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Abstract
Market segmentation studies have become very common in tourism research. While the majority of studies follow an a priori segmentation approach by profiling certain subgroups of the tourism market that are defined in advance, the popularity of post-hoc, a posteriori or data-driven segmentation approaches has increased dramatically since its introduction into tourism research in the early Eighties. This paper aims at reviewing data-driven segmentation studies conducted in tourism research with respect to the constructs under study and the methodology used, investigating developments over the past 24 years since the introduction of data-driven segmentation into tourism and providing an outlook on directions of further development.

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DATA-DRIVEN MARKET SEGMENTATION IN TOURISM – APPROACHES, CHANGES OVER TWO DECADES AND DEVELOPMENT POTENTIAL

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ABSTRACT

Market segmentation studies have become very common in tourism research. While the majority of studies follow an *a priori* segmentation approach by profiling certain subgroups of the tourism market that are defined in advance, the popularity of *post-hoc*, *a posteriori* or data-driven segmentation approaches has increased dramatically since its introduction into tourism research in the early Eighties. This paper aims at reviewing data-driven segmentation studies conducted in tourism research with respect to the constructs under study and the methodology used, investigating developments over the past 24 years since the introduction of data-driven segmentation into tourism and providing an outlook on directions of further development.

INTRODUCTION - MARKET SEGMENTATION IN TOURISM RESEARCH

Market segmentation research has a long history in tourism research. Both *a priori* (Mazanec, 2000) or commonsense (Dolnicar, 2004) and *post-hoc* (Meyers & Tauber, 1977) or *a posteriori* (Mazanec, 2000) or data-driven (Dolnicar, 2004) segmentation studies have frequently been undertaken to gain an in-depth understanding of parts of the tourism market in order to improve the possibilities of targeting marketing activities towards attractive sub-markets. The basic idea underlying market segmentation is to identify or define groups of tourists who are similar with respect to the construct of primary interest, for instance, travel behaviour, travel motives, patterns of expenditure.

Data-driven segmentation studies are exploratory in nature and consist of a number of steps that are crucial to the quality of the solution derived (Bailey, 1994; Aldenderfer & Blashfield, 1984; Arabie & Hubert, 1994; Wedel & Kamakura, 1998).

These steps include (1) the data collection stage, (2) the data pre-processing stage (if needed), (3) the segmentation stage, and finally (4) the validation stage. Within each of these stages a number of alternative options exist and it is the researcher's responsibility to evaluate the appropriateness of these options for the problem at hand and choose the optimal way to proceed. For instance, during the segmentation stage the researcher needs to decide which distance measure to use, which the most appropriate algorithm is (especially given that algorithms are known not only to reveal structure, but also impose it on the data), how to determine which number of segments best represents the market situation, and finally, which of the many possible solutions (even within the same number of segments) to select, and whether to inform tourism industry that the segments derived are naturally occurring distinct groups of tourists or artificially constructed by the

researcher for the purpose of more efficient target marketing, both of which are legitimate approaches to data-driven market segmentation.

The aim of this study is (1) to review data-driven segmentation studies undertaken in the field of tourism research with respect to the constructs that are typically investigated and the methodologies typically applied, (2) to study whether changes of focus or methodologies have taken place over the past 24 years since the introduction of data-driven segmentation into the area of tourism research, and (3) to derive development opportunities for the future from this systematic literature review. As such, this study extends the work undertaken by Frochot and Morrison (2000), who comprehensively reviewed benefit segmentation studies in tourism and by Dolnicar (2002), who reviewed data-driven segmentation studies in tourism that use different constructs as segmentation base.

Improving market segmentation solutions for the benefit of tourism industry thus requires strong segmentation bases rather than random information easily accessible as well as an unflawed methodological approach. While this article focused on methodological aspects of data-driven market segmentation, it should be clarified that the foundation of any segmentation solution is the quality of the information that is used to group tourists. A number of experimental studies have demonstrated that the inclusion of only one or two irrelevant pieces of information has major negative impacts on the ability to detect the true segments. It is not more difficult to collect the data for a data-driven market segmentation study than it is to conduct any other survey: the constructs used to segment have to be well operationalised, should not be redundant and should be expected to discriminate between segments.

The paper is structured as follows: first, details on the method are provided. Next, study results are presented in two sections, one profiling data-driven segmentation studies in tourism, the second one providing results on the comparison of studies conducted before and after 2000. Finally, the findings are discussed, and conclusions are drawn.

METHODS

In order to investigate the nature of data-driven segmentation studies typically undertaken in tourism research and changes that might have taken place since the pioneering work of data-driven segmentation in tourism in the early Eighties, a structured literature review approach was chosen. Only studies investigating market segments among tourists (as opposed to residents, or tourism businesses) that were published in academic journals were included. In sum, 75 manuscripts were reviewed and coded into a data set. Most of the studies were published in the Journal of Travel Research, Tourism Management and the Journal of Travel & Tourism Marketing. Papers from 1981 until 2005 were included, thus covering more than two decades of data-driven segmentation research in tourism.

Sixteen criteria were coded which reflect the basic structure of a data-driven segmentation study as described above: author, journal, publication year, sample size, number of variables in the segmentation base, format of the data used, whether data structure was studied before segmenting the data, of which nature the segmentation base was, whether or not data had been pre-processed before segmenting, if factor analysis was used for pre-processing: how many factors emerged, the clustering algorithms used, the distance measure used, the method used to determine how many clusters to extract, the number of clusters extracted from

the data, whether or not validity test were undertaken and in which way and whether or not stability tests were undertaken.

Frequency analysis of this data will allow conclusions to be drawn with regard to research question (1), a comparison across years will allow to investigate whether changes have taken place over the past decades (research question (2)) and development opportunities (research question (3)) will be derived by comparing methodological recommendations regarding segmentation procedures with the approaches typically taken in tourism research.

RESULTS

Data-driven segmentation studies in tourism

It is interesting to see that data-driven segmentation studies are essentially limited to behavioural (21 percent of studies) and psychographic segmentation bases, with psychographic constructs being used as grouping criterion in three quarters of all studies. Psychographic constructs typically include segmentation bases such as benefits, motivations, and preferences. Table 1 provides the detailed figures for all nominal criteria that were used to code the data. As can be seen only 3 percent did not use either behavioural or psychographic criteria, instead choosing a mixed approach including variables of different nature.

With respect to the segmentation base[1] that is typically used, the ordinal format dominates the field (see Table 1 for details): 68 percent of all authors collect data in ordinal format, such as Likert scales, or use data that is available in ordinal format. About one fifth of the authors use binary (yes-no) responses and only few studies apply metric data or variables with mixed formats. The studies that chose to use metric data usually do so because of the nature of the construct under study. For instance, most of the metric studies segment tourist on the basis of spending behaviour, which naturally suggest a metric monetary unit. Typically, 23 variables form the starting point of a segmentation study (Table 2); the average sample size amounts to 1179 (Table 2) with an impressive maximum of 11600 respondents and a minimum of 46. Given the methodological problems associated with ordinal data, the dominance of this answer format is surprising. Researchers could broaden their range of answer formats used in survey research to binary of metric formats. By doing so some of the problematic characteristics of ordinal scales (susceptibility to response styles, lack of metric scale property, danger of inter-individual differences in interpreting verbalised answer options etc.) would be avoided.

The structure of data is practically not investigated (99 percent of studies do not discuss the issue, see Table 1) and the concept of segmentation underling the study is consequently not entirely clear. For instance, if there were cluster structure in the data, the researcher's aim would be to identify existing groups. If, however, there were no cluster structure in the data, the researcher's aim would be to construct the segmentation solution that would be most helpful for management. Both approaches are perfectly legitimate and have been suggested by various authors in the past; it is important, however, to enable the user or reader of a study to know how to correctly interpret the resulting segments. The more explicit the author is in describing the actual data structure, the easier it is for the reader or user of the segmentation study to understand the strength of the segmentation

[1] Following the terminology introduced by Wedel and Kamakura (1998) the term "segmentation base" is used to describe the variables chosen to perform the grouping of respondents.

foundation for marketing action, where stable segments based on structure in the data would be preferable to instable ones, while artificially constructed instable segments would still be likely to be preferable to management than no segments at all, in which case a mass marketing strategy would practically be imposed on them.

Table 1
Nominal characteristics of data-driven segmentation studies in tourism

		Frequency	%
Construct of segmentation base	Behavioural	16	21
	Psychographic	56	75
	Mix	3	4
Data format of segmentation base	Binary	14	19
	Ordinal	49	67
	Metric	3	4
	Mix	4	5
	Not stated	3	4
Has data structure been investigated before clustering	No	74	99
	Yes	1	1
Method of pre-processing	No pre-processing	29	39
	Factor analysis	38	51
	Standardisation	3	4
	Other	5	7
Clustering algorithm chosen	Not stated	1	1
	k-means	29	41
	Ward's	12	17
	Undefined hierarchical	1	1
	Other hierarchical	13	19
	Neural Networks	3	4
	CHAID	2	3
	Others	9	13
Distance measure used	Not stated	58	77
	Stated	17	23
Method for determining the number of clusters	Not stated	28	37
	Personal judgment	11	15
	Heuristic procedure	23	31
	Dendrogram form hierarch. step	9	12
Evaluation of validity	No	24	32
	Discriminant analysis	10	13
	Chi^2	5	7
	ANOVA	15	21
	ANOVA and Chi^2	12	16
	MANOVA	1	1
	Mix	3	4
	Other testing	1	1
	Comparison with external variables	3	4
Evaluation of stability	None	63	84

	Yes	12	16

Half of the data-driven segmentation studies factor analyse their data before clustering it (Table 1), thus reducing the segmentation base from the original set of variables to six factors on average (Table 2). The number of factors ranges from a minimum of three to a maximum of 19. Using factor analysis before clustering is a questionable procedure given that not only a substantial amount of the originally collected data is removed, but the resulting segments are in fact revealed in transformed, component space rather than original item space. Generally, any pre-processing of data is not recommended in clustering.

The single most popular algorithm for the segmentation step itself is the k-means partitioning algorithm (Table 1). Hierarchical cluster analyses are very popular as well, however, the underlying linkage algorithm differs across studies, with the Ward's approach being most popular. The distance measures used to compute dis/similarities between respondents are typically not stated explicitly (Table 1).

Table 2
Metric characteristics of data-driven segmentation studies in tourism

	N	Min	Max	Mean	Std. Dev.
Sample size	75	46	11600	1179	1987
Number of variables in original segmentation base	73	3	58	23	12
Number of factors scores or reduced set of variables used for clustering	33	3	19	6	3
Number of clusters selected	75	2	7	4	1

A vast variety of approaches have been taken to determine the optimal number of clusters by tourism researchers in the past: heuristic procedures are most popular, followed by personal judgement and dendrograms emerging from a first hierarchical step of cluster analysis (Table 1). Interestingly the range of the number of segments selected for the final solution is very low given the diversity of the data-driven segmentation studies included: between two and seven segments are chosen to represent the data best in all the 75 reviewed studies. On average, four segments are derived from the data (Table 2). The number of clusters problem still remains one of the most crucial in market segmentation studies. No single best criterion to determine the number of clusters exists. One way to determine which might be the most suitable is to compute multiple replications of segmentation solutions with different numbers of clusters and evaluate the stability of replications for each number of clusters. This stability-based segmentation approach that makes use of the data structure to make these crucial decisions throughout the segmentation procedure forms the basis of bagged clustering which was introduced into tourism research by Dolnicar and Leisch (2003).

With regard to the evaluation of validity, the variety of options chosen by tourism researchers is wide (Table 1). Analyses of variance and chi-squared tests computed separately or in combination are the most frequently chosen option, followed my discriminant analysis. Only on third of the data-driven segmentation studies to not investigate validity. Evaluation of validity is essential to any data-driven segmentation study. Validity cannot be evaluated by testing how well those items that are used for segmenting discriminate between segments, an approach frequently

seen in empirical studies. Instead, external variables have to be used to evaluate the validity and managerial usefulness of a solution. Such external variables can be additional information available from the respondents or external information from entirely different sources.

The criterion of stability, however, does not appear to have been of major concern to tourism researchers so far: 84 percent do not investigate whether or not the data-driven segmentation solution chosen is stable or not (Table 1), only 16 percent do. Stability is essential as every clustering solution is different. Only if one solution can be repeatedly found, this gives the researcher the security to postulate the existence of segments. Otherwise one runs the risk of reporting on random results.

Changes in data-driven segmentation studies over the past 24 years

In order to investigate whether the nature of data-driven segmentation studies has changed since its introduction into tourism research, studies published before 2000 were compared to studies that were published after 2000 with respect to the same criteria that have been discussed above. Chi-squared tests were computed for nominal and ordinal variables and analyses of variance were conducted for metric variables.

In general, it appears that the way in which data-driven segmentation studies have been conducted over the past decades have not changed dramatically. Only a few differences are statistically significant at the 5% level: binary data format was used more frequently and metric format less frequently in earlier studies (p-value 0.02); the methods for determining the number of clusters have been investigated using heuristic procedures of different nature more frequently in earlier studies, whereas the use of dendrograms from a first stage hierarchical cluster analysis has increased in popularity later (p-value 0.02); and the validity of studies is investigated more frequently in recent studies than this was the case earlier, with the combined use of analyses of variance and chi-square tests rising in popularity (p-value 0.00).

The precise frequencies are provided in Table 3 separately for decades. Tests for significance of change were not conducted on the basis of this table because of the low sample size available before 1990.

Table 3
Comparison of data-driven segmentation characteristics across decades

decade of publication			1980-1989			1990-1999			2000-2005			Total		
			Mean	N	std dev	Mean	N	std dev	Mean	N	std dev	Mean	N	std dev
	sample size		532	8	440	1023	32	1560	1469	35	2476	1179	75	1987
	# variables		18	8	6	22	31	12	25	34	14	23	73	12
	# factors scores used		6	2	1	6	18	4	6	13	2	6	33	3
	# clusters selected		4	8	1	4	32	1	4	35	1	4	75	1
Data format of segmentation base	binary	Count	1			9			4			14		
		% within decade	13			30			11			19		
	ordinal	Count	7			20			22			49		
		% within decade	88			67			63			67		
	metric	Count	0			0			3			3		
		% within decade	0			0			9			4		
	mix	Count	0			1			3			4		
		% within decade	0			3			9			5		
	not stated	Count	0			0			3			3		
		% within decade	0			0			9			4		
Data structure investigation	no	Count	8			31			35			74		
		% within decade	100			97			100			99		
	yes	Count	0			1			0			1		
		% within decade	0			3			0			1		
Construct of segmentation base	behavioural	Count	0			9			7			16		
		% within decade	0			28			20			21		
	psychographic	Count	8			23			25			56		
		% within decade	100			72			71			75		
	mix	Count	0			0			3			3		
		% within decade	0			0			9			4		
Method of pre-processing	no pre-processing	Count	4			11			14			29		
		% within decade	50			34			40			39		
	factor analysis	Count	2			17			19			38		
		% within decade	25			53			54			51		
	standardisation	Count	0			1			2			3		
		% within decade	0			3			6			4		
	other	Count	2			3			0			5		
		% within decade	25			9			0			7		
Clustering algorithm chosen	not stated	Count	0			0			1			1		
		% within decade	0			0			3			1		
	k means	Count	3			12			14			29		

		% within decade	43	43	40	41
	Ward's	Count	1	4	7	12
		% within decade	14	14	20	17
	undefined hierachical	Count	0	0	1	1
		% within decade	0	0	3	1
	other hierarchical	Count	1	8	4	13
		% within decade	14	29	11	19
	NN	Count	0	1	2	3
		% within decade	0	4	6	4
	CHAID	Count	0	0	2	2
		% within decade	0	0	6	3
	others	Count	2	3	4	9
		% within decade	29	11	11	13
Distance measure used	stated	Count	6	28	24	58
		% within decade	75	88	69	77
	stated	Count	2	4	11	17
		% within decade	25	13	31	23
Method for determining # clusters	not stated	Count	3	12	13	28
		% within decade	38	41	38	39
	personal judgment	Count	0	4	7	11
		% within decade	0	14	21	15
	heuristic procedure	Count	5	12	6	23
		% within decade	63	41	18	32
	dendrogramm form hierarch. step	Count	0	1	8	9
		% within decade	0	3	24	13
Evaluation of validity	no	Count	5	11	8	24
		% within decade	63	35	23	32
	discriminant analysis	Count	1	6	3	10
		% within decade	13	19	9	14
	analysis of variance	Count	0	0	1	1
		% within decade	0	0	3	1
	chi 2	Count	0	0	5	5
		% within decade	0	0	14	7
	ANOVA	Count	1	8	5	14
		% within decade	13	26	14	19
	ANOVA and chi2	Count	0	0	12	12
		% within decade	0	0	34	16
	MANOVA	Count	0	0	1	1
		% within decade	0	0	3	1
	mix	Count	0	3	0	3
		% within decade	0	10	0	4
	other testing	Count	0	1	0	1
		% within decade	0	3	0	1

	comparison with external variables	Count	1	2	0	3
		% within decade	13	6	0	4
Evaluation of stability	none	Count	6	26	31	63
		% within decade	75	81	89	84
	yes	Count	2	6	4	12
		% within decade	25	19	11	16

DISCUSSION, CONCLUSIONS AND IMPLICATIONS

The review of data-driven segmentation studies undertaken in the past 24 years demonstrates strong preferences among tourism researchers for using ordinal data as the segmentation base (typically with five or seven scale points), pre-processing data before clustering (especially by using factor analysis), choosing certain algorithms (k-means and Ward's clustering in particular), and validating solutions by investigating differences between segments with respect to characteristics which were not included in the segmentation base (mainly by means of analysis of variance).

Given that data-driven segmentation is such a broad field with so many different possible ways of approaching the problem, most of the techniques predominantly used in the field of tourism have been debated in the past and/or have not been resolved as yet. For instance, the discussion about optimal answer formats is ongoing. For an excellent discussion of the problems associated with ordinal scales see the publication by Kampen and Swyngedouw (2000). With respect to the algorithm used there also seems to be a wide variety of different opinions as to what the optimal approach might be, with options including latent class analysis (Formann, 1984), finite mixture models (Wedel & Kamakura, 1998) and neural networks (Mazanec, 1992). The question about how to select the optimal number of clusters essentially still remains unsolved. A number of different heuristic procedures have been proposed in the past for clustering procedures (typically based on repetitions across or within number of clusters or both) and model-based approaches compare model likelihood values to make this selection. Yet none of these approaches provide clear and unambiguous answers. Pre-processing of data is another extensively debated issue. It appears that most of the authors of methodological books on cluster analysis tend to recommend that data not be pre-processed if it is not necessary in order not to transform the original information. Necessity to do so may, however, arise from the fact that variables of different format may be part of the segmentation base thus potentially leading to implicit weighting effects of variables with a larger range of values if left untransformed.

The investigation of differences between earlier and later studies leads to some encouraging findings, particularly with respect to the increased investigation of validity of segmentation results among tourism researchers. The broadening of data formats to metric data also represents a positive development as metric data solves the problems associated with assumptions of ordinal scales (that the distance between adjacent answer options is the same and that all respondents have the same interpretation of each scale point). The number of clusters investigation appears to have mainly shifted in nature, from heuristics to dendrograms.

Two main directions of future development become apparent from the review: the investigation of data structure before any kind of analysis is undertaken in order to assure transparency of the segmentation concept underlying the study (identifying naturally occurring segments or constructing artificial ones) and the investigation of stability. While stability is difficult to evaluate over time in tourism given that longitudinal samples of tourists are rare and very difficult to obtain, stability investigation of analyses of the same data set would provide increased levels of confidence that the derived solution is not random and thus strengthen the results of data-driven segmentation solutions significantly.

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APPENDIX: STUDIES INCLUDED IN THE REVIEW

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