



## Recent trends in Management and Commerce

Vol: 1(2), 2020

REST Publisher

ISBN: 978-81-936097-6-7

Website: <http://restpublisher.com/book-series/rmc/>



# Safety Evaluation of Coal Mines Using IBM SPSS Statistics

Patil Aaditi Sharad

SSt College of Arts and Commerce, Maharashtra, India

Email: aaditipatil@sstcollege.edu.in

### Abstract

Safety Evaluation of Coal Mines. Coal mining is from the ground it is the action of removing coal. In the 1880s, coal was widely employed to generate electricity due to its estimated energy content. Coal, iron, and removing iron from ore are used by the steel and cement industries. In the United Kingdom and south africa, a coal mine and associated structures, or a colliery, is also used as fuel for the production of cement. A pit is a term for a coal mine, and a hollow head refers to above-ground structures. Australian colliery usually means underground coal indicates mining. Coal mining many developments in recent years consist of men digging tunnels, coal in carts manually extraction first large open cut and up to the long wall tunnels. Of this scale, tracklines, trucks, conveyors, hydraulic jacks, and shears should be used. Safety of coal mines the situation is one of regional development that determines economic status, on the other hand of employees working in mines security. For managers of coal mines policies related to product safety develop and implement coal safety status of mines and improve performance significantly based on ahp to provide information safety level of coal mine this article introduces the scientific method of evaluation. SPSS statistics is a data management, advanced analytics, multivariate analytics, business intelligence, and criminal investigation developed by IBM for a statistical software package. A long time, spa inc. Was created by, IBM purchased it in 2009. The brand name for the most recent versions is IBM SPSS statistics. Don't Ignore the Danger, Dangerous Tasks Require Planning and Communication, Get Professional Training, Always Wear Safety Equipment, Supervise Your Team, Document Your Safety Peocedures, Follow the latest Safety Standards. The Cronbach's Alpha Reliability result. The overall Cronbach's Alpha value for the model is .566 which indicates 56% reliability. From the literature review, the above 57% Cronbach's Alpha value model can be considered for analysis. The outcome of Cronbach's Alpha Reliability. The model's overall Cronbach's Alpha value is.566 which represents a 56% reliability rating. The above 57% Cronbach's Alpha value model from the literature review can be taken into consideration for analysis.

**Keywords:** IBM SPSS Statistics, Supervise Your Team, Coal Mines

### Introduction

Effective control of accidents in chinese coal mines is critical to safe production becoming clear. Of coal, accidents identifying the development trend is urgent. In general, researchers in this field have made some important discoveries. Development of coal mines in china status and employment status and protection of foreign coal mines advanced experience of supervision according to, coal mining safety in china lack of oversight mechanism based on the analysis related countermeasures and proposed improvement recommendations. In the 1970s, the world's major coal coal mining-producing countries improved security levels, also supervisory management systems were installed and updated. Science, technology, education, and training based on the four main organizations in coal mining safety significant progress has been made [1]. Coal mine methane is with coal mining operations co-produced or coal releases methane gas from folds or underground term given from other gaseous systems. Generated in a specific process cmm's size of coal mine productivity, of coal seams gaseousness and any basic and superficial forms, functional variables and geographic conditions it depends. Ventilation of the mine by drilled boreholes that augment the structure hold the cmm or its mine may be expelled. During mining large amounts of methane are released, to ensure worker safety regarding adequate mine ventilation gives worries, but this gas if captured and used properly it can also create opportunities to generate energy [2]. And some scholars have coal mining aggregation in security assessment study the use of operators. In this paper, induced linguistically ranked weighted we are the geometric mean operator we propose, it is very rational contains, because of argument importance of sorting position not only that, but also the argument is given we consider, and decision making for coal mining we develop the method. Linguistics security assessment with values. Coal in mine safety assessment, decision makers usually make decisions with a vague knowledge of information, and their result information with correct numerical values cannot be estimated. Their preferences for linguistic variables rather than numbers it is more appropriate to provide via, for example, experts generally geological position of coal mine evaluated by linguistic terminology [3]. Safety assessments for coal mines scientific implementation, coal mining accidents effectively reduction in working conditions in mines, and achieving steady progress is a major opportunity. Safety of coal mines thoroughly evaluate the risks evaluating existing projects sorting is also included. The problem has been and is a constant and ignored impossible problem. Coal mining security assessment issues, geography environmental protection by status affected, and management of human diabetes can be affected by the condition [4]. Currently, safety in coal mines affects productivity gas is the main hazard.

Gaseous emissions open fire, improper explosion or mechanical operations may cause an explosion when ignited. Explosion in the early 1970s and the scope of explosion studies and predicting coal mining hazards it is also prevention. However, coal sewage gas is now a commercial energy source as considered, in studying development more attention is paid. Thus, coal seam gas is a hazard to changes in energy sources. Coal geology of gas explosions in mines structures are also closely related [5]. The natural environment is coal natural geology of mining natural as determined by conditions refers to attributes, not people. And they are in the manufacturing process to make an impact, on the product when people decide. Nature in contrast to context, derivative context is artificial and controllable. The theory of accident causation will be mentioned machinery, management, and workplace context are derived contexts that should be included. Derivative environment installation and preservation of coal a constant in the mining production system promoting security and mining workers derivative conditions highly adaptable by changing and can become reliable, therefore the derivation context is particularly important [6]. Safety in coal mining is an evergreen subject, but coal mining is crucial to the industrial process. Thus, safety in coal mining is to be observed at the highest level one of the main issues to be addressed. Carbon dioxide, coal dust, unstable wall stones, and coal sutures spontaneously ignite and cover many hazards like floods underground working of coal mines safety issue due to conditions occurs. Hence, coal mining technology and management in the production process by departments urgent security assessment system to implement, so thus employees' potential risks can be predicted and prevent accidents take appropriate action. Safety in production can be achieved with minimum investment [7]. In this system, mining of coal numerous elements influence safety, and the relationships between these factors are complex. In addition, among these factors scale most directly research using the method is more it is difficult to draw conclusions based on this a large number of experts to be judged by scientific standards of the required expert decision reliability, the ultimate coal mine safety directly affect the accuracy of the estimate [8]. Risk evaluation and safety evaluation are important in practically all sectors. Mining is a high-risk activity, and in this context, numerous studies using various methodologies have been conducted. However, accidents that occur in underground mines and other complicated events can result in unfavorable outcomes. Due to the importance of the problem, in underground coal mines injuries or death by useful parameters in human health and the environment relationship between conditions various studies were conducted to find out [9]. An example of a people-focused strategy is modern coal mine safety management scientific management is used. Of comprehensive management of coal mines reflects the scale. Now company-wide safety education is workers' ideas, technical or training for post-training emphasizing and workers improving safety psychological quality to ignore security psychology is a kind of people-oriented to reduce production accidents a study of the laws of human mental activity a kind of science of doing is, it is effective in coal mine protection it is of great importance for production [10]. The coal industry is big accident china's economic growth was severely affected. By security technology laws of progress and protection and following regulations safer by upgrading stability of production conditions improved, but the question remains serious. Safety in coal mining accidents is a major concern one of the reasons is inadequate security no investment, more of a safety investment the unfairness of structures in production can have a huge impact. Investment in coal mine safety production and safety production level through discussion of relationship safety in coal mining companies [11]. Implementation of this policy, state surveillance, local regulation, and corporate responsibility the idea of important because it's in china from the perspective of the monitoring system for safety production of coal mines guarantees. However, with the establishment of this new organizational structure death rate from coal mining accidents effectively reduced coal mining production has significantly improved security the next advance in computer architecture upgraded. The problems are qualitative and quantitative scientifically incorporating analytics should be evaluated [12]. Choice of evaluation coding system and not just basic detection, for the research content of the assessment the key is also the evaluation direct impact on accuracy and outcomes causes main of coal mining properties and basic conditions to be reflected by the code, this makes the computer dangerous lock down the target of the situation. Evaluation of excessive codes the complexity of the method, the difficulty and increase sensitivity and vital will hide the factor. . Coal on the one hand safety level for mines a detailed assessment of the very can't offer too little, on the other hand, it weakens the importance of security assessment [13]. A large one occurs in coal mines such decisions to prevent accidents will be helpful. Moreso, good security situation nowadays knowledge of other countries and china's defense management Based on both the situation, safety of china's coal mines we recommend management we did. Finally, in the coal mines problems prevailing in coal mines statistical studies of analyses according to the results, security supervision system integrity, government, coal among the mines and workers establishment of co-operative society, including completeness of safety rules were proposed. And regulations, enhancing defense investment, improving safety training, improving security technology, and development of emergency rescue techniques and equipment [14]. Good communication using ann to predict movement applying the ann factor of safety and collapse, the dump slope, and very results detected. Latrobe, australia hazelwood minn. In the valley design of examination of the internal overburden dump for mining he had read about the method of limit balance coal mining. Looked at the waste's stability. Analyzed the outcomes using numerical models and grids. Geo-phases at specified intervals waste collection using to significantly improve stability they found that it could [15].

### Materials & Methods

**Evaluation parameters:** Don't Ignore the Danger, Dangerous Tasks Require Planning and Communication, Get Professional Training, Always Wear Safety Equipment, Supervise Your Team, Document Your Safety Peocedures , Follow the latest Safety Standards.

**Don't Ignore the Danger:** very rarely traumatic events happen unexpectedly and occur without any reason. Usually, to attract your attention there are some lingering symptoms of trying, there are some lingering symptoms of trying, but you are very busy were, distracted, or don't want to solve the problem. Problem the thing is, avoidance never works does not and at some

point, you deal with the consequences of inaction will have to, unfortunately, many people ignore vital health signs and don't want to solve the problem. Problem conclude with consequences. Physically, just like your business, is always in touch with you also, when things don't go well also trying to let you know.

**Dangerous Tasks Require Planning and Communication:** when planning tasks, don't expect to finish as efficiently as possible. Extra for security needs set aside time and money. To meet deadlines or tasks when trying to raise the quality of yourself never compromise the safety of employees don't compromise. Including the possibility of accidents all risks must be assessed. Try to eliminate risks as much as possible. If the risk is still there, provide clear instructions to the team, how to reduce it educate them about dealing with danger if necessary.

**Get Professional Training:** all team members regularly have safety training. This is for new team members only does not apply. Even long-term employees to attend refresher courses have to do. Theory and practice safety training with components workers engaged in hard work, the physical demands of their job to determine acceptability, health and may be sent for fitness tests. Professional training offers new frontiers to the individual, expanding their knowledge base and brushing up their skills. Efficient for any organization and professionally trained staff it goes without saying how important it is to have.

**Always Wear Safety Equipment:** from helmets to safety glasses and mine-up gloves workers for the safety of safety equipment used, there is a cult. All workers also need protection always wear the equipment necessary for example, a helmet by saving workers there are countless stories. Personal protection equipment commonly referred to as "ppe", can cause serious workplace injuries and exposure to disease-causing hazards a tool to reduce wear. Personal protective equipment is commonly referred to as "ppe". As mentioned, it is for various risks a wearable to reduce exposure.

**Supervise Your Team:** supervision means directing, managing, or an act of oversight or event. A team leader is a key end or alignment other to achieve a group of results by mentoring a group of individuals (team), instruction, guidance, and leadership provider. All team members' security without exception follows the instructions. Follow supervisor rules be diligent in implementation. More than allowed don't allow people to enter a site. Of all team members throughout each shift location supervisors need to know. Likewise, all employees are their peer group what members do throughout the day should be informed. Any group members violation of safety rules without warning do not allow or repeat in cases of disobedience, appropriate there will be consequences. Surveillance, is more supportive, caring, and positive because it helps create a work environment regular communication is problematic enhancing problem-solving and teamwork provides space for

**Document Your Safety Peocedures:** when accidents happen, all the team members do exactly that must know that. Safety procedures are clear to be defined. Safety procedures while documenting, which may occur various incidents, what to do and whom to contact describe the by team members in easily accessible places safety procedures are prominently displayed spatially prostrates are prominently distributed the doer is also legally their work-related health identify potential security risks have a risk assessment. Risk assessment documents in the workplace and to plan for specific risks a strategy to respond to it can also be used as a tool. These documents raise awareness of the dangers, specific individuals who may be at risk and identify that risk to remove or restrict they also help in specifying routes.

**Follow the latest Safety Standards:** the following guidelines are for employees to keep healthy and protect their well-being. They do their job very effectively can do, and hurt them or suffer from disease not to worry about can be confident. A great one is practice is a constant or it is a set of guidelines if followed it will give good results. Best practices are how a task works to undertake or construct something related to strict best practice guidelines by the governing body can be set up or internal to an organization.

**Methods:** SPSS statistics is a data management, advanced analytics, multivariate analytics, business intelligence, and criminal investigation developed by IBM is a statistical software package. Long time, spa Inc. Was created by, IBM and purchased in 2009. The brand name for the most recent versions is IBM SPSS statistics. The "statistical package for the social sciences" (SPSS), a set of software tools for changing, analyzing, and displaying data, is commonly used. Multiple formats are available for SPSS. Numerous add-on modules may be purchased to increase the software's capability for data entry, statistics, or reporting. The main application is known as SPSS base. The most crucial of them for statistical analysis, in our opinion, are the SPSS advanced models and the add-on modules for the SPSS regression model. Additionally, independent programs that connect with SPSS are available from spas Inc. SPSS is available in versions for windows (98, 2000, me, nt, and XP), supported by windows 2000 running SPSS version 11.0.1. Although further versions of the SPSS will most likely be available by the time this book is released, we are certain that the SPSS instructions provided in each chapter will still apply to the studies outlined.

## Result and discussions

TABLE 1. Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.566	.576	7

Table 1 shows the Cronbach's Alpha Reliability result. The overall Cronbach's Alpha value for the model is .566 which indicates 56% reliability. From the literature review, the above 57% Cronbach's Alpha value model can be considered for analysis.

**TABLE 2.** Reliability Statistic individual

	Cronbach's Alpha if Item Deleted
Don't Ignore the Danger	0.45
Dangerous Tasks Require Planning and Communication	0.605
Get Professional Training	0.531
Always Wear Safety Equipment	0.521
Supervise Your Team	0.443
Document Your Safety Peecedures	0.621
Follow the latest Safety Standards	0.478

Table 2 Shows the Reliability Statistic individual parameter Cronbach's Alpha Reliability results Don't Ignore the Danger 0.45, Dangerous Tasks Require Planning and Communication 0.605, Get Professional Training 0.531, Always Wear Safety Equipment 0.521, Supervise Your Team 0.443, Document Your Safety Peecedures 0.621, Follow the latest Safety Standards 0.478.

**TABLE 3.** Descriptive Statistics

Descriptive Statistics													
	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance	Skewness		Kurtosis	
Don't Ignore the Danger	30	4	1	5	94	3.13	.202	1.106	1.223	-.444	.427	.204	.833
Dangerous Tasks Require Planning and Communication	30	4	1	5	90	3.00	.230	1.259	1.586	.333	.427	-.741	.833
Get Professional Training	30	4	1	5	94	3.13	.229	1.252	1.568	.070	.427	-.798	.833
Always Wear Safety Equipment	30	4	1	5	95	3.17	.204	1.117	1.247	-.192	.427	-.071	.833
Supervise Your Team	30	4	1	5	99	3.30	.276	1.512	2.286	-.101	.427	-1.517	.833
Document Your Safety Peecedures	30	4	1	5	95	3.17	.254	1.392	1.937	.175	.427	-1.267	.833
Follow the latest Safety Standards	30	4	1	5	91	3.03	.237	1.299	1.689	-.066	.427	-.820	.833
Valid N (listwise)	30												

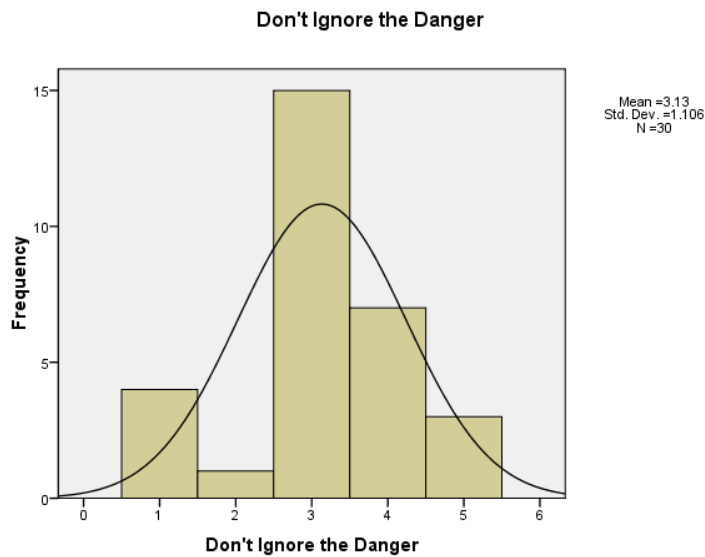
Table 3 shows the descriptive statistics values for analysis N, range, minimum, maximum, mean, standard deviation, Variance, Skewness, Kurtosis. Don't Ignore the Danger, Dangerous Tasks Require Planning and Communication, Get Professional Training, Always Wear Safety Equipment, Supervise Your Team, Document Your Safety Peecedures, Follow the latest Safety Standards this also using.

**TABLE 4.** Frequency Statistics

Statistics									
		Don't Ignore the Danger	Dangerous Tasks Require Planning and Communication	Get Professional Training	Always Wear Safety Equipment	Supervise Your Team	Document Your Safety Peecedures	Follow the latest Safety Standards	
N	Valid	30	30	30	30	30	30	30	30
	Missing	0	0	0	0	0	0	0	0
Median		3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Mode		3	3	3	3	5	3 <sup>a</sup>	3	
Percentiles	25	3.00	2.00	2.00	3.00	2.00	2.00	2.00	2.00
	50	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
	75	4.00	4.00	4.00	4.00	5.00	5.00	4.00	4.00
a. Multiple modes exist. The smallest value is shown									

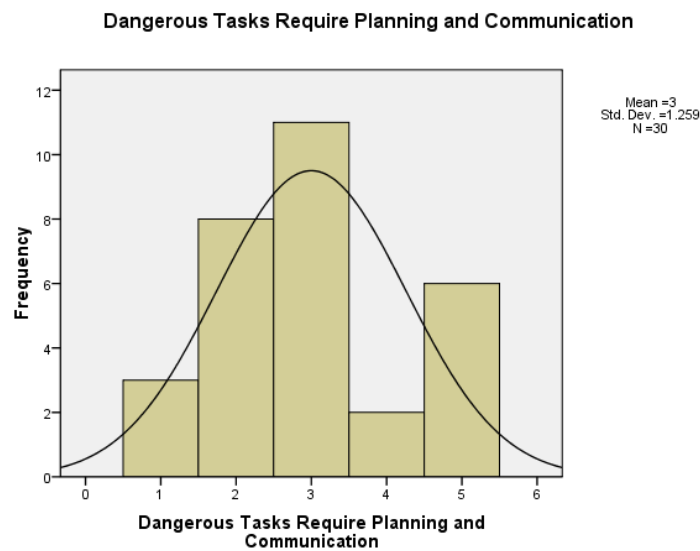
Table 4 Shows the Frequency Statistics in Don't Ignore the Danger, Dangerous Tasks Require Planning and Communication, Get Professional Training, Always Wear Safety Equipment, Supervise Your Team, Document Your Safety Peecedures, Follow the latest Safety Standards curve values are given. Valid 30, Missing value 0, Median value 3.00, Mode value 3.

**Histogram Plot:**



**FIGURE 1.** Don't Ignore the Danger

Figure 1 shows the histogram plot for the Don't Ignore the Danger from the figure it is clearly seen that the data are slightly Left skewed due to more respondents choosing 3 for the Don't Ignore the Danger except for the 2 value all other values are under the normal curve shows the model is significantly following a normal distribution.



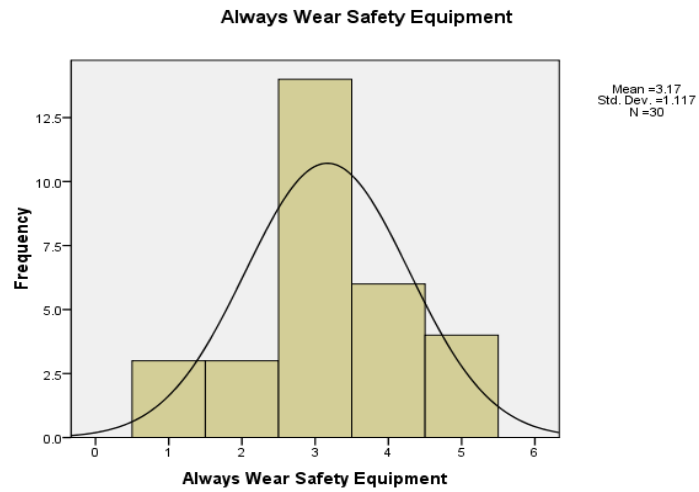
**FIGURE 3.** Dangerous Tasks Require Planning and Communication

Figure 3 shows the histogram plot for the Dangerous Tasks Require Planning and Communication from the figure it is clearly seen that the data are slightly Right skewed due to more respondents choosing 3 for the Dangerous Tasks Require Planning and Communication except for the 2 value all other values are under the normal curve shows the model is significantly following a normal distribution.

Figure 3 shows the histogram plot for the Get Professional Training from the figure it is clearly seen that the data are slightly Left skewed due to more respondents choosing 3 for the Get Professional Training except for the 3 value all other values are under the normal curve shows the model is significantly following a normal distribution.

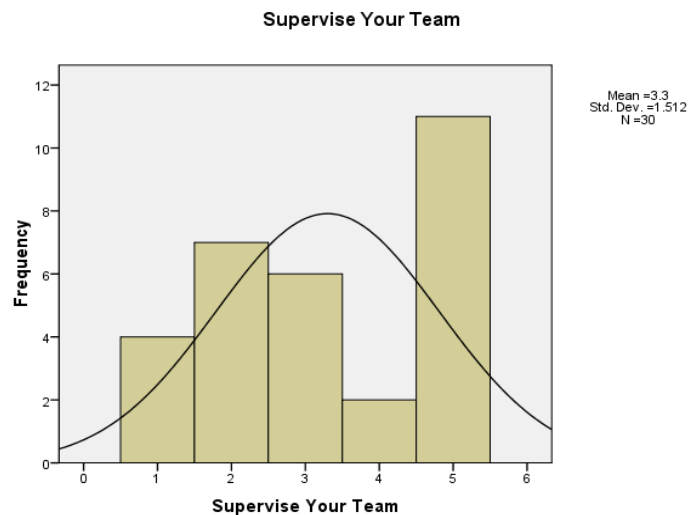


**FIGURE 3.** Get Professional Training



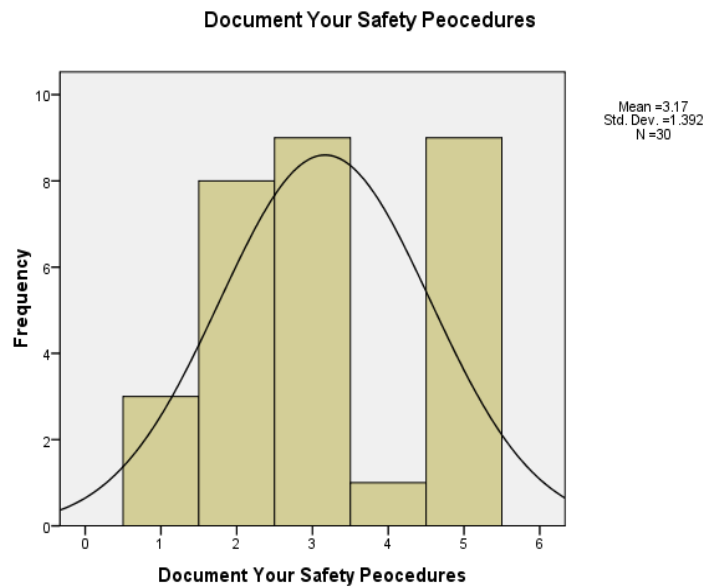
**FIGURE 4.** Always Wear Safety Equipment

Figure 4 shows the histogram plot for the Always Wear Safety Equipment from the figure it is clearly seen that the data are slightly Left skewed due to more respondents choosing 3 for the Always Wear Safety Equipment except for the 3 value all other values are under the normal curve shows the model is significantly following a normal distribution.



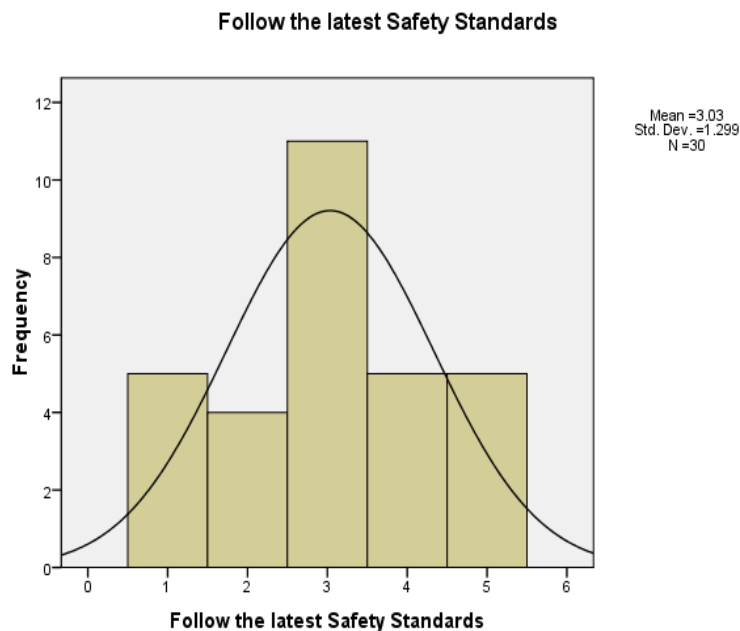
**FIGURE 5.** Supervise Your Team

Figure 5 shows the histogram plot for the Supervise Your Team from the figure it is clearly seen that the data are slightly Right skewed due to more respondents choosing 5 for the Supervise Your Team except for the 3 value all other values are under the normal curve shows the model is significantly following a normal distribution.



**FIGURE 6.** Document Your Safety Peocedures

Figure 6 shows the histogram plot for the Document Your Safety Peocedures from the figure it is clearly seen that the data are slightly Left skewed due to more respondents choosing 3,5 for the Document Your Safety Peocedures except for the 2 value all other values are under the normal curve shows the model is significantly following a normal distribution.



**FIGURE 7.** Follow the latest Safety Standards

Follow the latest Safety Standards 7 shows the histogram plot for the Follow the latest Safety Standards from the figure it is clearly seen that the data are slightly Right skewed due to more respondents choosing 3 for the Follow the latest Safety Standards except for the 3 value all other values are under the normal curve shows the model is significantly following a normal distribution.

**TABLE5.** Correlations

Correlations							
	Don't Ignore the Danger	Dangerous Tasks Require Planning and Communication	Get Professional Training	Always Wear Safety Equipment	Supervise Your Team	Document Your Safety Peecedures	Follow the latest Safety Standards
Don't Ignore the Danger	1	0.149	0.31	.372*	0.264	0.119	.429*
Dangerous Tasks Require Planning and Communication	0.149	1	0.087	0	0.29	-0.334	0.042
Get Professional Training	0.31	0.087	1	.452*	0.233	-0.172	0.082
Always Wear Safety Equipment	.372*	0	.452*	1	0.092	0.004	0.162
Supervise Your Team	0.264	0.29	0.233	0.092	1	0.238	0.328
Document Your Safety Peecedures	0.119	-0.334	-0.172	0.004	0.238	1	0.264
Follow the latest Safety Standards	.429*	0.042	0.082	0.162	0.328	0.264	1
*. Correlation is significant at the 0.05 level (2-tailed).							

Table 5 shows the correlation between motivation parameters for the Don't Ignore the Danger for Follow the latest Safety Standards is having the highest correlation the Get Professional Training is having the lowest correlation. Next, the correlation between motivation parameters for Dangerous Tasks Require Planning and Communication for the Don't Ignore the Danger is having the highest correlation with Document Your Safety Peecedures having the lowest correlation. Next, the correlation between motivation parameters for Get Professional Training for the Always Wear Safety Equipment is having the highest correlation with Document Your Safety Peecedures having the lowest correlation. Next, the correlation between motivation parameters for Always Wear Safety Equipment for the Get Professional Training is having the highest correlation with Document Your Safety Peecedures having the lowest correlation. Next, the correlation between motivation parameters for Supervise Your Team for the Follow the latest Safety Standards is having the highest correlation with Always Wear Safety Equipment having the lowest correlation. Next, the correlation between motivation parameters for Document Your Safety Peecedures for the Follow the latest Safety Standards is having the highest correlation with Dangerous Tasks Require Planning and Communication having the lowest correlation. Next, the correlation between motivation parameters for Follow the latest Safety Standards for the Don't Ignore the Danger is having the highest correlation with Dangerous Tasks Require Planning and Communication having the lowest correlation.

### Conclusion

Coal mining, around the world, has many intrinsic, and functional and so much so because of the occupational hazards is a regulated industry. The coal mines safety act in india is occupational health very comprehensive and one of the most widespread legal structures. Compliance with these safety rules is mandatory. In india, of coal mines operations mining act, 1952 mining rules 1955, and coal mines regulation-1957 and regulated by various laws made thereunder. Central labor and employment of mines under the ministry of (mol&e). Directorate general of defense (dgms) these laws responsible for managing occupational health and safety (ohs) applicable in coal mines the laws are as follows. Coal mining industry in local ecosystems has a significant negative environmental impact, on local communities and for global environmental crises like to contribute a lot. For these reasons, the diversity of the global energy economy the first phased out of the regions coal is one of the fossil fuels. China, indonesia, india, and major coal like australia producing countries, also in europe reversing the decline in america as well under production increase and growth by creating tunnels, peak production is not reached. By a mine established safety management system all hazards are identified ensure visibility and long term health and safety ensure critical risks are controlled. With a safety management system, mining operations are safe and necessary to ensure that it is carried out culture, structure, and practices should be set. Studies are the best workplace organization for design, security improving performance, risks raising awareness, and this eliminating and avoiding hazards recommended. Above studies in categories, as mentioned national level data and/or my specific information are based on, whereas category analyzes are mainly mine are based on specific data. Some of these studies are engineering and administrative security measures that pointed out the importance. However, safety for indian coal mines conventions and committees, rules, and regulations and at the national level based on circulars evaluate the effect of recommendations no attempt was made to do so. The safety task of a coal mine is complex systems engineering. Man is machine ecosystem engineering theory of coal mines using analyzing the security situation effectively through disasters and accidents can be prevented. Safety of coal mines to establish an evaluation target system, coal mines system level system and security assessment target man-machine for determination of weight as the foundation of the ecosystem taking then of the coal mines the triad of man-machine-environment judgment of the whole set of factors individually vaguely detailed it is done through the evaluation system. China is the world's largest producer of coal, it



is almost in the world's production contains half. However, among the major coal-producing countries china's coal production conditions are very bad ones. In numerous coal mines. At a similar stage of development to other major manufacturers, the mine's safety record is even worse. Coal is china's most important source of energy considering the evidence, all high gas mines, and those at risk of water disaster governments are reluctant to shut down.

### References

1. Li, Xuelong, Zuoyong Cao, and Youlin Xu. "Characteristics and trends of coal mine safety development." *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects* (2021): 1-19.
2. Karacan, C. Özgen, Felicia A. Ruiz, Michael Cotè, and Sally Phipps. "Coal mine methane: a review of capture and utilization practices with benefits to mining safety and to greenhouse gas reduction." *International journal of coal geology* 86, no. 2-3 (2011): 121-156.
3. Wei, Chunfu, Zheng Pei, and Huamin Li. "An induced OWA operator in coal mine safety evaluation." *Journal of Computer and System Sciences* 78, no. 4 (2012): 997-1005.
4. Peng, Hong-gang, Jian-qiang Wang, and Peng-fei Cheng. "A linguistic intuitionistic multi-criteria decision-making method based on the Frank Heronian mean operator and its application in evaluating coal mine safety." *International Journal of Machine Learning and Cybernetics* 9, no. 6 (2018): 1053-1068.
5. Li, Zhonghui, Enyuan Wang, JianchunOu, and Zhentang Liu. "Hazard evaluation of coal and gas outbursts in a coal-mine roadway based on logistic regression model." *International Journal of Rock Mechanics and Mining Sciences* 80 (2015): 185-195.
6. Han, Shuai, Hong Chen, Ruyin Long, Hui Qi, and Xiaotong Cui. "Evaluation of the derivative environment in coal mine safety production systems: Case study in China." *Journal of Cleaner Production* 143 (2017): 377-387.
7. Liu, Ya-jing, Shan-jun Mao, Li Mei, and Ji-ming Yao. "Study of a comprehensive assessment method for coal mine safety based on a hierarchical grey analysis." *Journal of China University of Mining and Technology* 17, no. 1 (2007): 6-10.
8. Hou, Yun-bing, Ren-fei Pan, Ji-yan Wu, and Bao-ping Wang. "Coal mine safety evaluation based on the reliability of expert decision." *Procedia Earth and Planetary Science* 1, no. 1 (2009): 1661-1667.
9. Mahdevari, Satar, Kourosh Shahrari, and Akbar Esfahanipour. "Human health and safety risks management in underground coal mines using fuzzy TOPSIS." *Science of the Total Environment* 488 (2014): 85-99.
10. Liu, Guoyu, and Chuanlong Luo. "Analysis of the safety psychological factors in the coal mine safety management." *Procedia Engineering* 45 (2012): 253-258.
11. Nie, Bai-Sheng, Peng-Fei Zhao, Jian-Hua Guo, Peng-Peng Niu, and Guo Wang. "Fuzzy comprehensive evaluation of coal mine safety investment structure based on the M (1, 2, 3) model." *Energy Procedia* 16 (2012): 592-597.
12. Chen, Sen-Sen, Jin-Hua Xu, and Ying Fan. "Evaluating the effect of coal mine safety supervision system policy in China's coal mining industry: A two-phase analysis." *Resources Policy* 46 (2015): 12-21.
13. Zeng, Qi, and Xu Wang. "Safety evaluation of coal mines based on analytic hierarchy process." In *2010 International Conference on Management and Service Science*, pp. 1-4. IEEE, 2010.
14. Wu, Lirong, Zhongan Jiang, Weimin Cheng, XiuweiZuo, DaweiLv, and Yujing Yao. "Major accident analysis and prevention of coal mines in China from the year of 1949 to 2009." *Mining Science and Technology (China)* 21, no. 5 (2011): 693-699.
15. Khandelwal, Manoj, Rajesh Rai, and B. K. Shrivastva. "Evaluation of dump slope stability of a coal mine using artificial neural network." *Geomechanics and Geophysics for Geo-energy and Geo-resources* 1, no. 3 (2015): 69-77.