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E-B Environment - Behaviour Proceedings Journal

ICoPS2025Bangkok

e-IPH e-International Publishing House Ltd., United Kingdom

International Conference on Public Policy & Social Sciences 2025
Al Meroz Hotel, Bangkok, Thailand, 3 - 5 Oct 2025
Organiser: Faculty of Administrative Science & Policy Studies, Universiti Teknologi MARA, Negeri Sembilan, Malaysia

How Can Tourist Reviews Reflect Governance Issues? An aspect-based sentiment study in the Greater Bay Area

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Abstract
This study analyzes 24,183 TripAdvisor reviews on six major attractions in Hong Kong, Macao, and Zhuhai to examine cross-regional tourism governance in the Guangdong–Hong Kong–Macao Greater Bay Area. By applying Latent Dirichlet Allocation (LDA) and Aspect-Based Sentiment Analysis (ABSA), the research uncovers concentrated negative perceptions regarding crowd management and service quality, as well as differences in governance characteristics across regions. The findings highlight the value of User-Generated Content (UGC) as evidence for governance and propose measures such as establishing collaborative platforms, early warning mechanism and digital governance tools to enhance governance effectiveness and promote high-quality tourism development.

Keywords: Latent Dirichlet Allocation; Aspect-Based Sentiment Analysis; Tourism Governance; Greater Bay Area

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DOI: https://doi.org/10.21834/e-bpj.v10iSI38.7648

1.0 Introduction

Cross-regional tourism governance in the Guangdong–Hong Kong–Macao Greater Bay Area faces challenges such as massive visitor flows, inconsistent service standards, and fragmented management. Traditional tools such as post-trip surveys often lack timeliness and cannot fully capture visitors' real experiences. With the proliferation of digital platforms, User-Generated Content (UGC) has become a new data foundation. Online reviews act as "digital sensors," reflecting visitor perceptions in real time and serving as diagnostic tools to identify service deficiencies and governance weak links. Advances in Natural Language Processing (NLP) have made it possible to transform large-scale review data into actionable evidence. Latent Dirichlet Allocation (LDA) can discover latent topics, while Aspect-Based Sentiment Analysis (ABSA) links sentiment polarity to specific governance dimensions. However, existing studies mostly focus on single cities or attractions and emphasize overall sentiment, lacking a cross-regional comparative framework with interpretable aspect-level indicators. Addressing this gap, this study aims to construct an interpretable, governance-oriented sentiment profile from cross-regional attraction reviews in the Greater Bay Area. Objectives are to (1) extract governance-relevant themes and map them into dimensions, (2) quantify aspect-level sentiment and identify negative hotspots, and (3) compare patterns across Hong Kong, Macao, and Zhuhai to inform collaborative governance priorities. To achieve this, this study analyzes 24,183 English-language TripAdvisor reviews of the top two attractions in each of Hong Kong, Macao, and Zhuhai (Hong Kong Disneyland, Victoria Harbour, The Venetian

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Macao, the Ruins of St. Paul's, Zhuhai Chimelong Ocean Kingdom, and Lovers' Road). By combining LDA topic modeling with ABSA sentiment identification, the framework identifies 5,944 negative aspect-units (13.64%), mainly concentrated in crowding management and service quality, and highlights clear regional differences to support tourism governance improvement in the Greater Bay Area.

Nomenclature

UGC	User-Generated Content
LDA	Latent Dirichlet Allocation
ABSA	Aspect-Based Sentiment Analysis

2.0 Literature Review

2.1 User-Generated Content and Governance Evidence

Studies in the past five years consistently indicate that platform reviews, as "digital sensors," can be transformed into actionable governance cues. A systematic review shows that text analytics in tourism and hospitality has moved from sentiment overviews toward more fine-grained managerial insights, serving both to understand tourist experiences and to support decisions by destinations and firms (e.g., topic extraction and indicator construction) (Bi et al., 2024). Taking destination e-reputation as an entry point, scholars demonstrate that negative reviews on platforms such as TripAdvisor can reveal concrete governance shortcomings, including deficiencies in operations and service (Ali et al., 2021). Social media-induced tourism research further emphasizes that behavioral interventions and dispersal strategies can alleviate hotspot crowding and improve on-site management (Siegel et al., 2023). From a collaborative governance perspective, such review signals can be seen as stakeholder voice, indicating pressure points in cross-departmental coordinated governance.

2.2 Topic Modeling and Aspect Mapping

Case studies show that long time-span TripAdvisor reviews can, through a combined framework of Latent Dirichlet Allocation (LDA) and sentiment analysis, identify the structural elements of tourist experience and thereby propose targeted recommendations for on-site and information management (Saoualih et al., 2024). More broadly, LDA can induce latent topics in large-scale tourism reviews and provide an extensible dimensional basis for subsequent managerial interpretation, and it is often combined with sentiment classification to form topic and sentiment combined insights (Ali et al., 2022). This approach suggests that interpretable thematic structures, when aligned with governance-related dimensions, can support cross-destination benchmarking.

2.3 Aspect-Based Sentiment Analysis

Aspect-Based Sentiment Analysis (ABSA) is used to precisely link specific touchpoints with sentiment polarity, thereby identifying positive and negative concentration zones, allowing identification of positive and negative orientations for concrete touchpoints such as service, transport, and facilities. Based on user-generated reviews, the combination of ABSA and sentiment analysis can predict tourists' behavioral intentions, reveal the existence of relatively inactive segments, and locate sources of dissatisfaction (Mehra, 2023). In weakly labeled settings, zero-shot or pre-trained models can further reduce annotation costs while stably extracting aspects and determining polarity, providing a practical path for large-scale attraction review analysis (Nawawi et al., 2024). These studies justify interpreting aspect-level negative clusters as actionable targets for service and crowd-management interventions.

2.4 Methodological Reflection and Research Gap

In summary, tourism text analytics increasingly moves toward diagnostic, action-oriented indicators, yet the field still calls for further progress in cross-regional comparisons, cross-linguistic settings, and the construction of interpretable indicators (Bi et al., 2024). Existing cases mostly focus on a single city, a single attraction, or a single region, and they lack systematic examinations, within a unified research framework, of parallel comparisons across regions and multiple destinations, as well as of "joint governance" mechanisms. This makes it difficult to benchmark horizontally and to govern collaboratively, especially in high-density the Greater Bay Area tourism contexts where crowding and frontline service capacity often constrain visitor experience. Although the hybrid paradigm that combines upstream topic modeling and downstream ABSA has been validated to have advantages of scalability and interpretability (Saoualih et al., 2024), future research should further deepen work on a unified aspect ontology, the introduction of confidence weighting, and comparative displays of "isomorphic matrices across locations," so as to provide transferable metrics and chains of evidence for cross-regional, multi-actor joint governance.

3.0 Methodology

This study implements an end-to-end, three-stage text-mining workflow that converts user reviews into evidence relevant to tourism governance: Python automation is first used to collect and clean the corpus; Latent Dirichlet Allocation (LDA) with rule-constrained document-level aspect induction is then applied; finally, a Transformer-based classifier performs aspect-based sentiment inference. As shown in Fig. 1, the workflow links topic induction, aspect mapping, and sentiment inference.

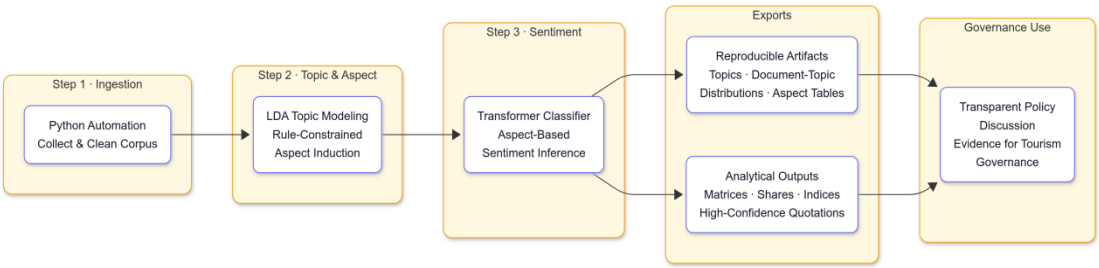

Fig. 1: Workflow of Aspect-Based Sentiment Analysis for tourism governance

3.1 Data Collection and Cleaning

To ensure source consistency and international comparability, data are drawn exclusively from TripAdvisor, a global platform with standardized review formats and broad coverage of major attractions across Hong Kong, Macao, and Zhuhai in the Greater Bay Area. We select the two attractions with the highest review volumes in each region and collect all publicly available reviews for those attractions, yielding 24,183 tourist reviews. Only the review content and minimal metadata are retained (region and attraction) for analysis. Cleaning removes non-textual noise (HTML/URLs/emails) and standardizes formatting. To enhance linguistic comparability, only reviews automatically identified as English are kept, and texts shorter than five words are removed. Deduplication is conducted in two steps: exact matching on a normalized key and near-duplicate removal using TF-IDF cosine similarity (≥ 0.95), retaining the earliest occurrence, resulting in a compact, high-quality modeling corpus.

3.2 Latent Dirichlet Allocation

Latent Dirichlet Allocation (LDA) was adopted for its interpretability and stability in uncovering latent thematic structures from large corpora, which is essential for mapping review content onto actionable governance dimensions. Preprocessing uses alphabetic tokenization, lowercasing, and WordNet lemmatization, with an expanded stoplist that masks place and brand names (e.g., Hong Kong, Macao, Disney, Ocean Park, MTR, Venetian) to prevent proper nouns from dominating topics. Data-driven bigram collocations capture frequent phrases (e.g., “queue time” and “ticket price”). LDA model was trained with K ranging from 6 to 20, and the final model (K = 13) was selected based on topic coherence and the interpretability of governance-oriented annotations. For each review, the full posterior topic distribution was retained to support conservative aspect induction: candidate aspects were restricted to terms drawn from high-probability topics and were required to appear in the text as noun or bigram candidates; up to six aspects were retained per review, with manually validated topic terms used as fallbacks when necessary.

3.3 Topic to Governance Mapping

Table 1 summarizes the mapping from LDA topics to six governance dimensions. To serve governance analysis, the 13 machine topics are consistency-checked against term distributions and sample passages and then merged into six governance dimensions: Destination image, Service quality, Crowding management, Transportation, Facilities, and Activities. The six dimensions are chosen because they represent actionable governance levers frequently discussed in destination management. The mapped outputs feed directly into subsequent sentiment inference.

Table 1. LDA Aspects - Topics Mapping

Aspect	Topic ID	Top Terms
Destination image	0	house, kingdom, strolling, worth visiting, calm, fake, bear, worthwhile, property, brand
Destination image	1	massive, memory, magnificent, waterfront, lit, fascinating, forever, picturesque, art, dream, fresh
Destination image	2	landmark, summer, weather, hot, cold, recommended, complex, rain, shopping mall, humid, winter, raining
Destination image	7	China, bridge, lover, path, background, true, load, amazed, known, surely, junk, situated
Destination image	11	place, see, nice, visit, great, good, view, night, beautiful
Service quality	3	beach, people, like, chinese, staff, money, game, visitor, table, service, bad, play, architecture
Crowding management	9	day, time, hour, line, food, ride, still, small, experience
Transportation	4	church, hotel, stroll, bus, walked, section, exhibit, free shuttle, walkway, cross, bakery, ceiling, passed, shuttle bus
Transportation	12	walk, ruin, shop, road, take, street, sea, water, side, way, along, local
Facilities	5	stair, stunning, hall, sightseeing, scale, cuisine, small compared, parking, burn, comparable, healthy, touch
Facilities	8	camera, glass, stroller, toilet, temple, hire, century, bet, trash, security, sidewalk
Activities	6	ride, show, kid, fun, parade, attraction, firework, like, enjoyed, theme, aquarium, land

Activities	10	casino, hotel, huge, boat, gambling, structure, sky, vega, bar, terminal, canal

3.4 Aspect-Based Sentiment Analysis

Sentiment inference employs a zero-shot setting using a DeBERTa-v3–based ABSA with sentence-pair inputs, conditioning on review text and mapped aspect to output positive/neutral/negative labels with confidence scores. DeBERTa-v3 is selected for its strong contextual representation and cross-domain generalization, making it suitable for aspect-level polarity inference under zero-shot conditions. A zero-shot setting is adopted to avoid costly manual annotation while enabling scalable analysis across multiple attractions. Confidence scores are retained to down-weight uncertain predictions when constructing indices and summaries. Based on the predictions, we construct overall polarity distributions, aspect × sentiment contingency matrices with row shares, and a confidence-weighted aspect sentiment index (positive = +1, negative = −1, neutral = 0). Sentiment results are first produced at the aspect-level and then aggregated by the mapped governance dimensions to compute dimension-level shares, indices, and intensities, yielding governance-oriented sentiment profiles.

3.5 Research Ethics

This study analyzes only publicly available content. We do not collect usernames, links, or other identifiable information; we do not attempt identity reconstruction, cross-platform linkage, or user contact. Quotations are de-identified and used solely for illustration; statistics are reported in aggregated form. Data collection follows platform guidelines and robots constraints where applicable, and all analyses adhere to academic norms.

4.0 Findings

This study collected 24,183 English TripAdvisor reviews and, after aspect-level extraction, formed 43,581 polarity-bearing text units. As shown in Fig. 2, the overall sentiment structure is clearly positive: positive 68.84% (30,000), neutral 17.52% (7,637), negative 13.64% (5,944). This pattern indicates that tourist evaluations are generally favorable, yet a small number of tightly focused negative clusters remain and should be identified and addressed in subsequent governance.

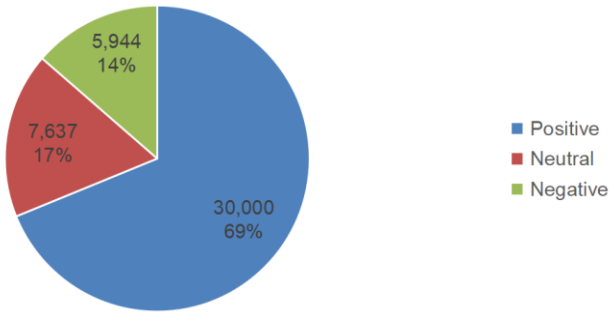

Fig. 2: Overall sentiment distribution at the aspect-unit level in the Greater Bay Area

4.1 Aspect-level Patterns

Guided by topic modeling and rule-based mapping, six dimensions organize the corpus: crowding management, service quality, transportation, destination image, facilities, and activities. Addressing Objective 2, we highlight two salient negative features. First, service quality carries the highest negative share (58.3%), signaling concentrated dissatisfaction with staff interactions, complaint handling, and response efficiency; although the absolute volume on this aspect is smaller, it remains a strong signal. Second, crowding management shows a moderate negative ratio (20.4%) but the largest discussion volume (12,370), which makes it the primary driver of large negative counts. The remaining aspects tend to be positive or neutral in their functional roles along the visitor journey: destination image is highly positive (80.3%); transportation is dominated by neutral, informational content (59.2%); facilities are net positive (58.8%); and activities are the most positive (71.8%). These patterns are summarized in the negative significance matrix (Fig. 3).

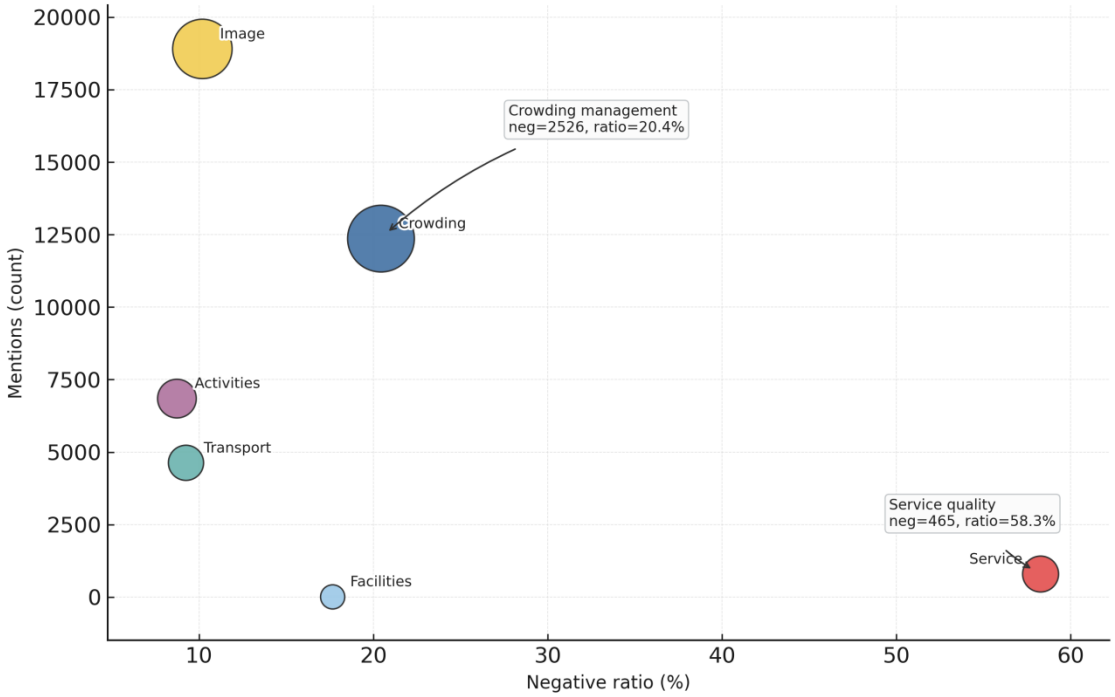

Fig. 3: Aspect-level negative significance matrix of six governance dimensions

4.2 Regional Differences

To address Objective 3, we compare regional sentiment patterns across Hong Kong, Macao, and Zhuhai. As shown in Fig. 4, Hong Kong has the highest overall positive share (71.19%), yet shows pronounced negative intensity on service quality (68.3%), with 334 negative out of 489 related samples. Crowding management also records a prominent negative volume, with 2,043 negative texts that account for 19.7% of all local mentions of that dimension. In Macao, transportation is led by neutral information (60.5%), with 1,913 neutral out of 3,163 related samples, which likely reflects descriptive sharing and inquiries about transfer and access routes. At the same time, crowding management has a negative ratio of 24.9%, and service quality has a negative ratio of 41.3%, both of which merit attention. In Zhuhai, the sample is smaller, but destination image is the most robust, with a positive ratio of 84.7%. Transportation again leans neutral (50.4%). Although service quality shows a high negative share (57.1%), its absolute volume is limited.

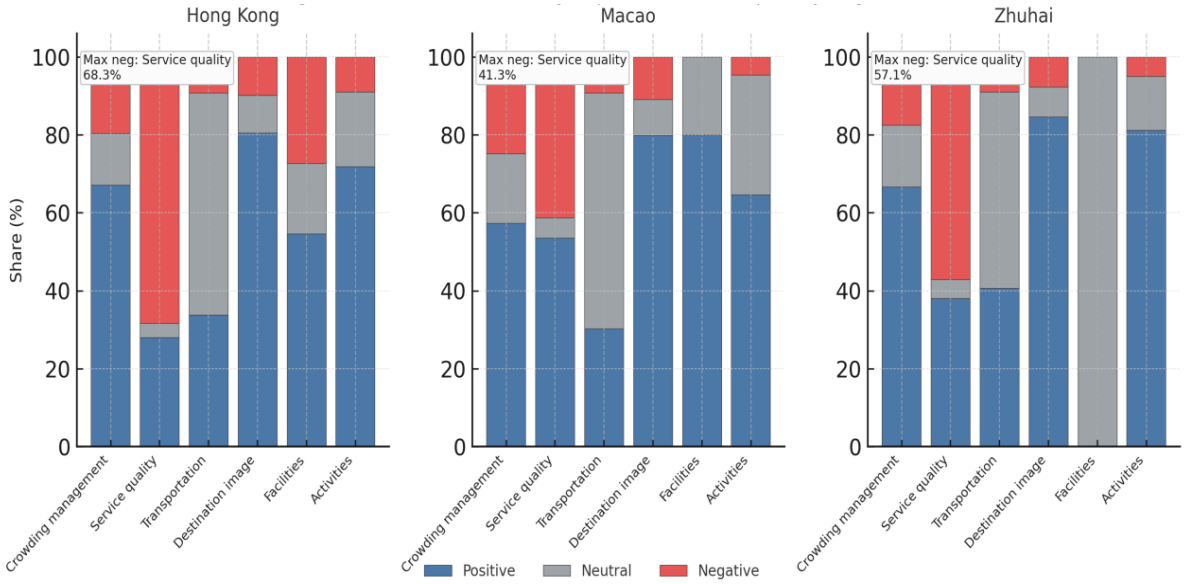

Fig. 4: Regional sentiment differences by governance aspects in the Greater Bay Area

4.3 Attraction–aspect Hotspots

From the attraction–aspect–polarity matrix, the largest negative "volume" cluster is concentrated in crowding management at Hong Kong Disneyland. This single site contributes 77.9% of all negative samples for that dimension across all sites in our corpus, with 1,968 negative out of a corpus total of 2,526. Within the same attraction, the total mentions of this dimension are 9,425, including 1,968

negative, for a negative ratio of 20.9%. At the same site, service quality shows the highest negative intensity (69.3%), with 329 negative out of 475 related samples, suggesting that queuing and congestion in high-flow scenarios can amplify negative perceptions of service. In Macao, the Venetian also shows a high negative proportion on service quality (42.35%), with 108 negative out of 255 related samples. The Ruins of St. Paul's concentrate 58.4% of all negative samples on the transportation dimension, contributing 250 of a corpus total of 428 negative texts; however, this aspect is predominantly neutral overall, with 1,723 neutral texts, indicating that narratives about access routes and approaches on foot or by bus are more common. Victoria Harbour shows the strongest advantage in destination image, with 3,177 positive texts and 169 negative, a negative share of 4.36%, computed over all destination-image mentions at this site. In Zhuhai, Chimelong and Lovers' Road present a small-sample pattern of positive image, neutral transportation, and mildly negative service quality, with limited contribution to the corpus-wide negative volume. These hotspots are visualized in Fig. 5.

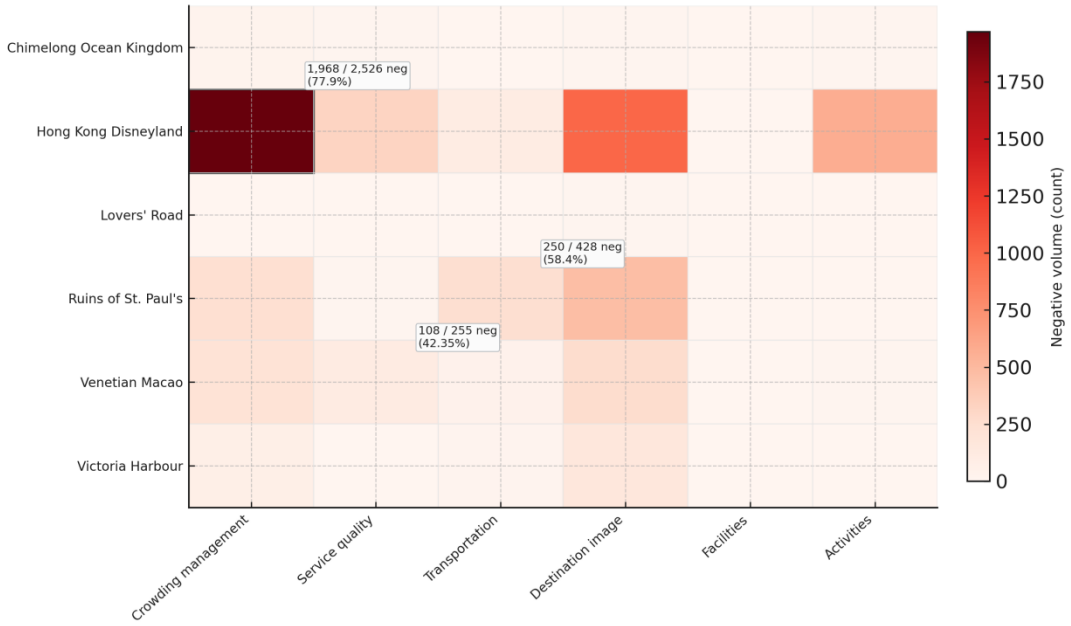

Fig. 5: Attraction–aspect negative hotspots in the Greater Bay Area

4.4 Evidence Excerpts

Concise, high-confidence quotations corroborate these quantitative patterns and illustrate their operational implications. Typical crowding complaints involve long queues and waiting bottlenecks, for example, "The line at the cashier took almost 30 minutes." Critiques of service quality emphasize perceived rudeness or inattention, for example, "Staff were rude and impatient." Reviews related to transportation often point to access routes and maintenance, for example, "The road leading to the site is poorly maintained." These excerpts provide qualitative anchors for the measured distributions and can, when needed, be linked to specific attractions and time windows to guide targeted auditing.

4.5 Synthesis and Governance Priorities

In sum, negative volume is concentrated in queuing and congestion under high visitor flows, while negative intensity is centered on service quality. Transportation is more often expressed as neutral, informational content. Differences across regions and attractions point to spatial heterogeneity in governance: Hong Kong should prioritize easing peak-time congestion and reinforcing service capacity at the frontline; Macao should improve the organization of information across the access–walking–transfer chain and strengthen crowding diversion; Zhuhai should maintain its strong image reputation while refining micro-level service touchpoints. These findings provide targeted focal points for the policy recommendations that follow.

5.0 Discussion

5.1 Implications for Tourism Governance in the Greater Bay Area

Our research findings hold significant implications for cross-regional tourism governance in the Greater Bay Area. First, the relationship between tourist sentiment and service deficiencies confirms the effectiveness of Aspect-Based Sentiment Analysis (ABSA) of User-Generated Content (UGC) as a diagnostic tool. The observed concentration of negative sentiment around service quality and crowding management demonstrates how UGC can be translated into actionable governance cues rather than aggregated impressions (Bi et al., 2024). This aligns with evidence that negative e-reputation on TripAdvisor can reveal concrete governance shortcomings in operations and service delivery (Ali et al., 2021). In addition, continuous monitoring and analysis of online reviews can serve as an early warning and rolling feedback mechanism. Compared with traditional post-trip surveys or occasional audits, managers can continuously "listen"

to tourists' voices and respond more proactively. Before the destination's reputation is seriously damaged, interventions can be carried out through staff training, workflow adjustments, or resource reallocation. This responsiveness is consistent with data-driven service governance, in which online review ABSA can achieve continuous monitoring and policy adjustment to improve service delivery (Nawawi et al., 2024)

In the context of the Greater Bay Area, each city can learn from each other by comparing sentiment data. We observed that service sentiment is higher in Macao, while infrastructure is better in Hong Kong, indicating that best practices can be shared across regions. By establishing a regional governance collaboration platform to regularly collect, benchmark, and review tourist feedback, knowledge transfer and standard coordination can be promoted. For example, the convenience of Hong Kong's public transportation and accessibility of attractions correspond to fewer transport complaints and can provide reference for route planning in Macao or Zhuhai, while Macao's strengths in the hotel industry and service culture rooted in the gaming sector can support staff training in other regions. Based on the comparison results of ABSA, destination management organizations (DMOS) can identify similar destination groups and carry out horizontal comparison, depict comparative advantages and weaknesses, and then optimize strategies (Mehra, 2023).

5.2 Limitations and Future Research

Although this study provides meaningful insights, its limitations still need to be acknowledged. Firstly, since only English reviews were analyzed, the sample is biased toward international tourists or platform users proficient in English, excluding Chinese mainland tourists who mainly use platforms such as Ctrip. Therefore, some governance issues may not have been fully addressed. Future research should integrate multilingual and cross-platform data to obtain a more comprehensive perspective. Secondly, although Latent Dirichlet Allocation (LDA) helps with topic discovery, it may merge or split topics in ways that are not entirely consistent with concept categories. We alleviate this by manually grouping, but this process inevitably brings some subjectivity. In addition, the advantage of the unsupervised approach lies in its ability to reveal the high-frequency issues genuinely discussed by tourists. For example, the frequent appearance of the word "transportation" indicates its relevance to both experience and management processes, but this direction still requires manual review and mixed methods for validation.

A key direction for future research is to introduce a time-series perspective, tracking the dynamic changes in sentiment data to assess the actual effectiveness of governance interventions driven by sentiment data early warning systems, and to capture the phased impact of major events (e.g., COVID-19) on tourist perceptions. Simultaneously, cross-cultural differences warrant further examination. Comparing Chinese and English reviews can reveal subtle differences in evaluation focus and expression, thereby enabling the development of more targeted governance and service improvement plans for different customer groups. In conclusion, future research should examine how sentiment signals can be truly transformed into actionable and measurable governance interventions through time dimensions, cross-cultural comparisons, and policy instrumentation approaches.

6.0 Conclusion and Recommendations

Based on 24,183 TripAdvisor English reviews, uses Latent LDA topic modeling and DeBERTa-ABSA sentiment recognition to reveal that tourist sentiments can effectively uncover shortcomings in services and governance, thereby providing actionable references for cross-regional tourism governance in the Greater Bay Area. The study proposes three recommendations. First, promote collaborative governance and knowledge exchange among the three regions of the Greater Bay Area, focusing on transportation, crowd management, and service standards to achieve cross-regional synergy. Second, strengthen the early warning and feedback mechanism by monitoring reviews in real time and intervening promptly in negative ones. Third, establish a cross-regional digital governance platform that integrates review monitoring, sentiment analysis, and feedback, forming a closed loop of "monitoring–response–evaluation." Overall, this study not only verifies the potential of review data in tourism governance but also provides empirical evidence for cross-regional collaboration, highlighting the practical value of digital sentiment analysis in promoting high-quality regional tourism development and modernization of governance.

Acknowledgement

I would like to thank Universiti Teknologi Malaysia (UTM) for providing an excellent environment for study and research, and I sincerely appreciate the support and collaboration of my co-author.

Paper Contribution to Related Field of Study

Theoretically, this study expands the application framework of User-Generated Content (UGC) as governance evidence and deepens the interdisciplinary integration between cross-regional tourism governance research and sentiment analysis. Methodologically, by combining Latent Dirichlet Allocation (LDA) with Aspect-Based Sentiment Analysis (ABSA), it establishes a cross-regional and interpretable text mining process that provides a replicable technical pathway for tourism governance research. Practically, the study identifies critical governance shortcomings in service quality and crowd management, and proposes the establishment of cross-regional collaboration platforms, real-time feedback mechanisms, and digital governance tools, offering empirical references for the modernization of tourism governance in the Greater Bay Area.

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