

THE USE OF DECISION TREES IN PLANNING EMPLOYMENT IN TOURISM ENTERPRISES*

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Abstract: *Tourism enterprises are the basic entity of the tourism economy, which operates on the basis of the assumptions of the microeconomic theory of companies. Their economic decisions focus on determining service levels and pricing to maximize profit. However, the functioning of tourism enterprises shows a significant sector specificity resulting mainly from the seasonality of tourism demand. Because seasonality means that tourism enterprises use their material, financial and human resources to the full only for a small part of the year. In the context of employment, this forces tourism enterprises to use different planning methods from the traditional ones.*

The aim of the article is to try to answer the questions about the basic possibilities of determining the labor demand in tourism enterprises and to check what determines the choice of approach to determining the level of employment. To solve this problem, the conclusions of the literature review and the conclusions of the survey conducted among the tourism industry companies in the Polish seaside area were used. Methods of building and analyzing decision trees were used to explain the mechanism of determining the labor demand in the tourism industry.

Key words: *tourism enterprises, employment, seasonality, decision tree, Poland*

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Introduction

In tourism enterprises, decisions regarding the amount of labor demand are the result of many factors, the most important of which is the seasonality of tourism demand. Fluctuations in tourist demand make it necessary to change the approach to employment of employees several times during the year and to make decisions regarding changes in the organization of work [1, 2, 3]. When making long-term employment decisions, tourism enterprises must also take into account seasonal adjustments. The seasonality of employment in tourism is its most important specificity.

The article presents a scheme for determining employment in tourism industry enterprises. The aim of the article is to present the possibility of determining the demand for work in companies in the tourism industry and to indicate the possibility of using the method of decision trees as an effective tool supporting making these decisions. The basic questions to which answers were sought concerned the approach used by tourism enterprises to determine the demand for work and the identification of factors that determine its selection. Literature studies made it possible to define possible strategies for determining the demand for work. Empirical analyzes were focused on the conclusions of



the survey conducted among the tourism industry enterprises operating in Poland in the Baltic Sea region. The traditional method of analyzing the results of a survey are cross tables, which can be used, inter alia, to determine the relationship between qualitative variables. However, a more effective way to study this relationship is through decision trees.

Decision trees support the decision-making process of enterprises in a simple way and are a good complement to traditional methods of analysis. This is because trees can be used to express any arbitrary function that maps the values of all attributes to a set of categories [4]. This method is based on creating a structure that divides a large number of cases into smaller groups until reaching the most homogeneous group in terms of the dependent variable [5]. Thus, Classification and Regression Trees is a non-parametric method of discrimination. The aim is to group and divide cases in terms of the distinguished features. It allows you to search for patterns and dependencies in the studied group and present them in the form of simple models.

The article consists of three parts. The first one reviews the literature on the labor demand and the determinants of its determination in the tourism industry. The second describes the data used. The third part presents the results of an empirical study and presents the possibilities of using the decision trees method in the process of making decisions about the size of employment. The summary was made in the last part of the work, trying to answer the questions related to the main purpose of the work.

Labor demand in industries with high seasonality

In the literature, the demand for labor is generally defined as a function of the demand for employees at various levels of remuneration. The amount of labor demand determined in this way refers to both employed persons and job vacancies for which enterprises reported a demand but did not find any employees. The demand for labor comes directly from the function of the demand for goods and services [6, 7].

The theories of labor demand essentially indicate two approaches to determining the demand for labor: static and dynamic [6].

The static approach assumes that the change in employment of enterprises smoothly adjusts employment to changes in the volume of production [8, 9]. In the long run, the labor demand function is determined by solving the problem of production optimization, and the determined labor demand describes the quantitative relationship between the level of the labor resource and the volume of production at fixed wage rates and determines the flexibility of substitution between inputs [8]. The assumption regarding the smooth adjustment of employment to changes in production volume is the greatest limitation.

In enterprises, short-term mismatches of the labor resource to the production volume appear [10, 11]. The reasons are, among others low unemployment and wage pressure from employees. Dynamic labor demand introduces to the modeling of labor demand the condition of a partial mismatch between the labor resource and changes in production volume [6]. The long-term labor demand curve is determined by solving the problem of dynamic optimization, in which companies maximize the discounted value of future profits and confront it with the estimated costs of adjusting the labor resource to changes in production volume [6, 8]. Therefore, the key issue is to determine the costs of adjusting the labor resource to changes in production volume and their variability in the face of production fluctuations. The costs of adjusting the workforce to changes in the production volume may result from the mismatch of employees' skills with the needs of employers,

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employment of people requiring training or periodic changes in the economic activity of the enterprise.

Periodic fluctuations in production significantly disturb the process of determining the demand for labor. Cyclically occurring fluctuations in economic activity cause periodic retention of employees in the enterprise [9, 10]. Analyzes of job storage indicate that the phenomenon is present in all economies of the European Union and the United States [12]. However, job storage varies regionally and sectorally, it affects employee groups to a different extent, and enterprises are particularly vulnerable to its occurrence, e.g. enterprises in industries requiring specific qualifications, such as the pharmaceutical industry.

Tourism is one of the sectors in which a natural condition is high seasonal variability [13]. Seasonality analyzes show that tourism enterprises naturally adapt to changes during the year [2]. Their labor demand changes significantly during the tourist season and reacts strongly to changes in the demand for tourist goods and services [1, 2]. The industry shows only a slight to moderate propensity to store workers [12]. The problem of seasonal adjustment of the demand for labor is relatively poorly understood, because the research on the demand for labor uses data of different frequency, ie annual, quarterly, monthly [10]. However, usually seasonality is treated as an impurity in the time series and removed from it before starting the analyzes.

Seasonality as the most important determinant of economic activity in the tourism sector is assessed in an extremely different way. There are companies that treat it as a challenge for their business. These enterprises try to cope with seasonal difficulties by keeping the enterprise functioning throughout the year. Such an organization of activities makes it necessary to maintain stable employment of employees and tourist offer throughout the year. On the other hand, in the tourism sector there are parallel enterprises for which seasonality is such a great challenge that these enterprises completely limit their activities after the tourist season – they remain closed for most of the year [1, 2, 3].

Employment decisions with tourism companies are some of the more difficult decisions that have to be made by tourism companies. On the one hand, smooth matching of employment to tourism demand necessitates additional expenditure on recruitment, training and dismissal, and may be associated with a deteriorated quality of the tourist service. On the other hand, maintaining employment throughout the year is associated with the need to incur additional wage costs and the risk of dismissal during the tourist season. The choice of approach is also an important element in the development of regions where the labor market is an important element. Therefore, it is interesting to know the factors that determine these decisions. Understanding the motivations of businesses can be of value and be useful in developing, for example, regional policy.

Research method and data sources

The empirical analysis focuses on: (i) identifying and assessing possible approaches to determining the demand for work in tourism industry enterprises in Poland in the Baltic Sea region, and (ii) the use of decision tree elements to determine the factors determining the selection of enterprises. The data used for the analysis comes from a survey of Polish tourism enterprises. The study was conducted in September – November 2019. 360 enterprises conducting tourist activity, ie enterprises running activities related to accommodation and catering services, participated in the study. Table 1 presents the basic characteristics of the companies participating in the study.



Table 1. Characteristics of enterprises participating in the study – selected statistics

	Population [n=360]	Percentage [%]
Enterprise size:		
- micro <10 employees	239	66,4
- small (10; 49 employees)	107	29,7
- medium (50; 249 employees)	9	2,5
- large (> 250 employees)	5	1,4
PKD section.		
- I.55 (accommodation activities)	219	60,8
- I.56 (catering activities)	141	39,2
Financial situation:		
- good: 2018 profit > 0	233	64,7
- 2018 profit = 0	40	11,1
- bad: 2018 profit <0	21	5,8
- refusal to answer	66	18,3
Seasonal specificity of the activity:		
- year-round activity with a large increase in revenues in the tourist season	126	35,0
- year-round activity with a moderate increase in revenues in the tourist season	55	15,3
- year-round activity with a small increase in revenues in the tourist season	20	5,6
- year-round activity without an increase in revenues in the tourist season	16	4,4
- seasonal activity – refusal to answer	139	38,6
	4	1,1
Seasonal employment in the 2018 season:		
- yes	245	68,1
- no	115	31,9

Source: own elaboration.

The research results

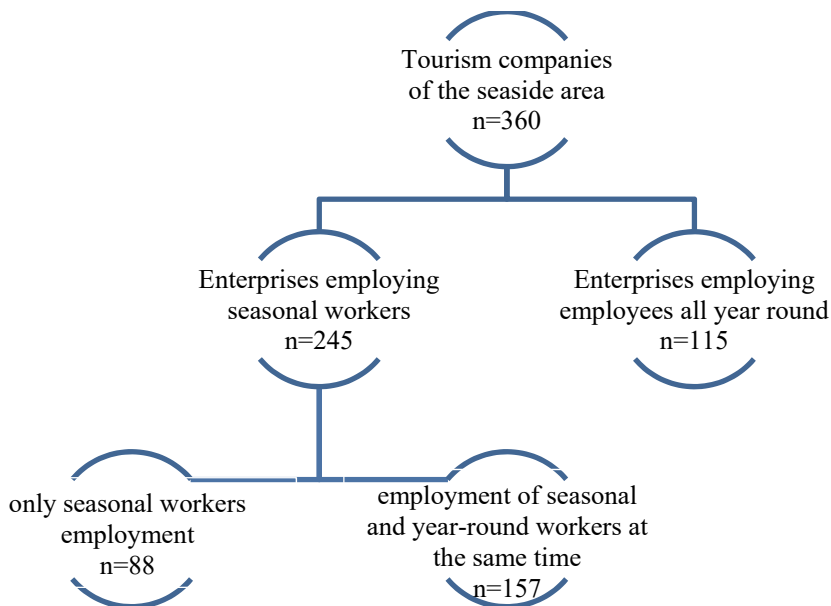
Tourism enterprises operating in the coastal region in Poland participating in the 2019 survey are mainly micro (employing up to 9 employees) and small (employing from 10 to 49 employees). They constitute a total of 96.1% of the surveyed sample of enterprises. The rest are medium-sized and large enterprises – 2.5% and 1.4%, respectively. The financial situation of the surveyed group of enterprises was good: 64.7% of enterprises declared a positive financial result last year, i.e. 2019, 11.1% – the financial result was zero, 18.3% did not answer this question, declaring that it is too sensitive. Only 5.8% of the surveyed sample of enterprises indicated financial difficulties and the achievement of a negative financial result.

68.1% of the surveyed enterprises employed seasonal workers, the remaining group of enterprises – 31.9% declared that they would maintain employment throughout the year. Enterprises declaring employment of seasonal workers were divided into two groups, i.e.

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enterprises employing only seasonal workers and enterprises employing both seasonal workers and year-round workers. The division into groups is presented in Diagram 1.

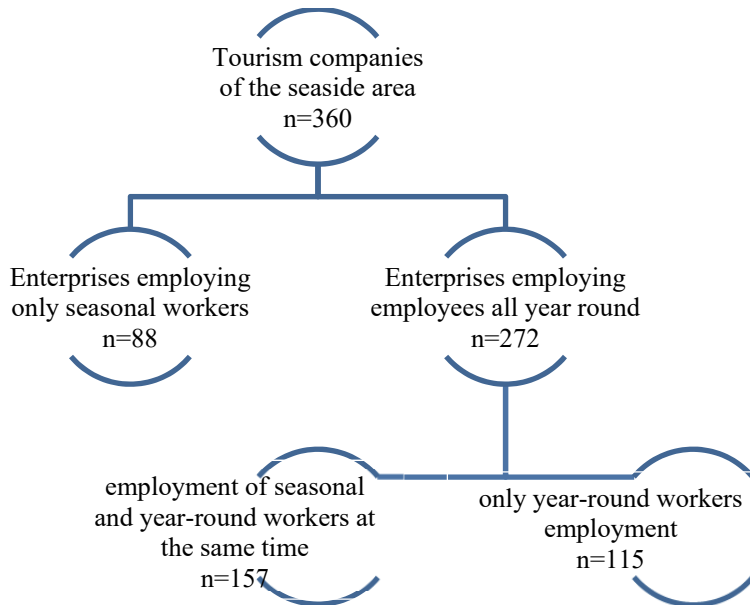
***Diagram 1.** Division of tourist enterprises in the seaside region in Poland by type of employment*



Source: own elaboration.

Taking into account the forms of employment of employees declared by the surveyed enterprises, it can be concluded about the approach applied by enterprises to determining the demand for work. Enterprises which immediately adjusted their employment to changes in the tourism demand were enterprises that did not keep employees. They only employed seasonal workers. After the season, these companies reduce employment altogether. The second group of enterprises are enterprises that do not make an immediate seasonal adjustment of employment. This group of enterprises includes two types of enterprises, ie those employing seasonal workers during the tourist season or enterprises planning different efforts of full-time employees during the year. The breakdown of the survey results is presented in Diagram 2.

Diagram 2. Division of tourist enterprises in the seaside region in Poland according to the approach to determining the labor demand



Source: own elaboration.

The applied approach to reporting the labor demand divided the enterprises into two groups, at the same time it was assumed that they are heterogeneous. Subgroup studies were performed in the next part of the analysis. The subgroups were examined in terms of: (i) size of the enterprise measured by the number of employees, (ii) achieved financial results, (iii) type of activity. Taking into account the nature and number of comparative groups, the measurement scale of the dependent variable and the homogeneity of variance in the groups, the Chi-square test was selected to verify the hypotheses. The results of the analysis are presented in Table 1.

Table 1. Subgroup Study Results

Variables	Enterprises employing only seasonal workers n=88	Enterprises employing employees all year round n=272	Chi-square df p=value
The enterprise size measured by the number of employees			
micro <10 employees	77 (87,5%)	162 (59,6%)	Chi- square = 2,0793 df = 3 p = 0,5561
small (10; 49 employees)	11 (12,5%)	96 (35,3%)	
medium (50; 249 employees)	0 (0,0%)	9 (3,3%)	
large (> 250 employees)	0 (0,0%)	5 (1,8%)	
Financial situation			
2018 profit > 0	62 (70,4%)	171 (62,9%)	Chi- square = 23,9711 df = 3 p = 0,0000
profit = 0	9 (1,0%)	31 (11,4%)	
profit <0	5 (5,7%)	16 (5,9%)	
refusal to answer	12 (13,6%)	54 (19,9%)	

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PKD section			
- I.55 (accommodation activit.)	57 (64,8%)	162 (59,6%)	Ch- square = 0,7586 df = 1 p = 0,3876
- I.56 (catering activities)	31 (35,2%)	110 (40,4%)	

Source: own elaboration.

The results presented in Table 1 show that the size of the enterprise and the type of activity conducted do not differentiate enterprises in terms of their approach to determining the demand for labor. On the other hand, the responses to the assessment of the financial situation of enterprises significantly differed in enterprises employing only seasonal workers from the responses provided by enterprises maintaining employment throughout the year. This conclusion indicates the need to look for differences between groups of enterprises. These differences may concern the opinion of enterprises about the situation in the local labor market, opinions about the characteristics of seasonal and full-time employees, the ratio of employee groups to wages and working hours, etc.

As the majority of the data obtained during the survey are qualitative data, it is best to use the classification tree method based on the CHAID (Ch-square Automatic Interaction Detection) algorithm to assess the factors determining the choice of approach to employment.

Decision trees are one of the methods of machine learning that is based on case studies [14]. Each case must be described with a set of attributes with different values. Decision trees can take the form of regression or classification trees. Regression trees are those whose explained variable is expressed at least at the interval level. In contrast, classification trees - when the level of the dependent variable is at the nominal or ordinal level. As the name suggests, they are used to solve either regression or classification problems.

Decision trees are used to build descriptive and predictive models [4, 5]. They are built in order to be able to classify future observations about which we have no information about class affiliation. The advantage of the method is a fast and effective method of building and testing causal models based on many variables. The use of classification trees allows: (i) to introduce a large number of variables into the model, (ii) to simplify the models by reducing the number of variable categories by combining similar categories, (iii) to present the results of analyzes in a simple manner [5]. The limitation of the use of decision trees is the instability of the results, the model is sensitive to the specifics of the data set.

Graphically, decision trees are described by graphs consisting of the root and branches leading to nodes and leaves. The trees are built top to bottom. The set of all analyzed cases is concentrated in the root. The edges of the graph are called branches, subgroups of cases move through the branches down the tree to the nodes. Nodes are vertices from which at least one branch comes out. The nodes select the shift direction. In this way, the set of all analyzed cases is divided into subsets. The remaining vertices are leaves. The leaves of the tree are the final building block and the leaves are assigned classes. There is only one path to each leaf, connecting it to the root [5].

The use of decision trees in the decision-making process requires the adoption of an appropriate algorithm.

The algorithm builds a tree on the basis of logical division conditions, in the following stages, ie building the tree, stopping the tree building, pruning the tree and selecting the tree [4, 5]. Decision tree algorithms allow for the construction of binary or multidimensional trees. The most popular ones: ID3, C4.5, CHAID allow you to build trees of any structure (binary or multidimensional). Classification trees based on the CHAID classification algorithm are one of the oldest classification methods [14]. CHAID builds trees in which more than two branches may extend from the nodes, ie splitting into multiple paths. Selects the independent variable with the strongest interaction with the dependent variable. To



assess the significance of the relationship between the data, the Chi-square test of independence for qualitative variables and classification problems is used.

Conclusions

The results of the conducted analyzes indicate:

- tourism enterprises use two approaches to job demand reporting - an average of 24.4% of tourism enterprises operating in the Baltic Sea region immediately match employment to changes in tourism demand; in 75.6% of enterprises, matching is immediate;

- the size of the enterprise and the type of activity conducted do not differentiate the approach of tourism enterprises to determining the demand for labor, while the groups of enterprises applying different approaches to determining the demand for labor are significantly different in terms of assessing their financial situation;

- application of the method of analysis in subgroups indicates the possibility of using classification methods to identify potential factors determining the decision made;

- classification trees based on the CHAID algorithm allow for the analysis of qualitative data.

Bibliography:

1. Jolliffe, L., & Farnsworth, R. Seasonality in tourism employment: Human resource challenges. *International Journal of Contemporary Hospitality Management*, p. 312-316, 2003.
2. Baum, T. Seasonality in tourism: Understanding the challenges: Introduction. *Tourism Economics*, 5(1), p. 5-8, 1999.
3. Andriotis, K. Seasonality in Crete: Problem or a way of life?. *Tourism Economics*, 11(2), p. 207-224, 2005.
4. Rojek, I. System ekspertowy doboru półfabrykatów przy użyciu drzew decyzyjnych. *Studies & Proceedings of Polish Association for Knowledge Management*, (83), p. 38-48 2017.
5. Zakrzewicz, M. Data Mining i odkrywanie wiedzy w bazach danych. In *Materiały konferencyjne III Konferencji Polskiej Grupy Użytkowników Systemu Oracle, Zakopane*, p. 1-12, 1997.
6. Hamermesh, D. S. *Labor demand*. Princeton University Press, 1996.
7. Ehrenberg, R. G., & Smith, R. S. *Modern labor economics: Theory and public policy*. Routledge, 2016.
8. Bentolila, S., & Saint-Paul, G. A model of labor demand with linear adjustment costs. *Labour Economics*, 1(3-4), p. 303-326, 1994.
9. Radlińska, K., Klonowska-Matynia, M., Jakubowska, A., & Kwiatkowski, G. Labor hoarding: an old phenomena in modern times? Case study for EU countries. *Journal of Business Economics and Management*, 21(3), p. 872-889, 2020.
10. Strzelecki, P., Wyszynski, R., & Saczuk, K. Zjawisko chomikowania pracy w polskich przedsiębiorstwach po okresie transformacji. *Bank i Kredyt*, 40(6), p. 77-104, 2009.
11. Burda, M. C., & Hunt, J. *What explains the German labor market miracle in the Great Recession?* (No. w17187). National Bureau of Economic Research, 2011.
12. Leitner, S. M., & Stehrer, R. *Labour hoarding during the crisis: evidence for selected new member states from the financial crisis survey* (No. 84). WIIW Working Paper, 2012.
13. Ferrante, M., Magno, G. L. L., & De Cantis, S. Measuring tourism seasonality across European countries. *Tourism Management*, 68, p. 220-235, 2018.
14. Kass, G. V. An exploratory technique for investigating large quantities of categorical data. *Journal of the Royal Statistical Society: Series C (Applied Statistics)*, 29(2), p. 119-127, 1980.