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SPECIAL DISTRIBUTION OF GEO-RESOURCE PARAMETERS

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ABSTRACT

New special statistical distribution is based on the theoretical concept of revealing and account of the high informative geo-indicative characteristics and invariant structures of geo-features distribution involving special hyperbolic cosine function. Sustainable invariant structure of the probability frequency development of geo-features set by result of symmetric distributions of various types of geo-features(N = 424,000) in various fields of ferrous, nonferrous and rare metals (N = 208). The density function distribution reflects the shape of unimodal symmetric bell-shaped curve, allowing different values of excess greater than zero with a minimum of asymmetry. According to the results of a comparative evaluation of more than 700 symmetric types of empirical distributions of 124 different geo-features with asymmetry and excess greater than zero is set high convergence of the new distribution almost 1.4-2.0 times more accurate than normal and other close theoretical distributions; confirmed that approximation power distribution is provided by the parameterization of the distribution function with the assistance of the modal characteristics and amplitude variability of geo-features, which are more informative and geo-indicative statistical index of geo-features prevalence.

Keywords: Distribution, geo-indication, option, geo-indicator, mode, variability, symmetrical, invariant, convergence, statistics.

1. INTRODUCTION

Currently, the problem of estimating empirical distributions of geo-features and other indicators of geo-resource, despite the great importance in solving various problems of the earth, and mining requires proper solutions. The complexity of solving this problem is caused by multi factorial and specific features of the nature of the processes of mineralization and relief formation inherent to different objects of geo-resources. Specific features of geological and genetic mechanism of mineralization of deposits creates a system of dispersion and concentration levels which creates the beginning of the statistical structure of variational series of frequency values in the form of sustainable patterns of change.

The range of received information by the empirical distribution is quite broad and includes a variety of spatial static characteristics of geo-features distribution. The formation of probability frequencies features of minerals are mainly influenced by geological and genetic factors such as geochemical anomaly, the trend, types and varieties of minerals, tectonic faults, the concentration of minerals, concentration micro local inclusions, geometry and orientation of the samples, geological and geometrical factors (degree and variability nature of the spatial distribution, mean and modal values of geo-features, the characteristics of the field structure, representativeness and accuracy of the sample, as well as other uncontrolled factors). It is difficult to estimate The real distribution is not considered as known due to numerous, hard bound and unstable distributed random impacts.

Theoretical principles of probability distribution are diverse and based on different phenomena, processes and objects. In the scientific literature are discussed theoretical accounting issues of "prestigious" works in which applied tasks are strictly in the language of mathematics regardless the realism of their performances. Analysis of the existing probability distributions formation and their application show that they are inherent in any abstract and idealized character, or they are intended for use in the basic sciences, i.e. in physics, biology, linguistics, demography, the science of science, etc.

At the same time, until recently, there are no special distribution in which the object is ore deposit or mine, distribution features of quality forming components. Furthermore, there is not developed direct methods of accounting invariant fluids and other geo-indicative principles, inherent to the structures of the empirical distributions of geo-features.

A source of incorrect predictions and assessments are existing indirect classification approaches of geological features distribution and mining geometrical parameters to the known theoretical probability distributions, which are based on certain phenomena or processes unrelated with distribution principles of geo-features of mineral deposits. The methodical procedure of evaluation and description of empirical distributions of minerals features does not have theoretical foundation and selects mechanically the well-known principle of distribution. Practice of empirical distributions description leads to different mechanical techniques and attempts to describe the features of the known principles of distributions committed all sorts of assumptions and artificial rounding of ejection, etc. Despite the fact that many of the empirical features distribution of deposits is not be described by any known laws, in practice they are approximately converging. This similarity curves are often accidental, because these things are not comparable, they are determined by different principles of nature, and naturally assume that all unknown called accidental.

At present, the most widely accepted practice is classifying of symmetrically shaped species qualitative characteristics distribution of minerals to the theoretical normal distribution of probabilities. The main reason for the widespread use of this practice is calculation formulas of analytical completeness of this distribution in a convenient way to determine the probabilistic frequency without complex computations. The desire to describe the empirical feature distribution by ready theoretical principles has led to the approval of the establishment of the most "better suited" forms of these distributions, as an example: the normal and lognormal. Mistakes made in the result of the mismatch of real convergence of the studied empirical distribution feature with selected theoretical distribution related to accumulating errors, accompanied by significant consequences. These errors are correspondingly increased due to the use of the parameters of the selected theoretical distribution for forecasting projection and regulatory and methodological development, feasibility studies and the creation of technological processes of exploration, engineering, mining.

The normal distribution, and many others, with tails going to infinity с хвостами уходящими в бесконечность, the variables do not have the actual values of the expectation and variance, although in reality they are existed. Rejection of such distributions by utilizing some finite distributions and use opportunity of truncated, correlation and other forms by replacing the variables is not sufficient to solve this problem. Gross and systematic errors are caused by analytical identification of the actual contour of distributed geo-features $(x_н < x < x_к)$ with "idealized" probability space of infinitely distributed variables $(-\infty < x < \infty)$. Definition formula of medium and other parameters derived for conditions of infinite limit of variable distribution is indirect and practically cannot provide sufficient certainty. A similar provision is inherent to the conditions of application of the fundamental laws of physics and mechanics for the specific application processes with certain parameters.

2. SYMMETRIC TYPES OF GEO-FEATURES DISTRIBUTION

In the literature, the main theoretical distribution of symmetric type are presented as normal, hypergeometric, uniform, angular normal and distributions of Student, Simpson, Cauchy, Rayleigh, Schx, χ2, Tikhonov, Feller, Mises, Pearson (IV) [Kurmankozhaev A., 1990 . Kurmankozhaev A., 1989]. Theoretically, more reasonable, widely studied and most common is a normal distribution, which is a limit law, approaching other distribution laws. The essence of this law is as follows: if the random value depends on many factors, each of which affects relatively small, than the approximately it is considered that random value is normally distributed, and the values of asymmetry and kurtosis (excess) are equal to zero (A = E = 0) [Mitropolsky A.K. 1956, Gnedenko B.V., Kolmogorov A.N., 1957].

There are a lot of attempts to treat various changes and modifications of the normal distribution [Ezhov A.I. 1961, Mitropolsky A.K. 1990]. For example, finding the distribution which associated with the normal distribution, and which become normal, if, instead of observed x consider the value z = φ (x). There are methods of determining good analytical approach through the use of a number of types Charles series and etc.

Symmetrical distribution of geo-features is studied by few scientists. In 50 enterprises are conducted studies to determine the distribution laws, which sufficiently describe the empirical combination containing components of extracted ore mass, by levels of formation of ore-flow [Kurmankozhaev A.K.1989, Yershov VV 1982 Milgram MT 1970].As a result, it was found that in the mines Belousovsky, Leninogorsk, Ridder, Gai, East Kazakhstan, Octyabrsk and other mines in most cases, the process of increasing the stability of the quality in the process of production is accompanied by transformation of asymmetric empirical distributions into more symmetrical. Similarly [Milgram M.T. 1970] found that the empirical distribution of daily indicators of commodity output of non-ferrous metals during production ($N_{рв}=N_{zn}=341$) have a symmetrical shape of the distribution. The symmetrical shape of the distribution attributable to the normal distribution is most often distributed in the dissemination of ferrous metals., $N_3=409$ For the normal distribution law is attributed the empirical distribution of ore varieties and host rocks deposits Krivorozheskii iron ore bassin [Sotsky A.G., Bazarya V.I. 1976]. As the normal distribution law is referred the empirical distribution of indicators of hardness undisturbed rocks represented by mudstone and sandstone and built according to N.G.Rusanova information, with statistical aggregates $N_1=751$, $N_2=798$, $N_3=409$ [Abuzov V.A. 1968].The author of this research work carried out [Kurmankozhaev A.K. 1971] investigation for evaluation of empirical distributions of chromium oxide content in the produced commodity ore stockpiled separately on six mines (N = 585) in Donsk mining and enrichment plant. As a result, it found that the content of chromium oxide are closer to the normal distribution.The empirical distribution of labor productivity is close to normal law according to the 239 preparatory excavation (N = 1446) in 30 mines of the Donbass, as specified in [Astakhov A.S., Goyeman E.I. 1967]. It often happens that in the same field the content of certain components have symmetrical, and other components have asymmetrical shapes, and thus leads to use of the normal and log-normal distribution together.The statistical processing of the measurement data of 130 samples in 2300 definitions found that the normal law of distribution inherent to hafnium and lognormal distributions - alpha activity in the zircons[Krasnobaev A.A. 1968]. As a result of statistical processing of the 2500 samples of plumbum-zinc deposits such as Karagaily, Bestyube, Zhairem Akzhal found that the empirical distribution of plumbum in these fields in the 17 cases are close to normal in 8 cases -lognormal distribution laws; zinc in 5 cases - normal distribution, and in 12 cases - lognormal [Mukanov K.M., Utegenov S.M. 1968].The statistical analysis of the content of elements - impurities coal of Kazakhstan [Azizov T.M. 1968] indicates that the empirical distribution of content of germanium, scandium, ytterbium, copper, zinc, nickel, molybdenum, and, though rarely, plumbum, zirconium, cobalt distributions obey a logarithmic law; empirical distribution of beryllium, chromium, gallium, titanium and vanadium are close to - normal distribution. If probabilistic and statistical study of empirical distributions of potassium, sodium, uranium, thorium, copper, barium, strontium, chromium, nickel, cobalt, vanadium, titanium, zirconium, germanium in Boschekulskii ore array found that they can be described as normal and lognormal [Zaravnyaeva V.K. 1968].According to statistical analysis of over 3000 samples for four lead-zinc and tungsten-molybdenum deposits of the North Caucasus (Tyrnauzskoe, Sadonskoe, Elbrus) found that the empirical distribution of the components in them is close to the curves of normal and log-normal, distribution[Radchenko L.M., Mikhailov V.I., Vershinin F.E. 1975]. Studies [Kurmankozhaev A.K. 1970, Kurmankozhaev A.K. 1971] for evaluation of empirical distributions of indicators of losses and dilution of ore (N = 195), intraore inclusions (N = 194), recovery rates of quantity and quality of extracted ore (N = 1854) based on actual data of five chromite mines shows that the empirical distribution of these indicators close to normal, and often described by lognormal distribution.The closeness of the distributions of the strength properties of rocks to the normal law in only one variety of rocks, which are characterized by a homogeneous structure of the mineral composition is proved in [Timofeenko E.P. 1981, Protodyankov M.M., Teder M.I., Ilnitskaya G.I. 1981], and authors describe the distribution coefficients of the strength and abrasion as a positive asymmetry type of lognormal and gamma distributions. In the study of statistical distributions of copper and molybdenum in deposit fields Karatas, Tesiktas [Los V.L. 1969, Sharapin V.P., Lapin S.S. 1969] Shatyrkul, Iris, and the content of lead and zinc deposits of the Altai-Sayan [Sharapin V.P., Lapin S.S. 1969] gold on deposits Zholymbet, Bakyrchik, Basil [Los V.L. 1968] found that their distribution is generally a multimodal, representing a compound of normal and log-normal distributions. Thus it follows that in the field of geology and mining-geometric study the symmetric types of distribution of content and performance of the various components of the geomechanical properties of are widely spread and the shape curves are close to the normal distribution; approval coming from the geometric proximity of the distribution curve of their normality has become a traditional and accepted without testing the hypotheses of convergence and equality to zero asymmetry and kurtosis(excess), mean difference and modal values.

3. CONCEPTUAL BASICS OF A SPECIAL DISTRIBUTION

The theoretical justification of the concept of special statistical distribution is based on the construction of the modelling function that describes a sustainable invariant development structure of the probability frequencies of symmetrical type geo-features distribution with sufficient reliability. As analytical basic of required distribution is accepted the modelling function as a reproducible display of geometric invariant "image" of the development laws of probability frequency distribution as the characteristic values growth. In constructing the distribution function of geo-features is used condition that invariance as unchanged structural parts of patterns can be represented as geo-indicative operator, allowing the interpretation of regular dependencies that determine the shape of the structural formation of probability frequency geo-features distribution. Thus, structural and empirical approach, including a set of provisions of the quantity theory, statistical and factor analysis, is used for integrating the effects of the main factors on the geo-features distribution. Invariant structures of forming the empirical frequency features distribution of minerals are established on the basis of natural-experimental research of empirical distributions of various features (N = 424,000) in various fields of ferrous, nonferrous and rare metals (N = 208) involving literary and production and reporting sources [Kurmankozhaev A., 1989]. The headship invariant structures are defined as non-parametric laws that reflect structural relationships between the empirical frequency geological features distribution and their values. To determine the stability of the invariant structure is used empirical symmetric types of distribution of the components in the produced commodities and diluted raw ores, technogenic waste- forming of substandard deposits of chromite, iron ore, bauxite, phosphate, asbestos and coal deposits, attracted distribution of quantitative and qualitative output of production, physical mechanical properties of the ore, vein and irregular deposits.

According to the analysis set empirical invariant "image": "unimodal symmetric bell-shaped development form of the empirical frequency geo-features distribution with minimal asymmetry (A≈0) and the degree of excess above zero (E≈1,0 ÷ 4,5)». The received stable empirical forming structure of geological features frequencies are summarized in an invariant way of a real symmetric type of statistical distribution, which serves as a adaptation basis qualimetrical compliance model structure of special distribution to the empirical.

Taken into account the position, that in geology the structural and taken separately parameter provides an additive natural characteristic of feature distribution. The parameters of the new special geo-features distribution put options that differ from the traditional as the main their qualimetrical empirical characteristics of the statistical distribution: mode (X_o), modal frequencies (f_0), amplitude variability of feature (d_i=x_i-x_o), normalized by mode and the location parameter (ß). Taken into account, that in geology the taken separately structural parameter provides an additive natural characteristic feature distribution. Modal characteristics – mode and modal value of geo-feature frequency as geo-indicative tests characterize a given statistical sample. It is used in formation of the intersection of a variety of linear and curved structures and various geometric sub-patterns defining distribution shape are grouped around. Modal characteristics as the most informative parameters of the empirical feature distribution are the basic structure-forming characteristics of geological and genetic mechanism of dispersion and serve as a bridge linking distribution function and stability of the invariant structure of frequency forming. The ratio of mode and mean reflects the type and the degree of development asymmetry of the probability frequency characteristic geometry. Mode less prone to all sorts of errors, is more stable in the samples with kurtosis, can be determined in the some uncertainties, it remains stable when converting random value. The geo-feature change amplitude (d) as variable parameter defines the degree of fluctuation of the single series swing, and is a measure of the interval sampling of invariant structures of frequency forming. In information theory, analogical value is used as informative and statistical measure , provided as the number of the scatter values of the feature, it determines the interval of variational series and other summation of statistical estimation. In this case, a modification of this parameter as a deviation from the normalized mode (d=x-x_o) is used as the evaluation index of the geo-features distribution.

4. A MODEL STRUCTURE OF THE SPECIAL DISTRIBUTION

The distribution function is constructed by the use of established stable invariant structures of distribution frequency forming and spatial-statistical characteristics of the scattering of geological features with the involvement of the theoretical properties of the hyperbolic cosine of a class of special functions Jacobi (cn=1/chx). Hyperbolic cosine has important theoretical properties; there are concentrated analytical properties of important functions, such as trigonometric, exponential, special, logarithmic, and elementary. As a function degenerated from elliptic functions, it is associated with many varieties of special functions, which used in the natural sciences, and easy for theoretical modifications and numerical calculations.

The real three-parameter probability distribution of the occurrence of the geo-feature specific values was obtained as a unimodal symmetric type distribution.

The density of the distribution function

$$f(x) = \frac{f_0}{ch^2 \beta (x - x_0)} \tag{1}$$

Distribution function

$$F(x) = \frac{f_0}{\beta}\left[th\beta(x - x_0) - \frac{1}{3} th^2 \beta(x - x_0) \right] \tag{2}$$

Mode of feature is used as a parameter of consistent estimate of the mean ($\bar{x}$), the parameter β - consistent estimate of the standard deviation (σ), variability rate of geo-feature (d) is represented as a scaled parameter of position distribution. These structural parameters as a natural and the most appropriate geo-indicative characteristics really show the principles of forming probability frequency of geo-feature distribution.

Scale parameter β inputted into the structure of the model as a theoretical option in the form of a scale factor characterizes the position of compression and tension distribution circuit. The higher value of this parameter leads to the wider contour of the distribution curve will and the greater swing of distribution. In fact, this characteristic of feature scattering is the analogue of mean-standard deviation and other measures of dispersion.

There is done the estimation of geometric features of the recommended distribution curve. There are derived the formulas for calculating the coordinates of three points of inflection, there was set equality formula of the extreme point of distribution curve (x_m=x_0) with modal, equality of distances from the modal point to inflection points of distribution($z = x_0 \pm 0{,}88/\beta$), which showed the symmetry of the new distribution. For certain values of the theoretical parameter β, the basic contours of the distribution curve takes on different domed forms with kurtosis greater than zero; it indicates the inherence of the distribution function to approximation power.

The characteristic theoretical distribution function

$$f(z) = \pi\left(\frac{\Phi_0}{\beta}\right)\frac{e^{itx_0}}{ch\left(\frac{\pi t}{2\beta}\right)}, \qquad (3)$$

Distribution entropy

$$H = \frac{\pi\Phi_0}{\beta}(\ln f_0 - 2) \qquad (4)$$

Mean

$$\begin{cases} x_{cp} = x_0 + \dfrac{d_2 th\beta d_2 - d_1 th\beta d_1}{th\beta d_2 - th\beta d_1}, & (x_{min} < x < x_{max}) \\ x_{cp} = x_0, & (-\infty < x < \infty) \end{cases} \qquad (5)$$

Mode

$$\begin{cases} x_0 = \dfrac{1}{\pi}\left(\dfrac{\bar{x}}{\Phi_0}\right)\cdot\beta, & (-\infty < x < \infty) \\ x_0 = \bar{x}_{cp} - \dfrac{d_2 th\beta d_2 - d_1 th\beta d_1}{th\beta d_2 - th\beta d_1}, & (x_{min} < x < x_{max}) \end{cases} \qquad (6)$$

Modal frequency

$$f_0 = 2\beta\left(\frac{1}{\pi}\right), \qquad (-\infty < x < \infty)$$

Kurtosis (excess) E>1,0. (7)

Asymmetry $A \approx 0$ (8)

Position parameter

$$\begin{cases} \beta = f_0\left(th\beta d_2 - th\beta d_1\right) & (x_{min} < x < x_{max}) \\ \beta = \dfrac{\pi}{2} f_0 & (-\infty < x < \infty) \end{cases} \qquad (9)$$

The involvement of sufficient statistical distributions (N> 130) identifies that the parameter of scale distribution (β) depends on the mean standard deviation and amplitude of feature variation($R \geq 0{,}81$). The relationship between the distribution parameter β and the variances (σ) and amplitude variation (d_i) obtained in the form of regression equations:

$$\begin{cases} \beta = a_1 \exp(-b_1 \sigma) & (r = 0{,}70) \\ \beta = a_2 \exp(-b_2 \sigma) + \dfrac{c}{d} & (R \geq 0{,}90) \end{cases} \tag{10}$$

where a_i, b_i, c, d - statistical parameters of relation.

5. RELATION OF SPECIAL DISTRIBUTION WITH OTHER THEORETICAL DISTRIBUTIONS

Probability of relation of special distribution with other theoretical distributions is extensive. The special distribution related to the normal distribution, the distribution of Fisher, Maxwell and Pearson (VIII type), uniform and Weibull (υ = 30%), and Mises, and it expressed in terms of the Cauchy distribution, x^2, Fisher, Student, binomial, hypergeometric and Gamma - distribution. For example, the special distribution converges with the Maxwell distribution $(\beta = m/2\theta)$, Pearson VIII type $(\beta = 1/2r^2)$, and uniform distribution $(\beta = 0)$ when the parameter is β.

The special distribution represents the empirical features of symmetric types geo-features degenerated form of the normal distribution. This theoretical position stems from certain features of their relationship:

- theoretical values of the mean, mode, median are equal and the asymmetry is zero ($A_p = A_н = 0$);
- nodal point of inflection of the curves have a similar position $x_н = x_0 \pm \sigma$, $x_p = x_0 \pm 0{,}44/\beta$, and when $\beta \approx 0{,}5/\sigma$, the distance between them becomes equal and the their curves merge;
- for large values of variables and parameters $\beta \geq 1/2\sigma^2$, both distributions are expressed in terms of the standard normal ($z = \dfrac{x-a}{\sigma}$),

$f_p(x) = 2 f_0 \exp(-z^2/2)$,

$f_н(x) = 1/\sqrt{2\pi} \exp(-z^2/2)$.

The special distribution has important properties which are quite different from the properties of the normal distribution:

1) The distribution has finite limits and it is easily determined the desired medium and intermediate values of geo-features with sufficient reliability;

2) Geo-feature distributions with significant values of kurtosis $(E > 1)$ and amplitude oscillation of geo-features can be satisfactorily described by the special distribution 1.4-2.0 times more accurate than a normal distribution;

3) Distribution is a three-parameter that consists of high informative geo-indicative characteristics of geo-features distribution modified as model parameters of the distribution.

6. ANALYSIS OF RESULTS AND CONCLUSIONS

Comparative assessment of the convergence of the empirical distributions (N = 700) with normal and recommended special distributions carried out with the attraction of criteria of Pearson and of Kolmogorov (Table 1). Statistical analysis involved the empirical distribution of the contents of phosphate oxide and chromium oxide on Kempirsai chromite, iron Sokolovsko- Sarbayskii, Liksakovski and Krivorozheskii iron ore, bauxite on Krasnooktyabrsky and Turgay bauxite, phosphorus in Karatau phosphorite deposits. The complex involve empirical distribution of the contents of main components of large deposits of ferrous metals (N = 18), bauxite (N = 7), phosphate (N = 8), asbestos (N = 3), sulfur (N = 2) ores and ash coal pools (N = 4).

Additionally attracted the morphometric characteristics of the relief of varying complexity (N=8000), indicators of physical and chemical properties (N = 2025), the outputs of the quantity and quality of production (N = 1729), the marginal power ore roughness (N = 3955). Total used various geo-features (N = 124) and more than 17 million data samples, done 246 empirical distribution of 74 mineral deposits. According to their results confirmed the high convergence of symmetric distributions types of geological features with the recommended special distribution with almost 1.5 - 2 times accurate than normal and others close to him the theoretical distribution (Table 1).

Symmetric types of distribution prevail also in the empirical distribution of the mean values (N = 513), (N = 274) and the modal frequency (N = 375) by geological features. There are stablished uniform pattern forming of frequency distributions of the contents of main components, their average and model values, and the modal frequency of the spread of minerals (N = 1156); It confirmed the high convergence of the recommended distribution.

According to the results of the comparative analysis, the conclusions:

1) Structural - empirical approach with the involvement of elements of the quantity theory by modifying the invariant structure of the forming probability frequency distributions as a real empirical 'image' of the title of a special statistical distribution ensures the effectiveness and reliability of the results in the evaluation of symmetric

distributions of various types of geo-features.

2) As a result of comparative assessment of the convergence of a set of empirical distributions of various geo-features with normal and recommended special distribution with the involvement of the above natural-experimental data set:

- distribution of the components in the extracted species of ores and an array of deposits of ferrous and some non-ferrous metals, linear reserves, near-contact of ore irregularities, excavation and ore capacity indicators mining thin and vein deposits of physical and mechanical properties of rocks, output quantity and quality of product and crude production lost and diluted run ore mass, size chunks of rocks and dust particles in the destruction of the array, morphometric characteristics of the relief are described by the recommended special distribution more than 1.4-2.0 times accurate than the normal distribution;
- these empirical distribution asymmetry parameters not equal to zero $(A \neq 0)$, the kurtosis is greater than one, the mode values , the average and the median are not equal, that shows significant deviations of symmetric distributions of species geo-features from the normal distribution.

3) The special distribution exceeds the normal distribution is not only accurate assessment, and as well as superior in approximating the power and flexibility needed to ensure the real-empirical distributions of geo-features display, which is achieved by:

- use of the important analytical properties of special functions of hyperbolic cosine and geo-indicative statistical characteristics of the distribution of geo-features: mode, amplitude variation, the modal frequency which is the main informative indices of geo-feature as the modal parameters of the distribution function;
- directly determine the mean and other predicted features by their specific value against the practice of equating them to the infinite limits using theoretical distributions;

Table 1 - Results of comparative assessment of the convergence of the normal and recommended distributions with the empirical distribution of the main geo-features on various objects of geo-resources

Name of the object	Features of minerals	The number of observers	The coefficient of variation	The values of the convergence of Pearson criterion (χ^2)	
				Specaial distribution	Normal distribution
1	2	3	4	5	6
1. 1. The content of the main components					
I. Mines NGO "Dzhezkazgantsvetmet" 1). The content in mined ore,%	Zn	580	0.26	7.8	30-32
2). By mined ore deposits of "Cross-west, Pokrovka,"%	Pb	598	0.26	8.2	30
3). By mined ore deposits of Zlataust II-VI,%	P_2O_5	3100	0.27	9.6	32.1
II. Donskoy GOK chromite mines 1). By commodity production,%	Cr_2O_3	3560	0.14	5.50	10.7
2). By ferroalloy technology produced brand%	Cr_2O_3	310	0.08	5.50	11.5
	Cr_2O_3	350	0.11	6.8	11.7
3). By chemical process produced brand%	FeO	307	8.8	18.9	31.9
	SiO_2	307	6.7	17.5	30.6
4). By commodity production,%	Cr_2O_3	105	0.19	6.2	16.5
	Cr_2O_3	101	0.16	6.7	15.6
5). By commodity production. %	Cr_2O_3	202	0.17	7.0	11.8
6). The content of the					

lost ore mass % 7). Diluted mined ore mass% 8). Crude initial ore for enrichment%					
III. Karaganda polymetallic mine, %	Pb	454	0,14	10,3	14,0
IV. Sarbaisky iron ore mine%	Fe	197	0.29	6.9	12.5
V. Lisakovsk iron ore mine%	Fe	334	0.30	11.1	16.6
VI. Krasnooktyabrsky bauxite mines,%	Al_2O_3	631	0.53	9.5	12.0
VII. Dzhetygarinsky asbestos mine, %	Cn	410	0.72	9.6	13.2
VIII. Kryvbas iron ore mines %	Fe	1800	1.6	2.5	11.9
Total		14685			
1	2	3	4	5	6
2. Physical and mechanical properties					
1. Donskoy GOK chromite mines					
1). Volume weight (average density, g / cm^3) 2). Loosening factor, s.u. 3). Angle of cracks in the sample, degree 4). Tensile strength, kg /	γ $К_{раз}$ $Ф_{тр}$ $С_{проч}$	250 150 100 103	0,07 0,20 0,21 21,2	7,8 2,1 6,3 1,8	9,5 3,0 8,9 7,6

cm^2 5). Angle destroying the sample, degree 6). Density t / m^3	$a_{раз}$ $q_{пл}$	109 110	12,5 0,20	2,5 3,6	4,1 12,2
Total		825			
3. 3. The outputs of the quantity and quality of extracted ore masses					
1. The amount of extraction ($K_{кол}$) and quality ($K_{кач}$)commodity production, s.u.	$\gamma_{к.в}$	105	0,29	6,0	20,6
2. The amount of quantified outputs of technogenic waste of Don chromite mines: 1) Lost ore mass, s. u. 2) Diluted poor ore mass, s.u. *3. The amount of quantified outputs of produced ore on Don chromite ore mines, s.u.*	$\gamma_{п.м}$ $\gamma_{р.м}$ $\gamma_{д.р}$	104 130 390	0,26 0,37	6,5 8,6	18,9 10,9
Итого		729			
4. The thickness of the contour ore irregularities					
А.. Мощности рудных приконтурных неровностей, м: 1). *По Донским хромитовым рудникам* *2). По Сарбайскому*	$t_{р.н}$	210	0.26	10.5	14.4

железорудному руднику	$t_{р.н}$	150	0.28	11.0	15.9
3). По Лисаковскому железорудному руднику	$t_{р.н}$	120	0.27	10.9	14.5
4). По Краснооктябрьским бокситовым рудникам	$t_{р.н}$	125	0.17	10.2	13.1
5).По Акжальскому полиметаллическому руднику	$t_{р.н}$	100	0.39	11.2	21.0
A. The thickness of the contour ore irregularities, m: 1). By Don chrome mines 2). By Sarbaisky iron ore mine 3). By Lisakovskaya iron ore mine 4). By Krasnooktyabrsky bauxite mine 5) .By Akzhal polymetallic mine					
Total		755	Total N = 17062 data set		

- completeness of the analytical account of the main characteristics of the spread of the geo-features: mean, mode, dispersion, amplitude variation in the evaluation of the empirical distribution by use of the equations relating them to the parameters of the special position of distribution (β).

4) The results of the comparative assessment of the absence of cases of equality of kurtosis and asymmetry to zero, mode equality, the median and the average between them, thus “ideal” normal in the

geo-features distribution, as well as the importance of the transformation of asymmetric distributions often to symmetric during the processes of extraction, loosening blast loading , storage and technological averaging of minerals shows that the recommended special distribution of geo-features has both theoretical and practical importance.

5) The theoretical concept of attracting high informative geo—indicative geo-features distribution characteristics as the model parameters of the statistical distribution is recommended to use in the evaluation of problems, prognosis, and management requiring high accuracy and reliability of the real.

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