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An Exploratory Study on Museum Visitor ship Trends in Singapore

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Abstract

The COVID-19 outbreak has unpredictably disrupted the operations of numerous museums. Museum visitor experience has a physical, personal, and social context, which are not achievable during the pandemic. Despite the depreciation during the Circuit Breaker period, the disruption also presents an opportunity for local museums to develop new strategies of audience engagement to accommodate the altered audience behavior. This exploratory study analyses data from six Singapore-based museums to understand the visitorship patterns across different ages and genders. The impact of COVID-19 is also analysed. Using R-studio and relevant packages, we conducted statistical tests such as hypothesis testing, Chi-square testing and regression. It was concluded that overall, museums attracted a younger demographic compared to the general Singapore population, and male visitors were more likely to visit more than once. Furthermore, the average number of visitors in the second half of 2020, after a nation-wide COVID-19 stay-home order, was found to be statistically greater than the average number of visitors before. An interactive R Shiny app was also designed to allow users to explore the visitor profile of each museum.

Keywords

Exploratory study, demographic, COVID-19, Museums and R Shiny

1. Introduction

Despite its small size, Singapore boasts a rich, diverse, and thriving museum environment that includes public and private museums that feature collections in the arts, culture and community, healthcare, national history, military, science, and technology. The National Heritage Board (NHB), a statutory government board in Singapore, is “responsible for telling the Singapore story, sharing the Singaporean experience and imparting Singapore spirit”. NHB manages a suite of museums and heritage institutions that collectively aim to “preserve and celebrate” shared heritage of diverse communities, “for the purpose of education, nation-building and cultural understanding”. The NHB also sets policies relating to heritage sites, national monuments and the national collection.

The impact of the COVID-19 pandemic on museum attendance has been severe. As the COVID-19 pandemic spread over the world, on 3 April 2020, in response to the Singaporean government's implementation of stay-home orders and a more severe set of safe distancing procedures, all museums in Singapore shuttered to prevent the disease's spread. According to the results of the survey, close to 75% of museums in Singapore suffered a significant decline in revenue. The remaining 25% consisted of museums that were already closed for renovation prior to COVID-19. The Singapore Tourism Board announced the reopening of all local museums on 28 June 2020 after nearly three months of closure. However, the museums were only allowed to operate at 25% of their full capacity at any given time in the first phase of reopening.

Following the end of the stay-home-order and the progressive relaxation of safe distancing measures in Singapore, the national broadsheet Straits Times stated that there were around 80,000 museum visits between August 2020 and

February 2021. During the later phases of the epidemic, as fewer individuals travelled out of Singapore, more individuals were visiting museums. The National Gallery Singapore drew more than twice the anticipated number of visitors. Comparing July to November 2020 to the first two months of 2021, the average monthly number of visitors has increased by around 40%. Additionally, specific complementing programs attracted more families and children on the weekends.

This study examines consumer behavior and identifies the factors that drive museum-goer demand over 3.5 years, from June 2017 to December 2020, in order to comprehend the local museum visitor ship trends across different ages and genders, as well as the impact of the COVID-19 pandemic. This covers the time before the onset of COVID and the reopening following the stay-at-home measure. More details are explained in the following subsection.

1.1 Objectives

This exploration and analysis of museum visitor ship before and during COVID-19 in Singapore is intended to serve as a foundation for future research on this topic. The purpose of this paper is to use appropriate statistical methods to conduct the exploratory data analysis on visitors to selected museums in Singapore over the past 3.5 years, including the impact of COVID-19 on museum attendance, particularly among youths, against the backdrop of larger visitorship studies conducted globally.

We also seek to determine if the overall profile of Singapore's museum visitors aligns with global trends. For instance, prevalent data indicates that women constitute the majority of museum visitors. According to a 2012 study of European museums, 58.9% of visitors were female. This study examines consumer behavior and identifies the factors that drive museum-goer demand. During the COVID-19 epidemic, this information is particularly vital. In this regard, it may give us with new and important knowledge based on museum data from Singapore. The conclusions of this study are intended to aid all the relevant stakeholders in formulating future policies.

2. Literature Review

Bollo and Pozzolo (2005) analyzed behaviour and usage models within the museum space by considering several factors, such as time, attention and the capacity to retain information and knowledge. A further objective of the study is to verify the correspondence degree between the exhibition the curators have in mind, and the actual interpretation of the occasional visitor. The studied was conducted in three different museums in the city of Turin, Italy. The survey results show some considerations, such as the visitor's time and attention span are always one of the parameters need to be assessed, the importance of creating a "watercourse" to be followed, to guide visitors along the route and other considerations that can be referred in the original paper.

Yi et al. (2022) studied and investigated the effect of providing information from visitors on museum visitors' experiences. To be specific, the interactions between personal and social contexts are the main focus of the work. The collected data, which is called "visitor-based social contextual information" (VSCI), is the social information individuals provide—feedback, reactions, or behavioural data—that can be applied to facilitate interactions in a social context. The suggestion is to use this VSCI application to guide strategies for enhancing the experience of museum visitors. However, the experiment was only conducted in a laboratory environment due to Covid-19. Kajzar (2022) focused more on identifying the influence of the factors on the repeat visits to certain tourism enterprises in Czechia. The study includes three factors: service, environment, and offer. It is concluded that most of repeat visitors are affected by professional behaviour, staff empathetic approach, offer knowledge and others. It is also highlighted the importance of studying consumer or visitor behaviour to fill the market gap and identify the new services.

Emanuela et al. (2017) focused on the museum visitors' profiling the experiential perspective, value co-creation and implications for museums in Italy. A museum visitor clustering method is implemented to group museum visitors according to the desired experiential dimensions which are derived from visitors' individual characteristics and their perception of museum attributes. A survey via face-to-face interviews was conducted on a wide sample of visitors to the National Gallery of the Marche (Urbino, Italy), one of the most important Italian, state-run museums focused on the Renaissance period. It is concluded that the visitors are very heterogeneous. Visitors do not just search for cultural enrichment but also want to live emotions, have fun, and socialize.

Based on the 2019 Heritage Awareness Survey administered by the NHB, in 2018, 75% of Singaporeans said that a better understanding of Singapore's heritage and culture increases their sense of belonging to Singapore, an increase

from 66% in 2014. The heritage participation of youths, in particular, was high at 84%. These trends were disrupted by the COVID-19 pandemic. The United National Educational, Scientific and Cultural Organisations, UNESCO has reported that “the cultural sector has been severely and persistently affected by the COVID-19 pandemic, with museums particularly hard-hit”. The report estimated that nearly 90%, or an estimated 85,000 institutions around the world, had been closed for varying lengths of time. Even for institutions that remained open with sanitary measures in place, the drastic decrease in world tourism resulted in a drop in attendance of 70%. In response, many museums, including Singapore’s, pivoted to digital forms of engagement. In spite of the clear benefits brought to museums by digital engagement, some studies have cautioned that the in-person experience was not substitutable for the digital experience because the creation of “virtual tourist worlds” separated visitors from the material space of socio-economic relations and had “negative effects on the way in which knowledge is constructed, or the difficulties for some user groups in accessing these technologies”.

This view is supported by a December 2020 study done by researchers from the Department of Archival, Library and Information Studies (ALIS) of the University of West Attica (UNIWA) in Greece on young people’s view on museums which found that while more than 80% said they would “often”, “very frequently” and “always” visit a museum when on a short break, “almost one in three said they missed visiting museums “a little” or “not that much” during the pandemic, while 51% of the respondents stated that they had not scheduled a visit to a museum before their closure due to the current public health concerns”. Further, while a significant percentage of the survey’s visitors (73%) said that the digital engagement was successful, an overwhelming majority (97%) indicated that it preferred “to visit museums physically”. Similarly, 87% of respondents stated that they learn more by visiting museums in person.

3. Methods

The dataset provided by the NHB comprises data over 3.5 years from June 2017 to December 2020. It contains an anonymous unique identifier for each local visitor, date and time of visit, museum visited, age, and gender. It also includes 6 different museums, comprising of 3 history-based museums which are in Singapore’s historical Civic District precinct, denoted as Museums H1, H2 and H3, and 3 community-based museums, which are located outside of the Civic District, and focused more on the heritage of specific ethnic communities in multicultural Singapore, denoted as Museums C1, C2 and C3. Due to some requests, all museum names are anonymous. Figure 1 illustrates the entire statistical analyses performed in this study:

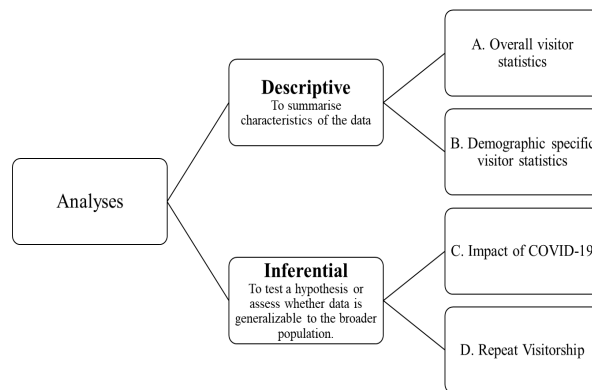


Figure 1. Statistical tests

Descriptive Statistics: to describe and summarize some basic features of the collected dataset, such as monthly visitorship, visitorship by time of day, and museum. We also include visitor demographic profiles by age and gender. The purpose of this is to understand if the visitorship patterns to the museums revealed any new insights especially from the demographic participation. Various charts, such as stacked bar charts, line charts, histograms, are used to represent the findings.

Inferential Statistics: to draw inferences or conclusions about populations based on the collected dataset as the sample. In this part, hypothesis testing was conducted to compare visitorship patterns pre- and post-Circuit Breaker in

2020. Logistic Regression was performed to investigate if there was any association between the demographic variables and the likelihood of a repeat visit.

5. Computational Results

In this section, Section 5.1 provides the detailed results and analysis of the visitor statistics. Section 5.2 presents the analysis from the visitor demographics point of view. The inferential statistics related to the comparison between pre- and post-Circuit Breaker is summarized in Section 5.3. Finally, Section 5.4. includes the association analysis between the demographic variables and the likelihood of a repeat visit.

5.1 Descriptive Analysis: Visitor Statistics

Visitorship to the various museums was grouped by months. As illustrated in Figure 2, the months with the minimum and maximum numbers of visitors both occurred in 2020, with the minimum in May, and the maximum was in December. This could be due to the impact of COVID-19. More details about the impact of Covid-19 are explained in Section 5.3. There was an increasing trend at the end of Year 2020 since not many locals can travel overseas. Most people in Singapore then spent their times by visiting local attractions including museums. On the other hand, in years of 2017 to 2019, there were no significant change across different months.

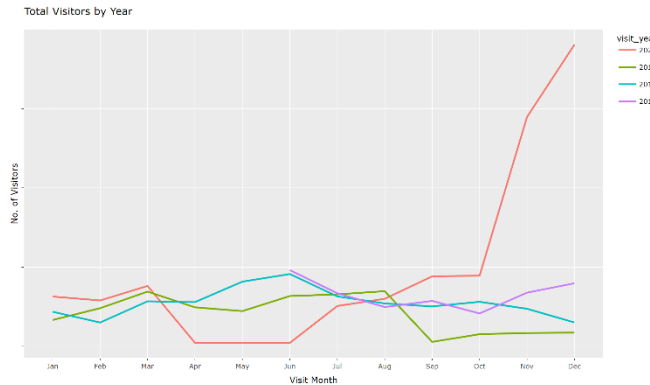


Figure 2. Total visitors to NHB museums by year

In Figure 3, we show that Museum H2 welcomed the greatest number of visitors over the time frame, and Museum H3 had the fewest. This was expected given that H3 was closed since April 2019 for refurbishments. The community museums, Museums C1, C2 and C3, had similar visitor numbers on average. Towards to weekends, the total number of visitors have increased proportionally as well. Again, many locals have spent their times to visit museums.

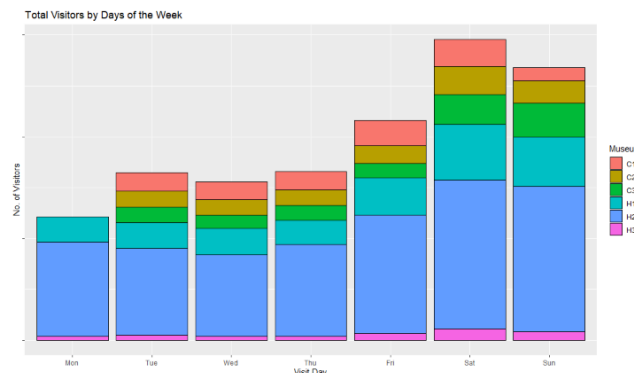


Figure 3. Total visitors to NHB museums by day

In terms of peak periods for museum visitors, the weekends were unsurprisingly the most popular days, with Saturday being the most crowded, as illustrated in Figure 4. Monday is most likely closure day for Museums C1, C2 and C3 as no visitors were recorded for these museums on that day. This is a common practice /*in some tourist attractions. They may close due to busy weekends and give some breaks for their staff. For any given day, the busiest time for all the

museums was the early afternoon, from 1 – 3 pm when visitors drop by the museums possibly after lunch. Visitors keen to avoid crowds should consider visiting museums in the evening, just before closing or just before lunch at around 11am.

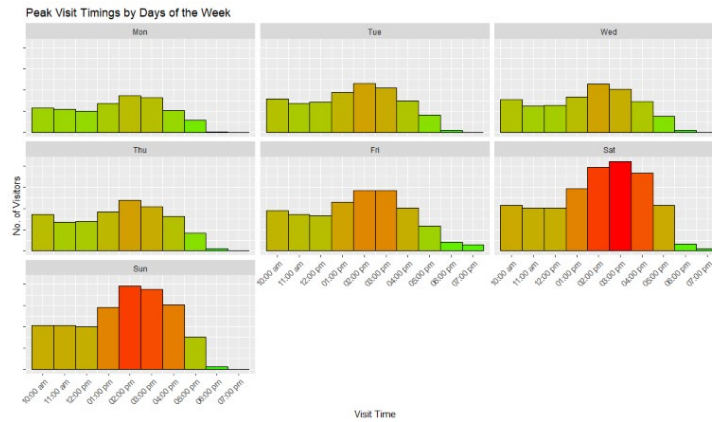


Figure 4. Peak times of visitors to NHB museums

5.2 Descriptive Analysis: Visitor Demographics

Visitor demographics was studied based on the composition of visitors to each museum across age and gender, as illustrated in Figures 5 and 6 respectively. These compositions were compared against the population demographics of Singapore to evaluate if there were any significant differences. Based on the plot for age in Figure 5, all museums attracted a larger proportion of the younger generation (<45 years old) with most visitors being between 20 to 44 years old. Museum C3 had the oldest demographic of visitors while Museum H2 had the youngest. For other ranges of age, we can refer to Figure 5 below.

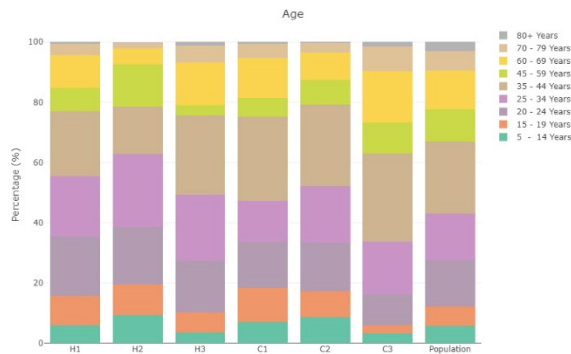


Figure 5. NHB museums visitor ship by age groups

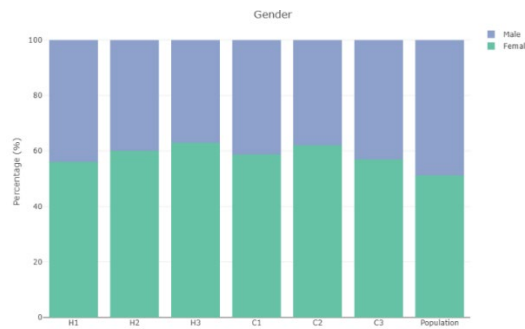


Figure 6. NHB museums visitorship by gender

In Figure 6, it is clear that females also made up a slightly higher proportion of visitors to all museums, higher than their population proportion. The highest percentages are in Museums H3 and C2. Unfortunately, we do not have more details about their backgrounds, e.g. visiting alone or with family etc.

5.3 Inferential Statistics: COVID-19 Hypothesis Testing

Hypothesis testing was performed to analyze the impact on visitor ship during the COVID-19 period. Hypothesis testing is a method of statistical inference used to decide whether the sample sufficiently support a particular hypothesis and allow us to make probabilistic statements about the population parameters. Based on the descriptive statistics results in previous sections, there were observable disruptions to visitor ship patterns. Here, we formulate four different point of interests or hypotheses for further studies:

Hypothesis 1: Was the average number of visitors post-Circuit Breaker higher than before the Circuit Breaker, as more local tourists visited the museums following a period of physical distancing and the inability to travel abroad?

H₀: Average Visitors Post Circuit Breaker (Jun-Dec 2020) less than or equal to Average Visitors before Circuit Breaker (Jan 2018-Mar 2020), i.e. $\mu_x - \mu_y \leq 0$

H₁: Average Visitors Post Circuit Breaker (Jun-Dec 2020) greater than Average Visitors before Circuit Breaker (Jan 2018-Mar 2020), i.e. $\mu_x - \mu_y > 0$

As the sample sizes for both means were <30 , and the population variances were unknown, an upper-tail t-test was conducted at the significant level of 10% using R-studio. The p-value was found to be 0.0756. Since this is smaller than the significant level, there is sufficient evidence to reject the null hypothesis and infer that the average number of visitors post Circuit Breaker (Jun-Dec 2020) is greater than the average number of visitors before Circuit Breaker (Jan 2018-Mar 2020). This is understandable that during the post Circuit Breaker, people may not be able to travel overseas and try to find other possible places to visit where museums are one of possible options for them.

Hypothesis 2: Was the average number of visitors pre-Circuit Breaker lower than the average number of visitors prior to COVID-19, as more Singaporeans would have had to adhere to safe distancing measures or would have been more cautious about visiting public spaces?

H₀: Average Visitors Pre-Circuit Breaker (Jan -Mar 2020) greater than or equal to Average Visitors before COVID-19 (Jan 2018-Dec 2019), i.e. $\mu_x - \mu_y \geq 0$

H₁: Average Visitors Pre-Circuit Breaker (Jan -Mar 2020) greater than Average Visitors before COVID-19 (Jan 2018-Dec 2019), i.e. $\mu_x - \mu_y < 0$

As the sample sizes for both means were <30 , and the population variances were unknown, a lower-tail t-test was again conducted at the significant level of 10% using R-studio. The p-value was found to be 0.973. Since this is larger than 10%, we conclude that there is insufficient evidence to reject the null hypothesis. Hence, we are unable to conclude that the average number of visitors pre-Circuit Breaker (Jan-Mar 2020) was lower than the average number of visitors before COVID-19 (Jan 2018-Dec 2019). In other words, there is no significant difference in terms of the number of visitors in the past.

Hypothesis 3: Was the average number of youth visitors (aged 15-35) post-Circuit Breaker higher than before the Circuit Breaker?

H₀: Average No. of Youth Visitors Post Circuit Breaker (Jun-Dec 2020) less than or equal to Average Visitors before Circuit Breaker (Jan 2018-Mar 2020), i.e. $\mu_x - \mu_y \leq 0$

H₁: Average No. of Youth Visitors Post Circuit Breaker (Jun-Dec 2020) greater than Average Visitors before Circuit Breaker (Jan 2018-Mar 2020), i.e. $\mu_x - \mu_y > 0$

As mentioned in the earlier section that majority of visitors are young adults, we want to test whether any difference between before and after the Circuit Breaker. an upper-tail t-test was conducted at the significant level of 10%. The p-value was found to be 0.0517. Since this is smaller than the significant level, we can conclude that there is sufficient evidence to reject the null hypothesis and infer that the average number of youth visitors post Circuit Breaker (Jun-Dec 2020) is greater than the average number of visitors before Circuit Breaker (Jan 2018-Mar 2020). Compared with

the ALIS/UNIWA study, youths in Singapore appear to be keen supporters of museums in a time of COVID-19 and are aligned in their preference for in-person visits once it was feasible to do so.

Hypothesis 4: Was the average number of female visitors post-Circuit Breaker higher than before the Circuit Breaker?

H0: Average No. of Female Visitors Post Circuit Breaker (Jun-Dec 2020) less than or equal to Average Visitors before Circuit Breaker (Jan 2018-Mar 2020), i.e. $\mu_x - \mu_y \leq 0$

H1: Average No. of Female Visitors Post Circuit Breaker (Jun-Dec 2020) greater than Average Visitors before Circuit Breaker (Jan 2018-Mar 2020), i.e. $\mu_x - \mu_y > 0$

Here, we only focus on female visitors. With the same setting as other previous hypotheses,, we found that the p-value was 0.0763. Since this is smaller than the significant level of 10%, there is sufficient evidence to reject the null hypothesis and infer that the average number of female visitors post Circuit Breaker (Jun-Dec 2020) is greater than the average number of visitors before Circuit Breaker (Jan 2018-Mar 2020). This supports the earlier observation discussed in Section 5.2.

5.4 Inferential Statistics: Regression Analysis for Repeat Visitors

In this Section 5.4, we first built the multiple linear regression. Here, a multiple linear regression model with stepwise selection was performed with age and gender as independent variables and number of repeat visits as the response variable. Although the output of the stepwise regression determined gender Male to be the most significant, the overall R square value (0.0095) was very low which indicated an absence of a linear relationship, or that the selected independent variables may not be sufficient to explain the variation of the response variable. In conclusion, the result of this multiple linear regression is not sufficient to draw or support our conclusion.

We then focus on the logistic regression. It was performed to investigate if there was any association between the demographic variables and the likelihood of a repeat visit. Repeat visitors were assigned to the response '1' while non-repeat visitors were assigned to '0'. For gender, we formed the following hypothesis:

H0: There is no association between Repeat Visitor ship and Gender when controlling for Age

H1: There is an association between Repeat Visitor ship and Gender when controlling for Age

The output of the logistic regression indicated a small p-value 7.88e-14 for Gender Male which is less than the significant level 10%. In other words, we have sufficient statistical evidence to reject H0 and infer that there is an association between Repeat visitor ship and being Male. Further, being Male is positively associated with being a Repeat Visitor, as observed by the positive coefficient estimate of 0.06. This is an interesting observation that can be further study for future.

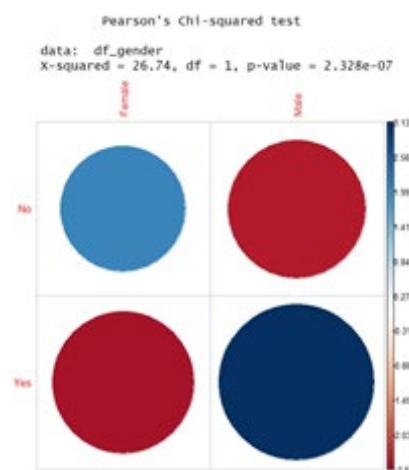


Figure 7. Chi-square testing of gender and repeat visits

Additionally, the chi-square statistical test was conducted to further understand the strength of association between gender and repeat visits. The output is shown in Figure 7. The p-value was smaller than the significant level 10%. We can conclude that there is sufficient evidence to reject the null hypothesis. As such it can be inferred that there is a positive association between male visitors and repeat visit. This is an interesting insight given that females made up the higher proportion of museum visitors compared with their population proportion.

Here, we observe that there are some limitations of the current work due to accessed dataset. Some possible future research work that can be considered are listed below:

- Given the data available, visitor ship was examined as an individual activity only. It may be useful to find a way to study visitors by the social groups that they were in during the visit, for example as a family, a couple, school trip or tour group.
- Variables that could potentially be better predictors than demographics e.g. income levels of visitors, the type of exhibition attended, and whether the ticket was paid or unpaid could be gathered to build a better predictive model for repeat visitor ship, extending from the logistic regression performed. Further studies can also be conducted into more specific characteristics of the male and female visitors that influence their probability of being repeat visitors.
- While the dataset provided a useful view of the impact of the early stages of COVID-19 in 2020, visitor ship patterns from the endemic phase (2022 onwards) might yield more stable results.
- To address the difference between the age distribution of museum visitors versus the national demographics, and assuming that the programming intent of NHB museums is to appeal to the broad spectrum of society, more studies and experimentation can be conducted to increase the appeal of specific museums to the lagging age groups.

6. Conclusion

Over 3.5 years, from June 2017 to December 2020, the trends in Singapore museum attendance have shifted. This study examines consumer behavior and identifies the factors that drive museum-goer demand. This includes the time from the commencement of COVID and the reopening after the stay-at-home measure. The scope of this paper was restricted to museums managed by the NHB. The findings of this study are helpful for comprehending local museum attendance trends by age and gender, as well as the impact of the COVID-19 outbreak. In this regard, it has provided us with crucial new information based on museum data in Singapore.

According to the study's findings, museums tend to draw a younger audience. This could represent Singaporeans' preferences or targeted programming. Female visitors predominated. Female visitors chose the museums C2, H2, and H3. While male visitors were underrepresented, they were more likely to return. The data also demonstrates a difference in museum visitor ship trends before and after the Circuit Breaker measure. Following a Circuit Breaker, the average number of visitors in the second half of 2020 was determined to be statistically greater than the average number of visitors prior to the COVID-19 start, particularly among teenagers and females. This suggests a growing preference for in-person museum visits following COVID-19 in Singapore.

On the basis of the findings of this article, museums could examine measures to increase their interaction with the young and female visitor segments, hence increasing their accessibility to neighboring tourist segments. Possible extensions of this work could include the addition of similar data from other museums and tourist attractions in Singapore to determine whether Singaporeans tend to visit the same destinations as part of their local tourism during the epidemic.

References

- Barrado- Timón, D. A. and Hidalgo-Giralt, C., The historic city, its transmission and perception via augmented reality and virtual reality and the use of the past as a resource for the present: a new era for urban cultural heritage and tourism?, *Sustainability*, vol. 11, no. 10, pp. 1-26, 2019.
- Bollo, A. and Pozzolo, L. D., Analysis of visitor behaviour inside the museum: an empirical study, 2005.
- Bounia, A., Nikiforidou A., Nikonanou, N. and Matossian A., *Voices from the museum: survey research in Europe's national museums*, Linköping University Interdisciplinary Studies, EuNaMus Report No 5, 2012.
- Emanuela, C., Tonino, P. and Massimiliano, V., Museum visitors' profiling in the experiential perspective, value co-creation and implications for museums and destinations: an exploratory study from Italy, *Proceedings of the Heritage, Tourism and Hospitality International Conference*, pp. 21-34, Pori, Finland, September 27-29, 2017.

- Kajzar, P., The impact of different factors on repeat visits to selected international tourism enterprises: case study from Chechia, *Frontier in Psychology*, vol. 13, 2022.
- King, E., Smith, M. P., Wilson P. F. and Williams, M. A., Digital responses of UK museum exhibitions to the COVID-19 crisis, March – June 2020, *The Museum Journal*, vol. 64, no. 3, pp. 487-504, 2021.
- Ong, S. F., Museum attendance on the rise as Singaporeans look homeward for leisure", Available: <https://www.straitstimes.com/life/arts/museum-attendance-on-the-rise-as-singaporeans-look-homeward-for-leisure#:~:text=SINGAPORE%20%2D%20Unable%20to%20travel%20out,number%20of%20visitors%20originally%20targeted>, February 5, 2021.
- Tan, A., Surveying and addressing COVID-19's impact on museums in Singapore, Available: <https://icom.museum/en/news/surveying-and-addressing-covid-19s-impact-on-museums-in-singapore/>, August 27, 2020.
- Tan, M. and Tan, C., Curating wellness during a pandemic in Singapore: Covid-19, museums, and digital imagination, *Public Health*, vol. 192, pp. 68-71, 2021.
- Tay, F., Wildlife parks, integrated resorts among attractions that can reopen from July 1: STB, Available: <https://www.straitstimes.com/singapore/wildlife-parks-integrated-resorts-among-attractions-to-reopen-from-july-1-stb>, June 28, 2020.
- Tranta, A., Alexandri, E. and Kyprianos, K., Young people and museums in the time of Covid-19, *Museum Management and Curatorship*, vol. 36, pp. 632-648, 2021.
- Yi, T., Lee, H. Y., Yum, J. and Lee, J. H., The influence of visitor-based social contextual information on visitors' museum experience, *PLoS ONE*, vol. 17, no. 5, 2022.

Biography

Aldy GUNAWAN is currently an assistant professor of computer science (practice) in School of Computing and Information Systems at Singapore Management University. He received his PhD in Industrial and Systems Engineering from the National University of Singapore in 2009. His main research interests include operations research, algorithm design and data analytics which relate to metaheuristics, algorithm configuration, design of experiments, combinatorial optimization and automated planning/scheduling. His past studies have been published in the top conferences and journals in Operations Research. He has been serving as a committee member of the Operational Research Society of Singapore since 2015.

Liu Chentao (Amber) is currently a Master of IT in Business (MITB) student at the School of Computing and Information Systems, Singapore Management University. She received her bachelor of science in Business Administration from Northeastern University in 2021. Her research interests focus on customer analytics and insights.

Heranshan Subramaniam is currently pursuing a Master of IT in Business (MITB) at School of Computing and Information Systems, Singapore Management University. He completed his Bachelor of Chemical and Biomolecular Engineering at the Nanyang Technological University in 2017. His interest lies in providing strategic business insights and problem-solving using data science and analytical methods.

Melissa Tan is currently completing her degree in the Master of IT in Business (MITB) programme, School of Computing and Information Systems, Singapore Management University. She is a public service professional with the Ministry of Community, Culture and Youth, Singapore. Her interests are in effectively applying digital strategy and data analytics to advance community and societal goals.

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Tasaporn Visawameteekul is a Master of IT in Business (MITB) student at Singapore Management University's School of Computing and Information Systems. In 2012, she graduated from Chulalongkorn University with a Bachelor of Electrical Engineering. She works in the upstream oil and gas industry as an electrical and instrument engineer. Her strength lies in applying her operational background and data analytical skill to create effective and high impact business solutions.