## ABSTRACT

Student, Eleni Bardaka, Purdue University, August 2012. Mixed Linear Modeling Techniques for Enhancing Pavement Performance Predictions. Major Professor: Samuel Labi

The use of appropriate advanced modeling techniques for predicting the performance of rehabilitation treatments may reap substantial benefits to a Pavement Management System (PMS). If the modeling technique is appropriately chosen on the basis of practicality, precision, the intended use of the model, and the nature of the pavement data, its applicability to PMS can be enhanced. Pavement rehabilitation data typically constitutes of repeated measurements that form an unbalanced three-level nested structure, which makes the analysis quite challenging. In this study, mixed linear modeling techniques are deployed to accommodate this structure and thus, lead to less biased estimations, compared to simplistic approaches.

The basic objective of using advanced approaches for modeling post-rehabilitated pavement performance within a PMS framework is to obtain accurate predictions. Two methodologies based on two different types of analysis are explored for this purpose. The developed methodologies are analytically explained and illustrated with case studies. Regarding the short-term and long-term performance and service life predictions of inservice pavements that have been rehabilitated in the past (predictions conditional on a specific in-service pavement section), a methodology that uses random effects analysis, which provides pavement managers the ability to duly incorporate the "realized values" of the random effects associated with unobserved heterogeneity in the prediction process through a method called Best Linear Unbiased Prediction, is shown to be more advantageous and demonstrates high accuracy. On the other hand, the second developed methodology, which focuses on the analysis of repeated measurements, is found more appropriate for obtaining predictions regarding pavement sections scheduled to be rehabilitated in the future and average treatment service life estimates ("population-wide" predictions and estimates).

The methodological framework proposed by this study is applied to data from different rehabilitation treatments that had been applied to Interstate Indiana pavements. Results indicate that the proposed approach is superior to other simplistic approaches used in the past and combines practicality with highly accurate deterministic performance and service life predictions, which makes it directly applicable to public highway agencies.