Reliability Analyses and Improvement for Automotive Industry

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About the Client

Our client is one of the leading commercial automobile manufacturers in India, producting various state of the art LMVs, HMVs and HTVs for use across multiple industries.

Motivation

The client wanted to increase the warranty period of the vehicles from two years to four years. The rationale was that an increase in warranty period offered for the vechicles would also increase the sales of the vehicles as the risk borne by the automobile fleet operators would be hedged by the OEM. The natural outcome of such a decision is that there is a very real possibility that there would also be a proportional increase in warranty claims. In order to account for this, a robust method for reliability analyses of the components of the vehicle and subsequently the improvement in reliability was needed.

Problem

The first step towards improving reliability of the components was to model the state of the vehicles that were in use on the field. The history of warranty claims did have this information, but was partial as it did not contain information of the components that were functioning successfully in field conditions. This needed to be augmented with the sales data as well.

Given that a model could be built, improving reliability involved redesigning of the components susceptible to failure. This redesign required changing the Design Verification and Validation Plan (DVVP). In order to change the DVVP one needs to know the interaction between the components i.e. how the failure of one particular component would affect other components.

In addition to redesign, improvement of the operational lifetime of a component could also be achieved by development of a predictive model. This model had to predict a potential failure of a component early, in real-time and alert the fleet operator to approach the nearest vehicle service station for repairs.

Solution

The traditional approach to model reliability involves fitting a Weibull distribution which would explain the past warranty claims of the component being modeled. This implies that past claims follow said distribution, which is often not the case. This hurdle was overcome by fitting an Artificial Neural Network (ANN) instead of the Weibull distribution. This approach also neatly considered data of components which had not failed in the field.

In order to improve reliability through change of DVVP, conditional probabilities explaining the relationships of the effect of a failure of one component on another were computed.

The problem of real-time prediction was addressed by using historic telematic data and error-codes generated by the various sub-systems of the vehicle to build a Support Vector Machine (SVM) classifier. This was then used to predict in real-time the potential failure of vehicle sub-systems.