

Twitter Reactions to Hurricane Irma: Mining social media for inferences

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Social media are important channels for information exchange. Platforms like Twitter offer individuals, government agencies, media, and other organizations the opportunity to interact and participate in a dialogue about topics as mundane as lunch, to those things as important as storm preparations. This research examines the Twitter dialogue and data in relation to how three Florida cities: Jacksonville, Tampa, and Miami, experienced Hurricane Irma. Tweets were analyzed for the topics of importance, sentiment, and the key influencers.



Jacksonville, Tampa, and Miami were chosen as sites for analysis.

Introduction

Hurricane Irma began as a tropical wave off of the coast of northwestern Africa in late August 2017. By September 10, 2017, the storm had gone from a Category 5 hurricane to Category 3 after hitting Cuba, then back to a Category 4 storm by the time it made landfall on Cudjoe Key, Florida.

In preparation for the storm, Florida Governor Rick Scott declared a state of emergency. As with any impending storm, Florida residents were encouraged to prepare hurricane kits and or evacuate certain low-lying or flood prone areas.

The storm is reported to have cost more than \$50 billion in damage to the state of Florida, with Monroe County, where sit the Florida Keys, sustaining the most damage.¹ According to a state report on the impact of Hurricane Irma, more than 65,000 structures sustained some kind of damage in West and Southwest Florida.¹

More than 7.7 million homes and businesses lost power around the state, and rain and storm surge caused the flooding of at least 32 rivers and creeks, including the St. Johns River and tributaries.¹ The City of Jacksonville experienced \$85 million in damage.² The Miami-Dade area also experienced significant damage, mostly from downed trees, along with widespread power outages.

Both during and after the storm, social media provided an insight into experiences in different parts of the state.

Social media are ubiquitous and are used for individual and organizational sharing of information and media. Government agencies and support organizations use social media to reach people in ways that traditional media does not.

Further, traditional media organizations recognize the power of social media, and most “old” media organizations have adopted the new(er) channels of expression. Nowhere is this more visible than on Twitter, where individuals, government agencies, and collide in the sharing of information. *The Wall Street Journal* called social media, particularly Twitter and Facebook, a tool for first responders, and Twitter has been touted as helping a woman save a friend during Hurricane Irma.⁴

More than tools for conversation and information sharing, social media data allow organizations and individual to make inferences about the experiences and issues of importance to social media users. Data can be analyzed to understand sentiment, public opinion, and major trends and influences. In recognition of the power of this information, Twitter offers users a view of what’s trending, as well as verifying many influencers.

This research report examines the Twitter data related to Hurricane Irma surrounding three Florida cities: Jacksonville, Tampa, and Miami. These three sites were chosen because they are large metropolitan areas within

the state. They also offer a glimpse into the disparate experiences of Florida residents in three different geographical areas. Finally, the three cities experienced varying levels and kinds of storm damage from Hurricane Irma.

Methods

Twitter data were obtained using Sifter, a product of DiscoverText, which allows the collection and retrieval and access to undeleted historic Tweets. Sifter also allows the targeting of Tweets by geographic area. For this research project, Tweets from a 25-mile radius of each city were collected. This allowed a larger view of the experiences of the varying parts of the metropolitan areas.

Tweets were searched for those containing hashtags and text related to: “hurricane,” “Irma,” and “storm,” a combination of these words, as well as terms related to various utilities in these areas including, “JEA,” “Duke,” “DukeEnergy,” “FPL,” and “FloridaPowerandLight.” Tweets were collected for the 10-day period starting with Hurricane Irma Florida landfall on September 11, 2017 and ending on September 20, 2017, when it was reported that power had been restored to most homes in the state.⁵

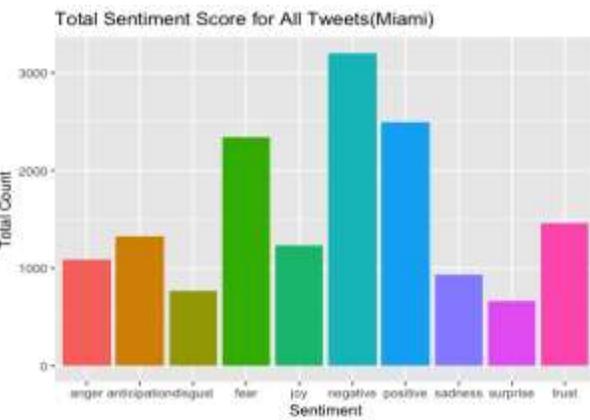
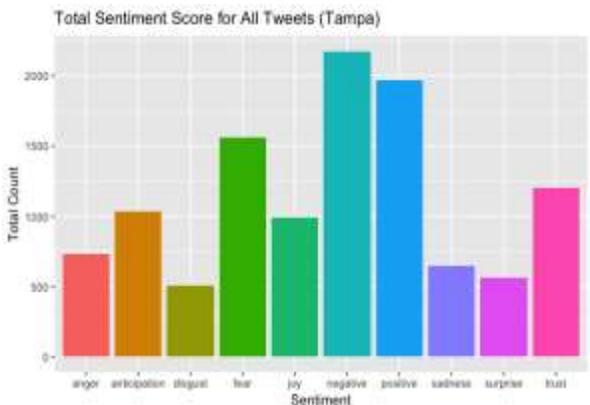
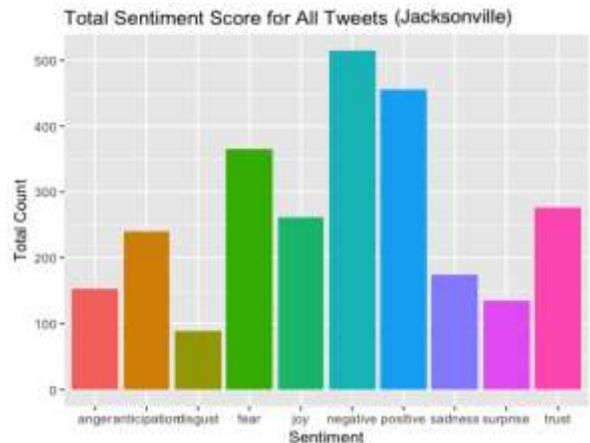
Tweets returned from each locale were then analyzed in two ways to reveal different inferences. First, tweets underwent Latent Dirichlet Allocation (LDA) topic modeling. Topic modeling can reveal hidden themes in documents. Topic models “provide probabilistic framework for the term frequency occurrences in documents.”⁶ A topic model analysis of tweets provides insight into the major topics in that set of tweets.

Second, the tweets underwent sentiment analysis. Sentiment analysis identifies opinions expressed in text. Also called opinion mining, this form of analysis provides a look into the attitudes of the tweet writers. For tweets, then, sentiment analysis allows the creation of inferences related sentiment by the comparison of tweet text to lists of words categorized as positive or negative. In addition to these forms of analysis, the Twitter data for each city was examined to understand the individuals and organizations who could be classified as “influencers” with regard to their shared storm related information.

Both sentiment analysis and topic modeling were conducted using the R programming language.

Results

While a search for each city returned tweet results, not all cities returned the same number of tweets. The number of tweets for each city does not reflect the



relative population size of each individual area. Therefore, although Jacksonville is the most populous city of the three, it returned the lowest number of tweets related to Hurricane Irma. Miami returned the most tweets, followed by Tampa. Possible explanations for this include demographics and relative importance of the storm to the area.

The sentiment analysis for each city revealed, as would be expected, significant positive and negative sentiment in relation to storm related tweets. For Tampa, the positive and negative sentiment scores were very close,

returning only a few hundred points difference. Jacksonville and Miami positive and negative sentiment were relatively closer in score. The figures above show the results of the sentiment analysis.

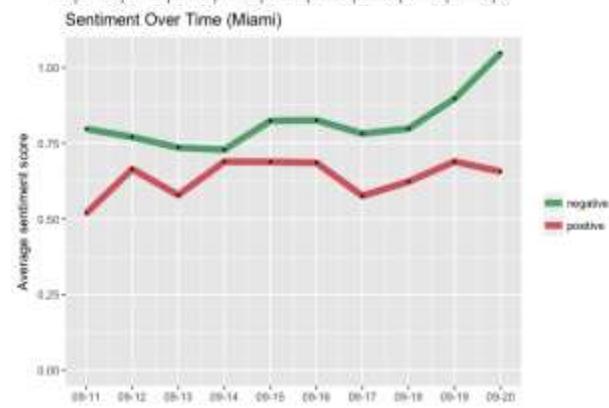
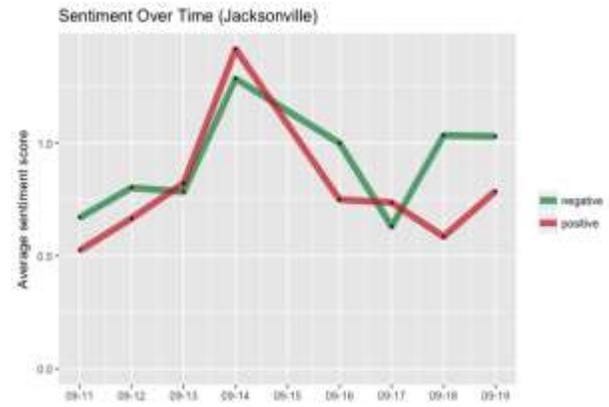
Along with scores for positive and negative sentiment, use of the NRC Word-Emotion Association Lexicon, allowed for an analysis of eight basic emotions: anger, fear, anticipation, trust, surprise, sadness, joy, and disgust. For all three cities the emotion scores followed a similar pattern. Fear scored the highest, followed by trust and anticipation. Anger also scored relatively high among the eight emotions in all cities, but less than joy.

It is important to note that this represents an analysis of the storm related tweets across the three cities aggregated over the 10-day period of study. For a more detailed description of the sentiment in each metropolitan area, it is important to examine the sentiment by day. The figures to the right describe the relative fluctuation in positive and negative sentiment by day in each of the three metropolitan areas.

The sentiment fluctuations across the 10-day period for each metropolitan area may be reflective of the experiences of individuals and organizations both during and post-Hurricane Irma. Tampa, for example, was predicted to experience substantial damage from the storm. Therefore, the significantly higher negative sentiment on September 11 can rationally be related to predicted damage. Note, the very next day, September 12, negative sentiment decreases as positive sentiment rapidly increases. After the storm had moved out of the area, and the state, the Tampa plot shows positive sentiment as remaining higher than negative for days before again decreasing.

The Jacksonville plot shows a pattern for negative and positive sentiment that mirror each other closely. Miami is the only city of the three for which negative sentiment remained higher than positive sentiment for the duration of the period examined. There are many possible reasons for this. First, the Miami area experienced widespread power outages as a result of the Hurricane Irma. Second, news reports sensationalized possible criminal activity in the area. In addition, many residents in the area had to evacuate, stay at shelters, or could not return home immediately after the storm.

Plots for all cities show an increase in negative sentiment toward the end of the 10-day period. This can be attributable to news of the approach of Hurricane Maria, which made landfall in the Virgin Islands and Puerto Rico on September 20, 2017. Hurricane Maria ultimately shifted course, turning north toward the Carolinas.



Topic models for each metropolitan area were completed separately. An analysis of tweets returned five topics for each city. The top themes returned for each topic are listed in the tables below. The topic models help to support inferences made from the sentiment analyses.

As would be expected, across all metropolitan areas studied, themes related to Hurricane Irma and its impact were present. In fact, topics detailing the impact of the storm had the highest probability of appearing in each tweet dataset. Therefore, along with thematic words like

“hurricane,” “Irma,” and the various terms related to utilities and utility companies, themes like “destroy,” and “flood” also appear.

Importantly, topic modeling also reveals influencers that may otherwise be hidden from the conversation. Many would expect those in government, otherwise assisting, or with some level of fame to be most influential during this time. No government entity or member of government, however, appears in the lists of top themes on any of the three models. Instead, there topics offer insight into the stories of local interest.

In the Miami dataset, a key influencer was CBS. An examination of the tweets from Miami demonstrates that CBSMiami played as significant role in the dissemination of information during and after the storm. Along with the local Miami station, CBS was a station those with power turned to for entertainment.

In the Tampa dataset, an unexpected influencer appearing among the topics was the bar Sports Roadhouse. An examination of the tweets related to this franchise indicate that the bar was used as a base for relief efforts. Famous local athletes also made appearances at the bar to show their support.

In the Jacksonville dataset, an unexpected influencer was a young woman who spammed celebrities seeking donations to a GoFundMe campaign she created to assist her grandparents who lost their house after a tree fell on it during the storm.

Conclusion

Social Media data can provide rich insights into the outcomes and impacts of important (and relatively unimportant) events. Sentiment analysis and topic modeling allowing interested parties to make inferences about the subjects, individuals, and organizations of interest to social media users. With Hurricane Irma and its aftermath, Twitter data allows individuals and organizations to understand key themes and major players in the storm and relief efforts. Ultimately, social media data, like that offered by Twitter, allow those interested to better know how to and who to share information with, and the best channels or doing so.

There are, of course, limitations to the use of social media research. First, not everyone uses social media. Further, even if an individual uses one social media outlet, they may not use the outlet chosen for study. Finally, the tweets collected only include public tweets. Therefore, the opinions/attitudes connected to tweets from locked accounts cannot be analyzed. These limitations should be considered when making inferences from social media data.

Tampa tweets topic models (9/11-9/20)

| Topic 1 | Topic 2 | Topic 3 | Topic 4 | Topic 5 |
|----------|----------|------------|----------------|----------|
| irma | maria | duekenergi | water | retweet |
| hurrican | anoth | week | aftermath | outsid |
| power | categori | work | sportsroadhous | clean |
| tampa | week | time | found | south |
| florida | team | duke | later | downtown |
| thank | almost | line | pole | mani |

Jacksonville tweets topic models (9/11-9/20)

| Topic 1 | Topic 2 | Topic 3 | Topic 4 | Topic 5 |
|--------------|--------------|---------|---------|-------------|
| john | hurricaneirm | will | coupl | irma |
| come | duval | counti | help | hurrican |
| mani | post | didnt | lost | jacksonvill |
| ffu | jax | gone | pleas | power |
| harvey | flood | beauti | home | florida |
| hurricaneirm | storm | best | sweet | thank |

Miami tweets topic models (9/11-9/20)

| Topic 1 | Topic 2 | Topic 3 | Topic 4 | Topic 5 |
|----------|----------|---------|--------------|---------|
| irma | bay | relief | brickel | maria |
| hurrican | cbsmiami | hot | took | anoth |
| miami | destroy | Friday | tmobil | week |
| power | enjoy | show | irmahurrican | season |
| fpl | kill | serv | gym | puerto |
| back | asap | take | check | rico |

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