

The Efficacy and Return on Investment of Loss Prevention Programs – Background, Methods and Results

A Case Study on the Ting Fire Prevention Program

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 Affiliated with The Institutes



Executive Summary

Whisker Labs and collaborators Octagram and the Insurance Information Institute (Triple-I) sought to understand the fire prevention efficacy of Ting and, in doing so, promulgate methods to evaluate other prevention solutions. This study examines fire claims in Ting homes over time. Claims data from a period of 56 months – equating to over 1.1 million home years of data – was analyzed. In homes equipped with Ting, 433 fire claims were reported in the data provided by insurance partners during this period.

Within this sample of fire claims, the frequency of fires declined by an estimated 63 percent. This resulted in a decrease of 0.39 claims per 1,000 home years of experience in the 3rd year of Ting installation. Further, it is estimated that the average severity of claims avoided equals \$216,500 in 3 years time. Thus, the loss prevention benefit of Ting equals \$81 per home per year.

Analyzing the efficacy of prevention solutions is difficult for many reasons. Perils are infrequent, poorly classified, and there are many sampling challenges. A novel method was developed to analyze the fire frequency trends in homes with Ting over time. Using a broad bucket of claims with a large volume of data, it was possible to order the data in time, divide it into deciles with an equal number of home years, and analyze the number of claims in each bucket. The number of claims decreased over time from 69 to 25.

Background

As the insurance industry and the general public seek risk reduction solutions, many have been proposed for a variety of risks. Video doorbells reduce theft and vandalism. Water shutoff and leak detection systems reduce water damage from leaks in home plumbing systems. And, from Whisker Labs, Ting helps predict and prevent electrical fires and water losses.

Many of these systems are easy to use and widely adopted, but surprisingly little is known about their economic efficacy. Yes, there are lots of great success stories, and customers love many of these services¹. Ting, for example, has an exceptionally high customer satisfaction rating with a Net Promoter Score of 87². Solution providers have numerous case studies and examples of potentially damaging events they have detected and mitigated. However, rigorous analysis of the reduction in claims is harder to find. While it is clear that Ting helps prevent fires, how many do they prevent that would have occurred if not for the technology, and how does that translate to a positive return for insurers and their customers?

Whisker Labs sought to answer these questions and has dedicated significant resources, working closely with its carrier partners, outside actuarial consultants, and insurance industry experts. In doing so, we have established a methodology that has broad application for many types of prevention solutions.

In summary, we have found that Ting works. **It reduced fire claims by an estimated 63 percent** in our claims sample, resulting in **0.39 fewer electrical fire claims per 1,000 home years** of experience, in the 3rd year after installation. This results in **fire claims reduction benefit of \$81 per customer by the 3rd year**.

Note that independent analysis by Whisker Labs has documented that Ting prevents at least 80 percent of electrical fires³. The findings in this report are consistent with that, since many of the claims analyzed are not electrical fires and include many claim categories, including kitchen and cooking fires.

Summary Findings

\$81

in fire claims reduction
per customer per year

0.39

fewer claims per
1,000 home years

\$216.5K

avg electrical fire
claims severity

¹ Example: "This Device Saved My House from an Electrical Fire. And You Might Be Able to Get It for Free." – New York Times, <https://www.nytimes.com/wirecutter/reviews/ting-electrical-fire-protection-device/>

² Net Promoter Score is a widely used customer satisfaction metric. https://en.wikipedia.org/wiki/Net_promoter_score#cite_note-0-2

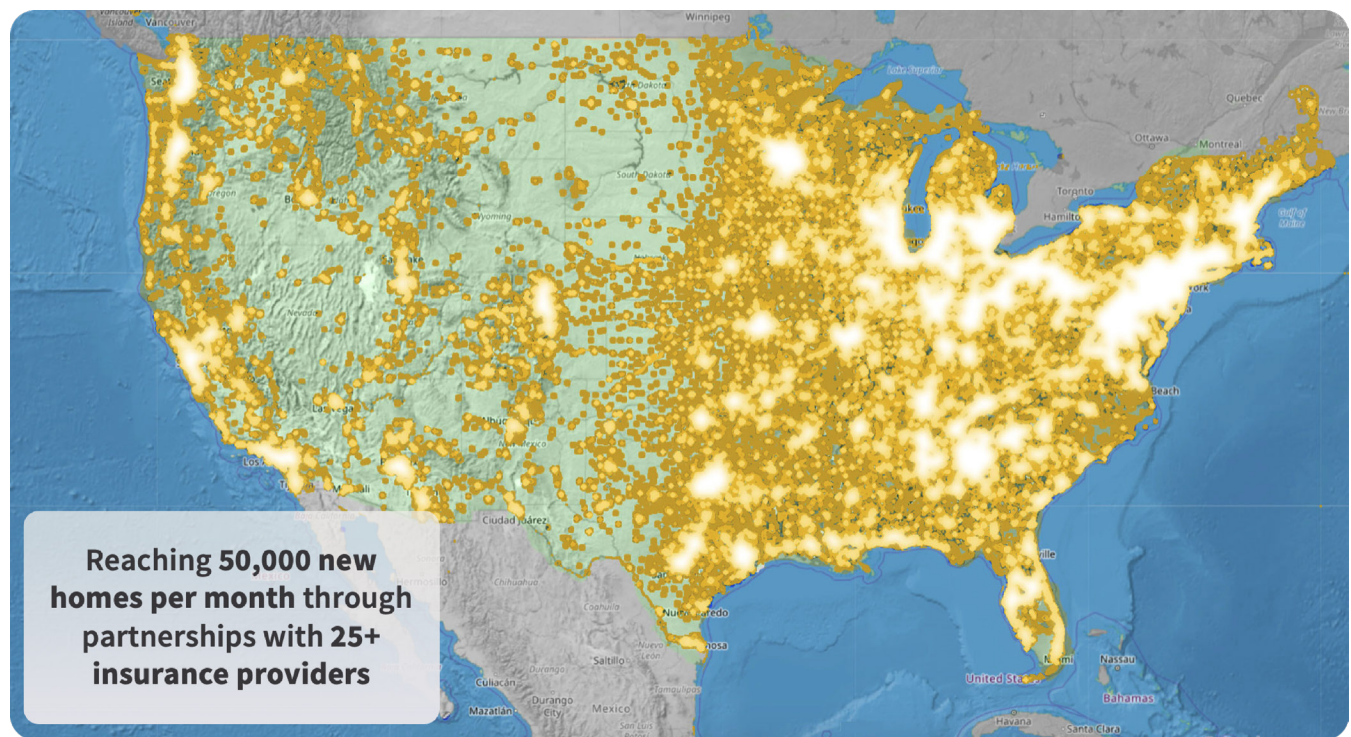
³ Vyto Babrauskas, Casey Grant, Stan Heckman, Theo Laughner, Joe McNulty, Michael S. Roy, Christopher Sloop New Data: Home Electrical Fire Prevention, March 1, 2022, <https://www.whiskerlabs.com/ting-performance/>

About Ting and Whisker Labs

Whisker Labs was founded in 2017 and developed **Ting** to help predict and prevent electrical fires in buildings. Ting uses AI and machine learning to monitor voltage at high frequencies (30MHz) and identify anomalies in a building's electrical system, the devices and appliances connected to it, and the utility connection to the home. Ting is a super-smart sensor that fits into any 3-prong outlet in a home.

On average, Whisker Labs sends fire hazard alerts to about 1 in 60 homeowners per year. Of these we estimate that about 1 in 27 would have resulted in a fire if undetected. A single Ting is all that is required for most homes. Ting is easy to set up, requires no maintenance, and has a lifetime warranty. It also provides power and internet outage notifications, monitors power quality, and provides other information about power safety. About **15 percent of customers engage with the Ting app every day. 93 percent of customers use the Ting app at least every month.**

Today, Whisker Labs works with a growing community of 30 insurers that provide Ting to their customers for free. **More than one million Tings are deployed in the U.S., and approximately 50,000 new Tings are installed each month** (see national map of the Ting network).



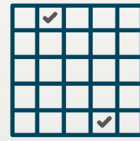
In addition to monitoring voltage and features of voltage at high frequencies to detect arcing that is indicative of fire hazards, Ting has a temperature sensor that monitors the temperature within the home. When the temperature drops below 42 degrees, an alert is issued. Thus, Ting detects and warns about conditions that can result in frozen and burst pipes and alerts the homeowner to correct the situation before damage occurs. Over the last three years **we have issued low temperature warnings to about 1 in 560 customers per year.**

Like Ting, other peril-based IoT solutions issue alerts and warnings when a hazard is detected. Thousands of hazards are detected and alerts sent, but how do you know that this reduces claims? How do you estimate the return on investment for these devices? How can you prove that the bad thing, a loss and a claim, didn't occur? We developed a rigorous methodology to do this in the real world with existing customers and experience data.

Methodology

There are a few big challenges in developing a method for evaluating the efficacy of any loss prevention solution. At the most basic level, we are trying to determine the absence of a loss. We are trying to see if the bad thing didn't happen in the cohort of homes that installed Ting. This is hard to do. It's made harder by a few characteristics.

Estimating the efficacy of fire prevention IoT is challenging



Losses are Infrequent



Claims Data is Incomplete



Sampling is Biased

First, claims are infrequent. For nearly all perils, claims are uncommon. Water losses occur in about 1 in every 50 homes per year; fire losses in about 1 in 700⁴; thefts in about 1 in every 200. With limited data, it can be hard to see a clear improvement in claims rates for these perils.

Second, the claims data — especially information about the secondary cause of claims — can be very limited or inaccurate. For example, about 50 percent of fire claims have an unknown or indeterminate secondary cause. That is, we may know the primary cause of the claim — a fire — however, 50 percent of the time we do not know if it was caused by an electrical problem or something else, like cooking. Prevention solutions only work on a subset of secondary causes, making it hard to pinpoint claims that should be prevented.

Third, nearly all the deployments of prevention solutions are targeted at particular customer segments and/or are voluntary opt-in programs. This introduces sampling bias that makes it nearly impossible to accurately compare the groups with and without the prevention solution.

In the face of these challenges, what analysis can be done? Whisker Labs developed a self-controlled study that assesses the behavior of claims over time in homes with the prevention solution, in our case Ting. By conducting this analysis, with a large quantity of home years of experience, and analyzing a broad bucket of claims, it was possible to sidestep the three main challenges presented above.

Here is a more detailed explanation of the methodology and data employed.

Claims Data Provided by Ting Insurance Partners:

417M Days of Data
1.1 M Home Years

433 Non-Cat Fire Claims

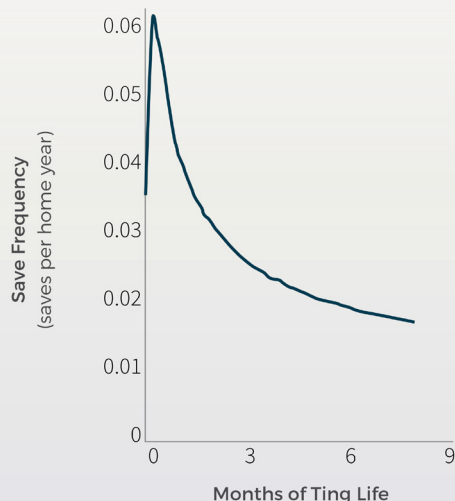
Given the infrequency of fires, over 1.1 million home years of data was used in this analysis with a corresponding 433 fire claims, across multiple insurers. The categorization of claims varies from carrier to carrier. Generally, a broad category of claims, encompassing most electrically related fires and most other non-catastrophic fires, was included. “Non-catastrophic fire losses” refers to fire claims not associated with a catastrophic loss event, such as a wildfire.

Several runs of the analysis have been done over time with increasing quantities of claims data from a growing number of insurers. The results are stable as the data set grows.

This large amount of data allows us to overcome the infrequency of the peril. This is aided by Ting being widely distributed with over 1 million Tings deployed currently and about 50,000 more coming online each month.

⁴ Verisk I ISO Fire Non-Cat frequency 2020-2024 average is 0.14 per 100 home years, which implies 1 in 700 $\sim$ (1/0.0014). <https://www.iii.org/fact-statistic/facts-statistics-homeowners-and-renters-insurance>

Ting Saves Over Time



A self-controlled study methodology was developed to avoid sampling bias. Ting, like many other IoT devices, takes time to detect hazards. This learning period acts like a placebo to determine the base frequency of claims within the study group. In each home, Ting's ability to prevent fires improves over time as home specific data is analyzed. Anyone who has installed a Ting has experienced this as the app indicates Ting is in "learning mode".

In the case of Ting, this is certainly an imperfect or "dirty" placebo. We see the fire hazard detection rates increase quickly, so it is possible our methodology underestimates the base-line fire risk within the Ting cohort at the outset of the study. The chart to the right shows the frequency of mitigated fire hazards, what we call "Saves" over time. You can see that it quickly rises within the first 11 days a Ting is installed. In some cases, it may also be possible to look at claims rates in homes before they enrolled in the prevention solution. This would provide a longer time series of pre-treatment data and more confidence of the baseline claims rate for the peril of interest.

Because fire claims often don't specify the secondary cause—like whether the fire was electrical or due to cooking—we look at a broad group of non-catastrophe fire claims to estimate a baseline fire frequency for the Ting group. This broader approach helps avoid errors tied to missing or inaccurate secondary cause data. However, since the prevention system only targets certain types of fires (like electrical), using this wider claim set lowers the relative efficacy of the prevention solution.

(1) Days	(2) Number of Ting Days	(3) Claim Count	(4) = (3) / (2) x 365.25 x 1,000 = Frequency
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Without Ting		69	0.61
0-49	41.6	59	0.52
50-102	41.3	40	0.35
103-161	42.1	40	0.35
162-226	41.9	57	0.50
227-296	41.3	38	0.34
297-376	42.0	45	0.39
377-476	41.9	48	0.42
477-610	41.6	46	0.40
611-835	41.8	35	0.31
836+	41.8	25	0.22

63% reduction
in fire frequency
= 0.22 / 0.61 - 1

0.39 fewer claims
per 1000 home years
= 0.61 - 0.22



Looking at the trend in claims frequency within homes that have Ting over time allows us to estimate the claims reduction efficacy. This same approach could be applied to other prevention solutions as well. To analyze the behavior of claims over time within the Ting cohort, the claims are ordered by age and put into bins or groups of equal number of Ting days. Age is defined as the time in days the Ting had been activated in the house. The table on the right shows the 433 fire claims in homes with Ting divided into 10 bins of an approximately equal number of home days of experience (column 2). You can see in column 3 that the number of claims in each bin varies over time.

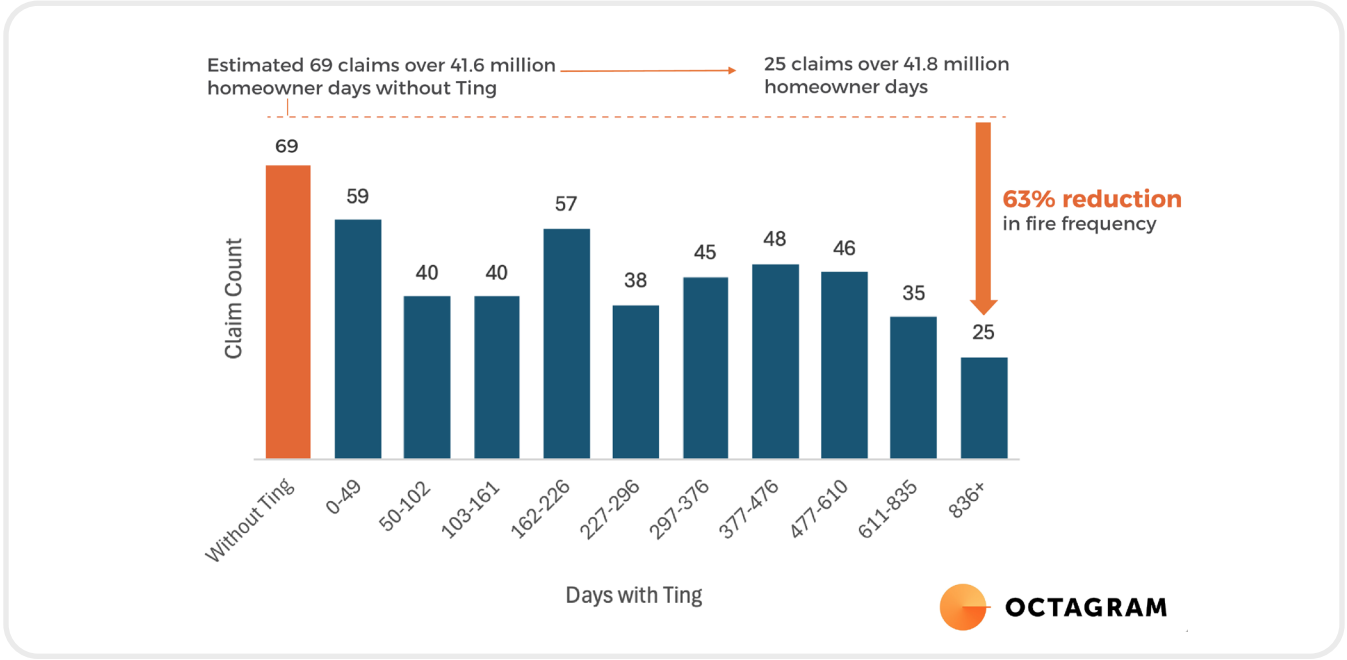
It's also possible to vary the number of bins to achieve the clearest results, depending on the volume of data available. A larger number of smaller bins have less statistical significance and can vary widely. A smaller number of large bins may not show enough trend in the data to draw clear conclusions. With some sensitivity analysis, 10 bins each with about 41.7 million home days of experience was deemed to be the best balance for the Ting analysis.

One interesting side note and a benefit of this method is that it requires minimal data about each claim. For each claim the analysis only requires the number of days from the time the prevention solution was implemented to when a loss occurred. In the case of Ting, this is the number of days from activation of Ting in a home to a fire occurring. Thus, no sensitive or detailed claims information is required for this analysis.

For the same number of home days, as we have in each bucket, you would expect roughly the same number of fire claims, all else being equal. If the prevention solution is working, one would expect to see a decrease in the number of claims. When looking at Ting data, what were the results and what did we learn from this analysis?

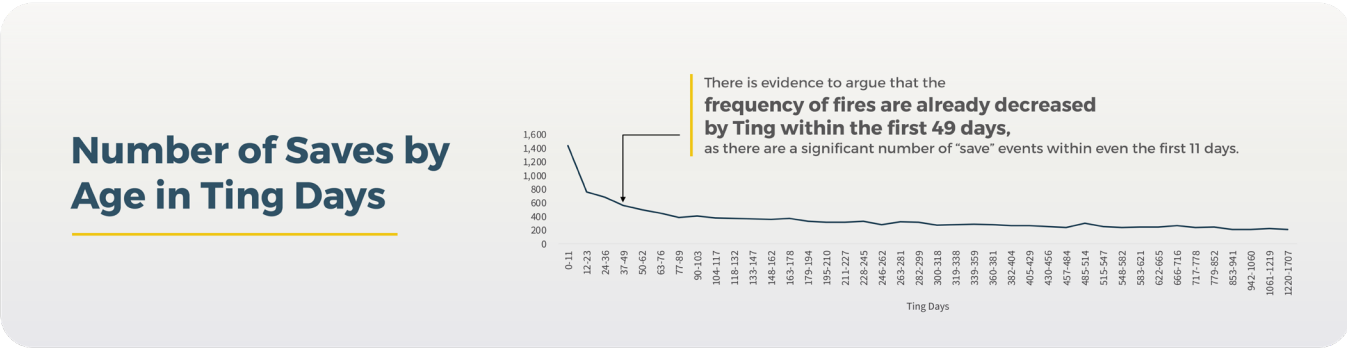
Fire Loss Prevention Efficacy

What we see in the Ting cohort is that the number of claims in each bin goes down from an estimate of 69 when Ting is first installed to 25 claims in the oldest bin. The **frequency of claims goes down from an estimated 0.61 claims per 1,000 home years to 0.22 claims per 1,000 home years, thus a total reduction in claims of 0.39 per 1,000 home years.** The claims frequencies observed and associated percent reduction in claims are highly dependent on the definition of the sample of non-cat fire claims provided by carriers that participated in the analysis. However, this does not impact the observed absolute reduction in claims.



One challenge with this analysis is accurately determining the base frequency of claims in homes before the prevention solution is applied. Variables such as an inverse self-selection bias can contribute to a higher base frequency of claims, i.e., when presented with an opportunity to opt-in to a prevention technology, customers that perceive themselves to be at a higher risk may opt in first. While there is data supporting this hypothesis, it is not the intent of this paper to study this phenomenon in detail. Rather, we simply estimate the baseline frequency of claims based on the data and the slope of claim frequency approaching day zero when the solution technology was installed.

In the case of Ting and other peril-based IoT solutions, there is frequently a delay in their efficacy, a “learning” mode, that acts as a placebo. However, we learned that in the case of Ting this period can be short. Electrical fire hazards evolve over time and grow more severe. We found that the number of fire hazards detected and mitigated (Saves) by Ting increases very fast and peaks after 11 days of Ting being installed. This and the key findings of this trend are shown below.



Thus, it is necessary to estimate what base frequency of fire claims in Ting homes would be before the Ting was installed. We came up with a simple estimate.:

- The most conservative approach is to assume that the frequency of claims before Ting is installed is 0.52, the same frequency we see in the first 49 days of experience. This implies 59 claims over 41.6 million home days.
- For our “best estimate”, we assume the claims decrease at the same rate. The claims frequency is the average within each decile. A simple way of calculating this is to take half of the difference in claims between the first bin and the second ($59 - 40 = 19$. $19 / 2 = 9.5$). Then we can add that to the claims in the first bin (59), which is 69 claims. This is equivalent to 0.61 claims per 1,000 home years. Note that the Verisk non-catastrophe fire frequency from 2020-2024 is higher at 1.4 per 1,000 home years⁵. This approach may still be conservative, given the high rate of Saves within the first 20 days a Ting is installed.
- A higher estimate would be to linearly apply the trend in the first two bins ($59-40=19$) on the bar chart. This would imply the base number of claims over 41.6 million home days in before having Ting was 78 claims or a claims frequency of 0.68. This would yield a reduction in claims of 0.47 per 1,000 home years.

As more data is accumulated, the analysis is rerun – aggregating data across multiple carriers as the Ting network grows. Over time this analysis will become even more accurate, especially at the ends of the distribution where there is less data.

We learned a few key things in this analysis and through more qualitative assessments of customer experience, testimonials and other details.

- As Ting goes to work, it prevents fires that would have occurred in the future – in some cases 2-3+ years in the future.
- Within the Ting cohort, there is a significant drop in the frequency of fire claims over time.
- Fire hazards reveal themselves over time. There may be fire hazards in seldom used areas of the house like guest rooms, or appliances, electronics or devices, like holiday lights.
- The spike in fire hazards in the early stages of Ting life is very interesting.
 - There is a reservoir of fire hazards that Ting taps into when new programs are launched
 - A higher proportion of risky customers enroll in Ting, their fire hazards are detected, and the risks are reduced.
 - The preexisting fire hazards may be in a more advanced stage with a stronger signal and more imminent threat.
 - Homes are also dynamic – the occurrence of fire hazards continues even after homes have had Ting for a year or more.
- In summary, the analysis clearly shows that Ting significantly reduces the frequency of claims over time. In short - Ting works.

Loss Severity and Return on Investment

As stated above, overtime we see the frequency of fires in Ting homes go down. That ultimate reduction is equivalent to 0.39 claims per 1,000 home years. This efficacy is very similar to independent analysis conducted by carriers utilizing Ting. Combining this with loss severity, we can determine the value of the prevented claims and ultimately the financial return associated with Ting. The same approach could be used for other prevention solutions.



Given the claims data used for this study and the fact that we are trying to measure the severity of events that didn't occur (the value of prevented claims), we relied on publicly available data and ranges of claims severity information provided by carriers. The graphic below summarizes this information. Within the Ting customer base, we see average electrical fire loss severity range from about \$140,000 to well over \$1.8 million as reported by carriers. The wide range reflects the differences in the insurer's customer bases.

Verisk shows that the national 2024 non-catastrophe fire severity was \$176,111⁶. FEMA states that “Residential building electrical fires resulted in over twice the dollar loss per fire than residential building nonelectrical fires did.”⁷ Nationwide says that for home electrical fires, “damages can average over \$200,000”⁸. These data points can serve as a guide for individual carriers to estimate the forecasted loss prevention benefits based on the nature of their book of insureds.

⁵ <https://www.iii.org/fact-statistic/facts-statistics-homeowners-and-renters-insurance>

⁶ <https://www.iii.org/fact-statistic/facts-statistics-homeowners-and-renters-insurance>

⁷ <https://www.usfa.fema.gov/statistics/reports/fire-causes/electrical-fires-v19i8.html?>

⁸ <https://news.nationwide.com/tech-thwarts-flames-averts-catastrophe/>

Further, we can also look at how claims severity may change going forward

- The 6 year average U.S. CPI is 3.8 percent⁹
- The Triple-I's average homeowners replacement cost yearly increase for 2019 to 2024 is 4.5 percent¹⁰
- The Verisk non-catastrophe fire severity for homeowners in 2024 is \$176,111 and in 2019 it was \$99,613, implying a 15 percent year-over-year inflation¹¹

With these data points in mind, we have assumed an average loss severity of \$190,000 (with a high estimate of \$220,000 and a low estimate of \$180,000) and yearly inflation of 4.5 percent. Note again that the severity for each insurer could be very different from our estimate, depending on their customer profile. These estimates equate to a severity of \$216,457 in year 3 and a corresponding loss prevention benefit of \$81 per home per year. Add in additional benefits associated with a reduction in water losses from frozen pipes, failing sump pumps and water heaters and power outages. Also add in improvements in customer retention and the total benefits are likely substantially higher. The table below summarizes these findings.

	Medium	Low	High	
Claim reduction benefit	\$81	\$69	\$116	$0.39 \times \$190k \times (1.045)^3 = \$81$
Annual fully loaded cost	\$56	\$56	\$56	
Net positive return	\$25	\$13	\$60	

Netting out the fully loaded annual cost of the prevention program, then yields a simple calculation of the return for customer per year. It's also possible to show all these benefits over time in a more sophisticated cost benefit analysis that yields a net present value and return on investment based on a discounted cash flow analysis.

In conclusion, we see that Ting works and, by year 3, provides a positive return for insurers providing Ting to their customers.

Combined with other benefits the return is higher. Further, the methods used in this study should serve as a guide for how other prevention solutions can be analyzed.

At Whisker Labs, our mission is to prevent losses before they happen. Behind every data point is a home, family, and lives. Studies like this help advance a future where prevention is prioritized, measurable, and scalable.

Key Uncertainties and Areas of Future Research

Here are some key risks and uncertainties in this analysis, as well as how we can improve in the future:

- The estimate of claim frequency without Ting still requires us to extrapolate back from the data we have from the first 49 days of installing Ting. This extrapolation is challenging. Going forward, to improve this analysis, getting data on the fire experience of homeowners who enrolled in Ting at the time of opt-in, but before Ting was installed, will provide data to confirm our estimate.
- We see the claim frequency drop at 836 days onwards. There are only 25 claims, so with more data we can see if this is sustained or indeed if this continues to decrease as the Ting gets older.
- The estimate of claim severity is based on nation-wide average non-catastrophe fire catastrophes, with the insight that electrical fires have a higher severity than non-electrical fires, as well as input from carriers. In the future, the return on investment analysis would benefit from more data on the claim severity of electrical fires, either directly from carriers or from industry sources. This will require more claims data, and additional detail on the nature of each claim in the data set.
- Currently we are assuming that buckets with the same number of Ting days should generate the same number of claims, with only Ting being the variable that explains the difference in claim outcomes. In reality, variables like home age may explain the difference in claims in each bucket, and we have implicitly assumed that the mix of homes by age is the same in each bucket. In the future, one improvement would be to obtain and analyze this data and consider how it impacts our benefit estimate, if at all.
- We assume that the performance of Ting doesn't change in this analysis, but we know that many improvements have been made during the time series of the data.
- Ting prevents a variety of water losses as well and no effort was made in this study to estimate those prevention benefits. With sufficient claims data, similar methods could be used to estimate those benefits.

⁹ <https://fred.stlouisfed.org/series/CPIAUCNS>

¹⁰ Source: Insurance data and analysis: Triple-I; U.S. economic data: BLS (as of 02/01/2024) https://www.iii.org/sites/default/files/docs/pdf/triple-i_trends_and_insights_homeowners_insurance_rates_07092024.pdf

¹¹ Triple-I, Homeowners Insurance Non-Catastrophe Fire Losses, Severity And Frequency, 2020-2024* https://www.iii.org/fact-statistic/facts-statistics-homeowners-and-renters-insurance?utm_source=chatgpt.com

About This Study

Whisker Labs, Inc. (www.whiskerlabs.com) is dedicated to helping insurance companies predict and prevent electrical fires and water losses. Understanding the efficacy of peril-based risk mitigation solutions is fundamental to our business.

We've sought to develop robust methods for credible evaluation of efficacy and associated ROI. This efficacy and ROI evaluation was conducted in partnership with Octagram (www.octagramanalytics.com), providing independent data analysis and modeling, and the Insurance Information Institute (Triple-I – www.iii.org), contributing insurance industry expertise and contextual insight.

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