

# Determination of the Cruise Vessels Seasonal Pattern in Eastern Adriatic

T. Stanivuk, A. Mišura, L. Stazić & I. Štolfa

<sup>1</sup> *University of Split, Split, Croatia*

**ABSTRACT:** The notion of a seasonal pattern of cruise ships has been used frequently, but very few authors have analysed all the features of this pattern. This article adds some new insights on this topic by analysing cruise ship activity in the three largest ports on the east coast of Adriatic Sea in 2017 and 2018. The article presents an analysis of cruise ship arrivals at the ports and compares the analysis to the established pattern in the Mediterranean, revealing the nature of the seasonal pattern for the ports analysed. In addition, two further analyses were carried out, firstly the analysis of ship size, which determines new characteristics of the seasonal pattern. The second additional analysis considered the duration of ship visit during different times of the year and determined another pattern characteristic.

## 1 INTRODUCTION

Seasonality is one of the challenges facing the cruise industry. There are numerous articles that use this term and exploit the consequences of this phenomenon [4, 5, 10, 19], but only few authors like Esteve-Perez et al. and Pavlić [8, 9, 15] analyse and determine the behaviour of the pattern. The purpose of this paper is to eliminate this problem and add more information and descriptions to the determination of the seasonal pattern, especially in Adriatic Sea, to add more data to previous researches [4, 16, 21]. This research only analyses the east coast of the Adriatic Sea, as a small part of the Mediterranean Sea.

When describing seasonal patterns in the Mediterranean Sea, most researchers [13] use data from the MedCruise Association [1, 2]. This is an association of Mediterranean Cruise Ports, which serves to promote the cruise industry and unites ports and ship owners. Seasonal patterns in the Med are

described in the next Chapter, presenting the data from MedCruise Association [1, 2] as well as from research performed by Esteve-Perez et al [8]. Following chapters analyse various aspects of the Adriatic East Coast seasonal pattern, ending with some new and until now unpublished findings which are presented in the Chapter 6 and in the Conclusion.

Findings presented in the article may help researchers of the cruise industry pollution impact or crowding effect to better appraise the seasonality effect in this area. Noted differences from Mediterranean pattern may help in some future calculations and researches.

## 2 SEASONAL PATTERN IN THE MEDITERRANEAN SEA

Figure 1 describes the seasonal pattern indicated in the percentage of number of arrivals at the port per month in 2017 and 2018.

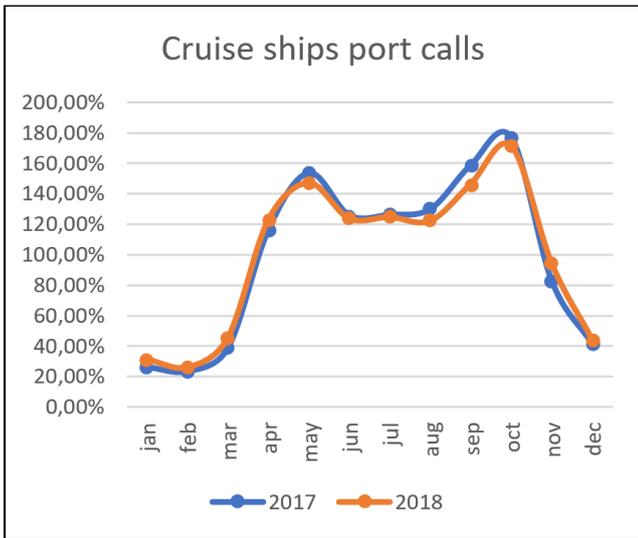


Figure 1. Seasonal pattern of cruise ships on the Mediterranean in 2017 and 2018 [16]  
\*Values are in the percentage of the average yearly number of ship port calls

Figure 1 also shows that the largest proportion of cruise ship port calls is in October (14.75% of all calls or 176.85% of the average) with 1789 calls, while the smallest proportion of port calls was recorded in February (1.95% of all calls or 23.43% of the average) with 237 calls. The same pattern was seen from 2014 to 2018, with October hosting around 14% of total cruise ship calls. In 2016, October was the dominant month, accounting for 14.4% of all calls, while this proportion was 14.27% in 2018 [1, 2]. It can also be seen that most of the ship calls occur in a period from April to October. During this period, the proportion per month varies between 10 and 15% of the total calls. On the other hand, the lowest arrival rate was recorded in the period from November to March, with monthly shares ranging from 1.5 to 7%. In 2017, the overall percentage from April to October was 82.26%, while from November to March it was 17.74%. The behaviour for 2018 follows the same pattern as for 2017, which can be seen in Figure 1.

Esteve-Perez et al [8] described two different seasonal patterns in the Mediterranean (Figure 2), the first with a peak in July/August and with duration from April to October and the second pattern with two peaks in April and October and with duration from March to November.

Analysis of the ports of Split and Dubrovnik in the Republic of Croatia and the port of Kotor in Montenegro produced the results that determine the pattern of behaviour and the laws that apply on our side of the Adriatic. These three ports host the most cruise ships during the year in the whole East Adriatic [4, 14, 21]. Data from Port Authorities [6, 11, 17] were used for the study. In order to exclude smaller vessels and yachts, vessels smaller than 500 GRT were excluded from the analysis. In addition to the numbers of arrivals at these ports, the study also included an analysis of the size of the cruise ships and an analysis of the length of stay in port. This analytical approach resulted in some new findings that were noticed, explained and published for the first time.

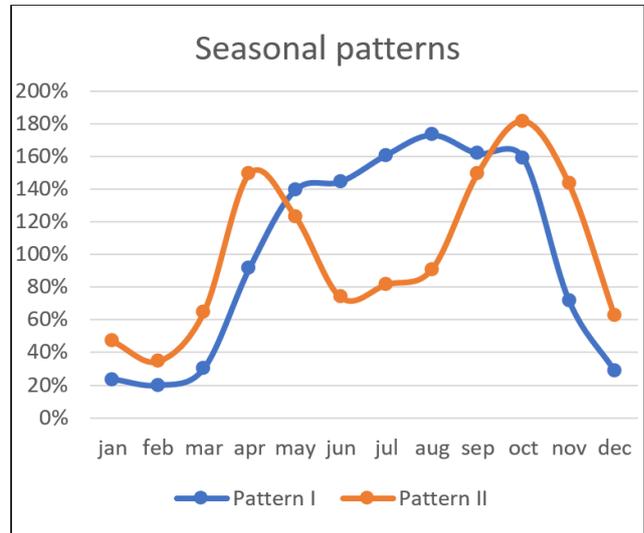


Figure 2. Two different types of seasonal pattern in the Mediterranean [8]  
\*Values are in the percentage of the average yearly number of ship port calls

### 3 ADRIATIC EAST COAST PORTS ARRIVALS

Esteve-Perez et al [8] analysed the ports of Dubrovnik and Kotor as part of the Adriatic cruise ports. In the article, these ports were referred to as ports with seasonal pattern I. Since the port of Split belongs to the same area and operates under similar conditions, it is expected that the port has the same pattern.

The determination of the pattern for the ports East Adriatic is carried out using the data obtained from the port authorities in the three largest passenger ports on the eastern Adriatic coast: Split, Dubrovnik and Kotor. Using the obtained data, Table 1 was prepared showing port traffic by month for 2017 and 2018.

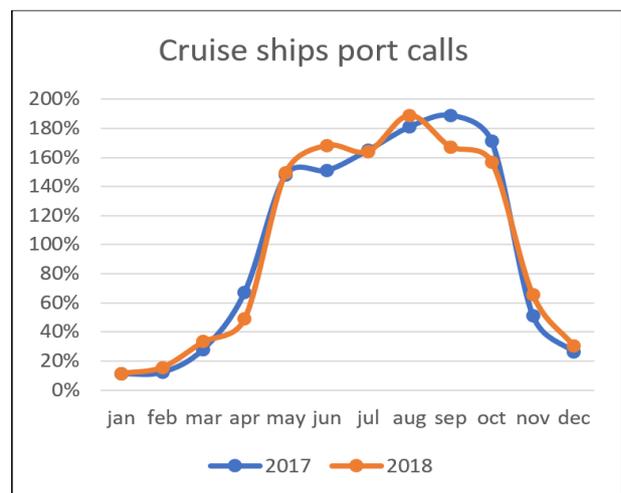


Figure 3. Eastern Adriatic coast Cruise ships port calls  
\*Values are in the percentage of the average yearly number of ship port calls

Aggregate data for the East Coast of the Adriatic Sea in the form of a graph are visually represented in Figure 3. In 2017, the highest number of arrivals was recorded in September with 189 vessels, representing 15.75% of all annual arrivals, while the month with

the lowest arrivals was January with only 11 arrivals or 0.92% of annual arrivals. A similar pattern was recorded in 2018 when the dominant month was August with 182 vessel arrivals, representing 15.75% of annual arrivals, and the month with the fewest arrivals was January with 11 arrivals, representing 0.95% of annual arrivals.

### 3.1 Adriatic East Coast Ports seasonal behaviour determination

Comparing Figures 2 and 3 it is evident that the pattern applicable to the East Coast of the Adriatic Sea corresponds to the pattern I described on Figure 2, as given by Esteve-Perez et al [8] in their paper. Comparing Figures 1 and 3 it can be seen that on the East Coast of the Adriatic Sea the season also starts in April, although with much less intensity than in the rest of the Mediterranean (almost 50% less). The intensity of the pattern during the summer months is more pronounced (up to 30% more) than in the Mediterranean. The timing of the seasonal peak also differs from the Mediterranean, on East Coast of Adriatic Sea the peak occurs in August/September, while in the Mediterranean the peak is in October. The end of the season also has some discrepancies, on the East Coast of the Adriatic Sea it ends in October, while in the Mediterranean there is still some activity in November (although to a lesser extent). The similarity of the charts (Figure 1 and 3) is that both have more than 80% of vessel visits during the season and a very inactive winter season.

According to the facts listed, the seasonal pattern in the East Coast of the Adriatic Sea can be summarized:

- It starts slowly in April, at the end of the month,
- It is very intense during the summer,
- It peaks in August/September,
- It ends at the end of October.

## 4 ADDITIONAL SEASONAL CHARACTERISTICS

The study focuses on the additional aspects of the cruise trade. These aspects are:

- Distribution of ship size over the year,
- Length of stay in port over the year,

- These two parameters will help to determine the seasonal pattern more precisely.

### 4.1 Distribution of vessel size

This section presents the analysis of cruise ship size in 2017 and 2018 in the East Coast of Adriatic Sea, as shown in Figure 4. In 2017 the average size of cruise ships in the ports of the East Coast of Adriatic Sea was 166.22 [m], while in 2018 the average size was 178.66 [m].

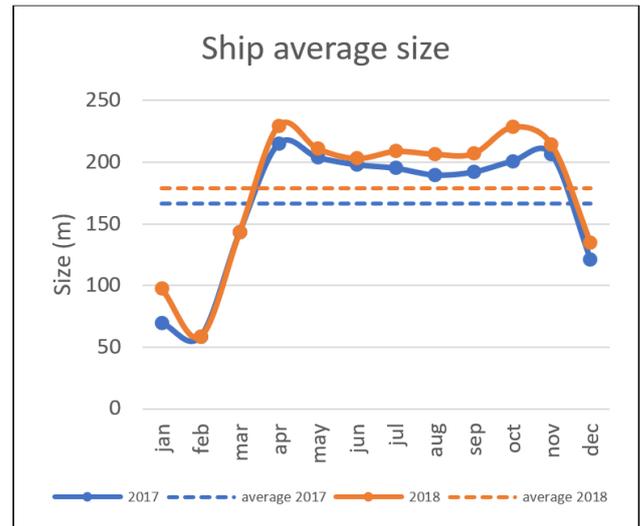


Figure 4. Eastern Adriatic coast Cruise ships average size

From Figure 4 it is evident that the average size is considerably larger during the summer season than during the winter. It is noteworthy that longer cruise ships arrive during the period from April to November than during the period from December to March, when the average ship size is much smaller. Comparing this pattern (Figure 4) with the pattern shown in Figure 3, it is clear that the distribution of cruise ship size during the year does not fully match the seasonal pattern of cruise ship arrivals in the East Coast of the Adriatic Sea. It is noticeable that the largest cruise ships arrive in April, while in Figure 3 the full season starts at the end of the month. Although according to Figure 3 the seasonal pattern ends in October, this pattern shows a decrease in size one month later.

Table 1. Cruise ships port calls in Eastern Adriatic Ports during 2017/2018

Cruise ships port calls - Eastern Adriatic 2017/2018												
	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec
<b>2017</b>												
Cruise Calls Split	2	4	7	11	28	26	27	31	33	40	13	10
Cruise Calls Split (%)	0.86	1.72	3.02	4.74	12.07	11.21	11.64	13.36	14.22	17.24	5.60	4.31
Cruise Calls Dubrovnik	5	4	10	33	63	72	79	88	85	76	17	6
Cruise Calls Dubrovnik (%)	0.93	0.74	1.86	6.13	11.71	13.38	14.68	16.36	15.80	14.13	3.16	1.12
Cruise Calls Kotor	4	4	11	23	57	53	59	62	71	55	21	10
Cruise Calls Kotor (%)	0.93	0.93	2.56	5.35	13.26	12.33	13.72	14.42	16.51	12.79	4.88	2.33
<b>2018</b>												
Cruise Calls Split	4	5	10	8	34	36	29	38	34	25	18	9
Cruise Calls Split (%)	1.60	2.00	4.00	3.20	13.60	14.40	11.60	15.20	13.60	10.00	7.20	3.60
Cruise Calls Dubrovnik	3	5	11	25	67	78	78	87	78	71	19	8
Cruise Calls Dubrovnik (%)	0.57	0.94	2.08	4.72	12.64	14.72	14.72	16.42	14.72	13.40	3.58	1.51
Cruise Calls Kotor	4	5	11	14	43	48	51	57	49	55	26	12
Cruise Calls Kotor (%)	1.07	1.33	2.93	3.73	11.47	12.80	13.60	15.20	13.07	14.67	6.93	3.20

It can be concluded that in the period from April to November, cruise ships are on average 20% larger than the annual average size. On the other hand, from December to March, the size is about 40% smaller than the annual average size.

According to the above facts, the size-related addition to the seasonal pattern in the East Coast of the Adriatic Sea can be summarized:

- Larger vessels begin arriving in April,
- Size decline begins in December,
- The average size of cruise ships is almost constant during the season,
- During the winter the average size of vessels is significantly smaller, 40% less than the annual average size,
- This pattern differs from the seasonal pattern of ship arrivals in timing (starts one month earlier, and ends one month later).

#### 4.2 Periods of stay in port

The average stay in port of cruise ships in analysed ports of Eastern Adriatic in 2017 and 2018 is shown in Figure 5. In 2017, the average time spent by cruise ships in the port of Eastern Adriatic was 18.54 hours, while in 2018 this time was 17.9 hours.

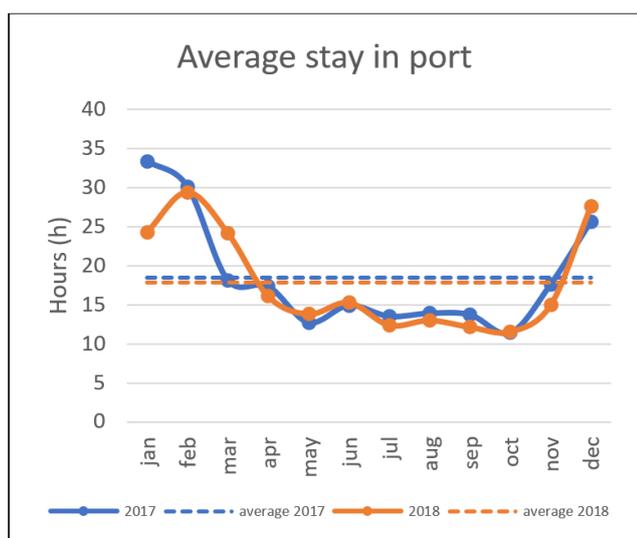


Figure 5. Eastern Adriatic coast Cruise ships average stay in port

Figure 5 shows that cruise ships spend significantly less time in port during the seasonal period, from May to October than during the rest of the year. The shortest stay in port is recorded in October, while they spend the most time in port in January/February. Comparing this pattern (Figure 5) with the seasonal pattern shown in Figure 3, it is clear that the distribution of ship stays in port is inversely proportional to the pattern of seasonal behaviour of cruise ships. During the period from May to October, the average ship stay in port is between 11 and 15 hours, while during the rest of the year it is significantly longer. Therefore, it can be concluded that during the period from May to October, cruise ships stay in port for about 27% less time than the annual average time of the ship in port, while during

the period from November to April, they stay for about 27% more time.

According to the above facts, the seasonal pattern of cruise ships in analysed ports of Eastern Adriatic can be summarized in terms of stay time:

- The average annual ship stay time in port is about 18 hours,
- The average length of stay of the ship in the port is almost constant during the seasonal period and is about 27% lower than the annual average length of stay in the port,
- During the period from November to April (off-season), vessels spend about 27% more time in port than the annual average,
- The pattern of ship stays in port is inversely proportional to the pattern of seasonal behaviour of cruise ship arrivals.

Why do ships stay longer in port longer during the off-season?

This fact surprised a whole group of researchers and it was further investigated. In the beginning, there was the question of port fees [20]. By re-examining all three Port Authorities [7, 12, 18], it was found that the prices are the same throughout the year. The next attempt was to ask information directly from the shipping companies involved to find the reason.

When they provided information, the reason was more than obvious. The off- season is mostly during winter months. Only smaller ships operate in the area during this time. Smaller ships are more susceptible to bad weather, which is more common during the winter season, as can be seen in Figure 6 [3].

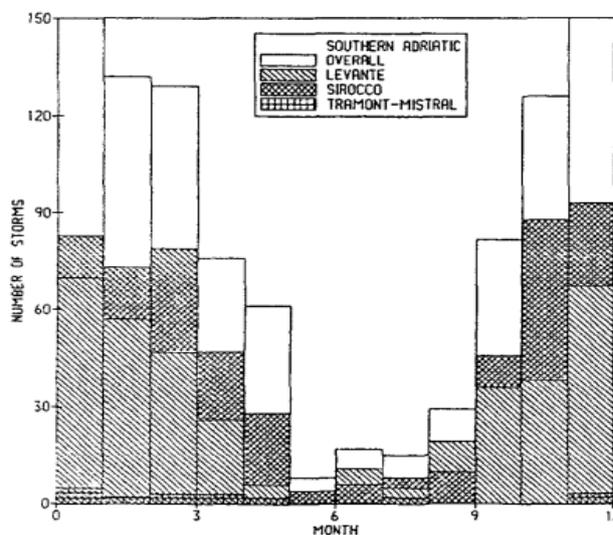


Figure 6. Southern Adriatic weather conditions during the year [3]

Cavaleri et al. published the research [3] presenting that during the winter there are up to 10 times more storms and stormy weather than during the summer season (Figure 3). Smaller vessels (the size of cruise vessels decrease in winter season) in a weather like that must stay in port causing increase of the stay in port value in winter months.

## 5 DESCRIPTION OF EASTERN ADRIATIC CRUISE SHIP PATTERN

From the analysis presented in the article, a comprehensive and detailed Cruise ships seasonal pattern for East Adriatic Coast can be described:

- The pattern of number of port calls presented on Figure 3 belongs to Mediterranean pattern I [8], as presented on Figures 1 and 2, with minor shape deviations
- The size-related addition (Figure 4):
  - Larger vessels begin arriving in April,
  - Size decline begins in December,
  - The average size of cruise ships is almost constant during the season,
  - Only smaller ships are in the area during the winter,
  - This pattern differs from the seasonal pattern of ship arrivals in timing (starts one month earlier. and ends one month later).
- In terms of vessel arrivals (Figure 3):
  - It starts slowly in April, at the end of the month,
  - It is very intense during the summer,
  - It peaks in August/September,
  - It ends at the end of October.
- Concerning the size of ships (Figure 4):
  - Larger ships begin arriving in April,
  - Decrease in size begins in December,
  - Average size of cruise ships is nearly constant throughout the season,
  - Only smaller ships are in the area during the winter,
  - This pattern differs from the seasonal pattern [8, 9] of ship arrivals in timing (begins one month earlier).
- Regarding vessel stay in port (Figure 5):
  - The average annual length of stay of vessels in port is approximately 18 hours,
  - The average length of stay of vessels in port is almost constant during the season and is approximately 27% lower than the average annual length of stay in port,
  - During the period from November to April (off- season), vessels spend approximately 27% more time in port than the annual average,
  - The pattern of vessel stay in port is inversely proportional to the pattern of seasonal behaviour of cruise ship arrivals.

## 6 FURTHER RESEARCH

During the research for this article, several questions arose that are still unanswered and remain for new research in this area. These questions are:

- How long does the cruise ship stay in port?
- Does that value change over the course of the year?
- Is the duration related to the number of passengers and the size of the ship?
- What influences the total length of stay in port?
- Is the seasonal pattern equally represented for all vessel sizes?

These answers will hopefully be provided soon by the same research team.

## 7 CONCLUSION

The discussion, analysis and results presented in the article are clearly showing that the main aspect of the seasonal pattern, i. e. number of port calls of cruise vessels on the East Coast of the Adriatic Sea corresponds to the seasonal pattern I in the Mediterranean, presented on the Figures 2 and 3. Graph of the number of port calls of cruise vessels on the East Coast of the Adriatic Sea in shape corresponds with the shape and design of the Mediterranean pattern, with smaller differences in height and width of the curves.

The analysis presents two additional aspects of the Cruise ships seasonal pattern for East Adriatic Coast. Those aspects, analysis of the seasonal size of ships in port and seasonal changes of the length of stay of vessels in port create second contribution of this research, both seasonal patterns were not noted or analyzed before. Both aspects are showing clear seasonal patterns with two different seasonal behaviors. The pattern of the ship size also corresponds with seasonal pattern I in the Mediterranean like the number of port calls. The pattern of the stay in port on the other side is inversely proportional to the same pattern. Both of these analyses, according to the knowledge of authors, are considered for the first time and are bringing new light on the seasonal pattern in the Mediterranean.

## ACKNOWLEDGEMENTS

Part of the research for this article was performed using the equipment obtained through the Project named: "Functional integration of the University of Split, PMF-ST, PFST and KTF-ST through development of scientific and research infrastructure in Three faculties building", contract number KK.01.1.1.02.0018.

## REFERENCES

1. A MedCruise Report: Cruise Activities in MedCruise Ports 2017 Statistics. , MedCruise Association, Piraeus, Greece (2018).
2. A MedCruise Report: Cruise Activities in MedCruise Ports 2018 Statistics. , MedCruise Association, Piraeus, Greece (2019).
3. Cavaleri, L., Bertotti, L., Tesaro, N.: The modelled wind climatology of the Adriatic Sea. *Theoretical and Applied Climatology*. 56, 3, 231–254 (1997). <https://doi.org/10.1007/BF00866430>.
4. Čorluka, G., Peronja, I., Tubić, D.: Cruise Port Passenger Flow Analysis: a Cruise Port Governance Perspective. *NAŠE MORE : znanstveni časopis za more i pomorstvo*. 67, 3, 181–191 (2020). <https://doi.org/10.17818/NM/2020/3.1>.
5. Dragović, B., Tzannatos, E., Tselentis, V., Meštrović, R., Škurić, M.: Ship emissions and their externalities in cruise ports. *Transportation Research Part D: Transport and Environment*. 61, 289–300 (2018). <https://doi.org/10.1016/j.trd.2015.11.007>.
6. Dubrovnik Port Authority: Statistics 2011 – 2020, Dubrovnik, Croatia, <https://www.portdubrovnik.hr/statistika/?idKat=8&godina=2017>, last accessed 2021/02/04.
7. Dubrovnik Port Authority: Tariff schedule of port services and charges of Dubrovnik port authority,

- Dubrovnik, Croatia, <https://www.portdubrovnik.hr//datoteke/tariff-eng2021final2021230111208.pdf>, last accessed 2021/02/10.
8. Esteve-Perez, J., Garcia-Sanchez, A.: Characteristics and consequences of the cruise traffic seasonality on ports: the Spanish Mediterranean case. *null*. 44, 3, 358–372 (2017). <https://doi.org/10.1080/03088839.2017.1295326>.
  9. Esteve-Perez, J., Garcia-Sanchez, A., Muñoz-Paupie, A.: Cruise Traffic Seasonality Patterns in the Western Mediterranean and the Adriatic Sea: A Challenge to Port Operators. *null*. 47, 4, 362–386 (2019). <https://doi.org/10.1080/08920753.2019.1612701>.
  10. Fernández-Morales, A., Cisneros-Martínez, J.D.: Seasonal Concentration Decomposition of Cruise Tourism Demand in Southern Europe. *Journal of Travel Research*. 58, 8, 1389–1407 (2018). <https://doi.org/10.1177/0047287518802094>.
  11. Kotor Port Authority: Cruise traffic statistics 2003 – 2015, Kotor, Montenegro, <http://www.portofkotor.co.me/O-luci/statisticki-podaci.html>, last accessed 2021/02/04.
  12. Kotor Port Authority: Tariff of port charges and other services, Kotor, Montenegro, <http://www.portofkotor.co.me/Tarifa%20luckih%20naknada%20i%20drugih%20usluga%20LUKA%20KOTOR%20AD%20KOTOR.pdf>, last accessed 2021/02/10.
  13. Murena, F., Mocerino, L., Quaranta, F., Toscano, D.: Impact on air quality of cruise ship emissions in Naples, Italy. *Atmospheric Environment*. 187, 70–83 (2018). <https://doi.org/10.1016/j.atmosenv.2018.05.056>.
  14. Perić, T., Mihanović, V., Golub-Medvešek, I.: Analysis of cruise ship traffic in the Port of Split. *Journal of Applied Engineering Science*. 17, 3, 304–310 (2019). <https://doi.org/10.5937/jaes17-22822>.
  15. Pavlič, I.: Cruise tourism demand forecasting-the case of Dubrovnik. *Tourism and hospitality management*, 19(1.), 125-142 (2013).
  16. Sciozzi, D., Jugović, T.P., Jugović, A.: Structural analysis of cruise passenger traffic in the world and in the Republic of Croatia. *Scientific Journal of Maritime Research*. 29, 8–15 (2015).
  17. Split Port Authority: Cruise traffic 2009 – 2019, Split, Croatia, [https://portsplit.hr/wp-content/uploads/1\\_-kruzeri-2019.pdf](https://portsplit.hr/wp-content/uploads/1_-kruzeri-2019.pdf), last accessed 2021/02/04.
  18. Split Port Authority: Tariffs of port dues port authority Split, Split, Croatia, [https://portsplit.hr/wp-content/uploads/tariffes-of-port-dues-july-2016\\_1-1.pdf](https://portsplit.hr/wp-content/uploads/tariffes-of-port-dues-july-2016_1-1.pdf), last accessed 2021/02/10.
  19. Stojanović M, Poletan Jugović T, Jugović A.: Indicators of passenger flows movements on the world and mediterranean cruise market. *Pomorstvo*. 23; 28(1): 40-8 (2014).
  20. Vukić, L., Peronja, I., Slišković, M.: Port Pricing in the North Port of Split: A Comparative Analysis. *Trans. Marit. Sci.* 7, 1, 59–70 (2018). <https://doi.org/10.7225/toms.v07.n01.006>.
  21. Žlak, B., Stojaković, M., Zanne, M., Twrdy, E.: Cruise Shipping in the Adriatic-Ionian Region and its Potential. *NAŠE MORE : znanstveni časopis za more i pomorstvo*. 63, 2, 56–61 (2016). <https://doi.org/10.17818/NM/2016/2.3>.