A MODEL FOR ENSURING THE SAFETY OF PERSONNEL OPERATING IN UNDERGROUND MINES USING THE LINEAR EXTRAPOLATION METHOD

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Annotation: the mining industry is one of the most technologically complex and dangerous areas of activity, in which the safety of employees plays an important role. In this article, we will consider approaches to mathematical modeling based on extrapolation analysis of personnel safety in underground mines, which is a modern means of efficiently managing risks and ensuring labor safety. Assessment and security in the mining industry is an important task that requires a comprehensive approach. The article examines various mathematical modeling methods aimed at extrapolating current safety indicators to analyze them and predict future events. The study involves the development of mathematical models taking into account various factors affecting employee safety in mines.

Keywords: prediction, safety data, extrapolation, Occupational Safety, mathematical model, risk assessment in mines, random risks.

Introduction. Predicting process progress in the 21st century information technology age research has been one of the main tools of the process [1,2]. Extrapolation methods are common among all methods of prediction and are one of the most developed. When forming forecasts using the extrapolation method, usually changes in the quantitative characteristics of the object arise from statistically evolving trends [3].

The extrapolation method is used when the following situations are used:

a) the time at which the function is constructed must be sufficient to determine the trend of development;

b) the process being analyzed has a stable dynamic and inertia, that is, it takes time for a significant change in the characteristics of the process.

The extrapolation method is based on the study of the forecasting object, a retrospective analysis of quantitative time series or trends [4,5].

In mathematics and statistics, the extrapolation method is seen as one of the types of approximation that approximates this function outside a given interval, rather than between given values [6-8]. An analysis-based mathematical model using the extrapolation method of predicting employee safety in underground mines involves accounting for prior data and trends to predict future risk-related events [9-11].

Linear extrapolation, polynomial extrapolation, and exponential extrapolation allow the creation of complex mathematical models capable of analyzing and predicting employee safety in various phenomena using approaches [12-17].

The developed models allow current trends to be extrapolated and warned against potential risks, an important tool for effective safety measures in underground mines [18,19].

For the construction of this model, let us give information about the initial variables: let D_t be a set of security data in t-time, including a set of past events, equipment maintenance, inspections and other related factors. Then

$D_{t+1}^{'} = f(D_t)$.

where $D_{t+1}^{'}$ is the function predicting the future security situation on the basis of the D_t – of the cell? Let f be the set of factors that affect the safety of the circuit. A function that determines the security level $(S_{t_1}, S_{t_2}, \dots, S_{t_n})$ based on predicted data $D_{t+1}^{'}$ and influencing factors (F_1, F_2, ...F_n) is given in the following (1) formula [20,22].

$$\begin{cases} S_{t_1} = g\left(D_{t_1}^{'}, F_1\right) \\ S_{t_2} = g\left(D_{t_2}^{'}, F_2\right) \\ \quad\quad . \\ \quad\quad . \\ \quad\quad . \\ S_{t_n} = g\left(D_{t_n}^{'}, F_n\right) \end{cases} \qquad (1)$$

$P_{bh_1}, P_{bh_2}, \dots, P_{bh_n}$– let the clock be a function that determines the likelihood of emergency situations on the basis of the level of risk and other factors. Then this function becomes.

$$\begin{cases} P_{bh_1} = h(S_{t_1}, L_1) \\ P_{bh_2} = h(S_{t_2}, L_2) \\ \quad . \\ \quad . \\ \quad . \\ P_{bh_n} = h(S_{t_n}, L_n) \end{cases} \quad (2)$$

where $L_1, L_2, \dots, L_n$ is the set of other factors.

Such a model provides a means of predicting risk levels based on previous data and allows for Trend Analysis, weak points detection, and measures to improve employee safety in underground mines.

Conclusion. Analysis of personnel safety in underground mines using the extrapolation method is an important modeling tool for the developing mining industry. This approach provides a systematic and accurate approach to predicting risks and developing strategies for ensuring labor security. Further research in this area will be a supportive system to improve existing models and provide a high level of security in underground mines. Imaging in underground mines using the extrapolation analysis method of mathematical modeling of employee safety provides an effective tool for predicting future safety events based on previous data and trends. The Model takes into account many factors affecting safety, including the technical condition of the equipment, the intensity of seismic activity and other variables. It allows you to regularly update, fix and adapt the model parameters based on new data to changing conditions. Thus, extrapolation can be used as a means of determining future expected values based on available information about trends in past changes.

List of literature used:

[1]. Owen, M. L. (2004). Exposure Model--Detailed Profiling and Quantification of the Exposure of Personnel to Geotechnical Hazards in Underground Mines. University of Western Australia.

[2]. Kalandarov, I., & Namozov, N. N. (2023). LoRa signallari yordamida yer osti kon ishlarida xodimlar harakatlanish traektoriyasini aniqlash modeli. Digital transformation and artificial intelligence, 1(4), 146-148.

[3]. Котова, Т. Н., & Хачатурян, Р. Е. (2014). Методы прогнозной экстраполяции в техническом сервисе. Достижения вузовской науки, (8), 242-249.

[4]. Кабанов, А. И. (2009). Прогнозы инновационного развития угольной отрасли.

[5]. Kalandarov I.I., Namozov N.N., Bozorov B.N. Sanoat korxonalarida xodimlar havfsizligini ta'minlashning axborot tizimlari tahlili va asosiy ko'rsatkichlar // ISSN 2181-7383 "O'zbekiston konchilik xabarnomasi" ilmiy texnik va ishlab chiqarish jurnali, №2(93), 2023, 120-123 bet. DOI:10.54073/GV.2023.2.93.029

[6]. Кубрин, С. С., & Журавлев, Е. И. (2018). Интеллектуальная система прогноза опасности динамических явлений на производственных участках угольных шахт. Горный информационно-аналитический бюллетень (научно-технический журнал), (3), 40-45.

[7]. Карначев, И. П. (2013). Научное обоснование методов анализа производственного травматизма и профессиональной заболеваемости при подземной добыче полезных ископаемых: автореферат дис.... д-ра техн. наук: 05.26. 01/Карначев Игорь Павлович.

[8]. Kabulov, A., Kalandarov, I., Raxmatov, D., & Namozov, N. (2022, May). Control System and Algorithm for Construction of Optimal Technological Routes for Machining Parts in the Machining Shop. In International Scientific Conference on Agricultural Machinery Industry "Interagromash" (pp. 2566-2574). Cham: Springer International Publishing.

[9]. Vakhromeev, A. G., Boboev, A. A., Namozov, N., & Khushvaqtov, S. (2023). Geoecological monitoring of the "Mustaqillikning 25 yilligi" gas field. In *E3S Web of Conferences* (Vol. 417, p. 04007). EDP Sciences.

[10]. Павлова, А. С., & Исаев, А. А. (2014). Оценка риска возникновения пожаров на объектах нефтегазового комплекса. Современные проблемы гражданской защиты, (3 (12)), 45-50.

[11]. Ботиров, Т., Латипов, Ш., Баракаев, А., & Намозов, Н. (2020). Синтез интервальных управляющих устройств в адаптивных систем управления с эталонной моделью. In Инновационные геотехнологии при разработке рудных и нерудных месторождений (pp. 231-234).

[12]. Кабанов, Е. И. (2020, April). Пространственная оценка риска аварий при ведении подземных горных работ Spatial assessment of accidents risk at underground mining. In themed collection of papers from international conferences by hnri «National development» (p.142).

[13]. Kadirov, Y., Samadov, A., & Goziev, O. (2023). Equation of dynamics of greenhouse microclimate parameters. In E3S Web of Conferences (Vol. 390). EDP Sciences.

[14]. Уринов, Ш. Р., Буранов, Э. М., Садиков, И. Т., Ахмедов, К. А., Ильин, Д. Н., & Гозиев, О. С. (2023). Изменения массы заряда промышленных

взрывчатых веществ и диаметра скважинных зарядов от расстояния между скважинными зарядами в ряду и между рядами. Journal of Advances in Engineering Technology, (1), 83-89.

[15]. Гозиев, О.С.У., Саидова, А.Х., Мохилова, Н.Т.К., & Тухтамишова, М.Ш.К. Специальность-автоматизация технологических процессов и производств-профессия xxi века. Интернаука Учредители: Общество с ограниченной ответственностью" Интернаука", 53-54.

[16]. Каландаров, И. И., Намозов, Н. Н., Изатуллаев, Х. И., & Абдуллаев, А. Р. У. (2022). Преобразователь передачи информации в информационную систему контроля горюче-смазочных материалов. *Journal of Advances in Engineering Technology*, (3), 5-8.

[17]. Карпович, Д. С., Овцов, С. А., Шумский, А. Н., & Намозов, Н. Н. (2021). Синтез систем управления с шумами в измерительных каналах.

[18]. Kalandarov I.I., Namozov N.N., Bozorov B.N. Yer osti kon ishlarida transportlarni xavfsiz harakatlanishini nazorat qilish algoritmi // «Matematik modellashtirish va axborot texnologiyalarining dolzarb masalalari» xalqaro ilmiy-amaliy anjuman tezislari to‘plami, 2-to‘plam, Muhammad al-Xorazmiy nomidagi Toshkent axborot texnologiyalari universiteti Nukus filiali, Nukus, 2-3 may, 2023 y., 80-82 bet.

[19]. Kalandarov, I. I. (2020). Algorithms for solving problems of managing a production unit with a discrete unit type of production. International Engineering Journal For Research & Development, 5(4), 8.

[20]. Гребенкин, С. С., Рябичев, В. Д., Павлыш, В. Н., Должиков, П. Н., & Зензеров, В. И. (2007). Математические модели и методы расчета параметров процессов подземных горных работ и добычного оборудования.

[21]. Kalandarov, I. (2022). Algorithm for the Problem of Loading Production Capacities in Production Systems. In XIV International Scientific Conference “Interagromash 2021” Precision Agriculture and Agricultural Machinery Industry, Volume 1 (pp. 887-896). Springer International Publishing.

[22]. Kalandarov I.I., Namozov N.N. Begmuratova Sh. Yer osti kon ishlarida faoliyat olib boruvchi xodimlar havfsizligini finch-kinney metodi yordamida tahlil qilish // MATERIALS International scientific conferences on the topic “Innovative solutions to current problems of the chemical and mining industry” Nókis-2023 (pp. 211-213).