

# Measuring the part worth of the mode of transport in a trip package: An extended Bradley–Terry model for paired-comparison conjoint data

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## Abstract

This study measures the travelers' perceived change in utility by accepting one of the modes of transport air, rail, or bus as one component of a packaged city trip. The part-worth values for the trip product elements are expected to depend on a number of traveler characteristics. The predictors hypothesized are city travel experience, general modal preference, socio-economic status, and car ownership. In the survey, the combinations of trip attributes differed between the two subgroups of leisure and business travelers. The leisure travelers rated three levels of mode, length of stay, and price, but only one level of the hotel category. The business travelers were shown four mode alternatives and only two levels for each of the other trip product elements. The conjoint measurements were elaborated by fitting an Extended Bradley–Terry Model. Demonstrating the application of the EBTM is the main purpose of the paper. The EBTM offers several advantages over the more popular versions of conjoint analysis. It correctly treats ties and allows for simultaneous estimation of the trip package ('object') parameters, object covariates (trip attributes), subject covariates (traveler characteristics) and their interactions. For both the business and the leisure travelers, the mode of transport dominated the assessment of a city trip package. For leisure tourists, e.g., switching from train 2nd class to an economy flight boosted the trip package more than twice as much as replacing train for bus. A variation of the package price was much more important for the leisure than for the business travelers. The socio-economic status proved to be an important factor and was particularly influential among the business travelers. In the leisure tourists' sub-sample age was not only important for valuing the mode of transport, but had a preferential impact for all trip components. Finally, the limitations of this demonstration study that discourage extrapolation to city travelers in general are emphasized.

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**Keywords:** *Bradley–Terry Model*; Conjoint analysis; Mode of transport

## 1. Introduction

This research uses data from a project aimed at assessing the 'importance of air transport' for the Greater Vienna area. While many different ways may be conceived of how to tackle this issue, the authors decided to focus on the travelers' point of view. If a *raison d'être* exists for air transport then — in the simple mind of a marketing scientist — the reason likely relates to the airlines' customers. The problem was downsized to a workable version involving travelers ex Vienna on leisure or business trips to another European city. From the consumer behavior point of view the 'importance' of air transport may be interpreted in terms of preference or utility. Its value becomes apparent as a variation in the height of preference or the amount

of perceived utility — the 'part worth' in the terminology of classical conjoint analysis — the airplane seat contributes to the overall benefit attributed to a city trip package.

Measuring the travelers perceived utility of a means of transport is nothing new. In transport studies, of course, the choice of a mode of transport represents one of the most popular problems. It may be analyzed on aggregate level by means of cross elasticities (Wardman, 1997) or by discrete choice micro-models (such as the multinomial logit). During the 1970s, MNL models were introduced by 2000 Nobel Laureate Daniel McFadden for investigating modal choice. Today, they are standard tools in transportation research and consulting practice (Wardman et al., 1992; Cambridge Systematics, Inc., 2002). Later, choice models were embraced by marketing scientists and have become one of the major threads in advanced consumer behavior research. A comprehensive review of choice models in tourism is provided by Crouch and Louviere (2001); among the

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38 pieces of research itemized, however, there is none dealing with alternative modes of transport in a trip package.

Sheldon and Mak (1987) applied logistic regression to analyze various attributes of package tours and traveler covariates. The mode of transport, however, was not included. In this study the mode of transport will be a prominent part of a trip package. Its utility as perceived by the travelers then may be compared to those of the other trip components simultaneously present in the package. A conjoint analysis approach is usually preferred for exploring the portions of utility contributed by individual product features. Again, this is not new methodology in tourism and hospitality research. Renaghan and Kay (1987) analyzed the part-worth utilities aroused by the services tied together in a convention product. One of the most popular sample applications of conjoint analysis for very complex mixtures of services also originates from hospitality research; it is the “Courtyard by Marriott” case outlined by Wind et al. (1989). Carmichael (1992) applied a standard version of conjoint analysis to analyze artificial attribute bundles representing ski resorts. Mazanec (2002) analyzed the effects of Euro versus old currency pricing of tour packages; he used a conjoint model with random coefficients to allow for traveler heterogeneity in the part-worth estimates.

The link between tourism and transport is ambiguous. The literature offers two interpretations of the transport-tourism interface: the transport “for” tourism or the transport “as” tourism philosophy. The former acknowledges only the utilitarian character of transport services while the latter admits “intrinsic value as tourism experience” (Lumsdon and Page, 2004). Regardless of which interpretation one chooses to follow, the role of the mode of transport in the travelers’ evaluation of a trip package seems largely unexplored. There are, of course, innumerable travel and guest surveys from commercial sources including the mode of transport

among their repertoire of trip attributes. However, these studies present their results in a usually narrative manner reporting about the frequencies of modes preferred without exploring the modes’ contribution to the overall utility of the trip. One of the rare exceptions employing an up-to-date model of mode choice in a tourism setting is Nerhagen (2003)’s recent analysis of the influence of previous experience on choice behavior. This author proposes a binomial probit model with train and car as the alternatives and a linear utility function combining mode and traveler attributes. She also estimates the willingness-to-pay for a fictitious return trip dependent on former car or train usage.

This study demonstrates a new method for analyzing conjoint data. The extended Bradley–Terry Model (EBTM) has not yet been applied in tourism research. This study employs it for measuring the travelers’ perceived change in utility by adopting one of the modes air, train, or bus as part of a packaged city trip. The respondents assess a set of fictitious city trips on a ten-point rating scale. They indicate the likelihood of booking such a trip package. Given the questionable metric properties of the rating data only the preferential relationships among pairs of trip alternatives (preferred, not preferred, no preference) will be exploited. The trip packages consist of the key product elements destination, mode of transport, type of accommodation, length of stay, and price. Realistic combinations were formed after examining the catalogues of 17 tour operators offering city trips to European destinations.

## 2. Method

### 2.1. Underlying hypotheses and data availability

The part-worth values for the trip product elements are expected to depend on a number of traveler characteristics. The

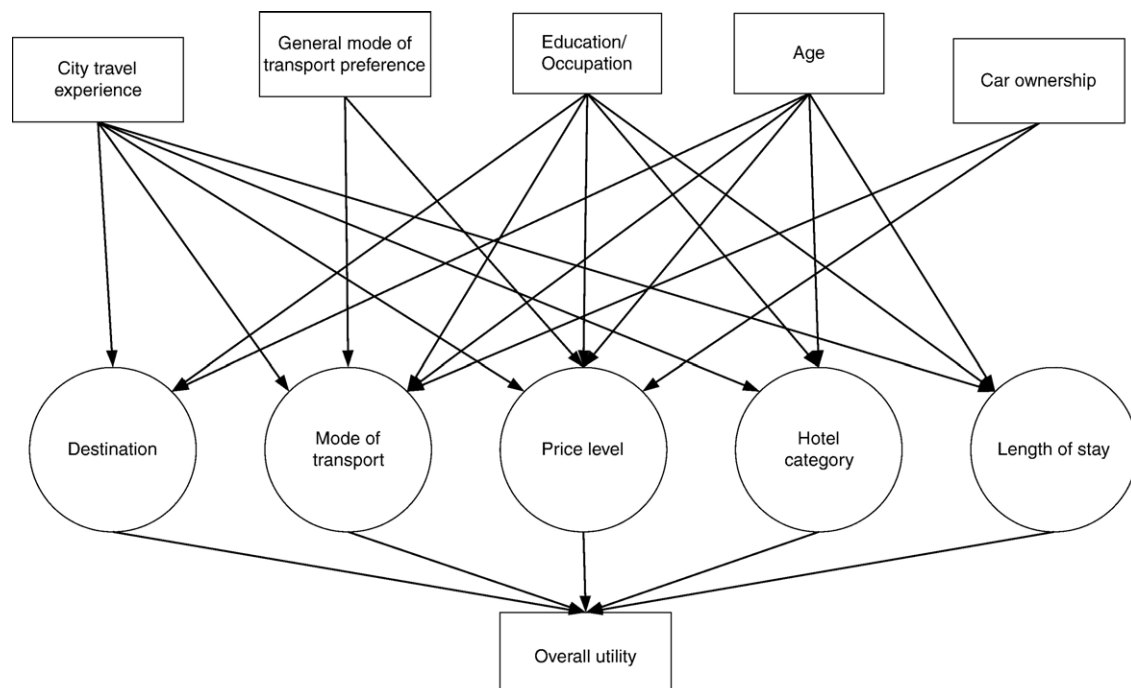


Fig. 1. A starting model of trip package elements and their covariates.

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