Selecting better attributes in third-party hotel reservation Web sites: A comparative analysis

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Internet has been viewed by many travel organizations as an innovative and competitive marketing tool in offering travel-related information and online transaction opportunities (Doolin et al., 2002). But, Internet also has proportionate opportunities to appear new intermediaries in the new hotel value chain (Connolly et al., 1998). A substantial portion of online room reservations continues to be accounted by the third-party Web sites (Law and Cheung, 2006).

Hotels have been actively involved in multi-channel distribution in order to sell products and services more efficiently using a combination of traditional and electronic channels. It is important for organizations to rely on the channels that best match the organizational goals (O’Connor and Frew, 2004).

The methodology for the experiment follows Statistical Design of Experiments (SDE). SDE is a statistical technique useful for developing, improving and optimizing processes and also has important applications in research into customer psychology and behaviour (Rosenbaum 1999). However, SDE is not a new tool in marketing; pioneering works such as those by Holland and Cravens (1973), Chevalier (1975) and more recently those of Starkey, Aughton and Brewin (1997), Almquist y Wyner (2001) have used full factorials and fractional factorial designs. In this work we use a fractional factorial design in four four-size blocks design and we have not find any reference that use this kind of design in Marketing.

Keywords: Distribution channel, Attributes, Statistical Design of Experiments (SDE)

Introduction

The Internet has been viewed by many travel organizations as an innovative and competitive marketing tool in offering travel-related information and online transaction opportunities (Doolin et al., 2002). But, the Internet also has proportionate opportunities to give rise to new intermediaries in the new hotel value chain (Connolly et al., 1998). A substantial portion of online room reservations continues to be made through third-party Web sites (Law and Cheung, 2006).

Hotels have been actively involved in multi-channel distribution in order to sell products and services more efficiently using a combination of traditional and electronic channels. It is important for organizations to rely on the channels that best match the organizational goals (O’Connor and Frew, 2004). Nevertheless, selling rooms though third-party Web sites often means deep discounting, resulting in brand erosion and rate imparity among distribution channels (Morosan and Jeong, 2007). However, the third-party companies have been positioned in a very competitive situation to encourage travellers to make room reservations through one-stop portals by offering deeply discounted price, opportunities to compare rates, and additional information about properties and destinations (Morosan and Jeong, 2007). Hotels must be interested in knowing how customers choose a hotel a through third-party Web site, where customers can compare their attributes with the competition.

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Literature Review

The Internet has generated intense discussions among researchers and industry practitioners in the sense that it would change the nature of businesses, markets, and economy in a profound way (Biswas and Krishnan, 2004). Lately, particular attention has been paid to Web site design (Rosen and Purinton, 2004) and to consumers on line, behaviour and their use of Internet for travel arrangements (Tang et al., 2004).

From a customer’s perspective, there have been numerous attempts to understand user’s adoption of the new online service in the hotel industry. Two main directions have been delineated: (1) online information search as part of the decision making process (Gusroy and Umbreit, 2004; Pan and Fesenmaier, 2006), and (2) online purchase intentions and channel choice (Jeong and Lambert, 2001; Kim et al., 2006). Using research on the decision making process, we are interested in to know the factors that influence the choices made via third-party hotel reservation Web sites.

Choosing a hotel room or a trip from a third-party hotel reservation Web site depends on the perceived usefulness that people hope obtain from this trip or room and the price they have to pay for it. The relationship between perceived usefulness and price is defined in the marketing literature as perceived value (Zeithaml, 1988). An important priority for marketers is to know the extrinsic and intrinsic cues that customers use as a sign of quality. However, in processes of purchase of services, when the intrinsic attributes are not available, the extrinsic attributes become cues in consumer choice (Zeithaml 1988). Several researchers have developed and tested models of buyers’ perceptions of value, with particular emphasis on the buyers’ extrinsic cues (such as price and brand name) as indicators of quality and value (Dodds, Monroe and Grewal, 1991). Perceived value in each phase of the decision to purchase is also an important restriction, because perceived value depends on the frame of reference in which customers make their evaluation (Hempel and Daniel 1993). It is defined as a dynamic variable that can be experienced (Woodruff 1997) before sale, at the moment of sale, at the moment of use and after use (Moliner et al. 2005). However, as Parasuraman (1997) points out, these types of difference are not very operative.

Zeithaml (1988) points out the necessity of research to investigate which cues are important and how consumers form impressions of quality based on technical and objective factors. It is therefore essential to identify the extrinsic characteristics that consumers use to identify perceived quality before sale, and which pattern of preferences must be considered when dealing with a product’s characteristics.

The Research Project

In order to know which cues are important for selecting a hotel via a Web site, we propose an experimental study that has been conducted with students at Barcelona University in 2007 as a convenient sample. The methodology for the experiment follows Statistical Design of Experiments (SDE). SDE is a statistical technique useful for developing, improving and optimizing processes and also has important applications in research into customer psychology and behaviour (Rosenbaum 1999). However, SDE is not a new tool in marketing; pioneering works such as those by Holland and Cravens (1973), Chevalier (1975) and more recently those of Starkey, Aughton and Brewin (1997), Almquist and Wyner (2001) have used full factorials and fractional factorial designs. In this work we use a fractional factorial design, in four four-size blocks design and we have not found any reference that uses this kind of design in Marketing.

From a previous work, we have obtained eight variables (Huertas, Laguna and Consolacion, 2007). To ascertain exactly which of these eight attributes determine the process of choosing the type of accommodation, we proposed an experiment using a two-level factorial design with 16 experiments in four four-size blocks. With these experiments, the students must evaluate two third-party hotel reservation Web sites simulated, one from a Spanish destination, Mallorca, and another from an exotic destination, Bali. In order to reduce the risk of the artificial laboratory surroundings when answering
the questionnaires, an ordinary and familiar format was chosen following the format of the most popularity Web sites, like Expedia.com and Travelocity.com. In order to provide the questionnaire that will not be analyzed that facilitates the decision of the interviewees, each scenario shows six advertisements: four experimental advertisements and two non-exposed advertisements.

Methodology of Statistical Design of Experiments (SDE)

SDE is a statistical technique useful for developing, improving and optimising processes. The most extensive applications of SDE relate to situations in which several input variables could influence some performance measure of a product or process. The input variables are called independent variables, and they are subject to the control of the experimenter. The field of SDE consists of an experimental strategy for exploring the relationship between the output and the process variables and for finding the levels or values of the process variables that produce the desirable values of the responses.1

In general, the experiment is concerned with a product, process or system involving a response y that depends on the controllable input variables \( \xi_1, \xi_2, \ldots, \xi_k \)

The relationship is

\[
y = f(\xi_1, \xi_2, \ldots, \xi_k) + \varepsilon
\]

where the form of the true response function \( f \) is unknown and probably very complicated, and \( \varepsilon \) is a term that represents other sources of variability not accounted for in \( f \). Assuming that \( \varepsilon \) has a normal distribution with mean zero and variance \( \sigma^2 \), then

\[
E(y) = E[E[f(\xi_1, \xi_2, \ldots, \xi_k)] + E(\varepsilon) = f(\xi_1, \xi_2, \ldots, \xi_k)
\]

The variables \( \xi_1, \xi_2, \ldots, \xi_k \) in equation (1) are called the natural variables, because they are expressed in the natural units of measurement—

e.g. price in euros or pounds. When working with SDE it is convenient to transform the natural variables to coded variables \( x_1, x_2, \ldots, x_k \) which are usually defined to be dimensionless with mean zero and the same standard deviation. In terms of the coded variables, the true function can be rewritten as

\[
\mu = f(\tilde{\xi}_1, \tilde{\xi}_2, \ldots, \tilde{\xi}_k)
\]

Because the form of the function \( f \) is unknown, we must approximate it. Usually, a low-order polynomial model is used. For the case of eight independent variables, as is our case, the fist-order model in terms of the coded variables is

\[
\mu = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8
\]

The form of the first order model in equation (4) is sometimes called a main effects model, because it includes only the main effects of the eight variables \( x_1, x_2, \ldots, x_8 \). The \( \beta \)'s are a set of unknown parameters. To estimate the values of these parameters, we must collect data about the system under study using an experimental design.

Most applications in SDE are sequential in nature. This entails that, firstly, qualitative research must be used to generate ideas to identify which factors are likely to be important in the response variable. This procedure in turn usually leads to designing an experiment to investigate these factors with a special focus on eliminating the unimportant ones. This type of experiment is usually called a screening experiment. The objective of factor screening is to reduce the list of candidate variables to relatively a few so that the efficiency of the subsequent experiments will increase—i.e. it is the situation where fewer runs or tests are required (Myers and Montgomery, 2002).

To accurately state which of these eight attributes determine the process, we propose an experiment using a two-level factorial design. The advantages of such a design are

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1 In our case was designed a scenario from a group of students who were first proposed the idea of a trip of ending career (location Mallorca / Bali), therefore this course was already set in stone, the scene was just deciding the hotel, no destiny. (Annex 1 can contemplate this scenario)
fundamentally two. On the one hand, it requires very few elemental experiments for each factor and provides some trends for determining the direction of future ones. On the other, they enable the sequential investigation that causal analysis demands.

In our particular case, the experiment design consists of 8 variables which accounts for a $2^8$ factorial experiment—i.e. 256 elemental experiments. To avoid saturation of the people interviewed, we used a design of IV resolution, a 1/6 fraction of a $2^{48}_{IV}$ full design. The IV resolution design does not confuse the main effects with two factor interactions although the two factor interactions get confused between them (Box et al., 1999). A comprehensive view on experimental design can be found in Box et al. (1999) or Myers and Montgomery (2002). Table 1 and 3 presents the 8 variables used in this study and the corresponding transformation in dummy.

To design the experiment we need a design generator. A $2^{kp}$ fractional factorial design requires the selection of $p$ independent design generators. To proceed with the selection, one reasonable criterion is to choose the generators such that the resulting $2^{kp}$ design has the highest possible resolution. In this particular point we followed Myers and Montgomery (2002). Besides, for an experiment we have considered a 16 run design, a 1/6 fraction of a $2^{48}_{IV}$ full design with generators $E = \pm BCD$, $F = \pm ACD$, $G = \pm ABC$, $H = \pm ABD$. The complete design is shown in Table 4. Notice that its construction started with a basic 16-run $2^4$ design in A, B, C and D and then four columns of the design generator were added.

In many situations, it is impossible to perform a complete replication of a factorial design in one block. Confounding is a design technique for arranging a full or a fractional factorial in blocks, where the block size is smaller than the number of treatment combinations in one run. For efficiency reasons, in this study we use four-size blocks of resolution IV experimental designs. Thus, we propose using a two block generator based on two-factor interactions—e.g. $B1 - AB$ and $B2 = AC$. Table 3 shows the experimental design with the two block generators.

After completing the two block generators design we can realign the 16 experiments in four four-size blocks. Table 4 depicts the blocked design. This kind of designs demands that each block and their corresponding experiments must be run in random order. It is also important to be aware that only the main effects can be interpreted, once the interactions between two factors are confounded with the variability of the blocks.

Once the eight-block experiments are configured they are delivered to a group of people to be evaluated on a scale basis. In our case, we used an attitudes scale (1 to 10). Unlike attribute ordering, the attitudinal scale allows a type of evaluation such that each particular scenario can be assigned a score that is higher, lower or the same as a different scenario comprising the experiment.

There are several ways to display the contributions between levels and factors to the interviewed people. For services, only cards with a description of attributes or a verbal description can be used—we must be aware though that the way they are presented affects the final result. While graphics are processed in a comprehensive way making it easier to consider interactions between attributes (Holbrook and Moore, 1981),

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Table 1. Variables proposed for an Spanish destination, Mallorca, and its transformation in dummies.

| Variable              | -   | +   |
|-----------------------|-----|-----|
| 1 Number of rooms     | 46 rooms | 144 rooms |
| 2 Price               | 740 euros | 1,200 euros |
| 3 Picture in advertisement | Indoors | Outside |
| 4 Number of pictures  | 2   | 3   |
| 5 Position on page    | On the top | On the |
| 6 Right or left location | Left  | Right |
| 7 Number of starts    | 4   | 5   |
| 8 Complementary activities | Not  | Yes |

Table 2. Variables proposed for an exotic destination, Bali, and its transformation in dummies.

| Variable              | -   | +   |
|-----------------------|-----|-----|
| 1 Number of rooms     | 46 rooms | 144 rooms |
| 2 Price               | 740 euros | 1,200 euros |
| 3 Picture in advertisement | Indoor | Outside |
| 4 Number of pictures  | 2   | 3   |
| 5 Position on page    | On the top | On the |
| 6 Right or left location | Left  | Right |
| 7 Number of starts    | 3   | 4   |
| 8 Complementary activities | Not  | Yes |
in descriptive cards and verbal presentations the information is processed sequentially which implies that the starting point is more important than the end (Wittink and Cattin, 1989) and that the task of identifying possible interactions between the attributes becomes even more difficult. Our proposed scenario is a third-party hotel reservation Web sites simulated one from a Spanish destination, Mallorca, and another one from an exotic destination, Bali, combining image and text, as in the work of Vriens et al. (1998), following a “tourist agency style” (an example is shown in the Appendix).

For the sample size, we employed the resource equation proposed by Mead (1988) which is a useful concept for the first stage of design building. This equation requires at least \( n \) runs in blocks of \( n_b \) size,

\[
n = \frac{n_b}{2} + q(q+3) + n_{lof} + n_{pe},
\]

where \( q \) is the number of variables, \( n_{lof} \) is a small number of degrees of freedom (typically between 5 and 10) for estimating higher order terms and check for lack of fit, and \( n_{pe} \) is a small number (typically between 5 and 10) of degrees of freedom for estimating the pure error.

In our specific case, where \( n_b = 4, q = 8 \) and \( n_{lof} + n_{pe} = 15 \)—a similar value is used by Gilmour and Trinca, 2005—the resource equation is:

\[
n = \frac{n}{4} + \frac{8(8+3)}{2} + 15,
\]

\[
\Rightarrow n = 78.6
\]
Thus, for the fieldwork, 4 blocks of four experiments with 49 runs each, 784 experiments for the Bali Web and 4 blocks of four experiments with 47 runs each, 752 experiments for the Mallorca Web were utilised. Each block of Bali scenarios was delivered to 196 students and each block of Mallorca to 188 students in their last year of study at the EUEM -Barcelona University of Catalonia—. The experiment took place during a one-hour class in November-December 2007. It followed two main stages. First, the students were informed about the objective of the study and asked to identify two three-scenario sets that best they liked and worst liked. Second, they were asked to score the six alternative scenarios according to a scale ranging from “1” (the scenario that least fits my needs) to “10” (the one that best fits my needs). As stated elsewhere in this study, this procedure makes it possible for two scenarios to have the same score.

### Results

The main effects from each attribute were calculated using the Yates Algorithm (1937) and the normal probabilistic paper proposed by Daniel (1959). It is a simple procedure that can be implemented on any spreadsheet. For a description of the Yates Algorithm and the use of the normal probabilistic paper one may consult Box, Hunter and Hunter (1978). An example of them can be found in Huertas and Consolación (2005). Table 6 and 7 show the estimated effects, for Bali Web and the Mallorca Web, while Figure 1 and 2 shows the normal probability plot for selecting the most important effects of each.

Figure 1 show the 10 estimated effects plotted on a normal probabilistic paper for determining the main effects and large interactions. This method was developed by Daniel (1959) and is oriented towards a sequential investigation process in which the unimportant factors and interactions can be determined in the initial experiments in order to rule them out of the next step in the investigation (Box, Hunter and Hunter 1978). The effects simply reproduce the accumulated relative frequency of a normal distribution, with mean equal to 0; when plotted on a probability paper it will appear as a straight line. In Figure 1 we can see that 6 out of the 10 effects are reasonably adjusted to this straight line. However, the ones referring to A and H are very far apart, from which we may conclude that they cannot be explained only by random effects. And there are two effects in an intermediate situation, F and C. Similar results should be obtained when a mean hypothesis contrast is made from the standard deviation.

The interpretation of a variable in statistical design can be interpreted singly if there is no evidence that this variable is confused with others, that is to say, of effects A, H, F and C. In this work the confused variables, B1 and B2, are not enough important factors.

As shown in Table 6 and Figure 1, A (Number of rooms) have an important negative effect on the evaluation of the consumer sample. For this target market, when people decide to go to Bali they prefer hotels with a small number of rooms. Other more highly valued effects

| Effect | Estimation |
|--------|------------|
| A      | -0.183     |
| B      | 0.078      |
| C      | 0.148      |
| D      | -0.067     |
| E = BCD| -0.042     |
| F = ACD| 0.136      |
| G = ABC| 0.095      |
| H = ABD| 0.278      |
| B1 = AB| -0.007     |
| B2 = AC| 0.085      |

| Effect | Estimation |
|--------|------------|
| A      | -0.115     |
| B      | -0.193     |
| C      | 0.034      |
| D      | 0.122      |
| E = BCD| 0.081      |
| F = ACD| 0.039      |
| G = ABC| 0.102      |
| H = ABD| 0.391      |
| B1 = AB| -0.091     |
| B2 = AC| 0.091      |

| Effect | Estimation |
|--------|------------|
| A      | -0.183     |
| B      | 0.078      |
| C      | 0.148      |
| D      | -0.067     |
| E = BCD| -0.042     |
| F = ACD| 0.136      |
| G = ABC| 0.095      |
| H = ABD| 0.278      |
| B1 = AB| -0.007     |
| B2 = AC| 0.085      |
Figure 1. Normal probability plot of effects for the Bali Web

Figure 2. Normal probability plot of effects for the Mallorca Web

are: H (complementary activity), C (Picture of advertisement) and F (Right or left location). All of them have a positive effect on the evaluation of the interviewees; that is to say, interviewees prefer hotels with a complementary activity, a view of the outside and the picture on the right side.

For Mallorca Web sites, in Figure 2 we can see that 5 out of the 10 effects are reasonably adjusted to this straight line. However, the ones referring to B and H are very far apart, from which we may conclude that they cannot be explained only by random effects. And there are three effects in an intermediate situation, A, D
and G.

As shown in Table 7 and Figure 2, the effects B (price) and A (number of rooms) have a negative effect on the evaluation of customers. In this case, people are more sensitive to the price, a factor that is not important in choosing a hotel in Bali. The other factor, A (number of rooms) has the same effect as in the Bali Web, the higher the number of rooms the lower its evaluation by interviewees. The other valued effects are H (complementary activity), D (number of pictures) and G (number of stars). All of them have a positive effect on the evaluation of the interviewees; that is to say, interviewees prefer hotels with a complementary activity, like in the Bali Web, but with 3 pictures and 5 stars, variables that do not have importance for choosing a hotel in a Bali Web.

Conclusions

Customer satisfaction has become one of the primary targets in all areas of business, and particularly in tourist management. However, determining which requirements to satisfy and how to satisfy them continues to be a difficult task. In order to understand customers’ needs we can ask them directly or deduce their desires by means of indirect methods such as experimentation. However, Kotler (2000) warns us that customers do not express all their needs, so the declared needs do not provide a full response to customers’ requirements. Statistical Design of Experiments (SDE) can be considered as a powerful tool for evaluating revealed importance, because in addition to providing an evaluation of the weight of the main attributes, it also shows the weight of the interaction of several attributes.

Employing an experimental design, in a context of pre-purchase, and with a static reference frame, we have tried to determine the main factors of value perception in the process of choosing a hotel from a third-party Web site. These consumers used a reduced number of attributes to infer perceived quality and the sacrifice necessary to acquire it. In this case, only two of the eight attributes are significant: the number of rooms (46 rooms or 144 rooms) and the existence of complementary activities as quality attributes, for the selection of a hotel in Bali on a website, and the number of rooms (46 rooms or 144 rooms) and the price (740 euros or 1200 euros) indicating sacrifice. For this market segment, formed by university students in their final year, the variables - “price”, “number of pictures”, “top/bottom location” and “number of stars” - are not very significant, for the evaluation of hotels on a website for Bali. Non have the variables for the expression of “picture of advertisement”, “top/bottom location” and the “left/right location” been very significant for evaluation of a website from Mallorca. The variables “picture of advertisement”, and “left/right location” for Bali and “number of rooms”, “number of pictures” and “number of stars” remain in an intermediate position of vagueness, and a new experiment would be required to make it more specific.

In this work, the perceived value attributes are considered in a pre-purchase situation, and therefore their validity disappears with the purchase. As indicated by Fisher et al. (1994), when consumers evaluate perceived service quality after purchase, they almost never mention the criteria used for the evaluation before purchase, and if they do mention them they are relegated to a lower hierarchic level than they occupied before purchase.

One limitation of this work is the fit sample size, which does not allow us to determine the significance of some main variables. And our sample is not fully representative of the overall consumer population; therefore inferences about all consumers may not be valid. Moreover, the design structure in blocks of two confuses the second-order factors both mutually and with the block designers. This design can be improved by taking advantage of number of runs for modifying the blocking design structure, which would have enabled the main factors and the second order iterations to be evaluated without confusion. Draper and Guttman (1997) show that k2k runs are needed in a design 2k for estimating all the main factors and the interactions.

One of the advantages of statistical design of experiments (in our case, factorial design solved by using the Yates Algorithm and the probability paper proposed by Daniel) is its great simplicity, since it requires only a basic knowledge of
mathematics and conventional software (such as Excel). On the other hand, its main limitation is the number of factors and levels that can be used, usually fewer than 11. This is why it can be used in advanced parts of product or advertising design, when some attributes have already been defined.

The proposed model helps us to get closer to customers, to identify their opinions and their preferences. Furthermore, it is a simple procedure that facilitates sequential research, which in turn enables us to continuously improve our knowledge of the subject.

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