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## How to Predict Warranty Claims (and Keep Cool Doing It)

Eston Martz · 24 August, 2012

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When the ambient temperature in my house reached 400 degrees one afternoon this summer, I realized that—no matter *what* the guy who answers the phone at the Weather Channel claimed—it was too possible for a human being to melt. So I broke down and bought an air conditioner. After a few minutes, my skin lost the alarming waxiness it had acquired. I was confident that I'd remain solid for the rest of the summer.



About a week later, though, the air conditioner began to emit a keening, metallic wail. Now, speaking as a guy who owns not one but several *Merzbow* albums, a little industrial noise seemed like a small price to pay for keeping my skin temperature safely below the melting point. In fact, after a while, I came to rather enjoy the air conditioner's shrieking siren song.

But the next day when the air conditioner delivered only shriecing, and no cool air, it no longer sounded so sweet. As the sun rose higher and the temperature soared, my brain latched onto a single idea:

### Warranty Analysis.

Somewhere, I knew, existed data that had predicted the demise of my fan, and quantified just how much it would cost the manufacturer to make good on this product's one-year warranty.

### Predicting Warranty Costs Is Good for Business

No manufacturer sets out to disappoint—let alone melt—a customer, but defects can exist so most provide a warranty to keep their customers satisfied. But anticipating warranty costs for a product or business can be challenging, even risky. Setting aside too little money or too many spare parts may lead to hardship if an unanticipated problem arises. Setting aside too much money ties up resources that might be used more effectively elsewhere.

So how can you estimate future warranty expenses with confidence? Very smart people at the company that made my air conditioner had grappled with that very question, and in a flash I realized how they could answer it.

All they needed was a little data! As rivulets of sweat dripped down my brow, I fired up my laptop to try it for myself.

Maybe it was just the heat getting to me, but I had a vision of the number of returns this manufacturer might receive each month for a year's worth of air conditioner production. All they needed to forecast warranty claims in the coming year was the number of fans shipped over the previous 12 months, and the number of each shipment returned each month.

### What Data Do I Need to Predict Future Warranty Claims?

When I entered my fever-dream [data](#) into a blank data sheet in Minitab, it looked like this:

Ship	Month1	Month2	Month3	Month4	Month5	Month6	Month7	Month8	Month9	Month10	Month11	Month12
2000	0	0	0	0	0	0	0	0	0	62	12	0
2000		0	0	0	0	0	0	0	0	0	31	12
2000			0	0	10	52	12	2	0	25	4	5
2000				20	5	0	1	0	6	7	2	10
2000					0	0	0	9	1	0	22	2
2000						10	7	1	0	21	18	22
2000								5	0	0	70	26
2000									0	12	14	2
2000										0	0	6
2000											43	10
2000												19
2000												5
2000												3

This data was in what's called a *triangular matrix format*. Though I could feel myself beginning to get a little pliable in my sweltering living room, I knew I had to convert this matrix into a regular *time-to-failure format* in order to run my warranty analysis.

I selected **Stat > Reliability/Survival > Warranty Analysis > Pre-Process Warranty Data** in Minitab. For "Shipment (sale) column," I entered *Ship*. For "Return (failure) columns," I entered *Month1-Month12*. Columns for *Start time*, *End time*, and *Frequencies* appeared as if by magic in my datasheet. Clearly, Minitab was in no way inconvenienced by the heat!

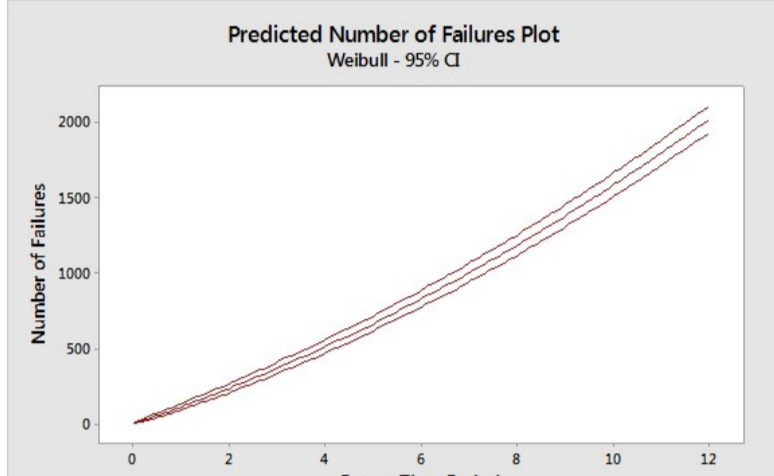
### Data Analysis for Warranty Prediction

Now I could proceed with my analysis, as long as I didn't suffer heatstroke before it finished. I chose **Stat > Reliability/Survival > Warranty Analysis > Warranty Prediction**. In the dialog box, I entered *Start time* in "Start time," *End time* in "End time," and *Frequencies* in "Frequency (optional)."

Next I clicked the button that said "Prediction." I entered 12 as the number of periods for which to predict failures. In "Production quantity for each time period," I entered 2000. Then, with what I felt sure would be my final breaths before succumbing, I clicked on OK in each dialog box.

### Interpreting the Warranty Prediction Results

Instantly, before I could expire, up popped a graph:



Even through my heat-seared eyes, it was easy to see how this graph outlined the number of air conditioner returns the manufacturer could expect for each month in the coming year.

But Minitab's Session Window had also filled with output. The Summary of Current Warranty table showed that mine was among 635 failed units shipped in the year.

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Summary of Current Warranty Claims

Total number of units          24000
Observed number of failures    635
Expected number of failures    614.401
95% Poisson CI                (566.773, 664.962)

Number of units at risk for future time periods  23365
    
```

Interesting, but cold comfort in my situation. Next, I looked at the Table of Predicted Number of Failures, which displays information about the potential and predicted number of failures in the upcoming months:

Future Time Period	Potential Failures	Predicted Number of Failures	95% Poisson CI Lower	95% Poisson CI Upper
1	25365	113.30	93.40	136.18
2	27365	236.46	207.28	268.59
3	29365	369.54	332.82	409.21
4	31365	512.61	469.18	558.96
5	33365	665.70	616.08	719.25
6	35365	828.86	773.39	887.27
7	37365	1002.14	941.04	1066.15
8	39365	1185.55	1119.01	1255.00
9	41365	1379.12	1307.28	1453.87
10	43365	1582.88	1505.85	1662.52
11	45365	1796.84	1714.71	1881.59
12	47365	2021.02	1933.86	2111.09

The Potential Number of Failures for each future time period is the number of units at risk at the end of the data collection period, plus the number of additional units that will ship in each subsequent period. The predicted number of failures is the number of failures that the model predicts from the end of the data collection period through the specified number future time periods. And the the 95% Poisson confidence interval provides a range of likely values for the predicted number of failures.

In the table above, 12 months from now, 47,365 fans will be at risk. With 95% confidence, you can expect the number of failures to fall between approximately 1,933 and 2,111. If I were the manufacturer of the air conditioners, I could plan accordingly.

Knowing that the manufacturer expected and probably already planned for the return of my failed unit somehow gave me the strength to fight through the heat and exchange it for another one, per the terms of the company's warranty. And the rest of the summer's been pretty cool around my house.

### You Might Also Like:

- [How to Calculate BX Life, Part 2b: Handling Triangular Matrix Data](#)
- [It Was the Best of Times, It Was the End of Times](#)
- [Do We All Really Want Violence on TV? A Study using Game of Thrones Data, Part 2](#)
- [Using Stepwise Regression to Explain Plant Energy Usage](#)

### Comments

**Name:** Deepak Patidar · Monday, August 11, 2014

The article is helpful but how to predict warranty after taking countermeasure??

**Name:** Eston · Monday, August 11, 2014

Hi Deepak, and thanks for the question. After taking countermeasures, you would need to update your data set to reflect the anticipated effect of the countermeasure in terms of fewer returns / failures over the next 12 months, then redo the analysis. Hope this helps!  
Eston

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