Determination of unconfined compressive strength of rock surrounding access tunnels in longwall mining using Mamdani fuzzy system

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Abstract

Unconfined compressive strength of rocks is one of the most important parameters in projects related to engineering geology, mining, geotechnics and rock engineering. For determination the unconfined compressive strength in laboratory tests, high-quality samples are necessary. However, such core samples cannot always be obtained from weak, thinly bedded and block-in-matrix rocks. For this reason, the development of predictive models for determination the mechanical properties of rocks such as unconfined compressive strength, seems to be an attractive study area in rock engineering. In this paper, fuzzy and statistical models were utilized to predict unconfined compressive strength of rocks based on data from the access tunnel in longwall mining. A total of 93 datasets of different rocks was used to develop the fuzzy and statistical models, from which, 75 datasets were considered for model construction and the rest was used for testing the models. Three parameters including Schmidth hardness, density and porosity were considered as input parameters. For evaluation of model performance, Root Mean Square Error (RMSE) and determination coefficient (R2) indices were used. For the fuzzy and statistical models, R2 equal to 94.3% and 87.9 and RMSE equal to 3.2 and 6.8, respectively. The results show that fuzzy model is significantly accurate comparing to the statistical model and its results are quite close to the actual values. Also, fuzzy model sensitivity analysis showed that Schmidth hardness is the most effective parameter on the unconfined compressive strength, whereas porosity is the least effective in this study.

Key words: nconfined compressive strength, Mamdani fuzzy model, Sensitivity analysis