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SUMMARY

During the 1990 June Agricultural Survey (JAS), personnel from the Area Frame Section began converting the area frame design from a 320 acre target segment size to a 640 acre target segment size for Ohio and North Carolina. Approximately one half of the target segment sizes of 0.5 square mile (320 acres) were increased to 1.0 square mile (640 acres) for strata 11 and 12 in Ohio and strata 13 and 20 in North Carolina. Hence, for Ohio and North Carolina, the 1990 JAS was a split sample containing two separate sample designs. The primary reason for making the conversion was to increase the number of resident farm operators (RFO's) and the number of agricultural tracts (AGTRACT's) to satisfy future sampling concerns.

When the expected totals from the two sampling designs (320 acre target segment size versus the 640 acre target segment size) were compared, the sample design for the 640 acre target segment design (SD-640) showed an increase over the 320 acre sampling design (SD-320) for both variables. However, this result was expected since SD-640 had more acreage in the survey sample than the alternate design. Hence, a comparison was made between the two designs for equal sized segments. Summary statistics, the F-test for equal variances, and the two-sample t-test were used to assess whether any differences occurred due to the use of the different sample designs in terms of the variables for number of resident farm operators and number of agricultural tracts for strata with sufficient degrees of freedom. The same analysis was performed for all strata. For stratum 11 in Ohio, the mean number of RFO's was significantly larger for the SD-320 design as compared to the SD-640 design. However, for North Carolina, no statistically significant differences were found with respect to the two different sample designs.

INTRODUCTION

Personnel from the Area Frame Section began implementing a new sample design in selected land use strata for Ohio and North Carolina for the 1990 June Agricultural Survey (JAS). This new design involved converting the 320 acre target segment size to a 640 acre target segment size for approximately one half of the sampled segments in strata 11 and 12 in Ohio and strata 13 and 20 in North Carolina (see Appendix A). Consequently, the 1990 JAS was a split sample in these strata containing two separate sample designs. The main reason for making the change was to increase the number of resident farm operators (RFO's) and the number of agricultural tracts (AGTRACT's) for future sampling concerns. The expected totals from the two sampling designs (320 acre target segment size versus the 640 acre target segment size) were compared. Also, summary statistics, the F-test for equal variances, and the two-sample t-test were used to assess whether any differences occurred between the number of RFO's and AGTRACT's through the use of the different sample designs.

METHODS

The variable RFO was coded "1" for farmers living within the segment and "0" for farmers living outside the segment. Similarly, the variable AGTRACT was coded "1" for tracts with agricultural acreage and "0" for tracts with agricultural acreage equal to zero. Means, variances, and degrees of freedom were estimated using formulae pertaining to the stratified random sampling design of the JAS (see Appendix B and C). To find the estimators, the number of agricultural tracts and resident farm operators were summed to the segment level and then summed to the paper strata level (see Appendix D).

In order to compare the total expected number of RFO's and AGTRACT's produced from each sampling scheme, the number of observations selected for each scheme was determined. The number of segments for SD-320 was determined by using the number of segments sampled in the 1989 JAS when all target segment sizes were 320 acres. Hence, multiplying the number of segments sampled in the 1989 JAS by the SD-320 means for RFO and AGTRACT from the 1990 JAS produces an estimate of the total expected number of RFO's and AGTRACT's for this sample design. Similarly, the total expected number of RFO's and AGTRACT's were found for SD-640 by multiplying the SD-640 means for RFO and AGTRACT from the 1990 JAS by the number of segments sampled in the 1991 JAS when all the target segment sizes were 640 acres. Therefore, the difference between

the expected totals of SD-640 and SD-320 gave an indication of the increase in farms and agricultural tracts when using SD-640. The ratio of SD-640 to SD-320 gave an indication of the percent increase when using SD-640. These data are shown in RESULTS I.

Next, several assumptions were made to ensure proper use of the procedures. First, both sample designs were independent stratified random samples. Second, the two samples were normally distributed such that the sample under SD-320 $x_1,\ldots,x_{n1}$ was from a $N(\mu_{320},\sigma_{320}^2)$ and the sample for SD-640 $y_1,\ldots,y_{n2}$ was from a $N(\mu_{640},\sigma_{640}^2)$. Considering the variable RFO, x_i was the number of RFO's in segment i in the SD-320 sample which has n_1 segments, and y_j was be the number of RFO's in segment j in the SD-640 sample which has n_2 segments. Further, since SD-640 has a segment which was two times the size of SD-320's segment, units had to be adjusted such that both samples were in terms of the same area. For example, one would expect that there would be twice the number of resident farm operators in a 640 acre sized segment as compared to a 320 acre segment because the area was twice as large. Hence, to assess the two sampling plans fairly, both distributions were expressed in terms of 100 acres rather than 320 acres or 640 acres. Therefore, at the segment level, the counts related to both SD-320 and SD-640 samples were divided by constants of 3.2 and 6.4 respectively. These transformations resulted in a common segment size of 100 acres. Let $x_{(adj)1}, \ldots, x_{(adj)n1}$ and $y_{(adj)1}, \ldots, y_{(adj)n2}$ be the new adjusted samples. An F-test (test for equal variances) and a two-sample t-test (test for equal means) were performed to compare the adjusted stratified random samples. These data are shown in RESULTS II.

RESULTS I

The expected total number of RFO's and AGTRACT's for each sampling scheme was calculated by multiplying the mean found from the 1990 JAS for RFO and AGTRACT by the appropriate number of segments sampled. Recall, for SD-320, the number of segments was equal to the 1989 JAS segment sample size and for SD-640, the number of segments was found from the 1991 JAS. Tables 1 and 2 list this estimated "n", the mean number of RFO's and AGTRACT's from the 1990 JAS, the expected total the sample would produce based on those sample sizes, the estimated variance of the estimated total, and the total area of the simulated sample.

Table 1: Expected total number of RFO's produced from SD-320 and SD-640

STATE	STRATA	TARGET SEGMENT SIZE	ESTIMATED "n" (YEAR)	1990 JAS RFO MEAN	1990 JAS RFO VARIANCE	EXPECTED TOTAL (VARIANCE)	TOTAL AREA (ACRES)
OH	11	320	140 (1989)	1.24	0.015	173.3 (284.5)	44,800
OH	11	640	105 (1991)	2.32	0.054	243.7 (598.8)	67,200
OH	12	320	55 (1989)	1.82	0.052	100.0 (157.7)	17,600
OH	12	640	55 (1991)	2.86	0.263	157.5 (796.5)	35,200
NC	13	320	30 (1989)	1.11	0.083	33.3 (74.5)	9,600
NC	13	640	30 (1991)	1.50	0.096	45.0 (86.4)	19,200
NC	20	320	210 (1989)	0.73	0.008	153.0 (345.5)	67,200
NC	20	640	140 (1991)	1.52	0.052	212.5 (1009.9)	89,600

Table 2: Expected total number of AGTRACT's produced from SD-320 and SD-640

STATE	STRATA	TARGET SEGMENT SIZE	ESTIMATED "n" (YEAR)	1990 JAS AGTRACT MEAN	1990 JAS AGTRACT VARIANCE	EXPECTED TOTAL (VARIANCE)	TOTAL AREA (ACRES)
OH	11	320	140 (1989)	3.99	0.031	558.3 (610.9)	44,800
OH	11	640	105 (1991)	6.61	0.102	693.7 (1129.0)	67,200
OH	12	320	55 (1989)	4.03	0.077	221.7 (233.0)	17,600
OH	12	640	55 (1991)	6.09	0.366	334.9 (1108.1)	35,200
OH	13	320	30 (1989)	4.33	0.417	130.0 (375.5)	9,600
OH	13	640	30 (1990)	5.50	0.672	165.0 (605.0)	19,200
OH	20	320	210 (1989)	2.93	0.029	615.0 (1298.8)	67,200
OH	20	640	140 (1990)	4.84	0.163	677.5 (3190.7)	89,600

From Tables 1 and 2, SD-640 produced more RFO's and AGTRACT's in every single case. However, the total area of the sample also increased every time for this sampling scheme.

Tables 1 and 2 were summarized in Table 3 as follows: the expected total from SD-320 was subtracted from the expected total from SD-640. Also, the ratio of the expected totals was found.

Table 3: Difference of expected totals and ratio of expected totals

STATE STRATA	EXPECTED TOTAL RFO DIFFERENCE	EXPECTED TOTAL RFO RATIO	EXPECTED TOTAL AGTRACT DIFFERENCE	EXPECTED TOTAL AGTRACT RATIO
OH 11	70.4	1.41	135.4	1.24
OH 12	57.5	1.58	113.2	1.51
NC 13	11.7	1.35	35.0	1.27
NC 20	59.5	1.38	62.5	1.10

For example, if the two simulated samples were implemented as designed in stratum 11 for Ohio (est "n" and appropriate segment sizes being used), one would expect to get 70.4 more resident farm operators in SD-640 over SD-320. Further, SD-640 would give approximately 41% more resident farm operators over the SD-320. Note, changing the est "n" would change the totals and the results, and consequently, the number of segments sampled could be adjusted appropriately such that both designs give approximately the same number of RFO's and AGTRACT's. Because the 640 acre target segment is twice as large as the 320 acre target segment, if the ratio of expected totals for the variable RFO was 2 then both designs would be capturing the same amount of farms. All the ratios are less than 2, which indicated that more area must be sampled in a 640 acre sample design to achieve the same number of resident farm operators or number of agricultural tracts. However, data collection costs are also lower for the SD-640 design, since travel to a randomly selected segment site is a major portion of the data collection cost.

RESULTS II

First, a test was performed to check if the variances of $\overline{y_{(adj)}}$ and $\overline{x_{(adj)}}$ were equal before performing the two-sample t-test. An F-test (Likelihood Ratio Test) was used for both variables RFO and AGTRACT. The hypotheses was H_o: $\sigma_{640}^2/\sigma_{320}^2=1$ vs H_a: $\sigma_{640}^2/\sigma_{320}^2\neq1$, and the

test statistic was $f_o=s_{320}^2/s_{640}^2$. Results are shown in Table 4 below.

Table 4: F statistics for the variables RFO and AGTRACT

STATE	STRATA	RFO F-STATISTIC	TWO-SIDED P-VALUE	RFO DF* 320	RFO DF* 640
OHIO	11	1.069	0.867	59.2	28.7
OHIO	12	0.792	0.678	11.6	4.0
NORTH CAROLINA	13	3.450	0.435	6.9	2.3
NORTH CAROLINA	20	0.608	0.211	93.5	10.1

STATE	STRATA	AGT F-STATISTIC	TWO-SIDED P-VALUE	AGT DF* 320	AGT DF* 640
OHIO	11	1.218	0.489	69.9	43.8
OHIO	12	0.841	0.754	8.4	3.5
NORTH CAROLINA	13	2.482	0.546	8.5	2.6
NORTH CAROLINA	20	0.724	0.282	99.4	22.4

* DF ESTIMATED USING SATTERTHWAITE (SEE APPENDIX B)

Since all of the p-values were very large, we failed to reject the null hypothesis that the variances were equal. Hence, the assumption for the two sample t-test requiring equal variances was satisfied. Since SD-320 and SD-640 are both estimating either the mean number of resident farm operators or the mean number of agricultural tracts "per equal sized segment", one would expect that the two means would be very similar. Recall that both means were expressed in counts per 100 acres. The two-sample t-test with hypotheses, H_o: $\mu_{320}=\mu_{640}$ versus H_a: $\mu_{320}\neq\mu_{640}$ with test statistic $t_o= (\overline{y_{640}}-\overline{x_{320}}) / (s_p*\sqrt{1/n_1+1/n_2})$ where $s_p=[(1-n_1)*s_{320}^2 + (1-n_2)*s_{640}^2]/(n_1+n_2-2)$, yielded the following results:

Table 5: T statistics for the variables RFO and AGTRACT

STATE STRATA	RFO T-STATISTIC	TWO-SIDED P-VALUE	RFO DF*	AGT T-STATISTIC	TWO-SIDED P-VALUE	AGT DF*
OH 11	-2.856	***0.005***	85.9	-0.774	0.440	111.7
OH 12	-2.843	***0.013***	13.6	-2.220	***0.051***	9.9
NC 13	-1.757	0.122	7.1	-1.845	0.098	9.0
NC 20	1.007	0.317	101.6	-0.671	0.504	119.9

* DF ESTIMATED USING SATTERTHWAITE (SEE APPENDIX B)

The only significant result occurred in stratum 11 for Ohio for the variable RFO. Although Ohio's stratum 12 appeared significant for both the variables RFO and AGTRACT, no conclusions were made due to the insufficient degrees of freedom. Based on the data, the significant case indicated that SD-320 had a higher mean "per equal sized segment" than SD-640. In addition, when all the means were expressed in terms of 100 acres, the mean for SD-320 was larger than the mean for SD-640 in every case, except for North Carolina's stratum 20 for the variable RFO (see Appendix C).

COMMENTS

The above analysis looks at the comparison of SD-320 versus SD-640 using a two-sample t-test based on the Central Limit Theorem, which states that as n grows large the distribution of the sample mean tends towards normality. However, in strata 12 and 13, the estimated degrees of freedom from the Satterthwaite formula cannot be considered large, which makes it difficult to make any statistical conclusions. Even though the data consists of discrete counts of resident farm operators (RFO's) and agricultural tracts (AGTRACT's), strata 11 and 20 can confidently be assumed to follow a normal distribution via the Central Limit Theorem Assumptions.

CONCLUSIONS

Comparing the expected totals from a simulated sample design for a 320 acre target segment size with a corresponding design for the 640 acre target segment size, resulted in SD-640 having more resident farm operators, agricultural tracts, and land. However, all the ratios of expected totals of SD-640 to SD-320 for RFO's and AGTRACT's were less than 2. Hence, more area must be sampled for SD-640 to achieve the same number of resident farm operators or agricultural tracts as SD-320. When comparing SD-320 to SD-640 for equal sized segments, there appeared to be no significant difference between the variances, therefore the precision of the estimates from either sampling scheme was essentially the same. A two-sample t-test was used to assess any difference in regards to the mean number of resident farm operators (RFO) and mean number of agricultural tracts (AGTRACT) for SD-320 to SD-640. No significant differences were found for the land use strata in North Carolina for either variable. A significant difference did occur in stratum 11 for Ohio between the two designs for the mean number of resident farm operators. In this significant case, the estimated mean "per equal size segment" was larger for SD-320 as compared to SD-640.

REFERENCES

[1] Bain, Lee J., Engelhardt, Max. INTRODUCTION TO PROBABILITY AND MATHEMATICAL STATISTICS. Boston, MA: Prindle, Weber, and Schmidt, 1987 pp 417-421.

[2] Cochran, William G. SAMPLING TECHNIQUES. 2nd ed. New York, NY: John Wiley & Sons, 1963 pp 87-153.

[3] Geuder, Jeff. PAPER STRATIFICATION IN SRS AREA SAMPLING FRAMES. U.S. Dept. of Agr., Stat. Rept. Serv. February 1984.

[4] Kott, Phillip S. ESTIMATING VARIANCES FOR THE JUNE ENUMERATIVE SURVEY. U.S. Dept. of Agr., Stat. Rept. Serv. May 1988.

[5] Mendenhall, William, Ott, Lyman and Scheaffer, Richard L. ELEMENTARY SURVEY SAMPLING. 3rd ed. Boston, MA: PWS-Kent, 1979 pp 79-117.

[6] Wolter, Kirk M. INTRODUCTION TO VARIANCE ESTIMATION. Springer-Verlag, 1985. pp 22-23, 228-229.

APPENDIX A: AREA FRAME DESIGN INFORMATION

(37) NORTH CAROLINA

STRATUM	TOTAL SQUARE MILES	TARGET SEGMENT SIZE	NUMBER OF SEGMENTS IN POPULATION	NUMBER OF SEGMENTS IN SAMPLE	NUMBER OF SUBSTRATA	STRATUM DEFINITION
13	1469	0.50	2938	18	6	>50% CULTIVATED
13	980	1.00	981	12	6	>50% CULTIVATED
20	16419	0.50	32834	140	14	15-50% CULTIVATED
20	6568	1.00	6538	56	14	15-50% CULTIVATED

(39) OHIO

STRATUM	TOTAL SQUARE MILES	TARGET SEGMENT SIZE	NUMBER OF SEGMENTS IN POPULATION	NUMBER OF SEGMENTS IN SAMPLE	NUMBER OF SUBSTRATA	STRATUM DEFINITION
11	8602	0.50	17203	84	7	>75% CULTIVATED
11	5735	1.00	5735	56	7	>75% CULTIVATED
12	3763	0.50	7514	33	11	15-51% CULTIVATED
12	2508	1.00	2510	22	11	15-51% CULTIVATED

APPENDIX B: FORMULAS FOR ESTIMATES OF MEANS, VARIANCES, DEGREES OF FREEDOM AND SAMPLE TOTALS

The sample estimate of the population mean μ for a stratified random sample is defined as follows:

$$\bar{y}_{st} = \sum_{h=1}^{L} (N_h * \bar{y}_h) / N$$

where L = the number of paper strata in the land use stratum

N_h = the number of segments in paper stratum h (substrata h)

$N = N_1 + N_2 + \ldots + N_L$
the total number of segments in the land use stratum

$$\bar{y}_h = 1/n_h \sum_{i=1}^{n_h} y_{hi}$$
the estimated mean number of RFO's (or AGTRACT's) in paper stratum h

where n_h = the number of segments sampled in paper stratum h

y_{hi} = the number of RFO's (or AGTRACT's) for segment i in paper stratum h

The estimated variance of $\bar{y}_{st}$ is as follows:

$$\hat{V}(\bar{y}_{st}) = (1/N^2) \sum_{h=1}^{L} N_h * (N_h - n_h) * (s_h^2 / n_h)$$

where L, N, y_{hi}, $\overline{y_h}$, and n_h are the same as defined above and

$$s_h^2 = [1/(n_h - 1)] \sum_{i=1}^{n_h} (y_{hi} - \bar{y}_h)^2$$
the sample variance for paper stratum h

An approximation to the appropriate degrees of freedom is as follows (Satterthwaite, 1946):

$$DF = \frac{\left(\sum_{h=1}^{L} g_h * s_h^2 \right)^2}{\sum_{h=1}^{L} \{ (g_h^2 s_h^4) / (n_h - 1) \}}$$

where $g_h = (N_h (N_h - n_h)) / n_h$

APPENDIX B (CONT'D):

The estimated total number of RFO's (or AGTRACT's) in a sample from the 320 acre segment sampling scheme was computed as follows:

$E[\text{total from sample}] = n_{320} * \overline{y}_{320}$

where n_{320} = the number of 320 acre segments sampled in the 1989 JAS for a particular stratum

$\overline{y}_{320}$ = the stratified mean number of RFO's (or AGTRACT's) for a particular stratum

NOTE: the estimated total number of RFO's (or AGTRACT's) in a sample from the 640 acre sampling scheme is found similarly)

APPENDIX C:
STRATIFIED ESTIMATES FOR MEAN AND VARIANCE (NOTE: ADJUSTED ESTIMATES A BASED ON A COMMON SEGMENT SIZE OF 100 ACRES)

RFO

STRATUM STATE	SEGMENT SIZE	ESTIMATED MEAN	ESTIMATED VARIANCE	ESTIMATED D.F.	ADJUSTED EST MEAN	ADJUSTED EST VAR
11 OH	320	1.238	0.0145	59.2	0.387	0.00142
11 OH	640	2.321	0.0543	28.7	0.363	0.00133
12 OH	320	1.818	0.0521	11.6	0.568	0.00509
12 OH	640	2.863	0.2633	4.0	0.447	0.00643
13 NC	320	1.111	0.0828	6.9	0.347	0.00809
13 NC	640	1.500	0.0960	2.3	0.234	0.00234
20 NC	320	0.729	0.0078	93.5	0.228	0.00077
20 NC	640	1.518	0.0515	10.1	0.237	0.00126

AGTRACT

STRATUM STATE	SEGMENT SIZE	ESTIMATED MEAN	ESTIMATED VARIANCE	ESTIMATED D.F.	ADJUSTED EST MEAN	ADJUSTED EST VAR
11 OH	320	3.988	0.0312	69.9	1.246	0.00304
11 OH	640	6.607	0.1024	43.8	1.032	0.00250
12 OH	320	4.030	0.0770	8.4	1.259	0.00752
12 OH	640	6.088	0.3663	3.5	0.951	0.00894
13 NC	320	4.333	0.4172	8.5	1.354	0.04074
13 NC	640	5.500	0.6722	2.6	0.859	0.01641
20 NC	320	2.928	0.0295	99.4	0.915	0.00288
20 NC	640	4.839	0.1628	22.4	0.756	0.00398

APPENDIX D: OHIO DATA SUMMED TO THE PAPER STRATA LEVEL

OHIO STRATUM 11 RESIDENT FARM OPERATOR

PAPER STRATA	SEGMENT SIZE	RFO n_i	RFO MEAN	RFO SUM	RFO VARIANCE
1101	320	12	1.083	13	1.356
1101	640	8	1.875	15	0.411
1102	320	12	1.667	20	2.424
1102	640	8	3.000	24	5.143
1103	320	12	1.750	21	1.659
1103	640	8	3.875	31	2.696
1104	320	12	1.333	16	0.424
1104	640	8	1.875	15	0.411
1105	320	12	0.667	8	0.424
1105	640	8	2.750	22	8.214
1106	320	12	0.917	11	0.811
1106	640	8	1.125	9	1.839
1107	320	12	1.250	15	1.477
1107	640	8	1.750	14	2.786

OHIO STRATUM 11 AGRICULTURAL TRACT

PAPER STRATA	SEGMENT SIZE	AGTRACT n_i	AGTRACT MEAN	AGTRACT SUM	AGTRACT VARIANCE
1101	320	12	4.750	57	1.841
1101	640	8	8.000	64	3.429
1102	320	12	4.167	50	3.061
1102	640	8	6.750	54	5.071
1103	320	12	4.083	49	3.356
1103	640	8	8.250	66	8.500
1104	320	12	4.250	51	2.568
1104	640	8	6.500	52	2.571
1105	320	12	3.833	46	1.242
1105	640	8	6.500	52	6.857
1106	320	12	2.917	35	2.447
1106	640	8	4.375	35	7.125
1107	320	12	3.917	47	3.902
1107	640	8	5.875	47	6.982

APPENDIX D: OHIO DATA SUMMED TO PAPER STRATA LEVEL

OHIO STRATUM 12 RESIDENT FARM OPERATOR

PAPER STRATA	SEGMENT SIZE	RFO n_i	RFO MEAN	RFO SUM	RFO VARIANCE
1201	320	3	3.00	9	1.00
1201	640	2	3.50	7	24.50
1202	320	3	1.67	5	2.33
1202	640	2	2.00	4	0.00
1203	320	3	1.67	5	1.33
1203	640	2	2.50	5	4.50
1204	320	3	1.33	4	0.33
1204	640	2	1.50	3	4.50
1205	320	3	1.00	3	1.00
1205	640	2	3.00	6	8.00
1206	320	3	1.67	5	1.33
1206	640	2	3.50	7	0.50
1207	320	3	0.33	1	0.33
1207	640	2	4.00	8	2.00
1208	320	3	1.67	5	2.33
1208	640	2	3.00	6	0.00
1209	320	3	2.67	8	0.33
1209	640	2	2.50	5	0.50
1210	320	3	3.67	11	6.33
1210	640	2	2.00	4	2.00
1211	320	3	1.33	4	2.33
1211	640	2	4.00	8	18.00

OHIO STRATUM 12 AGRICULTURAL TRACT

PAPER STRATA	SEGMENT SIZE	AGTRACT n_i	AGTRACT MEAN	AGTRACT SUM	AGTRACT VARIANCE
1201	320	3	5.33	16	1.33
1201	640	2	6.00	12	8.00
1202	320	3	3.33	10	2.33
1202	640	2	5.50	11	0.50
1203	320	3	4.00	12	0.00
1203	640	2	7.00	14	2.00
1204	320	3	3.33	10	1.33
1204	640	2	3.00	6	0.00
1205	320	3	3.33	10	2.33
1205	640	2	4.50	9	24.50
1206	320	3	4.00	12	3.00
1206	640	2	5.50	11	0.50
1207	320	3	2.33	7	0.33
1207	640	2	7.50	15	4.50
1208	320	3	4.67	14	1.33
1208	640	2	7.50	15	0.50
1209	320	3	4.67	14	1.33
1209	640	2	6.50	13	4.50
1210	320	3	5.67	17	2.33
1210	640	2	4.50	9	4.50
1211	320	3	3.67	11	12.33
1211	640	2	9.50	19	40.50

APPENDIX D: NORTH CAROLINA DATA SUMMED TO PAPER STRATA LEVEL

NORTH CAROLINA STRATUM 13 RESIDENT FARM OPERATOR

PAPER STRATA	SEGMENT SIZE	RFO n_i	RFO MEAN	RFO SUM	RFO VARIANCE
1301	320	3	0.67	2	0.33
1301	640	2	1.50	3	0.50
1302	320	3	0.00	0	0.00
1302	640	2	0.50	1	0.50
1303	320	3	1.00	3	3.00
1303	640	2	1.50	3	4.50
1304	320	3	1.33	4	0.33
1304	640	2	1.50	3	0.50
1305	320	3	2.00	6	3.00
1305	640	2	2.50	5	0.50
1306	320	3	1.67	5	2.33
1306	640	2	1.50	3	0.50

NORTH CAROLINA STRATUM 12 AGRICULTURAL TRACT

PAPER STRATA	SEGMENT SIZE	AGTRACT n_i	AGTRACT MEAN	AGTRACT SUM	AGTRACT VARIANCE
1301	320	3	4.00	12	9.00
1301	640	2	5.00	10	2.00
1302	320	3	2.33	7	2.33
1302	640	2	4.00	8	2.00
1303	320	3	5.00	15	13.00
1303	640	2	6.50	13	24.50
1304	320	3	5.67	17	2.33
1304	640	2	6.50	13	0.50
1305	320	3	4.67	14	4.33
1305	640	2	7.00	14	2.00
1306	320	3	4.33	13	14.33
1306	640	2	4.00	8	18.00

APPENDIX D: NORTH CAROLINA DATA SUMMED TO PAPER STRATA LEVEL

NORTH CAROLINA STRATUM 20 RESIDENT FARM OPERATOR

PAPER STRATA	SEGMENT SIZE	RFO n_i	RFO MEAN	RFO SUM	RFO VARIANCE
2001	320	10	0.10	1	0.10
2001	640	4	0.25	1	0.25
2002	320	10	0.30	3	0.90
2002	640	4	1.75	7	1.58
2003	320	10	0.80	8	1.07
2003	640	4	1.00	4	0.67
2004	320	10	1.40	14	2.49
2004	640	4	0.50	2	1.00
2005	320	10	0.80	8	1.51
2005	640	4	1.25	5	0.92
2006	320	10	0.70	7	1.57
2006	640	4	3.25	13	20.92
2007	320	10	1.10	11	1.66
2007	640	4	3.25	13	0.92
2008	320	10	1.10	11	0.99
2008	640	4	0.50	2	0.33
2009	320	10	0.80	8	1.29
2009	640	4	2.00	8	2.00
2010	320	10	0.50	5	0.50
2010	640	4	1.00	4	1.33
2011	320	10	0.10	1	0.10
2011	640	4	1.00	4	0.67
2012	320	10	1.10	11	0.99
2012	640	4	2.25	9	4.917
2013	320	10	1.00	10	1.778
2013	640	4	2.50	10	4.333
2014	320	10	0.40	4	0.489
2014	640	4	0.75	3	0.917

APPENDIX D: NORTH CAROLINA DATA SUMMED TO PAPER STRATA LEVEL

NORTH CAROLINA STRATUM 20 AGRICULTURAL TRACT

PAPER STRATA	SEGMENT SIZE	AGTRACT n_i	AGTRACT MEAN	AGTRACT SUM	AGTRACT VARIANCE
2001	320	10	2.00	20	1.33
2001	640	4	3.75	15	2.92
2002	320	10	3.00	30	3.33
2002	640	4	5.50	22	9.00
2003	320	10	3.10	31	6.10
2003	640	4	5.00	20	8.67
2004	320	10	4.00	40	2.67
2004	640	4	4.25	17	8.25
2005	320	10	3.70	37	5.57
2005	640	4	4.25	17	4.25
2006	320	10	4.60	46	8.49
2006	640	4	9.00	36	36.67
2007	320	10	2.80	28	5.96
2007	640	4	9.00	36	8.67
2008	320	10	3.70	37	3.12
2008	640	4	3.25	13	4.92
2009	320	10	2.40	24	6.71
2009	640	4	5.25	21	10.92
2010	320	10	1.70	17	1.79
2010	640	4	4.50	18	4.33
2011	320	10	2.00	20	1.33
2011	640	4	2.50	10	0.33
2012	320	10	3.30	33	4.23
2012	640	4	5.00	20	14.67
2013	320	10	3.20	32	5.07
2013	640	4	5.25	21	12.92
2014	320	10	1.50	15	2.28
2014	640	4	1.25	5	2.25

* U.S. G.P.o.:1992-311-404:60026/NASS