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ORIGINAL PAPER

Application of neural networks to predict net present value in mining projects

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Abstract Net present value (NPV) is the most popular economic indicator in evaluation of the investment projects. For the mining projects, this criterion is calculated under uncertainty associated with the relevant parameters of say commodity price, discount rate, etc. Accurate prediction of the NPV is a quite difficult process. This paper mainly deals with the development of a new model to predict NPV using artificial neural network (ANN) in the Zarshuran gold mine, Iran. Gold price (as the main product), silver price (as the byproduct), and discount rate were considered as input parameters for the ANN model. To reach an optimum architecture, different types of networks were examined on the basis of a trial and error mechanism. A neural network with architecture 3-15-10-1 and root mean square error of 0.092 is found to be optimum. Prediction capability of the proposed model was examined through computing determination coefficient (R^2=0.987) between predicted and real NPVs. Absolute error of US$0.1 million and relative error of 1.4 % also confirmed powerfulness of the developed ANN model. According to sensitivity analysis, it was observed that the gold price is the most effective and discount rate is the least effective parameter on the NPV.

Keywords Net present value · Artificial neural network · Zarshuran gold mine project

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Introduction

In investment projects, discounted cash flow (DCF) analysis is performed. In this analysis, decision-making economic indicators such as net present value (NPV), internal rate of return, pay back period, etc. are estimated amongst which NPV can be considered as the most popular and important criterion (Remer and Nieto 1995; Taggart 1996; Tsao 2012). Normally, estimation of NPV is made under uncertainty conditions, which are obviously associated with the economic input parameters. Effect of these uncertainties on the estimated economic criteria is very important and should be determined (Dowd 1995).

In conventional methods, sensitivity analysis is carried out to identify and assess the factors affecting the project success. During this process, the effect of uncertainties is investigated by considering the most probable range of variation for input parameters, which is defined by the economic experts. The declared input variations should be applied in estimating NPV (Jovanovic 1999). It should also be noted that this process is separately repeated for each parameter; however, it is required to realize and understand the combination effect of the parameters (Borgonovo et al. 2010).

To overcome the drawbacks of the conventional methods, artificial neural networks (ANNs) as a powerful branch of artificial intelligence can be utilized. These models are naturally empirical and can be implemented for solving formulated problems. Very special powerfulness of such models is applicability in phenomena that are only understood through experimental data and field observations (Basheer and Hajmeer 2000). Nonlinearity assumption, robustness, high parallelism, fault and failure tolerance, and ability to process imprecise or vague information are some of the positive aspects of the ANN models (Jain et al. 1996). ANNs' interpolation capability is advantageous for noisy datasets (Monjezi