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## 0-5 Heaping of Tourism Survey Expenditure Responses: Does it Matter?

Survey respondents often round responses to values ending in 0 or 5. Examination of bias from this for mean and total expenditures has not yet occurred. For fishing a 7% error due to heaping has been demonstrated. Such error can have practical consequences. Graphics for a Taiwan foreign visitor exit survey and for the Canadian travel survey are used to facilitate discussing 0-5 heaping and its consequences. It is clear, that distinctive heaping patterns exist suggesting that heaping bias can be understood and predicted. Practical and academic reasons to learn more about expenditure heaping and bias are considered.

*Key words*: expenditure responses, 0-5 heaping, prototypes, estimate bias

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Seminal social science articles on response heaping appeared in about 1989 (Hultsman, Hultsman, & Black, 1989; Huttenlocher, Hedges, & Bradburn, 1990). Because of concern about the bias caused by heaping influencing decisions made, using information articles have appeared in various fields (e.g., Miller & Anderson, 2002; Tarrant & Manfredo, 1993; Pickering, 1992; Rodgers, Brown, & Duncan, 1993; Rowe & Gribble, 1994; Rubin, 1996; Wen, Kramer, Hoey, Hanley & Usher, 1993). However, no tourism literature on heaping of expenditure responses was found. Nevertheless, many researchers will have noted that respondents typically give expenditures ending in 0 or 5. Not only do most responses end in 0-5, the gap between values on which responses are heaped widen as responses get larger (Figures 1 and 2). While one sees most responses ending in 0 or 5 (Table 1), logically the probability is only roughly 1/5 that an expenditure, $x$, or of one of $x$'s "neighbors" (e.g., $x - 2$, $x - 1$, $x + 1$, and $x + 2$) ends in 0 or 5. Is the consequence of most responses ending in 0-5 when most should not, large errors in means and totals of expenditures?

In cognitive psychology, the phrase *using a prototype* refers to 'representing' a range of responses by a single value (Huttenlocher et al., 1990; Reed, 1996). Using prototypes is a way of dealing with uncertainty in recall and Huttenlocher et al. (1990) believe people use them without any idea that their use may lead to serious bias in mean or total expenditures. However, when responses of 100, 500, 1000 and more contribute heavily to totals or means, treating these "best guesses" as accurate responses can result in errors that are large compared to the variability in estimates that is being paid for by having a large sample size. Beaman, Vaske, and Grenier (1998) determined a 7% bias occurred in fishing estimates as a result of heaping. They concluded

that the *bias from 0-5 heaping was not caused by respondents but resulted from not taking prototype use into account in making estimates.*

In Tarrant & Manfredo (1993) measurement of 0-5 heaping was by the proportion of responses ending in 0 or 5. Beaman, Vaske, Donnelly, and Manfredo (1997) introduced a measure of 0-5 heaping that tends to be near 0 when there is no 0-5 heaping and 1 when all responses are 0-5 heaped. However, given virtually all expenditure responses are in heaps, this measure is not useful for assessing expenditure heaping. Development is needed of a measure that gives information on the potential for estimates to be biased by a given amount. See Vaske & Beaman (in press) for other consideration of heaping.

<div align="center">Real Patterns and Some Things to Consider</div>

Figure 1 gives one a feel for expenditure response heaping. Frequency functions have been "normalized" to 100 for the greatest frequency that occurred with other frequencies as "parts/percents" of the largest. Canadian Travel Survey (CTS) data for 1994 and 1996 were used (Search for CTS at http://www.statcan.ca/ for documentation; Statistics Canada, 2005). Broad and narrow lines differentiate 1994 and 1996. From the figure, one sees expenditure type heaping patterns for 1994 and 1996 are very similar, and sees very different heaping patterns for different types of expenditures. For "clothes" there are probably often multiple expenditures making quite precise recall difficult compared to "lodging" for which there may be one expenditure. Therefore, one sees more small heaps for lodging. It is reasonable to think that large and more widely spaced heaps means more inaccurate approximations and therefore greater error in means and totals. However, because of lack of study, when expenditure heaping is obvious and reflects approximate recall, one has no idea about how it affects means and total being used in policy, planning and research.

A practitioner may feel that expenditure heaping should only be a concern of researchers. To a degree that is true. It is researchers who should be studying the psychological process to arrive procedures to see that planning and management information is not distorted by bias. Evidence for heaping being a psychological process that can be understood is growing (Beaman, Vaske, & Miller, in press). The author encountered such evidence in expenditure data from residents of the USA and Japan. Figure 2 shows heaping for $1.00USA and 100Yen for Taiwan's outbound visitor survey (Tourism Bureau of Taiwan, 2002). In spite of have grown up using different languages, being educated differently, using different currency, etc., Japanese and USA respondents exhibit similar 0-5 response heaping. Similar graphs for other expenditures were similar. "Systematic" behaviour suggests that research can understand and thus predict consequences of expenditure heaping.

## Practical and Research Implications

Given extensive heaping of expenditure responses and the real possibility that this results in errors in means and totals that impact decisions made based on them, practitioners should be pressuring researchers to arrive at ways to assess when heaping should be of concern and to correct for it when needed. That patterns persist across ethnic/cultural lines, is evidence that research can be successful. A first step in supporting practitioners is finding principles that allow measurement of expenditure heaping in a way that relates to correcting for bias. Researchers' goal should be correction approaches that are relatively easily and cheaply applied to a wide variety of expenditure data.

## Conclusion

This article has taken the reader through a progression of ideas. The bottom line is that research on bias in expenditure estimates caused by 0-5 heaping is needed. It also follows that it

is reasonable to think that appropriately focused research will lead to both a better understanding

of such bias and to some ability to correct for it, when correction is needed.

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Table 1

*Heaping comparison for Taiwan visitors from USA and Japan who reported expenditures in their "home" currency in Taiwan's 2001 foreign visitor exit survey*

| Expenditure Category | Sample Sizes | | Proportion Expenditures Values Not on 0-5 | |
|---|---|---|---|---|
| | Japanese Residents | USA Residents | Japanese Residents | USA Residents |
| Spending inside hotel | 410 | 776 | 0.020 | 0.045 |
| Food & beverage outside hotel | 848 | 700 | 0.026 | 0.043 |
| Transportation | 566 | 538 | 0.048 | 0.061 |
| Entertainment | 434 | 273 | 0.039 | 0.043 |
| Miscellaneous | 303 | 311 | 0.044 | 0.064 |

Figure 1

*"Normalized" patterns in expenditure response heaping for the Canadian Travel Survey 1994-1996 (see text for "normalized")\**
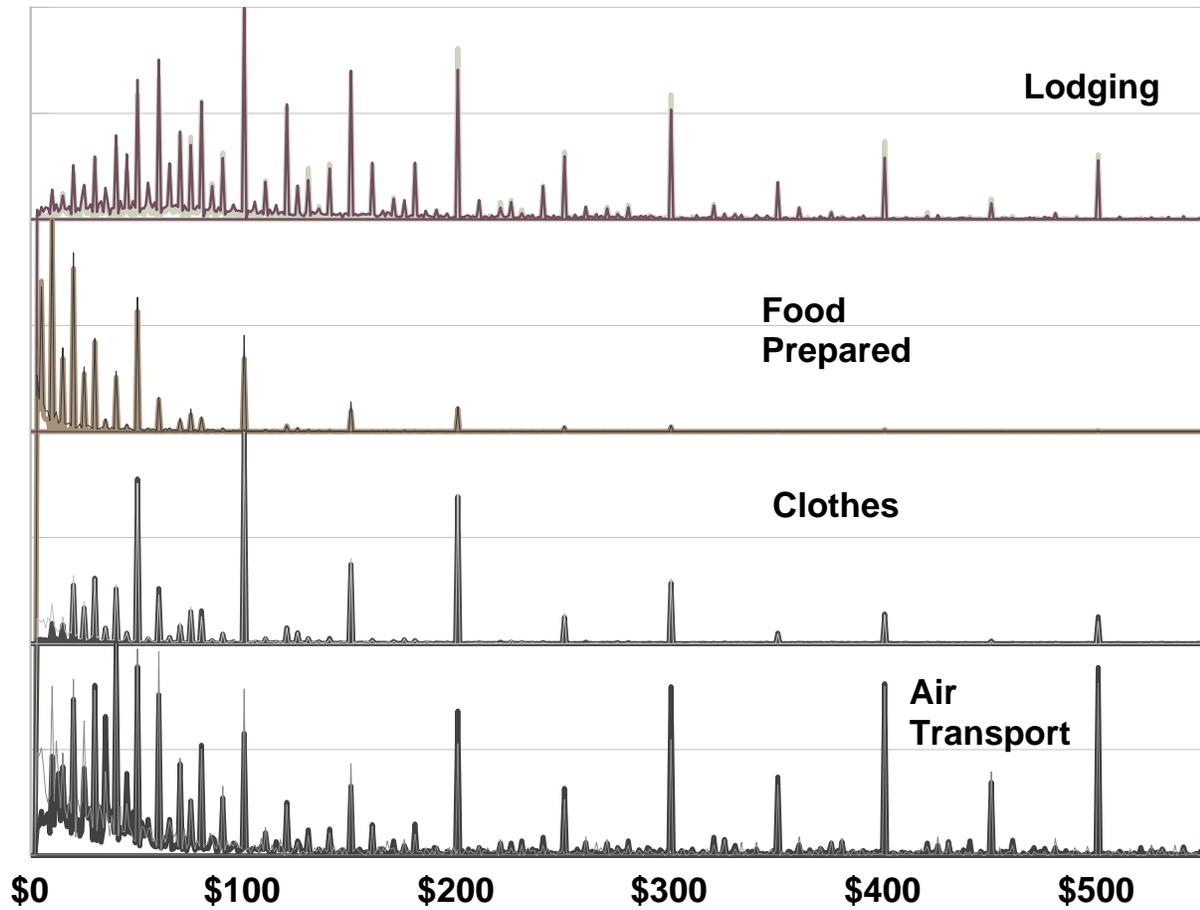


*The low "continuous" pattern is largely from Statistics Canada computing some responses.

Figure 2

*Food and beverage expenditure frequencies for USA and Japanese visitors to Taiwan reporting expenditure in domestic currency (scale is $US and 100Yen)*