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Joint Logit Model Approach to Analyze Soccer Spectators' Arrival Time and Location Preferences for Interim Activities in Istanbul

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ABSTRACT

Planned Special Event (PSE) is a public activity that has a defined location and time and has an influence on transportation system operations as a consequence of increases in travel demand or decreases in road capacity. Apart from the event itself, PSEs might generate additional activities based on location, time and duration of the event, and individual preferences. This paper focuses on the interim activities of soccer spectators in Istanbul. This paper is motivated by the mostly disregarded but significantly important demand for these activities by jointly analyzing the arrival time and location preferences for the interim activities carried out before the main activity. For this aim, a joint logit model capturing the factors influencing the arrival time and location choice collectively within the PSE circumstances is estimated. In this estimation, each trip and behavior of spectator groups are modeled separately. According to the results of the models, one significant and interesting finding is the behavioral differences of supporters of different teams which is mostly influenced by the activity opportunities present in the surrounding of the venues. Last motorized trips of the Besiktas and Fenerbahce's spectators end at the sub-centers in general, while the spectators of the Galatasaray prefer the stadium as their final destination. Moreover, league matches being on weekdays or weekends does not have a statistically significant effect on the choice of arrival time and location of the spectators. The findings provide useful information that might assist event organizers and decision-makers especially in planning special events.

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NOMENCLATURE

U	Utility of an alternative	**Greek Symbols**	
C	Choice set	ε	Stochastic component of the utility function (error term)
V	Deterministic component of the utility function	∑	Sum operator
P	Probability of a chosen alternative	**Subscripts**	
e	Exponential form of formula	*i*,*j*	Alternatives

1. INTRODUCTION

Planned special event (PSE) impacts on transportation network with its known location and scheduled time as a result of increases in travel demand or decreases in the capacity of road segments [1]. The effects of special events are mostly experienced on main arterials [2]. In addition, secondary roads and public transportation capacity are also affected to a lesser extent [3]. Skolnik et al. [3] reported that the level of the effectiveness of traffic demand management for PSEs is related to the number of attendees, arrival and departure patterns, available modes of transportation to and from the event, location and time.

PSEs frequently attract people from anywhere with different backgrounds into the host society, and then there can be interaction between societies and cultures [4]. Moreover, people create this interaction voluntarily

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and obviously, the driven force of this sharing is PSE [5].

Events can be classified in different ways in terms of their size, form, content, location and impact area [5]. Even though PSEs are planned occurrences, they raise the travel demand, abnormally and temporarily [3]. For PSE, Day [6] expressed that trip makers decide their departure times under consideration of the possible travel times and arrival times for their activity.

In general, individuals who participate in PSEs as the main activity attend to other derived activities such as eating, shopping, drinking, hanging out with friends, etc. These derived activities can be named as interim activities and they took place before and until the start of the PSE. This study analyzes the interim activity behavior of spectators by focusing on the preferences for the arrival time of the interim activity and the location of it. This analysis is performed by considering arrival time and location jointly as alternative pairs. The reason why arrival time is considered is straightforward; spectators who already paid for the tickets will always want to be at the venue at a convenient time before the event starts. This behavior is also applicable for the interim acitivites because, even though these activities are not compulsory and flexible by nature, their schedule must be arranged to avoid missing the start of the PSE. However, in the literature, mostly departure time is consideredand although the departure time seems to be what is chosen, it is the time to arrive what matters in the context of PSEs.

In the preferences for interim activities, location is also critical in a sense that in addition to (or combined with) the arrival time, the place where the interim activities are carried out is directly linked with the concerns for being at the PSE venue on time. The selection of the location mainly depends on the distance to the venue, the traffic situation of the roads leading to the venue, travel time between the location and the venue, and the characteristics of the participants. In this study, soccer games, a type of PSEs, are discussed. The aim of the study is to obtain an acceptable and applicable model by considering the arrival time and location choices as time and space dimensions. The paper concerns with the variables that affect the joint choice of arrival time and location of the spectators and model these variables by using the Joint Multinomial Logit Model (JMNL) approach. Only last motorized trips made for interim activities are considered, on the other hand, non-motorized trips are omitted because of the fact that these locations are fairly close to the venue.

The paper is structured as follows: The next section presents an overview of the literature, and then in the third section the modeling methodology is demonstrated. The fourth section explains details of the study area and data. The fifth section describes the modelling approach and variables of the model. The results of the model are given in the sixth section and the final section presents the discussions and final thoughts.

2. LITERATURE REVIEW

In the literature, PSE models generally consider only the main activity and travel demand from other zones to the event venues is solely forecasted [7-10], except very rare studies [11]. Moreover, PSE is analyzed by traffic management in some studies [1, 12-15] and spectator (customer) satisfaction point of view in others [16]. Most of the time, the literature on PSE studies is dominated by large-scale events such as Olympic Games, World Cup Tournaments, Winter Games, etc. [10, 13, 15].

A study conducted by Shin and Lyu [16] who argue the impacts of mega-scale planned special events' on the environment in terms of city planning and indicate urban regeneration challenges from the local residents' point of view. In this study, the PSE was a mega-scale event, which is called Glasgow 2014 Commonwealth Games. In another study, Giampiccoli et al. [17] compared the FIFA World Cup Football championship which is organized every four years and Comrades Marathon that is held yearly. They presented the effects of these sports events on economic development, tourism, and city plans. An analysis of these studies shows that mega-scale events have an important influence in the local economy. As can be seen from the examples, this effect on the immediate surroundings of the main activity areas is due to the presence of derived activities. For example, its contribution to the local economy is the crowd that comes there for the main event.

Generally, in literature in the field of urban trips or freight transport, mode and destination choice [18, 19], destination and parking choice [20], mode and departure time choice [21-23], time-use use expenditure and mode choice [24] are jointly modelled. In some cases, nested logit model approach can be used for destination choice, departure time and mode choice analysis [25]. However, studies in the field of PSE are very limited.

PSE travel demand models are also studied at various scales, including microscopic, mesoscopic and macroscopic. The study by Zhou and Tian [26] who investigated the link between incident clearing time and highway clearance time by using micro-simulation software in order to run multiple traffic incident scenarios. Another study focuses on the microscopic models by Florez et al. [27] who analyzed and highlight the most essential features related with the choice of walking as a mode of transportation, based on interviews done with spectators during three FIFA Confederations Cup matches performed in June 2013 at Maracan stadium in Rio de Janeiro. Furthermore, during special events such as festivals, Pratiwi et al. [28] looked into visitor

satisfaction with pedestrian accessibility. Zagidullin [14] investigated traffic management models during a major sporting event in a city and developed dynamic models to assess the influence of background traffic flow and public transportation that serves the sporting event. In another study, with various event scenarios, a mesosccopic traffic assignment tool is designed to examine participants' behavior during planned special events for mode and departure time choices [29]. Shakibaei et al. [9] tried to get to the bottom of estimation of mode choice preferences by conducting revealed preference surveys. Kuppam et al. [7] discussed from all aspects of the data gathering to the four-step trip-based model building of planned special event travel demand in the Phoenix metropolitan region. Chang and Lu [30] used the Multinomial Logit Model (MNL) to research concertgoers' behavior in terms of mode and arrival time choices. Consequently, as detailed above, even though in PSE field microscopic [26-28], mesoscopic [14, 29], or macroscopic [9, 30, 31] analyses were undertaken, jointly modelling of "mode and time", "mode and destination" or "time and destination" studies are very rare in the literature. Therefore, it can be argued that there is a gap in the literature about this aspect of PSEs that is needed to be explored bu using various modelling approaches.

3. METHODOLOGY

To understand the arrival time and location choice decisions of the interim activities, a joint MNL is estimated. MNL, which is easy to use and comprehend, is a commonly used modeling technique for choice modeling.

The utility theory underpins MNL's approach. This theory posits that among a choice set, each individual chooses the alternative that maximizes his or her utility. The utility of an alternative i (U_i) is comprised of two components given in Equation (1). In the equation, V_i is the deterministic (non-random) component of the utility and ε_i is the stochastic term that represents the differences in tastes [31]:

$$U_i = V_i + \varepsilon_i \quad (1)$$

In the MNL model, the probability of choosing an alternative i (P_i) over the alternatives in a choice set C is computed by using Equation (2) [32]:

$$P_i = \frac{e^{V_i}}{\sum_j e^{V_j}} \quad i, j \in C \quad (2)$$

P_i takes a value between 0 and 1, and the sum of the probabilities of each alternative equals to 1. In the literature, some research employed the MNL to model PSEs [9, 11, 30, 31], while others used the activity based modeling method [33, 34], and still others attempted various techniques like the mesoscopic simulation model [29], the category based modeling approach [35] and so on.The flowchart of the proposed model is given in Figure 1. After defining the overall choice set, the well-known MNL process is followed.

4. STUDY AREA and DATA

In this study, soccer games are considered as the main activities and 3 stadiums that belong to the 3 biggest football clubs, Besiktas, Fenerbahce and Galatasaray, with the most fans in Turkey and Istanbul are selected (Figure 2). Among these stadiums, Besiktas Vodafone Park and Fenerbahce Ulker Stadium are located in two of the central districts which are Besiktas and Kadikoy, with a capacity of 41,903 and 50,530, respectively. On the other hand, Galatasaray Turk Telekom Stadium is located at a peripheral region in the Sariyer district with a capacity of 52,280. As a result, the transportation connections of the Vodafone Park and Fenerbahce Ulker Stadium are better than the Turk Telekom Stadium. Except the game days, the travel demand of the metro line connects the Turk Telekom Stadium to the transport network is very low. The details of the stadium connections are presented in Figure 3.

Face-to-face surveys were employed to gather the data. 7 games were chosen in 2018 – 2019 Turkish Super League for each and a total 21 different game days are used. The surveys began roughly 3 hours before the game and ended just before the game. Only, randomly selected home team fans were surveyed. The questioners, on the other hand, were divided into groups by the stadium entrances in order to acquire non-biased statistics and fan information from diverse stadium stands. Furthermore, to eliminate prejudice, interviews with any of the observers were conducted attentively and in the absence of other people's attention.

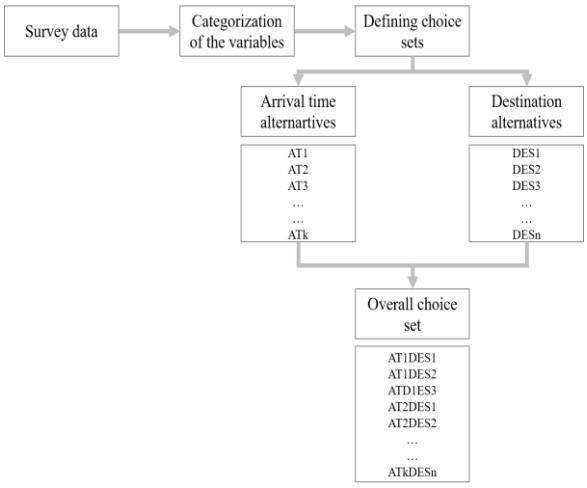

Figure 1. Flowchart of the proposed methodology

Figure 2. Selected stadiums and their location on the city

Besiktas Vodafone Park Fenerbahce Ulker Stadium Galatasaray Turk Telekom Stadium

Figure 3. Selected stadiums and their connections to the transportation network

The survey is split into two parts. In the first section, fans' socioeconomic data were acquired, and their fandom levels were assessed using a series of structured questions. The second section of the survey inquired about the fans' travel and activity patterns. The survey consists of 17 questions and sub-questions that were provided to the participants.

The descriptive statistics of the data are provided in Table 1. The number of valid surveys at Besiktas Vodafone Park, Fenerbahce Ulker and Galatasaray Turk Telekom Stadium were 357, 386 and 378, respectively.

In accordance with Table 1, while Besiktas and Galatasaray's games were generally organized on weekends, Fenerbahce's games were mostly played on

TABLE 1. Descriptive statistics

Criteria	Groups	Besiktas (N=357)	Percentage	Fenerbahce (N=386)	Percentage	Galatasaray (N=378)	Percentage
Weekend	Weekend	82	23%	268	69%	56	15%
	Weekday	275	77%	118	31%	322	85%
Gender	Female	21	6%	16	4%	27	7%
	Male	336	94%	370	96%	351	93%
Private Car Ownership	No	188	53%	221	57%	213	56%
	Yes	169	47%	165	43%	165	44%
Who Does the Activity with?	Alone	81	23%	78	20%	84	22%
	Not Alone	276	77%	308	80%	294	78%
Seasonal Ticket	No	251	70%	235	61%	215	57%
	Yes	106	30%	151	39%	163	43%
Watching Outside Stadium	No	24	7%	24	6%	29	8%
	Yes	333	93%	362	94%	349	92%

Activity Types	Eating	64	18%	61	16%	67	18%
	Entertainment	89	25%	61	16%	112	30%
	Transfer	141	39%	232	60%	15	4%
	Waiting	41	11%	15	4%	182	48%
	Other	22	6%	17	4%	5	1%
Age Groups	15-24	82	23%	159	41%	109	29%
	25-34	141	39%	127	33%	159	42%
	35-44	94	26%	67	17%	91	24%
	45 +	40	11%	33	9%	19	5%
Income Groups (TRY)	0-3000	141	39%	216	56%	164	43%
	3001-5000	103	29%	79	20%	111	29%
	5001 +	113	32%	91	24%	103	27%
Ticket Groups	0-75	71	20%	200	52%	143	38%
	76 - 150	195	55%	112	29%	169	45%
	151 +	91	25%	74	19%	66	17%
Last Activity Cost (TRY)	0	187	52%	249	65%	186	49%
	1-50	101	28%	100	26%	144	38%
	51 +	69	19%	37	10%	48	13%
Last Activity Duration (min)	0	161	45%	236	61%	18	5%
	1-120	120	34%	87	23%	192	51%
	121 +	76	21%	63	16%	168	44%

weekdays. The rate of playing on weekdays is 23% and 15% for Besiktas and Galatasaray, respectively; it is 69% for Fenerbahce. The number of female fans at venues is quite small and the percentage of them is changing between 4 - 7%. The rate of having a private vehicle is slightly smaller than not having a private vehicle for each club. Commonly, people prefer to attend the PSE with someone else. As it is seen in Table 1, for each club, around 80% of spectators participate to the PSE with someone. Of course, attending with someone or alone is strongly related with the social network of the spectators; however, because of the purpose of the study, the external circumstances like these are neglected.

The team with the highest number of seasonal tickets is Galatasaray with 43%. It is followed by Fenerbahce with 39% and Besiktas with 30%. Moreover, more than 92% of spectators follow their teams' away games via different ways and 7, 6 and 8% of Besiktas, Fenerbahce and Galatasaray spectators, respectively; declared that they do not follow their team's away games. Activities are divided into groups that are Eating, Entertainment, Transfer, Waiting, and Other in accordance with the responses of the participators. Transfer is the mostly preferred activity type for spectators of Besiktas and Fenerbahce, with respect to 39% and 60%. The situation is not the same for Galatasaray fans, because of the land use of vicinity of the stadium. As mentiıned earlier, the Turk Telekom Stadium is located in the periphery of the urban area and beccause of the lack of beverage places, spectators cannot choose a close place to transfer. Therefore, the stadium is their last destination of their last motorized trips. Moreover, age and income of the spectators are also grouped in order to use categorical data. For each club, games are followed mostly by 25-34 age group, and 3,000 Turkish Lira (TRY per 1 EUR varies between 5.98 and 6.90 in 2018) monthly income group of people. Tickets are also grouped as cheap (0 – 75 TRY), moderate (76 – 150 TRY) and expensive (151 + TRY). Ticket price means a single game price. The spectators of Besiktas and Galatasaray prefer moderate price for the ticket, while Fenerbahce's spectators normally choose the cheap tickets, mostly. Last activity is the interim activity which is participated just before the PSE starts.

Mainly, spectators are not willing to spend money mostly for each club. While the duration of the interim activity is less for Besiktas and Fenerbahce (45% and 61%, respectively), the activity duration of Galatasaray fans is considerably longer than the others. The rate of those whose activity duration is more than 120 minutes is around 44%. The source of this difference is related with the spectators' behavior. In this study, the interim

activities at the destination with the last motorized trip is examined. Spectators of Besiktas and Fenerbahce get closer to the stadium by walking mode after motorized trips and spend more time here, as there are places where interim activities can be done. Galatasaray fans, on the other hand, participate in interim activities when they arrive by motorized vehicle and then come to the stadium only to enter the game.

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5. MODELLING ESTIMATION AND VARIABLES

In this study, the joint MNL method was utilized to determine the probability of arrival time and location choice decisions. Spectators choose various arrival times for interim activities. In order to examine spectators' behavior, the difference between arrival time and PSE starting time is used and called as Arrival Time Difference (ATD). The 3rd percentile of the ATD which means three categories will be created and the number of observations in each group should be equal very close to each other is taken into consideration for each club. The classification of ATD differs among the clubs as in Table 2. Spectators of Besiktas arrive to the destination almost 197 minutes on average before the PSE start. This duration is 204 minutes for Fenerbahce's fan and 163 minutes for Galatasaray's spectators.

According to the observations and survey analysis, spectators tend to choose stadium and other close areas to arrive in order to participate in an interim activity just before the games start as their final destination of their last motorized trips. In this study, official postal codes are used to distinguish interim activity locations. For stadiums fictitious codes are assigned. These codes of the destinations are presented in Figure 4 and Table 3. As it was mentioned before, stadiums of Besiktas and Fenerbahce are located in central districts, so that people can find various places to attend any interim activity. For Besiktas district, Sinan Pasa neighborhood has several food and beverage places and main meeting point of Besiktas' spectators. Also it has strong transport connections with several central districs of the city. Omer Avni neighborhood is also has several commercial units but not as much as Sinan Pasa has, and it is also well connected to the transport network. Kadikoy district where Fenerbahce's stadium is located in is a central district and Caferaga neighborhood is one of the most visited area in the city and meeting point of the spectators. It is well connected area by sea line, metro, and other modes of transportation. Hasan Pasa neighborhood is also has several food and beverage places and strongly connected to the transportation infrastructure of the city, especially by metrobus. However, Turk Telekom Stadium is located at a peripheral district of Istanbul. Huzur neighborhood is newly developed area and the typical land use of the area is in the form of high-rise residences and offices. This neighborhood has a big shopping mall which is connected stadium by a monorail. Seyrantepe neighborhood is old developed but it is not a lively place like other important centers of the city. Seyrantepe and Huzur neighborhood is connected to the network by an additional metro line and several bus lines, only. As a result of the differences of the landuse can be seen on the average cost and duration of the last activities, and average waiting time of the spectators. In order to test and compare the applicability of the model in the same city but in different land uses, a separate model should be estimated for each team spectator, including land use decisions. The land use and transportation network effect can be seen on the destination choice preferences. While approximately 16% of Besiktas and Fenerbahce's spectators prefer the stadiums as the destination of their last motorized trips, 70% of Galatasaray fans prefer the immediate vicinity of the stadium as their last motorized trips' destination.

TABLE 2. Various Arrival Time Difference groups according to 3rd percentile

ATD Groups	Besiktas (N=357)	Number	Percentage	Fenerbahce (N=386)	Number	Percentage	Galatasaray (N=378)	Number	Percentage
ATD1 (Short time)	0-120	109	31%	0-139	124	32%	0-119	122	32%
ATD2 (Medium time)	121-210	119	33%	140-239	134	35%	120-179	132	35%
ATD3 (Long time)	211 +	129	36%	240 +	128	33%	180 +	124	33%

Figure 4. Destinations and codes

TABLE 3. Last motorized trips destinations

Teams	Destination	Destination	Codes	Number of Obs.	Percentage
	Vodafone Park Stadium	DES1	34001	58	16%
Besiktas	Sinan Pasa Neigh.	DES2	34353	175	49%
	Omer Avni Neigh.	DES3	34427	124	35%
	Ulker Stadium	DES1	34002	61	16%
Fenerbahce	Caferaga Neigh.	DES2	34710	199	52%
	Hasanpasa Neigh	DES3	34722	126	33%
	Turk Telekom Stadium	DES1	34003	263	70%
Galatasaray	Seyrantepe Neigh.	DES2	34418	33	9%
	Huzur Neigh.	DES3	34396	82	22%

In order to avoid endogeneity issues, these two dimensions of activity participation are jointly modelled. Three ATD groups and three location alternatives account for a total of 9 alternatives for each stadium. In the study, three separate models having 9 alternatives for Beşiktaş, Galatasaray and Fenerbahçe are estimated.

Variables of the models

As in the ATD variable, some variables were grouped by using appropriate percentile. Income variable is divided into 3 groups and converted into a dummy variable by using 3rd percentile. This dummy variable is coded by using effects coding approach and the middle income group is taken as the base and coded as -1.

The same procedure is done for the Last Activity Duration. From the surveys it was seen that majority of Besiktas and Fenerbahce's spectators tend to get close to the stadium by walking. In other words, they prefer to spend their time within the walking distance of the stadiums. Therefore, for a large group of spectators of Besiktas and Fenerbahce games, the last activity duration is zero (because it is done with a non-motorized mode). Ticket cost is also classified according to the 3rd percentile as well. Here, the cost of single game ticket is used. For this reason, if the participant owns a seasonal ticket, the cost of the seasonal ticket is divided into the games in a season to obtain this cost. 3 group of ticket cost are obtained which are cheap (base alternative and coded -1), moderate, and expensive. The variable "with whom" presents those who participate in the PSE with someone or alone. Participating the event with someone is coded as 1 while attending the event alone is coded -1. Surely, having a company with the activities is strongly related to his/her social network and other social issues. However, in this study these effects are neglected but this is another important perspective to study and analyze. The variable "weekend" represent the day of the games and "seasonal ticket" variables describes the spectators who has a seasonal ticket.

6. RESULTS

According to Leilei et al. [36], PSE participants typically come a short time before the start. However, from the sample it was observed that, the overall fans arrive at the vicinity of the stadium on average 188 minutes before the game begins, despite the fact that these games are held every two weeks.

Analyzing the relationship between the predicted model and the base model following results appear. For the estimated activity models, the value of -2LL for Besiktas, Fenerbahce, and Galatasaray are 822.950,

796.360, and 135.853, respectively (Equation (5)). These -2LL values are higher than the critical chi-square value of the degree of freedom of 72 for Besiktas and Fenerbahce which is 92.808 and 48 for Galatasaray which is 65.171 with significance at 5%. These results show that the estimated models are improved models. On the other hand, the Pseudo R2 (ρ2) (Equation (6)) values also show that the estimated models are strong ones with respect to goodness-of-fit. The Pseudo R2 value of Galatasaray is somewhat smaller than Besiktas and Fenerbahce's but it is still acceptable.

$$-2LL = -2(LL_{reference} - LL_{estimated} \quad (5)$$

$$\rho 2\ (Pseudo - R^2) = 1 - (LL_{estimated}/LL_{reference}) \quad (6)$$

TABLE 4. Model estimation results

Variables	Besiktas (N=357)		Fenerbahce (N=386)		Galatasaray (N=378)	
	Coefficient	**t-stats**	**Coefficient**	**t-stats**	**Coefficient**	**t-stats**
Constant 1	-0.22158	-0.36	**1.25291****	2	**1.88068*****	3.64
Private Car Ownership 1	-0.12502	-0.32	0.3656	0.85	**-.81164****	-2.13
Income 1 1	-0.46741	-0.87	-0.3599	-0.56	-	-
Income 3 1	0.23644	0.5	0.0885	0.17	-	-
Waiting 1	-0.96077	-1.06	**1.86609***	1.96	1.04974	1.49
Last Activity Duration 0 min 1	0.39843	0.9	**1.99201*****	2.86	-	-
Moderate Ticket Cost 1	0.1251	0.25	**-1.04346***	-1.94	0.4076	0.8
Expensive Ticket Cost 1	**-.83745***	-1.74	0.33339	0.64	0.45306	1.05
Weekend 1	0.21233	0.52	-0.28128	-0.7	-	-
With Whom 1	**.77193***	1.65	0.01084	0.02	-0.16808	-0.4
Seasonal Ticket 1	-	-	-	-	-0.37366	-1.02
Constant 2	-0.07052	-0.12	**1.15617***	1.82	-0.51773	-0.7
Private Car Ownership 2	**-.71346****	-2.03	-0.11565	-0.28	0.10748	0.21
Income 1 2	-0.04938	-0.1	0.09329	0.16	-	-
Income 3 2	-0.57199	-1.25	0.34751	0.71	-	-
Waiting 2	-0.23862	-0.29	0.82767	0.82	0.76985	0.87
Last Activity Duration 0 min 2	**1.16768****	2.53	**3.49429*****	4.89	-	-
Moderate Ticket Cost 2	-0.26673	-0.55	-0.44762	-0.93	0.67042	0.97
Expensive Ticket Cost 2	-0.4822	-1.07	0.61675	1.21	**1.51243****	2.5
Weekend 2	0.19256	0.51	-0.01783	-0.05	-	-
With Whom 2	**.77242***	1.84	0.6906	1.52	-0.20168	-0.38
Seasonal Ticket 2	-	-	-	-	**-1.09176****	-2.26
Constant 3	0.53033	1.03	-1.27272	-1.1	0.57063	0.95
Private Car Ownership 3	-0.49172	-1.47	-0.44928	-1.03	-0.0628	-0.14
Income 1 3	0.5929	1.33	-0.156	-0.25	-	-
Income 3 3	**-1.15370****	-2.53	0.68267	1.34	-	-
Waiting 3	-0.45935	-0.6	0.64567	0.38	0.20276	0.24
Last Activity Duration 0 3	**1.61170*****	3.6	**5.95924*****	4.91	-	-
Moderate Ticket Cost 3	-0.65051	-1.38	-0.5622	-1.1	0.64377	1.04
Expensive Ticket Cost 3	-0.55204	-1.28	0.41439	0.76	**.88676***	1.7
Weekend 3	0.04702	0.14	0.00185	0	-	-
With Whom 3	-0.13142	-0.4	0.43473	0.93	-0.38452	-0.81
Seasonal Ticket 3	-	-	-	-	-0.4655	-1.08

Constant 4			-0.64341	-0.72	**1.86623*** **	3.59
Private Car Ownership 4			0.41843	0.89	**-1.05876*** **	-2.76
Income 1 4			-0.74077	-0.98	-	-
Income 3 4			0.37013	0.67	-	-
Waiting 4	Reference		**2.01149** **	2.02	0.75881	1.07
Last Activity Duration 0 4			0.22756	0.27	-	-
Moderate Ticket Cost 4			-0.70992	-1.19	0.3672	0.72
Expensive Ticket Cost 4			0.22337	0.4	0.44403	1.03
Weekend 4			-0.2116	-0.47	-	-
With Whom 4			0.83195	1.27	0.00059	0
Seasonal Ticket 4	-	-	-	-	-0.56056	-1.53
Constant 5	**1.22770*** **	2.68	**1.59782*** **	2.62	-1.06306	-1.16
Private Car Ownership 5	**-.83776** **	-2.56	-0.09704	-0.24	0.11075	0.2
Income 1 5	0.15351	0.35	0.06375	0.11	-	-
Income 3 5	-0.40941	-0.99	0.55153	1.16	-	-
Waiting 5	**-1.43101** **	-1.98	0.09203	0.1	0.5205	0.53
Last Activity Duration 0 5	0.2276	0.61	**3.20792*** **	4.61	-	-
Moderate Ticket Cost 5	**-.83354***	-1.79	-0.42093	-0.89	0.1434	0.2
Expensive Ticket Cost 5	-0.31951	-0.78	0.66143	1.32	0.25238	0.43
Weekend 5	0.23233	0.69	-0.12025	-0.32	-	-
With Whom 5	0.34328	1.03	0.44793	1.03	0.28869	0.43
Seasonal Ticket 5	-	-	-	-	0.7338	1.13
Constant 6	0.32271	0.61	0.54984	0.78	0.50004	0.83
Private Car Ownership 6	**-.60624***	-1.78	-0.09001	-0.22	0.07851	0.18
Income 1 6	0.20985	0.46	0.20433	0.34	-	-
Income 3 6	**-.77227***	-1.73	0.80916	1.63	-	-
Waiting 6	-0.42985	-0.53	1.39396	1.15	0.49766	0.63
Last Activity Duration 0 6	**1.30850*** **	2.94	**4.54810*** **	5.67	-	-
Moderate Ticket Cost 6	-0.73254	-1.5	-0.53355	-1.09	0.93183	1.59
Expensive Ticket Cost 6	-0.3749	-0.86	0.5706	1.09	0.58017	1.21
Weekend 6	0.3954	1.05	0.0314	0.08	-	-
With Whom 6	0.11974	0.35	0.0745	0.17	-0.08862	-0.19
Seasonal Ticket 6	-	-	-	-	-0.10622	-0.26
Constant 7	0.22174	0.4			**1.60951*** **	3.05
Private Car Ownership 7	**-.69394***	-1.75			**-.83555** **	-2.14
Income 1 7	0.28917	0.54			-	-
Income 3 7	-0.85132	-1.54			-	-
Waiting 7	**-1.54227***	-1.89	Reference		0.93629	1.3
Last Activity Duration 0 7	**-1.17656** **	-2.34			-	-
Moderate Ticket Cost 7	**-1.11858***	-1.72			-0.05013	-0.1
Expensive Ticket Cost 7	-0.00487	-0.01			0.61252	1.38
Weekend 7	-0.45788	-1.18			-	-

With Whom 7	0.01751	0.04			-0.37372	-0.87
Seasonal Ticket 7	-	-	-	-	**-.99732*** **	-2.62
Constant 8	**1.70407*** **	3.88	**2.12828*** **	3.6		
Private Car Ownership 8	-0.51117	-1.59	-0.21117	-0.55		
Income 1 8	0.03478	0.08	0.11445	0.21		
Income 3 8	**-.66786***	-1.66	0.33931	0.75		
Waiting 8	**-1.88525*** **	-2.71	-0.77281	-0.99		
Last Activity Duration 0 8	**-.77805** **	-2.14	**2.26977*** **	3.4	Reference	
Moderate Ticket Cost 8	-0.53645	-1.22	-0.31979	-0.72		
Expensive Ticket Cost 8	-0.40529	-1.03	0.43449	0.92		
Weekend 8	0.18437	0.57	-0.33152	-0.91		
With Whom 8	0.31064	0.97	0.40567	0.98		
Seasonal Ticket 8	-	-	-	-		
Constant 9	0.71653	1.47	0.15778	0.22	**.94310***	1.68
Private Car Ownership 9	**-.90463** **	-2.49	-0.19307	-0.44	-0.27379	-0.68
Income 1 9	0.27043	0.56	0.36375	0.58	-	-
Income 3 9	-0.55238	-1.17	0.70111	1.34	-	-
Waiting 9	**-2.40475*** **	-2.91	1.48767	1.21	0.82819	1.1
Last Activity Duration 0 9	0.27323	0.64	**4.05461*** **	5.09	-	-
Moderate Ticket Cost 9	-0.53953	-1.08	-0.52154	-1.01	0.41473	0.76
Expensive Ticket Cost 9	-0.26747	-0.59	0.52172	0.95	0.53749	1.17
Weekend 9	-0.04309	-0.12	-0.25183	-0.6	-	-
With Whom 9	0.16158	0.44	0.40946	0.87	-0.06581	-0.15
Seasonal Ticket 9	-	-	-	-	-0.00302	-0.01
LL()	**-628.49491**		**-666.17231**		**-497.52337**	
LL(M)	**-217.0219**		**-267.99219**		**-429.59698**	
- 2LL	**822.94602**		**796.36024**		**135.85278**	
ρ^2	**0.65**		**0.60**		**0.14**	

***, **,* ==> *Significance at 1%,5%, 10% level.*

According to the model results, the weekend variable is not statistically significant for any fan group. Similarly, a monthly income of less than 3,000 TRY do not have a significant effect on arrival time and location choice compared to an average monthly income group. Private car ownership variable took a positive value only in cases where people arrived in the immediate vicinity of the Turk Telekom an average of time before the start of the event. Others have negative values. As the private car ownership of spectators of Besiktas increases; the tendency to arrive in Sinanpasa at a short and medium time before the start of the event, at a medium and long time in Omer Avni, and at a long time in the immediate vicinity of the stadium decreases. As the private car ownership of Galatasaray fans increases, the tendency to arrive at the stadium at a short or long time before the event decreases. Moreover, the tendency to arrive at the stadium at a medium time before the event increases, as well. However, the private car ownership variable is not significant for spectators of the Fenerbahce. According to the results, for Besiktas fans with a monthly income of more than 5,000 TRY arrive at the stadium on average of time before the start of the event, have a tendency to be in the immediate vicinity of the stadium at a short or average time before the event in Omer Avni, and at a long time before the event in Sinanpasa decreases. As the selection of the waiting activity increases, the tendency of Besiktas fans to arrive at the Sinanpasa with an average and long time before the start of the event, and at the Omer Avni Mahallesi and the stadium in a long time

decreases, while the tendency of Fenerbahce fans to arrive at the stadium with a short and average time before the event increases. As the duration of the activity at the last station of the motorized journey is 0 (zero), the probability of Besiktas fans to arrive at the stadium and Sinanpasa a long time before the start of the event decreases, while the probability of arriving at Omer Avni and Sinanpasa with a short and average time before the start of the event increases. Similarly, as the duration of the activity is 0, which means the spectators transfer from the motor vehicle to walking mode without waiting, the probability of arriving at the Caferaga and Hasanpasa on average or long time before the start of the event increases. As the ticket price is moderate, the tendency of Besiktas fans to be in Sinanpasa before the start of the games and in the Stadium with a long time before the start of the games decreases. Likewise, the possibility of Fenerbahce spectators being in the immediate vicinity of the stadium shortly before the games, moderate ticket price decreases. Moreover, as the ticket price increases, the tendency of Besiktas fans to be in immediate vicinity of the stadium shortly before the start of the event decreases, while the tendency of Galatasaray fans to come to the Seyrantepe and Huzur shortly before the event rises. As the number of Besiktas fans attending the event alone increases, the probability of being in the stadium or Sinanpasa climbs, as well. The tendency of Galatasaray fans with a seasonal ticket to prefer Seyrantepe shortly before the event, and the stadium for a long time before the event decreases according to their preference for being at Seyrantepe long time before the event. Having a seasonal ticket is insignificant for Besiktas and Fenerbahce's spectators as in the studies in the literature [9, 11].

Chang and Lu [30] developed a PSE model and variables such as age, gender, travel time, travel cost are significant. However, in this study, these variables were insignificant.

7. DISCUSSION

When the issue is a PSE that individuals pay for and expect happiness and pleasure, traffic management and understanding of the behavior of spectators become more important. The areas which face the travel demand more than the others are the destinations of the last motorized trips. In this study, the arrival time and location choice of the spectators for interim events are jointly analyzed to understand the behavioral differences of fans. As a result of this study, it is seen that whether the league matches are on weekdays or weekends does not have a statistically significant effect on the choice of arrival time and location. Spectators arrive at the immediate vicinity of the stadium approximately 4 hours before the game. As in the literature, cruise passengers expressed a high degree of pleasure with their location and spent over 5 hours on land and they spent an average of about 36 € per capita at the destination [37]. According to the observations, it has been seen that the biggest reason for this situation is traffic congestion and insufficient parking space; a deduction not supported by the model findings due to lack of variables. The waiting activity is mostly done by the low-income supporter group. In addition, as the ticket price increases, the spectators do not reach the vicinity of the stadiums, but prefer to go to other sub-centers where there are more food and beverage venues, more than 4 hours before the event. Fenerbahce and Besiktas fans gather in the centers where they have met for years for almost every game, while Galatasaray fans gather in a shopping mall close to the stadium.

Evidently, interim activities should be considered for an effective traffic management for PSEs as they reflect a distinguishable behavioral pattern. As a result, travel demand prediction is a very crucial aspect that effects directly traffic management policies [35]. It is seen that sub-centers are the first place to encounter motorized travel demand derived by PSEs. Policies should be developed for everyone who participates or does not participate in these events which are organized regularly every week. The policies may be produced according to the results as follow:

- Arrangement and planning of parking areas according to the maximum walking distance, not immediate vicinity of the stadium,
- Planning safe walking spaces from parking lots to stadiums,
- Considering the destination of the derived travel demand originating from the PSE as sub-centered, not stadium-centered,
- Ensuring more effective traffic management by planning various and small centers (perhaps temporarily only on PSE days) rather than being a single and big center.

8. CONCLUSION

Finally, as a purpose of the study, establishing an acceptable and applicable model by considering the arrival time and location choices as time and space dimensions is needed to understand the behaviour of the spectators of the PSEs. The model and its variables may differ from the proposed model in this study, but as a result of the approach which is tried to be emphasized in this study is that time and space dimensions should not be separated for a better model structure. The findings show useful information that might assist special event planners and politicians with marketing and planning initiatives.

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Persian Abstract

چکیده

رویداد ویژه برنامه ریزی شده (PSE)یک فعالیت عمومی است که مکان و زمان مشخصی دارد و در نتیجه افزایش تقاضای سفر یا کاهش ظرفیت جاده، بر عملیات سیستم حمل و نقل تأثیر می گذارد. جدا از خود رویداد، PSE ها ممکن است فعالیت های بیشتری را بر اساس مکان، زمان و مدت رویداد و ترجیحات فردی ایجاد کنند. این مقاله بر فعالیت های موقت تماشاگران فوتبال در استانبول تمرکز دارد. این مقاله با تحلیل مشترک زمان رسیدن و اولویت‌های مکان برای فعالیت‌های موقتی که قبل از فعالیت اصلی انجام شده است، انگیزه‌ی تقاضای عمدتاً نادیده گرفته شده اما بسیار مهم برای این فعالیت‌ها است. برای این هدف، یک مدل لاجیت مشترک که عوامل موثر بر زمان رسیدن و انتخاب مکان را به طور جمعی در شرایط PSE برآورد می‌کند. در این برآورد، هر سفر و رفتار گروه های تماشاگر به طور جداگانه مدل سازی شده است. با توجه به نتایج مدل‌ها، یکی از یافته‌های قابل توجه و جالب، تفاوت‌های رفتاری حامیان تیم‌های مختلف است که بیشتر متأثر از فرصت‌های فعالیت موجود در اطراف سالن‌ها است. آخرین سفرهای موتوری تماشاگران بشیکتاش و فنرباغچه به طور کلی در مراکز فرعی به پایان می رسد، در حالی که تماشاگران گالاتاسرای ورزشگاه را به عنوان مقصد نهایی خود ترجیح می دهند. علاوه بر این، برگزاری مسابقات لیگ در روزهای هفته یا آخر هفته از نظر آماری تأثیر معناداری بر انتخاب زمان ورود و مکان تماشاگران ندارد. این یافته ها اطلاعات مفیدی را ارائه می دهد که ممکن است به سازمان دهندگان رویداد و تصمیم گیرندگان به ویژه در برنامه ریزی رویدادهای خاص کمک کند.