The Impact of Climate and Weather on a Small Tourism Business: A wSWOT Case Study

Teaching Notes

ABSTRACT

Climatic variability and shifting weather patterns, resulting in extreme weather events and natural disasters, pose risks to small businesses in the United States. This is particularly true in coastal regions of the southeast United States where extreme events such as hurricanes, flooding, and thunderstorms are projected to increase in frequency and intensity. Yet, the vast majority of small business owners do not have a disaster plan in place and an estimated 40% to 60% of small businesses that have experienced a natural disaster never reopen. This teaching case explores the impact of climatic trends and weather on one location of an outdoor tourism industry business in the coastal community of Virginia Beach, Virginia. The case draws from observed weather and sales data for the local small business. Students will draw from descriptive statistics, statistical analysis, and graphs to explore: (1) long-term climatic trends for the business, (2) relationships between small business sales and local weather, and (3) strengths, weaknesses, opportunities, and threats relative to weather conditions and climate change.

OPTIMAL COURSES AND LEVELS

This interdisciplinary case is appropriate for upper-level undergraduate and graduate students in business fields as well as students in science, technology, engineering, and math (STEM) fields.

For business students, the value of the case is integrating STEM content related to climate change and weather to inform business decisions and strategy and the use of the accommodative wSWOT framework. Optimal target business courses include entrepreneurship and sustainability. The case is optimal for courses in entrepreneurship because it provides a methodological blue print to evaluate and understand important weather and business interactions and a framework (i.e., the wSWOT) that can be used to make business decisions. The case is optimal for courses in sustainability because it provides a framework (i.e., the wSWOT) to examine and quantify the economic and environmental components of sustainability. The case would also be appropriate for a variety of other business courses seeking to integrate STEM and sustainability topics into the curriculum including strategic management, applied business decisions, and general management.

For STEM students, the value of the case is applying STEM knowledge within a variation of a well-established business framework (SWOT) to make real-life business decisions. The optimal STEM courses include climatology and meteorology because: (1) the case provides a relevant quantitative research methodology related to weather and climate, and (2) the case provides a framework that outlines how weather and climate data can inform important business decisions. The case would be appropriate for a variety of other STEM courses seeking to integrate business and sustainability topics into the curriculum including environmental sciences, engineering, research methodology, and geography.

REQUIRED READINGS

Craig, C. A., & Feng, S. (2018). A temporal and spatial analysis of climate change, weather events, and tourism businesses. *Tourism Management, 67*, 351 – 361.

Metzger, E., Del Pino, S. P., Prowitt, S., Goodward, J., & Perrara, A. (2012). *sSWOT: A sustainability SWOT*. Washington, D.C.: World Resources Institute.

TEACHING APPROACH RECOMMENDATIONS

Prior to teaching the case, the instructor should require students to read Craig and Feng (2018) as well as Metzger et al. (2012). Craig and Feng (2018) will provide students with detailed information about weather and climate interactions with tourism businesses across the United States. The article will orient students with a variety of methodological techniques (e.g., descriptive statics, correlations, time-series forecasting) that can be used to analyze the supplementary business, weather, and climate data provided. Craig and Feng (2018) will also provide an example of how to interpret the findings from the case study. Metzger et al. (2012) will orient students with SWOT analysis and also provide an example of how to conduct SWOT analysis. The instructor can utilize information from the following two sections to assist with grading student assignments and teaching the case in class.

At the beginning of the teaching session, the instructor should ask students how local weather can influence business operations and customer behaviors. Teachers can lead students in a discussion of the trends relevant to the case from Craig and Feng (2018), including the including the positive impact of warmer days and the negative impact of extreme precipitation events on sales for tourism businesses across the United States. The instructor can then ask students to provide current event examples of extreme weather events that have impacted businesses (e.g., hurricanes, wildfire, floods) and also *how* the events impacted the business (e.g.,

interrupted operations, ability to reopen, resulted in insurance costs). Since threats are easier for students to identify, instructors need to help students appreciate that positive outcomes, or opportunities, can emerge from shifting trends.

Once students demonstrate they understand weather and extreme weather can have both positive and negative relationships with business outcomes, the instructor can then concentrate on long-term risks associated with climate change and shifting weather trends. The instructor can ask students to provide examples of long-term threats to businesses and also long-term opportunities for businesses as shown by Craig and Feng (2018). For example, a trend in warmer days and shifting seasonality in the long-term may offer some businesses an opportunity to increase sales and profit margins by increasing occupancy or charging different rates. Conversely, a trend in intense precipitation events may adversely impact sales by decreasing occupancy or causing physical damages to business assets. Students need to understand that short- and long-term climatic conditions cause both threats *and* opportunities and that businesses can take advantage of their own unique strengths and mitigate their weaknesses in addressing changing conditions. Metzger et al. (2012) cancan serve as as an example of a SWOT analysis and as a resource to help complete the discussion questions.

The instructor should allocate between 90 and 120 minutes to cover the case in class. Instructors can elect to have students conduct the analysis outlined in the student activity prior to the teaching session, or instructors can provide the output of the correlation analysis from Table 3 in the teaching notes. Instructors with students who have greater statistical competencies are encouraged to use additional methodologies such as hierarchical linear regression (i.e., where data is sorted by season to remove seasonality from the data) or retroactive time series forecasting which controls for seasonality. For instructors who wish to conduct the student

activity in class, or to conduct additional analysis, another 75 to 120 minutes should be allocated depending on student proficiency with data manipulation and statistical analysis. Craig and Feng (2018) provide additional information about statistical methods that can be used to analyze the supplementary data file. After students have completed the discussion questions, the instructor can then de-brief with students drawing from the instructor figure and statistics explanation section below in the teaching notes.

Insert Table 3

RELATION TO ACADEMIC LITERATURE

Because the case is focused on weather and climatic interactions with the business outcomes for CNA, a small entrepreneurial business in the outdoor tourism industry, the relationship of the case to the relevant academic literature is helpful to instructors. Accordingly, we provide a brief review of the literature related to outdoor tourism, weather and natural disasters trends, and the impact of the trends on outdoor tourism.

Outdoor Tourism

Tourism is one of the largest industries in the world and outdoor tourism accounts for the largest share of tourism business (Bigano, Hamilton, & Tol, 2006; Rutty & Scott, 2016). While weather conditions influence all organizations, clearly outdoor tourism businesses are particularly beholden to local conditions at any given moment. Changing climatic conditions and local weather influence location and activity decisions made by tourists (Bigano et al., 2006; Yu, Schwartz, & Walsh, 2009). Local conditions make outdoor tourism businesses economically vulnerable to past, present, and future weather (Craig et al., 2019; Craig & Feng, 2018). The

CNA Virginia Beach location makes an excellent choice of the case study because of its close proximity to the beach and reliance on tourists, which sets the stage for exploring the economic vulnerabilities (and opportunities) to weather and changing climatic conditions.

Natural Disasters and Extreme Weather

Climate change refers to long-term atmospheric behavior, whereas weather refers to short-term observations or events (NASA, 2005). For instance, extreme precipitation from a hurricane and warm weather in the artic are measures of weather, whereas the increase in the number of hurricanes during a season, the long-term trend of increasing sea-surface temperatures, and gradual seal level rise are all measures of climate. Businesses in coastal regions are susceptible to the economic and social impacts of climate-driven weather events due to the financial reliance on tourism, the large percentage of residents who reside in urban, coastal communities, and continued migration of residents to the communities (Craig & Feng, , 2018; FEMA, 2018; NOAA, 2017; United States Census Bureau, 2015). Climate-related weather threats are heightened across the southeast United States due to increasingly intense and frequent events (e.g., hurricanes, floods, and thunderstorms; Melillo, Richmond, & Yohe, 2014). While annual average precipitation levels have increased, the majority of precipitation is now attributable to intense events (Melillo et al., 2014). Preston (2013) estimates that the financial costs of climate change in the region will increase by almost four-fold over the next 25 to 35 years.

The southeast United States, where the focal CNA business is located, has experienced more billion dollar disasters than any other region over the past 15 years (NOAA, 2018a). Three of the five recorded Atlantic Ocean hurricane natural disasters that caused over $50 billion in damage occurred in 2017: Hurricanes Harvey, Maria, and Irma (NOAA, 2018a). These events

devastated coastal community economies throughout the southeast United States. Observed sea-surface temperatures have increased in recent years in the Gulf of Mexico and Atlantic Ocean, providing more energy to atmospheric systems and resulting in an increase in the intensity and severity of extreme weather events (Ingram et al., 2013; Melillo et al., 2014).

Trends and Tourism

Changing climatic conditions that attribute to weather trends in the region include an increase in average temperature, volume and intensity of precipitation, decrease in colder days, and shifts in seasonality (Craig et al., 2019; Craig & Feng, 2018; Monahan et al., 2016; Melillo et al., 2014). Generally, precipitation is negatively related to outdoor tourism activities, with extreme precipitation (i.e., over 10 millimeters (mm) in a day) demonstrating more salient relationships (Craig et al., 2019; Craig & Feng, 2018; Frich et al., 2002; Rutty & Scott, 2016). Based on a recent tourism survey, minimum temperatures below 23^{o}C (73.4^{o}F) are considered undesirable and the threshold for maximum temperature is 34^{o}C (93.2^{o}F; Rutty & Scott, 2016). Literature also suggests the early onset of the spring season across 76% of 276 outdoor tourism locations around the United States (Monahan et al., 2016). While CNA faces risks to sales that are related to extreme precipitation and temperature, opportunities simultaneously emerge related to trends in precipitation events, temperature trends, and seasonality shifts.

INSTRUCTOR FIGURE AND STATISTICS EXPLANATION

Climate Change and Weather Trends

As shown in Table 1, the strongest longer-term trend for the Virginia Beach location between 1990 and 2015 is related to precipitation. Precipitation increased by .63% per year over the study period. When taken into consideration alongside the 33.64% yearly decrease in cloud cover, the findings are consistent with historical data that rain is increasing primarily via intense events and not persistent, soaking events (Melillo et al., 2014). In the most recent 26 years from

1990 to 2015, minimum temperature increased by .038 °C per year for a total of .95 °C during the study period. The maximum temperature increased by .024 °C per year for a total of .60 °C during the study period. This increase is an indication that extreme temperature events, both hot and cold, may in fact be more influential than average temperature change during the study period.

Table 2 shows the descriptive statistics for the seasonal weather trends between January 1, 2007 and November 11, 2016 (exception cloud cover and wind speed). Precipitation is the greatest in the fall, which is likely attributable to the higher percentage of days where precipitation events over 50 mm and 100 mm occur, indicating very extreme events and possibly floods. Summer has a higher percentage of extreme precipitation events over 10 mm and 20 mm, thresholds that indicate localized severe precipitation, and by extension an increased likelihood of flash floods or storms. Average cloud cover remained fairly consistent throughout the study period, with wind speed noticeably dropping in the summer months. As shown in Figure 1, extreme precipitation events that identify potential natural disasters (>100 mm) increased from one event between 2007 and 2011 to six events between 2011 and November 11, 2016.

In terms of temperature, average maximum temperature of 29.95°C in the summer was on the higher end of the ideal temperature range of 27°C to 30°C for coastal tourists (Rutty & Scott, 2016). Over ten percent of the summer days are over the high temperature threshold of 34°C for tourists (Rutty & Scott, 2016). Over 40% of the days in the summer are also notably below the minimum temperature threshold of 23°C tourists reported as desirable (Rutty & Scott, 2016). Figure 1 shows trend lines for maximum and minimum temperature, both of which steadily increased throughout the study period. The figure also displays the slope of minimum

temperature which is slightly steeper. In 2014 and 2015, spikes in extremely cold minimum temperatures are present.

Impact of Weather on Sales

Mr. Lambo wants to understand how weather influenced sales. A correlation using matched sales and longitudinal weather data between January 1, 2007 and November 11, 2016 is presented to clarify existing relationships. Daily precipitation did not exhibit a significant relationship with sales. Nor did any of the extreme precipitation event variables. Mellilo et al. (2014) notes that, despite an increase of average annual precipitation, there are less frequent yet more intense precipitation events. Daily precipitation over 100 mm, however, exhibited a negative correlation that approached significance ($r = -.064$, $p > .05$). With increased occurrences of these severe events, which is the trend exhibited in Figure 1, this relationship is likely to become significant in the future. Cloud cover and wind speed, two weather variables related to potential precipitation events, were both negatively related to sales during the spring ($r = -.091$, $p < .01$; $r = -.076$, $p < .05$, respectively). Cloud cover was also negatively related to sales in the fall ($r = -.073$, $p < .05$). These findings suggest that in the shoulder seasons (i.e., spring and fall) the threat of precipitation-related inclement weather may be enough to keep customers away.

Insert Table 3 about here

While precipitation events have associated risks, Table 3 shows positive relationships between sales exist for both maximum and minimum temperatures during all seasons. As

temperature rises, no matter the season, sales increase. With fewer warm days in the winter months, it is to be expected that the correlations are lower for higher maximum temperatures ($r = .121$, $p < .01$) and minimum temperatures ($r = .158$, $p < .01$). For spring and summer, the strength of the correlation between minimum temperature and sales is notably higher than that for maximum temperature. Comparably, this correlation suggests that cooler nights are a better predictor of sales than day time temperature during the shoulder seasons. This finding is further supported by the negative correlations by days that did not exceed the minimum temperature threshold of $23^{o}C$ in the summer and fall ($r = -.261$, $p < .01$; $r = -.249$, $p < .01$). With both minimum and maximum temperatures trending up for long-term climate change (1990 – 2015) and during the study period (January 1, 2007 – November 11, 2016), the positive and moderate correlations indicate opportunities for growth across all seasons.

DISCUSSION QUESTIONS AND EXAMPLE RESPONSES

1. What are the longer-term climatic trends in Virginia Beach, Virginia?
    a. For the 26 years analyzed from 1990 through 2015, there are several trends in climatic variability. Annual average precipitation increased yearly by .63% while cloud cover decreased by 33.64%. This is consistent with historical findings (Melillo et al., 2014). Minimum temperatures increased by .038 ^{o}C a year for a total of almost 1 ^{o}C during the study period, and maximum temperatures increased by .024 ^{o}C for just over a .5 ^{o}C increase during the study period. The greater increase in minimum temperature indicates that average temperature change has been more attributable to minimum temperature than maximum temperature increases during the study period.
2. What relationships do the weather variables share with sales for the focal small business?
    a. Table 3 shows temperature shared the strongest relationship with sales. Maximum daily temperature and minimum daily temperature are positively and significantly related to total daily sales in each season during the study period. The strongest observed correlations are in the fall for maximum and minimum temperature ($r = .336$, $p < .01$; $r = .340$, $p < .01$). For maximum temperature, there is a positive correlation between sales and hot events in the summer ($r = .162$, $p < .01$), or days that exceeded 34^{o}C. Cooler minimum temperature events, or days where temperature was below 23^{o}C was negatively correlated to sales in both the summer and fall ($r = -.261$, $p < .01$; $r = -.249$, $p < .01$). The descriptives in Table 2 demonstrate that daily precipitation and percentage of extreme daily precipitation events are greater in the summer and fall, suggesting a higher exposure of sales.

However, the only significant relationships potentially related to severe precipitation events are with cloud cover in the spring and fall ($r = -.091$, $p < .01$; $r = -.073$, $p < .05$) and with wind speed in the spring ($r = -.076$, $p < .05$). Furthermore, as illustrated by Figure 2 and mentioned in the case, extreme precipitation from Hurricane Arthur in 2014 corresponded to a drop in sales at the focal small business location due to destruction of cabins and other damages to the property.

3. Conduct a wSWOT analysis (weather forces and trends, threats and opportunities, strengths and weaknesses, priorities and actions) based on the case and Figure 3.
    a. Weather Forces and Trends. The relevant weather forces in this case study are precipitation, temperature, cloud cover, extreme precipitation events, and extreme temperature events. As shown in Figure 2, the trends from 2007 through 2016 include increasing daily maximum and minimum temperatures and more extreme daily precipitation events that may be indicative of weather extremes or disasters. As Table 1 suggests, annual precipitation has increased, annual cloud cover has decreased, annual maximum temperature has increased, and annual minimum temperature has increased.
    b. Threats. The strongest threats include intense precipitation events such as severe storms and hurricanes (Figure 1). The negative (but insignificant) relationships between sales and precipitation events provide additional justification for this threat. Minimum temperatures below $23^{o}C$ and $0^{o}C$ are also negatively related to sales, indicating another threat. Finally, due to its coastal location, sea-level rise remains a threat.

c. Opportunities. As shown in Figure 1 and supported by the findings in Table 3, both maximum and minimum temperature are increasing and are positively related to sales in all seasons suggesting an opportunity. Likewise, extreme hot temperatures, or those above 34^{o}C, are also positively related to sales in the summer providing another opportunity. Warmer temperatures related to shifting seasonality and length of season also offer opportunities.

d. Weaknesses. The most dominant weaknesses include: location that exposes the business to adverse extremes and sea-level rise, product offerings that expose customers to adverse conditions (i.e., tent camping), and the outdoor nature of related offerings (e.g., swimming pool, national parks, beaches). Other direct competitors in the outdoor tourism industry have similar weaknesses. However, other lodging options such as hotels, condos, and home-sharing (e.g., Air bNb, VRBO) offer a higher degree of protection from weather and related adverse events and close proximity to popular tourist destinations.

e. Strengths. Strengths include: popular tourist destination, weather response capacity by corporate offices, other corporate support provided as a franchisee (e.g., marketing), pooled risks, pooled purchasing power, and a variety of product offerings that can protect customers from weather and events (e.g., cabins) while also providing an outdoor experience. The proximity of the location to a beach offers something that many competitors cannot replicate. The outdoor experience of cabin camping with a degree of protection from weather and related adverse events is also something that is difficult to replicate.

f. Priority and Action. Case study findings suggest that the business should consider the expansion of cabin camping. Cabin camping availability is a strength of the focal business that is difficult to replicate due to pooled purchasing power and desirable tourist locations. Cabins offer protection from weather related threats such as extreme precipitation. Likewise, cabin options provide a climate-controlled indoor environment allowing customers to enjoy outdoor activities such as the beach while minimizing unpleasant weather conditions (that may otherwise deter tent campers). In the future, the focal business should continue to use the wSWOT framework to improve understanding of how and when weather will impact the business and its customers. This can lead to short-term mitigating efforts such as customer preparedness for extremes and marketing efforts to take advantage of favorable conditions. In the mid- and long-term, expansion of cabin offerings should be explored to counter the increasing intense precipitation events, and shifting temperatures at the location. Based on the low percentage of businesses that plan for natural disasters and the high percentage that are unable to reopen in the face of natural disasters, both of these strategies can further support a businesses' competitive advantage.

GRADING RUBRIC

Category	Exceeds Expectations	Meets Expectations	Below Expectations
Statistics	Correctly identified all relevant information	Correctly identified some of the relevant information	Did not identify or mis-identified relevant information
Interpretation	Correctly interpreted all statistical relationships	Correctly interpreted some of but not all of the statistical relationships	Did not interpret or mis-interpreted statistical relationships
Support	Utilized multiple references to statistical information and interpretation to complete the wSWOT analysis	Utilized a single reference to statistical information and interpretation to complete the wSWOT analysis	Did not utilize references to statistical information and interpretation to complete the wSWOT analysis
wSWOT	Identified two or more strengths, weaknesses, opportunities, threats, and priorities and actions	Identified only one strength, weakness, opportunity, threats, and priorities and actions	Identified no strengths, weaknesses, opportunities, threats, and priorities and actions
Writing	No or very few grammar mistakes or typos	Minimal grammar mistakes or typos	Multiple grammar mistakes or typos

RESEARCH METHODS AND CONFIDENTIALITY

This case is composed of sales data obtained from the outdoor tourism parent company's CFO and from publicly accessible weather data by the first and third authors. The name of the company and CFO and other sensitive information are disguised in the case to protect the confidentiality of the privately held corporation. Sales figures were disguised using a method that did not alter the relationships with weather and climate variables that were reported.

EPILOGUE OF DECISION

At the time of the submission of this case, we shared the analytical results with Mr. Lambo, including the focal Virginia Beach, Virginia location. We will share additional analysis for remaining corporate-owned CNA locations upon completion of our engagement. In the future, we will continue to build adaptive and mitigating capacities for CNA in response to future climate change and extreme weather events.

References

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