Outage Management Analytics

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Introduction

The objective of the project was to improve Tacoma Power's (TPWR) power restoration efforts through predictive/prescriptive modeling and the creation of Tableau visualizations. Our model sought to predict the number of crews needed in order for TPWR to maintain, or improve upon, its historical average time needed for restoring power. Our Tableau dashboard then reflected TPWR's efforts to restore power, displaying the time in which it took for TPWR to restore power over a period of time.

Model

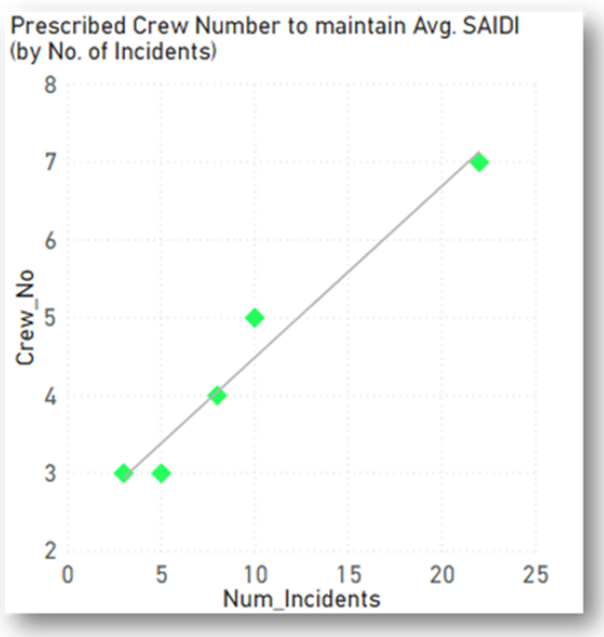
In order to identify the number of crews needed to quickly restore power, we first needed to predict how many incidents were likely to occur on any given day. To this end ,we created a 5-tier classification ordinally ranked outcome variable of the number of incidents one could expect on any given day. Then using weather variables such as Average Wind Speed, Min/Max Temperature, and Precipitation we utilized a Multiclass Decision Forest Model in Azure Machine Learning Studio to predict the number of incidents that would occur on any given day.

After we identified the number of incidents expected for the day, we were then able to input this variable along with our client's target SAIDI value (a measure of TPWR's effectiveness in restoring power) into an OLS—Linear Regression Model in Azure Machine Learning Studio. The result was a numerical value of the minimum number of crews Tacoma Power would need to maintain their aver-

System Average Interruption Duration Index (SAIDI)

$$\text{SAIDI} = \frac{\text{sum of all customer interruption durations}}{\text{total number of customers served}}$$

$$\text{SAIDI} = \frac{\sum U_i N_i}{N_T}$$



Results

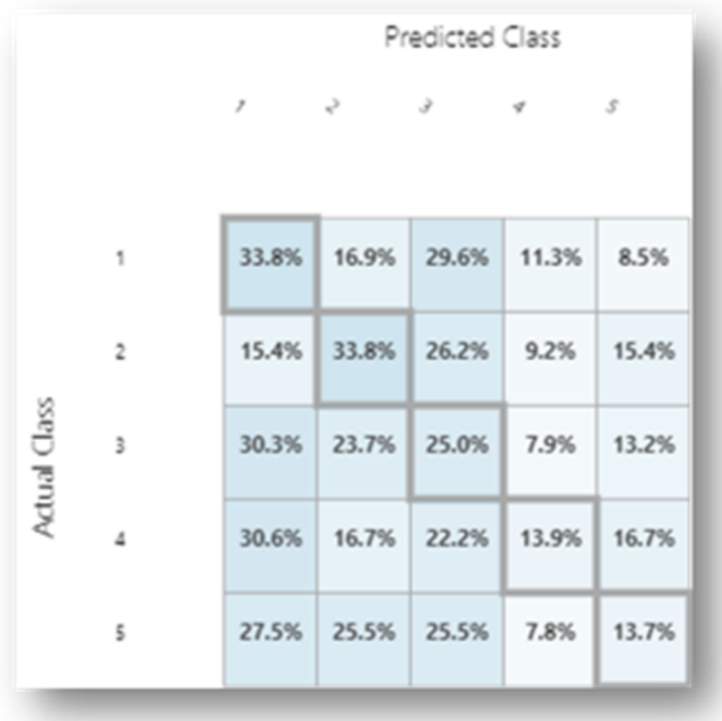
Our prescriptive model was highly effective. The coefficient of determination associated with our calculating the number of crews required for a given day was .70. In other words, if TPWR knows the number of incidents that are likely to occur on a given day, they can now easily decipher how many crews may be needed in order to achieve their historical average SAIDI value.

Tacoma Power - CREW_NO › Evaluate Model › Evaluation results

Metrics

Mean Absolute Error	1.692196
Root Mean Squared Error	2.28011
Relative Absolute Error	0.661084
Relative Squared Error	0.30491
Coefficient of Determination	0.69509

However, identifying the number of incidents likely to occur on a given day likely requires additional data (like vegetation and topographical data) . While our predictive model was able to accomplish a 75 percent average accuracy, overall accuracy was just 25 per-

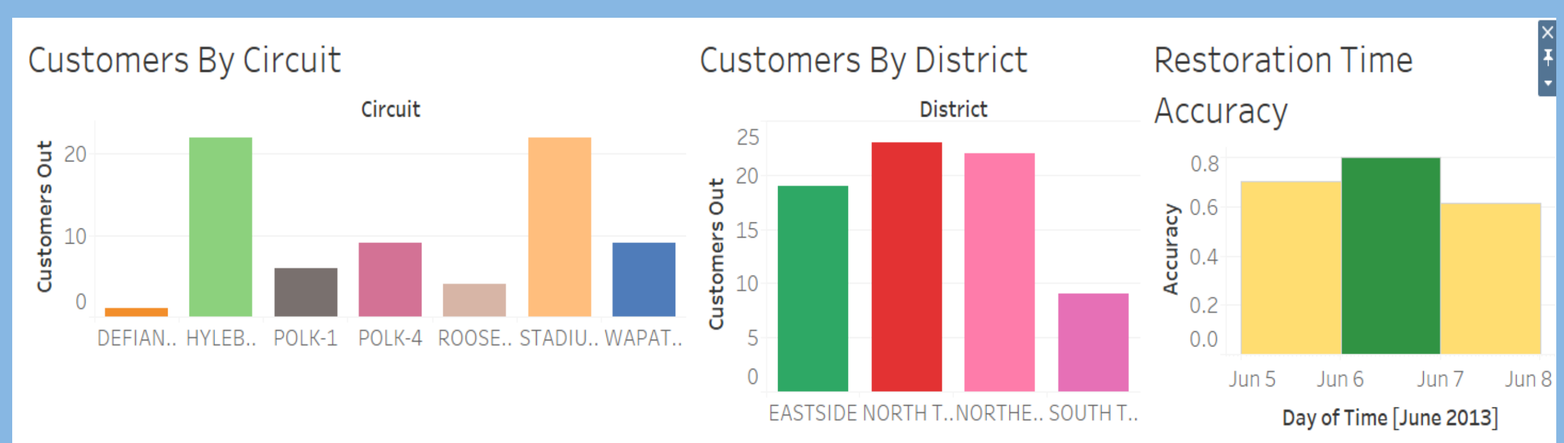


Conclusions

We believe we have developed a solid baseline model for TPWR's outage management analytics endeavor. Our crew prescriptive model shows promise and while our predictive model was less than optimal, we believe that it may eventually be improved upon with additional data. Weather data that accounts for an expanded number of locations, vegetative growth data and in-house operational variables are all future variables that should be considered in expanding upon this predictive model.

Tableau Dashboard

The OMS dashboard was a resounding success. The dashboard will effectively let TPWR monitor their performance in outage management in real-time, improving their outage situational awareness and response. The dashboard displays the amount of customers out by circuit and district during a one to thirty day time period. It shows the time in which outages occurred, a running total of customers out, and TPWR's ability to predict the amount of time it will take them to restore power. Furthermore, all of these features maintain drill-down functionality. Users are able to select a specific circuit and see the running total of customers out only associated with that circuit. They will also be able to see the specific incidents related with these outages and even see a numerical value of the number of minutes in which an incident lasted. With the OMS dashboard in place, TPWR management and dispatchers will have immediate access to past and future reliability metrics and trends.



Report

District	Circuit	INCIDENT_ID	DURATION	CUST OUT
EASTSIDE	POLK-1	2000881842	179.2	2.0
		2000881843	226.2	4.0
	POLK-4	2000881522	219.3	4.0
		2000881682	313.3	5.0
	ROOSEVELT-2	2000881842	176.1	4.0
NORTH TACOMA	DEFIANCE-3	2000881542	145.0	1.0
	STADIUM-2	2000881902	14.2	22.0
NORTHEAST	HYLEBOS-3	2000881702	339.9	22.0
SOUTH TACO..	WAPATO-6	2000881542	79.9	9.0