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SCIENTIFIC AND TECHNICAL AND MATHEMATICAL MODELING OF PROPERTY VALUATION

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Abstract: In this article, Uzbekistan Republic of only Section VI of the national assessment standard. Assessment approaches and according to methods (No. 6 MBS). enterprise property and main funds in evaluation comparative analysis , evaluation result values range borders as of the expressed evaluation result of uncertainty digital to the description relatively evaluator high at the level confidence with rated of property market value calculation results thoughts is considered. comments of formation natural method is this RICS in standards as shown , relevant mathematical models of limits is expressed . Also , methods of comparative approach to valuation, which can be calculated based on market data quoted .
Keywords: Foundation, benefit, property, property, oral trust, RICS standards, mean square error, transposed matrix, non-vanishing intervals .
Literature analysis . The analysis of investment valuation using artificial neural networks, financial time series forecasting and portfolio optimization, investment and its use, and investment project valuation were conducted by Samuel Björklund, Tobias Ulin, T. Kohonen, Howard B Demuth , Mark H Beale , P. Samuelson, G. Alexander, J. Bailey, Lawrence J. Gitman, Michael D. Jonk and C. R. McConnell. Also, the uncertainty interval of the market value is a relatively new concept in valuation. In this regard, L. A. Leifer "Unless otherwise specified in the valuation assignment, after the approval procedure, the appraiser, in addition to indicating the final result of the valuation in the valuation report, gives (has the right to give) his opinions on the possible interval limits of the valuation value" [1]- he emphasizes.
Methodology. During this scientific research work The matrix algebra method, pair correlation and regression analysis methods, and other methods were used.
Analysis and results. In the Republic of Uzbekistan, the valuation of fixed assets is carried out on the basis of a set of economic principles that allow determining the impact of various factors of enterprises and organizations on the value of property. When valuing property, such economic principles as the principle of the most appropriate and most effective use, utility, substitution, correspondence of demand and supply, competition, change, contribution, equilibrium, the principle of increasing and decreasing productivity, excess productivity, foresight, correspondence, dependence, allocation of property objects and property rights to them (optimal distribution of property rights) are used. Depending on the factors that have a decisive impact on the value of a property object, other things being equal, the set of economic principles used in valuing property can be classified as follows: valuation based on the market environment, valuation based on the owner's perception of the property, and valuation based on the nature of the use of the property.

[1] *Leifer L.A. Accuracy of assessment results and limits of appraiser's liability // Property relations in the Russian Federation. 2009. – No. 4 (91).*

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It is worth noting that the enterprise's property and fixed assets are valued based on Section VI of the Unified National Valuation Standard of the Republic of Uzbekistan. Valuation Approaches and Methods (IAS No. 6). The assessment uses comparative, income and expenditure approaches. Considering that this introduces some uncertainties, the research aims to review and improve this area with a new methodology.

In this sense, the valuation of fixed assets, depending on the method of its use and (or) the procedure for its normal sale on the market, is such that some enterprise objects acquire optimal profitability when used separately from the components of these fixed assets. Other property objects achieve optimal profitability when used as part of a certain group of property objects. Accordingly, it is necessary to distinguish between the profitability of property as a separate object and its profitability as part of a group of property objects. The appraiser must value the property in the form in which it appears on the market: as a separate object of property; as part of a group of property objects. If the value of the property being valued as part of a group of property objects differs from the value of the same property object as a separate property, such value must be included in the valuation conclusion.

In foreign measurement practice, the concept of measurement uncertainty was formed much earlier, as in modern metrology, and the need to standardize uncertainty arose due to the need to measure not directly observed quantities, but "indirectly" quantities. In such cases, it is possible to reasonably attribute uncertain parameters related to the measurement result and characterizing the distribution of values to the measured quantity. Measurement uncertainty is a non-negative parameter characterizing the distribution of the values of the quantity corresponding to the measured quantity, based on the data used. In this assessment, very similar situations can be cited that are carried out using the methods of the comparative approach:

- valuation uncertainty – this represents the possibility that the estimated value will differ from the price that would be obtained as a result of the transfer of the asset or liability being valued under similar conditions and in the same market at the measurement date;
- confidence interval - a numerical description of the uncertainty of the valuation result, expressed as the boundaries of the range of values of the valuation result, with which the appraiser can state with a high degree of confidence that the market value of the assessed property is within this range.

$$\text{ҚБ}_{min} \quad \text{ҚБ}_{max} \ \pm$$
$$\text{БҚБ} \quad \Delta$$
$$\text{БҚБ} \quad \pm\ \delta\ \%,$$

here BQB – market value price ,

$\pm\Delta = \text{ҚБ}_{max} - \text{БҚБ} = \text{БҚБ} - \text{ҚБ}_{min}$ - uncertainty half-interval ,

$\pm\delta\% = (\text{ҚБ}_{max} - \text{БҚБ}) / \text{БҚБ} = (\text{БҚБ} - \text{ҚБ}_{min}) / \text{БҚБ}$ – half interval of relative uncertainty.

If the cost is expressed in a specific figure in the report (or expert opinion), why is it necessary to indicate the uncertainty range of the calculation or estimate? Because if you do not draw the client's attention to the important factor of uncertainty, this may give him the impression that the

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conclusions drawn from the assessment are more important than they were intended, that is, the assessment report will mislead the client, which will lead to a violation of requirements.
The practice of disputes related to the use of valuation results in Russia shows that many participants in economic and legal relations, like judges, accept the appraiser's opinion about the "impressed" value as the exact value of the value. This is facilitated, among other things, by the expression "final cost value" in the relevant laws and standards. Such disputes, inconsistencies in units and even percentages in alternative calculations, do not reduce transaction costs in market operations, but rather increase them.
In order to recognize the reliability of two alternative valuations of the same object carried out by different expert appraisers, it is not necessary that the results of the indicated valuations coincide. In the absence of clear signs of the unreliability of each estimate, both estimates should be recognized as equal if their uncertainty intervals intersect at least at one point:

$ҚБ_{2min}$	$ҚБ_{2max} =$	$ҚБ_{1min}$	$ҚБ_{1max}$
$БҚБ_2$		$БҚБ_1$	
$БҚБ_2$	$\pm \Delta 2$	$БҚБ_1$	$\pm \Delta 1$
$БҚБ_2$	$\pm \delta 2$	$БҚБ_1$	$\pm \delta 1$

The logic is that each of the experts who presented the final result with the Uncertainty Interval actually managed to estimate the market value of the object as the middle of the interval and its limits were based on $\pm\Delta$, but could not say anything else, except that the cost could be at any point in this interval. But if the value can be at any point in each interval, then it can also be at a point common to the intervals being compared. That is, both experts, while expressing different opinions about the value, speak of the same value. It is possible to compare such estimates and say that one is greater than the other, and the other is less, but this is not possible. Because both of them are reliable and therefore have equal rights. Which of these estimates the customer accepts as the market value is his choice, his decision, his risk.
In this case, only if the uncertainty intervals characteristic of alternative estimates do not have common points, that is, they do not intersect, can we speak of different values of the value determined in the compared reports. Then it is natural that the question arises about the reasons for such a significant difference, including the unreliability of one (or even both) assumptions. The answer to this question can only be given by a professional analysis of the valuation reports.
Within the framework of the comparative approach, the appraiser's judgment about the possible boundaries of the value range is guided not by the value of objects on the market, but by their prices, the value is determined by the expert according to the valuation method he has chosen. by calculating using appropriate algorithms The natural way to make such judgements is to mathematically calculate the relevant limits, as set out in the RICS standards. Where a mathematical calculation of valuation uncertainty is used in the report, it should be accompanied by an appropriate description of the method or model used and any limitations .
However, not all methods currently used by experts have the ability to mathematically calculate uncertainty (which implies the processing of market data). In cases where calculation based on available market data is impossible or extremely difficult, an alternative to such calculation is to conduct appropriate expert surveys. Comparative approaches to valuation, which can calculate

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the boundaries of the uncertainty range based on market data, can be considered .

1. Sales comparison method (homogeneous, i.e., similar objects). The simplest version of the sales comparison method is the average value model, which is used, for example, in the valuation of non-real estate, when prices for similar (homogeneous) objects are presented on the market and no adjustments are made for differences in properties. In this case, the market value is understood as the arithmetic average of all possible prices for the same asset in the market under consideration. However, the expert, as a rule, does not have the opportunity to observe all possible prices and he can only observe the available options.

The average price for the sample obtained by him is not the market price, but only its value. A remarkable feature of the average estimate for such selected prices is that the distribution of its values \u200b\u200bis well approximated to normal patterns and practically does not depend on the type of distribution of the initial prices themselves. This means that in estimating the market value of the considered object $V_{0 \text{ with high confidence,}}$ one can use the well-known relations associated with the normal distribution:

$$\bar{P}_{samp} - t_{\alpha,n-1}\frac{s}{\sqrt{n}} \le V_0 \le \bar{P}_{samp} + t_{\alpha,n-1}\frac{s}{\sqrt{n}} \qquad (2.3.1)$$

here $\bar{P}_{samp}$ - the average price of the sample;

n - the number of elements in the sample;

$t_{\alpha,n-1}$ – Student's t-quantile distribution with *n-1 degrees of freedom* and α degree (*1-α – confidence interval);*

$s=\sqrt{\frac{\sum_{i=1}^{n}(P_i-P_{samp})^2}{n-1}}$ – selected root mean square deviation (RMS).

In expression (2.3.1), the number of sales of this product in the market N is assumed to be infinitely large and is taken to be at least as large as the number of prices in the processed sample. In real markets, the supply of the same product by a limited number of sellers is often far from reality. In such cases, other things being equal (same sample size, standard deviation and confidence interval), the uncertainty of the estimate is significantly reduced - the cost and the limits of the estimated range, taking into account the selection ratio, are reduced by the ratio of the sample size to the total population size n/N :

$$\bar{P}_{samp} - t_{\alpha,n-1}\frac{s}{\sqrt{n}}\sqrt{1-\frac{n}{N}} \le V_0 \le \bar{P}_{samp} + t_{\alpha,n-1}\frac{s}{\sqrt{n}}\sqrt{1-\frac{n}{N}} \qquad (2.3.2)$$

Thus, processing half of the market supply volume ($n/N = 0.5$) reduces the uncertainty of the estimate by 30% compared to the “classical” relation (2.3.1). Strictly speaking, we need not supply, but the number of sales and prices, but given the pace of digitalization of this economy, the difference in expected results is not so large. At the same time, taking into account the share of choice in real markets, we can use expression (2.3.1) as an upper estimate for the uncertainty interval. That is, the market value falls with high confidence into the interval calculated by relation (2.3.1).

that the range of the underlying asset value includes all prices $P_{i \text{ in the observed sample}}$ and may be wider if the sample does not include extreme (minimum and maximum) prices in the market, that is, when the price is set against the price of a certain or proposed transaction.

Based on the results of the research, it is possible to propose the 2.3.2 regression analysis method:

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2.1. In a simple version of the method, pairwise regression $\tilde{y}=a_0+a_1 f(z) \rightarrow \tilde{y}=b_0+b_1 x$ uncertainty interval (confidence interval) of the estimated object V_0 is given by the following expression for the value:

$$\tilde{P}_0-t_{\alpha,n-2}s\sqrt{\frac{1}{n}+\frac{(x_0-\bar{x})^2}{\sum_i (x_i-\bar{x})^2}}\le V_0\le\tilde{P}_0+t_{\alpha,n-2}s\sqrt{\frac{1}{n}+\frac{(x_0-\bar{x})^2}{\sum_i (x_i-\bar{x})^2}} \qquad (2.3.3)$$

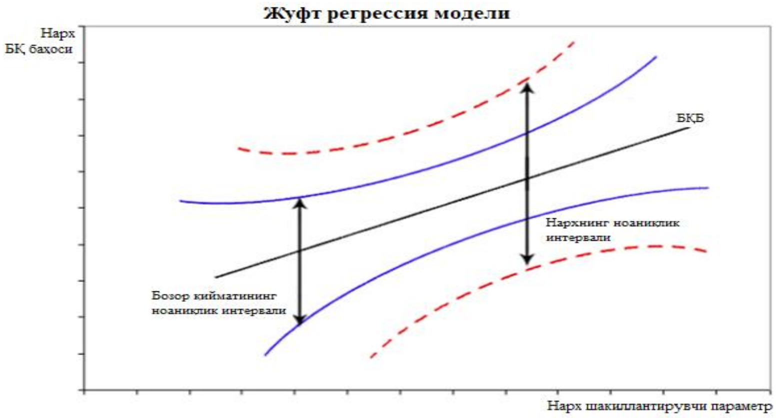
here $\tilde{P}_0$ - model value of object price (average price) ,

$s=\sqrt{\frac{\sum_{i=1}^{n}(P_i-\tilde{P}_i)^2}{n-2}}$ – standard deviation (SD) of the model residual, where P_i ,$\tilde{P}_i$ – the average model estimate and the observed price of the *i -th analog price,*

n – the sample size of the regression model,

x_0 – the value of the influencing factor for the object being evaluated,

$\bar{x}$ – the average value of the influencing factor for the selection of analogues. Here, as with similar assets, the confidence interval for the possible values of the object price is wider than *the value* interval.



2.3. 1 -Fig. Uncertainty intervals for value and price in a two-factor regression model

2.2. In general, V_0 Constructing a multivariate regression model of the continuous variable uncertainty interval for the value is calculated using the following relations using matrix operations

$$\tilde{P}_0-t_{\alpha,n-k-1}s\sqrt{x_0^T(X^TX)^{-1}x_0}\le V_0\le\tilde{P}_0+t_{\alpha,n-k-1}s\sqrt{x_0^T(X^TX)^{-1}x_0} \qquad (2.3.4)$$

where $\tilde{P}_0$ is the model indicator of object value estimation (price average),

$s=\sqrt{\frac{\sum_{i=1}^{n}(P_i-\tilde{P}_i)^2}{n-k-1}}$ – the mean square deviation (MSD) of the model residuals, where *k* is the number of influencing factors included in the model ,

x_0 – column vector of values of factors influencing the object being evaluated, filled with one from above,

x_0^T – row vector of factors of the object being evaluated, transposed to the vector x_0,

X – regression matrix of the values of the influencing factors of the objects of analogues in the

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sample, filled with a unit column on the left,
XT is the matrix transposed to the *X* matrix,
$X^T X$ – vector multiplication of matrices,
$(X^T X)^{-1}$ is the inverse matrix of the vector product matrix.
V_0 obtained using a regression model can be expressed as the following steps:

1. A regression matrix X, filled with a unit column on the left, is formed by the columns of the values of the influencing factors of similar objects.
2. The matrix *X is transposed to the matrix XT* .
3. *The XTC* is a matrix multiplication, the matrix has dimension (k+1)*(k+1).
4. *(XTX)-1* is the inverse matrix.
5. from the influencing factors for the object being evaluated, filled with unity from the left X_0^T.
6. X_0^TBy transposing, X_0 is a vector.
7. X_0^T*(XTX)-1* is a multiplication matrix, the matrix has dimension 1*(k+1).
8. X_0^T*(XTX)-1* X_0 is a multiplication matrix with dimension 1.
9. We take the square root of the result in the seventh step.
10. The degree of freedom *is nk-1* number and degree $_a t\ a\ _{,\ nk-1}$ The value of student statistics is determined.
11. The half-width of the uncertainty interval and the residual value of the model *s* are determined by multiplying the results of steps 8 and 9.

It should be noted that the above-calculated ratios for intervals in regression models are obtained under the assumption of a normal distribution of the residuals of the regression model. This assumption is usually well supported in mass valuation models, which use hundreds of market data for their construction. However, in individual valuations, the number of objects processed is smaller, and it is not possible to be completely sure of the correctness of such an assumption. Since with a small number of analogues, the known statistical tests for the normality of the distribution cannot give a reliable assessment. However, the applicability of the expression for calculating the interval based on the hypothesis of a normal distribution can be checked in another way, through simulation.
s_v within the sales comparison method can be calculated using the following formula:

$$s_v=\sqrt{s_m^2+s_k^2+s_r^2}, \quad (2.3.5)$$

here is s_m – OCR error associated with the dispersion of adjusted prices of analogues;
s_k – OCO error associated with incorrect adjustments to pricing factors;
s_r – OCO error related to incorrect adjustments for trade.
The uncertainty components s_k and s_r associated with the inaccuracy of knowledge about the corrections, as noted, cannot be measured and can be approximately determined on the basis of processing the collected expert opinions, observing the appropriate rules for their collection and processing. If such data are available, the uncertainty interval is calculated by formula (2.3.1) by replacing s_{with} *s* v accordingly.
As a further method of valuation of fixed assets, we can cite 4. The modified selection method. In the modified selection method, the value of one real estate object per unit area of the land plot

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- V_{eo}/S_{zu} *is linearly related to the* area of the land plot S_{zu} by the equation:

$$V_{eo}/S_{zu} = v_{zu} + v_{oks} k_{pz}, \qquad (2.3.6)$$

where $k_{pz} = S_{oks}/S_{zu}$ - coefficient of building density on the land area;
When switching to the traditional definition of dependent and influencing variables, $\tilde{y} = V_{eo}/S_{zu}$ and $x = k_{pz}$, v_{zu} What is the meaning of " b_0 *deb* "? By denoting b $_1$, we obtain the traditional pair *regression equation* $\tilde{y} = b_0 + b_1 x$.
Regression analysis involves determining the relationship between the influencing and affected variables, other things being equal, without the influence of all other factors. This requirement is satisfied only by analogues that differ in building density, and within these differences in density, the unit prices v_{zu} and v_{ox} can be considered constant. If it is possible to find a sufficient number of such analogues in the market, ignoring the effect of other differences, the uncertainty interval of the price estimates can be accurately determined by relation (2.3.3).
Conclusions and suggestions. In conclusion, today only two groups of cost estimation methods within the comparative approach can calculate uncertainty intervals based on processed market data. Among these methods, the simplest case of homogeneous object estimation (average price model), as well as variants of the regression analysis method - through pairwise and multivariate regression equations. Calculating the uncertainty range of the results of other methods requires the involvement of expert judgments of certain necessary components of such calculation.
Also, the details of calculating the uncertainty of the valuation result obtained in the Matrix Algebra method prove that the dispersion characteristics of prices cannot be measured for just one real estate object and can only be determined by an expert.
The last method recommended for the valuation of fixed assets is the matrix algebra method, which is rarely used in valuation practice, and is a multidimensional generalization of the “paired sales” method, since it does not assume the presence of a random component in the prices of objects presented on the market. This method is recommended for use when the pricing characteristics of similar objects have very small deviations from the corresponding characteristics of the object being valued. Therefore, the valuation result obtained by this method is considered accurate.

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