

Using Voyant Tools for Data Mining Social Media Comments about a Destination: A Guam Study

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Abstract : Advances in technology play an important role in the tourism industry, constantly allowing both consumers and producers of tourism products to access new information about tourism services. Tourists and residents are generating their own content on social media by sharing their views and experiences. New analytical approaches are now available to streamline the analysis of destination perceptions for tourism stakeholders, with data visualization tools examining semantic relationships and meaning in reviews. This paper explores a methodology using a specific open-source tool, Voyant Tools, and discusses a way to analyze large amounts of text. Results using comments from the website, TripAdvisor.com, about Guam's popular attraction, Ypao Beach Park, will be discussed as an example for destination stakeholders seeking to capture the perceptions of residents and visitors who frequent the site. The article concludes by recommending further research in tourism for specific markets as part of a broader data visualization approach.

Keywords: Data visualization, tourism, hospitality, sentiment analysis, social media, marketing

Introduction

The Micronesian island destination of Guam has been known as a popular vacation spot for international visitors from Asian metropolitan areas. In the year before travel restrictions in 2020 due to COVID, Guam the most visited of the Micronesian islands with a population of 153,836 (US Census Bureau, 2022), received a record 1.6 million tourists. These tourists originated mainly from the source markets of South Korea (45%), Japan (40.8%), the US (5.8%), and Taiwan (1.7%) (Guam Visitors Bureau, 2019). Guam, like small island territories or nations in the Pacific, faces various challenges within its tourism industries. These include vast distances from source markets, too much reliance on foreign investment and the resulting leakage of revenue, over-dependence on tourism (a mono-structured economy), dependence on imports, and overburdened infrastructure, just to name a few (Gössling 2003; Harrison 2004; McElroy 2006). With the outbreak of COVID-19 in late 2019, we can add to these challenges, the burden of finding ways to reinvigorate the tourism industry which was virtually non-existent due to international travel restrictions during the pandemic. Destination stakeholders can benefit greatly by accessing recently culled data of visitors and analyzing perceptions of their destination.

When making decisions regarding a trip, consumers have a variety of information sources available from which to choose, from induced sources or messaging controlled by the supplier, and organic sources consisting of

messaging not controlled by the tourism supplier (Cook et al., 2018). Information often does not come from official information providers, such as national tourism organizations (NTOs), but from other forms of media. These include social media and other online sites which are accessed via search engine results (Inversini and Buhalis, 2009). Xiang & Gretzel (2010) have referred to social media as being generally understood as internet-based applications that encompass media impressions created by consumers, typically informed by relevant experiences, and archived or shared online for easy access by other impressionable consumers. Because of social media's ease of use and accessibility, the medium has enabled a wide range of users to share opinions, especially in travel and tourism and often in real-time.

For the abovementioned reasons, the travel and tourism industry offers a wealth of data for the field of social media analytics. It has been vital for tourism organizations to recognize tourist trends so that they can identify and deliver unique services in an industry where commoditization is prevalent. It is also critical for destination managers to monitor the perceptions of residents to maintain their buy-in to support the tourism industry. Various tourism scholars have published works on this concept through the social exchange theory and how the theory applies in the field of tourism (Allen et al., 1993; Getz, 1994; Gursoy et al., 2002; Jurovski and Gursoy, 1997; Madrigal, 1993; Perdue et al., 1990; Pizam, 1978; Yoon et al., 2001). The buy-in improves the willingness of residents to participate in an exchange with tourists, an important consideration for the sustainable development of a tourism destination as resident participation is critical to success factors such as enhancing the visitor experience, minimizing leakage, and maintaining cultural authenticity (Schumann, 2021). Data culled from social media can provide valuable sentiment and semantic information, which is helpful in predictive analytics.

This paper explores a methodology using a specific open-source tool, Voyant Tools, to analyze the data available from social media to measure the perception of visitors to a popular Guam destination. The purpose of this paper is to show that by this tool and methodology, travel and tourism organizations can supplement other data collection methods to better understand the perceptions of resident and non-resident visitors to their destinations.

Voyant Tools

Voyant Tools (<https://voyant-tools.org/>) is a free, web-based data visualization and analysis tool used for documents, articles, and books. It was designed to facilitate reading and interpretive practices for digital humanities students and scholars as well as for the general public. It has been developed to function as a one-stop-shop for text analysis, offering an easy-to-use interface that processes text in seconds. Voyant features a package of 29 analytical tools, all supported by highly interactive, rich visualization effects. A user's compilation of text or collection of texts gathered from external sources can be used and uploaded in a variety of formats, including plain text, HTML, XML,

PDF, RTF, and MS Word. The platform accepts texts of any size and type and it permits the analysis of texts composed in 13 languages.

Voyant Tools is especially useful with large textual data sets when content analysis methods are extremely time-consuming. It can organize text into a series of interactive lists, charts, graphs, and networks and the application then allows users to maneuver through the resulting visualizations, to further explore the text from different angles, such as term frequencies, contexts, and relations (Calado, 2018). The gathered data from the inputted text can be displayed in a variety of ways, using links, the TermsBerry tool (a tool that provides a way of exploring high-frequency terms and their collocates), and bubble lines, thus allowing the user to analyze data by finding the most used words or phrases and their frequency throughout the text. The Voyant Tools interface consists of five panels with different text analysis tools, with the following text analysis tools available by default: 1) Cirrus, 2) Reader, 3) Trends, 4) Summary, and 5) Context.

The Cirrus tool is a word cloud that visualizes the frequency of words in a corpus or document and positions the words such that the terms that occur the most frequently are positioned centrally and are sized the largest. The algorithm goes through the list and draws words as close as possible to the center of the visualization. Small words are placed within spaces left by larger words that do not fit together snugly and the color of words and their absolute position are not significant. The Reader Tool is where the text is displayed for reading allowing the user to scroll down within the text reader to fetch more content and hover over words to show their frequency in the document. The user can also click on a word or search for it in the search box to see how often it appears in your corpus. The Trends tool (also known as the Terms Frequency Chart) provides distribution plots that represent the frequencies of terms across texts in the corpus with each series in the graph colored according to the word it represents. The Summary tool displays the number of documents in the corpus and the total number of words and unique words (multiple occurrences of words) in the corpus as well as other data concerning the vocabulary densities (the ratio of the number of words in the document to the number of unique words in the document) and the documents with the lowest vocabulary densities. And finally, the Contexts (or Keywords in Context) tool shows each occurrence of a keyword with its surrounding text (the context).

This Guam study provides an example of how Voyant Tools can be used by destination stakeholders, and uses a relatively small sample consisting of 1035 comments collected in June 2022 that were posted in the English language on TripAdvisor.com. The data set was culled from comments posted by reviewers of one of Guam's most popular attractions, Ypao Beach Park. According to TripAdvisor.com, this attraction ranks #2 out of 13 things to do in Tumon. Tumon is the centrally located village that is also considered Guam's tourism precinct with beaches within Tumon Bay, as well as international hotel brands and retail stores within the district. Ypao Beach Park is located in Tumon and

encompasses a large, public green area that has been traditionally frequented by both residents and visitors.

In mid-2020, the Guam Visitors Bureau (GVB) announced to the local media that Ypao Beach Park is being considered as a site for a USD 50 million development of a smart tourism park involving the development of multiple facilities (Perez, 2022). The announcement of the proposed plan created a division among residents as to the perceived priorities of the island's industry stakeholders with some residents expressing a desire to maintain green space in Tumon, while tourism officials expressed a need for new attractions (Leon Guerrero, 2022). In cases such as this, research instruments such as Voyant Tools can be useful to tourism stakeholders as one way to measure the perception of visitors to the park by analyzing text from public comments posted on social media. This method can not only measure, but also monitor perceptions over time and identify important trends.

Methodology

To make use of social media data, data extraction is necessary. Scraping data from social media platforms can be an important source of data and in most cases, the data generated by users on social media channels are readily available to organizations for research and marketing purposes. Social media scraping is a process of automatically extracting data from social media platforms such as Twitter, Facebook, and Instagram. Social media scraping bots are available programmed tools to automatically extract data and provide structured data that is ready to be analyzed. This enables organizations to update their strategies and better understand market trends. Web scraping is still a gray area in terms of the law; however, review data equates to facts/information/ideas, which are not protectable under U.S. copyright law. Scraping publicly available data is legal; there are no laws or regulations prohibiting it, but private information and copyrighted content are both protected by law and should be avoided (GDPR, 2022). Data from public posts that include information such as the date, location, number of likes, views, and comments, as well as text and media URLs, are considered publicly available data and are therefore permissible to use in research (Karatat, 2022). In recent years, web scraping and data mining companies have emerged to provide their professional programming services. This paper will focus on the analysis and practical use of collected data.

Comments posted under Ypao Beach Park in the "Things to do in Tumon" section were copied and included in the corpus for analysis. For this study, no distinction was made between residents and visitors when compiling English-language comments. However, comments were separated by year of posting and a pre-processing of the corpus was conducted by creating volumes by the year for each posted comment to allow for the analysis of the text by year.

In addition, stop words, were identified to fine-tune the results of the text analysis. Stop words are the words most common in any language (like articles, prepositions, pronouns, conjunctions, etc.) and do not add much information to

the text needed to be reviewed. Voyant automatically ignores several very common words, such as ‘the’, ‘a’, and ‘you’ and includes others in the Stopwords list, which can be examined and edited by selecting the options icon in the header region of the Summary tool. Additional stop words to omit were identified for this project due to their regularity (“Guam,” “Ypao,” “Beach,” and “Park”) and included in the Stopwords list to remove these words from Voyant Tool’s word cloud, also known as Cirrus Tool. In addition to the use of a word cloud, other lightweight text analytics methods such as word frequency lists, frequency distribution plots, and keyword in context (KWIC) were applied using Voyant Tools.

Comments posted in English by residents and visitors were analyzed quantitatively and visualized in various ways using the online toolset of Voyant Tools. In this study, four different analytical tools out of the twenty-nine offered by Voyant Tools were used to show how this free, web-based open-source application can be used by travel and tourism managers. These tools used in this study are the Cirrus tool, Trends tool, Contexts tool, and Correlation tool. Various settings were tested to demonstrate how input conditions influence the modeling of the textual data.

Findings and Analysis

The findings represented here are mainly for demonstration purposes as this study uses a relatively small data set to show how Voyant Tools can be used as a resource for travel and tourism organizations. As we review the findings, it is important to note that only a few of the 29 tools available in Voyant Tools are used in this study and that various other features of Voyant Tools’ interface and the analytics displayed can easily be customized by the user. The analysis page, by default, features five panels that represent different tools: *Cirrus*, *Reader*, *Trends*, *Summary*, and *Context*. The top section of every panel presents four option icons: ‘Help’, ‘Options’, ‘Tool’, and ‘Export’, whereas the bottom part offers a search box and a scale display, all adjustable based on user preference.

Figure 1 shows Voyant Tools’ user interface after uploading the corpus for this study on the Voyant Tools webpage. (Either uploading text files or copying and pasting text to the input field will initiate the analysis). As stated above concerning five default panels, the interface shows the Cirrus tool on the upper left, Reader tool in the top center, Trends tool in the upper right, Summary Tool in the lower left, and finally the Context tool in the lower right. These five panels present an overview of the many comments posted by residents and visitors on Tripadvisor.com as they relate to Guam’s Ypao Beach park as one of the island’s popular destinations.

separate documents (by year) that were then uploaded to Voyant Tools. This allows for a comparison of word frequency by year, which then allows for deeper analyses of the text posted in each calendar year. The Y-axis of the Trends tool graph shows the relative frequency that each word appears. The user can select specific words to track by inputting the words in the lower-left box, as Figure 3 displays the words fish, water, snorkeling, fishing, and parking. The increase in the frequency of the words “water” and “snorkeling” in 2021 may point to a need for deeper analysis as to the reason(s) for the change. Reviewing each occurrence of a keyword with a bit of surrounding text (the context) can be useful for studying more closely how terms are used in different contexts.

Table 1 is an example of how the Contexts (or Keywords in Context) tool displays each occurrence of a keyword with a bit of surrounding text (the context). The table view shows the following four columns: Document, (Titled “Year” in this table), which displays which keyword and contexts occur together; Left, which displays contextual words to the left of the keyword; Term, which displays the keyword matching the default or user-provided term query; and finally, Right, that displays the contextual words to the right of the keyword.

Table 1 and Table 2 show the results of the words “trash” and “clean.” Both words appear as the most frequently appearing words in the Cirrus tool, but they are seemingly contrasting words and should be analyzed in context. By reviewing the Context tool results in Table 1, we can review the contextual words to the left and right of the keywords to determine the context in which each reviewer used the term, and as a result, identify a pattern in the qualitative exploration of the text. In this case, we can see that the term “trash” is mentioned when referring mostly to items left by careless beachgoers, as well as references to lack of maintenance by park personnel. In Table 2, the term “clean” is frequently used primarily in reference to the water at Ypao Beach Park, as well as the beach area.

Table 1. Contexts Tool (Keywords in Context)

<i>Year</i>	<i>Left</i>	<i>Term</i>	<i>Right</i>
2017	come please take ALL your	trash	with you when you depart
2017	stepped due to all the	trash	, cans, and broken glass littering
2017	glass littering the grounds. No discourages	trash	cans are provided which
2017	anyone from cleaning up their	trash	. So sad!! I love Ypao
2017	facilities and there is frequently	trash	and you may find the
2018	kept park as people leave	trash	on the beach. The water
2018	love this beach. There is	trash	, there is noise, there is
2018	in the day. Everyday there's	trash	on the beach and in
2018	park. It overflows near the responsible	trash	containers. Don't know who's
2019	Why is it necessary to	trash	the surroundings? The coral is
2019	Things can get dirty with	trash	if the Parks department doesn't
2019	end of the weekend the	trash	can pile up. As with

Table 2. Contexts Tool (Keywords in Context)

Year	Left	Term	Right
2017	beaches in Guam. It is	clean	and not too crowded during
2017	people watching to be had.	clean	environment. Safe for the most
2017	calls for. The beach is	clean	with plenty of trees for
2017	nearby. The water is very	clean	and there are lots of
2017	great place to visit. It's	clean	and right by the beach
2017	a good job trying to	clean	the beach and keep the
2017	Good yellow coral sands, very	clean	water. Has a barrier of
2018	parking. The beach is so	clean	and calm. Good that this
2018	room and outdoor showers to	clean	yourself after swimming. Large area
2018	snorkeling and playing in the	clean	white sand is great. Ypao
2018	as well as nice and	clean	. The watercolor was AWESOME. But
2018	There is a shower to	clean	you up after a dip
2018	of KFC! and your set!!!!!	clean	park and beach, shallow waters
2019	beach is not the best	clean	one, though snorkelers surely enjoy
2019	small but it's nice and	clean	and the water is wonderfully
2020	do it. The beach is	clean	and so is the water
2021	and watchful. The beach is	clean	. The water is clear and

Collocates graph represents keywords and terms that occur in close proximity as a force-directed network graph. It generates a list of connections that exist between co-occurring words. As can be seen in Figure 4, the term “water” is selected as one of the most frequently used words, and it is directly linked to the words “parking,” “shoes,” “clean,” and “clear.” Upon a review of the data from the available tools, we can identify the links: Parking is near the water; Shoes should be worn in the water due to sharp coral; Water is described with the words clean and clear.

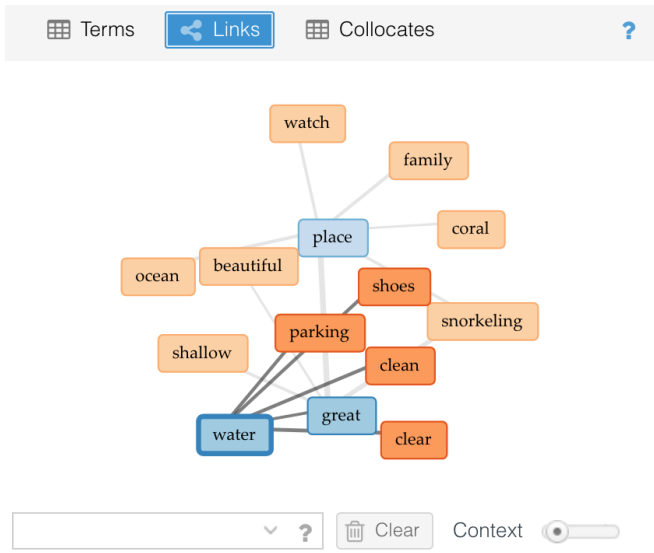


Figure 4. Collocates Graph

The Contexts tool introduced earlier is very useful in answering these questions about how frequently appearing words in the corpus are being used by examining their context usage. Measuring correlations can also be very helpful in determining the proximity of word pairs. Voyant Tool’s Correlations Tool reveals significant positive and negative correlations among frequent words, using Pearson’s and regression coefficients. The Correlations tool displays the pairs of words that display some statistical proximity. (The identification and inputting of stop words specific to the corpus is an important step for the accuracy of the Correlation tool.)

Table 3 displays data for this study in the four columns of the Correlation tool. The columns represent Term 1, Term 2, Correlation coefficient (“Correlation *r*”), and Significance (“Significance *p*”).

The correlation coefficient is calculated by comparing the relative frequencies of terms. A coefficient that approaches 1 indicates that values correlate positively, that they rise and fall together. Coefficients that approach 0 indicate little correlation. Approaching -1, terms correlate negatively (as one term rises, the other falls). The significance value is a measure of confidence in the correlation value. Often a significance of .05 or less indicates a strong correlation (which allows us to reject the null hypothesis that values are randomly distributed). The validity of this measure depends on assumptions about a normal distribution of the data and it is important to bear in mind that there may be a relatively small number of values (frequencies from texts in a document), so these values must be used with care.

Table 3 displays the results from the Correlation tool, using the keyword “family,” which is relevant in the case of Ypao Beach Park due to its popularity as a family destination.

Table 3. Correlation Tool

<i>Term 1</i>	←	→	<i>Term 2</i>	<i>Correlation (r)</i>	<i>Significance (p)</i>
bbq			family	0.78571427	0.00705792
beautiful			family	0.7293968	0.016667014
busy			family	0.52380955	0.12018079
crowded			family	0.52380955	0.12018079
clear			family	-0.4364358	0.20730484
clean			family	0.42857143	0.21654728
bit			family	-0.42857143	0.21654728
beaches			family	0.394771	0.2589022
day			family	0.35634834	0.31215996
amazing			family	-0.32732683	0.35588378
broken			family	-0.32732683	0.35588378
careful			family	-0.32732683	0.35588378

The results show the measuring of the correlation coefficient and the significance value as a measure of confidence in the correlation value. The bolded font highlights the word pairs with the coefficient approaching 1, which

indicates that values correlate positively and that they rise and fall together. The significance value for the highlighted word pairs also indicates a measure of confidence in the correlation value, with the significance of .05 or less often indicating a strong correlation. From the results below, we can infer that there is a strong correlation between the word pairs of “family” with “barbecue” and “beauty” in the visitor comments about Ypao Beach Park. Word pair correlations such as this example can provide deeper insight into the perceptions of visitors who provide feedback about specific destinations on a social media site.

Conclusions

Voyant Tools was initially developed for use in academic settings to support scholarly reading and interpretation of texts. The example in this study using comments from Tripadvisor.com show how the tools available in Voyant Tools might be valuable for professional purposes in the travel and tourism industry. Using time efficiently directly impacts cost-effectiveness and these tools can be invaluable in saving time and energy with the capability of analyzing large data sets such as thousands of pages of comments from an organization’s data collection. The tools that this paper presented using comments from Tripadvisor.com about Guam’s Ypao Beach Park vary in degree of sophistication and explanatory power. The tools selected for this paper are presented as examples for the demonstration of the possibilities Voyant Tools can offer. As operations management is increasingly dependent on Big Data analytics like data mining, Voyant Tools can serve as a useful and valuable supplementary technique.

This paper sheds light on evaluating and exploring large scales of online reviews in the tourism context for measuring the perception of (resident and non-resident) visitors to a destination. In terms of practical and managerial implications for travel businesses and tourism organizations, this research helps managers to discover how visitors experienced their destination and shared their understandings with others on online platforms, what kind of topics they tend to discuss more, and finally which aspects of the destination are more perceived as either positive or negative.

One of the limitations of this study is that the extracted data is only about a specific destination (Guam’s Ypao Beach Park), and other aspects such as sights and landmarks, transportation, or outdoor activities were not included in the analysis. Therefore, results must be interpreted carefully, and should not be generalized to be the same as other tourist destinations or attractions on the island. Future research can include more aspects of a specific destination to further develop the targeted sample, such as limiting the data to tourists from South Korea that commented on restroom facilities. Comparisons between resident and tourist sentiment as well as associations between sentiment results and visitors' overall ratings are also potential avenues for future studies.

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