



# Sentiment analysis of restaurant customer satisfaction during COVID-19 pandemic in Pattaya, Thailand

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## ABSTRACT

The tourism and hospitality industry, particularly the restaurant business, has been greatly affected by the COVID-19 pandemic. To comprehend customer behavior and preferences during this unprecedented time, it is crucial to analyze online restaurant customer reviews. Thus, this study utilized the valence aware dictionary for sentiment reasoning (VADER) model to examine TripAdvisor reviews of restaurants in Pattaya City, Chon Buri, Thailand, covering the period 2017–2022, which encompasses both pre-pandemic and pandemic years. The findings reveal a significant decrease in the number of reviews and a notable increase in negative sentiments during the COVID-19 pandemic compared to normal circumstances. We noticed two concern areas, i.e., service and staff, and food and taste, that should be addressed urgently. The findings of this study offer valuable insights into customer behavior and requirements, thereby empowering restaurant businesses to enhance service quality, satisfy customer requirements, and strategically plan for a post-COVID-19 future.

## 1. Introduction

In late December 2019, Wuhan, China reported the first case of the corona virus disease (COVID-19), which is caused by the SARS-CoV-2 virus. Subsequently, other nations observed significant spread of the disease [1]. COVID-19 has had significant and widespread negative impacts on society and the global economy [2,3], including halting tourism, increasing unemployment rates, decreasing consumer expenditures, and reducing revenue [4]. For example, travel and tourism were directly impacted by the global spread of COVID-19. Nearly all countries implemented severe COVID-19 prevention measures, including closing international borders and prohibiting tourist travel [5]. Approximately 72 % of worldwide tourist destinations were closed to international visitors [6], which has had a significant ripple effect on employment, i.e., 62 million jobs were lost, representing a drop of 18.6 %, leaving 271 million employed across the travel and tourism sector globally in 2020 [7]. These losses impacted all aspects of the tourism value chain, from destinations to service providers [8].

Restaurants, which are an integral element of tourism and service-related sectors, were impacted heavily by the COVID-19 pandemic compared to other sectors of the economy [9]. In many countries, the demand for sit-down dining completely disappeared as a result of government initiatives, e.g., travel bans, social distancing, and regulations restricting restaurants for delivery orders [10,11]. As a result, most restaurants experienced decreased revenue and were forced to cut back on staff [12]. The spread of

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COVID-19 also had a serious impact on Thailand. The Thai government announced that all restaurants were required to close to dine-in customers; only takeaway orders would be allowed. Even if takeaway sales increased under these circumstances, this would not be sufficient to compensate for the sharp decline in dine-in revenue. Due to global travel bans and dine-in restaurant closures, it is estimated that 10%–15 % of restaurants have closed permanently. As a result, Thailand lost \$9–10 billion in food purchases from tourists [13].

Electronic word-of-mouth (eWOM) involves sharing personal experiences and opinions about products or services using online platforms. Customers provide feedback in the form of ratings or text [14]. To inform effective decision making, travelers can benefit from reviews related to tourism and services as they plan their trips [15–17]. During the COVID-19 pandemic, it was discovered that fewer customers patronized restaurants, left low star ratings in the reviews, and spent less money [18]. Customers were able to gain information about the restaurant's level of sanitation and hygiene measures implemented to prevent the spread of COVID-19 [19], as well as assess associated risks from restaurant review data from various online platforms [20]. According to the Local Consumer Review Survey 2022, customers read more online reviews than ever before during the pandemic. In addition, 77 % of customers always read reviews when looking for information about local businesses, and 89 % of customers were extremely satisfied if business owners responded to online reviews [21].

Sentiment analysis methods are used frequently in the restaurant industry to analyze reviews posted to online platforms. Popular online platforms for restaurant reviews include Yelp [12,19,22], TripAdvisor [23,24], Twitter [25,26], and other foreign-language platforms, e.g., *Dianping.com* in China [18]. Utilizing customer feedback on restaurants from social media and websites was a simple way to help restaurant owners better understand their customers' needs and maintain profitability during this challenging time. In such reviews, customers can express their opinions freely and honestly. The process of acquiring review data is quicker than traditional surveys or interviews, and the data can be obtained in real time [27]. In addition, social media data covers a wide timeframe and can be selected for diverse study periods [28]. In terms of gathering and analyzing data, social media data also saves time and minimizes data collection costs.

Currently, to the best of our knowledge, only a few studies have attempted to investigate the use of social media to examine the reviews of tourism and services during the COVID-19 pandemic in Thailand. For example, Sontayasara et al. [29] employed a support vector machine algorithm to analyze Twitter reviews of tourism-related businesses, and Leelawat et al. [30] utilized a machine learning method to analyze Twitter reviews of tourism-related businesses in Bangkok, Chiang Mai, and Phuket.

A review of previous research indicated that several studies have investigated the impact of COVID-19 on restaurants [31–33]; however, to the best of our knowledge, no studies have focused on Pattaya City, Thailand. Thus, in this study, we focused on Pattaya, which is a well-known tourist attraction in Chon Buri Province, Thailand. Pattaya is a popular tourist destination that was seriously affected by the COVID-19 pandemic, and many tourism and service-related businesses in Pattaya have shut down [34,35]. Restaurants in Pattaya have been forced to close almost entirely due to lockdown measures imposed to prevent the spread of COVID-19. In addition, no study has explored the impact of the spread of COVID-19 on the Pattaya restaurant industry from the perspective of customers using data from internet reviews. Thus, there is a potential research gap in terms of the utilization of TripAdvisor restaurant review data during the pandemic. This study addresses a knowledge gap and provides needed information about the impact of the restaurant business in Pattaya during the COVID-19 pandemic.

The goals of this study are to analyze and compare the sentiments of restaurant customer reviews and interpret and describe customers' evaluations of restaurant services by identifying emotional words and opinion content before and during the COVID-19 pandemic. The findings of this study are expected to contribute to a better understanding of quantitative and qualitative restaurant customer feedback, e.g., food, service, cleanliness, and environmental aspects before and during the COVID-19 pandemic. Restaurant owners can utilize this information to effectively manage and improve services during similar crises in the future. It also utilizes additional data from online restaurant reviews.

The remainder of this paper is organized as follows. In Section 2, we review recent literature on the restaurant industry and food-related tourism during the COVID-19 pandemic. Section 3 describes the target study area, the data used in this study, and the methods. Section 4 presents and discusses the most relevant results and implications. Finally, the paper is concluded in Section 5.

## 2. Related work

### 2.1. Restaurant industry and COVID-19 pandemic

The COVID-19 pandemic's imposition of lockdown measures has reverberated significantly throughout the global tourism and hospitality sector, leaving a profound mark on its operations [36]. Notably, government-mandated travel restrictions led to the closure of many restaurants as part of the broader effort to curb the pandemic's spread [37]. The apprehension among customers regarding COVID-19 risks associated with dining out further exacerbated the situation [38]. The resultant sharp decline in patronage had a dire impact on the revenue of these establishments, ultimately pushing them to the brink of financial crises [39]. We can construct previous studies into the following areas, emphasizing the critical need for resilience, adaptability, and a deep understanding of customer behavior to navigate the tumultuous terrain of the pandemic:

2.1.1 Customer behavior and sentiment: During the COVID-19 pandemic, the profound impact on the restaurant industry emerged as a matter of paramount concern, given its direct repercussions on the broader economy. Consequently, several countries initiated research initiatives to understand the multifaceted issues faced by the restaurant industry during this turbulent period. These investigations encompassed a range of constructs, notably exploring customer behavior and emotions. Past studies examined topics such as customer satisfaction with food quality and service [23], expectations regarding restaurant service [40], and the motivational

factors influencing customers' intent to dine out [41]. For instance, one study delved into consumer attachment to upscale dining establishments and the emotional ambivalence that could lead to abandoned reservation sessions during the COVID-19 pandemic [42]. Another study investigated consumers' dining experiences and their perception of well-being while adhering to restaurant social distancing guidelines [43]. Understanding how customer preferences and concerns evolved during the pandemic is essential for tailoring services and regaining trust, ultimately leading to business recovery and growth.

**2.1.2 Operational adaptation:** As a response, restaurants find themselves compelled to evolve and devise new strategies for surviving this unprecedented crisis. In parallel, strict regulations pertaining to customer safety and hygiene standards must be diligently adhered to Ref. [44]. This encompassed various facets of restaurant operations, including the reconfiguration of dining layouts, imposition of customer number limits, and the maintenance of impeccable cleanliness and hygiene standards [45,46]. Additionally, in the face of evolving consumer behavior, restaurants are being called upon to adapt their service strategies. This adaptation spans various aspects, such as prioritizing online and phone-based ordering systems and revising their approach to delivery, takeout, and drive-through services [47]. Such strategic adjustments are critical to ensure the continued survival of these establishments until conditions improve.

**2.1.3 Economic impact and resilience:** Several studies have delved into the economic ramifications of COVID-19 on the restaurant industry. During the pandemic, customer footfall at restaurants witnessed a substantial decline [48,49], rendering many of these establishments financially vulnerable and unable to weather the storm [50] due to diminished revenues [51,52]. Neise et al. [53] have highlighted that restaurants with a track record of poor economic and financial performance prior to the COVID-19 crisis displayed less resilience during the pandemic. Conversely, restaurants with a well-established business foundation and a robust financial footing proved more resilient in the face of adversity.

**2.1.4 Adaptability and stress management:** In addition to financial challenges, restaurants grappled with a spectrum of other issues during the pandemic. These encompass stress, workforce shortages, operational closures, reopening complexities, and the inherent difficulties associated with adapting to a rapidly changing environment [54]. These multifaceted issues underscore the significance of comprehensive research into the restaurant industry's dynamics during the COVID-19 pandemic.

## 2.2. Food-related tourism during the COVID-19 pandemic in Thailand

This study is anchored in the intersection of food, tourism, and the Thai restaurant industry, acknowledging the pivotal role of food as a cornerstone of tourism, and recognized as a leading factor in attracting tourists [55,56]. Thai food, characterized by its distinctiveness and global popularity, holds a prominent place among international tourists [57,58]. Particularly, Thai street food emerges as a noteworthy subsector, exhibiting substantial growth potential within the broader context of global food tourism [59]. However, the study addresses the adverse repercussions of the COVID-19 pandemic, which directly affected the tourism and travel sectors, setting off a ripple effect that extended to the food and restaurant industry. Between 2019 and 2021, the Thai restaurant



Fig. 1. Study area (Pattaya City in Bang Lamung District, Chon Buri Province, Thailand).

industry faced severe challenges due to the pandemic, resulting in the closure of a staggering 16,720 restaurants [60].

Pattaya, renowned as a popular tourist destination both for domestic and international tourists, relies significantly on tourism, with more than 60 % of its revenue sourced from international tourists [61]. However, with the rapid spread of COVID-19, Pattaya found itself among the hardest-hit tourist destinations in Thailand. The drastic decline in international tourist arrivals had an immediate and pronounced impact on both the tourism and restaurant sectors in Pattaya.

Notably, the study identifies a gap in the existing research landscape, with limited scholarly attention devoted to exploring the specific impacts of COVID-19 on the Thai restaurant business, despite the fundamental role of Thai cuisine and food-related enterprises in the national economy and their appeal to international tourists. Our literature review, however, unearthed several reports from both governmental and private organizations [13,62,63], shedding light on this critical issue. Additionally, we encountered specific studies addressing various facets of the pandemic's impact on the Thai restaurant industry. For instance, Ryu et al. [31] delved into the self-protection intentions of restaurant patrons in Phuket, while Sunthompan & Hirata [32] examined the influence of COVID-19 across various tiers of the restaurant industry, encompassing micro, small, and medium-sized enterprises. Moreover, Piboonrunroj et al. [33] explored the impact of gastronomic tourism in the context of the COVID-19 pandemic. Consequently, this study seeks to comprehensively investigate the intricate interplay of food, tourism, and the pandemic's repercussions on the Thai restaurant industry, providing valuable insights and contributing to the body of knowledge in this field.

### 3. Data and methods

#### 3.1. Study area

In this study, we focused on Pattaya City, which is situated at 12°55'39"N and 100°52'31"E in Bang Lamung District, Chon Buri Province, Thailand. Fig. 1 shows the study area (53.84 square kilometers), including Koh Lan (Lan Island).

Pattaya is home to various world-renowned attractions, e.g., Pattaya Beach and Koh Lan, as well as many interesting nightlife attractions, e.g., walking streets, pubs, and bars lining the beachfront. Prior to the COVID-19 pandemic, Pattaya was the third most popular tourist destination in Thailand, following Bangkok and Phuket, with a total of 14.58 million tourists, including 4.95 million Thais and 9.63 million international tourists in 2019. In addition, Pattaya generated approximately \$7.60 billion in revenue from tourism [64].

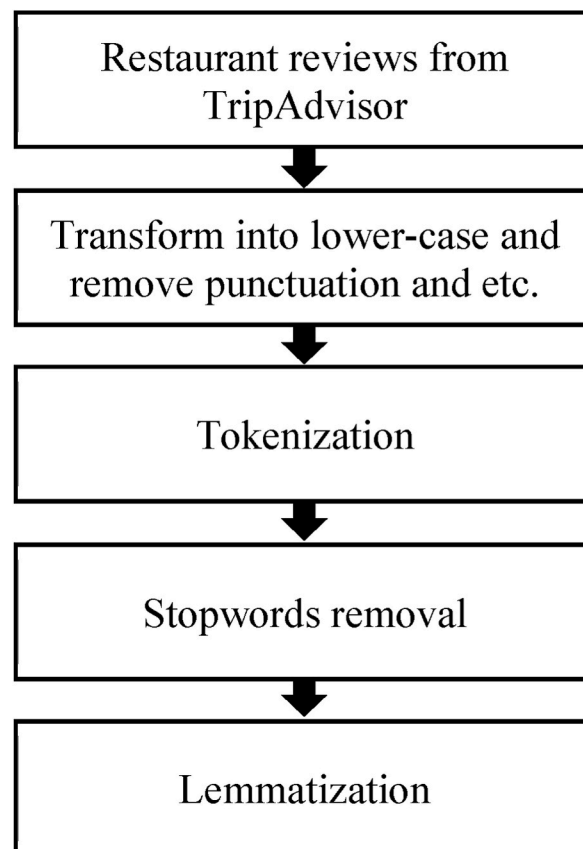


Fig. 2. NLP-based data preprocessing.

### 3.2. Data collection

The collected reviews of restaurants in Pattaya from TripAdvisor cover the period prior to the COVID-19 pandemic from January 1, 2017 to December 31, 2019, and during the pandemic from January 1, 2020 to December 31, 2022, for a total of six years. The collected reviews were for a wide range of restaurants, including cafes, fast food restaurants, bakery shops, and conventional restaurants. Pattaya has a variety of restaurants, ranging from street food to fine dining; thus, Thai and international tourists can enjoy a wide variety of dining experiences. When the COVID-19 pandemic broke out, all restaurants in Pattaya were impacted severely. As a result, information and reviews from all types of restaurants during this period were essential in terms of issue resolution and restaurant management planning in Pattaya.

The TripAdvisor reviews were obtained using a web scraping technique. Here, the unstructured HTML data from the review pages were scraped using the Python Selenium module, and the reviews were then gathered using the BeautifulSoup library. Then, a CSV file containing the entire dataset was generated and saved [65]. Typically, a restaurant review contains four types of information, i.e., name of restaurant, date, review, and the location of the restaurant. Note that reviews that did not include the coordinate system of the restaurant were excluded. In addition, only English reviews were considered in this study.

A total of 14,880 reviews of restaurants in Pattaya were collected from TripAdvisor and split into two periods, i.e., before the COVID-19 pandemic (11,162 reviews) and during the pandemic (3718 reviews).

### 3.3. Data preprocessing

After collecting the restaurant reviews, the reviews were preprocessed to facilitate effective sentiment analysis. Here, natural language processing (NLP) was applied to clean the review data. Data cleansing is an essential step in any machine learning model, especially in NLP. Without data cleansing, the dataset is frequently just a collection of words that cannot be recognized by a computer. In this study, the data were cleansed using several steps to remove unnecessary text and highlight the key attributes that are appropriate for the valence aware dictionary for sentiment reasoning (VADER) model (Fig. 2).

3.3.1 All text reviews were transformed into lower case, and all punctuation, URLs, symbols, numbers, and special characters were removed.

3.3.2 The text reviews were tokenized by splitting sentences into single words.

3.3.3 Stop words (e.g., “I,” “you,” “we,” “me,” “the,” “is,” etc.), which do not provide meaningful input, were removed.

3.3.4 All text data were lemmatized using the WordNetLemmatizer Python library.

### 3.4. Sentiment analysis

The goal of this study was to gather information about restaurant customer satisfaction before and during the COVID-19 pandemic. Data from restaurant customers, e.g., satisfaction comments, needs, complaints, and suggestions, were critical to manage restaurant operations, improve service to satisfy customer requirements, and determine marketing strategies during the post-COVID-19 period. To achieve this goal, the valence aware dictionary for sentiment reasoning (VADER) model was employed in this study to evaluate the acquired TripAdvisor restaurant reviews. The VADER model is a powerful tool for analyzing social media sentiment. In addition, VADER analysis does not require training data, supports online functionality, and can identify emojis for sentiment classification [66, 67].

The total score was determined by combining the valence scores of each word in the dictionary. The score was then normalized between  $-1$  (most negative) and  $1$  (most positive), and the compound scores were divided into three groups, i.e., positive ( $\geq 0.05$ ), neutral ( $> -0.05$  and  $< 0.05$ ), and negative ( $< -0.05$ ), in reference to the literature [68].

### 3.5. Validation of VADER sentiment analysis

In this step, the VADER results were validated using the gold standard development process [66]. Here, three tourism and hospitality experts, as well as data analytics experts, were asked to classify 600 randomly generated TripAdvisor restaurant reviews from the collected 14,880 reviews. Then, as shown in Table 1, a  $3 \times 3$  confusion matrix was generated [69].

In Table 1, the letters a–i represent the number of instances actually in class X that were predicted as class Y, where  $X, Y \in \{\text{positive, neutral, and negative}\}$ . Thus, the precision (P), recall (R), F1-score, and accuracy (A) can be calculated from this confusion matrix.

The precision (P) of class X is the proportion of the number of elements classified correctly as X to the total number of elements predicted as class X. The recall (R) of class X is the proportion of the number of elements correctly classified as X to the number of

**Table 1**  
 $3 \times 3$  confusion matrix used to verify VADER analysis.

|  |          | Predicted (sentiment values from VADER) |         |          |
|--|----------|---|---------|----------|
|  |          | Positive                                | Neutral | Negative |
| Actual (sentiment values from experts) | Positive | a                                       | b       | c        |
|  | Neutral  | d                                       | e       | f        |
|  | Negative | g                                       | h       | i        |

known elements in class X. The precision and recall values of the negative class are computed as follows.

$$P(\text{neg}) = \frac{i}{(c + f + i)} \tag{1}$$

$$R(\text{neg}) = \frac{i}{(g + h + i)} \tag{2}$$

The F1-score is the harmonic mean of precision and recall, which is calculated as follows.

$$F1(\text{neg}) = \frac{2P(\text{neg}) \times R(\text{neg})}{P(\text{net}) + R(\text{neg})} \tag{3}$$

Finally, the overall accuracy (A) is computed as follows.

$$A = \frac{a + e + i}{a + b + c + d + e + f + g + h + i} \tag{4}$$

### 3.6. Comparison of sentiments before and during the COVID-19 pandemic

Descriptive analysis was used to compare restaurant customer sentiments in Pattaya before and during the COVID-19 pandemic. Here, we used a nonparametric test because the restaurant reviews considered in this study were not distributed normally. The Wilcoxon signed-rank test was selected as the statistical technique because it is fairly robust against data normality [70].

The sentiment data were separated into three groups, i.e., positive, neutral, and negative, with each group encompassing 36 months prior to the COVID-19 pandemic (2017–2019) and 36 months during the pandemic (2020–2022).

### 3.7. Content analysis

The final step was a qualitative content analysis of the restaurant review data using FreqDist from the Natural Language Toolkit (NLTK) Python library to select the top-10 most frequent words in the reviews before and during the COVID-19 pandemic.

Then, the negative reviews based on the frequency of the top-10 words were identified and divided into four topics, i.e., service and staff (SS) (i.e., staff etiquette, staff attentiveness, staff adequacy, price, and value), food and taste (FT) (i.e., food quality, food quantity, food taste, and ingredients), cleanliness and hygiene (CH) (i.e., food cleanliness, equipment cleanliness, and restaurant hygiene), and environment and decoration (ED) (i.e., atmosphere, decoration, and safety both inside and outside the restaurant). The results can be implemented by restaurant owners or managers to plan and solve problems based on the urgency of the situation as determined by the number of reviews in each topic, where frequently mentioned groups should be handled first, followed by less frequent topics.

## 4. Results

### 4.1. Number of restaurant reviews

After compiling the reviews of restaurants in Pattaya from TripAdvisor for the period before and during the COVID-19 pandemic (2017–2022), we acquired a total of 14,880 reviews, including 11,162 reviews (75.01 %) from before the pandemic. The year with the most reviews was 2019, with 4160 reviews, followed by 2018 (3633 reviews) and 2017 (3369 reviews). During the COVID-19 pandemic (2020–2022), the number of reviews declined dramatically, with a total of 3718 reviews (representing 24.99 % of the

**Table 2**  
Number of TripAdvisor restaurant reviews before and during the COVID-19 pandemic (2017–2022).

| Month        | Before Covid-19 pandemic |              |              | During Covid-19 pandemic |             |              | Total         |
|--------------|--------------------------|--------------|--------------|--------------------------|-------------|--------------|---------------|
|              | 2017                     | 2018         | 2019         | 2020                     | 2021        | 2022         |               |
| Jan          | 404                      | 370          | 412          | 392                      | 32          | 77           | 1687          |
| Feb          | 306                      | 313          | 323          | 386                      | 33          | 72           | 1433          |
| Mar          | 317                      | 304          | 369          | 177                      | 73          | 66           | 1306          |
| Apr          | 288                      | 308          | 309          | 24                       | 56          | 98           | 1083          |
| May          | 220                      | 240          | 338          | 51                       | 29          | 89           | 967           |
| Jun          | 217                      | 261          | 287          | 57                       | 34          | 128          | 984           |
| Jul          | 252                      | 292          | 330          | 75                       | 43          | 132          | 1124          |
| Aug          | 232                      | 333          | 401          | 100                      | 5           | 171          | 1242          |
| Sep          | 225                      | 272          | 334          | 84                       | 20          | 151          | 1086          |
| Oct          | 244                      | 244          | 367          | 90                       | 64          | 187          | 1196          |
| Nov          | 313                      | 316          | 337          | 60                       | 64          | 207          | 1297          |
| Dec          | 351                      | 380          | 353          | 68                       | 67          | 256          | 1475          |
| <b>Total</b> | <b>3369</b>              | <b>3633</b>  | <b>4160</b>  | <b>1564</b>              | <b>520</b>  | <b>1634</b>  | <b>14,880</b> |
| <b>%</b>     | <b>22.64</b>             | <b>24.42</b> | <b>27.96</b> | <b>10.51</b>             | <b>3.49</b> | <b>10.98</b> | <b>100.00</b> |

total reviews). In 2020, there were 1564 reviews, which declined to only 520 in 2021. The number of reviews increased to 1634 in 2022 after the COVID-19 pandemic subsided, as shown in Table 2.

The change in the number of reviews from year to year corresponds to change in the number of visitors to Pattaya City (including both Thai and foreigners) and the circumstances related to the COVID-19 pandemic. During normal circumstances (2017–2019), the number of visitors tended to increase. We found that for the periods 2017–2018 and 2018–2019, the number of visitors increased by 6.22 % and 2.71 %, respectively; thus, the number of reviews also tended to increase. During the COVID-19 pandemic in 2019–2020 and 2020–2021, the number of visitors decreased by 62.56 % and 59.60 %, respectively, resulting in a reduction in the number of reviews. When the COVID-19 situation improved, the government allowed both domestic and international travel. We found that from the end of 2021 through 2022, the number of visitors increased by 421.90 % [71]. Correspondingly, the number of reviews also increased in the same period, as shown in Table 2.

#### 4.2. Sentiment of restaurant reviews

The VADER model was employed to analyze the restaurant reviews, and we found that the accuracy was 84.50 %. As shown in Table 3, most customers had positive sentiment (13,183 reviews, representing 88.60 %), followed by negative sentiment (869 reviews, representing 5.84 %) and neutral sentiment (828 reviews, representing 5.56 %). These findings clearly reveal that most Pattaya restaurant customers provided positive sentiments, with neutral and negative sentiments having similar values. Each year, the percentages of positive sentiment ranged between 87.12 % and 89.79 %, neutral sentiment ranged from 5.02 % to 6.20 %, and negative sentiment varied from 4.87 % to 7.71 %. During the COVID-19 pandemic, the percentages of positive sentiments tended to decline, and the percentages of negative sentiment tended to increase. The negative sentiment was the lowest in 2017 at 4.87 %, and thereafter it tended to increase until 2022, at which time it reached 7.71 %.

In this study, the Wilcoxon signed-rank test was used to describe the difference in restaurant customer sentiments in Pattaya before and during the COVID-19 pandemic. On average, the number of positive sentiments before the pandemic (*Mdn* = 275.50) was greater than the number of positive sentiments during the pandemic (*Mdn* = 64). The Wilcoxon signed-rank test results confirmed that the improvement was statistically significant (with *n* = 36, *Z* = 5.19, *p* = .00). A significant difference was observed in the neutral sentiment between these two periods, i.e., before the pandemic (*Mdn* = 16) and during the pandemic (*Mdn* = 4) (*n* = 36, *Z* = 5.06, *p* = .00). Finally, the results of the negative sentiment statistical test were comparable to those of the two previous classes. The number of negative sentiments prior to the pandemic (*Mdn* = 15) was greater than the number of negative sentiments during the pandemic (*Mdn* = 6), and the Wilcoxon signed-rank test results suggested that this was statistically significant, with *n* = 36, *Z* = 4.23, and *p* = .00, as shown in Table 4.

The sentiment analysis of restaurant reviews over the first three years of the study period (2017–2019) revealed that positive reviews were the most numerous and highly concentrated, with sentiment scores ranging from 0.0516 to 0.9886. The scores for the neutral and negative sentiments were −0.0454 to 0.0387 and −0.9576 to −0.0511, respectively. However, the neutral and negative sentiments were still concentrated in the same area as positive sentiments, as shown in Fig. 3(a)-3(c). During the COVID-19 pandemic in 2020–2022, the density of the sentiment data was reduced significantly. Upon closer examination, we found that there was little difference between the periods before and during the pandemic. The positive sentiment scores varied from 0.0516 to 0.9843, and the neutral and negative sentiment scores ranged from −0.0289 to 0.0258 and −0.9360 to −0.0516, respectively, as shown in Fig. 3(d)-3(f).

#### 4.3. Word frequency in restaurant reviews

In the following, we discuss the top-10 most frequent words extracted from the 14,880 TripAdvisor restaurant reviews from the periods before and during the COVID-19 pandemic. Here, the word frequencies were classified into those positive, neutral, and negative reviews, as shown in Fig. 4(a)-4(c) (before the COVID-19 pandemic) and 4(d)-4(f) (during the COVID-19 pandemic).

As shown in Fig. 4(a)-4(c), the most common word before the pandemic was “food,” which appeared in positive, neutral, and negative reviews, and “Pattaya,” i.e., the name of the study area, also appeared in all three classes. In addition, positive emotion words included “good,” “great,” “nice,” and “friendly,” whereas negative emotion words appeared, i.e., “bad” and “poor.” In addition, the

**Table 3**  
Numbers and percentages of positive, neutral, and negative sentiments in Pattaya restaurant reviews 2017–2022.

| Year         | Positive      |       | Neutral     |      | Negative    |      | Total reviews |
|--------------|---------------|-------|-------------|------|-------------|------|---------------|
|              | Number        | %     | Number      | %    | Number      | %    |               |
| 2017         | 3025          | 89.79 | 180         | 5.34 | 164         | 4.87 | 3369          |
| 2018         | 3254          | 89.57 | 191         | 5.26 | 188         | 5.17 | 3633          |
| 2019         | 3657          | 87.91 | 258         | 6.20 | 245         | 5.89 | 4160          |
| 2020         | 1368          | 87.47 | 88          | 5.63 | 108         | 6.90 | 1564          |
| 2021         | 453           | 87.12 | 29          | 5.58 | 38          | 7.30 | 520           |
| 2022         | 1426          | 87.27 | 82          | 5.02 | 126         | 7.71 | 1634          |
| <b>Total</b> | <b>13,183</b> |       | <b>828</b>  |      | <b>869</b>  |      | <b>14,880</b> |
| <b>%</b>     | <b>88.60</b>  |       | <b>5.56</b> |      | <b>5.84</b> |      | <b>100.00</b> |

**Table 4**

Wilcoxon signed-rank test of restaurant customer sentiments in Pattaya before and during the COVID-19 pandemic.

| Sentiment class | n  | Z     | p    |
|-----------------|----|-------|------|
| Positive        | 36 | -5.19 | 0.00 |
| Neutral         | 36 | -5.06 | 0.00 |
| Negative        | 36 | -4.23 | 0.00 |

Fig. 3(a)-3(f) show the sentiment analysis distribution from the VADER model. Here, the sentiment scores ranged from 1 to -1 and were classified as positive ( $\geq 0.05$ ), neutral ( $> -0.05$  and  $< 0.05$ ), and negative ( $\leq -0.05$ ). Here, each point represents a restaurant review.

term “good” was the eighth most frequently used in the negative reviews. When the corresponding comments were examined more extensively, we observed that, first, “good” was combined with other words that indicated negative emotions, e.g., “not good” and “nothing good.” Second, we found that the word “good” was combined with other words that conveyed positive emotions, e.g., “good service” and “good location.” When the score was combined with the other words in the sentence, the result indicated an overall negative sentiment. While words like “Indian” and “Thai” were more prominent in neutral reviews, they were derived from specific phrases, e.g., “Indian food,” “Indian restaurant,” “Thai food,” and “Thai restaurant.”

Fig. 4 (d) to 4(f) show the frequency of the top-10 words during the COVID-19 pandemic (2020–2022). Here, the most frequent word remained “food,” and the positive emotional words remained the same, i.e., “good,” “great,” “nice,” and “best.” Similar to the pre-pandemic period, “bad” was the most frequently identified word in the negative reviews.

No words related to the COVID-19 pandemic and food delivery were found in the extracted top-10 word frequencies Fig. 4(a)-4(f). As a result, the following describes the extraction of words related to the COVID-19 pandemic and food delivery, which is directly related to the situation of restaurants during the COVID-19 pandemic.

Table 5 shows that the following words related to the COVID-19 pandemic were solely discovered during the active pandemic period: “covid,” “corona,” “virus,” “pandemic,” and “lockdown,” almost all of which appeared in positive reviews. Note that the word “covid” appeared 37 times in positive reviews but appeared less frequently in both neutral and negative reviews. In addition, the words “delivery” and “takeaway” were discovered more before the pandemic than during the pandemic period, and most of them were found in positive reviews.

Negative reviews provide critical information to restaurant owners and managers, and such information can be utilized to manage and improve service in response to customer requests, especially during the pandemic. As a result, we extracted the customer reviews from the top-10 negative words and categorized them into four topics, i.e., SS, FT, CH, and ED. According to the findings, customers criticized restaurants the most in terms of the SS topic. In the 36 months prior to the pandemic, there were 243 reviews (49.90 %); however, during the pandemic, the number of negative reviews decreased to 100 (45.46 %). The second topic customers complained about was FT. Prior to the pandemic, there were 196 reviews (40.24 %), and during the pandemic, there were 115 reviews (52.27 %). In terms of the ED topic, we found that prior to the pandemic, 35 reviews (7.19 %) reported this issue, which was reduced to only two reviews (0.91 %) during the pandemic. In the final topic, i.e., CH, prior to and during the pandemic, there were 13 (2.67 %) and three (1.36 %) reviews, respectively, as shown in Table 6.

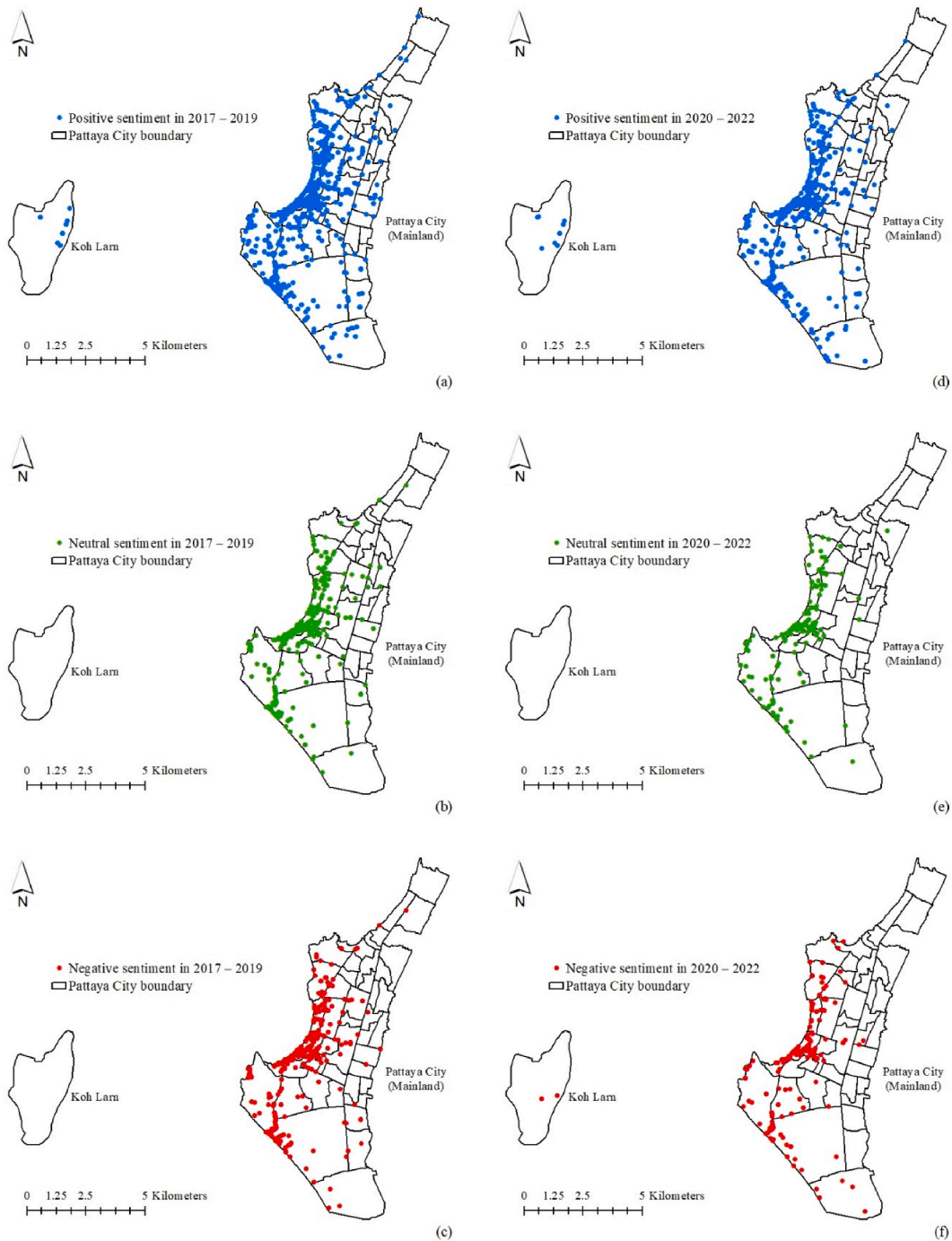
## 5. Discussion

### 5.1. Restaurant reviews and sentiment analysis

The large volume and variety of online review data can be exploited for business purposes by managing and analyzing the data using NLP and sentiment analysis techniques. The findings can then be used to manage and plan to satisfy customer requirements. It can be difficult to gather data through interviews, particularly in the context of the COVID-19 pandemic; thus, data acquired from social media or other online platforms represent an effective alternative for convenient, quick, secure, and up-to-date data access. Restaurant customer reviews published on websites, e.g., TripAdvisor, represent valuable information, particularly text reviews and ratings that customers can use to inform decisions regarding a restaurant, and restaurant owners can use such information to manage and improve services to satisfy customer requirements. However, during the COVID-19 pandemic, restaurants around the world were directly and severely affected, and restaurants in Pattaya were no exception.

The Wilcoxon signed-rank test was performed to examine whether there was a difference in the number of monthly reviews before and during the COVID-19 pandemic. The findings confirmed a significant difference in the number of reviews (positive, neutral, and negative) in each month both prior to and during the pandemic. Almost every month before the pandemic received more reviews than during the pandemic. With the exception of 2020 (January to February) when the pandemic began, we found that the number of reviews in this period was higher than prior to the pandemic. After that period, the number of reviews declined dramatically in March 2020 and decreased markedly during April. The Thai government enforced a state of emergency to control the spread of COVID-19 from March 26, 2020 onward, and various regulations were put in place, e.g., closing locations prone to spreading diseases, stadiums, pubs, bars, and restaurants, as well prohibiting travel to Thailand [72]. Nonetheless, the COVID-19 pandemic still spread to various areas across the country; thus, the government announced a curfew from April 3, 2020 onward that restricted people from going outside between 10:00 p.m. and 4:00 a.m [73]. Later, when the circumstances of the COVID-19 pandemic improved in Thailand,





**Fig. 3.** Restaurant review sentiment distribution in Pattaya City for the periods (a–c) 2017–2019 and (d–f) 2020–2022.

the government eased several measures, including allowing dine-in at restaurants. The curfew was lifted on June 15, 2020 [74,75]. Although some measures were relaxed, COVID-19 controls still required careful surveillance. As a result, the government closed the country throughout all of 2021 by banning international tourists from entering and limiting travel and tourism within the country. As a result, the year 2021 exhibited the lowest number of reviews. In late 2021, the government began to relax restrictions by permitting travelers to enter the country subject to a number of conditions, e.g., providing a certificate of laboratory testing confirming that travelers are free of COVID-19 and presenting a vaccination certificate [73]. Thus, by the end of 2021 until 2022, tourism began to revive, and the number of tourists increased, thereby resulting in an increased number of TripAdvisor restaurant reviews.

Restaurant reviews published on online platforms, e.g., TripAdvisor, significantly influence consumers' decisions when selecting a

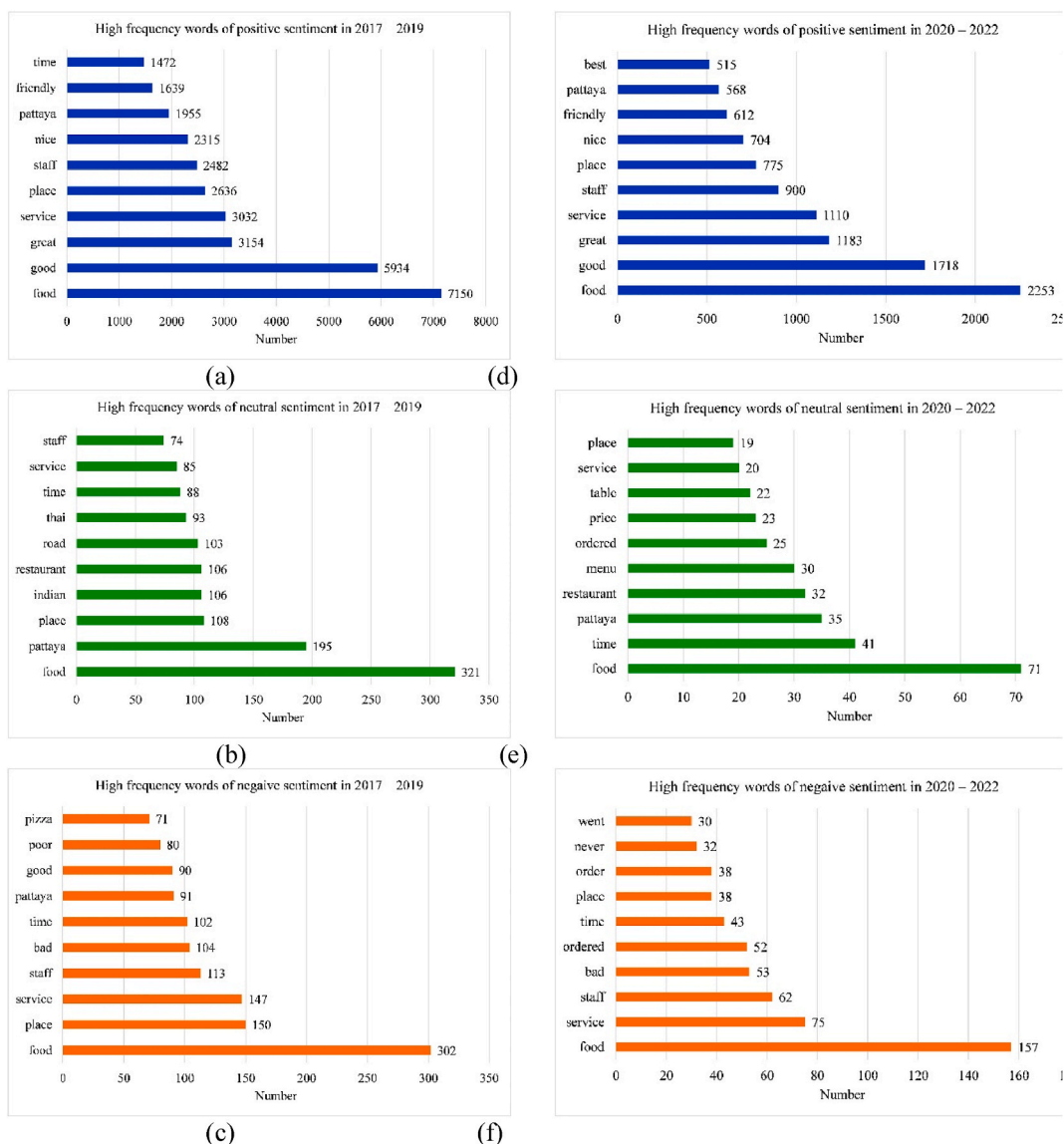


Fig. 4. Top-10 words in positive, neutral, and negative classes from restaurant reviews before and during the COVID-19 pandemic.

Table 5

Frequency of words from restaurant reviews that related COVID-19 and food delivery before and during the COVID-19 pandemic.

| Word     | Before COVID-19 pandemic |         |          | During COVID-19 pandemic |         |          |
|----------|--------------------------|---------|----------|--------------------------|---------|----------|
|          | Positive                 | Neutral | Negative | Positive                 | Neutral | Negative |
| covid    | –                        | –       | –        | 37                       | 2       | 1        |
| pandemic | –                        | –       | –        | 4                        | 1       | 2        |
| corona   | –                        | –       | –        | 4                        | –       | 1        |
| virus    | –                        | –       | –        | 3                        | –       | –        |
| lockdown | –                        | –       | –        | 9                        | 1       | 1        |
| delivery | 50                       | 4       | 5        | 35                       | 2       | 2        |
| takeaway | 21                       | 1       | 4        | 14                       | 2       | 1        |

restaurant, particularly one with positive scores or a 4–5 rating score. In other words, consumers tend to avoid restaurants with negative reviews or low rating scores. The sentiment analysis results obtained in this study confirm that during the COVID-19 pandemic (from 2020 to 2022), the proportion of negative reviews increased compared to before the pandemic. Due to customers' concerns about safety and hygiene, and due to limiting the number of customers eating at the restaurant during this time, online

**Table 6**

Number and percentage of restaurant reviews based on the top-10 words in negative classes before and during the COVID-19 pandemic.

| Topics                          | Before COVID-19 pandemic |               | During COVID-19 pandemic |               | Total      |               |
|---------------------------------|--------------------------|---------------|--------------------------|---------------|------------|---------------|
|                                 | Number                   | %             | Number                   | %             | Number     | %             |
| Service and staff (SS)          | 243                      | 49.90         | 100                      | 45.46         | 343        | 48.51         |
| Food and taste (FT)             | 196                      | 40.24         | 115                      | 52.27         | 311        | 44.00         |
| Cleanliness and hygiene (CH)    | 13                       | 2.67          | 3                        | 1.36          | 16         | 2.26          |
| Environment and decoration (ED) | 35                       | 7.19          | 2                        | 0.91          | 37         | 5.23          |
| <b>Total</b>                    | <b>487</b>               | <b>100.00</b> | <b>220</b>               | <b>100.00</b> | <b>707</b> | <b>100.00</b> |

customer reviews tended to be more negative during this period. This observation agrees with the findings of Jia [18], who stated that customer reviews of restaurants decreased, satisfaction dropped significantly, and expenditure fell during the COVID-19 pandemic.

Upon examining the word frequency trends during the pandemic, we found that the top-10 most frequent words did not include any words related to COVID-19 or delivery. To ensure that customers expressed their opinions about COVID-19, these keywords were employed in a search for restaurant reviews related to COVID-19, e.g., “covid,” “corona,” “virus,” “pandemic,” and “lockdown.” The findings revealed that there were very few reviews about COVID-19, with most reviews being positive. In addition, words involving delivery and takeaway were not found among the top-10 frequent words. During this period, most people were encouraged to order more food online or to order takeout. The main reasons why there were fewer reviews concerning COVID-19 and delivery than there should have been. Due to the spread of COVID-19, precautions were put in place to prevent tourists from visiting Pattaya, especially foreigners, who account for the greatest proportion of Pattaya’s tourists. Another significant factor was that most restaurants in Pattaya were closed. As a result, there were fewer customers and reviews related to the impact of COVID-19 on Pattaya restaurants declined.

The words most frequently found in negative reviews during the COVID-19 pandemic included “food,” “service,” “staff,” and “bad,” and the words most frequently found in positive reviews were “food,” “good,” “great,” and “service.” For example, the most negative (−0.9360) review mentioned the unpleasant taste of food and included the words “bad,” and “taste.” For example, one review stated: “Giant prawn bad taste. Even oven potato bad taste. Calamari fried I easily cut chew. Shrimps bad taste. Very disappointing I wasted 22 \$ bin.” The most positive evaluations (0.9843) emphasized delicious food and exceptional service using the words “great,” “superb,” and “best.” This review stated: “Visited new friends, great food usual, waitress service superb, and Charlies Angels great fun, one best restaurants anywhere, Thanks Jordi Eddie, and great staff.”

Despite the fact that the COVID-19 pandemic had a severe negative impact on customers and restaurant owners, a positive impact was observed for some customers. According to some reviews, ordering food online for delivery during the pandemic was convenient and did not require waiting in long queues at restaurants. For example, one review stated: “Still enjoy dining Covid restriction ordering delivery option. Delivery available Line application. They serve 1–2 h ordering. Good option don’t want wait long queue.” In addition, a new business emerged during the pandemic, i.e., food delivery business, which has a large number of clients and has been consistently popular to date.

The top-10 most frequent words in the negative reviews were examined to identify specific issues expressed by customers in terms of the four different topics. Initially focusing on the COVID-19 pandemic, we found that customers mentioned FT the most, followed by SS, ED, and CH. In terms of the FT topic, most customers complained that the food tasted awful, and others mentioned that the food was undercooked or overcooked, the portion size was too small, and the ingredients were low quality. In terms of the SS issue, most consumers complained about staff behavior, e.g., poor service, being impolite or rude, and not paying attention to the customers. In addition, some customers reported that the food was overpriced and not worth the cost. Another problem in this topic was having to wait too long for food. CH was the third topic addressed by customers. Here, we found that three cases involved customers becoming ill after dining at the restaurant. Customers were least likely to complain about ED, which they were observed to be complaining about the environment outside of the restaurant.

However, prior to the pandemic, there were customer reviews of the top-10 most frequent words in the negative reviews. According to our findings, customers complained the most about the SS issue. Customers, as they did during the pandemic, were the most critical about staff behavior. Here, the customer concerns included unprofessional staff, unwillingness to service, impolite speech, and high food prices. These problems were quite similar to those identified in the period prior to the pandemic. In terms of reviews, the FT topic came in second. In this context, customers complained about the awful taste of the food, the insufficient amount of food for the price, and the poor quality of the food. While evaluating the ED topic, customers pointed out a variety of issues, including the restaurant’s standing on the roadside, noise from passing vehicles, being bothered by mosquitoes, and the restaurant’s difficult location. The final topic is CH, where customers complained about many problems, including becoming sick from eating the food, the smell of pet urine, pets inside the restaurant, and a dirty dining table.

A study of the problems confronting the Pattaya restaurant industry found similar issues both before and during the pandemic. The most pressing issue was the quality of food and service. The issues discovered at restaurants are consistent with those identified by previous studies [12,76]. The difference in results between before and during the pandemic was that before the pandemic, customers mentioned SS issues most frequently. In contrast, during the pandemic, customers mentioned FT issues most frequently. In addition, customers complained of more ED-related concerns prior to the pandemic than during the pandemic. This difference can be explained by the fact that during the pandemic, restaurants were compelled to follow social distancing measures, restrict the number of customers sitting and eating at the restaurant, and most importantly, most restaurants were closed or switched to delivery or takeaway formats; thus, most customers could not visit the restaurants and did not receive direct service. As a result, during the pandemic,

customers complained about food quality and taste more than any other issue. In addition, an interesting point should be noted here, i.e., the CH issue, in which customers expressed a few comments about the cleanliness and hygiene in restaurants, particularly during the pandemic. As a result, there is a lack of knowledge on this subject to improve restaurant operations. Thus, this research gap should be studied in greater details in the future.

### 5.2. Impact of COVID-19 on restaurant business-related food tourism in Pattaya

Thailand's economic stability is partly dependent on the tourism and hospitality sectors. When tourism was disrupted by the COVID-19 crisis, the country's economy suffered enormous damage. A review of previous research revealed that several studies on the impacts of COVID-19 on tourism and hospitality have been conducted; however, very few studies have specifically investigated the impact of COVID-19 on food tourism. As mentioned previously, Pattaya is one of the most significant tourist attractions in Thailand and was severely impacted by both the lockdown measures and travel prohibitions. Tourist expenditure data (for both Thai and international tourists) from Pattaya before the pandemic in 2019 indicate that tourists spent 22.42 % on food and beverages [64]. As a result, when Pattaya was closed, tourism-related business came to a halt, and 25 % of Pattaya's food-service business income was lost. The variety of restaurant types, ranging from street food to fine dining restaurants, is the driving force of Pattaya's food-service industry. In addition, there is a wide range of international cuisines, including Thai, Indian, Italian, and Russian cuisine. Piboonrunroj et al. [33] highlighted positive signs that food tourism continues to play an important role in promoting the Thai economy, especially after the COVID-19 pandemic because Thai food remains a major tourist attraction. As a result, restaurant owners and managers should use the findings of this study to enhance their businesses practices, particularly in terms of the quality of food and service. Resolving these issues will help Pattaya's tourism recover and grow after COVID-19.

### 5.3. Theoretical implications

This study utilized the VADER model to analyze the TripAdvisor restaurant reviews. VADER is a lexicon and rule-based sentiment analysis algorithm that can be used to evaluate social media review data due to its various advantages. First, VADER's dictionary is particularly effective with social media reviews. Second, VADER provides details about sentiment scores, motivation, sarcasm, and guidelines to measure positive, neutral, and negative sentiment accurately. Third, VADER is open source, it can be used instantly online, and is unaffected by speed-performance tradeoffs. Fourth, VADER does not require training data and is built on man-made gold standard vocabulary. Finally, the VADER model can recognize emojis and process massive amounts of data [36,77–79]. With these advantages, the results obtained by the VADER model are highly precise and useable. According to previous studies, various levels of sentiment analysis accuracy have been obtained using the VADER model. For example, Min and Zulkarnain [66], Bonta et al. [78], Al-Shabi [80], and Wilksch and Abramova [81] obtained accuracy values of 79 %, 77 %, 72 %, and 57 %, respectively. In the current study, the results revealed an accuracy value of 84.50 %, which is acceptable for practical application. In addition, we have confirmed that the VADER model can be applied effectively to examine sentiment from online tourism and service industry customer reviews; thus, we will continue to use the VADER model in subsequent research.

The findings of this study strongly suggest that the sentiment analysis approach employing online reviews is well suited to assessing the satisfaction of tourists or customers regarding tourism and services during this crisis circumstance. Understanding customers' in-depth desires is consequently critical knowledge for developing marketing strategies to satisfy their needs [82]. Online reviews, particularly those from TripAdvisor, a prominent website for e-tourism social networks, are a valuable source of free information that demonstrates honest customer behavior [83]. We can affirm that TripAdvisor can be utilized to extremely effectively investigate restaurant customer behavior. Additionally, TripAdvisor's online reviews can be utilized to conduct studies on customer and tourist behavior in the context of tourism attractions, accommodations, and other related businesses.

### 5.4. Managerial implications

In this study, two key findings, i.e., the results of sentiment analysis and word frequency analysis, were utilized to classify and rank the problems in Pattaya restaurants. According to our findings, the most important issues are related to the SS and FT topics. The combined proportion of customer complaints regarding these issues was greater than 80 %, which indicates that customers were more concerned with the quality of food and service [12,19,23]. In particular, the issues of poor staff behavior, awful taste, and low food quality should be addressed and resolved as a priority. The issue of poor staff behavior is one of those that needs to be addressed immediately. We recommend that restaurant owners or managers organize staff training on customer service standards and manners. Furthermore, an English training course should be managed so that they can communicate with customers more effectively. Another interesting study found that the reviews of high food prices accounted for 11.29 % and 15.45 % before and during the pandemic, respectively. The reviews demonstrated that several restaurants in Pattaya charged exorbitant prices for their food, and some customers were displeased with this pricing. As a result, pricing issues should be addressed urgently as well. To take action on this issue, the agencies directly responsible for food prices, namely the Office of Commercial Affairs Chon Buri (Pattaya Branch), and the Office of Pattaya City, need to visit the area to inspect food prices in Pattaya restaurants and prevent restaurants from selling food at exorbitant prices, as well as strictly punishing restaurants that do so. The other two issues, i.e., the ED and CH topics, were the third and fourth most important issues. Customers mentioned these two issues less frequently during the COVID-19 pandemic because most of the restaurants in Pattaya were closed due to the lockdown and travel restrictions. However, restaurants should not disregard these issues, particularly the cleanliness factor. Customers were more worried and paid more attention to CH when eating at restaurants as a result

of the spread of COVID-19 [20]. Even though the COVID-19 situation has been resolved, restaurants should continue to implement the best practices followed during the pandemic.

## 6. Conclusions

In this study, we conducted sentiment analysis of online restaurant reviews or eWOM data from TripAdvisor before and during the COVID-19 pandemic in Pattaya, Thailand using the VADER model. This study reveals that both objectives were met successfully. The first objective was to analyze and compare customer reviews before and during the COVID-19 pandemic. According to the findings, the COVID-19 pandemic resulted in a significant reduction in the number of restaurant reviews compared to normal circumstances. Based on the customer experiences expressed in the acquired TripAdvisor reviews, we found that throughout the pandemic, negative reviews increased, and positive reviews decreased. The second objective was to interpret and describe the customers' evaluation of restaurant services from emotional words and customer reviews before and during the COVID-19 pandemic. We can achieve this objective by having most reviews focused on the quality of food and service, which was associated with the commonly used words "food," "service," "staff," and "restaurant." In addition, most customer reviews contained various words, e.g., "good," "great," "nice," "bad," and "poor" to express both positive and negative emotions. Based on the findings of this study, we suggest that the most serious issues requiring improvement are service and staff, followed by FT, ED, and CH. The current study fills a research gap in sentiment analysis from online restaurant reviews, particularly in Pattaya, which appears to suffer from a significant lack of knowledge on the subject. The findings of this study are expected to help manage and solve problems in restaurants in Pattaya after the COVID-19 pandemic.

During the course of this study, we observed three limitations, which are discussed in the following. First, we only examined restaurant reviews from TripAdvisor, which may be biased because data were only collected from a single source. Thus, in future work, it would be beneficial to acquire review data from multiple sources to acquire more diverse and comparable data. Second, the restaurant review data considered in the current study were taken from the period 2019 to 2022, with 2022 being the year in which when COVID-19 conditions began to improve. Thus, the study period should be extended to obtain additional information about customer reviews, behaviors, and needs in response to the COVID-19 pandemic, which may then be utilized to improve restaurant services. Finally, the VADER model is well-suited to assessing social media reviews; however, other models are equally effective. Thus, in future research, models could be adopted and compared with the results of the VADER model in order to improve accuracy.

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## Data availability statement

Data will be made available on request.

## CRedit authorship contribution statement

**Narong Pleerux:** Project administration, Funding acquisition, Methodology, Visualization, Writing - original draft, Writing - review & editing. **Attawut Nardkulpat:** Methodology, Formal analysis, Data curation, Validation.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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