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Statistical and Grey Forecasting of the Inbound Tourism to Malawi

Ethel Matambo[1,*] | Matthews Nyasulu[2]

[1] *School of Business, Nanjing University of Information Science and Technology, Jiangsu, China*

[2] *School of Applied Meteorology, Nanjing University of Information Science and Technology, Jiangsu, China*

*Corresponding author: *ethelmatambo20@gmail.com*

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Abstract: Tourism is one of the fastest growing and complex industries in Malawi. This article is aimed at forecasting the future pattern of the tourism industry in Malawi from the year 2018 to 2028. The study has employed grey forecasting model EGM (1, 1, α, θ) to predict the future pattern of tourism based on the initial data sets sourced from the data base of the World Data over Malawi. The findings of this study showed that the grey forecasting model EGM (1, 1, α, θ) performed well in forecasting the future pattern of tourism by comparing with the linear regression and exponential regression. The forecast has revealed that the tourism industry will grow with an average of 20.84% by the year 2028 based on the current conditions. Following the present findings, the tourism industry should therefore continue improving the current conditions in order to attract more tourists. Furthermore, the industry should continue to supply tourism products and services that can satisfy the increasing demand of the international travel experiences as well as the future growing number such as constructing more standard hotels, proper transportation and communication.

Keywords: Tourism; grey forecast; grey system; grey model; linear regression; Malawi.

1. Introduction

Tourism refers to the temporary movement of people to a particular place either for leisure or work (Bhatia, 1982). Tourism is a significant contributor to the local gross domestic product in many countries (Bunghez, 2015). It generates foreign currency hence aids and supports foreign exchange reserves (Zhang *et al.*, 2021). Tourism also generates job opportunities to the local people of the visited places such as in hotel industries, entertainment, transportation as well as hospitality (Saluja *et al.*, 2022). Furthermore, it also provides an opportunity to the local people of the visited places to generate income through opening up small businesses such as selling of local handicraft items, artifacts to the tourist's also known as private income (Kharipzhanova & Irfan, 2022).

Several techniques have been put in place to develop and promote the tourism industry over the globe. Such techniques include improving hospitality, hotels, transportation as well as planning for the tourists. In addition, a critical analysis in understanding the patterns of tourism in relation to the available conditions is instrumental in improving or maintaining the tourism industry. This includes an assessment of historical as well as future patterns of the tourism (Song *et al.*, 2019; Goh & Law, 2011). In recent years, forecasting of the future tourism pattern has attracted attention

of many practitioners and researchers for the planning purposes. Several forecasting skills have also been developed to generate more accurate and reliable future tourism patterns such as State-Dependent Models (SDMs) (Priestley, 1980; Guan *et al.*, 2022) and Grey Forecast Model (Javed *et al.*, 2020a).

Tourism is mainly focused on visiting places around the world, experience their culture and traditions. Over Malawi, there is limited information about tourism from the pre-independence era, but the industry was recognized in the colonial era. The wildlife, culture and Lake Malawi (the third largest lake in Africa) are the main attractions from both domestic and international arrivals. Before 1995 this industry was presented by the department within the ministry of commerce and industry and in 1995 the ministry responsible for tourism was established. The portfolio of culture, water bodies and wildlife were then later added to the new designed ministry of tourism and culture, responsible for the marketing, development and planning (Bello *et al.*, 2014). Previous studies over Malawi have shown that sustaining the tourism industry is a continuous process and it requires introducing precautions, proper management and planning. This is done with the aim of decreasing the negative impacts and increasing the positive impacts. This includes having a mindset of sustaining nature such as wildlife to stay wildlife because without such proper precautions, nature such as animals is not well taken care of. Furthermore, it keeps the environment clean by making sure the tourists enjoy the good environment (Bello *et al.*, 2018). Most of the international tourists to Malawi come from within the region such as neighboring countries and European countries, for example United Kingdom.

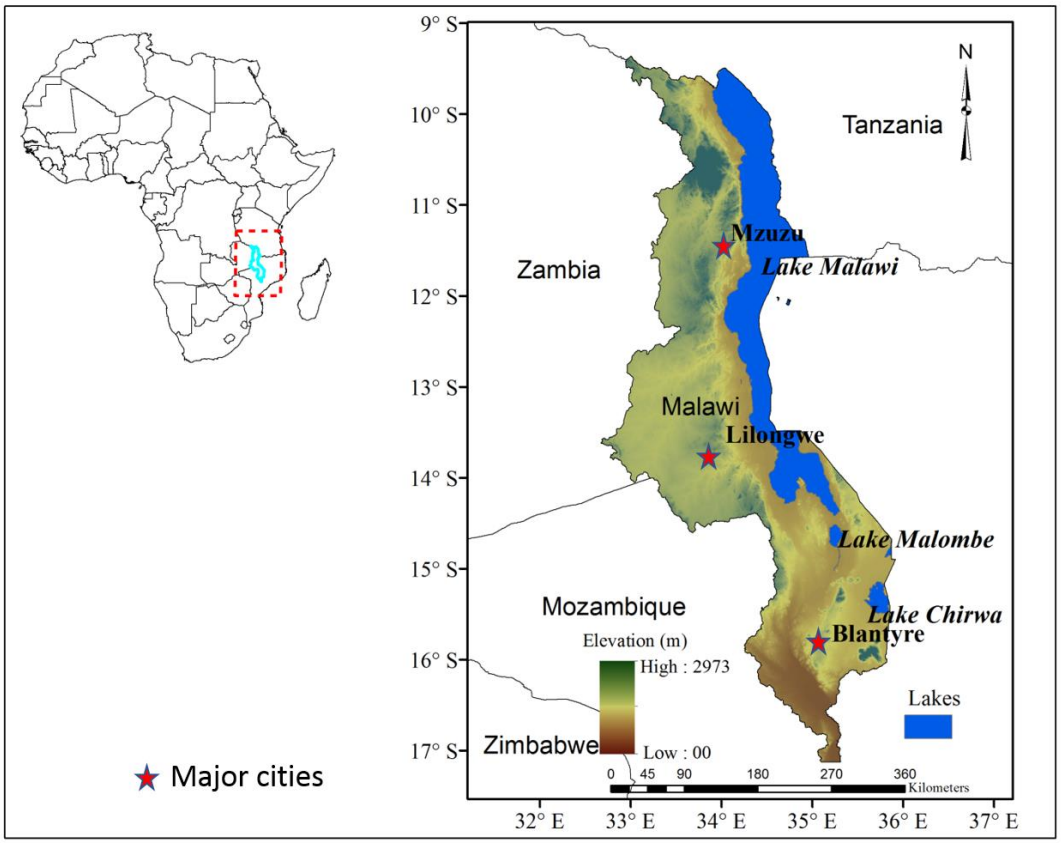
Malawi is one of the countries in southern Africa where tourism industry has played a huge role and is the second largest contributor to the nation's economy (MRA, 2022). On average, the tourism industry provides 24% of the country's gross domestic product (ADB, 2013). However, in 2019 the GDP% dropped to 7.7% signifying high fluctuation of influence of tourism to the country's GDP% (Knoema, 2022a; 2022b). Malawi has several tourist attractions sites such as Lake Malawi, several national parks such as Liwonde national park which tends to be the most leading tourism destination, game reserves and beautiful mountains such as Mulanje Mountain which is the highest mountain in Malawi located to the Southeast of Malawi. Malawi also attracts people for its unique cultural activities such as traditional dances like the gule wamkulu which is translated as "the big dance". There are several tribes with different cultural beliefs, and the major tribe is Chewa. Despite this industry's rapid growth, it has faced challenges such as limited platforms to advertise tourist places abroad. High cost to visit Malawi is another challenge as such it affects the number of tourists visiting the country annually. The country also has no information about the future patterns of tourism hence disrupt future planning purposes regarding the tourism industry. In this study, we utilize the historical data of the inbound tourists to Malawi and use the information to generate the near future forecast for the inbound tourists using the modern Grey forecast models. The findings from this are very crucial for future planning purposes and improve the tourism industry in Malawi.

The rest of the paper is structured as follows: Section 2 presents literature related to the present work, methods and the approach to the present work are highlighted in section 3. Results and discussions are given section 4 while section 5 summarizes the main conclusions drawn from this study.

2. Research design and methodology

2.1 Study area

Malawi (Figure 1) is a landlocked country with a geographical area of 118,484 square km. it shares boarders with Mozambique to the east and southwest, Zambia to the west and Tanzania to the north. Malawi has several tourist attractions while the wildlife and national parks are the most visited areas. The Liwonde national park which covers 548km is the largest and publicly managed by the national parks and wildlife (DNPW). This national park has built one of the top ranger forces and training grounds in the Southern Africa. It has the most advanced technology to protect



Source: The authors' own construct using ArcMap-GIS

Figure 1. Geographical location over Southern Africa and map of Malawi

and monitor its wildlife and management activities. Thousands of Malawians live around the Liwonde national park and depend on it as it creates jobs such as generating small businesses to the local people. Apart from the wildlife and national parks, Lake Malawi to the east, attracts many tourists each year.

2.2 Data and software

The study used total annual values of the inbound tourists defined as the total number of tourists that visit Malawi each year. The secondary data was collected from the WorldData (https://www.worlddata.info/africa/malawi/tourism.php). The data from 2010 to 2018 (Table 1) was used to build the model while the forecast horizon was from 2019 to 2028. More information about data collection can be accessed elsewhere. Data analysis including calculations and visualization were carried out using Microsoft Excel, Origin Lab and ArcMap of Geographical Information System (GIS).

2.3 Grey forecasting

Grey forecasting models are important part of the Grey System Theory, founded by Deng (1982). The models have seen their applications in various fields. They are effective for decision making and forecasting as they can be applied on environment where there is data scarcity (Carboni and Russu, 2014; Tian *et al.*, 2021). Furthermore, grey forecasting models have been considered as an interdisciplinary and intelligent techniques for exploring the pattern of variables that follow grey

Table 1. Data collected for the study

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
Number of tourists (1000s)	746	767	770	795	819	805	849	837	871

system, or uncertain pattern with partially known information such as inbound of tourists in tourism industry (Javed *et al.*, 2020a; Laksito and Yudiarta, 2021). We therefore observed that the application of grey forecasting model to understand the future pattern of tourism is suitable over Malawi, where data related to tourism is very uncertain and scare.

The model EGM (1, 1, α, θ) is a generalized form of the classical EGM (1,1) and was proposed by Javed *et al.* (2020b). Let the sequence of actual data expressed as (Javed *et al.*, 2020b):

$$x^{(\alpha)} = \left(x^{(\alpha)}(1), x^{(\alpha)}(2), \dots\ x^{(\alpha)}(n)\right)$$

where, $x^{(\alpha)}(k) = \sum_{i=1}^{k}(\frac{x^{(0)}(i)}{i^{1-\alpha}}), k = 1, 2, \dots, n, \alpha \in (0,1]$.

The adjacent neighbor average sequence of $x^{(1)}$ will be

$$Z^{(1)} = \left(Z^{(1)}(1), Z^{(1)}(2), \dots\ Z^{(1)}(n)\right)$$

where the background value $Z^{(1)}(k) = \theta . x^{(\alpha)}(k) + (1 - \theta). x^{(\alpha)}(k-1), \theta \in (0,1]$. The even form of GM (1,1), a first-order, single-variable grey forecasting model with parameters α and θ, is a continuous-time grey differential equation, defined as

$$\frac{dx^{(1)}(k)}{dk} + ax^{(1)}(k) = b$$

The inverse conformable fractional accumulation is executed through the following formula

$$\hat{x}^{(0)}(k) = k^{1-\alpha}\left(\hat{x}^{(\alpha)}(k) - \hat{x}^{(\alpha)}(k-1)\right), k = 1,2, \dots, n$$

And the time-response function of $x^{(0)}$ is given by

$$\hat{x}^{(0)}(k) = k^{1-\alpha}(1 - e^{a})\left(x^{(0)}(1) - \frac{b}{a}\right)e^{-a(k-1)}, k = 1, 2, \dots, n$$

The values of α and θ are estimated through an optimization technique available in Javed *et al.* (2020b). The EGM (1, 1, α, θ) is advantageous in such a way that it is able to change the parameters of α and θ since the data can have various shapes due to noise. This is different to the general EGM(1,1) because the parameters of the EGM (1, 1, α, θ) are dynamic and changes as the data varies, hence, easy to generate more precise forecast. For further information about the model and its properties, Javed *et al.* (2020b) can be read.

2.4 Statistical forecasting

For comparative analysis purpose, the study applied the linear and exponential regression models, which are popular statistical forecasting techniques. The linear and exponential models are respectively expressed as (Septyari, 2021)

$$y = bx + \varepsilon$$

and

$$y = e^{bx}$$

where y are the forecasted values, b is the constant and ε is residual (noise in the data). The models were run using the built-in functions available in Microsoft Excel.

2.5 Forecast error measurement

Mean Absolute Percentage Error (MAPE) is a popular metric in grey forecasting literature and is frequently used to compare the actual data with the simulation (Javed & Cudjoe, 2022; Wu *et al.*, 2022). For forecast error measurement, Mean Absolute Percentage Error (MAPE) was used as,

$$MAPE(\%) = \frac{1}{n} \times \sum_{k=1}^{n} \left| \frac{x(k) - \hat{x}(k)}{x(k)} \right| \times 100$$

where, $x(k)$ and $\hat{x}(k)$ are actual and forecasted data, respectively.

3. Results and discussion

The analysis on the performance of the model by comparing with the actual and the regression models is presented in Table 2. The results demonstrated that the EGM (1, 1, α, θ), hereby referred to as EGM, performed better than the regression models. The results from all models are likely to be accurate as the forecast error is less than 5% for all of them, however the EGM reported the lowest value of error.

It can be noted from the results that the mean absolute percentage error (MAPE) between the actual values and the model was 2.37%. The MAPE for the linear regression (LR) was 1.06% and for the exponential regression (ER) was 1.07% respectively in comparison to the actual values. Whereas MAPE between GEM and linear regression was 4.07% while between GEM and exponential regression was 3.23%. The observed MAPE values were generally low (<10%) signifying high accuracy in forecasting values as compared to the regression models and the actual values. The study hence utilized the EGM model to forecast the inbound tourists between the period of 2019 and 2028. The study found that the inbound tourism to Malawi in 2028 would be between 1,011,416 and 1,085,407.

Figure 2 shows the graphical representation of the forecasted values for regression models, EGM model and the actual values. The results have shown the number of tourists increased every year from the year 2010 to the year 2018. With the same precautions, the number is predicted to

Table 2. Forecast for inbound tourists to Malawi

Year	Actual Numbers	EGM (1,1,α,θ)	EGM (1,1)	Linear regression	Exponential regression
2010	746000	746000	746000	748022	749200
2011	767000	774445	764532	762655	762960
2012	770000	792762	778196	777288	776973
2013	795000	810280	792103	791921	791244
2014	819000	827497	806259	806554	805776
2015	805000	844636	820669	821187	820575
2016	849000	861817	835335	835820	835647
2017	837000	879113	850264	850453	850995
2018	871000	896574	865459	865086	866625
2019		914236	880926	879719	882542
2020		932125	896670	894352	898751
2021		950263	912695	908985	915258
2022		968666	929006	923618	932068
2023		987350	945609	938251	949187
2024		1006329	962508	952884	966621
2025		1025613	979710	967517	984374
2026		1045214	997219	982150	1002454
2027		1065142	1015041	996783	1020866
2028		1085407	1033181	1011416	1039615
MAPE (%)		1.04	1.14	1.06	1.07

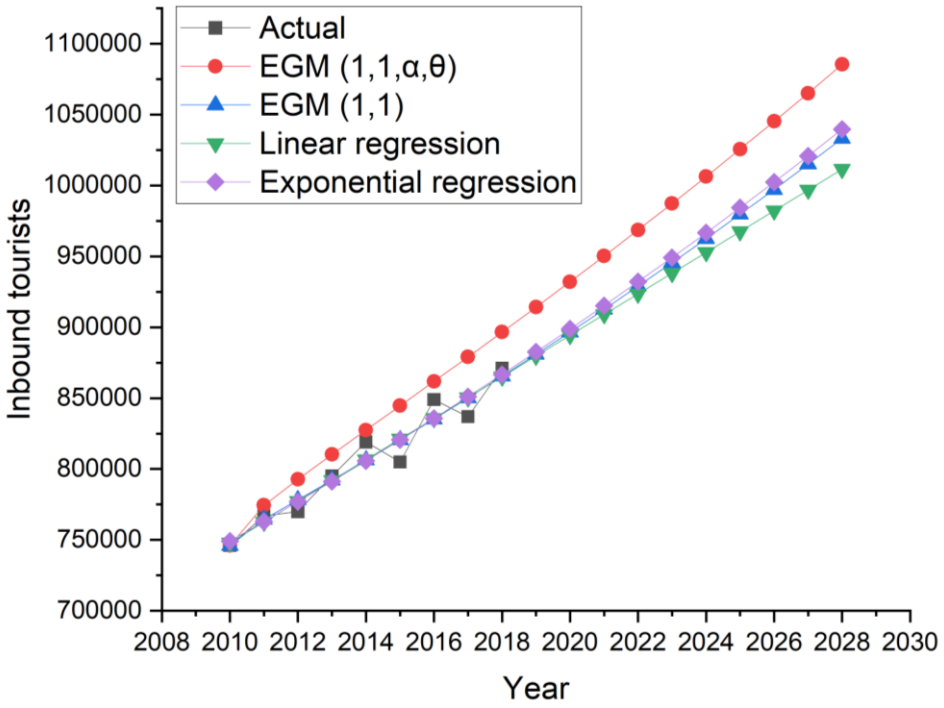


Figure 2. Forecast of inbound tourists to Malawi from grey and statistical methods

continue increasing by an average of 20.84% to the year 2028 as compared to 2010-2018 period. The observed increase in number of tourists implies that the conditions of tourism over Malawi are favorable hence the industry needs to maintain them. In addition, with the observed increasing trend, the country needs to concentrate on building more hotels to accommodate the increasing number of tourists to visit Malawi in the near future. Since tourism is a second major contributor to the total national GDP, the government can therefore take advantage of the increasing tourism industry to boost up national economy through proper management of income generated from tourism industry in the near future.

4. Conclusion and recommendations

The study has analysed future pattern of inbound tourists over Malawi using grey forecasting model. The findings have shown that the grey forecasting model can be reliable and utilized to forecast the future pattern of tourist inbound over Malawi. The results have clearly demonstrated that the tourism will likely increase in the next 6-years. The observed increase in tourist inbound signifies that the country should be more prepared to co contain the increasing number tourists. This may include proper planning such as construct enough and standard hotels to accommodate the tourists. Furthermore, the government should take advantage of the growing industry to boost country's economy through proper management of income generated from the tourism industry.

Below are some recommendations that can help increase the growth rate of tourism industry in the near future over Malawi:

(i) *Encourage operators to have more package trips*. Having package trips and having special offers would increase the marketing of a tourist area because they tend to be more affordable and the travelers do not have a difficult time trying to find a place or tour guide.

(ii) *Develop the tourism brand*. Branding is done to increase awareness and change of the image to meet the value of everyone. This is a very important thing for tourism destinations to do for marketing. It creates an identity for a destination and makes it famous.

(iii) *New attraction ideas*. Waiting for tourists to come does not generate interest. Finding new ways to make the stay of the travelers more comfortable and entertaining would

attract people to an area. This can be done by introducing different leisure activities or introducing a new marketing strategy that would want people to have an experience they would never forget over Malawi.

(iv) *Letting tourist become brand ambassadors.* In the current age social media has become one of the most successful advertising strategies. It is easy to get tourists to become brand ambassadors because most tourists want to share their experience on social media. Therefore, encouraging the travelers to create a personalized hashtag with a good comment review on their social media would get their friends, family members, work colleges and so on to have the interest of visiting the tourist attraction sites over Malawi.

References

ADB. (2013). *Malawi Country Strategy Paper 2013-2017*. African Development Bank. https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/2013-2017%20-%20Malawi%20-%20Country%20Strategy%20Paper.pdf.

Bello, F. G., Lovelock, B., & Carr, N. (2014). *Malawi, tourism*. In: Jafari, J., Xiao, H. (eds) Encyclopedia of Tourism. Springer, Cham. https://doi.org/10.1007/978-3-319-01669-6_658-1.

Bello, F. G., Lovelock, B., & Carr, N. (2018). Enhancing community participation in tourism planning associated with protected areas in developing countries: Lessons from Malawi. *Tourism and Hospitality Research*, *18*(3), 309–320. https://doi.org/10.1177/1467358416647763.

Bhatia, A. K. (1982). *Tourism Development: Principles and Practices*. New Delhi: Sterling Publishers.

Bunghez, C. L. (2015). *The importance of tourism to a destination's economy*. Proceedings of the 26th International Business Information Management Association Conference - Innovation Management and Sustainable Economic Competitive Advantage: From Regional Development to Global Growth, IBIMA 2015, 2016, 240–247. https://doi.org/10.5171/2016.143495

Carboni, O.A., & Russu, P. (2014). *Measuring Environmental and Economic Efficiency in Italy: An Application of the Malmquist-DEA and Grey Forecasting Model.* CRENoS, WP. https://crenos.unica.it/crenos/sites/default/files/WP14_01.pdf.

Deng, J. (1982). Control problems of grey systems. *Systems and Control Letters*, *1*(5), 288-294.

Goh, C., & Law, R. (2011). The methodological progress of tourism demand forecasting: A review of related literature. *Journal of Travel and Tourism Marketing*, *28*(3), 296–317. https://doi.org/10.1080/10548408.2011.562856

Guan, B., Silva, E. S., Hassani, H., & Heravi, S. (2022). Forecasting tourism growth with State-Dependent Models. *Annals of Tourism Research*, *94*, 103385. https://doi.org/10.1016/j.annals.2022.103385.

Javed, S. A., & Cudjoe, D. (2022). A novel Grey Forecasting of Greenhouse Gas Emissions from four Industries of China and India. *Sustainable Production and Consumption*, *29*, 777-790. https://doi.org/10.1016/j.spc.2021.11.017

Javed, S. A., Zhu, B., & Liu S. (2020b). Forecast of Biofuel Production and Consumption in Top CO2 Emitting Countries using a novel grey model. *Journal of Cleaner Production*, *276*, 123977. https://doi.org/10.1016/j.jclepro.2020.123997

Javed, S.A., Ikram, M., Tao, L., & Liu, S. (2020a). Forecasting Key Indicators of China's Inbound and Outbound Tourism: Optimistic-Pessimistic Method. *Grey Systems: Theory and Application*, *11*(2), 265-287. https://doi.org/10.1108/GS-12-2019-0064

Kharipzhanova, A., & Irfan, M. (2022). Evaluation of Barriers to Gilgit Baltistan's Travel & Tourism Industry: Pakistani Youth's Perception. *Management Science and Business Decisions*, *2*(1), 31–39. https://doi.org/10.52812/msbd.39

Knoema. (2022a). Malawi - Contribution of travel and tourism to GDP as a share of GDP.https://knoema.com/atlas/Malawi/topics/Tourism/Travel-and-Tourism-TotalContribution-to-GDP/Contribution-of-travel-and-tourism-to-GDP-percent-of-GDP.

Knoema. (2022b). *Malawi*. Knoema. https://knoema.com/atlas/Malawi/topics/Tourism

Laksito, I. Y., & Yudiarta, I. G. A. (2021). Grey Forecasting of Inbound Tourism to Bali and Financial Loses from the COVID-19. *International Journal of Grey Systems*, *1*(1), 48-57. https://doi.org/10.52812/ijgs.17

MRA. (2022). *Incentives for the tourism sector*. Malawi Revenue Authority. https://www.mra.mw/tax-update/incentives-for-the-tourism-sector

Priestley, M. (1980). Prediction based on a general class of non-linear models. *Technical report no. 126. Department of Mathematics*, UMIST.

Saluja, V., Anand, S., Kumar, H., & Peng, J. (2022). The perceived impact of tourism development and sustainable strategies for residents of Varkala, South India. *International Journal of Geoheritage and Parks*, *10*(2), 184–195. https://doi.org/10.1016/j.ijgeop.2022.03.003

Septyari, F. M. (2021). Grey Forecasting of the Exports of Indonesian Palm Oil to India. *International Journal of Grey Systems*, *1*(2), 33–41. https://doi.org/10.52812/ijgs.23

Song, H., Qiu, R. T. R., & Park, J. (2019). A review of research on tourism demand forecasting: Launching the Annals ofTourism Research Curated Collection on tourism demand forecasting. *Annals of Tourism Research*, *75*, 338–362. https://doi.org/10.1016/j.annals.2018.12.001

Tian, X., Wu, W., Ma, X., & Zhang, P. (2021). A new information priority accumulated grey model with hyperbolic sinusoidal term and its applications. *International Journal of Grey Systems*, *1*(2), 5-19. https://doi.org/10.52812/ijgs.27

Wu, W., Ma, X., Zhang, H., Tian, X., Zhang, G., & Zhang, P. (2022). A Conformable Fractional Discrete Grey Model CFDGM (1,1) and its Application. *International Journal of Grey Systems*, *2*(1), 5-15. https://doi.org/10.52812/ijgs.36

Zhang, H., Song, H., Wen, L., & Liu, C. (2021). Forecasting tourism recovery amid COVID-19. *Annals of Tourism Research*, *87*, 103–149. https://doi.org/10.1016/j.annals.2021.103149