A different procedure using these data is based on the mean vector and covariance matrix and is reported in "A Procedure for Editing Survey Data," by R. R. Hocking, H. F. Huddleston, and H. Hunt in the J. R. Statistical Society - Series C, Volume 23, Part 1, 1974.

In contrast to the positive bias in the respondents' reports, both types of estimates were biased in the negative direction (the estimates being less than the true values). The blind estimate had a negative bias of 20.7 percent, which is significantly different from zero with $\alpha = 0.05$. The refined estimate had a negative bias of 6.9 percent, or one-third of the blind estimate's bias and it was not significantly different from zero with $\alpha = 0.05$. For this survey, however, the bias of the refined estimate was still four times in magnitude the bias from the farmers' report.

CONCLUSIONS

There were only 45 out of the 540 reports which had no difference at all between the reported and true pounds of milk sold. The overall absolute error was 7.76 percent of the true quantity. Changes in procedures should be considered carefully because a change may only affect the negative bias or the positive bias. This would increase the error between the reported and true means.

The results indicated the telephone interview, especially with no presurvey contact, may give biased results in obtaining monthly milk production data in the CRMMO in Wisconsin.

The direction of bias was positive for both telephone and personal interviews, i.e. the dairymen tended to report more pounds of whole milk sold during the previous month than the recorded true value. However, the magnitude of reporter bias was greater for the data obtained by phone with 1.98 percent bias compared to 0.68 percent bias for personal interviews.

The refusal rate for telephone interviews was not significantly greater than for personal interviews. Only slightly more than 2 percent of the sample could not be reached because they had no telephone or listed telephone number. Therefore, the telephone can be an efficient data-gathering tool if there are no problems with a possible bias.

Enumerator effects on reported acres owned and operated were significant. This has serious implications because the acreage determines the reporting unit. Additional study is needed to identify and remove the enumerator effects.

The presurvey contacts brought the bias down to 0.69 percent while the bias for those farmers interviewed without presurvey contacts was 3.46 percent. Many farmers completed the questionnaire after the presurvey contact. This gave them more time to check their records. Also, their wives could provide the answers on the second contact. This, however, had an unknown effect on the bias analysis.

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16

APPENDIX A
WISCONSIN
STATISTICAL REPORTING SERVICE

UNITED STATES
Department of Agriculture

Box 5160, Madison, Wisconsin 53705

WISCONSIN
Department of Agriculture

FEBRUARY MILK PRODUCTION AND UTILIZATION

Dear Sir

Your farm was selected as a part of a random sample of Wisconsin dairymen. A representative from our office will contact you within the next three weeks asking for information concerning your dairy operation for February. The questions to be asked will be the same as on this questionnaire. Please keep this questionnaire for reference when contacted. Do not return it by mail. Your cooperation during the survey would be appreciated. Your individual report will be confidential and will be combined with others for statistical purposes.

Sincerely,

H M Walters

H. M. Walters
Agricultural Statistician in Charge

SECTION I. LAND OPERATED ON MARCH 1, 1971
(Include cropland, woodland, wasteland, and non-agricultural land)

		ACRES
1	Acres you OWN	
2	Acres you RENT FROM OTHERS (Include land you rent from others either for cash or for a share of the crop)	
3	Acres you MANAGE FOR OTHERS	
4	Total owned, rented from others, and managed for others (add line 1, 2, and 3)	
5	Acres you RENT TO OTHERS (Include land worked by others either for cash or for a share of the crop)	
6	Total land you OPERATE (Subtract line 5 from line 4)	

SECTION II. MILK PRODUCTION AND DISPOSITION

7. TOTAL MILK PRODUCED on this farm (item 6, acres) during the MONTH of February

POUNDS	or	GALLONS

(Report in either unit)

8 Of the milk produced on this farm (question 6, acres) during February, how much was (Account for all milk produced)

	Answer Here — Report in Either Unit	
	Gallons	Pounds
(a) Sold as WHOLE MILK		
(b) Separated and sold as cream		
(c) Used or will be used for making butter on this farm		
(d) Used as whole milk for food or drink by people on this farm (Do not include milk purchased)		
(e) Fed as whole milk (unskimmed) to calves or other livestock on this farm (Do not include milk sold)		

9 Of the milk produced on this farm during February, how much did you sell direct to consumers

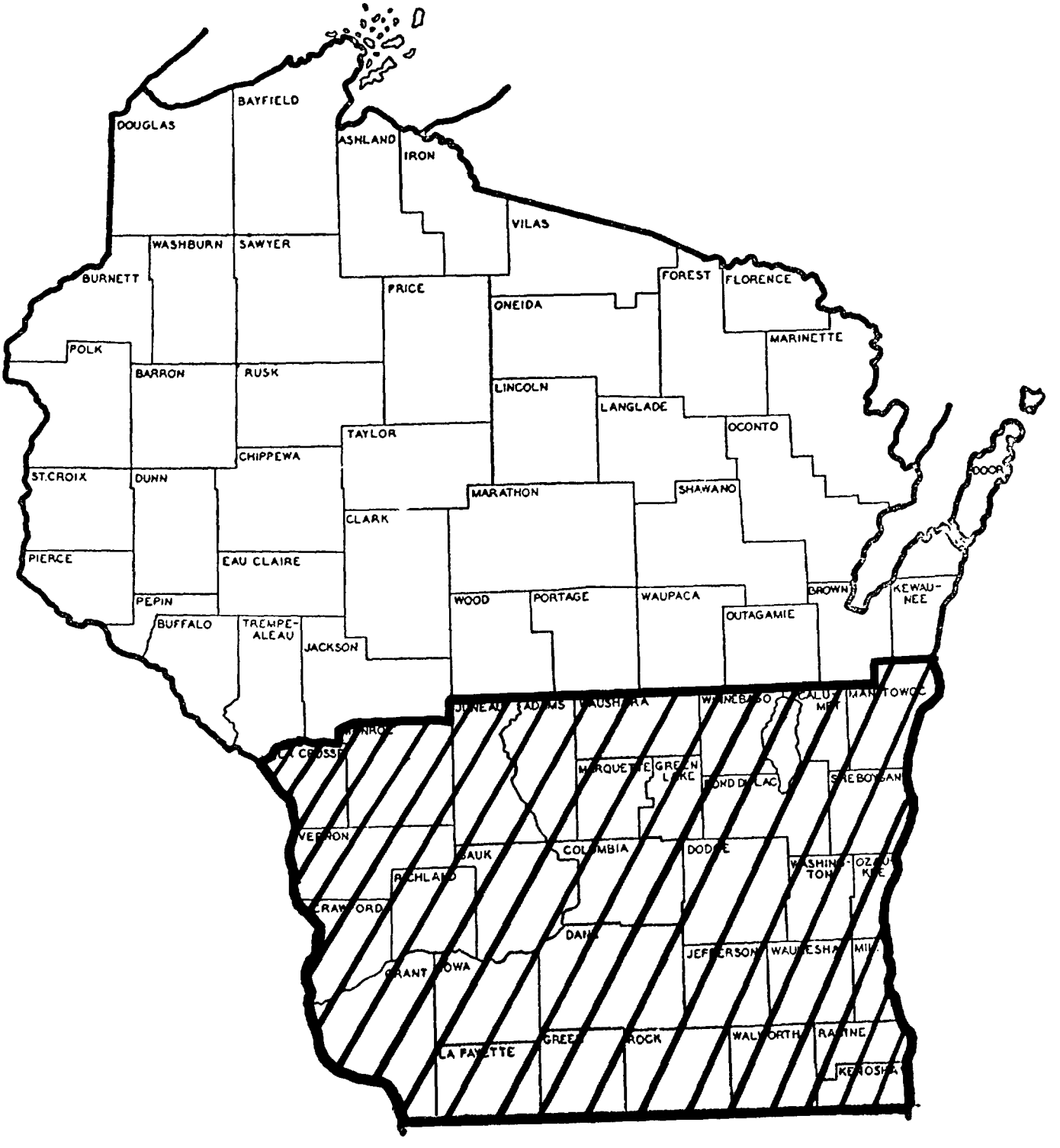
10 Cows milked on this farm March 1, 1971 — Number

11 What firm(s) purchased the milk reported sold in item 8 (a)?

NAME OF FIRM(S) — CITY

A P P E N D I X B

THE SAMPLE AREA IN WISCONSIN



A P P E N D I X C

ANALYSIS OF VARIANCE TABLES 7-18 FOR INDIVIDUAL SURVEY ITEMS

* Indicates statistical significance of computed F with $\alpha = .05$ in the following tables

$F_{5,486} = 2.23$

$F_{8,486} = 1.95$

$F_{1,486} = 3.86$

$F_{40,486} = 1.41$

Table 7.--Analysis of variance with orthogonal treatment comparisons of reported acres owned

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F ratios
Enumerator	5	279,422	55,884	2.253*
Treatment	8	93,092	11,637	.469
L_1	1	14,141	14,141	.570
L_2	1	105	105	.004
L_3	1	5,736	5,736	.231
L_4	1	11,623	11,623	.469
L_5	1	20,115	20,115	.811
L_6	1	7,600	7,600	.306
L_7	1	105	105	.004
L_8	1	33,667	33,667	1.357
Interaction	40	1,064,698	26,617	1.073
Error	486	12,053,816	24,802	
Total	539	13,491,028		

Table 8.--Analysis of variance with orthogonal treatment comparisons of reported acres rented from others

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F ratios
Enumerator	5	29,955	5,991	.637
Treatment	8	119,020	14,877	1.582
L_1	1	17,869	17,869	1.900
L_2	1	16,906	16,906	1.797
L_3	1	32,471	32,471	3.452
L_4	1	36,296	36,296	3.858
L_5	1	4,354	4,354	.463
L_6	1	3,652	3,652	.388
L_7	1	1,882	1,882	.200
L_8	1	5,590	5,590	.594
Interaction	40	394,104	9,853	1.047
Error	486	4,571,860	9,407	
Total	539	5,114,939		

Table 9.--Analysis of variance with orthogonal treatment comparisons of reported acres managed

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F ratios
Enumerator	5	197	40	.658
Treatment	8	538	67	1.117
L_1	1	6	6	0.100
L_2	1	138	138	2.300
L_3	1	250	250	4.167*
L_4	1	0	0	-
L_5	1	0	0	-
L_6	1	0	0	-
L_7	1	14	14	.233
L_8	1	130	130	2.167
Interaction	40	2,521	63	1.055
Error	486	29,036	60	
Total	539	32,292		

Table 10.--Analysis of variance with orthogonal treatment comparisons of reported acres rented to others by respondents

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F ratios
Enumerator	5	345	69	.622
Treatment	8	948	118	1.063
L_1	1	21	21	.189
L_2	1	6	6	.054
L_3	1	124	124	1.117
L_4	1	371	371	3.342
L_5	1	71	71	.640
L_6	1	213	213	1.919
L_7	1	36	36	.324
L_8	1	106	106	.955
Interaction	40	5,283	132	1.193
Error	486	53,781	111	
Total	539	60,357		

Table 11.--Analysis of variance with orthogonal treatment comparisons of reported acres operated by respondents

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F ratios
Enumerator	5	347,641	69,528	2.541*
Treatment	8	252,010	31,501	1.151
L_1	1	164	164	.006
L_2	1	23,733	23,733	.867
L_3	1	6,011	6,011	.220
L_4	1	100,862	100,862	3.686
L_5	1	39,753	39,753	1.453
L_6	1	1,710	1,710	.062
L_7	1	1,900	1,900	.069
L_8	1	77,877	77,877	2.846
Interaction	40	1,361,462	34,037	1.244
Error	486	13,298,586	27,363	
Total	539	15,259,699		

Table 12.--Analysis of variance with orthogonal treatment comparisons of reported pounds of milk produced

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F ratios
Enumerator	5	2,217,590,591	443,518,118	.558
Treatment	8	3,978,504,584	497,313,073	.626
L_1	1	34,410,159	34,410,159	.043
L_2	1	26,748,057	26,748,057	.034
L_3	1	445,080,227	445,008,227	.560
L_4	1	215,118,385	215,118,385	.271
L_5	1	583,171,505	583,171,505	.734
L_6	1	199,439,240	199,439,240	.251
L_7	1	218,542,225	218,542,225	.275
L_8	1	2,255,994,786	2,255,994,786	2.841
Interaction	40	25,249,523,694	631,238,092	.795
Error	486	385,933,158,902	794,101,150	
Total	539	417,378,777,771		

Table 13.--Analysis of variance with orthogonal treatment comparisons of reported quantity of whole milk sold

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F ratios
Enumerator	5	2,963,682,812	592,736,562	.837
Treatment	8	3,501,146,954	437,643,364	.618
L_1	1	395,160,603	395,160,603	.558
L_2	1	64,665,947	64,665,947	.091
L_3	1	109,287,544	109,287,544	.154
L_4	1	54,432,270	54,432,270	.077
L_5	1	546,635,958	546,635,958	.772
L_6	1	167,737,630	167,737,630	.237
L_7	1	317,541,642	317,541,642	.448
L_8	1	1,845,685,360	1,845,685,360	2.606
Interaction	40	22,589,006,211	564,725,155	.797
Error	486	344,185,527,608	708,200,674	
Total	539	373,239,363,585		

Table 14.--Analysis of variance with orthogonal treatment comparisons of true quantity of whole milk sold

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F ratios
Enumerator	5	2,587,297,381	517,459,476	.764
Treatment	8	4,195,584,286	524,448,036	.774
L_1	1	198,586,714	198,586,714	.293
L_2	1	118,483	118,483	0
L_3	1	168,466,466	168,466,466	.249
L_4	1	75,300	75,300	0
L_5	1	621,663,915	621,663,915	.917
L_6	1	79,176,506	79,176,506	.117
L_7	1	1,072,574,375	1,072,574,375	1.583
L_8	1	2,054,922,527	2,054,922,527	3.032
Interaction	40	22,347,786,605	558,694,665	.824
Error	486	329,365,717,870	677,707,238	
Total	539	358,496,386,142		

Table 15.--Analysis of variance with orthogonal treatment comparisons of reported quantity of milk used for food or drink on the farm

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F ratios
Enumerator	5	222,535	44,507	1.011
Treatment	8	481,959	60,245	1.368
L_1	1	345	345	.008
L_2	1	148,434	148,434	3.371
L_3	1	39,732	39,732	.902
L_4	1	46,021	46,021	1.045
L_5	1	10,769	10,769	.245
L_6	1	187,309	187,309	4.254*
L_7	1	45,653	45,653	1.037
L_8	1	3,696	3,696	.084
Interaction	40	2,048,262	51,207	1.163
Error	486	21,401,376	44,036	
Total	539	24,154,132	44,813	

Table 16.--Analysis of variance with orthogonal treatment comparisons of reported quantity of milk fed to livestock

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F ratios
Enumerator	5	10,145,933	2,029,187	3.982*
Treatment	8	4,718,125	589,766	1.157
L_1	1	1,026,750	1,026,750	2.015
L_2	1	129,504	129,504	.254
L_3	1	766,182	766,182	1.503
L_4	1	32,935	32,935	.065
L_5	1	767,013	767,013	1.505
L_6	1	1,979,158	1,979,158	3.883*
L_7	1	13,913	13,913	.027
L_8	1	2,670	2,670	.005
Interaction	40	21,977,268	549,432	1.078
Error	486	247,688,421	509,647	
Total	539	284,529,747	527,885	

Table 17.--Analysis of variance with orthogonal treatment comparisons of reported milk sold directly to consumers

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F ratios
Enumerator	5	24,922	4,984	1.085
Treatment	8	26,245	3,281	.714
L_1	1	2,641	2,641	.575
L_2	1	6,225	6,225	1.355
L_3	1	1,284	1,284	.280
L_4	1	2,430	2,430	.529
L_5	1	132	132	.029
L_6	1	10,305	10,305	2.244
L_7	1	1,673	1,673	.364
L_8	1	1,555	1,555	.339
Interaction	40	173,400	4,335	.944
Error	486	2,232,227	4,593	
Total	539	2,456,794	4,558	

ble 15.--Analysis of variance with orthogonal treatment comparisons of reported number of cows milked on March 1, 1971

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F ratios
Enumerator		2,533	507	.914
Treatment	[illegible]	3,955	494	.890
L_1	1	164	165	.297
L_2	1	40	40	.072
L_3	1	36	36	.065
L_4	1	6	6	.011
L_5	1	792	792	1.427
L_6	1	97	97	.175
L_7	1	548	548	.987
L_8	1	2,271	2,271	4.092*
Interaction	4	19,795	495	.892
Error	488	269,603	555	
Total	539	295,884	549	

A P P E N D I X D

RESPONSE ERROR ENUMERATOR QUESTIONNAIRE

Gentlemen:

Please comment on all of the following topics with your personal views. Extra paper is attached to cover inadequate space on the questionnaire and any additional opinion you would like to make on either general or specific subjects.

I. School for Dairy Response:

a. Was interview manual of assistance?

b. Was school instruction sound?

II. Presurvey

a. What was farmers' reception to phone call to personal contact?

b. What were your feelings as enumerator?

III. Survey Proper

In discussing each treatment, indicate the farmer's reaction to the particular form of treatment. You may want to discuss other differences in farmers' attitude that you feel was due to a certain aspect of the treatment. Also, from your point of view, was home or office phoning easiest, was the mail contact of help as a reference when calling, etc?