A25 Comparative Study of Shotgun Spread Patterns

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After attending this presentation, attendees will learn how to interpert statistical data, a shotgun spread pattern, and how the muzzle-to-target distance can be determined.

This presentation will impact the forensic science community by allowing examiners to refer to a statistical model to approximate the muzzle-to-target distance at a crime scene instead of performing test fires for each shotgun found at a crime scene.

When a shotgun is fired, the pellets exit the barrel in a tight packet. As the pellets get farther from the shotgun, they start to spread out and cover a larger area when they impact. The farther the target is from the shotgun, the wider the spread pattern becomes. Given that the same gauge, choke, and shot size is used, one should be able to predict the spread of the pellets over time. In 1983, Heaney and Rowe used a linear regression to model pellet dispersion from shotguns.[1] In their research; however, only one spread pattern at each distance was presented. This does not account for any variation in the spread pattern that could occur at that distance. In order to produce an accurate statistical model that accounts for variation, a larger sample size must be used. This research also only covered one degree of choke and pellet size. Arslan *et al*, completed a similar study in 2011.[2] A larger sample size at each distance was used in this study, which allows their statistical models to be more accurate. In this research, the effect of various gauges, choke types, and pellet sizes were also studied. The Arslan group concluded that each factor results in a new model to estimate shooting distances.

In this research, the effect of choke and pellet size was studied using a 500 series shotgun. Measures of dispersion such as maximum radius, a 95% confidence interval of the maximum radius, bounded rectangle, and fitted ellipse were used to measure the dispersion patterns. The position of each pellet in a spread pattern was calculated using the x and y coordinates of each pellet with the origin set in the center of the spread pattern. The 95% confidence interval at each distance was calculated by taking the average maximum radius plus/minus the standard deviation of the maximum radius multiplied by a t-value for that sample size. The bounded rectangle was calculated for each spread pattern by taking the maximum x value minus the minimum x value and the maximum y value minus the minimum y value. The x and y coordinates of each spread pattern were also used to calculate the width and height, a and b, of a fitted ellipse that represents the smallest ellipse that covers all of the pellets in the spread. Models were developed to estimate the firing distance and to associate an uncertainty in each particular test condition.

In the past when shotgun spread patterns were found at a crime scene, examiners would have to perform test fires with the suspect weapon to find the spread patterns of that gun at various distances. These test spread patterns would then be compared to the pattern found at the crime scene so the distance could be approximated. This research would instead allow examiners to refer to a known spread pattern at a given distance, pellet size, and gauge. The 95% confidence interval will allow examiners to say that they are 95% certain that the suspect spread pattern falls within the range presented in the model at that distance. Although the examiner may wish to confirm that these distances are correct with the suspect shotgun, this would allow the examiner to have a starting point, and save time when reconstructing the crime scene.

References:

1. Heaney, K. D., and W. F. Rowe. “The Application of Linear Regression to Range-of-Fire Estimates Based on the Spread of Shotgun Pellet Patterns.” *Journal of Forensic Sciences* 28.2 (1983): 433-36.
2. M. Mustafa Arslan, *et. al*. “Firing Distance Estimates with Pellet Dispersion from Shotgun with Various Chokes: An Experimental, Comparative Study.” Journal of Forensic Sciences 56.4 (2011): 988-92.

Distance, Spread Pattern, Mossberg 500

 ** Presenting Author*