A Comparison of Survival and Truncated Negative Binomial Models: Modelling Tourist Length of Stay in Sabah Using the Theory of Planned Behaviour

(Perbandingan Model Survival dan Model Binomial Negatif Terpangkas: Pemodelan Tempoh Penginapan Pelancong di Sabah Menggunakan Teori Tingkah Laku Terancang)

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ABSTRACT

In the present study, a comparative analysis was conducted between count-based and survival analysis models to understand the dynamics affecting the length of stay (LOS) of tourists in Sabah. In addition, the impacts of the socio-demographics, trip characteristics, theory of planned behaviour (TPB) and tourism activities on the LOS of tourists were examined. The data obtained from a survey of 725 departing tourists were analysed using a count-based truncated negative binomial (TNB) model and a survival analysis model. The factors of education level, income level, travelling with family, visiting friends and family, luxury accommodation, and full-board tour packages correlated with longer LOS. The comparative modelling approach provided a robust framework for the LOS analysis, demonstrating how different methods can yield holistic insights. These insights are valuable for tourism marketers to develop tailored packages targeting these specific segments. Most of the tourism activities had a positive impact on LOS, validating Sabah's offerings for extending the LOS of tourists.

ABSTRAK

Dalam kajian ini, analisis perbandingan dijalankan antara model berasaskan kiraan dan model analisis survival untuk memahami dinamik yang mempengaruhi tempoh penginapan (LOS) pelancong di Sabah. Di samping itu, kesan sosio-demografi, ciri-ciri perjalanan, teori tingkah laku terancang (TPB) dan aktiviti pelancongan terhadap LOS pelancong turut dikaji. Data yang diperoleh daripada tinjauan terhadap 725 orang pelancong yang sedia berlepas dianalisis menggunakan model binomial negatif terpangkas (TNB) berasaskan kiraan dan model analisis survival. Faktor tahap pendidikan, tahap pendapatan, bepergian bersama keluarga, melawat rakan dan keluarga, penginapan mewah, serta pakej pelancongan semua inklusif berkaitan dengan LOS yang lebih panjang. Pendekatan pemodelan perbandingan ini memberikan rangka kerja yang kukuh untuk analisis LOS, menunjukkan bagaimana kaedah yang berbeza dapat memberikan pemahaman yang holistik. Pemahaman ini amat bernilai bagi pemasar pelancongan untuk membangunkan pakej tersuai yang mensasarkan segmen khusus ini. Kebanyakan aktiviti pelancongan mempunyai kesan positif terhadap LOS, sekaligus mengesahkan daya tarikan Sabah bagi memanjangkan LOS pelancong.

JEL: C1, C5, M3, D7

INTRODUCTION

Length of stay (LOS), or the duration of a tourist's visit, is a critical metric in tourism due to its significant influence on the economy, tourists' experiences, and destination planning (Chen & Nijkamp 2018). A longer LOS correlates with increased expenditure and deeper engagement with the destination, enhancing both local revenue and tourist satisfaction (Gómez-Déniz & Perez-Rodriguez 2021; Pérez-Cabañero et al. 2017). The LOS of tourists at a destination is largely determined by their decision-making process, which is influenced by several factors, including travel purpose (Gozgor et al. 2021), planning and research (Prats et al. 2016), budget considerations (Aguiló et al. 2017), travel preferences (Alegre et al. 2011), and the overall appeal of the destination (Martínez-Roget et al. 2020). These interconnected elements shape how tourists plan their trips, ultimately impacting their LOS.

Extant studies have extensively examined the various determinants of LOS; however, most of these studies focused primarily on the socio-demographics of tourists and their trip characteristics, as well as the attributes of their destination (Alegre & Pou 2006; Gokovali et al. 2007; Thrane 2015). However, the internal, psychological factors that drive the intention of tourists to extend their LOS remain comparatively under-explored. While the theory of planned behaviour (TPB) has proven to be successful in predicting various tourist behaviours (Quintal et al. 2010), its application to model the specific behaviour of LOS decision-making is limited. For instance, a comprehensive review of LOS literature by Tay (2018) highlighted the scarcity of studies employing psychological frameworks like the TPB, noting a predominant focus on econometric models and tangible variables, thus establishing a clear theoretical gap. According to the TPB, behavioural intention is shaped by personal attitudes, subjective norms, and perceived behavioural control (PBC) (Ajzen & Fishbein 1977). Applying this to LOS, the decision of tourists to stay longer is likely influenced by their positive attitude towards the experience, social pressure from peers, and their perceived control over time and resources. Therefore, the present study

posits that it is crucial to integrate the psychological constructs of the TPB for a more holistic understanding of the determinants of LOS, thus addressing a significant oversight in the current literature.

The state of Sabah in Malaysia was selected as the research context for the present study due to its significant yet underperforming tourism economy, which presents a critical case for investigating the determinants of LOS. While Sabah boasts world-renowned natural attractions, its economic indicators reveal a strategic imperative to shift from focusing on tourist arrival numbers to maximising revenue per tourist. A primary lever for achieving this is to extend the average LOS, as underscored by the data. Although the average LOS for domestic tourists in Sabah showed a slight increase to 2.55 days in 2022, the overall trend has been relatively stagnant, averaging 2.45 days from 2008-2022 (Department of Statistics 2021). More critically, a comparative analysis highlighted a significant opportunity gap: in 2021, Sabah attracted 10.34 million domestic tourists, who generated receipts of USD 576 million, which is approximately USD 55.75 per tourist. In contrast, neighbouring Sarawak, with only 9.39 million tourist arrivals, generated USD 768 million in revenue, yielding a substantially higher revenue of USD 81.82 per tourist. This disparity clearly indicates that it is simply not enough to increase tourist numbers, but it is paramount that the value derived from each tourist is enhanced (Tay 2024). Since a longer LOS directly correlates with higher per-capita expenditure, understanding the factors that influence a tourist's decision on how long to stay in Sabah is not merely an academic exercise but a pressing economic priority for local stakeholders and policymakers.

Another gap in the LOS studies is the econometric issue, where LOS, being a dependent variable, presents statistical challenges (Archer & Shea 1975; Wurst 1955), such as overdispersion and zero inflation. The truncated negative binomial (TNB) model was used by Alén et al. (2014) to address these challenges by providing a flexible variance structure and focusing on non-zero outcomes. Survival models have also been used to overcome the statistical issues, which include censoring, for example, the data collected does not include the complete information on the LOS of all the subjects; the time-to-event analysis, where the event is the departure from the destination, as traditional count models may not adequately capture the timing aspect of LOS; and the non-normality of the data, because LOS data often does not follow a normal distribution, especially if there are many short LOS and a few long LOS, leading to skewed data (Aguilar & Díaz 2019; Alegre et al. 2011). Critics argue that using the TNB model may not be the most appropriate choice for analysing LOS, as it may oversimplify the complexity of the data and fail to account for the continuous nature of time (Aguilar & Díaz 2019; Barros et al. 2010). Nevertheless, survival models are plagued by theoretical and technical challenges when it comes to measuring LOS, according to Thrane (2015, 2012). Consequently, there is a pressing need for improved econometric methods for measuring LOS, but no superior alternative has emerged to date. In this context, Santos et al. (2015) suggested the use of models that are more theoretically robust. As such, this study combined survival models and the TNB model to identify the determinants of tourists' LOS in Sabah.

The present study was aimed at providing actionable insights specific to Sabah's context, which can inform targeted strategies to extend the LOS, thereby boosting tourism receipts and ensuring the sustainable economic development of the region's tourism sector. This study had three primary objectives: (i) to identify the key determinants of tourists' LOS in Sabah, incorporating both traditional factors and the psychological constructs of the TPB; (ii) to apply the TPB framework to model the intention behind tourists' LOS decisions; and (iii) to empirically compare the performance of a TNB model with survival analysis models, namely, the Cox proportional hazards model (CSA) and log-rank test (LSA) model, to determine the most robust approach with which to analyse LOS data.

DETERMINANTS OF LENGTH OF STAY (LOS)

SOCIO-DEMOGRAPHIC FACTORS

Socio-demographic factors, such as age, gender, marital status, education level, income level, and type of tourists, significantly influence tourists' LOS. Martínez-Garcia and Raya (2008), Peypoch et al. (2012), and Thrane and Farstad (2011) have consistently emphasised that age is a crucial determinant of tourists' LOS, with seniors often tending to have longer trips. This trend may stem from seniors having more time for travel and potentially greater financial resources (Alén et al. 2014). However, having a health condition can reverse and negatively affect this correlation (Fleischer & Pizam 2002). In terms of gender, male tourists tend to stay longer than female tourists (Barros & Machado 2010; Peypoch et al. 2012), while single individuals stay longer as they may have more flexibility (Tay et al. 2022). Although married couples may have more financial resources, their LOS may be influenced by family considerations, potentially leading to shorter LOS (De Menezes et al. 2008). The education level of tourists may impact their LOS in terms of cultural enrichment. For instance, higher education levels have been found to correlate with a greater interest in exploring a destination and participating in educational activities, consequently, leading to longer LOS (Barros & Machado 2010). However, this correlation may vary, as some well-educated individuals may prefer making shorter, more frequent trips (Aguilar & Díaz 2019).

In the traditional view, LOS negatively correlates with overall spending and daily accommodation costs, but positively correlates with income levels (Lancaster, 1966; Rosen, 1974). In a broader context, the literature suggests that price, income, and travel budget collectively shape the financial constraints of planning a vacation. Generally, tourists with higher income levels have longer LOS, with accommodation costs serving as a proxy for their economic capacity (Wang et al. 2012). International tourists are more likely to extend their LOS to offset their high transportation costs (Kreeger et al. 2025; Mak et al. 1977). These inconsistencies suggest that socio-demographic differences may affect tourists' LOS at a destination differently.

TRIP CHARACTERISTICS

Trip characteristics, comprised of familiarity with a destination via repeat visits, accommodation type, purpose, sources of information, and travel mode, are a pivotal determinant of LOS. First-time tourists often express a greater desire to explore new destinations (Brida et al. 2013). Repeat visits increase tourists' familiarity with a destination, which, in turn, encourages them to extend their LOS to engage in more tourism activities (Gokovali et al. 2007). Tourists prioritise visiting major tourist attractions during their first visit, but broaden their planned tourism activities with repeat visits (Barros & Machado 2010). Repeat visits are significant as a second visit indicates tourist satisfaction with a destination, while subsequent visits indicate loyalty to the destination, both of which correlate with longer LOS (Kozak & Rimmington 2000).

The choice of accommodation has a significant impact on LOS. For instance, the LOS of tourists staying at homestays or hotels is shorter than that of tourists staying at apartments and villas (Alegre & Pou 2006). The LOS of tourists staying at 1- or 2-star hotels and homestays is longer than those staying at higher category hotels (Aguilar & Díaz 2019). Interestingly, the hotel category, such as 3-, 4-, or 5-star hotels, does not significantly affect the LOS (Martínez-Garcia & Raya 2008). The purpose of the trip significantly influences the LOS. According to Alén et al. (2014), tourists who desire to visit friends and family often stay at their homes, thereby saving on accommodation costs, and allocate larger budgets for an extended LOS (Santos et al. 2015). Conversely, Rodríguez et al. (2018) argued that individuals travelling for business purposes have the longest LOS, while Martínez-Garcia and Raya (2008) found that travel purpose has an insignificant effect on LOS.

When individuals spend more time seeking information and using different sources of information, they tend to stay longer (Richards 2002). However, Luo et al. (2004) reported insignificant differences in the LOS of tourists who used the Internet and those who relied on other sources of information. These discrepancies highlight the complex correlation between information channels and LOS. In terms of travel companions, solo travellers are more likely to prolong their LOS at a destination (Alén et al. 2014; Lawson 1991), while those travelling with their families have shorter LOS than solo travellers or those travelling with friends, due to the costs involved (Mak et al. 1977). Apart from that, the higher trip expenses and inflexibility that come with travelling with a larger group may also cause individuals to opt for shorter LOS. Typically, the LOS decreases as the group size increases, probably due to the financial limitations that come with travelling with a larger group.

In terms of mode of travel, tourists who choose full-board packages are less likely to stay longer than those who choose half-board accommodation (Gokovali et al. 2007), while fully independent travellers are more likely to stay at a destination longer than those who choose tour packages (Alegre & Pou 2006; Alén et al. 2014). However, Alegre et al. (2011) reported that tourists who choose full-board tour packages stay for a significantly longer period as they do not need to plan their itinerary. Therefore, trip characteristics influence LOS, but their impact varies depending on the destination.

TOURISM ACTIVITIES

Extant studies have focused on the impact of destination attributes on LOS (Martínez et al. 2020; Salmasi et al. 2012; Scholtz et al. 2015). However, it is evident that these attributes primarily influence tourists' intention to visit rather than their decision on LOS (Liew et al. 2021). The determinants of LOS should be centred on the tourism activities offered by a destination and which can be participated in during a tourist's LOS. Therefore, the present study focused on the tourism activities offered in Sabah rather than examining the destination attributes. The tourism activities provided at a destination significantly shape the decision on LOS (Jang et al. 2005; Littrell et al. 2004). Destinations that offer diverse and engaging tourism activities may increase tourists' LOS, especially if they offer immersive experiences that align with the tourists' travel purpose (Brida et al. 2013). These findings suggest that tourists who are motivated by a strong interest in what a destination has to offer may extend their LOS.

THE THEORY OF PLANNED BEHAVIOUR (TPB)

The TPB highlights a causal chain, wherein behavioural beliefs, normative beliefs, and control beliefs influence behaviour (Ajzen 1991). This suggests that the decision of tourists regarding LOS is influenced by their expectations of positive outcomes, approval from their significant others, and their available resources (Montano & Kasprzyk 2008). Tourists' attitudes toward a destination significantly influence their LOS (Vieira et al. 2021). For example, if tourists feel that they are getting value for their money or enjoying unique experiences, they may decide to extend their LOS. Emotional bonds are often reinforced by positive social proofs, such as recommendations by friends and families or reviews from social media, which can persuade tourists to stay longer than initially planned (Gokovali et al. 2007; Prats et al. 2016).

Perceived behavioural control (PBC) underscores the importance of perceived ease or difficulty due to resource availability or constraints, which have been empirically linked to LOS (Muzenda 2019). This perception is influenced by control beliefs about the factors that may facilitate or hinder a behaviour, such as the available resources or situational constraints, and the perceived power of these factors to affect that behaviour, in this case, LOS (Ajzen 2002). For example, tourists' perceptions of their financial resources, time availability, and logistical support may significantly influence their decision about how long they feel they can afford to stay at a destination. Therefore, the present study examined the effects of three intrinsic factors on LOS.

METHODOLOGY

The present study was grounded in the TPB, which provided the conceptual framework for investigating the determinants of LOS. To empirically test this framework, LOS was operationalised as the total number of nights a tourist spends in Sabah, from arrival to departure. A self-administered questionnaire was used to collect the necessary data due to its advantages, such as comprehensive data collection on trip characteristics, the guarantee of anonymity, and cost-effectiveness (Mitchell & Jolley 2009). The questionnaire comprised six sections: (1) trip characteristics, namely, familiarity (first time visit or repeat trip), accommodation, motives, information sources, and travel companions; (2) travel mode: tourism activities, which were rated on a Likert scale (1. Not a priority … 5. Absolutely Essential); (3) attitudes (*how do you feel about Sabah*); (4) subjective norms (*whose suggestion would make you stay longer in Sabah*); (5) control beliefs (*factors that facilitate or hinder your ability to stay longer in Sabah*); and (6) tourists' socio-demographic details, namely, country of residence, gender, age, income level, marital status, and education level. The questionnaire was developed in English, translated into Malay and Mandarin, and then pilot tested before the data collection. The measurement items are presented in Appendix 1.

The data collection was conducted at the airports in Kota Kinabalu (KKIA), Sandakan (SDK), and Tawau (TWU), Sabah, between 30 January to 20 March 2023. The selection of these three airports was critical for achieving a representative sample of tourists visiting Sabah. As the primary international gateway, KKIA handles the vast majority of tourist arrivals, while SDK and TWU serve key tourism zones in Eastern Sabah (notably wildlife destinations like Sepilok and Semporna's diving islands). Together, the selection of these three airports ensured that the sample captured diverse travel itineraries and avoided a bias towards only the capital city's tourists. This approach provided a more comprehensive picture of the determinants of LOS across Sabah's different tourism offerings. Stratified and convenience sampling were used to select the sample for the present study. Formal approval was obtained from the airports before the survey was conducted at the departure halls or boarding gate areas. The tourists were surveyed at the boarding gate area to minimise sample bias and ensure that the respondents had completed their trip. Tourists travelling by car or bus from Sarawak were excluded. The population included tourists travelling to Sabah, and stratified random sampling was employed based on origin (domestic or international). A total of 725 questionnaires were collected from KKIA (69%), TWU (17%), and SDK (14%).

The present study employed a dual-model rather than a single-model approach, combining a TNB model with a survival analysis (Almeida et al. 2021). The TNB model is specifically designed for count data, where the variance exceeds the mean (over-dispersion). This is a common feature of LOS data, where most tourists have short LOS, but a few have very long LOS (Brida et al. 2013). It effectively models the number of nights stayed as a count, focusing only on positive values (hence, "truncated" at zero). A survival analysis models the time until an event occurs, in this case, the tourist's departure. This framework is inherently suitable for modelling duration data such as LOS (Tay et al. 2022). A key advantage is its natural ability to handle various data complexities. For the present study, the CSA model was selected due to its flexibility, as it does not require assumptions about the underlying shape of the hazard function.

MODEL SPECIFICATION

The TNB model was specified as follows:

$$P(Y_{LOS} = y \mid X_{Demo \cdot TC \cdot Act}) = \frac{\Gamma(y + \alpha)}{\Gamma(\alpha)y!} \left(\frac{\alpha}{\alpha + \mu e^{x\beta}}\right)^{\alpha} \left(\frac{\mu e^{x\beta}}{\alpha + \mu e^{x\beta}}\right)^{y}$$

where, Y is the number of variables affecting LOS and X refers to the socio-demographic data, trip characteristics, tourism activities, attitudes, subjective norms, and PBC-related variables. The equation involved the gamma function (Γ), the over-dispersion parameter (α), the mean parameter (μ), the coefficient (β) associated with the $X_{Demo \cdot TC \cdot Act}$., the base of the natural logarithm (e), and the factorial function (*!*).

In survival analysis, the hazard function h(t) represents the instantaneous probability of departure at time (t), given that the tourist has stayed until t. The CSA model is expressed as:

$$H(t) = h_0(t_{LOS}) \cdot \exp(\beta_{Demo} \cdot Demo + \beta_{TC} \cdot TC + \beta_{Act} \cdot Act)$$

Where, h(t) is the hazard rate (HR) at LOS t, h_0(t) is the baseline hazard function, and exp(β_{Demo}, β_{TC}, and β_{Act}) are the coefficients to be estimated. A positive coefficient β indicates an increase in the HR, which translates into a higher probability of leaving, which corresponds to a shorter LOS. Meanwhile, a negative β indicates a decrease in the HR, which translates into a lower probability of leaving, which corresponds to a longer LOS. To validate the suitability of the CSA model, several parametric models, such as the Weibull model and the LSA model, were also examined. The LSA model was the best fit as it yielded the lowest Akaike information criterion (AIC) value, suggesting a hazard function that initially increases before decreasing.

RESULTS AND DISCUSSION

Appendix 1 displays the results of the descriptive analysis of the measurement items, encompassing the labels of the variables, minimum and maximum values, frequency, percentage, mean, and standard deviation. The model selection, based on the lowest AIC values in Appendix 2, confirmed that the LSA model was the best fit for the data across all the variables (socio-demographics, trip characteristics, tourism activities, TPB). This indicated that the hazard of departure, which was the probability of a tourist leaving, initially increased, peaked, and then decreased over time, and this pattern was well-suited to tourists' LOS. However, the results from the TNB, CSA and LSA models in Appendix 3 were used for comparability and interpretability. The following discussion integrates these results, focusing on the robust findings that were consistent across the models while critically examining the insights provided by their differing perspectives.

The comparative modelling approach was a core contribution of the present study. While both the TNB and survival models identified similar key determinants, they offered complementary interpretations. The TNB model estimated the inter-rater reliability (IRR), which indicated the multiplicative change in the expected count of nights stayed for a one-unit change in a predictor. An IRR of > 1 signifies a longer LOS. The CSA model estimated the HR, which represented a change in the instantaneous risk of departure. An HR of < 1 signifies a longer LOS, as the hazard of leaving is reduced. For example, the IRR of the full-board tour packages (TM1) variable was 1.21 (TNB) and 0.73 (CSA). The TNB result suggested that, on average, tourists on full-board packages stayed 21% longer than those who were not. The survival analysis result indicated that these tourists had a 27% lower risk of ending their trip on any given day. This dual confirmation strengthened the validity of the finding. The survival framework is often more intuitive for duration data, as it directly models the timing of the event (departure). The superior fit of the LSA model (Table 2) further validated that the LOS in Sabah followed a non-monotonic pattern, which simpler models, such as the exponential, were unable to capture as effectively.

For the socio-demographic variables, age negatively affected the LOS, indicating that older tourists had shorter LOS. This might have been due to logistical considerations, such as mobility and health, which may explain their preference for shorter LOS (Fleischer & Pizam, 2002). However, it is important to note that the HR was very close to 1.00, suggesting a very small increase in the risk associated with each unit increase in age. Gender and marital status did not significantly influence LOS. Conversely, previous studies mostly reported significant correlations between gender (Peypoch et al. 2012), marital status (Tay et al. 2022), and LOS. Education level significantly influenced LOS, with lower education levels linked to shorter LOS, supporting the findings of Barros and Machado (2010). The finding suggested that tourists with higher education might have been more inclined to engage in longer LOS. This could be due to a variety of factors, including greater financial resources, more flexible work schedules, and a heightened awareness of travel opportunities (Eugenio-Martin & Campos-Soria 2011). Therefore, tourism providers should consider educational background when designing marketing strategies. Tourists of higher-educational status may seek more enriching experiences, such as cultural and educational activities, which may encourage longer LOS (Brida et al. 2013).

The finding that higher-income tourists tended to have longer LOS aligned with common assumptions in tourism research (Barros & Machado 2010; Martínez-Garcia & Raya 2008; Wang et al. 2012), which suggest that individuals with greater financial resources have more flexibility and opportunities for longer LOS. This correlation may be attributed to several factors, such as higher-income travellers often having the means to afford luxurious accommodations, exclusive experiences, and extended itineraries that encourage deeper engagement with the destination (Gómez-Déniz & Perez-Rodriguez 2021). Consistent with economic theory, a higher median income strongly correlated with a longer LOS (IRR=1.10, HR=0.88). Sabah should continue to develop and market high-yield tourism products, such as luxury eco-resorts and exclusive wildlife tours, to capitalise on this segment. Furthermore, the international tourists demonstrated a significantly longer LOS (IRR=1.21, HR=0.72), likely to amortise high travel costs. This underscored a critical strategic priority, namely that securing more direct international flights and streamlining visa processes are not just about increasing arrivals but are essential for maximising the economic contribution per tourist.

Familiarity with a destination had a positive and significant impact on LOS. It implied that tourists who make repeat visits to Sabah tend to stay longer (De Menezes et al. 2008). Given the positive correlation between familiarity and LOS, Sabah's tourism stakeholders should focus on strategies that encourage repeat visits. This could include developing loyalty programmes, offering discounts or special packages for returning tourists, and promoting new attractions or experiences to entice previous tourists back (Albaity & Melhem 2017). Contrary to some previous studies, accommodation in 4- or 5-star hotels (ACC1) was linked to longer LOS (IRR=1.23, HR=0.71), while budget accommodations (ACC3, ACC4) correlated with shorter LOS. This finding contrasts with those of most previous studies (Aguilar & Díaz 2019; Alén et al. 2014), indicating that tourists typically curb accommodation costs to extend their LOS. This suggests a market shift, where luxury is no longer a barrier to LOS, but an enabler. Tourism stakeholders should move beyond the assumption that budget tourists stay the longest. Investment in and promotion of high-quality accommodation should be framed as a strategy for increasing LOS and revenue, not just the average daily rate.

The purpose of the visit yielded critical insights. Travellers visiting friends and family and those pursuing education had longer LOS. Sabah can foster these segments by creating visiting friends and family-plus packages that offer tourism activities for entire families and by strengthening its position as a hub for educational tourism, such as promoting marine biology field courses and rainforest ecology programmes. Conversely, the shorter LOS of business travellers (MOTIVE2) presents an opportunity (Hateftabar & Chapuis 2020) to develop targeted leisure, a portmanteau of business and leisure

packages that offer easy-to-book, half-day excursions or weekend extensions, convincing business travellers to extend their LOS (Atsız et al. 2022). A pivotal finding was the negative impact of information from friends and relatives, the Internet and social media (INFO1, INFO2) on LOS. This indicated that pre-trip information may lead to highly efficient, condensed itineraries focused on must-see highlights (Prats et al. 2016). Marketing must pivot from simply promoting attractions to strategically promoting the value of a longer LOS. Campaigns should theme experiences by duration to structure and justify extended LOS, showcasing depths beyond the iconic attractions.

All the travel modes examined were significant, with only the full-board tour package showing a positive effect on LOS. Public transportation in Sabah posed significant challenges for fully independent or half-board travellers (Li et al. 2023). The ease of travel and transportation cost between destinations were crucial factors that impacted LOS. Therefore, to increase the LOS, it is essential to improve Sabah's transportation system and enhance connectivity between various attractions (Besar et al. 2020). Smoother travel experiences for all tourists will be facilitated by addressing accessibility and connectivity issues, ultimately contributing to longer LOS in Sabah. The significant correlation between tourist preferences for various tourism activities and LOS in Sabah highlighted the need to diversify and promote a wide range of experiences to attract tourists. Tourists who prioritise local cultural experiences, outdoor activities, water sports, nightlife, wildlife exploration, golfing, homestays, wellness-based activities, and luxury experiences are more likely to extend their LOS. The focus should be on creating and marketing integrated experience bundles. Instead of selling isolated tourism activities, operators should create multi-day circuits, for example, a 5-day culture and nature circuit combining ACT4, ACT5, and ACT6, that naturally encourage longer bookings (Atsız et al. 2022; Gemar et al. 2022).

The TPB constructs provided powerful psychological insights. Positive attitudes (ATT3, ATT5) and high PBC over time, resources, and opportunities were consistently linked to extended LOS (Borges et al. 2020). Marketing communications should actively shape positive attitudes by using an emotive language that emphasises value, uniqueness, and enjoyment. Furthermore, marketers can enhance the PBC by providing clear information to mitigate perceived barriers, such as showcasing easy inter-city transport options, full-board packages, and flexible booking policies, to empower tourists to feel that extending their LOS is easy and manageable. Interestingly, contrary to expectations, recommendations from friends who had visited Sabah (SN2) had a negative effect (Gokovali et al. 2007). This warrants further investigation but suggests that word-of-mouth may sometimes set unrealistic expectations or highlight limitations. Destination management should actively manage post-visit engagements, encouraging satisfied tourists to share comprehensive, positive stories through referral programmes or targeted social media campaigns.

THEORETICAL AND PRACTICAL IMPLICATIONS

Various analysis models were utilised due to the intricate nature of tourists' LOS. However, a notable gap in the literature exists on direct comparisons between traditional count-based models, such as the TNB model (Alén et al. 2014; Brida et al. 2013), and time-to-event analyses, such as the CSA and LSA survival models (Aguilar & Díaz 2019; Barros et al. 2010; Barros & Machado 2010). The present study addressed this gap by examining and contrasting the insights provided by the TNB, CSA, and LSA models. The goal was to enhance the understanding of the determinants influencing LOS and offer a perspective that accommodates both count-based occurrences and the temporal aspect of tourists' LOS. The consistency in the direction of the coefficients in the TNB, CSA, and LSA models indicated the robustness of the findings of the present study.

The negative correlation between LOS and age in Sabah may be attributed to the region's focus on promoting nature and adventure tourism, which may not be as appealing or suitable for older tourists (Malaysia Tourism Promotion Board, 2024). Many individuals in this demographic, often referred to as "quality tourists", tend to prefer more luxurious experiences that cater to their specific needs. This calls for the development and marketing of accessible luxury packages that combine high-comfort accommodations, such as resorts with spas, seamless transportation to key nature sites, and curated experiences, such as private cultural tours or wellness retreats (Mohamed et al. 2016). At the same time, there should be a move beyond strenuous adventure to cater to the older demographic's preference for comfort and immersion.

Socio-demographic factors, such as education level, income level, and travel with family, substantially influenced the LOS of tourists in Sabah. These results underscored the need for tourism businesses to tailor and market products and services that meet the diverse preferences of different demographics. For instance, premium, extended-length packages should be created for high-income and international tourists. These should be full-board and bundled luxury stays with exclusive access to tourism activities such as private wildlife tours and premium diving slots. Marketing campaigns for culturally-rich and educational tourism activities, such as heritage trails and conservation workshops, should be targeted specifically at those with higher-educated demographics.

The trip characteristics revealed that tourists staying at 4- or 5-star hotels tended to stay longer than those in lower-tier accommodations. High-tier hotels are, therefore, advised to offer exclusive luxury tourism packages with longer LOS. Apart from that, tour operators could strategically design and promote longer full-board packages and special interest tours. For example, Sabah's popular bird-watching tours could attract enthusiasts and increase the LOS. Special-interest tours like birdwatching, scuba diving, or rainforest photography could be actively promoted as multi-day, dedicated packages to attract niche markets with inherently longer LOS.

With Sabah's emerging meetings, incentives, conferences, and exhibitions (MICE) industry, exemplified by the establishment of the Sabah International Convention Centre (SICC), which can cater for up to 20000 delegates (SICC 2023), packages should be tailored for business associates or colleagues, and business-friendly amenities, meeting facilities, and networking opportunities should be developed. "Bleisure" (Business-Leisure) packages should be designed to offer MICE attendees discounted extensions to their LOS. These should include post-conference tours, family-based tourism activities and access to wellness- or adventure-based tourism activities to encourage longer LOS.

Additionally, tourism activities that involved experiencing the local food and culture, sightseeing in the city, nightlife, participating in outdoor tourism activities, sports, water sports, and wellness-based tourism activities, wildlife exploration, as well as homestays and luxury experiences, considerably increased the tourists' LOS in Sabah. These findings emphasised the importance of considering specific tourist characteristics and tourism activities when shaping regional tourism strategies (Mammadova & Abdullayev 2025). Tourism activities that directly correlate with longer LOS must be strategically packaged and promoted. These include cultural experiences, such as homestays and local cuisine workshops, wellness-based tourism activities, such as yoga retreats and spa treatments, and dedicated wildlife explorations, such as multi-day river safaris and jungle trekking.

A positive attitude towards Sabah can enhance LOS, prompting tourism stakeholders to implement practical strategies to improve tourists' experiences. These strategies include investing in quality customer service training, developing diverse tourism activities that cater to various interests and creating targeted marketing campaigns that highlight Sabah's unique attractions. However, subjective norms did not appear to affect LOS, a finding that was surprising given that many studies have established the influence of suggestions from influencers on tourists' intentions (Magno & Cassia 2018; Seçilmiş et al. 2022). The present study revealed that while influencers effectively attracted tourists to a destination (Guerreiro et al. 2017), they did not significantly impact their LOS.

Tourists' perceptions of control, specifically regarding autonomy, resources, time, and opportunities, clearly influenced their decision to extend their LOS in Sabah. This underscored the importance of PBC, as suggested by the TPB, in shaping tourist behaviours (Ajzen 2002). A centralised digital platform should be developed to provide clear information on affordable lodgings, transportation passes, and flexible tour options to reduce planning friction and make tourists feel more in control (Deely et al. 2022). Furthermore, direct financial incentives can be implemented for longer LOS, such as "stay 4 nights, get 1 free" offers, discounted multi-attraction passes, or loyalty rewards for extended bookings.

LIMITATIONS AND RECOMMENDATIONS FOR FUTURE STUDIES

The differences in the significance of the determinants across the TNB, CSA, and LSA models underscored the inherent complexity of modelling LOS and affirmed the value of a multi-model approach. A primary limitation of the present study, however, stemmed from its cross-sectional design. While this approach is effective for identifying correlations at a single point in time, it cannot capture the dynamic decision-making process that unfolds during a trip. For instance, a tourist's initial intention to stay for a short LOS may be extended due to a spontaneous discovery or a positive on-site experience, factors that a single post-trip survey cannot adequately measure. Consequently, the findings of the present study reflected the factors associated with the final LOS, but were unable to establish causality or reveal how perceptions of control, attitudes, or social influences evolve from planning to departure. To address this, future research should adopt longitudinal methods. This could involve panel surveys that track the same tourists at multiple stages, such as pre-trip to capture intentions, during the trip to track changes in plans and perceptions, and post-trip to record the final LOS. Experience sampling methods using mobile applications to prompt tourists daily about their tourism activities, satisfaction, and evolving intentions to stay, can provide a fine-grained view of behavioural dynamics. Secondly, while the present study found that subjective norms and influencers did not significantly impact LOS, the reasons behind this were unclear and warrant further qualitative exploration. This gap suggests a need for mixed-methods research, where in-depth interviews or focus groups could uncover why certain social influences fail to alter LOS despite their prevalence in marketing. By combining a robust multi-model analysis with longitudinal and qualitative designs, future research can move beyond identifying correlations to building a causal and process-oriented understanding of LOS decisions.

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TABLE 1. Measurement items

Variables (N=725)	Label	Min	Max	feq	%	Mean	SD
LOS in Sabah (nights)	LOI	1	90			6.08	4.67
1-3				154	21.24		
4-6				351	48.41		
7-9				126	17.38		
>10				94	12.97		
Age (years old)	Age	18	70	-	-	37.34	10.56
Gender	Gender	1	2			-	-
1. Male				352	48.55		
2. Female				373	51.45		
Marital Status	MS	1	2			1.69	.46
1. Single/widowed				223	30.76		
2. Married/In the relationship				502	69.24		
Level of education	LOE	1	5			2.38	.81
1. Higher Degree – Master/PhD				59	8.14		
2. Tertiary Education – Diploma/Degree				422	58.21		
3. Secondary/High School Education				157	21.66		
4. Primary/Elementary Education				83	11.45		
5. No Formal Education				4	.55		
Average monthly income (USD)	AMI	1	5			2.42	1.20
1. Less than 680				200	27.59		
2. 684-1040				207	28.55		
3. 1041-1520				184	25.38		
4. 1521-2350				85	11.72		
5. More than 2351				49	6.76		
Travel	TravDI	1	2			-	-
1. Domestic				624	86.07		
2. International				101	13.93		
Familiarity	FRT	0	1			.37	.48
0. First time				458	63.17		
1. Repeated Trip				267	36.83		
Accommodation 0. No 1. Yes	ACC			(yes)			
4- or 5-stars hotel	ACC1	0	1	137	18.9	.19	.39
3 stars hotel	ACC2	0	1	237	32.69	.33	.47
Guesthouse or 1- or 2-stars hotel	ACC3	0	1	239	32.97	.33	.47
Rented house or apartment (Airbnb)	ACC4	0	1	254	35.03	.35	.48
Friend or relative's house	ACC5	0	1	98	13.52	.14	.14
Homestay program	ACC6	0	1	141	19.45	.19	.19
Motivation 0. No 1. Yes	MOTIVE			(yes)			
Leisure / holiday	MOTIVE1	0	1	457	63.03	.63	.48
Business	MOTIVE2	0	1	49	6.34	.06	.24
Culture and heritage	MOTIVE3	0	1	40	5.52	.06	.23
Visiting friends and families/back to hometown	MOTIVE4	0	1	107	14.76	.15	.35
Education/teaching/training	MOTIVE5	0	1	34	4.69	.05	.21
Shopping	MOTIVE6	0	1	25	3.45	.03	.18
Health treatment	MOTIVE7	0	1	6	.83	.01	.09
Convention/conference/trade show/exhibition	MOTIVE8	0	1	6	.83	.01	.09
Source of information used 0. No 1. Yes	INFO			(yes)			
Internet/social media	INFO1	0	1	513	70.76	.71	.46
Friends/relatives/words of mouth	INFO2	0	1	531	73.24	.73	.44
Past experience	INFO3	0	1	172	23.72	.24	.43
Magazine/newspaper/guide book/pamphlet	INFO4	0	1	133	18.34	.18	.39
TV/radio	INFO5	0	1	88	12.14	.12	.33
MATTA Fair	INFO6	0	1	49	6.76	.07	.25
Travel agency/tour company	INFO7	0	1	90	12.41	.01	.33
National government tourist office	INFO8	0	1	21	2.90	.03	.17
Travelling partner 0. No 1. Yes	PAR			(yes)			
Alone	PAR1	0	1	200	27.59	.28	.45
Spouse/partner	PAR2	0	1	288	39.72	.40	.49
Family/relative(s)	PAR3	0	1	295	40.69	.41	.49
Friend(s)	PAR4	0	1	237	32.69	.33	.47
Business associate/colleague(s)	PAR5	0	1	54	7.45	.07	.26
Lecturer/teacher	PAR6	0	1	9	1.24	.01	.11
Other travellers met along	PAR7	0	1	24	3.31	.03	.18
Travel mode 0. No 1. Yes	TM			(yes)			
I purchase full board tour package	TM1	0	1	177	24.41	.24	.43
Fully independent travel/ on my own	TM2	0	1	509	70.21	.70	.46
I purchase accommodation only through agent	TM3	0	1	73	10.07	.10	.30
I purchase air flight only through agent	TM4	0	1	79	10.90	.11	.31
Activities 1. Not a priority … 5. Absolutely Essential	ACT						
Experiencing local food	ACT1	1	5	-	-	4.18	.91
Sightseeing in the city	ACT2	1	5	-	-	4.15	.85
Visiting museum/art gallery	ACT3	1	5	-	-	3.95	1.04
Experiencing local cultural	ACT4	1	5	-	-	4.10	.99
Outdoor activities (ATV, hiking, trekking)	ACT5	1	5	-	-	4.03	.98
Enjoying water sport (sunbathing, snorkelling, etc.)	ACT6	1	5	-	-	4.10	.94
Shopping	ACT7	1	5	-	-	3.81	1.05
Enjoying night life	ACT8	1	5	-	-	3.71	1.14
Wildlife (visit orangutan, Bird watching, safari, etc.)	ACT9	1	5	-	-	3.81	1.16
Playing sports (Golf)	ACT10	1	5	-	-	3.42	1.26
Homes	ACT11	1	5	-	-	3.53	1.22

experience (living with the host)							
Wellness (Spa, massage, meditation, etc)	ACT12	1	5	-	-	3.69	1.11
Romantic (honeymoon, wedding, anniversary, etc)	ACT13	1	5	-	-	3.58	1.20
Luxury experience (5 stars hotel, water villa, etc)	ACT14	1	5	-	-	3.54	1.23
Attitude	ATT	1	5	-	-		
Bad-Good	ATT1	1	5	-	-	4.22	0.72
Boring-Interesting	ATT2	1	5	-	-	4.18	0.79
Worthless-Valuable	ATT3	1	5	-	-	4.23	0.77
Unpleasant-Pleasant	ATT4	1	5	-	-	4.22	0.77
Unenjoyable-Enjoyable	ATT5	1	5	-	-	4.28	0.76
Undesirable-Desirable	ATT6	1	5	-	-	4.24	0.76
Subjective Norm	SN	1	5	-	-		
Travel companion(s)	SN1	1	5	-	-	4.09	0.76
Friend(s) who been to Sabah	SN2	1	5	-	-	4.05	0.79
Family member(s) who been to Sabah	SN3	1	5	-	-	4.07	0.89
Social media	SN4	1	5	-	-	3.81	0.99
Tour agency	SN5	1	5	-	-	3.60	1.08
Influencers	SN6	1	5	-	-	3.58	1.08
Perceived Behaviour Control	PBC	1	5	-	-		
How many days to stay in Sabah is totally up to me.	PBC1	1	5	-	-	3.76	0.97
I have resources to stay longer in Sabah.	PBC2	1	5	-	-	3.63	0.96
I have time to stay longer in Sabah.	PBC3	1	5	-	-	3.54	1.06
I have opportunities to stay longer in Sabah.	PBC4	1	5	-	-	3.57	1.04

TABLE 2. Model comparison

	Demo			TC			Act			TPB		
Item	P	LL	AIC	P	LL	AIC	P	LL	AIC	P	LL	AIC
Cox	0.5	-4159.03	8330.06	1	-4126.96	8321.91	1	-4168.72	8365.44	1	-4167.95	8367.89
Exponential		-820.89	1655.78		-805.47	1680.94		-822.78	1675.55		-820.24	1674.48
Weilbul		-665.32	1346.63		-590.34	1252.68		-660.18	1352.36		-648.57	1333.14
Gompertz		-812.17	1640.34		-786.29	1644.58		-812.01	1656.01		-807.9	1651.79
Loglogistic		-473.32*	962.64*		-421.01*	914.01*		-487.22*	1006.44*		-485.08*	1006.17*
Lognormal		-488.71	993.42		-434.01	940.01		-499.74	1031.48		-496.82	1029.64
Gamma		-1767.32	3550.63		-1701.30	3474.60		-1774.68	3581.37		-1764.75	3565.51

P=-Prob>chi2, *LL*=log-likelihood

TABLE 3. Results from truncated negative binomial versus cox and loglogistic survival analysis

N=725	TNB			CSA		LSA	
Variable	β	SD	IRR	HR	SD	β	SD
Age	-0.00	0.00	1.00	1.01*	0.00	-0.00	0.00
Gender	-0.01	0.04	0.99	1.05	0.08	-0.02	0.03
MS	-0.04	0.05	0.96	1.11	0.09	-0.06	0.04
LOE	-0.09**	0.03	0.91	1.23**	0.06	-0.11**	0.02
AMI	0.10**	0.02	1.10	0.88**	0.03	0.08**	0.01
TravDI	0.19**	0.06	1.21	0.72**	0.08	0.16**	0.05
FET	0.10*	0.05	1.11	0.93	0.07	0.05	0.04
ACC1	0.21**	0.05	1.23	0.71**	0.07	0.19**	0.05
ACC2	-0.11*	0.05	0.90	1.14	0.09	-0.03	0.04
ACC3	-0.36**	0.05	0.70	1.14**	0.09	-0.28**	0.03
ACC4	-0.21**	0.05	0.81	1.32**	0.10	-0.14**	0.04
ACC5	-0.14*	0.07	0.87	1.19	0.13	-0.09	0.05
ACC6	-0.07	0.06	0.93	1.11	0.10	-0.07	0.04
MOTIVE1	-0.00	0.05	1.00	1.01	0.08	0.01	0.04
MOTIVE2	-0.24*	0.10	0.79	1.37*	0.21	-0.21**	0.08
MOTIVE3	-0.13	0.10	0.88	1.21	0.20	-0.11	0.07
MOTIVE4	0.11	0.06	1.12	0.86	0.09	0.11*	0.05
MOTIVE5	0.25**	0.10	1.29	0.71*	0.12	0.20*	0.09
MOTIVE6	-0.22	0.13	0.81	1.34	0.27	-0.17	0.09
MOTIVE7	0.17	0.24	1.19	0.72	0.30	0.21	0.21
MOTIVE8	-0.33	0.27	0.72	1.53	0.63	-0.18	0.18
INFO1	-0.10*	0.05	0.90	1.20*	0.10	-0.13**	0.04
INFO2	-0.13**	0.05	0.88	1.12	0.09	-0.03	0.04
INFO3	0.02	0.05	1.03	1.07	0.09	-0.04	0.04
INFO4	-0.11	0.06	0.89	1.17	0.11	-0.09*	0.04
INFO5	-0.08	0.07	0.92	1.10	0.13	-0.06	0.05
INFO6	0.00	0.09	1.00	0.95	0.14	0.06	0.07
INFO7	0.00	0.07	1.00	0.99	0.11	-0.04	0.05
INFO8	0.04	0.13	1.05	0.94	0.21	0.05	0.10
PAR1	-0.08	0.05	0.92	1.15	0.10	-0.14**	0.04
PAR2	-0.19**	0.05	0.82	1.27**	0.10	-0.10**	0.04
PAR3	0.09*	0.05	1.09	0.91	0.07	0.10**	0.03
PAR4	-0.12**	0.05	0.88	1.15	0.09	-0.06	0.04
PAR5	-0.23**	0.09	0.80	1.37*	0.19	-0.21**	0.07
PAR6	-0.14	0.21	0.87	1.20	0.40	-0.06	0.15
PAR7	-0.23	0.13	0.79	1.49*	0.31	-0.28**	0.10
TM1	0.19**	0.05	1.21	0.73**	0.06	0.20**	0.04
TM2	-0.13**	0.05	0.88	1.28**	0.10	-0.14**	0.04
TM3	-0.28**	0.08	0.75	1.49**	0.18	-0.22**	0.06
TM4	-0.18*	0.07	0.84	1.28*	0.15	-0.16**	0.05
ACT1	0.03	0.03	1.03	0.95	0.04	0.04*	0.02
ACT2	0.01	0.03	1.01	0.91*	0.04	0.05**	0.02

ACT3	0.01	0.02	1.01	0.97	0.03	0.02	0.02
ACT4	0.06**	0.02	1.06	0.89**	0.03	0.07**	0.02
ACT5	0.09**	0.02	1.09	0.88**	0.03	0.06**	0.02
ACT6	0.07**	0.02	1.07	0.90**	0.04	0.06**	0.02
ACT7	0.02	0.02	1.02	0.97	0.03	0.02	0.02
ACT8	0.04*	0.02	1.04	0.93*	0.03	0.03*	0.02
ACT9	0.06**	0.02	1.06	0.93*	0.03	0.04*	0.01
ACT10	0.06**	0.02	1.06	0.93**	0.03	0.03**	0.01
ACT11	0.05**	0.02	1.06	0.92**	0.03	0.04**	0.01
ACT12	0.07**	0.02	1.07	0.90**	0.03	0.06**	0.02
ACT13	0.04*	0.02	1.04	0.96	0.03	0.02	0.01
ACT14	0.07**	0.02	1.08	0.92**	0.03	0.03*	0.01
ATT1	0.07*	0.03	1.07	0.94	0.05	0.04	0.02
ATT2	0.07**	0.03	1.08	0.93	0.04	0.04	0.02
ATT3	0.11**	0.03	1.12	0.87**	0.04	0.08**	0.02
ATT4	0.06	0.03	1.06	0.95	0.05	0.05*	0.02
ATT5	0.10**	0.03	1.10	0.89*	0.04	0.07**	0.02
ATT6	0.08**	0.03	1.08	0.91	0.04	0.06**	0.02
SN1	-0.01	0.03	0.99	1.00	0.05	0.03	0.02
SN2	-0.06*	0.03	0.95	1.06	0.05	-0.02	0.02
SN3	-0.00	0.03	1.00	0.99	0.04	0.02	0.02
SN4	-0.01	0.02	0.99	0.99	0.04	0.02	0.02
SN5	-0.02	0.02	0.98	1.00	0.03	0.01	0.02
SN6	-0.00	0.02	1.00	0.99	0.03	0.02	0.02
PBC1	0.09**	0.02	1.09	0.91*	0.04	0.04**	0.02
PBC2	0.07**	0.02	1.07	0.92*	0.03	0.05**	0.02
PBC3	0.09**	0.02	1.09	0.90**	0.03	0.06**	0.02
PBC4	0.09**	0.02	1.10	0.89**	0.03	0.06**	0.02

NB: * P-value <0.05 and **P-value <0.01