Analytical and Numerical Methods in Mining Engineering Vol. 12, No. 31, Summer 2022, pages 25-34

Predicting the coal production rate of shearer device based on the gas properties and coal Strength in Tabas No. 1 Parvade coal mine

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(Received: September 2021, Accepted: December 2021)

Keywords

Prediction

Shearer rate

Statistical analysis

Regression

Tabas No. 1

Parvadeh coal mine

Abstract

To increase production in coal mining panels along with the use of other equipment, the use of coal machines (shearers) is very beneficial. Predicting the shearer rate and determining the effective parameters in it plays an essential role in estimating costs. Full knowledge of the Strength and properties of coal gas and evaluation of the performance of shearer loader devices causes an increase in the speed of the loader and coal-rock production. Therefore, to achieve high production efficiency in the extraction of coal seams, it is necessary to predict the shearer rate and determine the effective parameters in it. In this paper, the shear rate prediction in relation to the Strength and gas bitumen properties of coal is investigated with the help of statistical analysis. For this purpose, 1260 types of coal cutting were done by coal machine (shearer) in E3 Tabas extraction panel No. 1 of Parvadeh coal mine. In the first stage, after harvesting and recording the shearer rate of each cut, information about degassing was done at three points along the entire length of the panel. These three points include the percentage of methane gases emitted in sensor number 88 and the input sensor (TG) and the sensor installed on the armored face conveyor (AFC). Then, using the strength properties such as coal hardness and methane degassing system, the shearer rate prediction was investigated. Using statistical studies, Shearer rate prediction was performed with three models of linear and nonlinear multivariate regression (exponential and logarithmic). To develop the predicted models, 70% of the data (882 data) were used as educational data and 30% of the data (378 data) as test data. Among the three regression models performed, the results show that the linear multivariate regression model has a more accurate prediction than the other two methods. Therefore, using the linear multivariate regression model, the amount of shearer rate in the coal mine number one of parvadeh Tabas can be predicted with good accuracy.

1. INTRODUCTION

Coal mining has long been a complex mineral issue around the world. Among the most important factors to consider when choosing an extraction system are factors such as layer thickness, charcoal capability, operating cost, dust production, number of manpower required, maintenance cost, production rate, geological conditions, layer slope, the strength of the rock includes the strength of the backs and the gas content of the layers. One of the most important criteria for choosing the type of charcoal machine is the thickness of the layer. So that in thin layers below 1.3 meters, the use of the shearer device is limited [1].

Now, for the extraction of coal in underground mines, using the longwall method is one of the major and widely used methods. This method of extraction is an old method that has been common in European coal mines since the early seventeenth century and has been rapidly applied in all coal-producing countries except the United States. From the early 1960s onwards, the United States used its first progressive hydraulic maintenance device. In 1979, there were about

260 long-term active fronts in the United Kingdom. In 1983, more than 100 panels were held in the United States to extract the frontline [2].

The longwall method is a large-scale extraction method used in low slopes, relatively thin layers, and 1 to 4 meters. To extract coal in a width of one zone, two main and secondary corridors are created and the extraction is done by digging narrow sections (about 60 cm) in a retreating way. As the front of the work progresses, the roof or the upper back of the coal seam behind the front of the work completely disappears.

To increase the production rate and create continuous production in the coal mining panels, along with other used equipment, the use of coal loader machines is very helpful. Sheer loaders are highly flexible machines that create deep cuts and are suitable for thick to very thick layers. The main components and elements of the long-duty front extraction method include three extractions, loading, and maintenance systems. In mechanized operations, the loader shearer machine is used as the coal miner, the chain boat as the loading system, and the power bases as the maintenance system. The review and selection of the equipment used in each operation should be based on its compatibility with other operational equipment and the overall performance of the three operations [2].

The number of research activities carried out in the world to optimize the extraction speed of the shearer loader machine is limited. In 2014, Wang et al. proposed a new method for determining shearer loader rate using neural network optimization and for predicting coal mining tonnage by providing a model of the relationship between velocity and shearer rate. Research by Wang et al. Examines the reasons for the reduction in coal mining, the safety mechanism in the proposed method, and the reduction of staff accidents. Using particle swarm optimization (PSO) algorithm based on the studies, solutions to diversify and improve the quality of extraction methods were presented. In addition, a sample simulation was performed and the comparison results showed that the proposed method is possible. It is more efficient and advanced than previous methods [2].

The purpose of this study is to investigate the performance of the shearer loader machine based on the parameters affecting it and finally to predict and evaluate the shearer loader rate according to the gas flow of the layers and the strength properties of the rock in the Tabas No. 1, Parvadeh coal mine.

2. POSITION AND GENERAL CHARACTERISTICS OF TABAS NO. 1, PARVADEH COAL MINE

One of the areas of the Tabas coal basin is Parvadeh which is located in the eastern part of Central Iran, southwest of Khorasan Razavi province, northeast of Yazd province, northwest edge of Lut Desert, and southwest of Tabas city. The study area is located in the central-eastern part of the country in the southeastern part of Tabas city with a latitude of 32° and 50’ north and longitude of 56° and 45’ to 52° and 65’ east.

Parvadeh region is a desert region with a dry continental climate. The region is very poor in terms of vegetation and thorn bushes are rarely seen in its plains. The approximate length of Tabas coal is 40 km. This coal basin consists of three areas: Parvadeh, Nayband, and Mazino. Parvadeh area has been concentrated with an area of 1200 square kilometers. In the Parvadeh area, based on geological information obtained from boreholes, surface mapping, chipping and various exploration tunnels, five layers of coal in vertical sections have been proven. The five layers of coal from bottom to top as shown in Figure 1, are: B1, B2, C1, C2, D which according to the boreholes and excavations, layer C1 has the highest thickness (thickness between 1.8 to 2 meters) compared to Other layers are available and workable. Tabas Parvadeh No. 1 coal mine is the first and only fully mechanized coal mine in the country with an annual production capacity of 1.2 to 1.5 million tons of coke. From the coal seams in this area, only layer C1 is being extracted. Extraction operations in this mine are done by the longwall method [3].

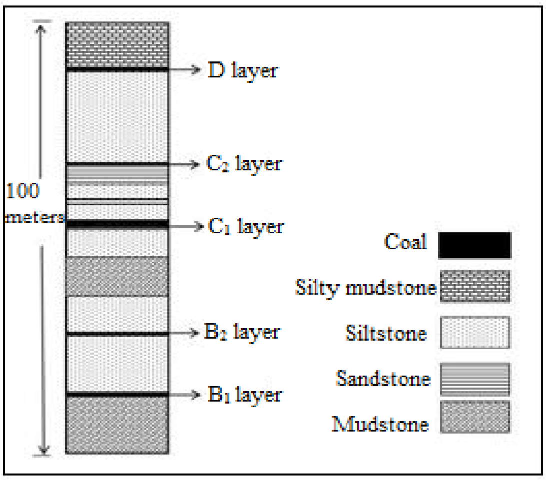

Figure 1. Stratigraphic column of No. 1, Parvadeh coal basin [3].

3. SHEARER CHARCOAL MACHINE

The shearer loader is a relatively narrow machine, they move on the AFC of the work front and usually make a cut with a depth of 60 to 90 cm. In general, the shearer loader is a highly flexible machine that cuts almost any layer and passes through faults well [4, 5]. Conform with the changes in the layer and material of coal well and the time lost due to tectonic and geological problems in them is very low. The shearer load used in the coal mines of Parvadeh Tabas is the most common coal mining machine in the longwall method. This machine removes a complete cut of coal in one pass and has relative flexibility without any reduction in production. In this machine, theoretically, the front drum should be high and the rear drum should be low during each pass to perform more precise cutting operations. With this action, the operator is placed in a suitable position to provide the continuation of the correct horizon [6].

3.1. Field Impressions Of The Performance Of The Shearer Machine

The use of coal mining machines (Shearer) in the Parvadeh Tabas coal mine is the result of the mechanization operation of mine number one, in which it is used for cutting or extracting coal inside the extraction workshop. In this way, the excavated materials are dumped on the ship adjacent to the work front and transported by it to the main conveyor in the transport tunnel. In mechanized systems, transportation within the extraction face is done by an Armored Face Conveyor (AFC) [8, 9]. The roof of the longwall is made of hydraulic jacks due to the use of a shearer machine, which can withstand many loads and consists of a base and a shield. As the longwall progresses, the front boat and maintenance equipment move forward with a special program, and the roof area behind the maintenance equipment can be demolished. Demolition reduces the high pressure due to the weight of the floors on the storage equipment. Therefore, the destruction of maintenance equipment will be prevented. Figure 2 shows the sheer used in the Tabas mine number one. Table 1 shows the main characteristics of the Shearer machine in Tabas mine number one [10].

Figure 2. Shearers used Parvadeh coal mine [3].

Table 1. Characteristics of Shearer machine in the Tabas No. 1, Parvadeh coal mine [3].

Characteristic	Amount	Unit
Machine width	2.3	Meters
Device height	1.3	Meters
The rotation angle of the device	45	Degree
Drum diameter	1.6	Meters
Cutting depth	0.8 – 0.9	Meters
The real speed of the device	3	Meters per minute
The speed of the machine in the cutting mode	9	Meters per minute
Length of the movable arm	1.7 - 2	Meters
Body thickness	0.8	Meters
Maximum chain speed	1.3	Meters per second
Machine time efficiency coefficient	1.1 – 1.4	---
Machine load factor	0.0 – 95.9	---

To evaluate the performance of Shearer, the first step is to establish a database of rock and machine mass characteristics and the amount of methane emitted. In this regard, field studies and surveys were performed with high accuracy and reliability, which was done by attending the site and following and controlling the extraction operation of the shearer machine in the E3 extraction panel for 1260 cuts throughout the panel. Table 2 summarizes the results of the 10 impressions made. Impressions of methane gas were performed using methane gas sensors inside the panel and main routes. The impressions include the hardness (Mpa) of the emitted methane gases as a percentage on sensor number 88 and the tailgate input sensor (TG) and the sensor installed on the AFC device.

Table 2. Summary of 10 withdrawals made during the operation of the shear machine inside the extraction panel E3

Withdrawal number	Hardness	Gas Sensor (88) %	Gas Sensor (AFC) %	Gas Sensor (Sarmileh, TG) %	Methane Degassing	Shearer Speed (m/min)
1	1	0.35	0.65	0.59	12	3.5
76	15	0.59	0.73	0.78	12	2
179	17	0.53	0.94	1.29	12	4
457	32	0.67	0.73	0.84	13	4
564	13.31	0.9	0.84	0.41	21	3.6
622	8.95	0.29	0.78	0.29	18	3.8
882	6.98	0.9	0.93	0.39	26	3.8
955	6.43	0.35	0.98	0.25	32	4.8
1122	66.34	0.68	0.95	0.37	13	4
1260	9.35	0.63	0.73	0.47	18	3.7

3.2. Statistical Analysis Of Shearer Rate Using SPSS Software

Each statistical analysis consists of two parts: descriptive statistics and inferential statistics. In the discussion of descriptive statistics, centrifugal criteria such as mean, mode, average, and scattering criteria such as variance, standard deviation, range of changes, and most importantly graphs and Frequency distribution tables are examined. In this research, multiple linear regression and correlation coefficients have been used to test the hypotheses in the inferential statistics section to test the hypotheses. The research findings are presented in two sections: descriptive and inferential statistics. Table 3 shows the central indicators, a wide range of variable components for shearer rate. Figure 3 shows the mean of the variables affecting the shearer speed.

Table 3. Central indicators, a wide range of variable components for shearer rate

Variable	Sample size	Min	Max	Ave.	Standard deviation
Shearer rate	1260	0	5.5	3.79	0.62
Hardness of coal	1260	0	33	19.64	5.44
88 Methane gas sensor	1260	0	1.12	0.39	0.09
AFC Methane gas sensor	1260	0	1.69	0.77	0.16
TG Methane Gas Sensor	1260	0	2.04	0.84	0.19
Methane degassing system	1260	0	13.31	9.86	2.68

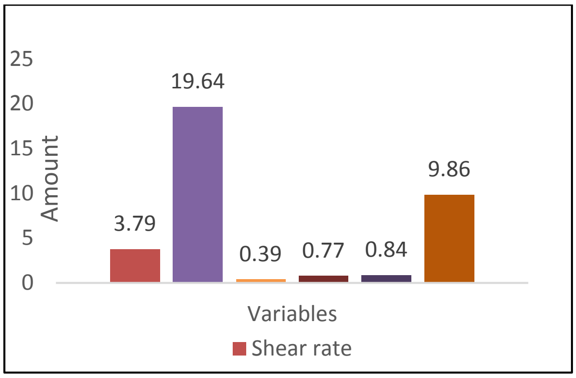

Figure 3. Average of the variables affecting the shearer rate

4. PREDICT SHEARER SPEED USING SPSS SOFTWARE

Predicting shearer speed performance is a very important factor in evaluating the successful use of shearers. This generally deals with the choice of machine type, production rate, and amount of methane emitted from coal mining. The correct and successful use of Shearer extraction technology in any mining operation suggests that accurate estimates of Shearer rate must be considered. For this purpose, regression methods using SPSS software were used to predict the shearer rate. To develop the predicted models, which include linear and non-linear regression models, 70 percent of the data (882 data) are used, which are called training data. For this purpose, linear and non-linear multivariate regression models will be examined by defining the measured shearer rate as a dependent parameter. To evaluate the developed models, 30 percent of the data to the remaining 378 data were used, which are called test data. All three models of linear multivariate regression, exponential multivariate regression, and logarithmic multivariate regression have been used to predict the shearer rate based on training and test data, which is discussed below.

4. 1. Shearer Rate Prediction Using Linear Multivariate Regression Based On Training And Test Data

In this part of the research, the relationship between the shearer rate and the effective parameters in that multivariate analysis was performed. As mentioned earlier, 882 data were used as training data and 378 data as test data out of a total of 1260 data. To predict the shearer rate, a statistical relationship (Interface No. 1) was performed according to Table 4 for multivariate linear regression. In this regard: ST Coal hardness in MPa, CH488 The amount of methane gas of sensor 88 on percent, CH4AFC The amount of methane gas of sensor on AFC in percentage, CH4TG The amount of methane gas of sensor TG in percentage, and DRG of methane degassing system. Methane gas variables were used on sensor 88, TG, AFC, coal hardness, and methane degassing system as an independent variable and shearer rate as a dependent variable.

Table 4. coefficients of variables in linear multivariate regression

model	Non-standard coefficients		Standard coefficients	T Statistic	The significance level of variables
	Coefficient value	Standard error	Beta		
Coefficient	3.13	0.11	----	27.11	0
Coal Hardness	0.02	0.003	0.18	6.68	0
88 gas sensor	0.42	0.20	0.06	2.06	0.039
AFC gas sensor	0.35	0.11	0.09	3.21	0.001
TG Gas Sensor	0.39	0.09	0.12	4.02	0
Methane degassing system	-0.05	0.007	-0.23	-7.47	0

$$S = 3.31 + 0.021(ST) + 0.427(CH488) \\ +0.358(CH4AFC) + 0.396(CH4TG) \\ -0.054(Drg) \quad (1)$$

The results of estimating the linear multivariate regression model show that because the level of significance obtained for the independent variables of coal hardness, gas sensors 88, AFC, TG, and methane degassing system are equal to 0.0, 0.039, 0.001, 0.000, and 0.000, respectively. These values are less than 0.05, so these factors affect the shearer speed. The effect of variables other than the methane degassing system is positive. Therefore, all of these variables, except the gas supply system, are directly related to the shearer rate variable, and this variable is inversely related. Table 4 shows the correlation coefficient, determination coefficient, and root means square error (RMSE) in the linear multivariate regression model based on training and test data.

Table 4. Correlation coefficient and coefficient of determination and root mean square error in the linear multivariate regression model

Characteristic	Training stage	Test stage
Determination coefficient	0.90	0.73
Correlation coefficient	0.95	0.86
RMSE	0.29	0.34

According to Table 4, regarding the correlation coefficient, it can be concluded that the training stage data with a value of 0.95 has a higher correlation than the test stage data in the linear multivariate regression model. Also, the square root of the error has the lowest error, related to the training stage data with a value of 0.29. In the linear multivariate regression model, according to Table 5, the amount of Durbin-Watson statistics related to training data with a value of 1.02 has a better correlation than training data. The performance index (VAF) of the training data with a value of 0.89 has a better performance than the test data. The mean square error (MSE) of the test data with a value of 0.33 compared to the training data has a meter error. The average absolute error percentage (MAPE) of training data with a value of 11.059 is less than the test data.

Table 5. Values of performance criteria for evaluating the proposed models for the linear multivariate regression model

Characteristic	Training stage	Test stage
MSE	0.35	0.33
MAPE	11.05	18.85
Durbin-Watson	1.02	1.56
VAF	0.89	0.81

Figures 4 and 5 show the relationship between measured and predicted shearer rates using test and experimental data in a linear multivariate regression model, respectively.

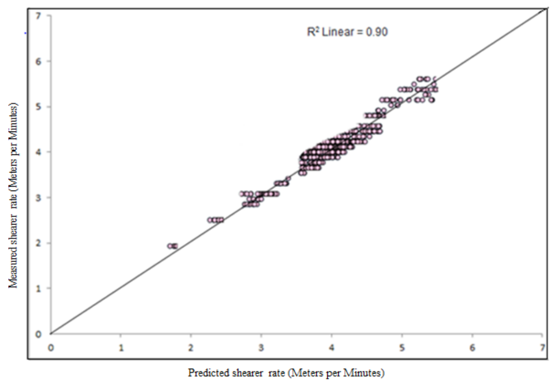

Figure 4. Relationship between measured and predicted shearer rates in multivariate linear regression using training data

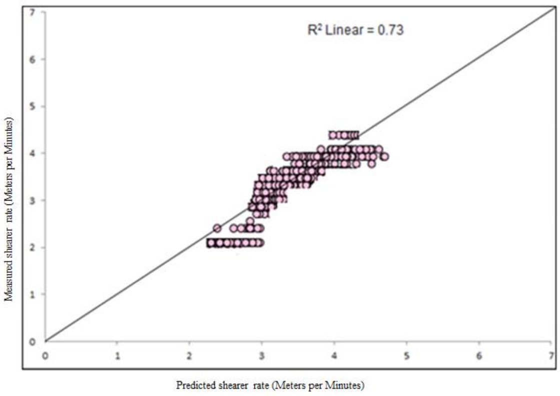

Figure 5. Relationship between measured and predicted shearer rates in multivariate linear regression using test data

The results of estimating the model by linear multivariate regression method show that the training data for predicting the shearer rate with a coefficient of determination of 0.90 and a correlation coefficient of 0.95 and the square root mean of the errors had the lowest error. In linear multivariate regression, all independent variables except the methane degassing system can have a direct effect on the predicted shearer rate.

4. 2. Shearer rate prediction using exponential non-linear multivariate regression based on training and test data

In general, the data related to the shearer rate of the statistical relationship (Equation 2) for nonlinear multivariate linear regression were performed exponentially according to Table 6.

Table 6. coefficients of variables in exponential non-linear multivariate regression

model	Non-standard coefficients		Standard coefficients	T Statistic	The significance level of variables
	Coefficient value	Standard error	Beta		
Coefficient	4.739	0.262	-----	18.08	0
Coal Hardness	0.135	0.057	0.064	2.35	0.019
88 gas sensor	-0.067	0.088	-0.024	-0.765	0.444
AFC gas sensor	-0.056	0.078	-0.020	-0.712	0.477
TG Gas Sensor	0.073	0.073	0.029	0.999	0.318
Methane Degassing system	-0.613	0.062	-0.302	-0. 928	0

$$S = 4.73 \times exp0.135(ST) - 0.067(CH488) \\ -0.056(CH4AFC) + 0.073(CH4TG) \\ -0.613(Drg) \quad (2)$$

The results of estimating the model with non-linear multivariate regression method show exponential because the significant levels obtained for the independent variables are coal hardness, gas in 88, AFC and TG sensor and methane degassing system equal to 0.019, 0.44, 0.47, 0.31, and 0.000 respectively and these variables in methane hardness and degassing system are less than 0.05. Therefore, these two factors have more effect on the shearer rate. The coefficient of determination in the exponential non-linear multivariate regression model, related to the training stage data with a value of 0.78, has a greater impact than the test data with a value of 0.55. The training stage data with a value of 0.88 has a higher correlation than the test stage data in the exponential non-linear multivariate regression model. Table 7 shows the correlation coefficient, determination coefficient, and root means square error (RMSE) in the exponential non-linear multivariate regression model based on training and test data.

Table 7. Correlation coefficient and coefficient of determination and root mean square error in the non-linear exponential multivariate regression model

Characteristic	Training stage	Test stage
Determination coefficient	0.78	0.55
Correlation coefficient	0.887	0.744
RMSE	0.42	0.42

The values of the performance criteria for evaluating the proposed models for the exponential non-linear multivariate regression model are estimated in Table 8.

Table 8. values of performance criteria for evaluating the proposed models for the exponential non-linear multivariate regression model

Characteristic	Training stage	Test stage
MSE	0.23	0.45
MAPE	19.78	34.09
Durbin-Watson	1.77	1.96
VAF	0.77	0.51

In the exponential non-linear multivariate regression model, the VAF performance index related to training data with a value of 0.77 has a better performance than the test data. The average percentage of absolute error related to training data with a value of 19.78 has less error than test data. The Durbin-Watson statistic for training data with a value of 1.77 is better than the training data. The average square error of the training data with a value of 0.23 has less error than the test data. Figures 6 and 7 show the relationship between measured and predicted shearer rates using test and experimental data in an exponential non-linear multivariate regression model, respectively.

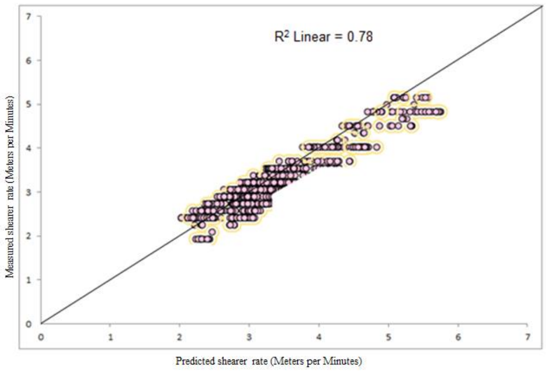

Figure 6. Relationship between measured and predicted shearer rates in exponential non-linear multivariate regression using training data

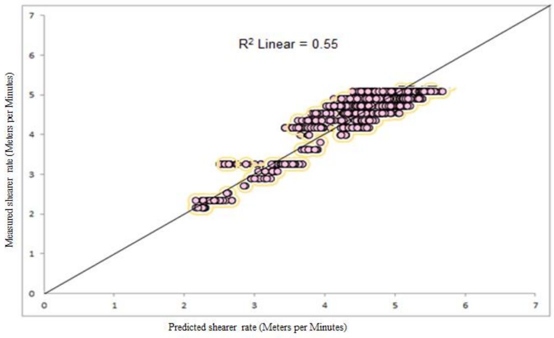

Figure 7. Relationship between measured and predicted shearer rates in exponential non-linear multivariate regression using test data

The results of estimating the model by exponential non-linear multivariate regression method show that the training data for predicting the shearer rate with a coefficient of determination of 0.78 and a correlation coefficient of 0.88 and the root mean square of the errors had the lowest error. In non-linear multivariate regression, all independent variables except the gas extraction system and coal hardness can have a direct effect on the predicted shearer rate.

4. 3. Shearer rate prediction using logarithmic non-linear multivariate regression based on training and test data

Overall, the shearer rate data predicted the statistical relationship (Equation 3) according to Table 9 for logarithmic multivariate linear regression.

Table: 9 coefficients of variables in logarithmic non-linear multivariate regression

model	Non-standard coefficients		Standard coefficients	T Statistic	A Significance level of variables
	Coefficient value	Standard error	Beta		
Coefficient	3.180	0.282	----	11.265	0
Coal Hardness	-10.146	7.232	-0.716	-1.403	0.161
88 gas sensor	-0.007	0.173	-0.001	-0.041	0.968
AFC gas sensor	3.898	2.486	0.801	568.1	0.117
TG Gas Sensor	-0.432	0.184	-0.068	-2.324	0.019
Methane degassing system	-0.846	0.197	-0.129	-4.300	0

$$S = 3.180 - 10.146\,ln(ST) - 0.007\,ln(CH488) + 3.898\,ln(CH4AFC) - 0.432\,ln(CH4TG) - 0.846(Drg) \quad (3)$$

The results of model estimation by nonlinear logarithmic multivariate regression method show that because the significant levels obtained for the independent variables are coal hardness, sensor gas 88, AFC, TG, and methane degassing system are 0.161, 0.968, 0.117, 019, and 0.000, respectively and these variables in TG sensor gas and methane degassing system are less than 0.05. Therefore, these two factors have more effect on the shearer rate. The coefficient of determination in the non-linear exponential multivariate regression model related to the training stage data with a value of 0.63 has a greater effect than the test data with a value of 0.39. The training stage data with a value of 0.79 has a higher correlation than the test stage data in the exponential non-linear multivariate regression model. Table 10 shows the correlation coefficient, determination coefficient, and root means square error (RMSE) in the nonlinear logarithmic multivariate regression model based on training and test data.

Table 10. Correlation coefficient and coefficient of determination and root mean square error in the logarithmic non-linear multivariate regression model

Characteristic	Training stage	Test stage
Determination coefficient	0.63	0.39
Correlation coefficient	0.794	0.629
RMSE	0.53	0.59

The values of the performance criteria for evaluating the proposed models for the logarithmic non-linear multivariate regression model are estimated as in Table 11.

Table 11. values of performance criteria for evaluating the proposed models for the logarithmic non-linear multivariate regression model

Characteristic	Training stage	Test stage
MSE	0.12	0.19
MAPE	33.70	55.56
Durbin-Watson	1.22	1.08
VAF	0.54	0.43

In the logarithmic non-linear multivariate regression model, the VAF performance index of the training data with a value of 0.54 has a better performance than the test data. The average percentage of absolute error related to training data with a value of 33.70 has less error than test data. The amount of Durbin-Watson statistics related to training data with a value of 1.22 has a better correlation than training data. Figures 8 and 9 show the relationship between measured and predicted shearer rates, respectively, using test and experimental data in a non-linear logarithmic multivariate regression model.

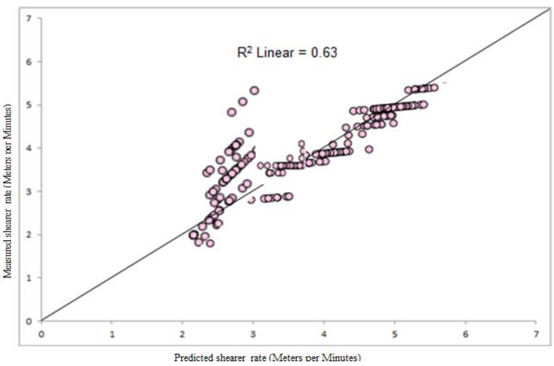

Figure 8. Relationship between measured and predicted shearer rates in logarithmic non-linear multivariate regression using training data

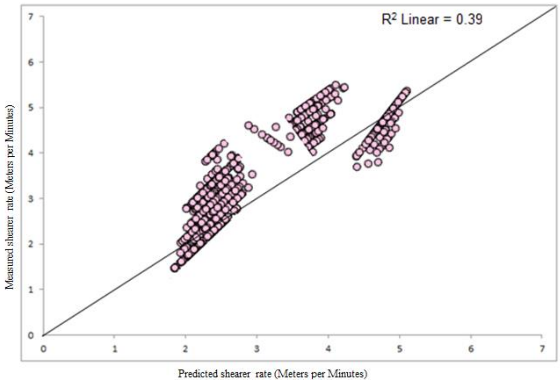

Figure 9. Relationship between measured and predicted shearer rates in logarithmic non-linear multivariate regression using test data

The results of estimating the model by logarithmic non-linear multivariate regression method show that the training data for predicting the shearer rate with a coefficient of determination of 0.63 and a correlation coefficient of 0.79 and the root mean square of the errors had the least error. In non-linear logarithmic multivariate regression, all independent variables except the methane degassing system and TG sensor gas can have a direct effect on the predicted shearer rate.

4. 4. Choose the best forecasting model

To compare the three models, the correlation coefficient and the coefficient of determination between the predicted variable with the descriptive characteristics of Table 12 were used using three methods with the actual value of the dependent variable. The higher this value, the higher the power of the model.

Table 12. Comparison of predicted shearer speed using three models

Model	Amount	Average speed (meters per minute)
Linear multivariate regression	1260	3.81
Exponential non-linear multivariate regression	1260	3.78
Logarithmic non-linear multivariate regression	1260	3.22
Real shearer rate	1260	3.79

Considering the performance criteria values in all three models, it is clear that the linear multivariate regression method has a more accurate prediction than the other two methods. According to the coefficient of determination of 0.90, the linear multivariate regression model is determined that the prediction value obtained from the exponential model and the logarithmic model have a better relationship. As can be seen from the value of the coefficient of determination, it was found that in the three models designed to determine the prediction of the shearer speed, the training data in the linear multivariate regression model have a coefficient of determination higher and close to 1, which is better than the test data. In all the preformed models, the coefficient of determination and correlation related to the training data is more desirable than the test data. Among the three models performed, the linear multivariate regression model still had the highest correlation coefficient, which shows that all independent variables can be more effective than the dependent variable in this model. The highest correlation coefficient calculated between the three models in relation to training and test data is estimated to be 0.90 (training data of linear multivariate regression model). In the linear multivariate regression model, the root means square of the errors related to the training data has the lowest error, and the value is equal to 0.29. Therefore, the best model can be a linear multivariate regression model.

5. CONCLUSION

In this study, using statistical studies and multivariate regression in SPSS software, the relationship between shearer rate with Strength characteristics and coal gas conversion in Tabas No. 1, Parvadeh coal mine was investigated. For this purpose, 1260 types of coal cutting were paid by the coal machine (Shearer) in the extraction panel of the E3 mine of Parvadeh Tabas. Parvadeh area is concentrated with an area of 1200 square kilometers. In the Parvadeh area, based on geological information obtained from boreholes, surface mapping, trenching, and various exploration tunnels, five layers of coal in vertical sections have been proven. According to the boreholes and excavations, layer C1 is one of these five layers, which has the highest thickness compared to other layers (thickness between 1.8 to 2 meters) and can be used. Extraction operations in this mine are carried out by the method of the longwall. The use of coal mining machines (Shearer) in the Parvadeh Tabas coal mine is the result of the mechanization operation of mine number one, and it is used for cutting or extracting coal inside the extraction panel. The shearer loader of the machine is relatively narrow; they move on the AFC of the longwall and are usually cut with a depth of 60 to 90 cm. Predicting shearer rate performance is a very important factor in evaluating the successful use of shearers. This generally deals with the choice of machine type, production rate, and amount of methane emitted from coal mining. To evaluate the performance of Shearer, the first step is to establish a database of rock and machine characteristics and the amount of methane emitted. Methane information was obtained using methane gas sensors inside the panel and on the main routes. Impressions such as hardness (Mpa) of the emitted methane gases as a percentage on sensor number 88 and the Tailgate input sensor (TG) and the sensor installed on the non-chain device (AFC) the methane degassing system, and the velocity of the extractor. All three models of linear multivariate regression, exponential multivariate regression, and logarithmic multivariate regression have been used to predict Shearer rate based on training and test data, which is discussed below.

To develop the predicted models, 70 percent of the data (882 data) were used as training data, and 30 percent (378 data) were used as test data. Among the three regression models performed, the results show that the linear multivariate regression model has a more accurate prediction than the other two methods. So that the training data to predict the shearer rate in the linear multivariate regression model with a coefficient of determination of 0.90 and a correlation coefficient of 0.95 and the root mean square of the errors had the least error. In linear multivariate regression, all independent variables except the methane degassing system can have a direct effect on the predicted shearer rate. The root mean square error of the training data in the linear multivariate regression model has the lowest error, and this value is equal to 0.29. Therefore, using the linear multivariate regression model, the value of the shearer rate in the Tabas No. 1, Parvadeh coal mine can be predicted with good accuracy.

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