Factors influencing the destination choice of day tourists to ski resorts

Monika Tepfenhart, Wolfram Mauser & Florian Siebel

Abstract

This work aims at developing a model that facilitates the analysis of potential impacts of climate change on the competition among ski resorts for day tourists and the consequences on tourist traffic. For this purpose a multi-agent model calculating the number of day visitors to different ski resorts was developed assuming day tourists to maximise utility. The decision to visit a ski resort depends on external and internal factors, and on tourists' socio-economic background. To calibrate the model, a household survey for ski tourists was developed and carried out. The current work describes the questionnaire and the results of the data analysis. The results allow quantification of the factors influencing the destination choice and therefore their description in the multi-agent model.

Keywords: climate change, discrete choice model, ski tourists, traffic dynamics

1 Introduction

This work aims at developing a model that allows the analysis of possible impacts of climate change on the competition among ski resorts for day tourists and the description of its consequences on tourist traffic in the hydrological catchment of the Upper Danube (Ludwig et al. 2007), covering parts of southern Germany, Austria and Switzerland. The river basin has an extension of approximately 75,000 km^2 with about 10 million inhabitants. The spatial representation is realised using a 1x1 km grid, while 9,115 of the units are inhabited.

Several studies examined day tourism and the influence factors on ski destination choice. Harrer (1986) examined day tourism in general and specifically ski tourism for Germany. Klassen (2001) assumes that the destination choice depends on external static factors, such as the size of a ski area and the lift ticket costs, on external dynamic factors, such as weather and snow conditions. Further, ski destination choice depends to a certain extent on internal factors, such as income and personal preferences. He further assumes that the level of knowledge about the existence of alternative ski resorts and the peculiarity of certain attributes, such as snow condition in another ski resort, is a crucial factor for the destination choice.

In this work, the decision to visit a ski resort depends on external and internal factors, and on the socio-economic background of the individuals. External factors comprise the snow depth, temperature, precipitation values, the attractiveness of the ski resorts such as lift capacity and travel times between the residences of day tourists and the ski areas. The internal or individual decision factors include age, income of the individual agents, and environmental awareness.

For the hydrological catchment of the Upper Danube, Tepfenhart et al. (2007a) examined possible impacts on the competition among ski resorts. For the same area Tepfenhart et al. (2007b) also examined possible impacts on tourist traffic. According to these studies, ski resorts at medium altitudes may profit from climate change in near future due to a redistribution of the day tourists. In the long run only ski resorts located high enough are expected to survive (Tepfenhart et al. 2007a). With decreasing snow-reliability traffic jams on access roads to the ski resorts will significantly gain importance (Tepfenhart et al. 2007b). Both studies used a simple discrete choice model (Train 2003) for day tourism.

This work therefore aims at a more sophisticated model, which considers socio-economic differences between individuals and works with snow data from climate models that describe local effects. Hence a model able to perform multi-agent simulations was developed. A questionnaire for ski tourists was developed to describe the model and influence factors on ski destination choice. Decisive factors for the model are the influence of weather and snow conditions in ski resorts, the importance of personal attitudes, and the attractiveness of a ski area on ski destination choice. Very important are also the influence of the interviewees' socio-economic background, of their income, age, education and of the professional life on the ski destination.

2 The model

The multi-agent model calculates the number of day visitors to different ski resorts, i.e. determines the Origin – Destination – flows (OD – flows) of the activity based daily traffic skiing, and corresponds therefore to an activity-based traffic model (Widmer & Axhausen 2001).

The model is embedded in the generic DeepActor framework of the DANUBIA Decision System (Ludwig et al. 2003). The DeepActor framework allows to integrate social simulation models in DANUBIA, which apply a Multiactor approach to the simulation of socioeconomic processes (Ernst et al. 2006).

The model works with clustered groups of individuals, the Sinus-Milieus®, which are provided by Sinus-Sociovision GmbH and the corresponding spatially explicit data of Microm® (Micromarketing Systeme und Consult GmbH). Each Sinus-Milieu represents an agent. The model runs with households as elementary units. The socio-economic background of the corresponding household head is assumed to determine the milieu affiliation of a household. Therefore, the agents in the model possess individual profiles depending on their sociological lifestyles. In this paper, agents will be called actors. Actors and day tourists maximise utility.

While the model calculates the number of ski tourists to a ski resort, it simulates the decision process of the ski tourists consisting of three elements: a set of choices (i.e. the ski resorts), the decision makers as actors, and a decision protocol. The decision protocol is a two-level process. First, a set of options is generated and then the decision maker decides for one of them. The set of options, i.e. ski resorts, is completely known.

The model architecture is based on the belief-desire-intention (BDI) architectures (Wooldridge 1999). The actors in the model posses five of the seven main components of a BDI agent: a set of current beliefs (i.e. environmental perception), a belief revision function, an option generation function (options), a set of current options (i.e. set of the available ski resorts), and a maximal utility filter function (filter). The filter function represents the agent's deliberation process. It determines the agent's intention to visit one of the available ski resorts on the basis of its current beliefs (i.e. information about their environment) and desires (i.e. to make a day trip to one of the ski resorts).

In the following the filter function will be described in more detail. The actors evaluate their beliefs about the ski resorts. Priority functions π_j describing the evaluation process are defined for the external and internal factors of the model j denotes the respective factor: snow depth (SD), temperature (T), precipitation (P), lift capacity (C), snow guns (SG), age (A), social situation (SS), and financial situation (FS), according to our model assumption. The range of the values of the priority function is between 0 (no utility at all) and 1 (maximal utility). The overall priority of a ski resort is a product of all contributing priorities of the ski resort (Tepfenhart et al. 2007). The overall priority of a ski tourist for a ski resort not only depends on the priority functions but also on the actor's affiliation to one of the Sinus-Milieus. The internal factors in the model are described through constants between 0 and 1. The overall priority of an actor describes the utility for a ski resort and is therefore a measure for the actor's destination choice.

3 The questionnaire

To describe the priority functions of the model and the factors influencing ski destination choice, a household survey for ski tourists was developed, which was accessible online.

The objective of the questionnaire was to describe to which extent the external and internal factors of the model influence destination choice. The questionnaire contained closed questions and was pre-tested by students.

The potential respondents were identified during a field study conducted in five ski resorts during ten weekends between January and April 2006. During the field study, ski tourists in ski resorts were informed with a flyer about the research work and their addresses or email addresses were gathered for the household survey. 344 addresses and 120 email addresses were collected. Additionally, 223 ski clubs and ski associations were informed via email about the research project and the corresponding questionnaire. A total of 295 individuals answered the questionnaire, 86 of them online.

The questionnaire is divided into four parts. The first part relates to the importance of weather and snow conditions in the ski resorts. The second part comprises questions dealing with the importance of personal attitudes and the ski area. The third part contains questions of the Sinus-Sociovision GmbH on the socio-economic background of the interviewees. The items of the last part of the questionnaire

are to great extent questions on income, age, education, and professional life. The Sinus-Sociovison GmbH will evaluate the third and last part of the questionnaire dealing with the social affiliation of the respondents.

4 Results

The objective of the questionnaire was to describe to which extent the external and internal factors of the model influence ski destination choice and to describe the corresponding priority functions of the model. The results about the factors influencing ski destination choice are described in the subchapter "Factors of the model". The subchapter "Validation of the model parameters" describes additional analyses validating the model.

4.1 Factors of the model

To calibrate the model and to describe the priority functions of the model the received cumulative percentages of the required factors were fitted. Finally, the obtained functions were scaled with a factor of 0.01, thus a value of 100% corresponds to a value of 1 in the corresponding priority function.

The first part of the questionnaire relates to the influence of weather and snow conditions in the ski resorts. Skiing is only possible at sufficient snow conditions, i.e. above at a minimum of snow depth. Therefore, the respondents were asked to specify the minimum snow depth in a ski resort at which they would undertake a ski trip. Hereby they could select one of the following options: 10, 50, 100, 150 and 200 cm and more. The results show how snow depth influences the ski tourists' willingness to visit a ski resort (figure 1). Whereas 7.9% of the ski tourists will visit a ski resort at a minimum snow depth of 10 cm, approximately a quarter of the tourists prefer better snow conditions of at least 100 cm in a ski resort. For the priority function of the model the first three values of the cumulative distribution were fitted with

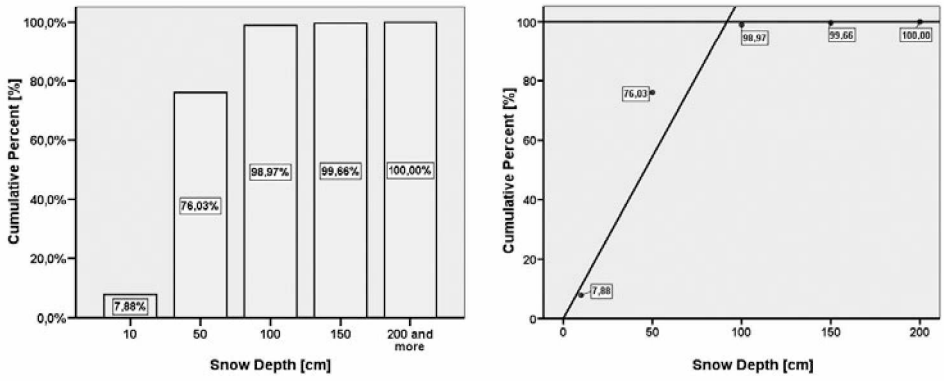

Figure 1: Ski tourists' willingness to visit a ski resort in dependence on snow depth.

$$P = 1.09 \cdot SD \quad (1)$$

with an R-Square of 0.963, where P stands for the cumulative distribution and SD for the respective snow depth in cm. Above a snow depth of 91.45 cm a constant value of P of 100% is assumed.

Low negative and high positive temperatures in a ski area are limiting factors. Therefore the respondents were asked to specify their temperature range acceptable for skiing. The options for negative temperatures were: −5°C, −10°C, −15°C, −20°C and any lower temperature. The options for positive temperatures were: 0°C, 5°C, 10°C, 15°C, 20°C and any higher temperature. The respondents had a single choice for their answer. The left diagram of figure 2 depicts the cumulative responses to this item. The right diagram depicts the quadratic fit

$$P = 100 - 0.43 \cdot T - 0.13 \cdot T^2 \quad (2)$$

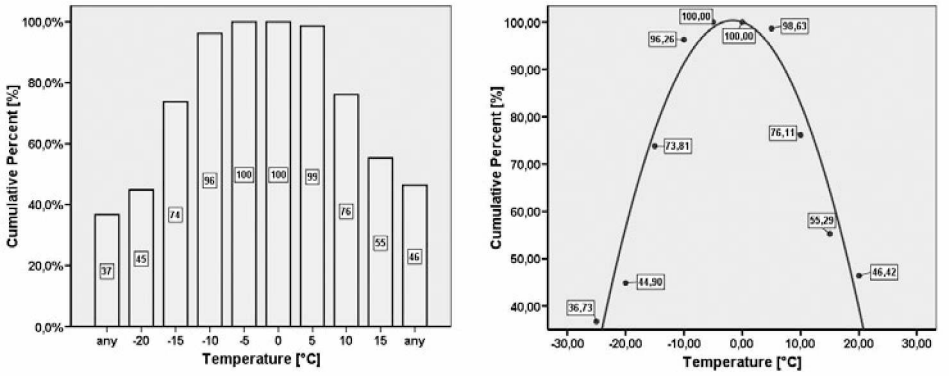

Figure 2: Ski tourists' willingness to visit a ski resort in dependence on temperature (left) and the corresponding quadratic fit (right).

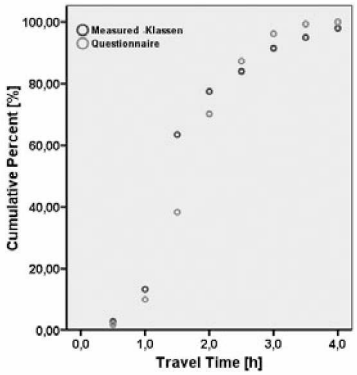

Figure 3: Ski tourists willingness to visit a ski resort in dependence on travel time. Light grey dots depict the results of our questionnaire. Dark grey dots represent real data.

of the observed values, where P denotes the cumulative percentage of the respondents and T the temperature. With an R-Square of 0.928 the curve describes quite well how temperature influences the ski destination choice of tourists, between −25°C and 20°C. For temperatures above 20°C and below −25°C the values for 20°C and −25°C are assigned for the percentage of tourists, who visit a ski resort.

The second part of the questionnaire relates to the importance of personal attitudes and the attractiveness of a ski area. The travel time to the ski resorts is of interest for the model. The respondents were asked to specify the maximum time they would spend on the roads. The options ranged from 0.5 h to 4 h with 0.5 h intervals. The answers were compared with measured data, which were obtained in the ski area Garmisch Partenkirchen during a field study (Klassen 2001). Figure 3 shows both the results of the questionnaire and the results of the field study. Further, the relation between questionnaire results and field study results was examined (figure 4). The values were fitted with

$$P_q = 1.06 \cdot P_m - 6.7 \tag{3}$$

with an R-Square of 0.943 indicating that the questionnaire corresponds very well with the measured values.

4.2 Validation of the model parameters

To validate the model and the chosen factors that influence ski destination choice, additional factors and their cross correlation to the parameters of the model were examined.

As concerns the model factor snow, snow depth is sufficiently describing this factor. Skiers' destination choice is not only influenced by snow depth, but also by other factors like "slope that goes to the village" is opened or closed, and slope and snow conditions in the ski resorts. "Talabfahrt" is the German expression for the ski slope that goes to the village. In this paper the German expression will be used. The natural snow depth in a ski resort determines whether the "Talabfahrt" is opened or closed. The natural snow depth partly determines slope conditions. Therefore the

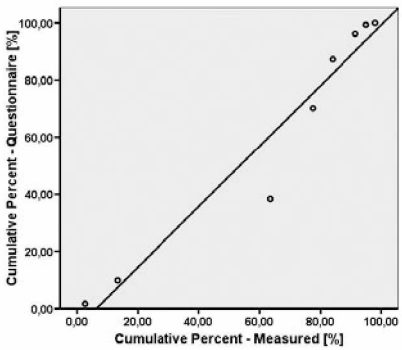

Figure 4: The relation between data received through the questionnaire and measured data (Klassen 2001).

answers given for the factors mainly determined by the snow depth should be in accordance with the answers given for the snow depth.

The cross correlation of the answers given for the additional factors "Talabfahrt" opened or closed and snow depth was examined. Asking the interviewees whether they would undertake a ski trip to a ski area if the "Talabfahrt" was closed, 24.3% stated that they would not visit a ski resort in such case.

The relation between the percentage of visitors in dependence of snow depth and the possibility to use the "Talabfahrt" was examined with a crosstable. Two classes were build for a snow depth of 50 cm and less, which corresponds to the minimum snow depth necessary for the operation of the ski resort, and a snow depth of 100 cm and more for good snow conditions in a ski resort. The results of the Chi-Square-Test delivers a two-sided asymptotic significance of 0.96, which indicates a relation between the answers given for the snow depth and the "Talabfahrt". Hence the latter was not considered separately.

One item related to the importance of the slope conditions in the ski destination choice. Respondents were asked to specify under which slope conditions they would undertake a ski trip to a ski resort. The options were: very good, good, and ridable while multiple choices were possible. The answers were classified in three classes: very good, good and better, and ridable and better, i.e. tourists who voted for good and better will undertake a ski trip, when the slope conditions are at least good. The results were 2.39%, 53.24% and 44.37% for very good, good and ridable slope conditions in a ski resort.

Not only the dependence of the ski choice destination from the piste condition was examined but also possible relations between the answers given for the piste conditions and snow depth. The result of the corresponding Chi-Square-Test of the cross-tables has a two sided significance of 0.71. That means that the answers given for the snow depth correlate with the answer given for the slope conditions. The results of the cross correlations of other parameters are similar.

5 Conclusions and outlook

A multi-agent model calculating the number of visitors to different ski resorts was developed. The model enables to analyse possible impacts of climate change on the competition among ski resorts for day tourists and the consequences for tourist traffic. A household survey for ski tourists allowed calibration of the model.

The results of the data analysis delivered the description of the chosen external and internal factors of the model. To validate the model and the chosen factors that influence ski destination choice, additional factors and their cross correlation to the model parameters were examined. The results of the data analysis show that the model is sufficiently described by the chosen parameters. Taking the example of travel times, it could be demonstrated that the results of the questionnaire correlate very well with measured data from literature.

References

Ernst, A., C. Schulz, N. Schwarz & S. Janisch 2007, "Modeling of water use decisions in a large, spatially explicit, coupled simulation system", in: B. Edmonds, C.H. Iglesias & K.G. Troitzsch (eds.), *Social Simulation: Technologies, Advances and New Discoveries*, Hershey

Harrer, B., M. Zeiner, & S. Scherr 1995, *Tagesreisen der Deutschen: Struktur und wirtschaftliche Bedeutung des Tagesausflugs- und Tagesgeschäftsreiseverkehrs in der Bundesrepublik Deutschland*, München

Klassen, J. 2001, *Einfluß der Information auf die inidividuelle Freizeitmobilität*, (Ph.D. thesis, TU München), München

Ludwig, R., W. Mauser, W. Niemeyer, A. Colgan, R. Stolz, H. Escher-Vetter, M. Kuhn, M. Reichstein, J. Tenhunen, A. Kraus, M. Ludwig, M. Barth, & M. Hennicker 2003, "Web-based modeling of energy, water and matter fluxes to support decision making in mesoscale catchments-the integrative perspective of GLOWA-Danube", *Physics and Chemistry of the Earth 28*, 621–634.

Siebel, F., & W. Mauser 2007, "Simulating vehicular traffic in a network using dynamic routing", *Mathematical and Computer Modelling of Dynamical Systems 13*, 83–97.

Tepfenhart, M., & W. Mauser 2006, *Fragebogen zum Skifahrverhalten*, on: http://www.tepfenhart.net/Fragebogen_Skifahrverhalten.doc (26.09.2007).

Tepfenhart, M., W. Mauser & F. Siebel 2007a, "Climate change and the competition among ski areas for day tourists", in: *Nationalpark Berchtesgaden Forschungsbericht 53/2007: Alpine Snow Workshop*, München

Tepfenhart, M., W. Mauser & F. Siebel 2007b, "The impacts of climate climate change on ski resorts and tourist traffic", in: *Proceedings of the Third International Workshop on Climate, Tourism and Recreation 2007: Developments in Tourism Climatology*, on: http://www.mif.uni-freiburg.de/isb/ws3/report.htm (07.04.2008).

Train, K.E., 2003, *Discrete Choice Models with Simulation*, Cambridge

Widmer, P. & K.W. Axhausen 2001, Aktivitäten-orientierte Personenverkehrsmodelle: Vorstudie, (Bundesamt für Strassen, UVEK, Bern – Schriftenreihe, Bd. 471), on: http://www.ivt.ethz.ch/vpl/publications/reports/ab70.pdf (26.09.2007)

Wooldridge, M. 1999, "Intelligent Agents", in: G. Weiss (ed.), *Multiagent Systems – A Modern Approach to Distributed Artificial Intelligence*, Cambridge (MA)