Accuracy and Precision for Long Range Shooting

A practical guide to successful long range shooting

By Bryan Litz

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Introduction

Accuracy and Precision for Long Range Shooting is a book for riflemen who want to understand the important elements of their craft. All too often, ambitious shooters strive to hit smaller targets at greater distances, without a clear understanding of what's *really* required for success. Determination can take you far, but with truly *informed* determination, you can approach challenges in a more systematic way and achieve far greater success while suffering from less of the pitfalls.

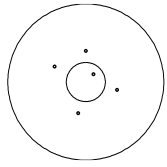
Even the basic distinction between *accuracy* and *precision* is not well understood by many long range shooters. Of course it's common knowledge that small groups are good (this is precision) and a good zero and trajectory prediction are important (accuracy). But beyond this basic guidance, little is known or discussed about the relative importance of the various elements from a quantitative point of view.

Critical thinking 101: ***In order to get better at hitting targets, we must understand what causes us to miss targets***. Identifying the reasons for missing is the hard part. Once you know the specific cause of missing targets, you can apply focused effort to improve that weakness, and you'll get more hits. The logic is good, but the problem is that you can't always figure out what's causing your misses. That's where this book comes in. ***The intent of this book is to explore the uncertainties and inaccuracies of real world shooting so rifleman can make well informed decisions about how to improve their hit percentage.*** In order to do that, this book addresses the elements of precision and accuracy separately.

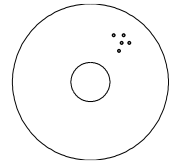
The first part of this book examines precision. Precision is commonly expressed as *group size* by shooters. It's clear that if you want to hit small targets at long range, your rifle, ammo, and yourself as a shooter have to be capable of firing shots into a small group.

Once you achieve small groups, all you have to do is *center* the group on your point of aim at long range, and you have a good

chance of hitting the target. *Centering* the group or shot is a challenge of *accuracy*, which is addressed in Part Two of the book.



Accurate but not precise



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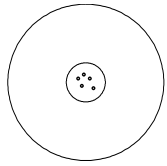
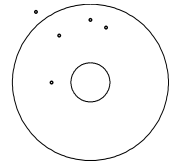


Accurate and precise



Neither accurate nor precise

Examples of accuracy and precision.

It's important to clearly define and treat precision and accuracy as their own separate topics, because they are just that. You need a sufficient combination of accuracy and precision to hit a target in any given scenario. If a shooter worked to make himself and his equipment capable of 1/4 MOA groups (high precision), then missed a 20" target at 1000 yards (which is nearly 2 MOA), he would be ill-advised to keep working on precision. 1/4 MOA precision is more than adequate to hit a 2 MOA target. Missing such a large target is an obvious failure of *accuracy*, not *precision*. Understanding this, the shooter should work to identify *what aspects* of accuracy are poor enough to cause the miss, and address them.

Beyond the basic concepts, the chapters in this book isolate and focus on specific elements of accuracy and precision one at a time so the reader can understand the effects of each variable. The trends will be familiar to most long range shooters, but the specific results will probably surprise many readers. For example; the effect of muzzle velocity on hit percentage. Everyone *knows* that higher muzzle velocity promotes better ballistic performance and increases hit percentage, but how much? Is it *really* worth stressing your equipment for another 20 or 50 fps extra velocity? How much does that *really* affect your hit percentage on different sized targets? Understanding the actual numbers involved leads to more informed decisions about one's equipment and training.

The method used to calculate hit percentage against various targets is known as Weapon Employment Zone (WEZ) analysis. WEZ analysis relies heavily on computer simulation supported by real world results. The long list of variables affecting accuracy and precision could never be fully isolated in live fire tests. The computer simulation environment allows the variables to be considered in isolation, as well as provides large statistical samples which would be cost prohibitive in a live-fire evaluation. The WEZ

methodology used to assess ballistic performance is described in Chapter 1 and used throughout the book. All of the elements of ballistics that were published in *Applied Ballistics for Long Range Shooting* are applied to produce the most accurate and complete ballistic model possible. Modeling hit percentage requires the simulation to fire many shots with defined uncertainties. The resulting trajectory variations produce a hit percentage on a given size target. The flexibility of the simulation approach enables many different kinds of analysis from comparing rifle/ammo combinations in a constant environment, to studying how various environments affect hit percentage for a specific rifle/ammo combination.

After *Precision* and *Accuracy* are covered in Parts 1 & 2, some example analyses are included in Part 3. These are actual ballistic assessments that were written for real world projects.

As the author, I've tried hard to write a book that's both effective and easy to read. ***Ultimately, my highest goal is to help improve your success and enjoyment of long range shooting through a better understanding of the underlying science***.

Enjoy