A Bimodal Distribution Function with Fuzzy Regression for Predicting Truck Load Population including Overloads

B. Jang[1] **and J. Mohammadi**[2]

[1]Research and Development, Sharma & Associates, Inc., Countryside IL 60525, United States, bjang5@hawk.iit.edu

[2]Civil, Architectural and Environmental Engineering, Illinois Institute of Technology, Chicago IL 60616, United States, mohammadi@iit.edu

Keywords: *Truck overloads, statistical models, mixed distribution function, goodness-of-fit test; fuzzy regression.*

Abstract

This study presents a bimodal distribution function with statistical parameters based on fuzzy regression for predicting truck loads including the contribution from overloads. Overloads refer to truck weights in excess of the 356 kN (80 kips). Overload trucks often appear as a sizeable portion of truck populations on highways. In applications when damage estimation of transportation facilities such as pavements and bridges are desired, theoretical models providing a reasonable representation of truck load populations including overloads will be useful. Load populations mostly exhibit an inconsistent pattern - often with two or more distinct peaks in most cases because of a combination of loaded and empty trucks as well as overloads appearing in the data. In the past, mixed probability distribution models consisting of two functions (bimodal models) using truck load population data have been tried and appear to offer a better solution for truck load populations. A combination of beta and lognormal distribution was used as a suitable model to represent the truck load populations. In this study, if no truck load population is available, the theoretical bimodal distribution model is proposed with certain assumptions based on fuzzy regression using information that may be available for the roadway and the bridge. The goodness-of-fit tests such as Kolmogorov-Smirnov (K-S) and Anderson-Darling (A-D) methods were used to demonstrate the suitability of the proposed model to represent the data. The mathematics of the goodness-of-fit test, especially for the A-D method, is presented to show the applicability of this method.

References

Jang, B. *Bridge Rating with Considerations for Fatigue Damage Effect from Truck Overloads*. PhD Dissertation, Illinois Institute of Technology, 2018.

Jang, B. and Mohammadi, J. A Bimodal Distribution Function for Truck Loads including Overload, In Y. Kim, I. Yoshitake, V. Vimonsatit, X. He, and Y. Ji, editors, *Proceedings of the official conference of the Bridge Engineering Institute (BEI-2019)*, Honolulu, HI, United States, July 2019.