Risk Mitigation at Call Centers

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Summary:
Climate catastrophes (i.e. tornadoes, hail, hurricanes, etc.) have a significant economic and operational impact on the operation of call centers. It was found that catastrophe events such as hurricanes critically impact the operation of the affected location for a period of two months after the hurricane has occurred. A sudden increase of demand affects the service level agreement Company X has with its customers due to a shortage of labor resources to attend the inbound calls until the process stabilizes and the location can achieve an adequate service level. This study focuses on the development of a call rerouting model to utilize available resources from other geographies to serve the demand incoming to the affected location.

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KEY INSIGHTS

1. In 2017, across the U.S. there were 15 weather and climate events that resulted in material and financial losses that exceeded $1 billion each.

2. By leveraging resources across all call centers during a catastrophe event, the company can achieve promised service levels.

3. The optimization model had the capability to give a response in under four minutes. Thus, bringing an easy to use model for the internal customer to take decisions under a high-pressure environment that these needs are generated in (e.g. climate events).

Introduction

Since 1980, the United States has experienced 218 weather and climate disasters. In 2017, across the U.S. there were 15 weather and climate events that resulted in material and financial losses that exceeded $1 billion each. These events were composed of droughts, flooding, severe freezing, severe storms, tropical cyclones and wildfires (NOAA-NCEI, 2017).

Between 1980 to 2016 the annual average was 5.5 events (CPI-adjusted). Although the annual average from 2012 to 2016 was 10.6 events (CPI-adjusted) with an increase of around 50% in 2017 (15 climate disasters as of October 6th 2017).

Climate catastrophes (i.e., tornadoes, hail, hurricanes, etc.) have a significant social and economic impact on the operation of various businesses. These natural disasters typically cause damages that range in the millions of dollars, as well as, leaving a trail of distressed citizens and disrupted industries looking to recover as soon as possible.

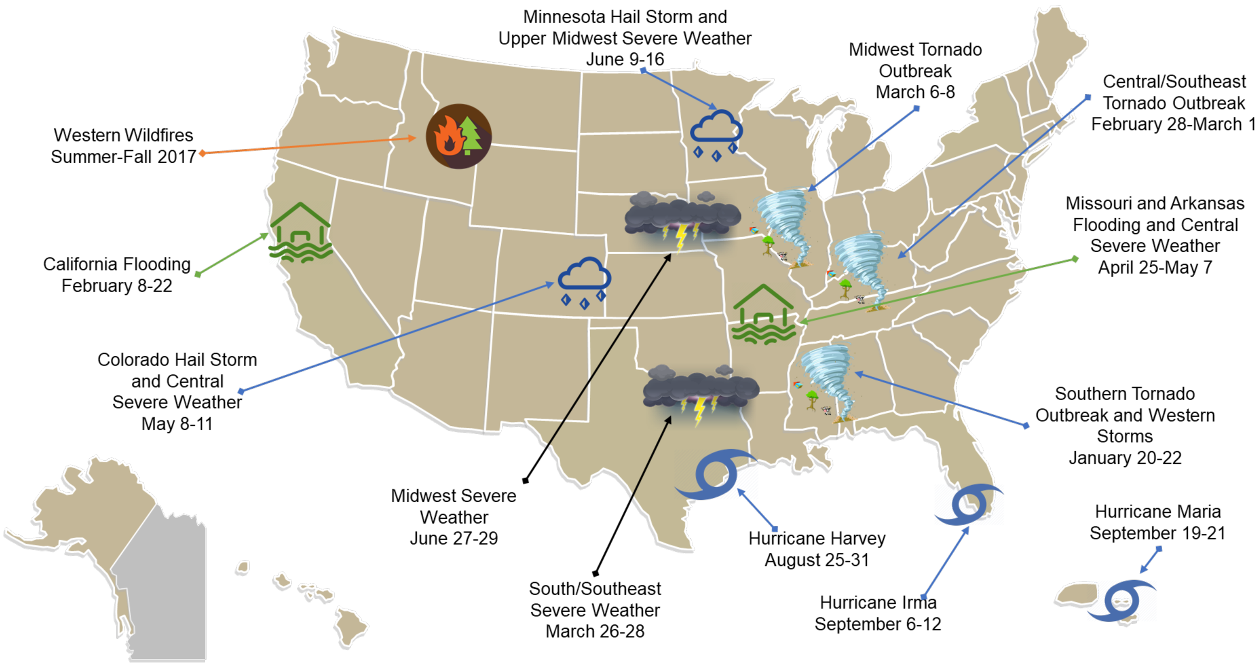

Figure 1 - Areas Critically Affected by Climate Events During 2017

Unfortunately, there has not been research focusing on the direct impacts of climate catastrophe events on call centers.

Climate catastrophes can cause major disruptions to call center operations including but not limited to completely shutting them down, only allowing Intermittent service, or the opposite, resulting in large increases of incoming calls.

This project focuses on mitigating impacts due to sudden increases of inbound calls to the call center system that can directly influence customer decisions on conducting business with Company X.

Company X manages an operation that helps sellers connect with buyers of product A. There are over 150 physical locations (warehouses) across the US, where Company X conducts storage, distribution and call center operations relating to the transfer of product A. During a typical day, the call center operation handles inbound and outbound calls related to: (i) coordination of the pickup of product A to be delivered to one of the warehouses, and (ii) inbound calls serving the buyers that use the ecommerce site to make purchases.

Company X has a target Service Level Agreement (SLA) to respond to incoming calls in under 60 seconds, based on internal studies and widely accepted standards for example those analyzed by (Batt, Holman & Holtgrewe, 2007). However, some call centers fail to meet the SLA due to significant increases in the rate of incoming calls during climate catastrophes. This in turn leads to an abandonment rate greater than 15% and Company X's goal is to have abandonment rates below 5% at each call center. The key question that this study aims to answer is: How to temporarily utilize/borrow available staff from unaffected call centers to affected call centers during climate catastrophe events?

Methodology

Currently, there is not a strategic decision-making process in place to reroute inbound calls to unaffected call centers with available capacity (man-hours). In this study, Queuing Theory and Optimization techniques are applied to develop a model that can select the appropriate call centers to divert inbound call queues to. This study is focused on the acute inbound call increases caused by destructive climate catastrophe events such as hurricanes, since there is not a risk mitigation process in place.

To create a generalized framework for call rerouting, we partitioned the problem into four main parts: (i) Data preprocessing, (ii) Demand analysis with the use of exponential smoothing, (iii) Capacity analysis utilizing queueing theory, and (iv) Optimization model using Mixed Integer Linear Programming (MILP) to define the locations to deviate the calls to during and after a catastrophe event, based on Company X's requirements.

The tools that were used to analyze and provide an optimization solution were Tableau for initial data analysis and R for model definition and results. These tools were chosen because they provided a smoother integration with Company X's databases and the possibility of creation of an interactive dashboard to run the optimization with minimum dedication of personnel for code maintenance.

To create a base optimization case for the rerouting of calls from a chosen location i for each combination of queue j and timeslot k, a Mixed Integer Linear Programming model was developed using the Rglpk package in R. While the GNU Linear Programming Kit (GLPK) solver was chosen to solve the optimization, any other mixed integer linear programming package could be used to create a similar model. The Rglpk package is a free optimization solver that counts with the option of building MILP models, thus providing Company X with a low-cost solution that could easily be implemented in the dedicated servers they have for the use of R.

Results

The Mixed Integer Linear Programming (MILP) model using the GLPK solver in R gives as an output the locations i to send the calls to for each combination of queue j and timeslot k. The first time the model was run it took six hours to give a result due to the size of the optimization matrix (7000 by 7000) and iterations needed to get a result considering all variables. Therefore, multiple trials with different number of locations were done to accommodate for a solution for Company X that will give them results in a shorter timeframe and without sacrificing the robustness of the model

Location 310 was affected by a hurricane in 2017. Therefore, we proceeded with the analysis of inbound call demand for location 310 before and after the catastrophe event. The distribution of inbound calls for location 310 is mapped in Figure 2 and it showcases that there was an increase in demand of around 250% for the first two weeks immediately after the hurricane occurred and it started decreasing steadily at the beginning of the fourth week after the hurricane.

The MILP model takes as inputs the forecasted demand for the location the calls need to be rerouted for and the capacity constraints established previously. Then, it populates a table with the results of the combination of location, queue and timeslot the calls should be deviated to by taking into consideration the demand, capacity and linking constraints mentioned in the methodology. The output

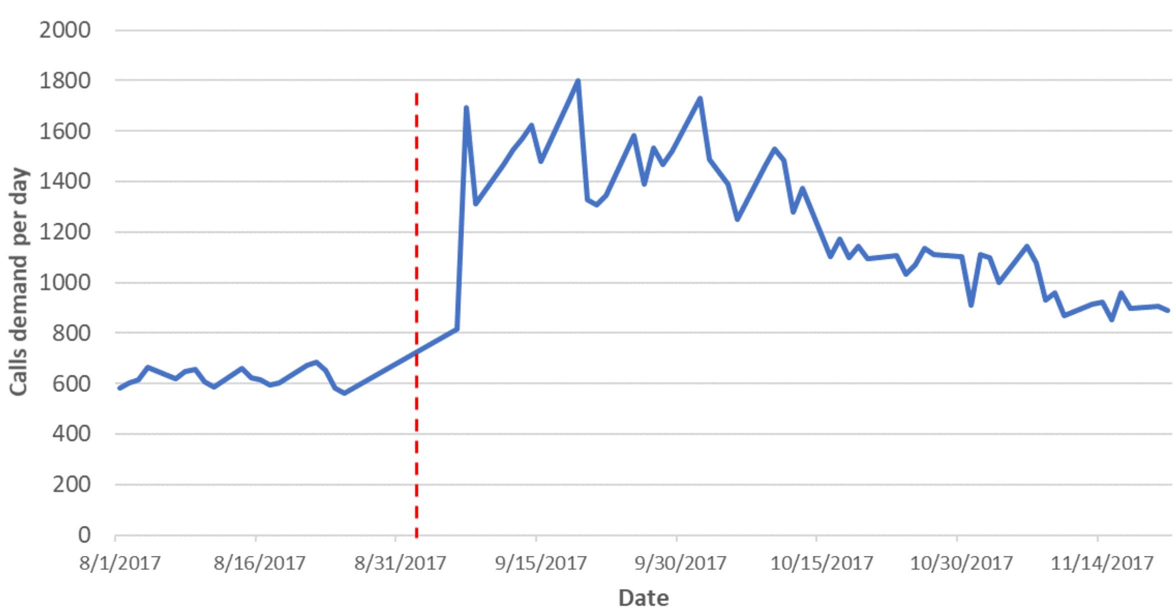

Figure 2 - Calls Demand per Day for Location Affected by Hurricane

from the optimization of one of the locations is shown in Figure 3. The last column makes reference to the timeslot the calls are coming from, for example if the target location 437 for calls in queue 1 was one hour ahead of the location the calls are being deviated for, the value of the timeslots for location 437 would increase by one when setting up the call receiving times at location 437 (e.g. Timeslots 437=c("3", "6", "8") given that the optimization accounts for this restriction.

Conclusions

Queue Location "A"	Location to	Timeslots "A"
1	349	c("1", "3", "4", "6", "8", "9")
1	437	c("2", "5", "7")
2	365	c("1", "2", "3", "4", "5", "6", "7", "8", "9")
3	429	c("1", "3", "7", "8")
3	391	c("2", "4", "5", "6", "9")
4	447	c("1", "2", "3", "4", "5", "6", "7", "8", "9")
5	349	c("1", "3", "4", "6", "7", "9")
5	447	c("2", "5", "8")

Figure 3 - Example Optimization Output

The research objective of the project was to find the effects of hurricanes to call centers and propose a solution for call deviation based on the combination of location, queue and timeslot. However, we recommend Company X to explore the feasibility of call deviation for the combination of queue and timeslot with holding time above 60 seconds for a period of two months by using the proposed optimization model. This will help Company X on improving service level by reducing variability in the inbound call process through the optimized use of resources.

There are three main benefits captured by the proposed MILP model. First, the optimization model had the capability to give a response in under four minutes. Thus, bringing an easy to use model for the internal customer to take decisions under a high-pressure environment that these needs are generated in (e.g. climate events). Second, the model did not require the purchase of additional software for the organization, since it uses a free open source software infrastructure, R. Third, there was no need for Company X to acquire additional dedicated servers to run the model since they developed applications using R at the moment this project was done and were able to use the same servers for the model.

In conclusion, Company X will greatly benefit from this research because it is a real-life application to solve one of the major problems currently facing the company. Based on climate projections, catastrophe events are becoming more relevant and more common place. Therefore, it is critical that Company X implements this methodology to help relieve its overburdened call centers during future climate events. This will lead to quicker response times, better customer service and higher customer satisfaction. Thus, having the potential to yield additional business and further growth of Company X in the industry.