CR Reliability Ratings Methodology Bulletin: Peak Problem Year

Standardization

Consumer Reports’ predicted reliability analyses model the cumulative problem rate (the likelihood of encountering a problem) of a brand by a specified year of ownership, within a given timeframe. That specified year of ownership, referred to as the “prediction year” in these analyses, is set at the middle year of consumers’ expected lifespan for various product categories.

The expected lifespan for each product category is determined through surveys with CR members, verified every three years.

- For example, CR member surveys show that members expect newly purchased refrigerators to last for a median of 10 years. Based on this data, the “prediction year” in refrigerator reliability analysis is set at the 5th year of ownership, the midpoint of the expected lifespan.

When modeling cumulative problem rates, the predictions should increase at each year of ownership. In other words, the reliability predictions within the half life of the product should be the highest at the “middle year” of ownership. We call this the “peak problem rate year.”

- For example, the following graph shows an increasing predicted problem rate as year of ownership increases. Note, however, that there is a decrease in the raw sample proportion of problems from the 1st to 2nd year of ownership. This would primarily be due to sampling error.

[see next page]
However, we have found that due to random sampling error and product attrition in later years of ownership, the “peak problem rate year” can occur prior to the midpoint of the expected lifespan of the product.

- CR reliability surveys are conducted annually or bi-annually for each product category with a new sample of members in various stages of product ownership from brand new purchases to end of lifespan ownership. Attrition can happen in our samples when models within a brand are replaced by owners rather than repaired prior to the “midlife” of the product. This can result in our sample including fewer owners of problematic models in later stages of a product’s expected lifespan. As a result, we are only sampling from owners of more reliable models for that brand. Together, this can lead to lower observed problem rates in later years of ownership for a brand, and an overall “peak problem rate” earlier than the midpoint of the expected lifespan.

- For example, in the following graph there is significant attrition starting after the 2nd year of ownership. In this hypothetical example, our prediction year is set at the 3rd year of ownership. However, the peak problem year for this brand occurs at the 2nd year of ownership. We would therefore base our reliability rating for this particular brand on its predicted estimate at the 2nd year of ownership.
We saw evidence of this potential anomaly in the development of our predicted reliability models, and refined our models in the following ways:

- For brands with large sample sizes (i.e., 500+), we use an independent slopes model, since the problem rates of these brands tend to be less affected by attrition and sampling error.
- For brands with sample sizes less than 500, we use a common slopes model to estimate problem rates. A common slopes model incorporates the average trend of all brands in our predictive model to minimize the impact of attrition and sampling error.
- We also combine multiple years of survey data to increase brand sample sizes. For our 2020 refrigerator reliability predictions, we combined survey data collected from independently selected samples of members in 2018, 2019, and 2020. Where there is overlap across samples, we retain the most recent data submitted by a product owner for that category.

We have found that these modifications provide more accurate and stable predicted reliability ratings year over year.

By using the common slopes model for small sample size brands, the likelihood that the early years of a product’s life span will have higher problem rates than the “middle year” have been
reduced. Yet, in our 2019 survey data, we encountered a brand in a major product category that received a predicted reliability rating based on problems occurring by the “middle year” of ownership when the brand’s “peak problem rate” occurred one year prior to the midpoint of the expected lifespan. In theory this could give a brand an advantage over other brands whose reliability is predicted to their actual peak problem rate (occurring as expected at the midpoint of the expected lifespan rather than earlier).

To avoid similar instances in the future, in the publishing of our 2020 survey ratings we began basing all brands’ reliability ratings across all product categories on the “peak problem rate year” regardless of whether that occurs at the midpoint of the expected product lifespan (as it is in the vast majority of cases) or any year prior to the midpoint. This is consistent with our definition of predicted reliability, which is intended to represent the likelihood of encountering a problem by the “middle year” of product ownership. This change mitigates the potential impact of sample attrition or random sampling error on our reliability estimates.