UDC: 656.13(497.5)
DOI: http://dx.doi.org/10.7708/ijtte2022.12(2).05

PARKING ON STREET PARKING LOTS IN TOURIST DESTINATIONS – CASE STUDY CITY OF ŠIBENIK

Ana-Mari Poljičak[1], Dragan Grubišić[2], Kristian Nimac[3]

[1,3] *Polytechnic of Šibenik, Undergraduate Professional Study Programme Traffic and Transport, Trg Andrije Hebranga 11, 22000 Šibenik, Republic of Croatia*

[2] *Gradski parking d.o.o., Parking and Vehicle Relocation Division, Draga 14, 22000 Šibenik, Republic of Croatia*

Received 15 January 2022; accepted 17 March 2022

Abstract: The city of Šibenik is one of the most attractive tourist destinations in Croatia. Its street parking is managed by a city company. In this paper, it was our aim to establish whether there was a difference in the methods of payment for street parking and the use of such services between different parking zones, as well as to determine the developments in the use of parking services and the impact of the SARS-CoV-2 pandemic. The analysis established the cyclical nature of the methods of payment for parking services and the use of such services by zones, caused by the tourist season. The research has shown that m-parking is the most frequently used method of payment for parking in the zones 0, 1 and 2, as well as that the significance of this method of payment declines in the summer months in comparison with winter. The research has also shown that the use of parking meters is the most prevalent in Zone 1+, while it is the least prevalent in Zone 0, whereas m-parking is most frequently used in Zone 1 and the least frequently in Zone 1+, while in Zone 0, bank cards are used more frequently in relation to other zones. A trend model has also been elaborated, and it was established that an average growth in the number of issued invoices of 209 per month is to be expected.

Keywords: parking zones, street parking, methods of payment, trend, SARS-CoV-2.

1. Introduction

A tourist destination is a location that attracts tourists for various reasons, i.e. benefits, offered by the tourist destination. Generally, the higher the investments of a country or city in its tourism offers, the more attractive for tourists it becomes, thus having an influence on their arrivals. However, an increase in the numbers of tourists at a specific tourist destination causes an additional demand for parking spaces (Maršanić, 2008; Brčić and Šoštarić, 2012). The Republic of Croatia is among the more attractive tourist countries. Since 2011, there has been a constant increase in the number of tourist arrivals, with the exception of 2020 because of the SARS-CoV-2 pandemic. Thus, the average annual increase in tourist arrivals from 2011 until 2019 has been 7.21% (Croatian Bureau of Statistics, 2022). Another characteristic of Croatian tourism is its pronounced seasonal character. Most Croatian tourist destinations have extreme peaks in tourism demand, with more than two thirds of tourist overnight stays occurring in July and August. During the summer months, the burden on the

[1] Corresponding author: jankovic@vus.hr

infrastructure increases, with the occurrence of traffic jams and lack of parking spaces, due to a very strong population increase (Corluka, 2019). The growth in the degree of motorisation brings about a growing demand for parking spaces. Since 2000, the number of motor vehicles worldwide has experienced a growth trend of 2% per annum (Brčić and Šoštarić, 2012). Thus, in Croatia, the average annual increase in the number of registered motor vehicles from 2011 until 2020 was 4.64% (Ministry of the Interior of the Republic of Croatia, 2021). It needs to be noted that 73% of the guests arrive in Adriatic Croatia by car (Marušić, *et al.,* 2020) and that, for instance, in 2018, the total number of registered personal vehicles in Europe was 292 million (Statista, 2022). In most European countries, implementation of the parking policy is left to the local governments, which thus create parking policies for their respective cities or town (Gies *et al.,* 2021). Street parking as one type of the parking offer is, as a rule, of a public character and supervised by the local authorities (Brčić and Šoštarić, 2012). Local government units are introducing parking zones in the case of an expansion of the city area outside of the central area (Maršanić, 2008). The city of Šibenik has four street parking zones (Zone 0, Zone 1, Zone 1+, Zone 2) (Gradski parking, 2022). There are various methods of parking fees payment in street areas (parking meter, mobile phone etc.) (Maršanić, 2008). In the city of Šibenik, the street parking service can be paid by mobile phone, through the parking meters or by purchasing a parking ticket on a newsstand (Gradski parking, 2022). On the basis of what has been presented above, we arrived at the problem of this research, which is the development of an optimal system of parking fees organisation and collection, based on data on the use of parking spaces and the use of the available payment tools in different zones, information on the presence of seasonality, on the impact of the SARS-CoV-2 pandemic and finally on the occurrence of changes through time, thus acquiring the characteristic of a longitudinal research.

2. Materials and Methods

By using secondary data sources obtained from the public company that engages in parking maintenance and parking fees collection, we analysed the developments in the use of parking and methods of payment for parking in the territory of the city of Šibenik. In our work, we applied the methods of descriptive statistics, the arithmetic mean as the median value, and the standard deviation, the minimum and maximum as the indicators of deviations around the arithmetic mean.

The impact of the pandemic on the number of invoices issued has been examined by means of the trend model, which is also used for examining the presence of cycles within seasons of the year.

The difference in the use of available methods of payment (parking meters – cash payment or cashless payment by means of bank cards, m-parking (SMS text message – Short Message Service)) between different parking zones is examined by means of the ANOVA test, with the LSD test as a post-hoc test.

The analysis was performed in the statistical software STATISTICA 12 (TIBCO Software Inc., Palo Alto, California).

In this paper, we analysed the parking zones of the city of Šibenik, Zone 0, Zone 1, Zone

1+ and Zone 2, used for street parking. For the analysis, we used data from the period between 2017 and 2021.

3. Parking in the City of Šibenik

The city of Šibenik is the administrative capital of the Šibenik-Knin County. It was first mentioned on the Christmas of 1066 (City of Šibenik, 2022). According to the 2021 Census, 96,624 persons live in the Šibenik-Knin County. Out of this number, 42,589 inhabitants belong to the administrative area of the City of Šibenik, while the city of Šibenik itself has 31,085 inhabitants (Croatian Bureau of Statistics, 2022). The city gradually turned towards tourism and today it represents one of the most attractive tourist destinations in Croatia (Šibenik Tourist Board, 2022). For this reason, apart from the local population, there are also many tourists during the tourist season in the summer months. According to the Croatian Bureau of Statistics, the number of tourist arrivals in the Šibenik-Knin County was 923,233 persons in 2017, 965,203 persons in 2018, 1,009,451 persons in 2019, only 400,046 persons in 2020 due to the SARS-CoV-2 pandemic and 705,002 persons in 2021 (Croatian Bureau of Statistics, 2022). It can be observed from the above data that the city of Šibenik is an attractive city both for living and for tourism. Namely, due to the growing number of vehicles in the present time, there is also the growing problem of their parking. The problem is especially pronounced in the very centre of the city, because almost all of the most attractive amenities are situated there, thus attracting additional traffic. Therefore, the highest dynamic and stationary traffic takes place precisely in those zones of the city. However, the other peripheral parts of the city also have a problem with vehicle parking (Nimac, 2021).

3.1. Street Parking Management

As already stated, the city of Šibenik represents a very attractive destination for many tourists from various parts of the world. Parking spaces are few, and the domestic population naturally desire to park their cars next to their home, not leaving much additional space for the cars of tourists. It is therefore definitely necessary to increase the parking offer, first in the old town centre, but also in the new parts of the city. The level of satisfaction with the parking possibilities in the city of Šibenik among the domestic population, but also among tourists, is very low. The problems with parking occur as a consequence of bad planning of traffic areas and a lack of parking capacity (Nimac, 2021). In order to solve the problems with parking and parking spaces, the company Gradski parking d.o.o. was founded in the city of Šibenik in 2001. The purpose of the company's operations is to establish a regulation of stationary traffic and to constantly find new lots and expand the parking capacities of the city of Šibenik. At present, Gradski paking d.o.o. manages more than 1,500 parking spaces (City of Šibenik, 2022).

3.2. Methods of Payment and Parking Zones

In the period from 1 June until 30 September, the fee collection time for all street parking lots is from 7 a.m. to 11 p.m., from Monday to Sunday including holidays, for all parking zones (Zone 0, Zone 1, Zone 1+ and Zone 2). In the period from 1 October to 31 May,

the fee collection time for all street parking lots is Monday to Friday from 7 a.m. to 9 p.m. for all zones. On Saturdays, parking fees are collected from 7 a.m. to 2 p.m. in all zones, with the exception of Zone 0, for which the collection time on Saturdays is from 7 a.m. to 9 p.m. There is no collection of parking fees on Sundays and holidays. Parking can be paid at a parking meter, on a newsstand or by mobile phone (Gradski parking, 2022). Mobile phones are used for payments of street parking via m-parking (SMS messages) and by means of the PayDo (PayDo services, 2018) and Aircash (Aircash, 2022) applications.

Figure 1 displays the public parking lots in the city of Šibenik and its parking zones. Each zone is marked with a different colour (Zone 0 – pink, Zone 1 – red, Zone 1+ – blue and Zone 2 – yellow) (Gradski parking, 2022).

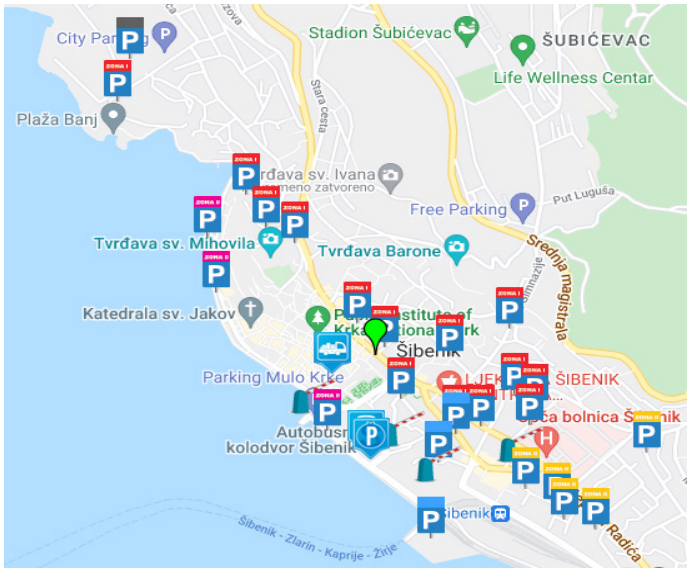

Fig. 1.
Public Parking Lots in the city of Šibenik
Source: Gradski parking, 2022

If payments are conducted by mobile phone, it is necessary to send an SMS text message containing the vehicle licence plate number (without spaces and special characters) to the m-parking number for the respective parking zone. Subsequently, the user receives a confirmation on their mobile phone, in the form of a return SMS message, that the parking service has been paid. A single SMS message can be used for the payment of maximum one hour of parking, while there is no limit on maximum parking time. Apart from payment by mobile phone, a parking ticket can be purchased at a parking meter installed close to the parking lot, by inserting money or a bank card (if it has this option), entering the parking duration and waiting for the meter to eject the parking ticket.

The parking ticket shows the end time of the parking duration selected by the user. The ticket needs to be placed at the interior side of the windshield, in a visible position (Nimac, 2021; Gradski parking, 2022).

The street parking fees for Zone 1, Zone 1+ and Zone 2 remain the same throughout the year, namely 5 kunas (approximately 0.66 euro) for Zones 1 and 1+ and 3 kunas for Zone 2. The street parking fee is changed only in Zone 0, amounting to 5 kunas during the winter months and 10 kunas (approximately 1.32 euro) during the summer months (from 1 June to 30 September) (Gradski parking, 2022).

4. Results and Discussion

In the observed period, the use of street parking spaces has had a growth tendency, with a negative correction caused by the SARS-CoV-2 pandemic. Apart from changes in the use of parking spaces, a change in the methods of payment used was also observed. It can be established that there is a cyclical character in the frequency of parking payments via m-parking (SMS), declining in the summer months in relation to the winter months in all of the years observed (Fig. 2).

The use of m-parking is the most used method of payment in the entire observed period, except in the period from June until September 2017, when the share of the use of parking meters increased (cash payments) compared to other methods of payment.

Furthermore, a tendency of slight growth in the use of m-parking as method of payment has been established. In the observed period, there are also oscillations in the extent of use of parking meters, with a decline tendency. From January to April of the pandemic year 2020, only an insignificant use of parking meters could be observed. The use of bank cards (with parking meters) for payment is present in the summer months, with a cycle opposite from the one established for m-parking. It can therefore be concluded that payment with bank cards is related to tourist arrivals.

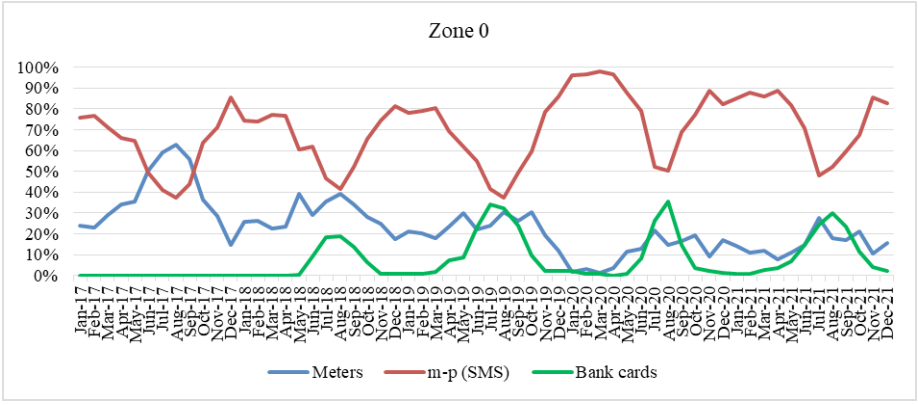

Fig. 2.
Extent of use of Individual Methods of Payment for Street Parking in Zone 0 in the Period from 2017 to 2021
Source: Edited by the author according to internal data obtained from (Gradski parking, 2022)

In parking Zone 1, displayed on Fig. 3, slight oscillations in the use structure of the observed methods of payment have been established in relation to parking Zone 0. Seasonal cycles have also been observed, with a decline in the use of m-parking in the summer months in comparison with the winter months. In the first year of the SARS-CoV-2 pandemic, a more significant increase in the importance of m-parking has been observed, with the highest ratio of this method of payment, 93.79%, in February 2020. The extent of bank card payments in this zone has stayed at its minimum and it was present in the last two years during the summer months.

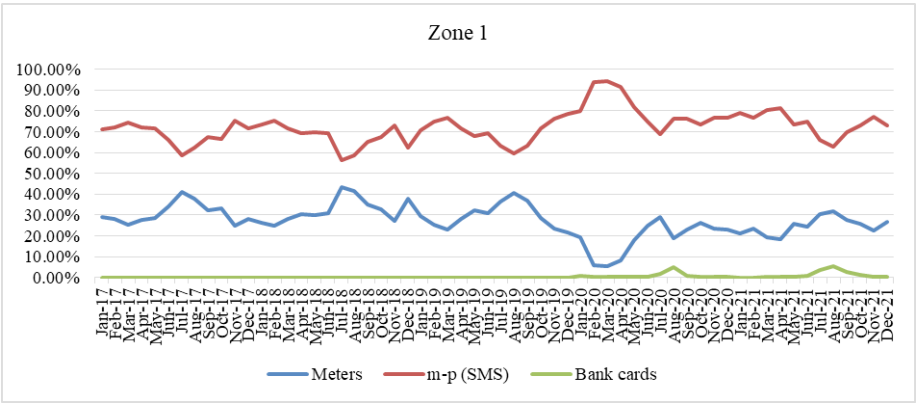

Fig. 3.
Extent of use of Individual Methods of Payment for Street Parking in Zone 1 from 2017 to 2021
Source: Edited by the author according to internal data obtained from Gradski parking d.o.o., Šibenik

In Zone 1+, it is only possible to pay for parking at parking meters and by means of SMS text messages. It can be observed from Fig. 4 that the ratio structure of the use of parking meters and m-parking oscillates around 50%: 50% with the growth in the share of parking meter payments in the summer months, while 2019 represents a turning point, i.e. there are oscillations in favour of m-parking in the summer months.

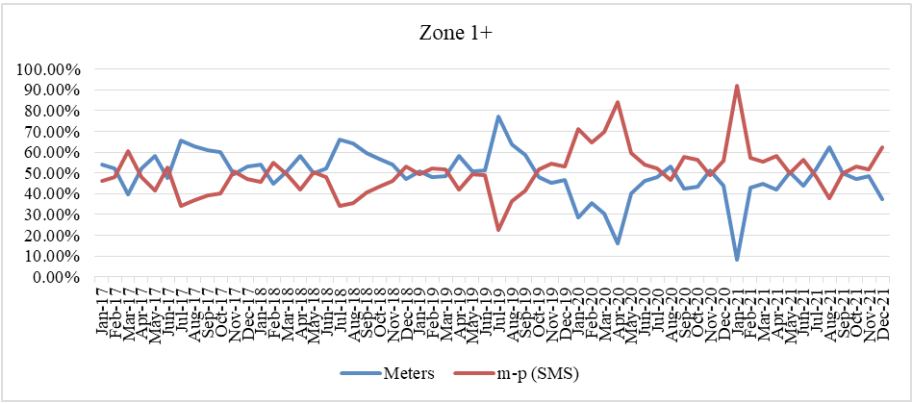

Fig. 4.
Extent of use of Individual Methods of Payment for Street Parking in Zone 1+ from 2017 to 2021
Source: Edited by the author according to internal data obtained from Gradski parking d.o.o., Šibenik

In parking Zone 2, m-parking is used the most frequently in all of the observed periods, with a tendency of growth in importance until the end of the observed period, while seasonal oscillations occur on an annual level, with increased significance of parking meters in the summer months. The extent of bank card payments in this zone has also stayed at the minimum and was present in the last two years during the summer months, which can be observed on Fig. 5.

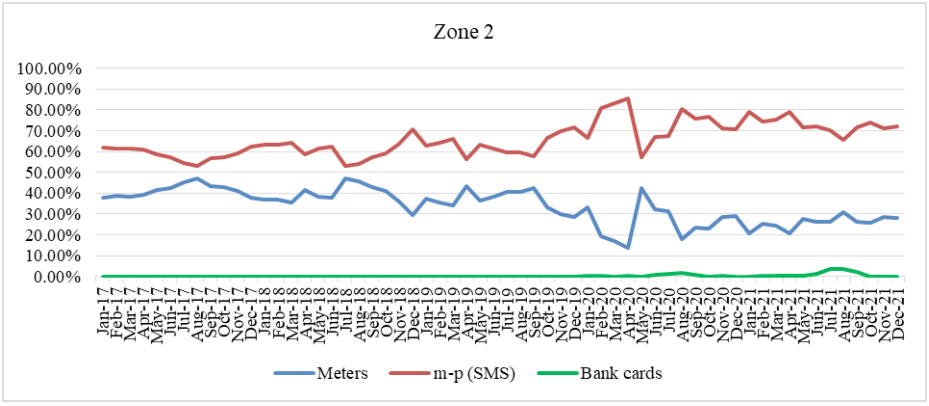

Fig. 5.
Extent of use of Individual Methods of Payment for Street Parking in Zone 2 from 2017 to 2021
Source: Edited by the author according to internal data obtained from (Gradski parking, 2022)

It can be observed from Table 1 that the average monthly number of invoices issued for parking in the observed area is 60,803.59, with an average deviation of 16,333.49 from the arithmetic mean. In the observed five-year period from 2017 to

2021, the total number of invoices issued was 3,648.197. In the month with the lowest number of invoices issued, 11,672 invoices were issued, while in the month with the highest number of invoices issued, there were 100,198.

Table 1

Analysis of the Number of Invoices issued through the Application of Descriptive Statistics

	N	Mean	Sum	Minimum	Maximum	Std. Dev.
Number of Invoices	60	60,803.28	3,648,197	11,672	100,198	16,333.49

Source: Edited by the author according to internal data obtained from (Gradski parking, 2022)

When observing the number of invoices issued by months, on Fig. 6, a cyclical nature can be established in the entire observed period, with cycle peaks in the summer months. In the pandemic year 2020, the lowest number of invoices issued was established in relation to the entire observed period, while the cycle peaks are at invoice numbers that are lower by around 20,000 in relation to the pre-pandemic period.

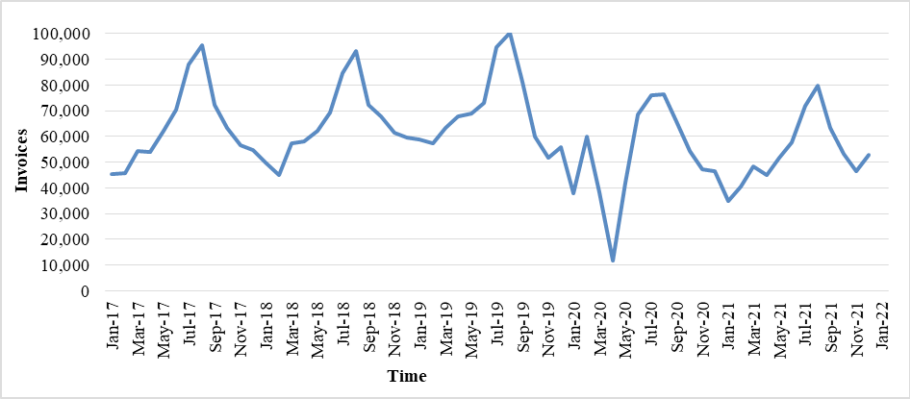

Fig. 6.

Number of Invoices issued by Months

Source: Edited by the author according to internal data obtained from (Gradski parking, 2022)

The impact of the pandemic on the developments in the number of invoices is examined by means of the multiple regression model, with a trend that, along with the time variable, also contains the variable of the presence of the SARS-CoV-2 pandemic as well as monthly impact (M) components.

The estimated model interprets 87.77% of the sum of square values of the deviation of the invoice number from the arithmetic mean, i.e. the model in question is a representative one. The empirical F ratio is 25.39, while the empirical level of significance is <0.001, leading to the conclusion that the estimated model is of statistical significance (Table 2).

Table 2

Model Validation (Correlation, Determination, F-ratio, Standard Error)

Statistic	Summary Statistics; DV: Number of invoices
	Value
Multiple R	0.9368
Multiple R2	0.8777
Adjusted R2	0.8431
F(13.46)	25.39
P	<0.001
Std. Err. of Estimate	6,469.76

Source: Edited by the author according to internal data obtained from (Gradski parking, 2022)

According to the estimated model, we expect an average monthly growth of 209.32 in the number of invoices issued, while the SARS-CoV-2 pandemic caused a reduction in the expected number of invoices issued by 20,320.97 on average. Oscillations in relation to January are present in all months except February and April. The highest number of invoices issued can be expected in August, when it is expected to increase by 46,256.72 in comparison with January (Table 3).

Table 3

Multiple Regression Model with Trend

N=60	β*	Std. Err. of β*	β	Std. Err. of β	t(46)	P
Intercept			44,432.39	3,344.48	13.29	<0.001
Trend	0.22	0.10	209.32	91.13	2.30	0.026
COVID	-0.60	0.10	-20,320.97	3,248.44	-6.26	<0.001
M2	0.07	0.07	4,124.87	4,092.85	1.01	0.319
M3	0.18	0.07	10,632.34	4,123.00	2.58	0.013
M4	0.09	0.07	5,390.22	4,115.94	1.31	0.197
M5	0.26	0.07	15,274.09	4,110.89	3.72	0.001
M6	0.44	0.07	25,527.97	4,107.86	6.21	<0.001
M7	0.69	0.07	40,430.84	4,106.85	9.84	<0.001
M8	0.79	0.07	46,256.72	4,107.86	11.26	<0.001
M9	0.48	0.07	27,980.79	4110.89	6.81	<0.001
M10	0.28	0.07	16,555.67	4,115.94	4.02	<0.001
M11	0.16	0.07	9,348.14	4,123.00	2.27	0.028
M12	0.17	0.07	10,240.22	4,132.05	2.48	0.017

Source: Edited by the author according to internal data obtained from (Gradski parking, 2022)

The regression model with trend has the following form eq.(1):

$$\widehat{rac}_t = 44.432{,}39+209.32*T_t-20{,}320.97*Cov_t+4.124{,}87 * M2_t+10{,}632.34*M3_t+5{,}390.22*M4_t+15{,}274.09*M5_t+25{,}527.97*M6_t + 40430{,}84 * M7_t+462{,}569.72*M8_t+27{,}980.79*M9_t+16{,}555.67*M10_t+9{,}348.14*M11_t+10{,}240.22*M12_t \quad (1)$$

Table 4 offers a comparison in the use of methods of payment by zones. The highest extent of the use of parking meters was established in Zone 1+, while the lowest was established in Zone 0, and an examination established the presence of a statistically significant difference (F=76.05; P<0.001). A post-hoc examination established a difference in the extent of payments through parking meters between all parking zones (P<0.001). M-parking (SMS) is used the most frequently in Zone 1 and the least frequently in Zone 1+, while an examination established the presence of a statistically significant difference (F=43.73; P<0.001). A post-hoc examination established that there was no statistically significant difference in the extent of m-payments between the Zones 0 and 1 (P=0.203) and between the Zones 0 and 2 (P=0.074), while the presence of a statistically significant difference was established among the other zones (P<0.050).

In parking Zone 0, bank cards are represented by 7.26%, and the examination established a difference in the extent of its representation in relation to the other parking zones. A post-hoc examination established a higher representation of bank card use in Zone 0 in relation to the other zones (P<0.001), while no presence of a statistically significant difference between the zones related to the extent of bank card use was established (P>0.050).

Table 4

Comparison of used Methods of Payment

Zone	N	Average	SD	F	P
METERS					
Zone 0	60	23.14%	12.98 points	76.05	<0.001
Zone 1	60	27.33%	7.61 points		
Zone 2	60	33.82%	8.27 points		
Zone 1+	60	49.45%	11.22 points		
M-PARKING					
Zone 0	60	69.60%	16.40 points	43.73	<0.001
Zone 1	60	72.25%	7.59 points		
Zone 2	60	65.87%	8.03 points		
Zone 1+	60	50.55%	11.22 points		
BANK CARDS					
Zone 0	60	7.26%	10.18 points	28.14	<0.001
Zone 1	60	0.43%	1.07 points		
Zone 2	60	0.31%	0.76 points		
Zone 1+	60	0.00%	0.00 points		

*LSD post-hoc test

Source: Edited by the author according to internal data obtained from (Gradski parking, 2022)

The correlation in the number of invoices issued for parking is the highest between Zone 0 and Zone 1+ (r=0.886); P<0.001), while the correlation between the number of parking invoices issued in Zones 1 and 2 is the lowest (r=0.285; P=0.027), which is displayed in Table 5.

Table 5

Analysis of the Correlation between the Numbers of Invoices issued in Different Parking Zones

Variable	Correlations: Number of invoices issued, marked correlations are significant at p < ,05000 N=60 (casewise deletion of missing data)			
	Zone 0	Zone 1	Zone 2	Zone 1+
Zone 0	1.0000			
	p= ---			
Zone 1	0.6753	1.0000		
	P<0.001	p= ---		
Zone 2	0.6324	0.2854	1.0000	
	P<0.001	P=.027	p= ---	
Zone 1+	0.8858	0.8284	0.7089	1.0000
	P<0.001	P<0.001	P<0.001	p= ---

Source: Edited by the author according to internal data obtained from (Gradski parking, 2022)

5. Conclusion

As an attractive tourist destination, the city of Šibenik has available street and off-street parking spaces. On street parking lots, it is possible to pay for parking at parking meters and by means of mobile phones. Research has established the presence of a difference between parking zones regarding the available methods of payment, with the listed methods of payment available in all zones except in Zone 1+, where it is only possible to pay for parking by using parking meters (cash payment) and m-parking services. The collection times for parking fees are corrected depending on the period of the year, i.e. during the months of the season the times are of longer duration than in the months outside of the season. The parking fee in Zone 0 is changed in the months of the season, while the parking fee in the other observed parking zones remains unchanged throughout the year. Depending on the season period, there is a change in the structure of the use of different methods of parking payment, i.e. there is a decline in the significance of m-parking.

The total number of invoices issued oscillated in the observed period, ranging from 11,672 invoices per month to 100,198 invoices per month. In every following month, the expected average growth in the number of invoices is 209, while the SARS-CoV-2 pandemic has had the consequence of an average decline in the number of invoices by 20,321 in each month of the pandemic. The highest number of invoices issued can be expected in August, when it is expected to be higher by 46,257 on average in comparison with January of the year observed.

By comparing the use of each method of payment between parking zones, it can be established that parking meters are the preferred method in Zone 1+, m-parking (SMS) in Zone 1 and bank cards (on parking meters) in Zone 0. Changes in demand for parking services among all parking zones are positively correlated, in a statistically significant manner, whereby the highest correlation was established between the parking Zones 0 and 1+, while the lowest correlation in the number of times parking services were used was established between the Zones 1 and 2.

References

Aircash. 2022. Parking. Available from Internet: <https://aircash.eu/kako-radi-aircash/usluge/parking/>.

Brčić, D.; Šoštarić M. 2012. *Parking and Garages [In Croatian: Parkiranje i garaže]*. Faculty of Transport and Traffic Sciences, Croatia, p. 112.

Corluka, G. 2019. Tourism seasonality – An Overview, *Journal of Business Paradigms* 4(1): 21-43.

Croatian Bureau of Statistics. 2022. Available from Internet: <https://www.dzs.hr/>.

Gies, J.; Hertel, M.; Tully, S. 2021. *Parking standards as a steering instrument in urban and mobility planning. How to make parking standards more sustainable*. CIVITAS Initiative, European Union, p. 39.

City of Šibenik. 2022. Available from Internet: <https://www.sibenik.hr/>.

Gradski parking. 2022. Available from Internet: <https://www.gradski-parking.hr/stranice/javna-parkiralista/13.html>.

Maršanić, R. 2008. *Parking in Tourist Destinations [In Croatian: Parkiranje u turističkim destinacijama]*. IQ PLUS d.o.o. Kastav, Croatia, p. 466.

Marušić, Z. *et al.* 2020. *Attitudes and Consumption Habits of Tourists in Croatia [In Croatian: Stavovi i potrošnja turista u Hrvatskoj]. TOMAS Croatia 2019.* Institute for Tourism, Croatia, p. 264.

Ministry of the Interior of the Republic of Croatia. 2021. *Bulletin on Street Traffic Safety in 2020 [In Croatian: Bilten o sigurnosti cestovnog prometa u 2020].* Republic of Croatia, Croatia, p. 139.

Nimac, K. 2021. *Parking in Tourist Destinations Displayed through the Example of the City of Šibenik [In Croatian: Parkiranje u turističkim destinacijama na primjeru grada Šibenika]*. Bachelor thesis, Undergraduate Professional Study Programme Traffic and Transport, Polytechnic of Šibenik, Croatia, p. 43.

PayDo services. 2018. PayDo presented to Šibenik media. Available from Internet: <https://paydo-services.hr/paydo-predstavljen-sibenskim-medijima>.

Statista. 2022. Number of registered passenger cars in Europe in 2018 and 2019, by country. Available from Internet: <https://www.statista.com/statistics/452449/european-countries-number-of-registered-passenger-cars/>.

Šibenik Tourist Board. 2022. Available from Internet: <https://www.sibenik-tourism.hr/#>.