

# Evidence on the Accuracy of Expenditures Reported in Recreational Surveys

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This article discusses the results of four experiments to test the accuracy of recreational expenditures reported in surveys relative to expenditures reported in diaries. We found few situations in which the reported expenditures in the surveys and diaries differed significantly. In general, we conclude that individuals are able to accurately report recreational expenditures in ex post mail surveys. Given the wide usage of survey expenditure data by economists, we find this result encouraging.

*Key words:* expenditure diaries, expenditure surveys, recreation

## Introduction

Although much focus in resource valuation has been on estimation issues, it is desirable to take a step back and evaluate the accuracy of data collected through surveys. In particular our research is concerned with the accuracy of recreational expenditures reported in surveys. Collecting expenditure data with diaries is difficult because the burden it places on respondents usually results in low response rates. Therefore, ex post surveys are often used as a second-best method of collecting expenditure data. Since these surveys are conducted after expenditures are made, individuals may have a difficult time remembering exactly what they bought and how much they spent to participate in a particular activity. This may be especially true for recreational expenditures since they tend to be intermittent.

We conducted four experiments to test the magnitude of response errors, one involving turkey hunters and the other three involving deer hunters. In all experiments, we gave half of the sample a diary to record expenses as they were incurred. The other half of the sample received a mail survey after participating in the recreational activity. In the survey, individuals were asked about expenditures associated with the recreational activity. The diary results served as a standard for evaluating the accuracy with which survey respondents recalled their expenditures. We expect data collected with a diary to be more accurate than data collected with a survey because it encourages participants in advance to remember what they spent and it provides a convenient way to immediately record amounts spent, reducing response errors due to poor recall.

To our knowledge, previous studies comparing data collected in a diary with data collected in a survey have not dealt with recreational expenditures. One study of the recreational expenditure data collected in the National Surveys of Fishing, Hunting, and Wildlife-Associated Recreation looked at the effects of the length of the recall period. This

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All remaining errors are the responsibility of the authors.

study found that the longer the recall period, the more exaggerated reported expenditures become (Chu et al.). However, this study did not include a comparison of recreational expenditures reported in a diary with expenditures reported in a survey.

### Previous Research Comparing Diary Data and Survey Data

Wind and Lerner looked at one of the national subsamples of data developed by Marketing Research Corporation of America, a marketing research supplier. They asked a sample of 450 respondents to participate. Each individual reported margarine purchases in a six-month diary (June through November 1976). These purchases were compared with margarine purchases reported in a mail survey conducted in November and December 1976. The diary and survey asked about the brand of margarine bought most often, the other brands of margarine bought by the household, and the brands the respondent would consider purchasing. The margarine brands that survey respondents reported to have purchased differed from the brands the same individuals reported purchasing in the diary. Overall, such errors appeared to cancel each other out since, at the aggregate level, surveys were found to provide a good approximation of the frequency of purchase of the various brands of margarine as measured by the diary.

Stanton and Tucci extended the research of Wind and Lerner by comparing the results of consumption data collected by two-day diaries and a 24-hour-recall personal interview survey. They collected consumption data on 39 different food groups. At the aggregate level, Stanton and Tucci found no difference in the reported amount of food ingested measured by personal interview and by diary.

Silberstein and Scott used data from the 1987 U.S. Consumer Expenditure Survey to evaluate the magnitude of measurement errors associated with this survey. Their study compared household expenditure data collected in a diary with retrospective data collected in an interview for three categories of expenditures—home furnishings, apparel, and entertainment. They concluded that annual mean expenditures calculated from the diary data were higher in the home furnishings and apparel categories. However, in the entertainment category, the mean expenditure estimated from the diary data was lower than the mean expenditure estimated from the interview survey. The authors did not report whether these differences in mean expenditures were statistically significant.

These studies of consumer expenditures suggest that, in the aggregate, individuals can accurately recall their expenditures on consumer goods. Recreational expenditures may be more difficult to recall since they are not usually made on a regular basis.

### Diary Design

Sudman and Ferber performed a series of experiments to determine the best design for an expenditure diary. They designed three kinds of diaries: (a) a journal diary in which the entries are made in the order that purchases are made; (b) an outlet diary in which the entries are made by the type of store or service; and (c) a product diary where entries are made by product group. They asked individuals to keep weekly diaries of household expenditures for varying periods of time ranging from two weeks to four weeks. Cooperation did not vary among the three diary forms in terms of initial agreement to keep a diary. However, individuals receiving the product diary were much more likely to keep the diaries for four

weeks than individuals receiving the journal or outlet diaries. Individuals apparently found diaries in which they report purchases structured by product group easier to use. Sudman and Ferber noted that a table of contents at the front of the diary can help individuals locate the correct page for entries.

In light of the Sudman and Ferber results, we organized our diaries by type of expenditure, with a table of contents at the front. The expenditure diaries were small enough to fit in a shirt or pants pocket. This design encouraged individuals to carry the diary with them when they went on shopping, scouting, or hunting trips.

### Turkey Hunting Expenditures

The first experiment involved Wisconsin turkey hunters. In Wisconsin, individuals receive a permit to hunt turkeys during five days in the spring. We randomly selected 150 hunters who received a permit to hunt turkeys between 1 May and 5 May 1991. We sent a subsample of 75 hunters an expense diary on 1 April 1991 and asked them to record all expenses related to turkey hunting since 1 January 1991, and then, to write in all later turkey hunting expenses for the spring season.<sup>1</sup> The hunters were asked to return the diary as soon as possible after 5 May. We mailed two follow-up postcards and a follow-up letter with a replacement diary. The response rate for the diary was 59%. Only 38 of the 44 participants who returned the diary had a chance to go hunting during the 1 May to 5 May period.

On 4 May, we mailed the other 75 hunters a survey asking them about their expenditures after 1 January associated with the 1 May to 5 May turkey hunting period. Sixty-eight hunters returned the survey (91%). Fifty-eight of these hunters did hunt turkeys in 1991. The response rate to the survey was significantly higher than the response rate of the diary.

Table 1 shows the average turkey hunting expenditures reported in the expense diary and the survey. The average turkey hunter responding to the survey reported spending a total of \$208 preparing for and participating in the 1991 spring turkey hunt. Hunters returning the diary reported spending approximately \$197 on average. The difference between these two expenditure levels is not significant at the 5% level.<sup>2</sup>

Survey respondents reported spending significantly more than diary respondents on restaurant meals. We see no obvious explanation for this anomaly. Survey respondents also reported spending significantly more on license fees. One possible explanation for survey respondents reporting more spent on license fees is that they reported license fee expenditures prior to 1 January, perhaps because they did not read the instructions carefully or remember them when they got to this part of the expenditure question. No other differences in expenditures by category were statistically significant at the 5% level or better. We also looked at the percentage of reported zero expenditures for each item in table 1 and found no significant difference between the survey and diary responses.

Average miles traveled for hunting and scouting trips by hunters returning the survey and by hunters completing the diary were not significantly different. On average, hunters responding to the survey traveled 183 total miles for all hunting trips and 134 total miles for

<sup>1</sup>Thus, some recall was required, although presumably, most expenditures directly attributable to turkey hunting would be made as the date of the hunt approached.

<sup>2</sup>The Lilliefors test of normality (Conover) could not reject the hypothesis that the data are normally distributed, indicating *t*-tests of the difference in means were appropriate for analyzing these data. This test was conducted for the Sandhill deer hunting data sets as well as the turkey hunting data set.

**Table 1. Average 1991 Wisconsin Turkey Hunting Expenditures Reported in Expense Diaries and Surveys**

Expenditure Type	Diary Mean (Std. Error) N=38	Survey Mean (Std. Error) N=38	t-Statistic <sup>a</sup> (Significance)	Significant Difference in Percentage Zero Expenditures?
Equipment	\$106.29 (26.80)	\$108.33 (22.23)	-0.06 (0.953)	NO
Fees	\$ 9.34 (1.70)	\$30.37 (3.45)	-5.24 (0.000)	NO
Restaurant meals	\$ 6.55 (1.97)	\$14.85 (3.02)	-2.30 (0.023)	NO
Groceries	\$17.51 (4.18)	\$18.51 (3.38)	-0.20 (0.845)	NO
Fuel	\$36.32 (5.27)	\$25.70 (3.04)	1.75 (0.086)	NO
Hotel	\$5.92 (2.96)	\$6.66 (2.97)	-0.18 (0.861)	NO
Lodging other than hotel	\$10.54 (5.00)	\$2.69 (1.82)	1.48 (0.146)	NO
Other	\$4.27 (3.61)	\$1.28 (0.54)	0.82 (0.417)	NO
Total	\$196.74 (35.42)	\$208.44 (28.47)	-0.26 (0.798)	NO

<sup>a</sup> This is a two-tailed test for equal means and unequal variances. The implications of the *t*-test do not change if we assume equal variances. We also conducted *t*-tests on the positive expenditures only and found the results to be consistent with those shown in this table.

all scouting trips. Hunters who returned the expense diary traveled an average of 176 miles for all hunting trips and 171 miles for all scouting trips.

### Deer Hunting Expenditures

The Sandhill Wildlife Demonstration Area, a wildlife research property of the Wisconsin Department of Natural Resources in Wood County, Wisconsin, provided us with the other three opportunities to collect expenditure data with both a diary and a survey. We conducted split sample experiments in 1991, 1992, and 1993. The nature of the deer hunt changed each of those three years so we are not able to aggregate data across years. However, the changing nature of the hunt provided us with diverse samples across the years. Comparisons of the diary and survey data for individual years are enlightening.

### Sandhill Deer Hunt 1991

On 16 and 17 November 1991, the Wisconsin Department of Natural Resources held a public deer hunt with a total of 352 one-day permits issued. We randomly selected 175 of these hunters. Approximately two weeks before the hunt, we sent them an expense diary along with their permit.<sup>3</sup> In the expense diary we asked them to keep track of all expenditures related to scouting trips prior to the hunt and expenses for the hunting trip itself. Because nearly everyone who participates in the Sandhill public hunt normally hunts deer during the regular season, we anticipated few, if any, purchases of licenses and equipment directly attributable to this particular hunt. Hence, the diary focused only on trip expenditures. The diary also included a variety of questions about the background of respondents. We told hunters that their expense diaries would be collected as they entered the Sandhill Wildlife Demonstration Area. Diaries were collected from 116 of the 117 hunters who were sent expense diaries and showed up for the hunt.

We mailed the 177 remaining hunters who had *not* been sent an expense diary a survey on 16 November asking about expenditures associated with scouting trips and the hunt. Seventy of these individuals did not attend the hunt at Sandhill. Of the 107 hunters who received a survey and hunted, 104 (97%) returned a survey. Total expenditures reported in the survey were slightly higher on average than expenditures reported in the diary. This difference is significant at the 10% level but not at the 5% level (table 2).

Fuel was the only item where the *t*-test results suggest that the amount reported in the diary and the survey differ significantly. Expenditures on fuel reported in the deer hunting survey were significantly *higher* on average than those reported in the expense diary. Since we collected the diaries as hunters entered the Sandhill hunting area and we did not explicitly remind diary holders to estimate fuel costs for the trip home, it is possible that individuals who received the diary did not include the fuel costs for the trip home from the hunt. Table 2 shows the average expenditures on the various items for the survey and the expense diary. As with the turkey hunting data, we examined the percentage of reported zero expenditures and found the percentage to be the same for all expenditure categories except the "other" category which was a general category for items not specifically asked about in other sections. Survey respondents reported more zero expenditures for the other category than the diary respondents.

We observed no significant difference in the average number of miles traveled for hunting and scouting trips by individuals who returned the survey and individuals who returned the diary. Hunters returning the survey, traveled an average of 180 miles round trip to the Sandhill hunt. Likewise hunters who completed the diary traveled 198 miles on average to the Sandhill hunt. For scouting trips, survey respondents traveled 185 miles on average and diary respondents traveled 167 miles on average. Given that the two treatment groups traveled the same number of miles on average, we would expect similar fuel expenditures.

Since demographic questions were included in the diary and the survey, we could compare the demographic background of individuals returning the expense diary and the survey. Contingency table analysis shows that the two groups did not differ in terms of their education, employment, or income.

<sup>3</sup>We realized that the lead time for the diary was short, but we could not send out diaries until we knew who would be receiving a permit. We mailed the diaries as soon as possible after the drawing for permits took place. Furthermore, we were looking for expenditures directly attributable to the hunt and did not expect such expenditures likely before individuals knew whether they had permits.

**Table 2. Average 1991 Sandhill Deer Hunting Expenditures Reported in Expense Diaries and Surveys**

Expenditure Type	Diary Mean (Std. Error) N=115	Survey Mean (Std. Error) N=104	t-Statistic <sup>a</sup> (Significance)	Significant Difference in Percentage Zero Expenditures?
Restaurant meals	\$8.87 (1.18)	\$11.89 (1.81)	-1.40 (0.165)	NO
Groceries	\$8.63 (0.86)	\$10.89 (0.86)	-1.49 (0.138)	NO
Fuel	\$17.70 (1.67)	\$25.93 (2.29)	-2.91 (0.004)	NO
Hotel	\$3.69 (1.04)	\$4.39 (1.42)	-0.40 (0.692)	NO
Lodging other than hotel	\$0.17 (0.17)	\$1.69 (1.06)	-1.41 (0.160)	NO
Other	\$8.05 (1.59)	\$4.57 (1.61)	1.54 (0.126)	YES
Total	\$47.12 (3.99)	\$59.40 (5.78)	-1.74 (0.083)	NO

<sup>a</sup>This is a two-tailed test for equal means and unequal variances. The implications of the *t*-test do not change if we assume equal variances. We also conducted *t*-tests on the positive expenditures only and found the results to be consistent with those shown in this table.

### Sandhill Deer Hunt 1992

On 31 October 1992, deer hunters interested in obtaining a permit for the 14–15 November general public, antlerless-only deer hunt at Sandhill Wildlife Demonstration Area had to apply in person at Sandhill. This differed from the 1991 hunt in that hunters were given permits for one antlerless deer. So a hunter who was not successful on Saturday (14 November) could return the next day and try again. In 1991, the permits were for one day only. We gave out expense diaries to 115 of the 231 hunters who were issued a permit during the in-person registration. Three of the hunters who received expense diaries did not appear for the 14–15 November deer hunt. Diaries were collected as hunters entered Sandhill on Saturday. As hunters who were not successful on Saturday incurred more expenses if they decided to return on Sunday, we issued another diary to the unsuccessful Saturday hunters as they left Sandhill and collected them as they entered Sandhill on Sunday. The expenses from the second diary issued to unsuccessful hunters were added to those reported in the diaries that were collected on Saturday. The expenditures reported in table 3 are for the "Sandhill hunt" which was one day for some hunters and two days for those who were not successful on the first day. The 117 hunters who did not receive an expense diary were sent

an expenditure survey after the hunt. One hundred nine (93%) of the hunters who were sent an expenditure survey returned it to us.

The distributions of responses to questions about demographic background (income, education, and employment status) were similar for both the diary and survey respondents. Therefore, we assume that our attempt to randomly divide the group of hunters by treatment was successful.

In five of the six expense categories, the average expenditures reported in the expense diary were greater than those reported in the survey (table 3). However, based on the results of *t*-tests, the difference between the average reported expenditures in the diary and the survey is only significant for two categories, restaurant meals and groceries. The difference between average expenditures on restaurant meals reported in the diaries and the surveys is significant at the 10% level. The average expenditure reported in the diary for groceries was \$30 compared with \$19 in the survey, the difference being significant at the 5% level. This difference in reported grocery expenditures seems to be responsible for the significant difference in the total average expenditures for the diaries and the surveys. When grocery expenditures are excluded from the calculation of total average expenditures, the difference is not significant at either the 5% or 10% level. As mentioned earlier, individuals who were not successful on Saturday's hunt were asked to keep track of expenses they incurred to come back on Sunday and try again. Many of the hunters reported incurring expenses on Saturday night at taverns for beer purchases (beverage purchases were reported in the grocery category). One might hypothesize that survey respondents made similar expenditures on Saturday night but were not able to recall as clearly how much they spent since they reported the expenditures at least a week after the hunt.<sup>4</sup>

### Sandhill Deer Hunt 1993

More data were collected at Sandhill in 1993. The hunt in 1993 differed from previous years in that only youth and first-time adult hunters with a chaperon were given permits. Permits were issued after completion of a workshop at Sandhill in July 1993. The hunt was 6–7 November. As in previous years, the hunting permit population was randomly split so that approximately half received expenditure diaries and half received ex post expenditure surveys. Separate diaries or surveys were mailed to the chaperon and the youth or first-time adult hunter. However, each pair of hunters (the chaperon and the youth or first-time adult) received the same treatment (either both a diary or both a survey). In many cases, the chaperon and youth were a parent and child, and the chaperon and first-time adult hunter were spouses. There were also some pairs of hunters who were unrelated individuals. We stressed that only expenses paid for by the individual completing the diary or survey were to be recorded. This warning was to avoid double counting of expenditures. As in 1992, unsuccessful hunters on Saturday were given another expense diary to keep track of expenses associated with returning on Sunday.

As with the other data sets, the results of contingency table analysis suggest that the diary and survey respondents had similar levels of education, employment, and income. The two

<sup>4</sup>One of the reviewers suggested that this explanation of the difference due to spending at taverns seems gratuitous. However, we went through each diary individually to investigate this difference. We found that removing reported expenditures at taverns on Saturday night resulted in an insignificant difference in the expenditures reported in the diaries and surveys. We did not feel that dropping these expenditures from the data set was justified as we have no reason to believe they are not valid.

**Table 3. Average 1992 Sandhill Deer Hunting Expenditures Reported in Expense Diaries and Surveys**

Expenditure Type	Diary Mean (Std. Error) N=112	Survey Mean (Std. Error) N=109	t-Statistic <sup>a</sup> (Significance)	Significant Difference in Percentage Zero Expenditures?
Restaurant meals	\$14.75 (1.73)	\$10.58 (1.42)	1.86 (0.064)	NO
Groceries	\$30.14 (2.51)	\$19.40 (1.62)	3.59 (0.000)	NO
Fuel	\$33.89 (2.44)	\$29.25 (2.66)	1.28 (0.201)	NO
Hotel	\$3.18 (1.54)	\$2.91 (1.23)	0.14 (0.888)	NO
Lodging other than hotel	\$2.03 (0.62)	\$3.12 (1.10)	-0.86 (0.391)	NO
Other	\$14.42 (1.82)	\$9.54 (3.82)	1.15 (0.251)	YES
Total	\$96.59 (6.88)	\$74.48 (7.38)	2.19 (0.030)	NO

<sup>a</sup>This is a two-tailed test for equal means and unequal variances. The implications of the *t*-test do not change if we assume equal variances. We also conducted *t*-tests on the positive expenditures only and found the results to be consistent with those shown in this table.

groups of respondents also traveled from approximately the same distance on average to Sandhill. Therefore, we assume that differences in expenditures are due to the treatment.

The expenditures reported in table 4 are for the combined expenses of the chaperon and the youth or first-time adult. The total average expenditures reported in the survey (\$205) were slightly higher than those reported in the diary (\$197). However, *t*-test results indicate the difference is not significant. When we compared the percentage of reported zero expenditures for the various categories, we found that significantly more survey respondents reported zero expenditures in the "other" category.

### Conclusions

The results of these four experiments seem to suggest that although total expenditures reported in a survey may be different on average than expenditures reported in an expense diary, the difference is, at least in our experiments, not statistically significant for most expense categories. Individuals seem to be able to recall expenditures associated with a particular recreational activity accurately when surveyed soon afterward. The 1992 Sandhill

**Table 4. Average 1993 Sandhill Deer Hunting Expenditures Reported in Expense Diaries and Surveys**

Expenditure Type	Diary Mean (Std. Error) N=87	Survey Mean (Std. Error) N=82	Difference in <i>t</i> -Statistic <sup>a</sup> (Significance)	Significant Difference in Percentage Zero Expenditures?
Restaurant meals	\$38.19 (4.19)	\$39.05 (4.44)	-0.61 (0.540)	NO
Groceries	\$32.88 (2.91)	\$34.06 (3.13)	-0.28 (0.783)	NO
Fuel	\$60.81 (4.84)	\$64.63 (4.83)	-0.56 (0.577)	NO
Hotel	\$33.85 (6.61)	\$35.36 (5.63)	-0.19 (0.849)	NO
Lodging other than hotel	\$0.77 (0.48)	\$1.24 (0.54)	-0.66 (0.723)	NO
Other	\$30.96 (11.25)	\$30.28 (10.63)	0.04 (0.965)	YES
Total	\$197.46 (18.38)	\$204.63 (19.98)	-0.26 (0.792)	NO

<sup>a</sup> This is a two-tailed test for equal means and unequal variances. The implications of the *t*-test do not change if we assume equal variances. We also conducted *t*-tests on the positive expenditures only and found the results to be consistent with those shown in this table.

data did show a significant difference between total average expenditures reported in a diary and those reported in an ex post survey due to a significant difference in the grocery category. We think this may be due to expenditures on alcoholic beverages which might be different from other types of expenditures associated with recreation. Furthermore, the finding that significantly more survey respondents reported zero expenditures in the "other" category suggests that individuals are better able to recall expenditures if the type of expenditure is explicitly stated.

Some caveats are in order. Sample sizes were rather small. The results are less conclusive than they would have been had we been able to increase the sizes of our samples. In the Sandhill case, only trip-related expenditures were estimated. Longer periods of time between the survey and the activity may affect an individual's ability to accurately recall expenditures as found by Chu et al. Additional research could clarify the strength of this probable tendency.

Still, given the widespread use of surveys to collect data on expenditures for recreational activities, the results are encouraging. To be on the safe side, expenditure surveys should be conducted as soon after the recreational event as possible.

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## References

- Chu, A., D. Eisenhower, D. Morganstein, and J. Waksberg. "Investigation of Possible Recall/Reference Period Bias in National Surveys of Fishing, Hunting and Wildlife-Associated Recreation." Contract 14-16-009-008. Rep. to U.S. Fish and Wildlife Service, Rockville MD, 1989.
- Conover, W. J. *Practical Nonparametric Statistics*. New York: John Wiley and Sons, 1980.
- Silberstein, A. R., and S. S. Scott. "Expenditure Diary Surveys and Their Associated Errors." Paper prepared for the International Conference on Measurement Errors in Surveys, Tucson AZ, 11-14 November 1990.
- Stanton, J. L., and L. A. Tucci. "The Measurement of Consumption: A Comparison of Surveys and Diaries." *J. Mktg. Res.* 19(1982):274-77.
- Sudman, S., and R. Ferber. "Experiments in Obtaining Consumer Expenditures by Diary Methods." *J. Amer. Statis. Assoc.* 66(1971):725-35.
- Wind, Y., and D. Lerner. "On the Measurement of Purchase Data: Surveys versus Purchase Diaries." *J. Mktg. Res.* 16(1979):39-47.