

# Google Search Volume as a Proxy for Post-Hurricane Behavior: Initial Investigation

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## Introduction

- Hurricane-induced damage often leads to wide-spread electric-power losses. Both before power is expected to be lost and after power is lost, consumers often seek information on both how to best prepared for and manage the outage situation.
- People in different hurricane-prone regions may have different preparedness levels for and expectations during an electric-power outage event. This is reflected in the information they seek.
- Numerous studies suggest that using Google search and trends data is a reliable method for understand the information sought in various regions.
- By understanding the information that consumers seek, emergency managers can more effectively preposition consumables before an event and better respond to the unique needs of the community.

## RESEARCH GOALS

- Compare storm and outage related search terms in Google between regions that experience hurricanes frequently and infrequently
- Is the differing responsiveness in search volume reflected in actual behavior? For example, are popular inquiries into 'Generators' reflected by an actual increase in demand for power generators?

## Methodology

### PROCEDURE

- Obtain Google trends data for 16 metro regions, half from regions with frequent hurricanes and the other half from regions with less hurricanes.
  - Google provides data in monthly/weekly intervals
  - Data are available starting January 2004 to present
- Make plots of search term & location, annotate dates where a hurricane was within 200 miles of location or anywhere that made landfall in the US
  - Information on hurricanes was gathered from the NOAA (National Oceanic and Atmospheric Administration)
- Identify outliers in search volume history, search for correlation when a increase in search volume is during when a Hurricane was within region
  - Outliers are identified by including plots of running mean (past 3 months) and the running standard deviations. Plots above bounds of S.D. noted as outliers

| General Term | List of Terms (searched in Google Trends)   |
|--------------|---|
| Hurricanes   | Hurricane + Storm + Hurricane Tracking  |
| Generators   | Portable Generators + Backup Generators + Diesel Generators + Electrical Generators |
| Gas          | Gas Shortage + Gas Station  |
| Tools        | Batter Radio + Flash Light + First Aid Kit  |
| Food         | Canned Food + Non Perishable Food + Supermarket                                     |
| Ice          | Cooler + Ice + Freezer Pack   |
| Water        | Boil Water + Bottled Water + Water Purification + Drinking Water                    |

Fig 1: List of categorized search terms, 'Gas' most likely refers to gasoline shortages, but distinction between gasoline and natural gas is unclear

| Rare Regions                          | Frequent Regions                            |
|---------------------------------------|---|
| Baltimore MD                          | Miami - Ft. Lauderdale FL                   |
| New York NY                           | Charlotte NC                                |
| District of Columbia                  | Raleigh - Durham (Fayetteville) NC          |
| Philadelphia PA:                      | Mobile AL - Pensacola (Ft. Walton Beach) FL |
| Boston MA - Manchester NH             | Jacksonville FL                             |
| Norfolk - Portsmouth- Newport News VA | New Orleans LA                              |
| Hartford & New Haven CT               | Greensboro-High Point-Winston Salem NC      |
| Buffalo NY                            | Baton Rouge LA                              |

Fig 2: List of metro-regions studied, divided between regions with frequent and infrequent hurricanes

### Sample Plot, with Running Mean and Standard Deviation Bounds

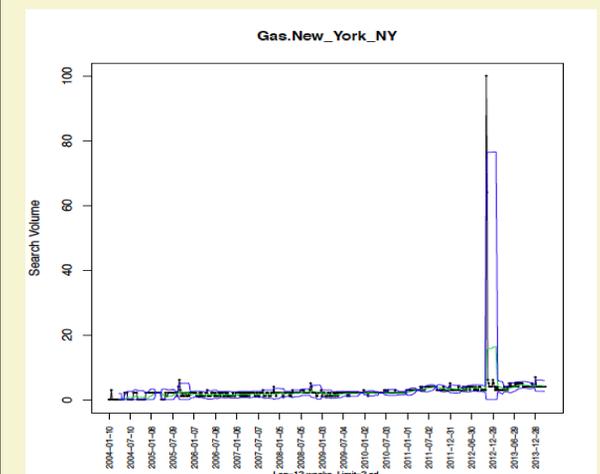


Fig 3: Plot of search term "Gas" in the New York metro region. The green line is the running mean from the last 12 weeks. The blue lines are 2 standard deviation bounds of the running mean. The blue lines are truncated to fit within bounds 0-100.

## Results – Comparing responsiveness of Search Volume to Hurricanes

### RESULTS

- The table below summarizes the inquiries from hurricane-infrequent and hurricane-prone regions to the 7 different terms.
- The control search term "Hurricanes" had very strong responsiveness to the incidence of hurricanes, as expected, but the other terms responsiveness varied.
- Rare regions had much stronger interest in "generators" compared to frequent regions, while search terms "water" and "ice" had very weak interest in both regions.
- Search terms for "Gas" and "Food" had medium levels of interest within hurricanes-infrequent regions, which is greater than the interest within hurricane-prone regions.
- "Tools" is the only term where interest is higher within hurricane-prone regions.

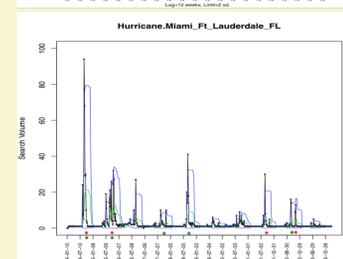
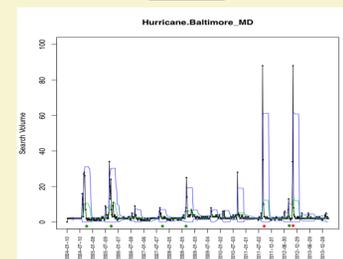
| Search Term | Rare Regions | Frequent Regions |
|-------------|--------------|------------------|
| Hurricanes  | Very Strong  | Very Strong      |
| Generators  | Strong       | Weak             |
| Gas         | Medium       | Weak             |
| Tools       | Weak         | Medium           |
| Food        | Medium       | Weak             |
| Ice         | Very Weak    | Very Weak        |
| Water       | Very Weak    | Very Weak        |

Scale of: Very Weak, Weak, Medium, Strong, Very Strong  
Fig 4: Comparison of information search-history within hurricane-infrequent and hurricane-prone regions prior, during, and after hurricanes.

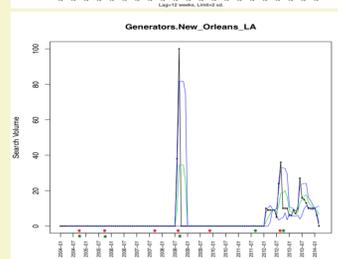
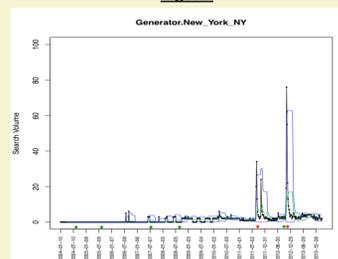
### Graph Comparisons

Example of plots to illustrate the different interest levels of the terms. Dates where hurricanes are within 200 miles of the region are marked with red star. Dates where hurricanes made landfall anywhere within the US are marked with green star.

Both Hurricane-infrequent and hurricane-prone regions show great search interest in hurricanes



Hurricane-infrequent regions show more search interest in generators than hurricane-prone regions



Both Hurricane-infrequent and hurricane-prone regions show little search interest in ice

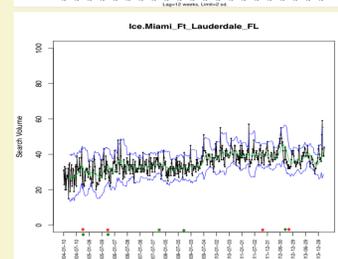
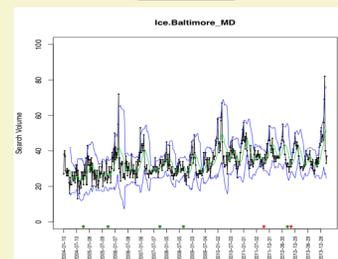


Fig 5: Comparisons of search volume interest for the terms "Hurricane," "Generators," and "Ice"

## Conclusions

- "Generators" and "Gas" are of higher interest in regions that don't experience Hurricanes frequently. This could be due to these regions not being as equipped to handle storm-induced outages relative to hurricane-prone regions.
- "Ice" and "Water" both had very weak search interest change within hurricane-prone and hurricane-infrequent regions. Possible reasons include that these items are more readily available to affected people compared to items such as generators and gas.
- "Tools" is the only category where interest is generally higher within hurricane-prone regions. Items such as a first-aid kits, battery radios, and flash lights need to be restocked often, which could explain the higher degree of interest.

## Future Work

- We need to confirm if changes in search volume is corresponded with changes in actual behavior, i.e. is a spike in search volume for generators reflected in a larger increase in generator sales?
- We will be collaborating with Dr. Robin Dillon-Merrill of Georgetown University moving forward, who studies how and why people make the decisions that they do under conditions of uncertainty and risk.

## References

- J. Ginsberg, M.H. Mohebbi, R.S. Patel, L. Brammer, M.S. Smolinski, L. Brilliant. (2009). "Detecting influenza epidemics using search engine query data", *Nature* 457, 1012-1014
- H. Choi, H. Varian, (2009). "Predicting the Present with Google Trends", Google Inc.