Improving Estimated Time to Restoration (ETR) with Machine Learning

Leveraging big data to improve customer satisfaction and operational efficiency.

The Challenge

To most customers, their utility has only one job - to keep the lights on. And utilities do an excellent job – the US EIA indicated that in 2015, the average utility customer experienced approximately 1.5 outages with a total outage time of about 3 hours[1], representing >99.97% uptime.

For an average residential customer, a power outage might be an unexpected inconvenience, but for a business, it can result in a significant loss in revenue. And for a medical facility, a power outage can put lives at risk. Communicating to customers what is happening, and when their power will return is a critical function of Customer Service and Operations.

Utilities are increasingly offering their customers more proactive messaging about outages, including publicly available outage maps and automated text messaging alerts, notifying customers about outages and expected restorations times. Providing an accurate estimate of the time to restore power is an important way to increase customer satisfaction during an outage — one of the few times a customer engages with their utility. In an annual study of customer satisfaction with electric utilities, J.D. Power found that "Overall satisfaction among customers who receive outage information is much higher than among those who do not receive such information."[2]

The History

Treverity has been working closely with a large, TX-based electric and natural gas distribution utility to develop and test new models for calculating the Estimated Time to Restoration (ETR). The utility has been using a method to calculate ETR based on average historical restoration times across several variables, including the type of equipment and the service center where the outage occurred. This approach has provided their operations and customer service teams with an ETR forecast, implemented via a static lookup table that has proven to be effective. The utility recognized that this analysis could be improved by factoring in other variables that may influence restoration time – for example – the number of outages, weather, staffing levels, and real-time locations of crews. An automated prediction method was also desired, to reduce demands on staff and field crews, and to automatically update ETR estimates with the latest real-time information.

[1] Source: US Energy Information Agency, http://bit.ly/2zLC4X6, http://bit.ly/2lr3X1l

[2] Press Release, "Overall Residential Electric Utility Customer Satisfaction Increases for Sixth Consecutive Year, J.D. Power Finds", http://bit.ly/2lilslj

SUMMARY

Treverity developed a new model to estimate outage restoration time using statistical modeling and machine learning techniques.

The model delivered 34% improved accuracy in ETR over current methods used by a large TX-based electric distribution utility.

New ETR model deployed in a live utility operations environment using TeverityEDGE™.

CUSTOMERS WOULD RATHER YOU TELL THEM NOTHING, THAN GIVE THEM WRONG INFORMATION

Operations Manager | TX-based Utility

To improve their method of estimating ETR, the utility turned to Treverity to apply modern statistical modeling and machine learning techniques, and the power of the TreverityEDGE™ software platform.

TreverityEDGE™ has been operating at the utility since 2012, capturing data from over 30 different utility systems and providing numerous situational awareness, workflow management, and operational analytics applications. TreverityEDGE powers many of the control room, desktop, and mobile displays that the operations and customer service teams use to manage the daily operations of the utility, as well as operations during challenging storms, like Hurricane Harvey.

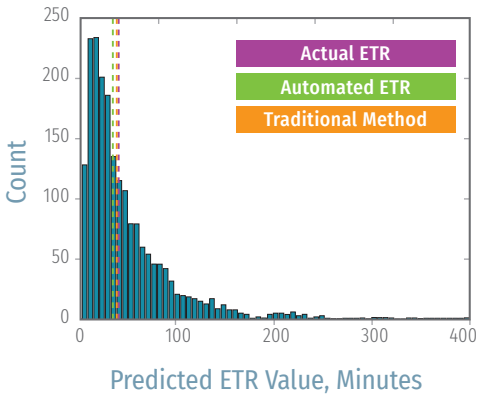
The Solution

TreverityEDGE has collected years of data relevant to outages, and Treverity's Data Science team used this trove of data to assess the relationships of hundreds of unique variables to outage times. Treverity developed a machine learning model – a probabilistic deep Gaussian process model – that provides not only more accurate ETR predictions, but also a full probability distribution of restoration time for each outage, and metrics that summarize repair operations status. Further, ETR predictions are produced automatically, every few minutes. This information-rich output provides greater context to the organization for decision making.

The Treverity model was tested and verified by applying it to historical data containing a record of the actual restoration times, and the results were compared to the current method used by the utility. The new model showed an impressive 34% improvement in predictive accuracy.

The new ETR model is deployed on the TreverityEDGE platform, which collects data from multiple operations and IT systems. It delivers a new ETR prediction automatically, every 5 minutes, taking into account changes in underlying conditions – weather, dispatch status, presence of new outages, customer segmentation and more. It also minimizes the demand on operations, customer support, and field crews to manually update ETR estimates as conditions change. And it improves situational awareness for operations and customer service teams, driving better decisions.

Automated ETR Prediction Uncertainty



Event	Hrs Out	Automated ETR	
2862295	03	1:12	MEDIUM
2862336	02	2:15	LOW
2862342	01	3:45	HIGH

TOP: Sample model output of a Treverity ETR prediction.

BOTTOM: Treverity's machine learning ETR predictions enable new interactions for operations and customer service to assess outages and communicate with customers.

What's Next

Treverity is continuously working to improve the ETR model by employing ever-more sophisticated machine learning and data preparation techniques. Additional gains in accuracy are expected as improvements to the model are made and as newly occurring data become incorporated into the model. The next step for Treverity is go beyond predicting ETR, and use the TreverityEDGE platform to deploy a decision support model – to help operators, customer support, and field crews make better decisions during outages. The end result will not only be more accurate ETR values, but greater potential to reduce outage times through more efficient deployment of resources and improved understanding of the underlying factors that contribute to prolonged restoration times.