

Survival Analysis of Toyota Trucks

Toyota Material Handling is a leading international manufacturer of fork-lift trucks and other warehouse equipment. As part of a research project on sustainability in manufacturing, a preliminary assessment has been made on problems amenable to machine learning techniques.

An application identified as both suitable and important would be predictive models of the life expectancy of trucks and their parts. This information could then be used for improving product development and preventative maintenance of the large fleet of Toyota trucks operating world-wide.

Data

There is a sizable dataset of manually collected invoicing data from Toyota's international repair services. It includes customer id, forklift id, the components replaced, and the time and cost of repair. The type of error and repair is categorized by the repair agent on-site, which also includes free-text fields with explanations for the malfunction. Some trucks also automatically log additional data.

Problem

This problem has quite a bit of structure. Truck malfunctions can be seen as a composition of parts, each of which can break and need to be replaced. Part breakage is likely affected by both part type, the truck type it is in, and possibly the customer, which may use it in different ways. To go all out, one could also look at interactions between repairs to truck parts over time and the wear on the other parts.

Creating a good model may include finding a good level of abstraction to work on, and ideally infer some interactions in the model. Even though a sizable data set exists, with full interactions, the data will still likely be very sparse. It may be a good idea to try a simple survival model as a base-line, and depending on problems identified, extend it. We suggest looking at modern probabilistic inference tools like STAN (Carpenter et al, 2017). Another direction could be to try a survival model with a deep neural network (Katzman, 2016; Ranganath, 2016).

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References

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