

CONVERTING RIFLE TRAJECTORY TABLES:

You don't need a computer or a degree in physics to compute your own tables. Learn how here.

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Think of how many times you've examined a cartridge manufacturer's tables and found the trajectories calculated only for, say, a 100-yard zero, but because you intend to hunt out West, all this data is irrelevant - your hunting needs demand trajectory information for a 200-yard zero. What can you do?



Despite the existence of computer programs that calculate such trajectories, (which I'm not at all opposed to), there's an easy way to convert trajectory which, when it suddenly occurred to me earlier this year, almost caused me to run naked through the streets shouting, "Eureka!- Instead I quietly sat down and wrote it up, then tested it against published tables and found, indeed this new technique was accurate to within one-quarter of a Minute of Angle - which is one click of elevation on quality rifle scopes so it fits the needs of even the most discerning shooters.

The beauty of this technique is that it at last gives all my fellow rifle shooters the means to calculate trajectory changes without the need for a computer or special software programs - and certainly this data will help them be more precise shooters and better hunters.

The key is understanding MOA. If you can grasp what a Minute of Angle is, you will master this technique before the end of this article.

We describe shot groups in Minutes of Angle because this thin angular width almost exactly equals one inch at 100 yards, then widens so nicely that it becomes two inches at 200 yards, three inches at 300, and so on, resulting in a ten-inch width at 1000 yards. When you say your rifle is shooting a one-inch group at 100 yards, you could just as well say it's a one Minute of Angle (MOA) rifle, and by expressing it this way you would see instantly that this same group would be two inches at 200 yards, four inches at 400, etc.

And what about when your rifle generates a two-inch group at 100 yards? Simple, the ratios are all the same. You are just starting with a wider group. This two-inch rifle would, therefore, yield a four-inch group at 200 yards (twice as wide, get it?); then a ten-inch group at 500 yards since that is five times the distance as your 100-yard, two-inch group.

By expressing your groups in Minutes of Angle, you'll enable yourself to understand how your rifle will perform at any distance. And with study, it will allow very precise adjustments of sights or scope.

So that this relationship between distance and MOAs is clear, I am plotting it on **Table One**. If later you get confused, come back and check it. And now we are ready for the simple technique for converting trajectories.

How to convert a trajectory without a computer. The difficulty with converting a bullet's trajectory is that when you switch from one zero distance to another - say, from 100 yards up to 200 yards - the trajectory changes are a little different at each distance. Because a bullet starts flat and straight, then it slows and plunges, your trajectory will shift modestly at short-range but dramatically at long-range whenever you change your scope or sight setting. You cannot conclude, "I am now going to shift four inches high, so there will be a four-inch change at all other ranges." - No way. This raising of sights will cause little changes at close ranges, and great big changes at longer distances; at each 100-yard increment, the effect will be different.

The key is predicting HOW MUCH it will change and - get ready to shout "Eureka!" - how much it changes is pure and simple, an IDENTICAL AMOUNT AT EACH DISTANCE, when expressed as a Minute of Angle.

My technique uses a simple, two-step process. **STEP ONE:** Learn how much change is needed for the new zero, and restate it as Minutes of Angle for that distance; then, **STEP TWO:** Apply these same Minutes of Angle changes at each distance, for a completely new trajectory table. That's all.

We'll demonstrate this for the Federal Supreme 30.06, 165 grain, Boattail Soft Point, using "book" data from Art Blatt's Extended Ballistics for the Advanced Rifleman. (Of course, you can use manufacturer's ballistic tables, too.)

Look at the chart we've labeled, "**STEP ONE.**" Just to make sure that you keep the MOA measurements correct at each distance, I suggest that you "write this" above the respective yard ranges.

TABLE ONE

Relationship Between One MOA and Distances

Distance	100 yds	200 yds	300 yds	400 yds	500 yds
1 MOA Equals	1"	2"	3"	4"	5"

Step One: Learn how much MOA to convert by noting you will have to raise sights 5.4 inches to zero at 200 yards. Since one MOA equals 2" at 200 yards, that 5.4 inches at 200 yards equals 2.7 MOA - which is exactly what we will apply in Step Two to all other distances.

Now, since we're converting from a 100 -yard zero trajectory to a 200-yard zero trajectory, we begin by looking at how much we must adjust to rezero to the new distance. In this case, our "book" data says this round impacts 5.4 inches low at 200 yards when a rifle's zeroed for 100 yards, so to hit dead-on (and be zeroed at 200 yards), just raise your sight 5.4 inches. That should be simple and obvious. And here's

where the MOA comes into plan. Since one MOA equals two inches at 200 yards, this 5.4 inches equates to 2.7 MOA, a figure we'll use in **STEP TWO**.

Ready? This is really very, very easy. Use that same 2.7 MOA in **STEP TWO** to compute the necessary changes at all the other distances, too. For example, at 100 yards, where one MOA equals one inch, it's exactly 2.7 inches; since that was the old zero distance, the trajectory will now be 2.7 inches high.

STEP ONE:
Converting Federal Premium 30.06, 165 Grain BTSP from 100 yards to 200 yards

Write this:	MOA=1"	MOA=2"	MOA=3"	MOA=4"	MOA=5"
	100 yds	200 yds	300 yds	400 yds	500 yds
Book Data 100 Yds	Zero	-5.4"	-16.8	-35.0"	-61.4"
Result for 200 Yds		Zero			

Step Two: Apply this 2.7 MOA at all distances, then add or subtract to yield the new trajectory data.

And at 400 yards, 2.7 MOA equates to 10.8 inches of change - $2.7 \text{ MOA} \times 4 = 10.8$, right? We subtract this from the old figure to yield the new trajectory, which is 23.2 inches. And so on.

To test how accurate our computations are, took at **Table Two**, which compares "book" data to our results: Right on the mark, with only a minor deviation at 400 yards, but it's still within 1/4 MOA. But is there a danger this technique could generate enough deviation from "book" that cumulative error may cause problems when shifting the zero to longer ranges?

STEP TWO:

Write this:	MOA=1"	MOA=2"	MOA=3"	MOA=4"	MOA=5"
	100 yds	200 yds	300 yds	400 yds	500 yds
Book Data 100 Yds	Zero	-5.4"	-16.8	-35.0"	-61.4"
Changes @2.7 MOA	+2.7"	+5.4"	-8.11"	-10.8"	-13.5"
Result for 200 Yds	+2.7"	Zero	-8.71"	-24.2"	-47.9"

The only notable variance is at 400 yards - but even there we are within 1/4 MOA.

To test this, look at **Tables Three and Four**, where we again use Blatt's data for this same Federal Supreme round, this time converting the trajectory from a 100-yard zero to a 500-yard zero.

TABLE TWO
Comparing the Results of Our Calculations to 200 Yds "Book" Data

	100 yds	200 yds	300 yds	400 yds	500 yds
200 Yd Zero	+2.7"	Zero	-8.7"	-23.2"	47.9"
(Our conversion) 200 Yd Zero	+2.7"	Zero	-8.6"	-24.2"	-47.9"

TABLE THREE

Converting Trajectory of Federal Premium 30.06, 165-Grain BTSP to 500 Yards

Write this:	MOA=1"	MOA=2"	MOA=3"	MOA=4"	MOA=5"
	100 yds	200 yds	300 yds	400 yds	500 yds
100 Yd Zero	Zero	-5.4"	-16.8	-35.0"	-61.4"
(Book Data) 500 Yd Zero					Zero

Eureka! The only variance whatsoever from "book" data is 1/10th of one inch at 300 yds and 4/10ths at 200 yds, proving accuracy and reliability of technique. Despite this extreme leap in elevation 61.4 inches or 12.28 MOA - the resulting are amazingly on-the-mark, with only the tiniest of variations from "book" data. If there's any danger of cumulative error, this should have shown it.

The only caution I would pass along is to ensure the initial "book" data you convert from was calculated for a sight the same height above the bore as your own. Most ammunition manufacturers now assume you will be using a scope, so they calculate trajectories for a sight 1.5 inches above the bore, although some sources may still use the old 0.9 inches to reflect the height of an open metallic sight.

After reading this article, sit down with the manufacturer's data for your favorite load and calculate all the trajectories for 100- through 500-yard zeroes, then keep the resulting table in your rifle case so you will always have it with you.

And don't disparage the computer, but neither under estimate the power of a stubby pencil when matched with common sense.

TABLE FOUR

Applying 12.28 MOA Changes to Convett Trajectory for 500-Yard Zero

	100 yds	200 yds	300 yds	400 yds	500 yds
Book Data 100 Yds	Zero	-5.4"	-16.8	-35.0"	-61.4"
Changes @12.28 MOA	+12.3"	+24.5"	+36.8"	+49.1"	-61.4"
Result for 500 Yds	+12.3"	+19.5"	+20.0"	+14.1"	Zero
Book Data 500 Yds	+12.3"	+19.1"	+20.1"	+14.1"	Zero