Understanding California wildfire risk part two: Zesty.ai risk score model

Annie Shen, ACAS
Sheri L. Scott, FCAS, MAAA, CSPA
Katherine Dalis, ACAS, MAAA, CCRMP

Milliman

This article is the second in a series of articles examining California wildfire risk and tools that could be used to identify, quantify, and mitigate this risk. Since our previous white paper in this series, 'Understanding California Wildfire Risk,' the California Department of Forestry and Fire Protection (CAL FIRE)[1] has updated its wildfire statistics, summarized below.

FIGURE 1: CAL FIRE CALENDAR YEAR STATISTICS

Year	Number Of Wildfires	1000 Acres Burned	Structures Damaged/ Destroyed	1000 Acres Burned Per Fire	Structures Per 1000 Acres
2013	9,907	602	456	0.06	0.76
2014	7,233	626	471	0.09	0.75
2015	8,283	881	3,159	0.11	3.59
2016	6,954	670	1,274	0.10	1.90
2017	9,270	1,548	10,280	0.17	6.64
2018	7,948	1,975	24,226	0.25	12.27
2019	7,860	260	732	0.03	2.82

As illustrated in Figure 1, the number of acres burned per wildfire as well as structures damaged per acre burned have increased since 2013. Relentless years of devastating wildfires are stretching the California homeowners insurance industry to its limits, with losses of $37 billion outstripping premiums of $32 billion since 2016.[2]

In recognition of increased wildfire losses that appear to be the new normal, insurance companies have been filing for rate increases with the California Department of Insurance. Although the California rate template allows insurance companies some recognition of the cost of capital for catastrophic wildfire insurance, it does not permit consideration of the net cost of reinsurance.[3] As further described in our prior white paper, reinsurance rates have dramatically increased in the wake of several years of devastating global catastrophes.

Faced with the inability to recover all the costs of insuring California wildfires, the California admitted insurance market has been reducing its wildfire exposure. Stricter underwriting eligibility guidelines and higher rates for wildfire exposed properties have pushed more policyholders into secondary markets, such as the California Fair Access to Insurance Requirements (FAIR) Plan.

The FAIR Plan is designed to accept properties that are having difficulty finding insurance in the market, and does not decline risks due to wildfire exposure. The FAIR Plan's recent rate filings help explain how the tightening admitted market has driven a large volume of homeowners with wildfire-exposed properties into its portfolio. Because the California Department of Insurance has recently taken the position that the FAIR Plan cannot include any cost of capital, the FAIR Plan is struggling to prevent its rates in wildfire-exposed areas from becoming lower than the admitted market.[4] All else equal, not permitting the FAIR Plan to include the cost of capital, which the admitted market is permitted to include, results in lower FAIR Plan rates relative to the admitted market. As a result, there has been an influx of homeowners moving to the FAIR Plan simply because they can get a lower premium. This is expanding the FAIR Plan from a market of last resort to a cheaper provider of wildfire insurance in the state.

[1] California fires of 10 or more acres from CAL FIRE as of January 6, 2021. See https://www.fire.ca.gov/incidents/.

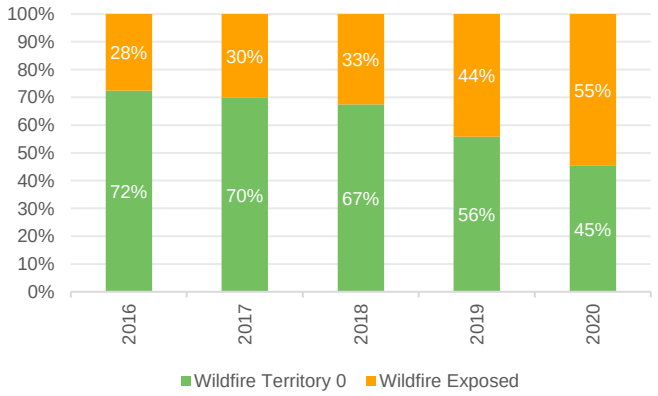
[2] S&P Global, National Association of Insurance Commissioners (NAIC) Annual Statement, Statutory State Page, Line 4: Homeowners, Direct Incurred Losses and Direct Earned Premium, calendar years 2015 to 2019, as of September 28, 2020.

[3] California Insurance Code (CIC) Section 2644.25 and the CA Rate Template only permit net cost of reinsurance to be considered for medical malpractice or earthquake. CIC Section 2644.15-16 permits a rate of return (ROR) between the risk-free ROR and 6% higher than the risk-free ROR, and an additional 2% at the Commissioner's discretion based on market conditions. The ROR range could be used to consider the higher cost of capital to provide catastrophe coverage.

[4] FAIR Plan California rate filings 19-4339 and 20-2965, where the California Department of Insurance did not permit consideration of net cost of reinsurance nor any cost of capital.

Figure 2 illustrates that FAIR Plan properties located in wildfire-exposed territories ("Wildfire Exposed") have doubled from 28% in 2016, to 55% in 2020, shifting the FAIR Plan's footprint across the state to higher wildfire-exposed areas.[5] "Wildfire Territory 0" denotes the FAIR Plan's lowest wildfire-rated territory.

FIGURE 2: FAIR PLAN DISTRIBUTION BY WILDFIRE EXPOSURE



To better understand its exposure to wildfire, the FAIR Plan asked Zesty.ai, Inc. (Zesty.ai), a company that provides a wildfire risk score model, to score the FAIR Plan properties relative to wildfire risk. Zesty.ai calculated that 4% of all residential properties across California are heavily exposed to wildfire, compared to 21% of FAIR Plan properties.[6]

WILDFIRE EXPOSURE MEASUREMENT TOOLS

Insurance companies and reinsurance companies have been early adopters of property-level wildfire risk models to assess a property's wildfire risk level and help understand and manage its wildfire risk. As discussed in our previous paper, traditional wildfire risk score models consider the following:

1. **Fuel**: The grass, trees, dense brush, and vegetation that feed wildfires.
2. **Slope**: Steeper slopes increase the speed of wildfire and affect reconstruction costs.
3. **Access**: Dead-end roads impede firefighting equipment.

Modern computing power and technological advancements have enabled companies to create more sophisticated models that consider more granular property-level data.

According to documentation provided by Zesty.ai, its Z-FIRE wildfire risk model is unique in that it uses high resolution satellite imagery along with climate and other data sources to provide two layers of information about the property's wildfire exposure. The first layer (L1) provides the annualized probability of the property being within the perimeter of a wildfire by identifying the type and proximity of fuel source, precipitation, temperature, and other geospatial variables. The second layer (L2) provides the conditional probability of the property being destroyed in the event of a wildfire by using high resolution satellite imagery to identify specific details about the property such as how close certain types of vegetation are to the structure, whether there are tree branches overhanging the roofline, whether fire-resistant building materials are used, and other details about the building. The homeowner can influence L2 probability of destruction by clearing brush within the property perimeter, trimming tree branches hanging over the roofline, upgrading to modern building materials such as fire-resistant roofs, and other home-hardening measures.

In this paper we use the Zesty.ai Z-FIRE model L1 and L2 probabilities to assess exposure to wildfire and how the insurance industry and homeowners can use wildfire risk score models to better understand, assess, and mitigate wildfire risk. This case study was performed independently, and not commissioned by Zesty.ai, FAIR Plan, or any other company.

Case study

PORTFOLIO OF PROPERTIES

The FAIR Plan's portfolio of properties is uniquely suitable for evaluating a wildfire model and wildfire exposure because it has sufficient properties with varying levels of wildfire exposure.

To start the analysis, FAIR Plan residential properties insured between January 1, 2016, through September 30, 2020, were sorted in order of FAIR Plan wildfire territory, and then the territories were grouped into five groups of increasing wildfire exposure.[7] Group 1 contains the lowest wildfire exposure territory that couldn't be further segmented, while Group 5 represents properties in territories currently classified as having the highest wildfire risk under FAIR Plan's current rate plan.

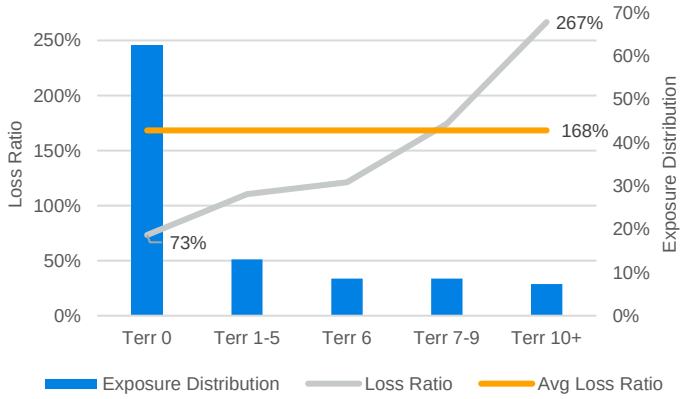
Figure 3 summarizes the distribution of earned exposures and reported loss experience ratio for each FAIR Plan territory group. The loss ratio for a territory group was calculated as the sum of each property's reported wildfire loss in the territory group, divided by the earned premium for each property in the territory group during the experience period.

[5] Distribution of FAIR Plan calendar year earned exposures split into FAIR Plan wildfire Territory 0 versus Territory 1 and higher, valued at September 30, 2020.

[6] Heavily exposed defined as Zesty Z-FIRE L1 x L2, very high-risk score groups, using FAIR Plan residential dwelling policies in force on December 31, 2019.

[7] Earned premium calculated by rerating each policy during the experience period, using September 30, 2020 rates. Reported loss and defense and cost containment expense (DCCE) for accidents from January 1, 2016 through September 30, 2020, are valued as of September 30, 2020, without incurred but not reported (IBNR).

FIGURE 3: WILDFIRE REPORTED LOSS RATIO BY FAIR PLAN TERRITORY

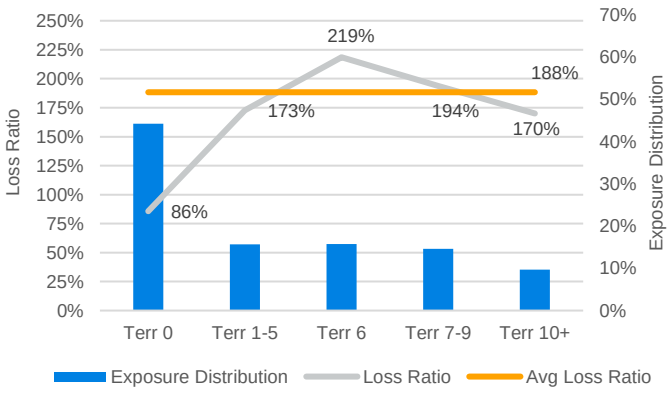


The orange line is the average loss ratio across all territory groups combined, which is 168%. This means that over the experience period, for every $100 in premium collected, $168 was reported by FAIR Plan in losses. The area between the orange line and the gray line represents the cross-subsidization that occurred. The area below the orange line, down to the gray line, represents the subsidization that properties in the less risky FAIR Plan wildfire territory groups provided to properties in the very high-risk territory group. The amount of subsidy that the very high-risk territory group received is the area below the gray line, to the orange line.

Because the FAIR Plan's footprint is shifting toward more wildfire-exposed areas, using historical experience without adjustment can underestimate the wildfire loss ratio. Also, because catastrophe losses widely fluctuate from year to year, modern insurance ratemaking techniques generally employ stochastic catastrophe model average annual loss (AAL) on in-force properties instead of historical experience losses. For these reasons, this case study also performs a similar review, with a widely used industry stochastic catastrophic model AAL obtained on FAIR Plan policies in force on December 31, 2019.[8]

Figure 4 summarizes the distribution of in-force properties and loss ratio, for each FAIR Plan territory group. The loss ratio was calculated as the sum of each property's wildfire AAL in the territory group, divided by on-level premium for each property in the group.

FIGURE 4: WILDFIRE AAL LOSS RATIO BY FAIR PLAN TERRITORY



The loss ratio is 188%, using AAL on in-force policies as the measurement of expected annual losses. All territory groups except Territory 0 have a loss ratio above 100%, which means that the rates need an increase to simply cover the expected loss costs for properties in these territory groups.

STRATIFY RISK WITH A WILDFIRE RISK SCORE MODEL

To further assess its wildfire risk, FAIR Plan asked Zesty.ai to provide its Z-FIRE L1 and L2 probabilities for each property, which were multiplied together to arrive at a combined Z-FIRE wildfire risk score (WRS) for each property. To mimic underwriting, characteristics about each property immediately before the experience period were used to calculate the WRS. After calculating each property WRS, properties were then sorted into five groups of increasing WRS.

Figure 5 summarizes the distribution of FAIR Plan residential dwelling fire properties in force on December 31, 2019, by current FAIR Plan wildfire territory group and WRS group.

FIGURE 5: DISTRIBUTION BY WRS GROUP

		WRS Group					
		Very Low	Low	Moderate	High	Very High	Total
Current Wildfire Territory Group	Terr 0	20.1%	18.4%	5.3%	0.3%	0.1%	44.3%
	Terr 1-5	0.4%	1.1%	6.0%	4.5%	3.7%	15.7%
	Terr 6	0.0%	0.2%	3.7%	5.8%	6.0%	15.8%
	Terr 7-9	0.0%	0.1%	2.8%	5.2%	6.4%	14.6%
	Terr 10+	0.0%	0.0%	1.4%	3.6%	4.7%	9.7%
	Total	20.5%	19.8%	19.2%	19.4%	21.0%	100.0%

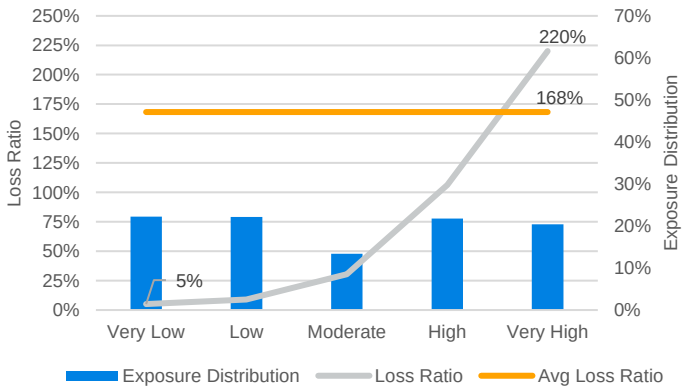
[8] AAL was from a widely used industry stochastic catastrophe model and does not include DCCE. For consistency with experience period analysis, in-force analysis used rates current at September 30, 2020.

The diagonal of the above matrix, outlined in gold, represents properties where wildfire risk was classified similarly by both the current rate plan territory assignment and WRS. Below the diagonal represents properties the WRS classified as lower risk than the current rate plan. For example, the WRS used additional characteristics specific to each of the 9.7% of properties in the FAIR Plan's highest wildfire risk territories (Terr 10+), to reclassify some of these properties into less risky WRS groups, leaving only 4.7% classified as very high risk. Above the diagonal represents properties the WRS classified as higher risk than the current rate plan. In total, the WRS classified 21.0% of FAIR Plan properties as very high risk.

HISTORICAL EXPERIENCE PROPERTIES

After a WRS group was assigned to each property, FAIR Plan's actual wildfire reported loss experience ratio from January 1, 2016, through September 30, 2020, was calculated[9] for each WRS group. Figure 6 summarizes reported loss ratio by WRS group.

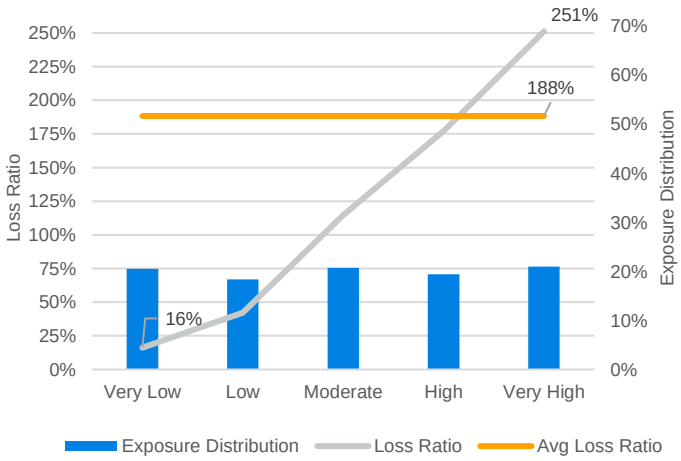
FIGURE 6: WILDFIRE REPORTED LOSS EXPERIENCE RATIO BY WRS GROUP



The orange line is the average loss ratio across all territory groups combined. The area below the orange line, down to the gray line, represents the subsidization that properties in the less risky WRS groups provided to properties in the very high WRS group. The amount that the very high WRS group obtained in subsidy is the area above the orange line to the gray line.

The graph in Figure 6 is called a lift chart, where the gray line is a measurement of how well the model classifies risk beyond the current rate plan. The 220% loss ratio for the very high-risk WRS group, divided by the 5% loss ratio for the very low-risk WRS group, results in a lift of 44. Lift measures the ability of the WRS to segment the best from the worst risks. The higher the lift, the better the model differentiates the very high risk from the very low risk. Typical insurance models have lifts in the single digits, such as the one in Figure 3 above, so a lift of 44 has significant predictive power over typical models, as well as the current FAIR Plan classification system. To address the FAIR Plan's growing wildfire exposure, a similar review was done using AAL on in-force policies, as summarized in Figure 7.

FIGURE 7: WILDFIRE AAL LOSS RATIO BY WRS GROUP



The upward sloping gray line with a lift of 15 indicates that the Zesty.ai WRS is able to significantly stratify risk between the very high-risk and very low-risk wildfire properties, beyond the current FAIR Plan rate plan. Please note that a lift chart is simply one method that can be used to assess the model. There are other model validation techniques, such as a Lorenz curve or Mean Square Error approach, which measure how well the model segments risks across all groups.

The shift of FAIR Plan policies into higher WRS groups, which have higher loss ratios, is driving up the overall FAIR Plan wildfire loss ratio. Compounding the increasing loss ratio is the inability to recover all the costs to insure wildfire-exposed properties, creating market conditions and a deterioration of FAIR Plan's rate adequacy as further described in FAIR Plan's recent rate filings.

[9] January 1, 2016, to September 30, 2020, earned premium using rates on-level to September 30, 2020, and loss and DCCE reported for the same accident period, without incurred but not reported (IBNR).

Summary

The above analysis demonstrates how insurance companies can use modern WRS models to assess and manage wildfire risk. Having access to modern WRS models is only half the battle. Updating California regulations to enable insurance companies and the FAIR Plan to recover the full cost of wildfire exposure, such as net cost of reinsurance and cost of capital related to providing catastrophic coverage, could help reverse the shrinking admitted market trend. Coupling that with facilitating the use of WRS models to introduce discounts that encourage home hardening or other wildfire risk improvement measures taken by homeowners and communities could help mitigate escalating wildfire costs. The industry, regulators, communities, and homeowners can work together to use the insights and modern techniques that the insurance industry has developed to assess and mitigate wildfire exposure, such as wildfire risk scoring models, to better understand and reduce the impact from California wildfires.

Milliman

CONTACT

Sheri L. Scott, FCAS, MAAA, CSPA
sheri.scott@milliman.com