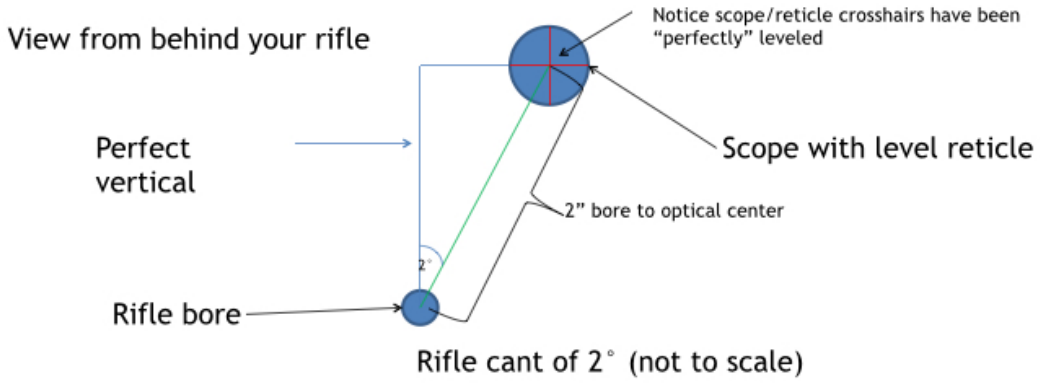
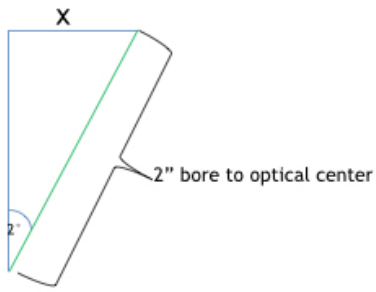
Canting a leveled rifle is far more damaging than having a slight offset.

Scenario 1: In this scenario we have canted our rifle 2° to find the most natural and comfortable rifle position. After finding this position we rotated the scope in the rings until it is perfectly "level with the world". (i.e. Frank's Method)



Rifle cant of 2° (not to scale)

This problem broken down: Trig: solve for x



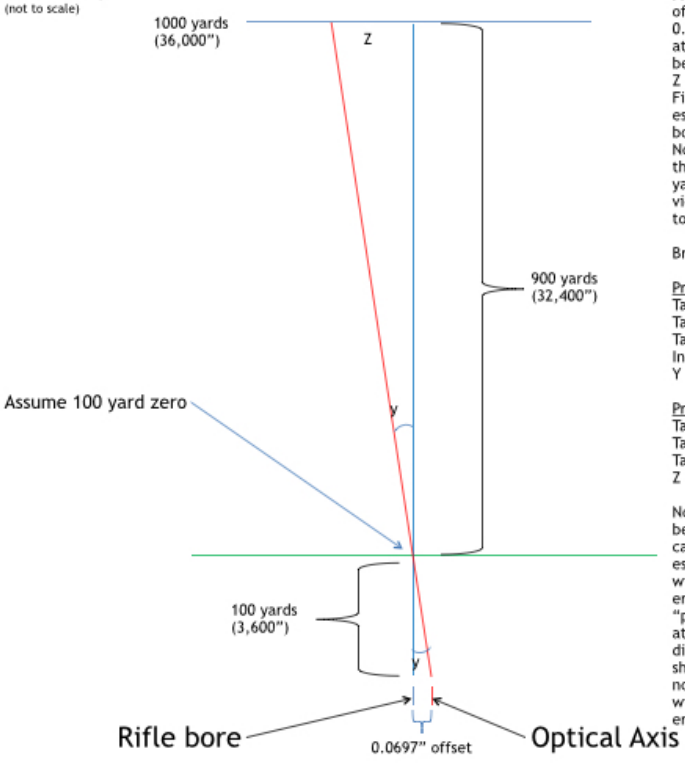
Sin 2° = Opposite/Hypotenuse
Sin 2° = x/2”
Sin 2° * 2” = x
X = 0.0697”

Your optical center and crosshairs are laterally offset (x the drawing above) from your rifle bore by 0.0697”

How is your bullet impact affected by 0.0697” of lateral bore/scope offset?

Bird’s Eye View

(not to scale)



From the previous slide we know our horizontal offset of rifle bore to optical center and thus reticle center is 0.0697”. Assuming we zero our rifle to a perfect zero at 100 yards (3,600”), what will our horizontal offset be at 1,000 yards (36,000”)?
Z = horizontal offset at 1,000 yards.
First we need to solve for the angle Y, which is essentially the “pointing error” angle between the bore of the rifle and the optical axis of the scope. Notice that the angle of the scope axis at 100 yards = the angle of the scope axis leaving 100 yards for 1,000 yards (in both cases it is Y). In other words, you could view your scope as horizontally angled by Y° in relation to your rifle bore.

Break this down into two problems.

Problem 1: solve for Y.
Tangent Y = Opposite/adjacent
Tangent Y = 0.0697”/3,600”
Tangent Y = 0.00001936
Inverse tangent of 0.00001936 = Y
Y = 0.0011°

Problem 2: Now that Y is known, solve for Z
Tangent Y = Opposite/Adjacent
Tangent 0.0011 = Z/32,400”
Tangent 0.0011 * 32,400” = Z
Z = 0.622”

Notice nothing about your ballistics matters at all because your scope is level. Only if your scope is canted would ballistics start to contribute to error, especially as you dial your turrets for range and/or windage. In this situation we care about the “pointing error” of your scope in relation to your bore. The “pointing error” is written as either 0.0011° OR 0.622” at 1,000 yards assuming a 100 yard zero, with a 2” distance between rifle bore and optical axis and a 2° shooter/rifle cant. Because the scope is level there is no additional error when dialing any elevation or windage adjustments. You have a fixed “pointing error” of 0.0011° OR 0.622” at 1,000 yards, period.

Scenario 2: Level rifle and scope perfectly. Shooter’s natural position is a rifle cant of 2° which leaves potential to induce a 2° cant to the rifle AND scope for a 1,000 yard shot. How much potential error is there for the bullet?

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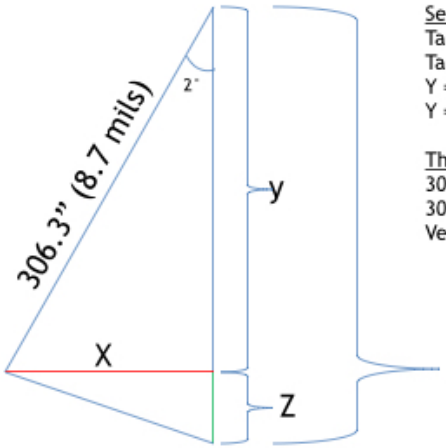
Inputs/assumptions:

- 6.5 Creedmoor
- 140grn. AMAX
- 2,780 fps muzzle velocity
- G7: 0.294
- Standard day
  - Honestly, ballistics don't matter that much for this scenario. All we need is a rough approximation of drop in inches of a fairly common bullet.
- Inches of drop at 1,000 yards: 306.3" - based on G7 ballistics calculator
- ** Note: Even if your ballistics are a little different than this it won't make much of a difference in the final answer…



Problem: what is the horizontal and vertical error, in inches, at 1,000 yards by having your scope and rifle canted by 2° given the equipment and conditions stated to the left?
X = horizontal offset error
Z = vertical offset error

First, Solve for X:
Sin 2° = opposite/hypotenuse
Sin 2° = x/306.3"
Sin 2° * 306.3" = x
X = 10.689" of horizontal error.

Second, solve for Y:
Tan 2° = opposite/adjacent
Tan 2° = 10.7"/Y
Y = 10.689"/Tan 2°
Y = 306.11"

Third, solve for Z (vertical offset error):
306.3" - Y = Z
306.3 - 306.113 = 0.187"
Vertical offset error = 0.187"

Had the rifle and scope been level this dimension would have been 306.3" (8.7 mils), therefore Z represents the vertical offset error when a 2° rifle/scope cant error is induced by the shooter.

Conclusion

- If the shooter purposely cants their scope in relation to the rifle by 2° in order to fit their natural shooting position on the rifle so that the scope is "level with the world" the induced error would be 0.622" at 1,000 yards.
- If the shooter has a natural cant of 2° on the rifle but levels the rifle and scope perfectly with one another and then during a 1,000 yard shot cants the rifle/scope combination by 2° in order to fit their natural shooting stance shooting a fairly common bullet the error induced is 10.689" horizontally and 0.187" vertically.
- The shooter must decide: Do you want to have a purposefully induced horizontal error of 0.622" at 1,000 yards? Or do you want to have the potential to have a 10.689" horizontal error at 1,000 yards due to an unnatural shooting position?