ONLINE TRAVEL SURVEYS AND RESPONSE PATTERNS

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Submitted Exclusively for Journal of Travel Research
First Submission: May 13, 2008; Second Submission: October 15, 2008;
Final Submission: January 22, 2009

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ACKNOWLEDGEMENTS

The author would like to thank Dr. Tanya MacLaurin at the University of Guelph for providing the initial idea and a reference for the study; also sincere thanks go to Dr. Stephen Litvin, Dr. Wayne Smith, and Dr. Robert Frash at the College of Charleston for valuable comments and discussions; thanks to Dr. John Crotts and Melinda Patience at the College of Charleston, who also worked on the survey projects in this study; thanks to Dr. Daniel Fesenmaier from Temple University for providing critical feedbacks for the paper. Also thanks to the anonymous reviewers for constructive comments and suggestions.
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ABSTRACT

This paper reviews the benefits and issues with online surveys as it relates to response rates, speed of response, representativeness of the samples, and the differences in results due to different survey medium. Analysis of the response data for four travel-related online surveys showed consistent response patterns. This paper demonstrates that an exponential growth model is most appropriate when modeling the numbers of returns over time. The model can predict the final number of returns based on seven or eight days’ survey return numbers with a relatively small degree of error. The study suggests that surveying a pilot sample and analyzing their responses can allow a researcher to estimate the parameters of the response model for a large scale survey and thus conduct a study in a more effective way.

Keywords: Internet Survey, Web Survey, Online Travel Survey, Response Time, Exponential Growth Model
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INTRODUCTION

Survey methodology is one of the most, if not the most, widely used methodologies in the tourism research field, for the purpose of understanding travelers’ behavior, psychology, and economic impacts; for a few examples, see (Bai, et al. 2004; Beldona 2005; Card, et al. 2003; Cha, et al. 1995; Fesenmaier 1994; Gursoy and McCleary 2004; Hwang and Fesenmaier 2004; Kim, et al. 2007; Lehto, et al. 2006; Long and Perdue 1990; Luo, et al. 2004; Weber and Roehl 1999). With the emergence of the Internet, online surveys have quickly gained popularity (Schonland and Williams 1996; Tierney 2000). In general, compared to traditional mail surveys, online surveys allow researchers to quickly and easily design and implement surveys and collect participant responses (Dillman 2007; Tierney 2000). There are two common types of online surveys: nonprobability surveys used by popular media companies for entertainment purposes and probability surveys used for sampling the Internet population or given email lists (Couper 2000). There are also many off-the-shelf online tools available to create online surveys and collect responses including the following: QuestionPro (http://www.questionpro.com), Zoomerang (http://www.zoomerang.com/), and SurveyMonkey (http://www.surveymonkey.com/). While generally easy to learn and use, these tools usually have pre-defined templates, which limit the flexibility of online surveys; for example, they do not accommodate complex skip patterns. However, with just elementary programming knowledge, one can use Web CGI (Common Gateway Interface) programming tools, access to web server software and bypass the pre-defined survey templates, allowing for more customization (Yun and Trumbo 2000).
Researchers caution users of online surveys to consider methodological issues related to the specific medium when adopting the Web as the primary medium for survey delivery (Hwang and Fesenmaier 2004; Tierney 2000). Concerning issues include response rates, representativeness of online samples, technical uncertainty of online surveys, and the overall effects on the survey results (Couper 2000; Dillman 2007). For example, studies in other fields have shown that online surveys capture a slightly different population compared to other survey methodologies (Couper 2000; Ross, et al. 2003). Online respondents are also more likely to respond to sensitive and private questions and provide more text on open-ended questions (Ritter, et al. 2004; Wang, et al. 2005; Wang and Fesenmaier 2006).

With an increasing population of Internet users and refinements of the methodology, online surveys will be continue to gain popularity and more likely become the preferred medium for travel survey research (Dillman 2007). Little research, however, has been conducted on response patterns: Does the response speed of online travel surveys follow consistent patterns? How fast are online surveys returned by most respondents? How long should a researcher wait to collect sufficient responses? In other words, at what point is it considered that a researcher has received most if not all responses that are going to come in for the survey? Does the researcher need to send out a reminder email? How many surveys in total should a researcher expect given the numbers of responses from the first few days? In order to collect an appropriate number of responses with limited effort and to determine the initial survey sizes for sending out solicitations, it is important to address these questions; the answers would allow a tourism business to respond more effectively to a changing market environment using online surveys.
This paper first reviews past studies on the benefits and issues related to online surveys. Further, based on four different types of tourism-related online surveys, this study aims to determine the best mathematical model to fit online survey response patterns so that the model can be used to predict the total number of returns from response data received during the first few days of surveying. In addition, with the understanding of response time during one day, the goal of this study is to help researchers determine the best time of day to send out solicitations in order to maximize response rates.

LITERATURE REVIEW

Internet surveys are preferred over traditional mail surveys in many ways; however, the methodological concerns associated with online surveys needs to be understood. Numerous articles have been published on the benefits and issues related to online survey methodology, including speed of responses, response rates, representativeness of online samples, technical uncertainty related to online surveys, and overall effects on survey results (Cook, et al. 2000; Couper 2000; Dillman 2007; Hamilton 2003; Ilieva, et al. 2002; Sheehan 2001). Studies on patterns of responses over time have been published in regard to mail surveys and direct marketing campaigns (Basu, et al. 1995; Hill 1981; Huxley 1980; Parasuraman 1982). However, due to the different natures of these media forms, it remains questionable as to whether or not the response patterns of mail surveys and mailing campaigns can be applied to online survey methodology. The next section will discuss the definitions, advantages and issues pertaining to online surveys, with additional emphasis given to studies on survey response patterns.
Defining Online Travel Surveys

There are many forms of surveys utilizing Internet technologies. On the technology side, surveys can be embedded in and returned through email messages (Dillman 2007); solicitation messages can be displayed randomly via pop-ups from web sites; a survey can be designed and delivered through online survey web sites such as Zoomerang.com. A researcher can also use mixed methodology, for example including the web address of the online version on mail surveys allowing respondents to fill out the same survey online. With the development of advanced Internet technologies, new forms of surveys are likely to continue emerging.

Online surveys can also be distinguished by the methods of sampling (Couper 2000). Many popular media, such as CNN.com, use nonprobability and self-selected online surveys for news and entertainment purposes; other online surveys use probability sampling of an online population or subscribers of email lists (Couper 2000).

Researchers have defined Internet survey as survey methods for designing the instrument, drawing a sample, and/or disseminating the results using Internet technology (Hwang and Fesenmaier 2004). For purposes of the current discussion, the term online survey will be adopted and defined specifically as survey solicitations delivered through emails and survey responses collected through a web site. This type of survey is gaining more and more popularity primarily because email solicitations are faster to deliver, bypassing the delays of the postal service system, and survey forms on a web site are more customizable than email surveys; it could also eliminate the cost of data entry (Dillman 2007). There are two possible survey populations in the
tourism industry: the visitors or travelers and tourism businesses and professionals (Pan and Fesenmaier 2000). Consequently, online travel surveys can be defined as those online surveys intended to understand the demographics, behavior, spending patterns, or other behavioral aspects of tourists; online tourism surveys are those online surveys which target tourism professionals or businesses in order to understand the economics, development, management, or marketing of tourism businesses and the tourism industry. This study is focusing on the former type. The following sections review issues related to online surveys in general.

Advantages of Online Surveys

The Internet brought about a revolution in survey research (Dillman 2007). Compared to traditional mail surveys, Internet surveys have many advantages: they eliminate postage, mailout efforts, and sometimes data entry costs; with the help of various Internet technologies, researchers can design surveys with more interactive content, richer format, and complex skip patterns (Dillman 2007; Schaefer and Dillman 1998; Sheehan 2001).

Speed of Responses. With the nearly-instantaneous traveling speed of computer-to-computer communication from one corner of the world to another, the response time of online surveys is generally much shorter due to the elimination of geographical barriers (Dillman 2007; Hwang and Fesenmaier 2004). One study showed that, on average, email surveys can be returned in as few as 5-10 days while mail surveys took about 10-15 days (Sheehan and McMillan 1999), and a survey on hospitality educators also showed significant time savings in regard to receiving responses (Cobanoglu, et al. 2001). Online surveys allows tourism researchers and practitioners to gather feedback at a faster speed: in the tourism research field, this could dramatically shorten
the research cycle; in the tourism industry, through market surveys, tourism businesses could proactively respond to their customers’ needs and wants in a more timely fashion. They would be able to understand the market environment and adjust their service and marketing efforts accordingly, gaining a competitive advantage.

*Cost of Surveying.* The cost of online surveys can be significantly lower in large due to reduced or eliminated use of paper and mailing cost (Dillman 2007; Sheehan 2001; Sheehan and Hoy 1999). Email surveys can cost only 5% to 20% of paper surveys (Sheehan and Hoy 1999). The savings can add up especially with larger sample sizes (Sheehan 2001; Watt 1999).

*Interface Advantages.* Online surveys can be designed in a way that is more interactive and easier to navigate (Dillman, *et al.* 1998). They also allow the researchers to include multimedia and complex skip patterns (Couper 2000; Schaefer and Dillman 1998).

*Survey Tracking.* Online surveys can provide researchers the detailed traces about survey response time and pattern; for example, the exact time, down to the second, when a respondent filled out a survey and the exact page that one abandoned a survey. This information provides survey researchers with the great advantage of understanding response patterns, enabling them to continue refining their methodology through a more in-depth understanding of their target populations’ response behavior.

*Open-ended and Sensitive Questions.* Compared to paper surveys or telephone interviews, several studies have shown that respondents will provide more information for open-ended
questions in online surveys (Paolo, et al. 2000; Schaefer and Dillman 1998). Respondents are more likely to disclose sensitive information in online surveys, such as alcohol consumption, usage of substances, and sexual activity (Link and Mokdad 2005; Wang, et al. 2005).

Methodological Issues with Online Surveys

Despite the many benefits of online surveys, researchers are wary of adopting online surveys because of the many methodological concerns. These are mainly related to low response rates, representativeness of samples, technological uncertainty, and the effects of survey media on the research results.

Response Rates of Online Surveys. Response rates for email surveys can range from 6% to 75% (Sheehan and McMillan 1999). Another study conducted more than eight years ago has reported an average of around 40% for response rates from a synthesis of 39 separate online surveys (Cook, et al. 2000). In general, most of the previous studies show that Internet surveys may induce a lower response rate (Best, et al. 2001; Leece, et al. 2004; Sheehan and McMillan 1999). A small quantity of studies, especially email surveys in the early years of the Internet, showed a higher response rate than mail surveys (Cobanoglu, et al. 2001; Parker 1992). The latter cases may be due to the novelty effects of the online surveys and the Internet in general (Schaefer and Dillman 1998). There are many factors that may influence the response rates of online surveys (Sheehan and McMillan 1999). Ways to increase response rates include having more instances of contact, more personalized contact, and the use of precontacts. It is also important to create email solicitations, distinguishable from spam emails, since email solicitations might be blocked by spam filters. Despite the varying percentages of response rates, researchers have observed a
declining rate of response with online surveys over time (Sheehan 2001). The Internet population has evolved from a cohesive and small population mainly in higher education and research institutions to almost everybody (Dillman 2007); the amount of emails we receive, especially junk mails, are increasing dramatically; some of those malicious emails also contain computer viruses (Sheehan 2001). All these factors contributed to the declining response rates of online surveys. Survey researchers also noticed this same trend in mail surveys (Goyder and Leiper 1985). This might be due to our more hectic life style, information overload in our everyday life, and our limited attention span.

Representativeness of Online Surveys. The main concerns in online survey methodology include the representativeness of the respondents and the factors that may influence response rates. In the United State, about 72.5% of the population have Internet access; only 45% of homes have broadband access (Horrigan 2008; Nielsen/NetRatings 2008). Since Internet respondents tend to be younger and more educated (Best, et al. 2001; Ross, et al. 2003), the representation of the online population might be the major challenge on the legitimacy of online survey research (Best, et al. 2001; Couper 2000). Providing Internet access to those under-represented in the online population might be one way to mitigate the problem, but the method is costly to implement (Couper 2000). Furthermore, a lack of computer expertise of certain respondents might restrict the successful completion of an online survey, which further exacerbates the representativeness problem. In the tourism area, Hwang and Fesenmaier (2004) have argued that Internet users are prone to coverage biases due to the self-selecting nature of online travelers who are willing to participate. However, other studies show that there is no sampling bias in the content of responses on information source usage for politics or political decisions (Best, et al. 2001;
Hayslett and Wildemuth 2004). Other researchers also showed that the Internet started to mirror the general population (Kehoe, *et al.* 1997) and a mixed method with online and offline surveys could alleviate the problem (Schaefer and Dillman 1998). Others argued that one could use statistical adjustment methods, such as post-survey weighting, to counter the nonresponse bias (Couper 2000).

With a futuristic perspective, the representativeness problem of online surveys will become less of an issue when Internet broadband access is more ubiquitous; but the accurate representation of a certain group of people in an online survey may remain as a problem due to the self-selecting nature of online respondents. The latter problem is not unique to online surveys but to survey methodology in general. Thus, when conducting an online survey, it is more critical than ever to have a thorough understanding of the differences between those respondents who are willing to respond versus those who are not.

**Technological Uncertainty.** Unlike paper surveys, online surveys need to be delivered through respondents’ hardware, software, and Internet connections and thus, are subject to the limitations of the technological infrastructure (Dillman 2007). Survey questions might appear differently depending on web browser types, browser settings, user preferences, computer screen configurations, computer speed, and the speed of Internet connection (Couper 2000; Dillman, *et al.* 1998). This problem is worse with more interactive and complex surveys designed with advanced technologies such as Java. All these factors may contribute to measurement errors in that the interactions between the respondents and the display of the surveys are not entirely controllable. Many different email spam filters may transfer the solicitation emails to spam
folders, which will influence the response rates. Furthermore, technical infrastructure might induce privacy concerns: confidentiality can hardly be guaranteed since the survey responses contain the IP (Internet Protocol) addresses of the respondents, or employers might be monitoring the Internet access of their employees when they are filling out online surveys (Couper 2000).

Survey Response Patterns

Several studies have been conducted on the response patterns of mail surveys. Early papers showed that the mail surveys tended to be returned rather rapidly in the early stages followed by a gradual decline. This pattern is universal regardless of subject matter, quantity, or quality of responses (Huxley 1980). Thus, Huxley (1980) used a simple exponential model to fit the response patterns:

\[ R_t = N - a b^t \]

- \( R_t \): Number of responses received at week \( t \);
- \( N \): Total number of initial mailing;
- \( t \): Number of weeks from initial mailing;
- \( a, b \): Parameters to be estimated empirically.

In the formula, \( b \) can be viewed as the resistant rate of respondents on returning the survey, and it takes the value from 0 to 1, which indicates the declining ratio of the number of responses compared to the number in the previous week. In his study, the author then used a survey to demonstrate that this model fit the empirical data well. Using the returned survey data for the
first few weeks to model the response patterns, the $r^2$ for the regression models usually ranged from .94 to .98. As a result, when estimating the final numbers of responses from the initial few weeks, the rates of errors were relatively small (from 9% to 22%). He also reported survey response data from other studies to corroborate the validity of the exponential growth model. Thus, the exponential growth model appeared to be a good fit in predicting future survey returns from the response numbers in the initial weeks.

However, in the following paper found in the same *Journal of Marketing Research* by Hill (Hill 1981), the S-shaped curve was demonstrated to be more superior to the exponential growth model in predicting future responses. Compared to the exponential growth model, S-shaped curves have a slower beginning and a steeper tail. This indicates that fewer responses may come back in the early stage and more returns will be expected at the end, when compared to the exponential growth model. He proposed two types of S-shaped curves:

Logistic: $y = \frac{1}{a+be^{ct}}$

Gompertz: $y = e^{a+be^{ct}}$

In those two models, $a$, $b$, and $c$ are parameters to be estimated and $t$ is the number of weeks from the initial mailing; $e$ is a constant value and can be approximated at 2.71828183. He finally determined that a revised logistical model is the best fit:

$$y = \sqrt{\frac{1}{a+be^{ct}}}$$
Another follow-up article (Parasuraman 1982) pointed out that the exponential model did not take the follow-up mailing into account. With additional analysis, the researcher demonstrated that an S-shaped curve did fit the response patterns better than the exponential growth model.

More recently, a study on direct marketing campaigns used the response data of four mail orders to model the response through time (Basu, et al. 1995). They based the new model on the naïve model of exponential growth proposed by Huxley (1980). However, their model took into account the different time the respondents may receive the mail. Thus, using the maximum likelihood procedure, they added different starting times onto the original exponential model. Their models performed significantly better than the naïve model and other alternative models.

Response Patterns of Online Surveys

The Internet and the mail are two different media and delivery channels, and thus the response patterns of mail surveys might not be applicable to online surveys. For example, emails transfer almost instantaneously across the world (in the speed of light and electricity) and the respondents will receive the solicitation message almost at the same time. Thus, the assumption of different starting time from the model by Basu et al. (1995) will not be applicable. This author has yet to locate any academic research on response patterns of online surveys. A few exceptions came from reports from commercial companies. For example, SuperSurvey.com compiled a white paper on the response rate and time of the online surveys conducted on their web site (Hamilton 2003). From their analysis of 199 online surveys, the response rates varied sharply: the median was 26.5% and the average was 32.5%. Those large consumer surveys with sample sizes more than 1,000 tend to have lower response rates. Half of the surveys were returned in one day;
96.5% of all the surveys were returned in two weeks. However, the author did not specify whether or not email reminders were used. S/he concluded that the early hours in a day (6AM to 9AM) were the best time for soliciting participation in order to achieve the highest response rates. The author suggested two applicable rules in conducting online surveys: send out surveys in the early hours; and, factor in at least two-weeks for survey response time. The white paper was informative but failed to provide a general model for responses. The fact that this was done by a single web survey service (http://www.SuperSurvey.com) may also limit its applicability to other online surveys.

**METHODOLOGY**

The current study used survey response data from four different web-based surveys in the tourism context. The four surveys had different sample populations and used different survey tools. However, the populations sampled were all events or tourism related; they were all based on email solicitations with results collected through a web site. The author reported response data gathered from the 35 days when responses were collected. At most, one or two responses were returned after 35 days, so those numbers could be safely ignored. Table 1 and Table 2 list the characteristics of the four web-based surveys. To be noted is the Preservation Society survey, in which the first round of solicitation emails were sent out on two consecutive days. This was due to the fact that the Preservation Society did not feel comfortable giving out the email addresses of their clients to a third party (the author) and thus did the email solicitation independently. The response data from this survey is included since it will show that the general model still fits even with the unique timing of the first solicitation emails.
The four surveys referenced in this study were all based on a tourist city in the Southeast United States: Charleston, South Carolina, USA. It has around 4 million visitors every year (Charleston Area CVB 2006). The surveys were all conducted during the years of 2006 and 2007. However, these four surveys were different from each other in many ways: 1) two surveys sampled visitors of a certain event (Food & Wine Festival survey and Tour of Homes and Gardens survey); and the other two sampled information inquirers either for Charleston or for a golf vacation in Charleston; 2) the sample sizes ranged from 1,215 to 15,000; 3) the surveys were designed using surveymonkey.com, zoomerang.com, or CGI programming by the author; 4) two surveys had incentives (random drawing for a prize) and the other two did not; and 5) survey response rates ranged from around 10% to 40%. A small percentage of email solicitations were returned due to incorrect email addresses and some emails might have been caught by the respondents’ spam filters. The numbers were small and appeared to be random.

RESULTS

One of the benefits of web-based surveys is that the exact time of completing the survey can be precisely tracked. Four surveys’ response data were first analyzed on a day-to-day basis. Figure 1 illustrates the daily response patterns. Only the response patterns of the first 35 days were graphed due the following reasons: 1) there are very few surveys returned after 35 days; 2) it is much easier to compare the patterns when the data were graphed on the same time scale. Table 3 tabulates the response percentages after certain days; response percentage is defined as the
percentage of the numbers of responses after certain days to the number of responses at the end of the 35 days.

Even though the four surveys were conducted under four different contexts, using different methods, and with different sample sizes, the figure and the graph show several common characteristics of online survey responses. First, there are sharp slopes beginning with the first few days; especially on the first day, the response percentages of the first days are generally larger than 70% (Preservation Society survey being an exception, as indicated in previous section); then the return rates flatten out, showing the time decay factor. After two weeks, there are about 10% of responses left to be returned; after three weeks, more than 95% of responses were returned; after four weeks, more than 98% were returned. Secondly, sending email reminders will help increase responses in later days considerably. However, the amount of increase seems dependent on the number of days after the first email solicitation. Thirdly, the response curves after email reminders were sent out follow a similar trend (a sharp increase followed by flattened curve) compared to the survey without any reminders.

*(Insert Figure 1 about here)*

*(Insert Table 3 about here)*

**Fitting Response Pattern Model**

Based on past research, several mathematical models were used to fit the response data. The initial model proposed by Huxley (1980) actually took the initial point \( t = 0, y(0) = 0 \), when no responses were returned at the beginning) into account and included that point in the regression model. For other models, the initial point was not included due to the reason that it might be a great limiting factor since it must fulfill \( y(0) = f(0) \) (Hill 1981; Parasuraman 1982). For this
study, the initial point (0,0) was not included so every statistical model considered will have the same number of data points.

The first survey used to fit response patterns had no follow-up email reminders; thus, the data were cleaner and it provided a model with the most data points. Five different models were used based on past studies (Table 4): (A) the logistic model; (B) one of the derivatives of the logistic model; (C) the Gompertz model; (D) the S-shape model (Hill 1981; Huxley 1980; Parasuraman 1982); and (E) the transformed original exponential growth model proposed by Huxley (the two models are mathematically equivalent) (Huxley 1980; Parasuraman 1982). The parameters of the five models were estimated using SPSS 14.0 nonlinear regression function (Norusis 2006). Table 4 shows the estimated parameters of these five mathematical models.

(Insert Table 4 about here)

For all the models, the $r^2$ ranged from 0.839 to 0.988. Model E, the exponential growth model, seems to be the best fit for the data. In addition, it also has the support from prior research (Basu, et al. 1995; Huxley 1980). Thus, Model E is chosen as the model to fit other response data. Similar to the original exponential growth model proposed by Huxley (1980), the parameters in the model also have specific meaning. For example, in model E, $a$ is actually the predicted final number of returns, giving $b < 0$, $c < 0$, and $t \to \infty$; the parameter $e^c$ (the equivalent of $b$ in Huxley’s model) is the time decaying rate, giving $c < 0$ thus $e^c$ is between 0 and 1, indicating the proportion of returns for a certain day versus the previous day. Since there are three parameters to estimate
in model E, given three or more days of data, we can actually use this model to predict final returns at the end of the survey period.

A plot of residuals was also produced for Model E (Figure 2). It shows some random residuals at the beginning, but after 10 to 14 days, the model shows consistently increasing residuals. The results provide interesting insights into the respondents’ behavior on returning surveys. Besides the time decay factor, by which the number of returns will slow down proportionally from day to day, there was another force that counters this trend: after 10 to 14 days, the rate of decay slowed down. The author hypothesizes that this might be due to a “guilt factor”: after about two weeks, the recipients of the email solicitations felt more and more “guilty” so the actual decreasing rate of responses would slow down. The author tried to use an additional linear component along with the exponential growth model to fit the data; however, the increase of $r^2$ was not significant enough to validate estimating another parameter. A parsimonious model with fewer parameters would be more useful for estimating parameters and predicting future numbers of returns, since it only takes around 35 days for the almost complete return of all the surveys.

(Insert Figure 2 about here)

The author also used Model E, the exponential growth model, to model the different stages of a survey when separated by email reminders, if the survey had those (Table 5). Table 5 shows the results of the modeling: the $r^2$ values ranged from 0.89 to 1.00 (an actual 0.9998), indicating a good model fit. The results validated the appropriateness of exponential growth model for fitting the four online travel survey returns over time.
Predicting Total Responses Using First Few Days of Response Data

Similar to Huxley’s (1980) and Basu’s et al. (1995) studies, the model could be used to predict future responses from a few days of response data. When the surveys had follow-up reminders, the last stage of response data after the last reminder email was used to estimate the parameters of the model and predict the final responses. Table 6 shows the prediction of final numbers of returns (the estimated values of a in Model E, Table 3) with predicted accuracy rates. The final numbers of returns at the end of 35 days were used as the actual final numbers. The results indicate that the model could predict the final response rate within 10% of error rates. However, the predicted values are more likely to be in the lower ends. The Preservation Society survey is an exception since the initial solicitation emails were sent out in two days, instead of all at once.

Response Pattern in the First 24 Hours

The previous patterns showed the time decaying patterns of online surveys in terms of days. However, researchers often want to know, during one day, how quickly will the surveys be returned? Do the respondents tend to return the surveys during certain hours, or do they tend to respond as soon as they receive them? The following sections explore the survey response patterns in a more defined time frame of hours.

First, the number of responses in the first 24 hours was plotted (Figure 3). The hours are technically web server time. The web server is in the Eastern Time Zone of the United States.
(ETZ). The majority of the respondents are also in the ETZ, since Charleston, South Carolina is a regional destination and its markets are mainly in the Southeast and Northeast. The first email solicitations were sent out at different times of the day: from 9AM in the morning to 4PM in the afternoon (Figure 3). However, all the surveys have the highest peaks in the beginning of the survey time. For the Preservation Society survey, there are obvious dual peaks with one at the beginning and one at the end of first 24 hour period. In that survey the solicitation emails were sent out in two consecutive days. These indicate that the respondents of the four surveys tended to fill out the surveys right after they received them. Even after just a few hours, the response rates per hour dropped precipitously. It also shows peaks during the morning, afternoon, and early night hours for the four surveys, indicating that the respondents might have had specific hours to access emails and respond to surveys.

(Insert Figure 3 around here)

Responses in a Day for Non-Survey Day

Given that we know the respondents tended to fill out surveys as soon as they received them, it is obvious that the researchers should send out surveys at the time when desired respondents are checking their emails to maximize response rates. In order to determine the peak hours in a day in which the respondents were more likely check emails, one needs to see which hours the respondents tended to return their surveys. Due to the heavy influence of large numbers of responses in the beginning hours, the authors eliminated the response data from the 24 hour period after sending out the first email solicitations or reminders. The respondents’ local hours might be different from the server hours if they are not located around the East Coast. Thus, the
author translated those server hours into respondents’ local hours using a Zip Code database with
time zone information (ZIPInfo 2007), since. Figure 4 shows the response patterns for non-
survey days. The figures show that most responses were returned during day time and early
night. The late night hours, from 11PM to 6AM (8 hours) only provided only 6.6% of responses.
Especially, three of the four surveys had the highest peaks in the morning from 8AM to 9AM,
extcept the Food & Wine Festival survey. These indicate that most respondents in the four
surveys checked emails and replied to surveys during early morning hours or the early night after
their dinner.

(Insert Figure 4 around here)

By combining the users’ tendency to respond as soon as they received the surveys and the
response peaks during non-survey days, it was clear to see that the early morning hours (8AM to
9AM in the case of the four surveys discussed) seem to be the best time to send out email
solicitations. It would ensure that the email solicitations would be more likely to reach the
respondents’ inboxes while many would be checking emails. It would also minimize the time
that it would take to reach other respondents at other peak times of day when they check their
emails. The time when most of the respondents are resting (from 11PM to 6AM in the four
surveys) should be avoided as the time to send out email solicitations.

CONCLUSIONS, DISCUSSIONS, AND IMPLICATIONS

Online surveys are advantageous to traditional surveys in many aspects: they are faster, cheaper,
easier to implement, more interactive, better for open-ended questions, and can be tracked
precisely. However, there are also methodological concerns: they might not represent the general population; there are technical uncertainties; and the response rates are usually lower. With the advancement of the Internet technology, online surveys will likely become more and more widely adopted (Dillman 2007), including in the tourism industry. Understanding how online travel surveys are returned is crucial for the tourism industry and tourism research.

This study demonstrated consistent patterns of four online travel surveys, in terms of the mathematical model for the returns over time, the time during a day when they are returned, and the individuals’ tendency to respond to the surveys as soon as they receive them. The results demonstrated that the exponential growth model is the appropriate parsimonious model to fit the four online travel surveys. Different from mail surveys, the S-shaped curve is not a good fit. In mail surveys, the geographic distance is one important factor in determining the speed of responses, since the surveys from the respondents who live farther away may require one or two more days to travel back (Basu, et al. 1995). This might be the reason for the slow slope at the beginning of S-shaped curve model and the best fitting for maximum likelihood model (Basu, et al. 1995). With online surveys, the nearly instantaneous delivery of email messages bypasses those geographic barriers.

In the case of the four surveys, one could also predict the final number of returned surveys with a relatively small error rate (less than 10%) by using the first seven or eight days of response data. However, the prediction is usually on the lower end due to a possible “guilt factor”; thus a market researcher could expect a slightly higher final response rate at the end of the survey period.
In these travel surveys, most survey respondents tended to respond as soon as they received the email solicitations. There are peak periods in the day time and early night when the respondents tended to return the majority of the surveys. The early morning hours in the respondents’ local time seem to be the best time for sending out email solicitations, so that the emails will be opened and checked with minimal delay in the respondents’ inboxes.

Following those conclusions, the author would propose the following guidelines in order to more effectively conduct large scale online travel surveys; the goals are to maximize response rates, save surveying costs, and reduce survey errors:

1) Every online email survey should capture detailed response information, including the time a respondent accesses a survey and the time he or she abandons it. On one hand, the information can be used to model return patterns and thus have better control of the total amount of surveys returned and the effort needed; on the other hand, the researchers might better understand the response behavior for a given group of individuals and thus proceed with better knowledge for future projects.

2) Surveying a pilot sample and gathering their responses can allow a researcher to estimate the parameters of the response model and thus predict the future returns. This will also allow the researcher to understand the time when most respondents check their email; with a question asking about their zip codes, the researcher could estimate the time zone where most respondents live;

3) With information gathered from 2), s/he should send out the solicitation emails during the hours when most respondents are likely to check their email. If the respondents live in
different time zones and if the researcher has information about their zip codes, s/he can send out surveys via email solicitation that are strategically associated with the time when respondents are more likely check their email. This could be accomplished with some basic CGI programming, access to a web server, and a zip code database with time zone information (ZIPInfo 2007);

4) Using the initial data from the first few days’ responses, the researcher could estimate the number of final returns using the exponential growth model. This will help to determine whether or not more samples or reminder emails are necessary;

5) Reminder emails should be sent out early, preferably no later than 3 or 4 days after the initial email solicitation.

LIMITATIONS AND FUTURE RESEARCH

Response rates and response patterns might be influenced by many different variables including a different target population, the time when the email solicitations were sent out, the message in the solicitation email subject and body, and etc. However, studying a large number of surveys with all possible combinations of those variables will be extremely difficult, if ever possible. The past studies have used one, two, or at most four studies to study response rates or patterns (Basu, et al. 1995; Cobanoglu, et al. 2001; Hill 1981; Huxley 1980; Parasuraman 1982; Rogelberg, et al. 2006; Sheehan and McMillan 1999; Truell and Goss 2002). Though limited in number, this research provided a study with one of the largest scales. However, all four surveys in this study are specific to a regional tourist destination in the southeastern part of the United States. Survey response patterns in other cities and other fields, and even some tourism-related surveys in a different context- for example, surveys on attendees of a sporting event- need to be tested.
In this study, the author specifically defined *online survey* as survey solicitations *delivered* through emails and survey responses *collected* through a web site. Though this type of online survey is one of the most popular types, there are many more types of online surveys that were not tested in this model (Dillman 2007). Further, *online travel survey* is defined as those online surveys intended to understand tourists’ demographics, behavior, and spending patterns.

The estimated final numbers of returns tended to be on the lower end compared to the actual final returns. The residuals seemed to follow a linear pattern after 10 to 14 days. Thus, the author suggested that this might be due to a “guilt factor”. This needs to be empirically tested and validated; other researchers might try to use other components to model that factor.

It appeared that the earlier the email reminder was sent out, the greater its effect of soliciting more returns. Thus, the first few days seem to be the best time for sending out email reminders. However, the optimal number of days for sending out the first reminders for achieving the highest response rate needs to be empirically tested. For example, a reminder on the next day might also annoy some respondents. Other researchers might try to empirically test the optimal number of days for sending out the first reminders for achieving the best response rates (Schaefer and Dillman 1998).

This study used survey response data to model the response patterns. No behavioral explanation was given as to why the respondents behaved this way. Dillman (2007) used social exchange theory to explain the response behavior of mail surveys. Using costs, rewards, and trust, he
explained how different design elements influenced response rates (Dillman, 2007). The author of this study did not attempt to explain the response patterns of online surveys theoretically, but future research should attempt to explain and test different behavioral theories and thus might produce good methods for increasing response rates.

Furthermore, with the evolution of the Internet and the Internet population, new types of survey methods might emerge and the response patterns might vary as a result. Survey researchers need to keep current with the technological updates and monitor respondents’ behavioral changes closely.
<table>
<thead>
<tr>
<th>Survey Name</th>
<th>First Email Solicitation Time</th>
<th>Reminder Emails</th>
<th>Survey Tools</th>
<th>Incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inquiry Survey for the Charleston Convention and Visitors Bureau, 2006</td>
<td>March 23, 2006, Friday, 4PM</td>
<td>No reminder email</td>
<td>A web-based survey was programmed in-house using Perl CGI on an Apache server; solicitation emails were sent out through Perl Script in one hour.</td>
<td>Win a two-night getaway at a hotel in Charleston, SC.</td>
</tr>
<tr>
<td>Charleston Preservation Society Tour of Homes Visitor Survey, 2006</td>
<td>December 12, 2006, Tuesday, 12PM and December 13, Wednesday, 8AM</td>
<td>December 20, 2006, Wednesday, 12PM</td>
<td>Survey was designed using Zoomerang.com; Email solicitations were sent out through mail merge using Microsoft Outlook in two days.</td>
<td>None</td>
</tr>
<tr>
<td>Charleston Food and Wine Festival Survey 2007</td>
<td>March 14, 2007, Wednesday, 11AM</td>
<td>First: March 19, 2007, Monday, 11AM; Second: March 27, 2007, Tuesday, 8AM</td>
<td>Survey was designed and results were collected through SurveyMonkey.com; solicitation emails were sent out through Perl Script in 5 minutes.</td>
<td>None</td>
</tr>
<tr>
<td>Charleston Golf Inquiry Survey, 2007</td>
<td>December 11, 2007, Tuesday, 9AM</td>
<td>December 19, 2007, Wednesday, 9AM</td>
<td>Survey was designed and the results were collected through SurveyMonkey.com; solicitation emails were sent out through Perl Script in 15 minutes.</td>
<td>Win a two-night getaway at a golf resort in Charleston, SC.</td>
</tr>
</tbody>
</table>
TABLE 2. SAMPLES, RESPONSE RATES, AND DEMOGRAPHICS OF RESPONDENTS

<table>
<thead>
<tr>
<th>Survey Name</th>
<th>Samples</th>
<th>Response Rate</th>
<th>Demographics of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inquiry Survey for the Charleston Convention and Visitors Bureau, 2006</td>
<td>A total of 15,000 randomly selected email addresses from around 75,000 information inquirers to Charleston CVB.</td>
<td>1,541 responses (including partially completed) with a response rate of 10.3%.</td>
<td>64.2% females; 77.6% married; 55.4% college education or above; mean age 49.3; 62.8% full-time employed; 72.4% in Eastern Time Zone</td>
</tr>
<tr>
<td>Charleston Preservation Visitor Survey, 2006</td>
<td>A total of 1,514 email addresses from those visitors who bought tickets online and left their email addresses.</td>
<td>A total of 640 surveys were returned with 42.3% response rate.</td>
<td>No demographic questions; 62.9% in Eastern Time Zone</td>
</tr>
<tr>
<td>Charleston Food and Wine Festival Survey 2007</td>
<td>A total of 1,215 emails were collected from those visitors who bought tickets online and left their email addresses.</td>
<td>A total of 491 responses with a response rate of 40.4%.</td>
<td>69.5% females; 70.3% married or living with a partner; 63.6% full-time employed; mean age 45.7; 82.7% in Eastern Time Zone</td>
</tr>
<tr>
<td>Charleston Golf Inquiry Survey, 2007</td>
<td>A total of 3,135 emails were collected from information inquirers requesting information from <a href="http://www.charlestongolfinc.com/">http://www.charlestongolfinc.com/</a>.</td>
<td>A total of 592 responses with a response rate of 18.9%.</td>
<td>12.9% females; 86.4% married; 91.6% college education or above; 55.0 mean age; 58.0% full-time employed. 61.1% in Eastern Time Zone</td>
</tr>
<tr>
<td>Survey</td>
<td>First Day</td>
<td>First Week</td>
<td>Second Week</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-----------</td>
<td>------------</td>
<td>-------------</td>
</tr>
<tr>
<td>CVB Inquiry Survey</td>
<td>69.6%</td>
<td>93.3%</td>
<td>97.4%</td>
</tr>
<tr>
<td>Preservation Society Survey</td>
<td>27.1%</td>
<td>71.0%</td>
<td>93.5%</td>
</tr>
<tr>
<td>F&amp;W Festival Survey</td>
<td>78.3%</td>
<td>76.6%</td>
<td>90.2%</td>
</tr>
<tr>
<td>Golf Inquiry Survey</td>
<td>73.6%</td>
<td>60.5%</td>
<td>95.4%</td>
</tr>
</tbody>
</table>

*Response percentage is defined as the percentage of the numbers of responses after certain days to the number of responses at the end of 35 days.
TABLE 4. FITTING FIVE MODELS FOR INQUIRY SURVEY RESPONSE PATTERN*

<table>
<thead>
<tr>
<th>Model Name</th>
<th>Estimated Model</th>
<th>df</th>
<th>r^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Logistic Model I</td>
<td>$y = \frac{1}{a+be^{ct}}$ $y = \frac{1}{0.000659+0.0003588\times e^{-0.324t}}$</td>
<td>3</td>
<td>0.982</td>
</tr>
<tr>
<td>B. Logistic Model</td>
<td>$y = \sqrt{\frac{1}{a+be^{ct}}}$ $y = \sqrt{0.000000449+0.000000149\times e^{-0.929t}}$</td>
<td>3</td>
<td>0.839</td>
</tr>
<tr>
<td>C. Gompertz Model</td>
<td>$y = e^{a+be^{ct}}$ $y = e^{7.325-0.454\times e^{(-0.298t)}}$</td>
<td>3</td>
<td>0.985</td>
</tr>
<tr>
<td>D. S Curve Model</td>
<td>$y = e^{a+\frac{b}{t}}$ $y = e^{7.340-\frac{0.447}{t}}$</td>
<td>2</td>
<td>0.961</td>
</tr>
<tr>
<td>E. Exponential Growth</td>
<td>$y = a+be^{ct}$ $y = 1518.877-578.249\times e^{-0.272t}$</td>
<td>3</td>
<td>0.988</td>
</tr>
</tbody>
</table>

*All models are significant at 0.01 level.
### TABLE 5. FITTING EIGHT CURVES OF DIFFERENT STAGES IN FOUR SURVEYS

<table>
<thead>
<tr>
<th>Survey</th>
<th>Time</th>
<th>Decay</th>
<th>$r^2$</th>
<th>Total Days*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVB Inquiry Survey</td>
<td>1517.84</td>
<td>-579.44</td>
<td>0.76</td>
<td>0.99</td>
</tr>
<tr>
<td>Preservation First Stage</td>
<td>412.55</td>
<td>-1078.89</td>
<td>0.28</td>
<td>0.99</td>
</tr>
<tr>
<td>Preservation Second Stage</td>
<td>165.40</td>
<td>-145.63</td>
<td>0.76</td>
<td>0.89</td>
</tr>
<tr>
<td>F&amp;W Festival First Stage</td>
<td>269.61</td>
<td>-102.09</td>
<td>0.57</td>
<td>1.00</td>
</tr>
<tr>
<td>F&amp;W Festival Second Stage</td>
<td>131.30</td>
<td>-64.28</td>
<td>0.58</td>
<td>0.98</td>
</tr>
<tr>
<td>F&amp;W Festival Third Stage</td>
<td>92.72</td>
<td>-66.42</td>
<td>0.67</td>
<td>0.98</td>
</tr>
<tr>
<td>Golf Inquiry First Stage</td>
<td>361.37</td>
<td>-151.84</td>
<td>0.60</td>
<td>0.97</td>
</tr>
<tr>
<td>Golf Inquiry Second Stage</td>
<td>224.79</td>
<td>-84.19</td>
<td>0.80</td>
<td>0.95</td>
</tr>
</tbody>
</table>

* The number of days from the first solicitation or an email reminder day to the next email reminder day or the final 35 days.

*All models are significant at 0.01 level.*
TABLE 6. PREDICTING FINAL SURVEY NUMBERS FROM DATA OF FIRST FEW DAYS

<table>
<thead>
<tr>
<th>Days after First Solicitation</th>
<th>CVB Inquiries*</th>
<th>Error Rate</th>
<th>Preservation Society Survey*</th>
<th>Error Rate</th>
<th>F&amp;W Festival Surveys*</th>
<th>Error Rate</th>
<th>Golf Inquiry Survey*</th>
<th>Error Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1299</td>
<td>-15.3%</td>
<td>131</td>
<td>-25.4%</td>
<td>80</td>
<td>-15.0%</td>
<td>191</td>
<td>-16.4%</td>
</tr>
<tr>
<td>4</td>
<td>1344</td>
<td>-12.4%</td>
<td>131</td>
<td>-25.0%</td>
<td>78</td>
<td>-17.0%</td>
<td>191</td>
<td>-16.2%</td>
</tr>
<tr>
<td>5</td>
<td>1458</td>
<td>-4.9%</td>
<td>131</td>
<td>-25.1%</td>
<td>81</td>
<td>-13.8%</td>
<td>194</td>
<td>-14.8%</td>
</tr>
<tr>
<td>6</td>
<td>1417</td>
<td>-7.6%</td>
<td>136</td>
<td>-22.6%</td>
<td>86</td>
<td>-8.5%</td>
<td>197</td>
<td>-13.5%</td>
</tr>
<tr>
<td>7</td>
<td>1431</td>
<td>-6.7%</td>
<td>144</td>
<td>-18.0%</td>
<td>88</td>
<td>-6.4%</td>
<td>200</td>
<td>-12.3%</td>
</tr>
<tr>
<td>8</td>
<td>1450</td>
<td>-5.5%</td>
<td>162</td>
<td>-7.4%</td>
<td>89</td>
<td>-5.3%</td>
<td>204</td>
<td>-10.7%</td>
</tr>
<tr>
<td>9</td>
<td>1454</td>
<td>-5.2%</td>
<td>170</td>
<td>-2.6%</td>
<td>91</td>
<td>-3.2%</td>
<td>206</td>
<td>-9.5%</td>
</tr>
<tr>
<td>10</td>
<td>1503</td>
<td>-2.0%</td>
<td>173</td>
<td>-1.3%</td>
<td>93</td>
<td>-1.4%</td>
<td>209</td>
<td>-8.4%</td>
</tr>
<tr>
<td>11</td>
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<td>-3.6%</td>
<td>188</td>
<td>7.2%</td>
<td>91</td>
<td>-3.1%</td>
<td>211</td>
<td>-7.4%</td>
</tr>
<tr>
<td>12</td>
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<td>171</td>
<td>-2.2%</td>
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<td>213</td>
<td>-6.6%</td>
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<td>-3.9%</td>
<td>217</td>
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<td>-3.3%</td>
<td>218</td>
<td>-4.5%</td>
<td></td>
<td></td>
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<tr>
<td>17</td>
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<td>-2.9%</td>
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<td>-4.1%</td>
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<td>-2.2%</td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

* The numbers are predicted numbers of returns from first \( n \) days of survey return data; the final numbers at the end of 35 days are used as the actual total number of returns for that survey.
FIGURE 1. RESPONSE PATTERNS OF FOUR TOURISM RELATED ONLINE SURVEYS
FIGURE 2. THE PLOT OF RESIDUALS BASED ON EXPONENTIAL GROWTH MODEL
FIGURE 3. RESPONSE PATTERNS IN THE FIRST 24 HOURS AFTER RECEIVING THE SURVEY
FIGURE 4. RESPONSE PATTERNS OF SURVEYS RECEIVED AFTER 24 HOURS (NON-SURVEY DAYS)
REFERENCES


