# Analysis of Proactive Approaches to Wildfire Insurance Claim Reduction

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**Abstract**

Wildfires cause an incomprehensible amount of damage every year; $400 Billion in California during 2018 alone[1]. Our initial forecast predicts a nationwide increase of 21% in the coming decade. Many home insurance policies have been dropped recently as these black swan disasters have crippled insurance company profits. We identified a far better solution that takes a proactive approach to the problem. Specifically, we have proven with causal methods that a privatized prevention program will generate a high ROI. Not only will this new market reduce premium payouts but has the capability to reduce loss of life, alleviate government spending and help fight greenhouse gas emissions in the process. The technique discovered in our analysis could easily be sold to insurance companies as a hedge against fire season.

## Background

The suppression method calling for privatization that our team identified is called prescribed burns. Also known as controlled burns, this methodology consists of burning sections of the forest pre-fire season to generate clearings that bring an uncontrolled wildfire to standstill as it will have run out of fuel. A well-planned controlled burn will logically divide a forest into subsections, limiting losses to the subdivisions kept away from residential neighborhoods. There is much literature on the causes of less sparse forests today, but this has been identified as a root cause of super fires that have arisen in the last century.

## Methods

Our analysis began by scraping fire, weather and insurance data. We had nearly 30 variables that influence a fire season's devastation for 5 states: California, Colorado, Oregan, Utah and Nevada. Next, we ran an exhaustive subset search to identify the weather patterns that most influenced fire season. After removing the shocks caused by the weather patterns, we extracted the correlation between prescribed burns and wildfires. The correlation became causation after running the statistical test, Granger Causality, to prove the directional relationship. For all states the coefficient of prescribed burns was negative and highly significant. All of our models were also very effective at generating highly accurate predictions with up to 98% of variance accounted for, as seen by the R-squared in the regression shown below for Colorado. Finally, we also used a Cross-Validation to be certain that we did not overfit to the data we had, which validated this assumption.

Figure 1:

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Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)    5.685e+06  4.987e+05  11.400 3.17e-06 ***
RXBURNS       -4.105e+00  7.695e-01  -5.334 0.000699 ***
TempJanuary   -4.266e+04  5.985e+03  -7.128 9.92e-05 ***
TempApril     -8.123e+04  8.997e+03  -9.028 1.81e-05 ***
TempDecember   3.107e+04  5.907e+03   5.260 0.000765 ***
RainApril     -3.145e+05  2.714e+04 -11.590 2.79e-06 ***
RainSeptember -2.522e+05  2.368e+04 -10.647 5.30e-06 ***
RainDecember  -3.769e+05  4.445e+04  -8.479 2.87e-05 ***
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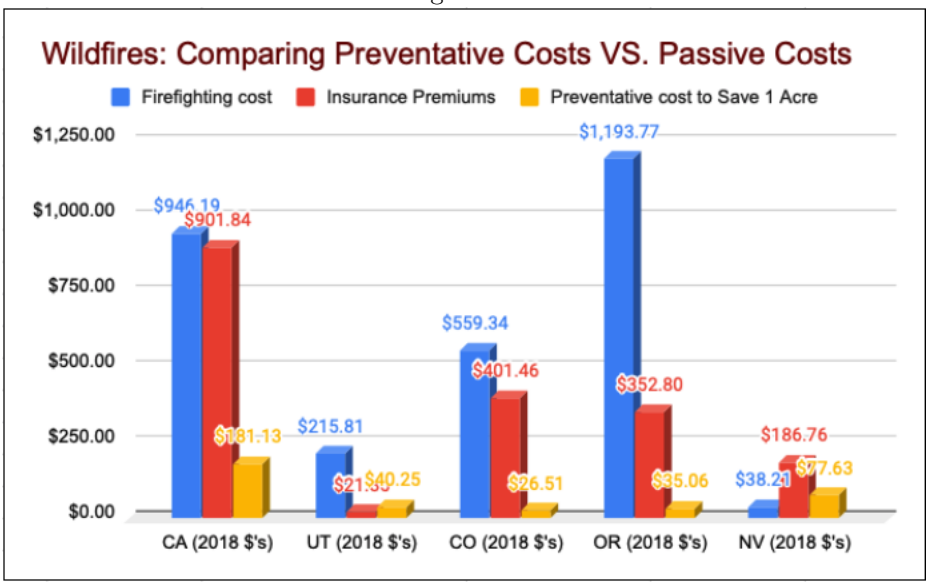
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard deviation: 52650 on 8 degrees of freedom
Multiple R-squared: 0.9755
F-statistic: 45.55 on 7 and 8 DF,  p-value: 8.011e-06
```

# Results

The highlighted coefficient for RXBURNS is interpreted as the number of Acres saved in wildfire season for doing 1 acre of prescribed burns. Using the average cost to perform 1 acre of controlled burns, we calculate the proactive cost to save 1 acre during wildfire season which can be seen below in yellow. We aggregate all the data we could find for insurance premiums and divide by the associated acreage burned. Putting all of this into 2018 dollars, we estimate an average cost to Insurance companies for each acre burned as in Figure 2 in red. Comparing these per acre costs preventively in yellow and reactively in red makes it clear most states' preventative measures will generate a very high ROI. Further, we did the same averaging for fire department costs per acre. If insurance companies helped alleviate some of the cost shown in blue from the government there would plausibly be subsidies in place.

Figure 2:




While this proof of concept on the profitability of prescribed burns is exciting, there is much more work to be done on this project such as:

1.) Conducting a more granular analysis of fires within counties to provide more targeted plans.

2.) Gathering more data in order to apply more advanced machine learning techniques.

3.) Calculating the long term effects this plan could have on reductions in CO2 emissions and climate change as a whole.

# References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