



B40 Choosing a Statistical Method for the Data Assessment of the Compositional Analysis of Bullet Lead

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The goal of this presentation is to provide a description of five statistical approaches to trace element concentration data is provided. These methods were compared for 93 randomly selected cases. Results will describe how each approach grouped the case data and explain which approach was ultimately selected for use in current casework.

This presentation will impact the forensic community and/or humanity by serving the forensic community through the discussion of several statistical approaches that one may utilize in determining acceptable match criteria for quantitative analysis of man-made products.

The FBI Laboratory is one of the few forensic laboratories that perform quantitative trace element analyses on a routine basis for a wide variety of specimens, including glass, steel, and bullet lead evidence. The bullet lead protocol was specifically developed by the FBI Laboratory over 35 years ago to assist local and federal law enforcement agencies with shooting investigations where a firearm is not recovered or the fired bullets are badly damaged. The protocol, including the association criteria used to determine if two or more specimens are *analytically indistinguishable*, has evolved over the course of this examination's history. As the 21st century progresses, the FBI Laboratory has revised its analytical protocol for comparative bullet lead analysis. Part of this revision involved a review of the statistical approach used to determine associations.

To that end, this poster will present work that has recently been completed through the collaborative efforts of the FBI Laboratory Division's Chemistry Unit and the analytical research group of the Counterterrorism and Forensic Science Research Unit. Five statistical approaches were applied to the quantitative results collected for 93 randomly selected comparative bullet lead cases that have been submitted to the FBI Laboratory over the last decade. The purpose of this study was to determine if any of the results reported out to contributors using the established criterion would have been affected if a different statistical approach had been used.

The bullet lead protocol for the past decade has employed an association criterion that requires the measured precision of the specimens being compared to overlap within the range of 20. Therefore, in order for two specimens to be considered *analytically indistinguishable*, an overall range of 40 was applied to the concentration results. The five methods compared in this study were: range overlap, 20, the student t test, the successive t test, and Hotelling's T² test. The first three methods utilized measured precisions associated with the specific case results as a basis for establishing match criteria. The latter two statistical assessments required the use of pooled historical data in order to calculate precision measurements for the necessary equations. Any assumptions that were made in order to perform the testing on the pooled results will be described.

Results will be presented for the five tested analytical approaches as well as the conclusions issued in the corresponding reports. Ultimately, there were no cases in which a Q/K association was reported in the absence of corroborating associations from at least one of the tested methods. The method chosen for the revised protocol will be described and the rationale for its use will be addressed.

Statistical Analysis, Bullet Lead Analysis, Comparative Examinations