

A Method of Statistical Evaluation of Handwriting Characteristics Developed in Russia

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Document experts providing the examination of handwriting evaluate the individual characteristics according to their own experience. Deciding which characteristics are more significant presents difficulty to the examiners with limited experience.

A methodology developed in Russia is intended to assist document examiners in the stage of evaluation of similarities and differences in the handwriting. It employs tables of statistical frequency of individual characteristics derived from examination of representative handwriting samples in Russian. Although this method of evaluation of individual characteristics in the handwriting cannot substitute for personal experience of the document examiner, the values assigned to characteristics based on statistical probability of their occurrence help the examiner to evaluate significance of these characteristics. Moreover, it helps to visually illustrate the process of identification and justify the conclusion in courts.

This article describes a methodology involving the statistical evaluation of handwriting characteristics that is currently employed by some Russian document examiners to assist in handwriting examinations.

Document examiners in different professional environments employ various terminology regarding elements of handwriting. To avoid ambiguity, key terms used in this article are defined as follows:

- *Writing Quality* is a general assessment of writing skill, as characterized by the relative degree of fluency, stability/uniformity, smoothness, and maturity of the writing.
- *Characteristics* are graphic features of handwriting (in text and signatures) that characterize writing movements. Characteristics are defined here as general characteristics and specific characteristics.
 - *General Characteristics* are graphic features that apply to a body of handwriting as a whole.
 - *Specific Characteristics* are graphic features that reflect movement traits in

executing particular characters (letters or numerals), their parts and connecting strokes (ligatures) between letters or numerals.

Specific characteristics are subdivided into 8 categories. For instance, the 2nd category involves the shape of a character or its part; the 4th category deals with proportions of the elements of a character; and the 7th category captures the sequence of movements involved in executing the letter or numeral. Each of the specific characteristics may have innumerable manifestations. For example, the shape of a letter, or its elements, could be angular, curved, in the form of a loop, etc. Manifestations of the similar specific characteristics may be found in the handwriting of different people, but the combination of characteristics is different for each writer. In the ACE-V (Analysis, Comparison, Evaluation and Verification) methodology, evaluation of characteristics is considered to be the most important phase of document examination.

While performing an examination of handwriting, document experts base evaluation of the

specific characteristics on their own training and experience. More experienced examiners can usually determine the significance of the characteristics more accurately. Deciding which characteristics are more significant presents greater difficulty to examiners with limited experience. Whether an examiner is new or more experienced, all express a subjective opinion as to the significance of the characteristics.

In order to achieve better objectivity in the examination of handwriting, document examiners may apply scientific methods based not only on the knowledge of human physiology and anatomy, but also on methods based on statistical analysis. Such methods will make the evaluation more objective and be helpful to the less experienced experts.

This method of evaluation of specific characteristics of handwriting is not intended to replace the personal experience of a document examiner but to be used as a tool in conjunction with the document examiner's judgment. The values assigned to characteristics, based on statistical probability of their occurrence, help the examiner to evaluate the significance of these characteristics. Furthermore, it helps to visually illustrate the process of identification and justify the conclusion in courts.

Experts at research institutes at the Russian Ministry of Internal Affairs and Ministry of Justice developed a methodology of statistical evaluation of handwriting characteristics based on examination of representative handwriting samples in Russian. Writers of the samples varied as to gender, age, level of education, and native language. All handwriting instruction in Russia is uniform throughout the country and has not changed for decades. Russia does not have a large immigrant population. Although the users of the tables were not provided specific information as to how the creators assured that the sample was representative, circumstances indicate that it was. In order to validate the methodology, conclusions

obtained using it were verified and confirmed by traditional methods.

This methodology has been applied to develop 2 branches of analysis, 1 focusing on evaluation of uppercase letters and the other on lowercase letters and numerals. These 2 branches could be applied independently as well as in combination with each other.

Application of the Methodology

The methodology employs tables of statistical frequency of specific characteristics and their significance. Numerical significance values assigned to the characteristics were derived from statistical frequency of their occurrence using probability methods. In order to evaluate the overall significance of selected characteristics, the frequencies of specific characteristics should be multiplied. To simplify the process of application of the methodology, the significance value of each characteristic was introduced as a logarithm of frequency of the characteristic. As a result, the overall significance of a combination of characteristics is the sum (rather than product) of their logarithmic significance values.

Depending on the particular branch of the methodology, the tables may include some of the following columns:

- A picture (sketch) of a letter or numeral, indicating a specific characteristic
- Detailed description of the sketched characteristic to avoid mistakes in choosing characteristics
- Frequency of occurrence of the characteristic in the handwriting of different people
- Significance value of the characteristic, which is not always a single datum. Values may vary depending on the number of similarities chosen for the identification
- Reference to interdependent characteristics of other letters with similar writing

# (ID)	Letter, numeral	Description of the manifestation of the characteristic	Frequency of occurrence	Significance value
23	g	Angular shape of the lower part of the loop	0.15	0.51

This example is not copied from any real table used by document examiners. It was made up to help visualize the structure of such tables.

movements, such as in shape or direction. An example of such interdependency of characteristics could be in letters "y/g;" "m/n;" "h/b," etc.

Angular shape of the lower part of the loop in "y" and "g" might be an example of interdependency of characteristics. If the loops of these letters show the same writing movement, such as from top down and clockwise, they cannot be considered as completely independent variables.

Another example of interdependency of characteristics is the commencement of the letters "m" and "n" on a base line, since these letters usually have the same writing movements in their execution.

There are innumerable variations possible in each category. It would not be possible to illustrate all of them. The user selects the best match from those offered. Descriptions guide the user's attention to the feature that is being illustrated. The example above is an illustration of the columns that might be included in the tables.

Having determined what specific characteristics are similar in the questioned document and in known samples, the examiner finds the significance values of the corresponding characteristics in the tables. The number of specific characteristics needed for a positive conclusion depends on their values. More significant characteristics may be conclusive in smaller numbers. After checking the values of the specific characteristics in the tables for lowercase or uppercase letters (or both), the examiner calculates the total sum by adding these values. The scale had been chosen in such a way that if the sum of the significance values is 10 or more, the examiner can make a positive conclusion, "Writer A wrote the questioned text," provided that the examined handwriting meets the following requirements.

Applicability of the Methodology

- The writing quality of an examined handwriting should be sufficiently high (fluent, stable, smooth). The described methodology cannot be applied in examination of disguised or distorted handwriting.
- The interdependence of certain characters must be taken into account.
- Positive identification can only be made in the absence of significant disparities between the questioned and known writings.

Since no table representing the significance of specific characteristics can include all possible

manifestations of the characteristics (as they are innumerable), the personal experience of a document examiner remains the critical factor in the evaluation of handwriting characteristics. The method of statistical evaluation of handwriting characteristics performs a supplemental role in the evaluation of characteristics and reaching the final conclusion.

Use of this methodology with traditional methods of handwriting examination has been shown to increase the confidence of document examiners in their decisions.

The method of statistical evaluation of specific handwriting characteristics makes the examination more objective and helps to support the conclusion. This method is also an effective way for beginning examiners to learn the relative frequency of occurrence of characteristics and to evaluate their significance.

The creation of the table for this methodology took great effort. Its use by document examiners is not required. It is unknown how many examiners use it and how many do not. In either case, final conclusions are left to the judgment of the expert.

References

- Bogachkina, G.F.; Vul, S.M.; Orlova, V.F.; Prosolova E.M.; et al. *Application of Methods Based on Probabilistic Modeling to Questioned Document Examination*. Moscow: 1976.
- Kolesova, E.Y.; Levitskiy, A.B.; Molokov E.P.; Seregin V.V.; et al. *A Methodology of Statistical Evaluation of Specific Characteristics in Handwriting of Uppercase Letters of Russian Alphabet*. Moscow: 1996.
- Moiseev, A.P.; Murashova, O.S.; and Yurkov, I.S. *Tables of Handwriting Characteristics*. Moscow: 1984.