Pavement Deterioration Models for Pavement Management

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Background

The Vermont Agency of Transportation (VTrans) annually collects pavement condition data such as smoothness, rutting, and cracking for 3,100 centerline miles of paved public roads. These data are stored in a pavement management system that uses pavement deterioration models

Figure 1. New pavement in Wolcott, VT.

to predict future pavement conditions, which supports target-setting, life-cycle planning, and financial planning. Current models had not been updated since 2004. Plus, models had yet to be established for thin overlays or the National Performance Measure for cracking.

Development of New and Revised Models

More than 20 years of VTrans historical pavement condition data was analyzed to identify pavement performance trends and establish updated prediction models. Models were based on existing VTrans model formats and family groupings, such as asphalt over concrete, thin pavement on strong bases, or thin pavement on weak 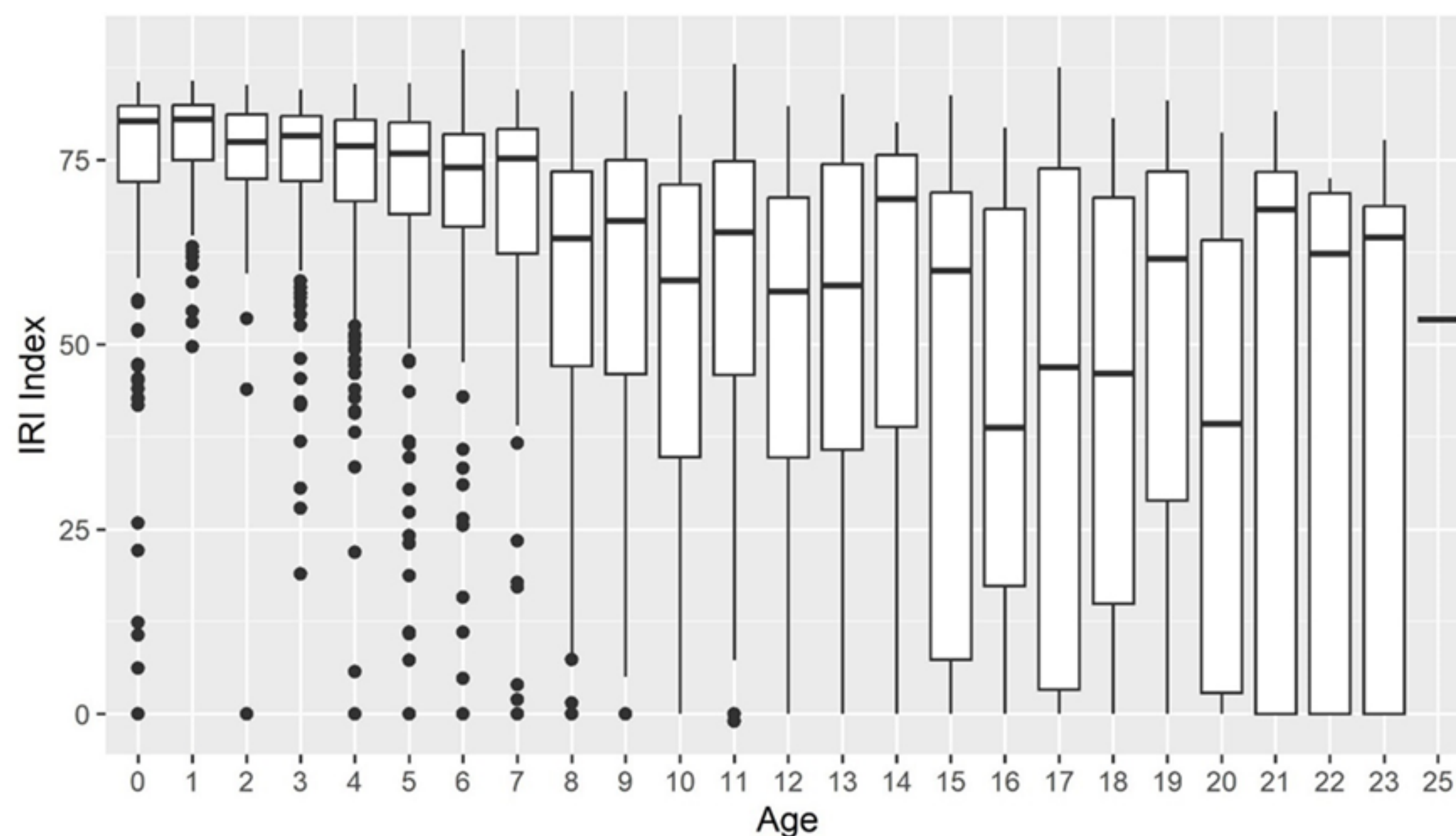bases. Prior to developing models, data were assessed for completeness, and outliers were removed. Boxplots, such as the one in figure 2, were developed for all potential model combinations to support data review and removal of outliers.

Figure 2. Boxplot of IRI index data for the Asphalt on Concrete (AONC) pavement type and Mill and Fill (MAF) treatment family.

Findings

Constraints in the existing model forms that force models to intercept both neutral axes limited options for assessing model fit. The asymmetrical error caused by these restrictions eliminated traditional model fit parameters such as r-squared. Multiple model fit parameters were considered, and the mean squared error (MSE) was used to compare new models to pre-existing ones.

Current Fixed End Point:	15
Proposed Fixed Endpoint:	19
MSE (current):	209.8
MSE (power):	60.5
MSE (quad):	63.1

Recommended Model:
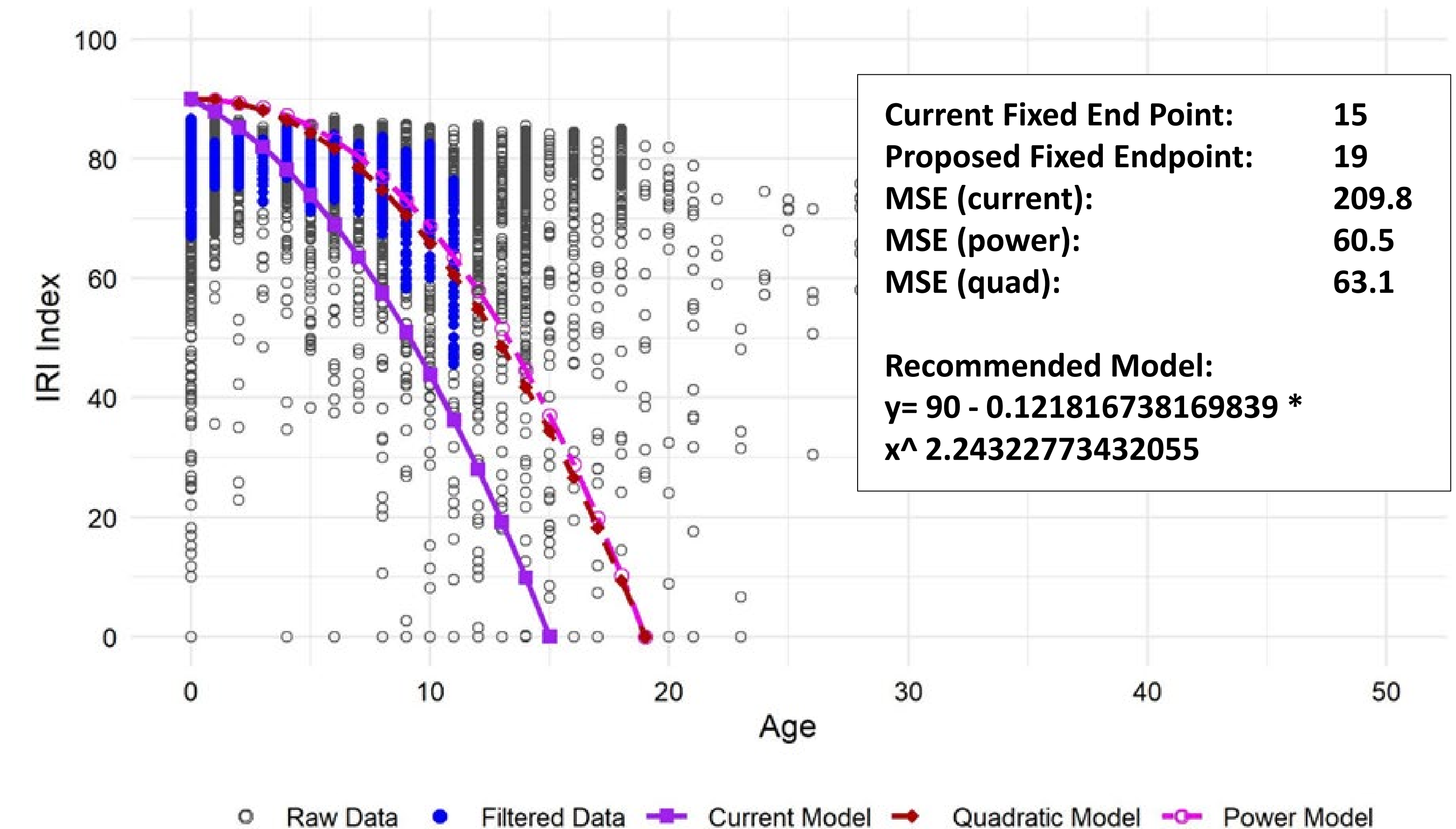$y = 90 - 0.121816738169839 * x^{2.24322773432055}$

Figure 3. Regression results for Mill and Fill, Thin on Strong IRI index with forced y-intercept = 90 and fixed endpoint = 19.

Conclusions

New or revised prediction models were developed for 140 family combinations. Models were developed for each VTrans pavement condition indicator, including the National Performance Measure for cracking and the IRI, rutting, transverse cracking, and structural cracking indices. The MSE was reduced for all combinations that had pre-existing models.

Acknowledgments