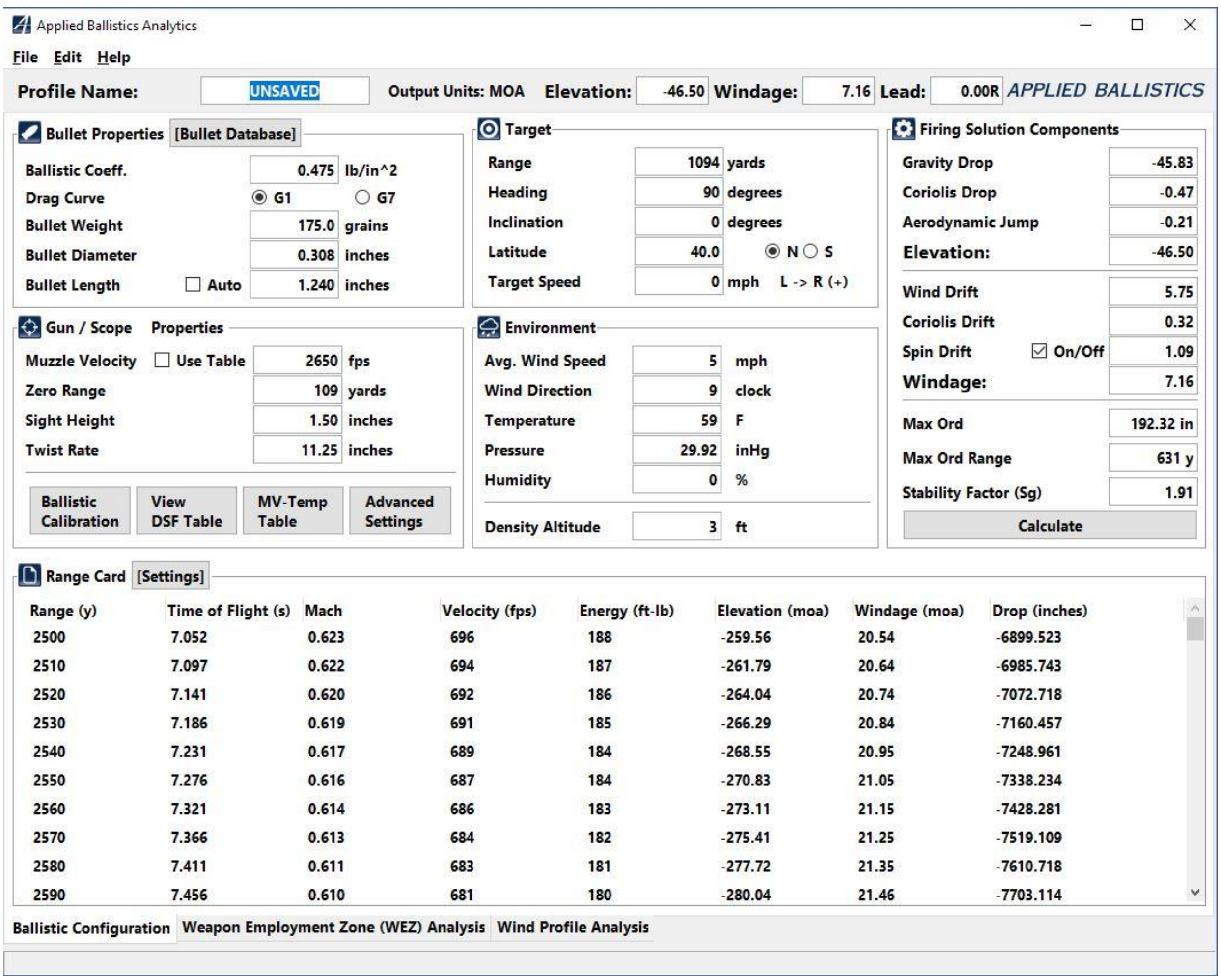
# Applied Ballistics Analytics User Manual



# Table of Contents

## 1.0 Introduction

The Applied Ballistics (AB) Analytics software tool is a full-featured ballistics solver that includes the capability to compute expected probability of hit using the same Weapon Employment Zone (WEZ) method described in Bryan Litz’s book *Accuracy and Precision for Long Range Shooting*. This tool allows a shooter to see how his rifle can be expected to perform under a wide range of conditions, and how errors contribute in causing a bullet to miss its target.

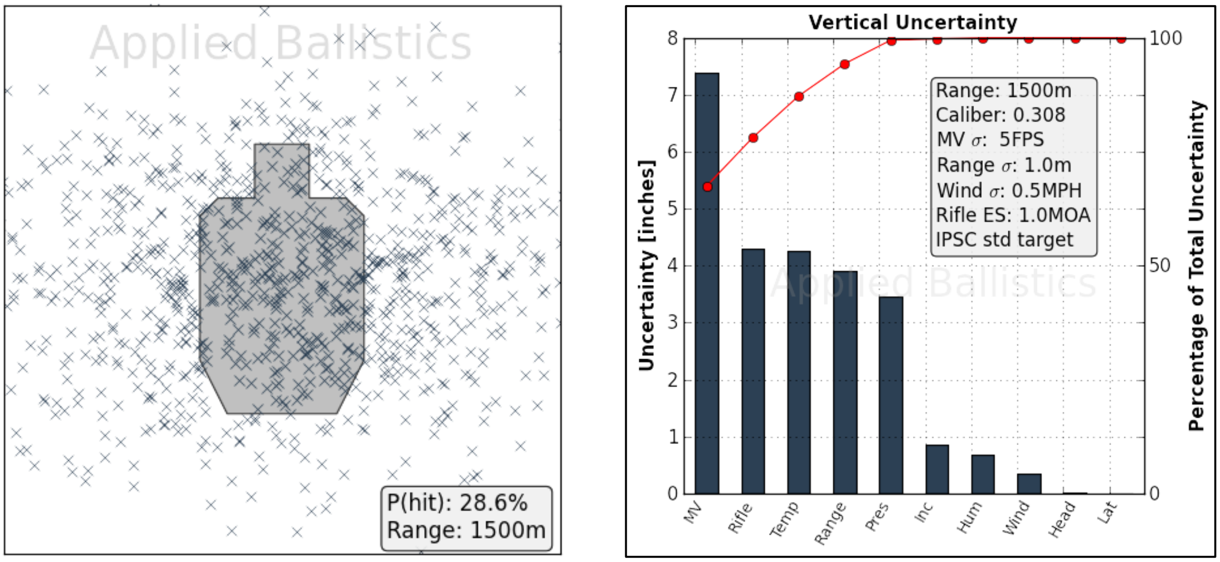



**Figure 1 – AB Analytics provides users with the ability to perform their own WEZ analyses**

The AB Analytics software includes two automated calibration tools that dramatically increase accuracy at long range. First, muzzle velocity is calibrated by firing a range where the round is supersonic. The user enters the actual drop at that range, and the AB solver computes the calibrated muzzle velocity automatically. Second, for long range shooting - where the round is subsonic – Applied Ballistics uses the actual drop at another range to automatically compute the drop scale factor (DSF).

This DSF provides a finer level of control in the subsonic flight than BC-Mach/Range tables, especially when used with the custom drag curves that Applied Ballistics has computed for many common bullets. While AB's solver supports the use of G1 and G7 ballistic coefficients, these custom drag curves offer a new level of accuracy that cannot be matched by the conventional G1/G7 ballistic tables. These highly accurate solutions are displayed in easy-to-read, and easily exported, range cards.

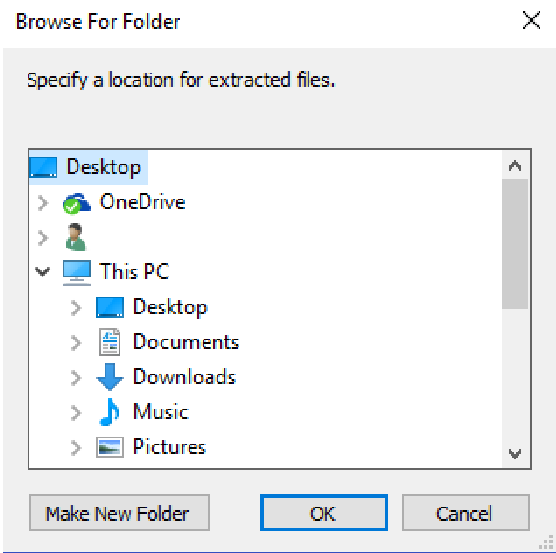
Range Card [Settings]

| Range (m) | Time of Flight (s) | Mach | Velocity (fps) | Energy (ft-lb) | Elevation (mils) | Windage (mils) | Drop (inches) |
|---|---|---|---|---|---|---|---|
| 0 | 0.00 | 2.374 | 2650 | 2729 | 0.00 | 0.00 | -1.50 |
| 100 | 0.13 | 2.190 | 2444 | 2322 | -0.06 | 0.12 | -5.08 |
| 200 | 0.27 | 2.014 | 2248 | 1964 | -0.75 | 0.27 | -15.57 |
| 300 | 0.42 | 1.847 | 2061 | 1651 | -1.67 | 0.44 | -34.23 |
| 400 | 0.59 | 1.688 | 1884 | 1379 | -2.75 | 0.62 | -62.63 |
| 500 | 0.77 | 1.538 | 1717 | 1146 | -3.99 | 0.81 | -102.66 |

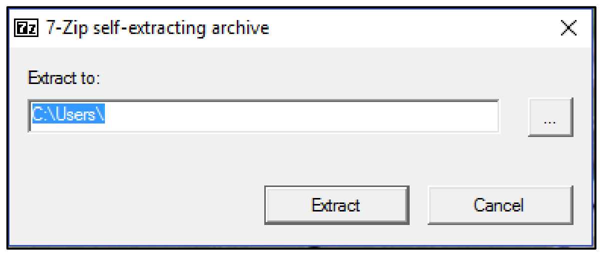
**Figure 2 – Range card**

## 2.0 Installation/Unlock

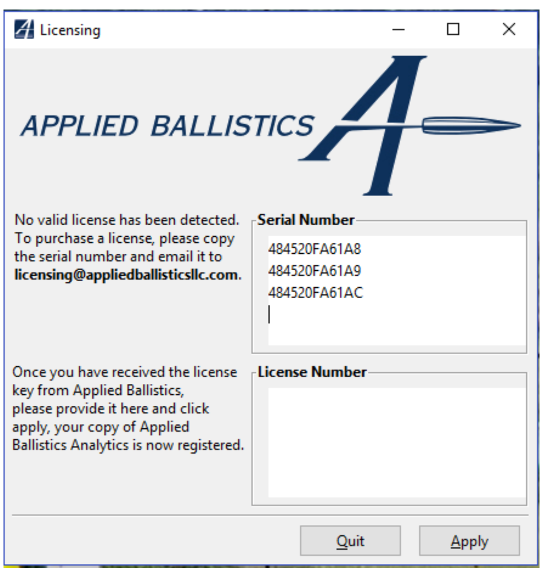
When you first download the software you will receive an executable file (.exe). This file can be stored any number of places depending on your computers settings. Mae sure when you download it, that you set it to save to the desktop. Once you double click on the file, it will prompt you to do an extraction. Don't just click ok through the prompts. Change the file location to the desktop, then do the extraction. It does not physically install on the PC. This makes the software military computer friendly. Once you complete the extraction, you will have a folder on your desktop, or whereever you unzipped it, that says AB Analytics.




In simple terms. Step 1 double click the ABAnalytics File you downloaded. Step 2 click the browse button on the right of the extraction program. Step 3 select "Desktop". Step 4 click "Extract".




### 2.1 Unlock/Licensing (Obtaining a License)




The next phase is getting your license. The first time you open it, you will see a prompt with a serial number and an email address. Copy that serial number (exactly as you see it and include a copy of your receipt in to an email and email it to licensing@appliedballisticsllc.com. You will then get a reply with an unlock code that goes in this block. This code is only good for one computer, each computer will have its own unique code and will not transfer to other devices. Each license purchases is authorized a total of 3 installs. Each install will require a unique unlock code.

Unlock codes will not transfer from one computer to another.

## 3.0 Ballistic Calculations

This section describes how to edit parameters and use them to compute a ballistic solution. NOTE: pressing the Enter key after typing in a number will cause the ballistic solution to be updated with the new number.

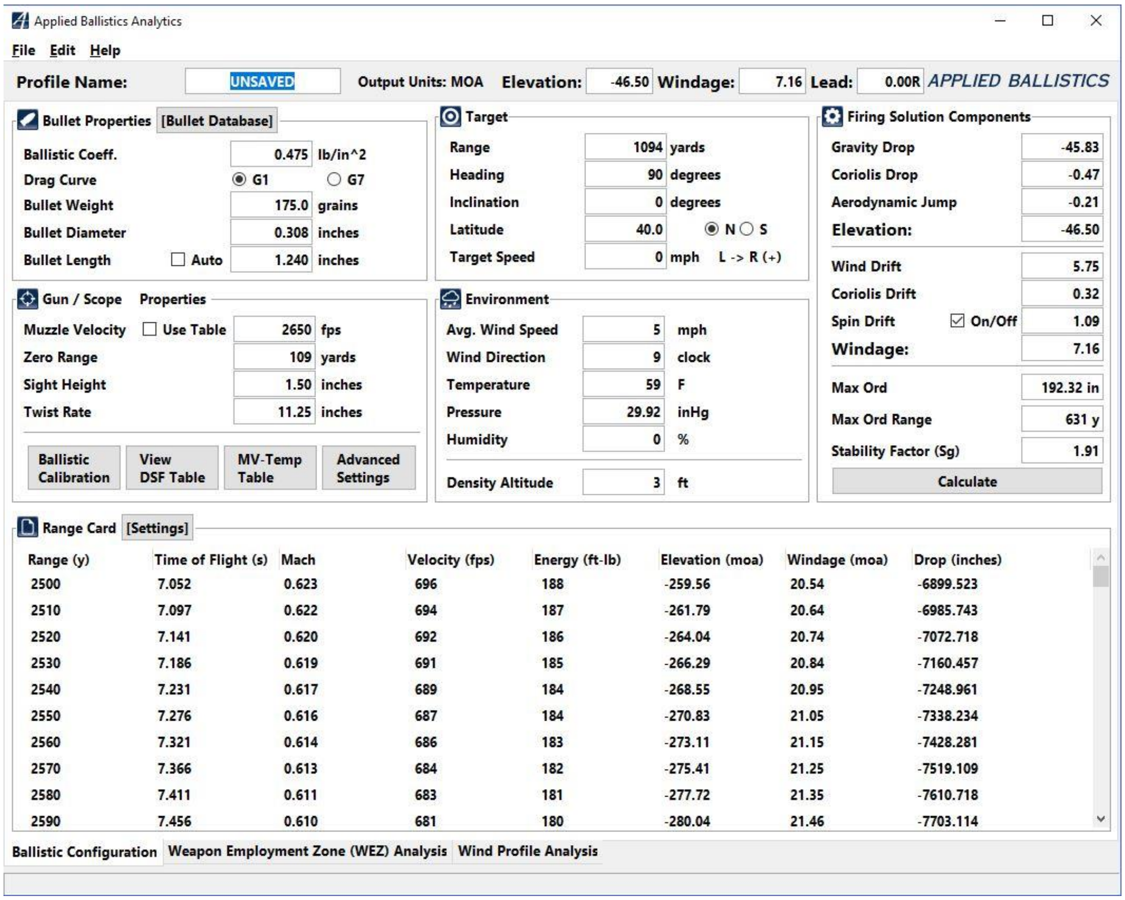



**Figure 3 - Main ballistic configuration screen**

### 3.1 Bullet Properties

The bullet properties subheading is located under the Profile Name section, and allows the user to edit parameters about the bullet itself, including ballistic coefficient, drag curve, bullet weight, bullet diameter, and bullet length. In addition, AB's extensive bullet library can be accessed from here by clicking on the Bullet Database button.

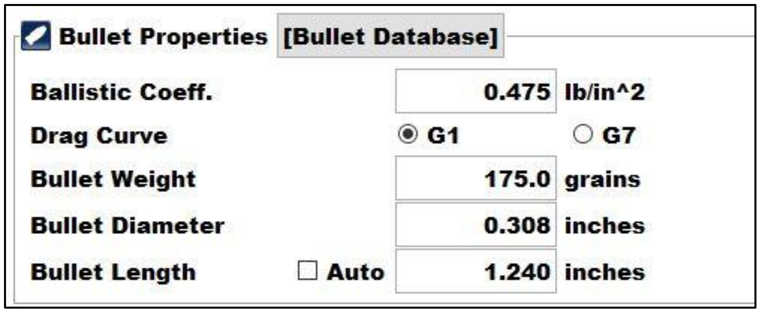



**Figure 4 - Bullet Properties**

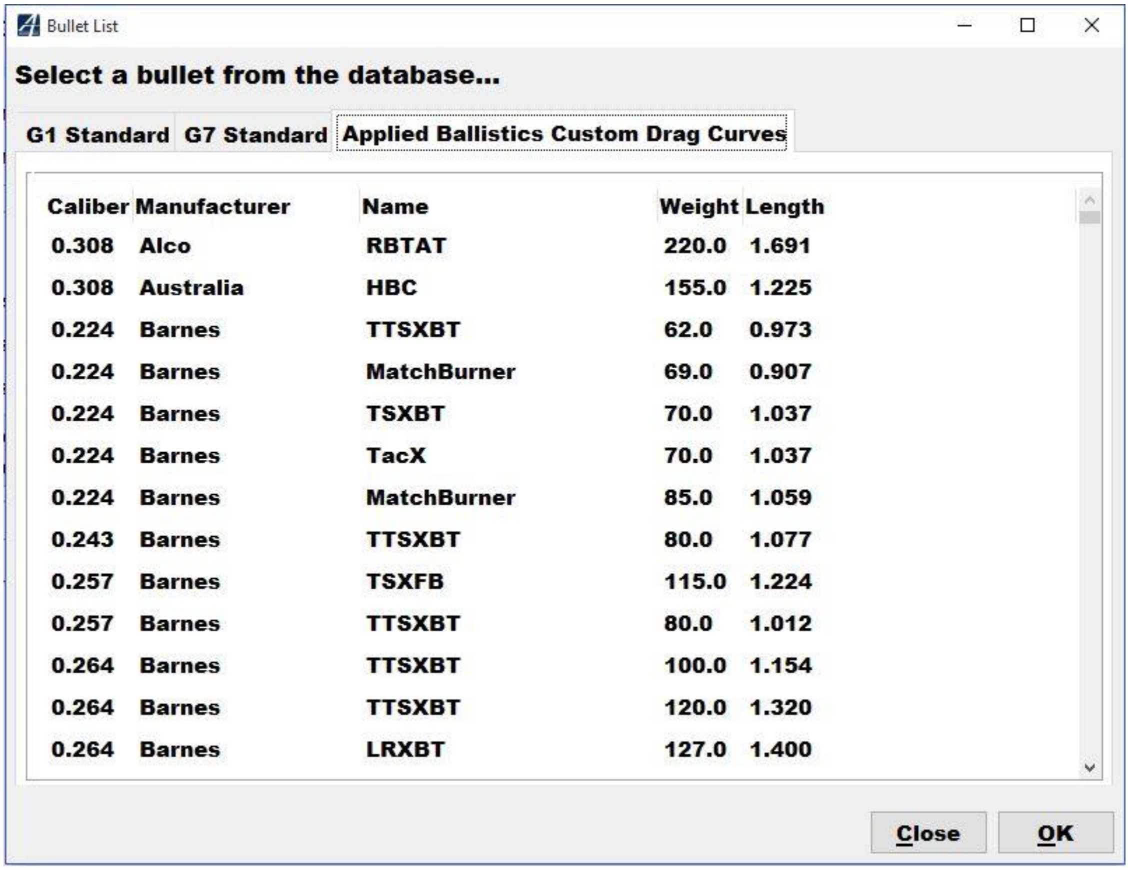
Most long-range bullets are better matches to the G7 standard, and using G7 BC's (Ballistic Coefficient) will provide sufficiently accurate trajectory predictions out to a range where the bullet slows to transonic speeds (~1340 fps which is in the neighborhood of 1000 yards for many cartridges). Be sure that if you select the G7 drag model that you enter a G7 BC (not a G1 BC). Click here for further reading about G1 and G7 BC's.

When using custom drag curves, the ballistics engine is solving the equations of motion using the exact drag curve for a specific bullet, not referencing a standard (G1 or G7) curve. The added accuracy in trajectory predictions that is possible with custom drag curves is especially valuable when shooting at targets at or beyond transonic range, because that's the speed region where drag curves tend to diverge most.

Checking the Auto box next to Bullet Length is helpful if the user does not know how long his bullet is. This tool uses empirical data from a number of known bullet configurations to estimate the length of the bullet based on its diameter. Bullet length is used for stability and related trajectory calculations including spin drift.

### 3.1.1 Bullet Database

The bullet database includes parameters for over 780 bullets, including bullet weights, diameters, lengths, G1 & G7 ballistic coefficients, as well as AB-measured custom drag curves. These custom drag curves provide a highly drag model through transonic flight, and are recommended for use instead of G1 & G7 to maximize accuracy.




| Caliber | Manufacturer | Name | Weight | Length |
|---|---|---|---|---|
| 0.308 | Alco | RBTAT | 220.0 | 1.691 |
| 0.308 | Australia | HBC | 155.0 | 1.225 |
| 0.224 | Barnes | TTSXBT | 62.0 | 0.973 |
| 0.224 | Barnes | MatchBurner | 69.0 | 0.907 |
| 0.224 | Barnes | TSXBT | 70.0 | 1.037 |
| 0.224 | Barnes | TacX | 70.0 | 1.037 |
| 0.224 | Barnes | MatchBurner | 85.0 | 1.059 |
| 0.243 | Barnes | TTSXBT | 80.0 | 1.077 |
| 0.257 | Barnes | TSXFB | 115.0 | 1.224 |
| 0.257 | Barnes | TTSXBT | 80.0 | 1.012 |
| 0.264 | Barnes | TTSXBT | 100.0 | 1.154 |
| 0.264 | Barnes | TTSXBT | 120.0 | 1.320 |
| 0.264 | Barnes | LRXBT | 127.0 | 1.400 |

**Figure 5 - Bullet Database**

Selecting a bullet will overwrite the current settings in the main Ballistic Configuration window; if a custom drag curve is selected, then the BC and drag curve selection options will be grayed out in Bullet Properties.

### 3.2 Gun/Scope Properties

The next section below the Bullet Properties allows the user to edit parameters related to the rifle system and scope used, including muzzle velocity, zero range, sight height, and barrel twist rate. In addition, there are several tools that can be accessed from here that enable the user to further refine the accuracy of the ballistic solution; these tools are discussed in the following sections.

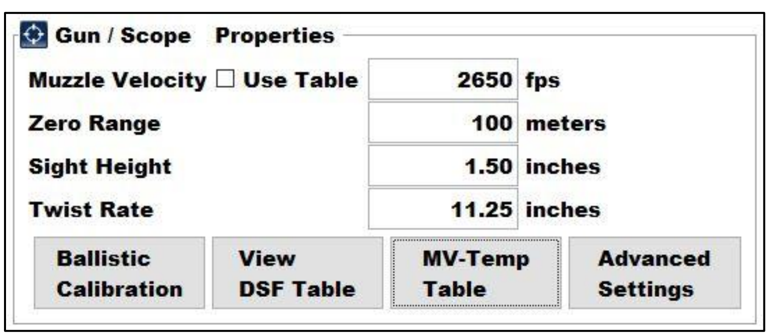



**Figure 6 - Gun/Scope Properties**

### 3.2.1 Ballistic Calibration

The ballistic calibration feature allows a user to calibrate the ballistic solution based on observed bullet drop at range. There are two parameters that can be calibrated: muzzle velocity (MV), and drop scale factor (DSF).

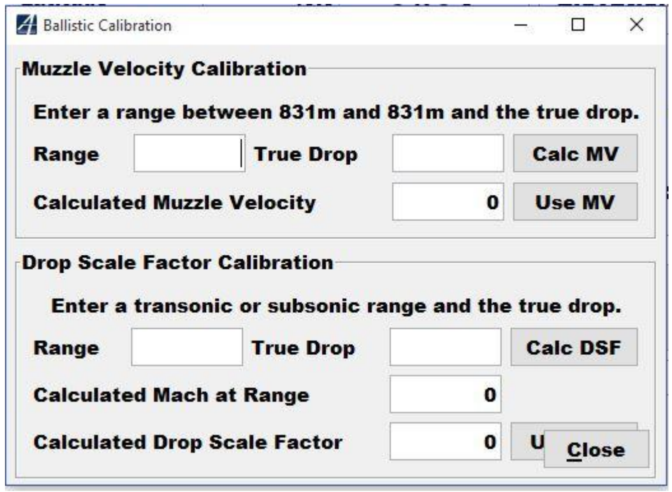



Figure 7 - Ballistic Calibration

Due to uncertainties involved with modern chronographs, velocity measurements are not always as accurate as we would hope. Therefore the first variable a shooter should attempt to calibrate is muzzle velocity. The recommended range for muzzle velocity calibration is where the bullet is at Mach 1.2 in its flight. If you have multiple 'observed' data points, use the farthest high confidence data point available for muzzle velocity calibration. The interface will provide recommended ranges range in which to calibrate muzzle velocity based on the bullets remaining velocity. After you've entered the observed range/drop pair, hit *Calc MV* and the program will calculate and display the actual MV that results in your observed drop. Click *Use MV* and the calculated MV will be applied in the main screen and future ballistic calculations will be based on this value.

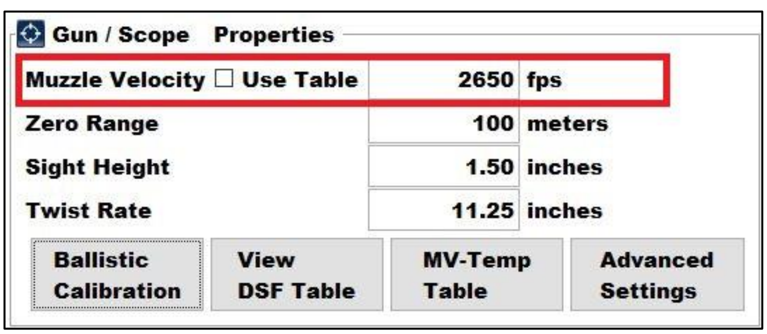



Figure 8 - Updated MV

For long-range shooting, the drop scale factor (DSF) is used to refine the ballistic solution in subsonic flight using a similar process. By firing rounds at long range, and noting the true drop, a drop scale factor is computed. Clicking *Use DSF* populates the DSF value and Mach number into the View DSF Table (section 3.2.2).

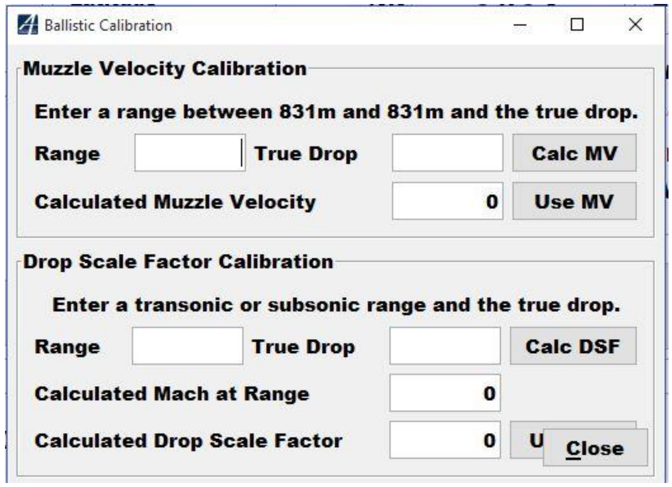



**Figure 9 - Completed Ballistic Calibration**

### 3.2.2 View DSF Table

Clicking *View DSF Table* in Figure 6 presents the user with all DSF values that have been calculated and saved. This window allows the user to edit and/or clear these values as necessary.

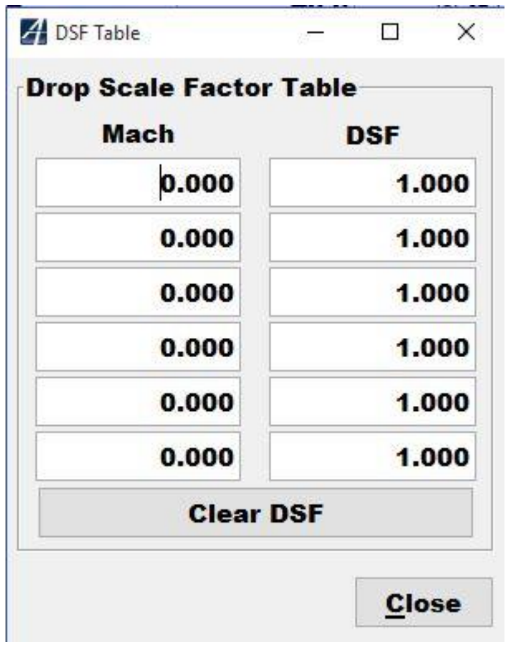



**Figure 10 - DSF Table**

### 3.2.3 MV-Temp Table

The AB Analytics tool also allows the user to use a MV-Temperature table that updates the muzzle velocity based upon the measured temperature. To use this feature, the user first clicks the box next to *Use Table.*

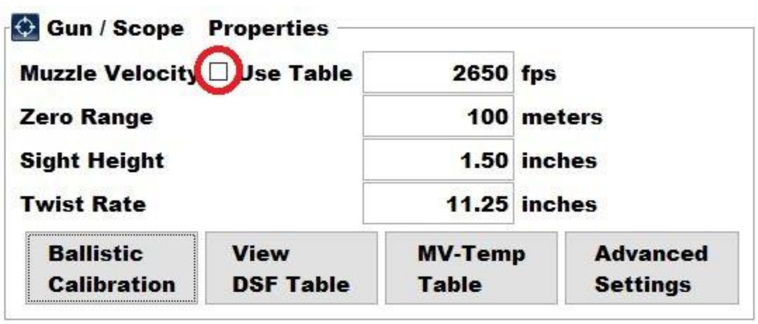



**Figure 11 - Gun/Scope Properties**

The user then clicks the *MV-Temp Table* button to access the window shown in Figure 12. The user enters the temperature and associated muzzle velocity in the table, making sure to press Enter after typing each value.

**NOTE: The Enter key must be pressed after each entry, or the entry will not be saved upon closing the window.**

The values should be entered starting with the highest temperature first. Clicking the *Close* button saves this table.

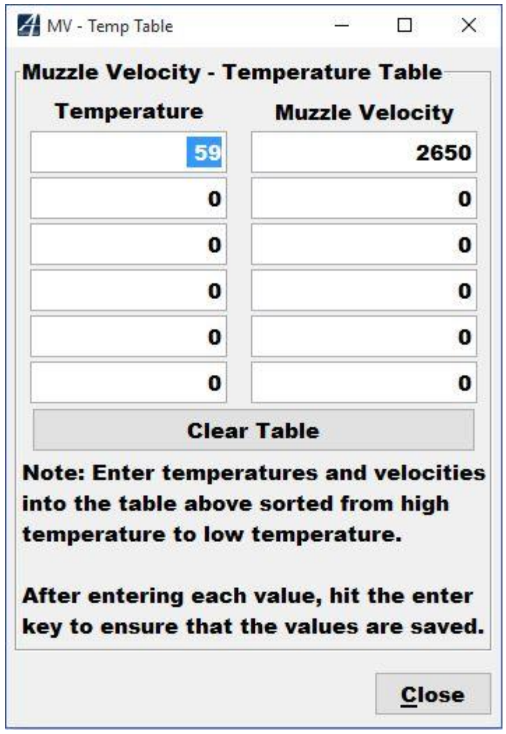



**Figure 12 – Example MV-Temp table**

Once the table has been populated, any change in the temperature will update the muzzle velocity. The system automatically interpolates for values between table entries, as shown in Figure 13.

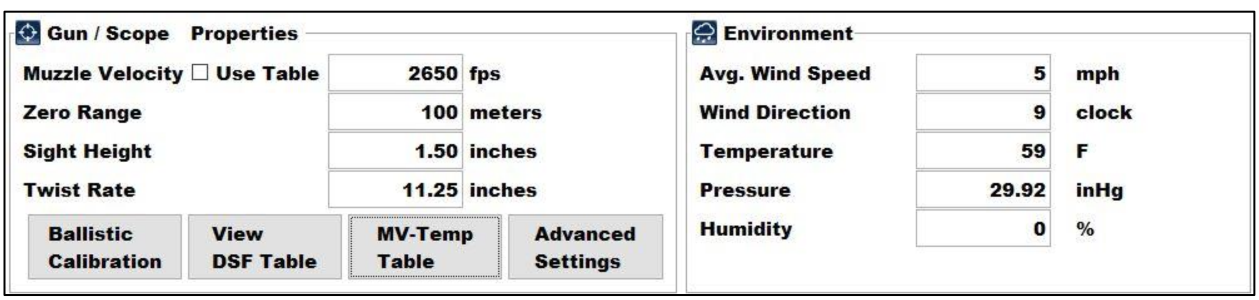



**Figure 13 - Muzzle Velocity updates with temperature**

### 3.2.4 Advanced Settings

The *Advanced Settings* button provides the user access to additional settings and tools to tweak results and further refine accuracy. First, the user can adjust environmental settings for when the rifle was zeroed, which is helpful when the rifle is zeroed under dramatically different circumstances than when it is intended to be fired. To do so, the user checks the *Enable Sight-In Conditions* box, then enters the zero conditions above.

The second setting is a zero offset; which allows the user to accommodate a shift in point of impact at zeroing, such as is seen through the addition or removal of a suppressor.

Lastly, the sight scale factor inputs enable the user to compensate for any irregularities in the travel of a rifle scope through its range of elevation and windage. Simply place a 'tall target' at 100 yards or meters and draw a plumb line (using a plumb bob or level). The user fires a group at the bottom of the target, then dials the scope up 30 MOA or 10 MILS and shoots another group. The user then measures the distance between the two groups and determines how much the group actually moved in relation to the adjustment that was made on the scope. For example, if the groups are only 29 MOA apart when 30 MOA were dialed, then the correction factor is 30/29 = 1.035. The program will scale the calculated drop by this correction factor to account for the error in scope travel.

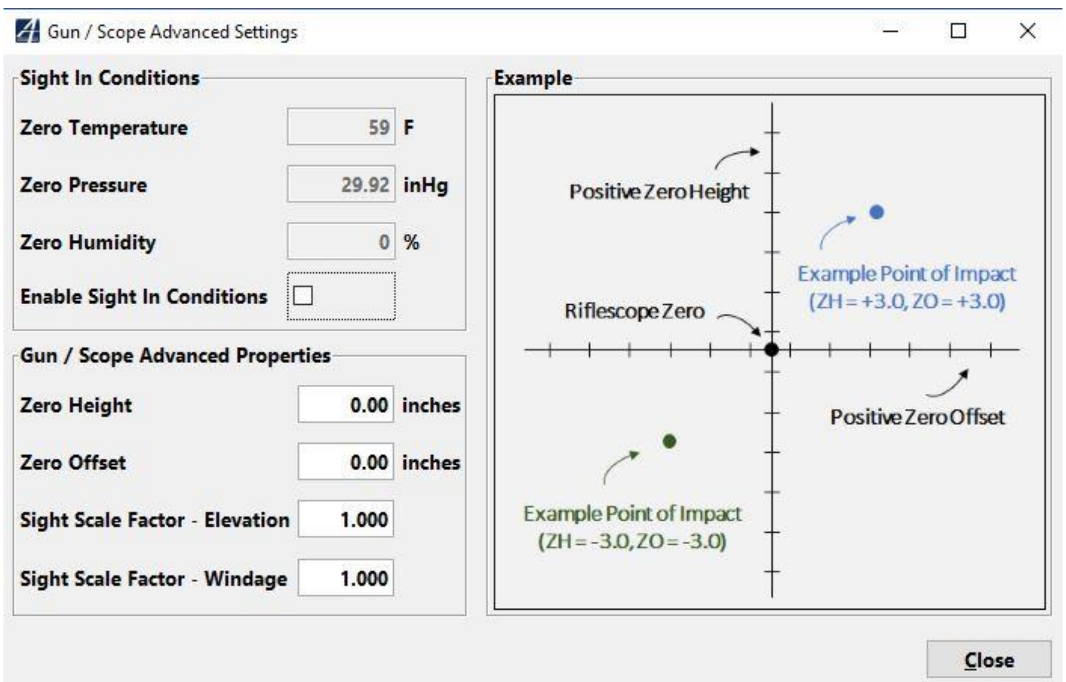



**Figure 14 – Advanced settings window**

### 3.3 Target

The target section allows the user to enter information about the target, including range, heading to target (0 degrees is North, 90 degrees is East, etc), inclination angle to target, latitude, and target speed in MPH. Again, pressing the Enter after entering a value will cause the ballistic solution to update with any changes.

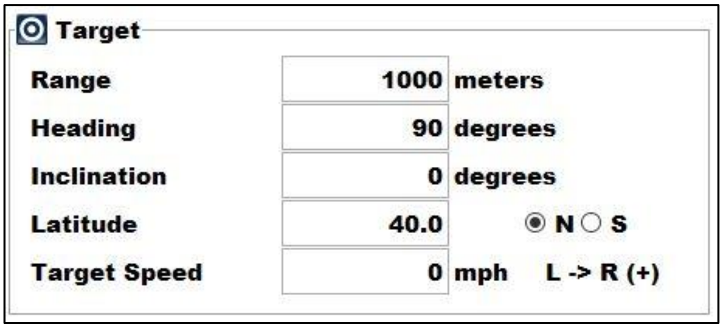



**Figure 15 – Target properties section**

### 3.4 Environment

The environment section allows the user to enter values for the wind speed, the direction it is coming from, temperature, pressure and humidity. In the case of wind direction, the number represents the direction **from which** the wind is coming; so a 12 o clock wind is coming directly at the shooter from the target direction, a 9 o clock wind is blowing from left to right across the range. The software also calculates and outputs the Density Altitude (DA) based upon your current inputs so you can mark printed range cards at the DA they have been created at.

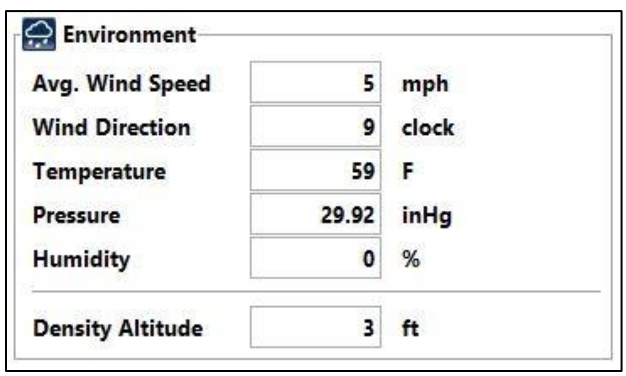



**Figure 16 – Environment properties section**

Atmospheric inputs have historically been the least understood and caused the most trouble for shooters running ballistics programs, in particular the pressure inputs. The following discussion elaborates on the correct way to manage these variables. Basically there are two options for describing pressure to a ballistics program; 1) Enter the barometric (aka *corrected*) pressure and altitude, or 2) Enter the Station pressure where you are. Some definitions are in order regarding barometric and station pressure.

Barometric pressure is also known as sea level corrected pressure, and is what the weather station and airports report because it's useful for pilots and making weather assessments. Barometric pressure is not the actual air pressure where you are, rather it's a number that's corrected to sea level. In order to determine the actual air pressure where you are (which is what the ballistics program cares about), you have to account for the effects of altitude. However if you have a handheld weather meter like a Kestrel, you can measure *Station Pressure* directly which is the actual air pressure where you are. This is the preferred method of inputting pressure data because it's one less input and relies on only one measurement instead of two.

A common error is to mistake station pressure for barometric or vice versa. The consequence of this error is that the wrong air density gets applied which degrades the accuracy of trajectory predictions. This error is increasingly more severe the higher up you are above sea level.

**NOTE: In the AB Analytics software, station pressure must be used.**

### 3.5 Firing Solution

The Firing Solution section displays the results of the ballistic computation, broken up into its constituent parts. In the case of elevation, the drop from gravity, Coriolis effects, and aerodynamic jump are shown; for windage, drift from wind, Coriolis effects and spin drift are shown. Spin drift can be turned on and off using the checkbox. The *Calculate* button can be used instead of pressing Enter to update the ballistic solution. Max Ord is the highest point in the bullets trajectory above the ground, and Max Ord Range is the range at which this occurs.

Stability Factor (SG) indicates if your Rifle, Bullet, & Environmental combination is optimized. An SG Above 1.5 means you have no loss in BC, and are fully stable. An SG of 1.0 to 1.5 indicates a Stable Projectile but not optimized. You will lose an average of 3% BC for each 0.1 you fall below an SG of 1.5. An SG below 1.0 is neither stable nor optimized and may tumble.

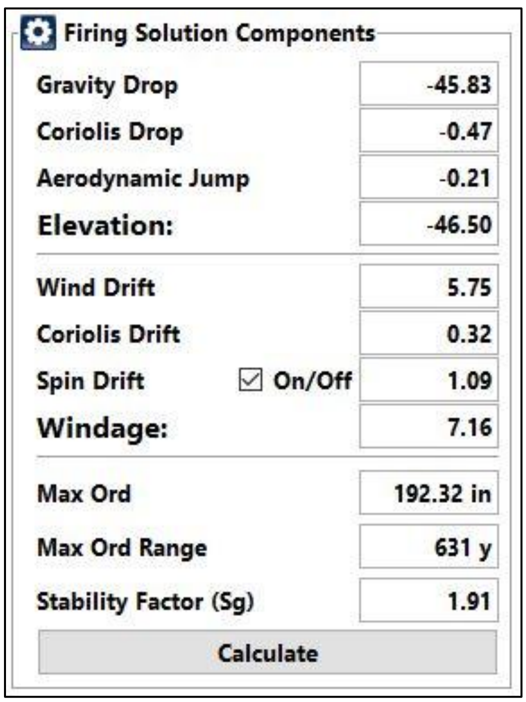
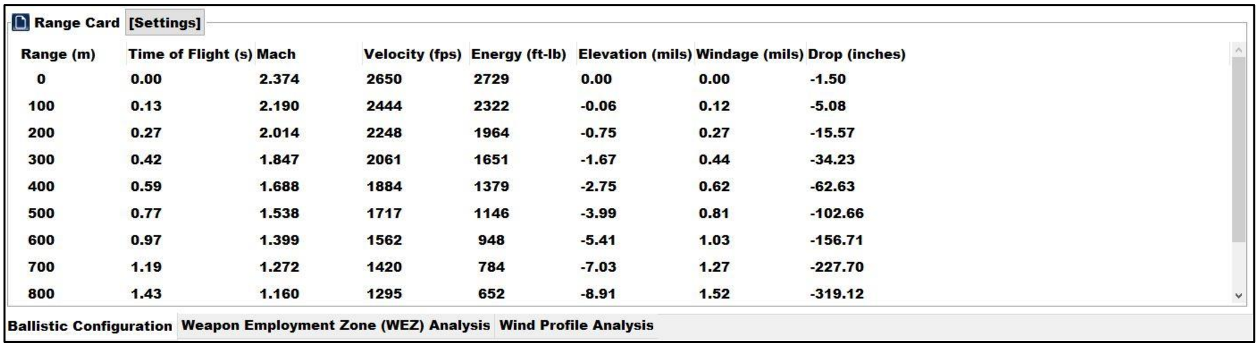



**Figure 17 – Firing solutions**

### 3.6 Range Card

At the bottom of the main screen, a range card is displayed that shows the ballistic computation at user-set increments, accessed by clicking the *Settings* button. As described in section 4.2, the range card can be exported.




| Range (m) | Time of Flight (s) | Mach | Velocity (fps) | Energy (ft-lb) | Elevation (mils) | Windage (mils) | Drop (inches) |
|---|---|---|---|---|---|---|---|
| 0 | 0.00 | 2.374 | 2650 | 2729 | 0.00 | 0.00 | -1.50 |
| 100 | 0.13 | 2.190 | 2444 | 2322 | -0.06 | 0.12 | -5.08 |
| 200 | 0.27 | 2.014 | 2248 | 1964 | -0.75 | 0.27 | -15.57 |
| 300 | 0.42 | 1.847 | 2061 | 1651 | -1.67 | 0.44 | -34.23 |
| 400 | 0.59 | 1.688 | 1884 | 1379 | -2.75 | 0.62 | -62.63 |
| 500 | 0.77 | 1.538 | 1717 | 1146 | -3.99 | 0.81 | -102.66 |
| 600 | 0.97 | 1.399 | 1562 | 948 | -5.41 | 1.03 | -156.71 |
| 700 | 1.19 | 1.272 | 1420 | 784 | -7.03 | 1.27 | -227.70 |
| 800 | 1.43 | 1.160 | 1295 | 652 | -8.91 | 1.52 | -319.12 |

**Figure 18 – Range card**

#### 3.6.1 Range Card Settings

The *Settings* button presents the window in Figure 19, where the user can adjust the start range, stop range, and increments for the output in the range card.

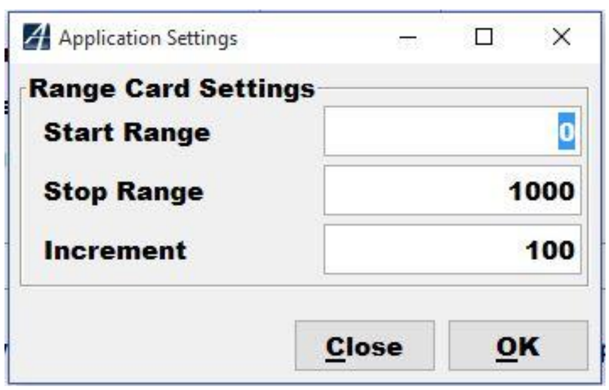



**Figure 19 – Range card settings window**

## 4.0 Menu items

### *4.1 Save/Open Profiles*

At the top of the window, the user can input a name for the current ballistics configuration and save a profile. This allows the user to build profiles for all of his rifles, and move between them quickly and efficiently.

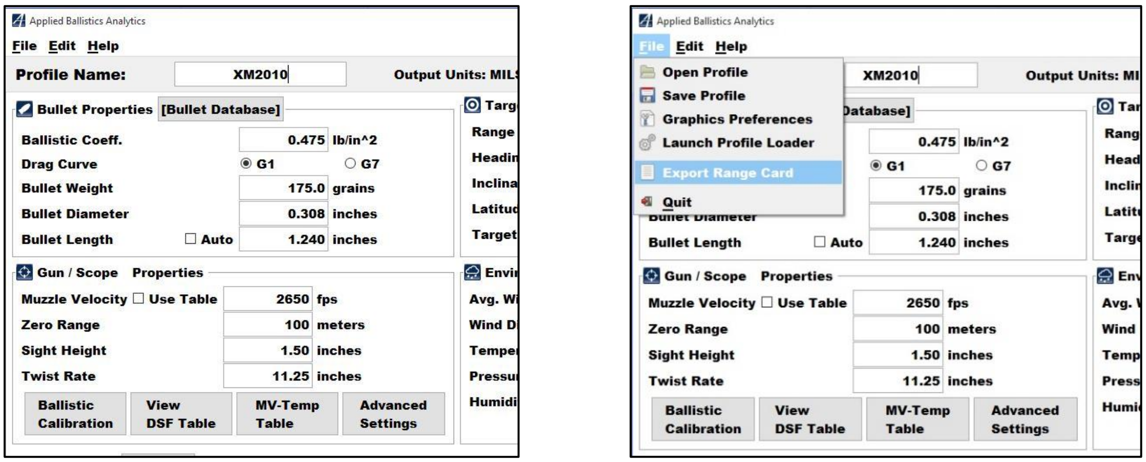



**Figure 20 – Naming and saving a profile**

The profiles are saved by default to the Profiles folder within the AB Analytics, with a ".pro" file extension. Using Menu > Open profile, the user can access previously saved profiles with the dialog box shown in Figure 21.

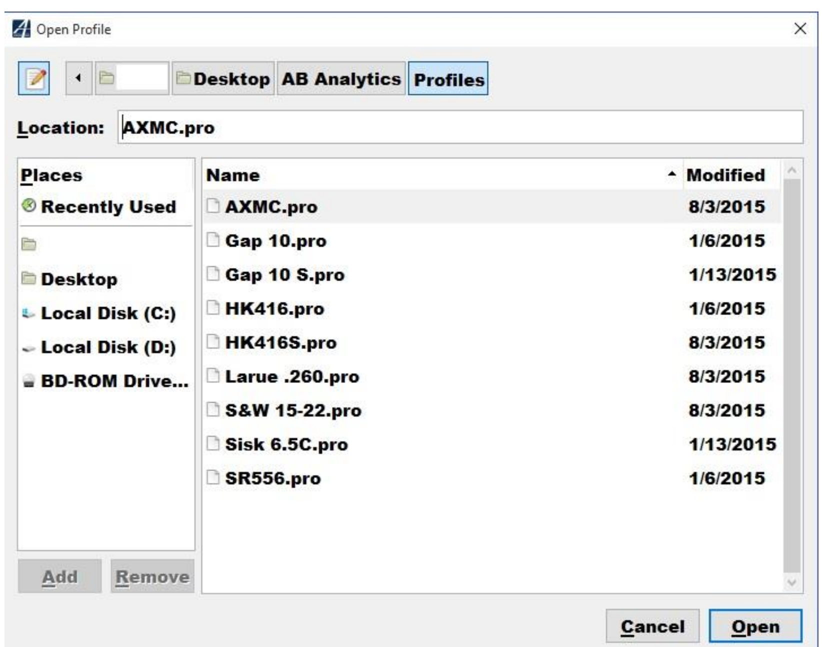



**Figure 21 – Open profile dialog**

## 4.2 Export Range Card

In addition to saving and opening profiles, the Menu includes an option to export range card, which will output the current range card to a comma-separated value (CSV) file format. This CSV file can be opened in a text reader, Excel, or an equivalent program.

| Range (m) | TOF (s) | Mach | Velocity (fps) | Energy (ft-lb) | Elevation (mils) | Windage (mils) |
|---|---|---|---|---|---|---|
| 0 | 0 | 2.374 | 2650 | 2729 | 0 | 0 |
| 100 | 0.13 | 2.193 | 2448 | 2329 | -0.06 | 0.12 |
| 200 | 0.27 | 2.02 | 2255 | 1977 | -0.75 | 0.26 |
| 300 | 0.42 | 1.855 | 2071 | 1667 | -1.66 | 0.4 |
| 400 | 0.58 | 1.698 | 1896 | 1397 | -2.73 | 0.56 |
| 500 | 0.77 | 1.548 | 1728 | 1160 | -3.96 | 0.74 |
| 600 | 0.96 | 1.404 | 1567 | 954 | -5.36 | 0.93 |
| 700 | 1.18 | 1.266 | 1413 | 776 | -6.97 | 1.15 |
| 800 | 1.43 | 1.135 | 1267 | 624 | -8.84 | 1.4 |
| 900 | 1.7 | 1.015 | 1133 | 499 | -11.02 | 1.67 |
| 1000 | 2 | 0.938 | 1047 | 426 | -13.58 | 1.98 |

**Figure 22 - Example CSV output of range card**

## 4.3 Edit > Units > Input/Output

Under the Edit menu item, the user has the option to change input and output units independently to suit his needs. The following tables summarize how the units for parameters change with the selection of a set of units from the menu; the Mixed option offers units that are most commonly used in the shooting community.

**Table 1 – Input parameters**

| Parameter | Menu item | Mixed | English | Metric |
|---|---|---|---|---|
| Bullet length, diameter, sight height, twist rate | | inches | inches | centimeters |
| Zero range, range | | meters | yards | meters |
| Muzzle velocity, downrange velocity | | feet/second | feet/second | meters/second |
| Wind Speed | | miles per hour | miles per hour | meters/second |
| Pressure | | inches of mercury | inches of mercury | millibars |
| Temperature | | deg Fahrenheit | deg Fahrenheit | deg Celsius |
| Energy (range card) | | foot-pounds | foot-pounds | joules |

**Table 2 - Output parameters**

| Parameter | Menu item | Inches | MILS | MOA |
|---|---|---|---|---|
| Elevation, windage, drop, drift | | inches | mils | moa |

## 5.0 WEZ Analysis

To use the WEZ tool[1], simply click on the WEZ analysis tab to access the screen in Figure 23. This tool allows a user to investigate how the bullet's point of impact is affected by changes or uncertainties in the input parameters, as it can reveal how accurately the parameters need to be measured. For example, if the temperature is only known to within 5F, what uncertainty is added to the bullet's point of impact? Or, if the rifle's accuracy is expected to be about 2 minutes of angle (MOA - extreme spread), does it make sense to try to measure temperature to better than 5F?

Uncertainties represent the 95% confidence intervals assuming a normal distribution. In other words, if the uncertainty in range is cited as +/- 1 yard, it means the standard deviation of range error is 0.5 yards. The simulation will model a bell curve of range error with 67% of the estimates being within +/- 0.5 yards (+/- 1σ) and 95% of the estimates being within +/- 1.0 yards (+/- 2σ)

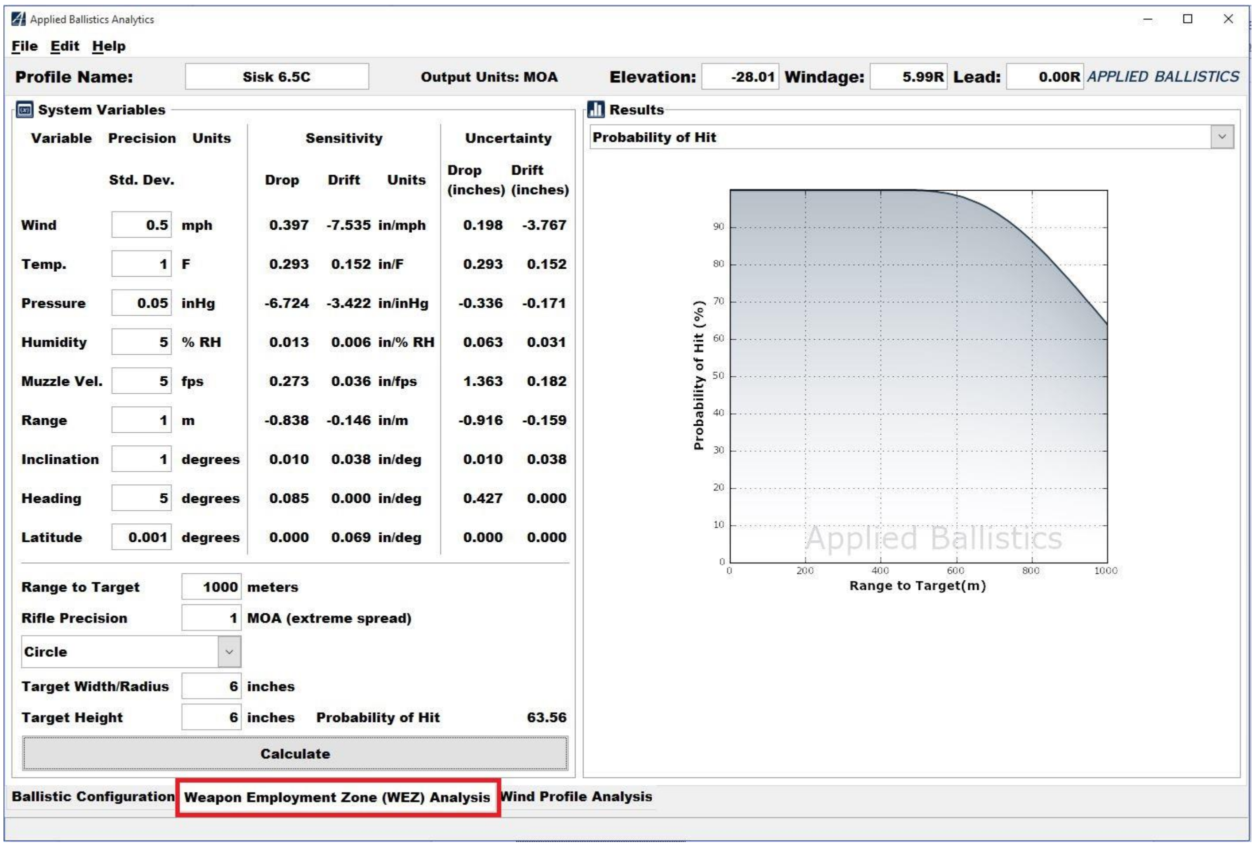



**Figure 23 - WEZ tab**

The left side of the screen allows the user to enter the precision of various inputs, as well as range to target, the precision of the rifle system used, the shape of the target, and the dimensions of the target. On the right, the results of the computation are displayed.

### 5.1 System Variables

The WEZ tool provides the user with the insight to see how each of the variables in Table 3 affects the accuracy of a ballistic computation. The tool comes prepopulated with some precision values, as described in Table 3, mostly based on use of the Kestrel to measure atmospheric conditions. Bryan Litz's *Accuracy*

[1] Further discussion on the concept of Weapon Employment Zone and how it can be applied to shooting scenario can be found in Litz's *Accuracy and Precision for Long Range Shooting.*

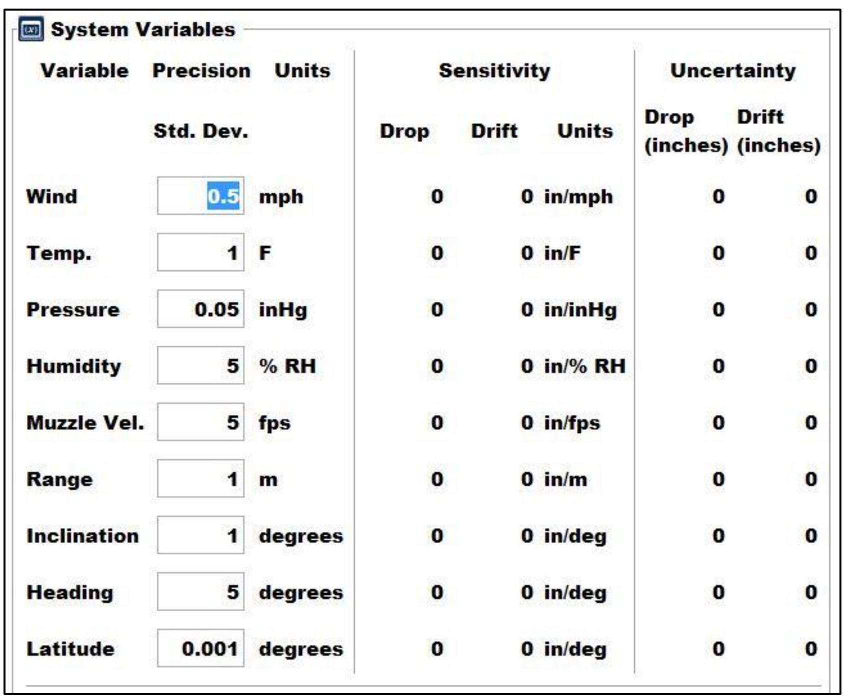
*and Precision for Long Range Shooting* provides several good estimates for rifle accuracy and muzzle velocity variation. These values can be changed to match the user's experience, such as muzzle velocity variations measured by a chronograph.

The precision numbers are assumed to be one standard deviation values, which is a common measure for the precision of tools making measurements. In this case, 67% of measurements will fall within +/-1 standard deviation of the mean; 95% will fall within +/-2 standard deviations.

**Table 3 – Overview of parameters**

| Parameter | Units for Analysis | Precision (1σ) | Rationale for Precision Value |
|---|---|---|---|
| Temperature | degrees F | 1.8 | Kestrel Specification |
| Pressure | inches of mercury | 0.05 | Kestrel Specification |
| Relative Humidity | % | 3 | Kestrel Specification |
| Wind Speed | MPH | 0.5 | Kestrel Specification; 3% of measure, say 15MPH |
| Range | meters | 1 | COTS LRF accuracy |
| Azimuth/Heading | degrees | 4.0 | Honeywell HMR3400, worst case |
| Latitude | degrees | 0.1 | Commercial GPS accuracy: <10m |
| Inclination | degrees | 1.0 | Honeywell HMR3400, worst case |
| Muzzle Velocity | FPS | Rifle specific | |
| Rifle Precision | FPS | Rifle specific | |

Once the fields are populated, the user can click the *Calculate* button at the bottom, which will compute how each of those error sources influence the bullet's flight, and show some results to the right of the text entry boxes. The Sensitivity heading shows how much one unit of change in a given parameter (wind, temperature, etc) changes the drop and drift of the bullet at the selected range; for the Figure 24 example, 1MPH of average wind pushes the bullet an additional 13.2 inches horizontally. An uncertainty of +/- 0.5MPH in the wind call adds +/- 6.6 inches of uncertainty to the bullet's point of impact at range.



System Variables

| Variable | Precision Std. Dev. | Units | Sensitivity Drop | Sensitivity Drift | Sensitivity Units | Uncertainty Drop (inches) | Uncertainty Drift (inches) |
|---|---|---|---|---|---|---|---|
| Wind | 0.5 | mph | 0 | 0 | in/mph | 0 | 0 |
| Temp. | 1 | F | 0 | 0 | in/F | 0 | 0 |
| Pressure | 0.05 | inHg | 0 | 0 | in/inHg | 0 | 0 |
| Humidity | 5 | % RH | 0 | 0 | in/% RH | 0 | 0 |
| Muzzle Vel. | 5 | fps | 0 | 0 | in/fps | 0 | 0 |
| Range | 1 | m | 0 | 0 | in/m | 0 | 0 |
| Inclination | 1 | degrees | 0 | 0 | in/deg | 0 | 0 |
| Heading | 5 | degrees | 0 | 0 | in/deg | 0 | 0 |
| Latitude | 0.001 | degrees | 0 | 0 | in/deg | 0 | 0 |

**Figure 24 – WEZ tool shows how each parameter influences the bullet's flight**

In addition to adjusting the parameters above, the WEZ tool also accepts different target shapes and sizes. The IPSC target is standardized and its dimensions locked, but the rectangle and circle targets can be adjusted to match actual targets in use.

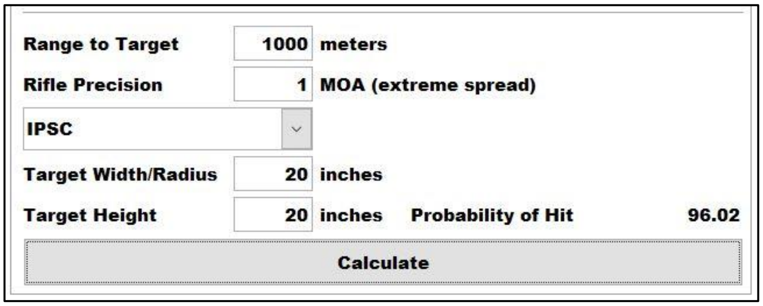



**Figure 25 – Target Parameters**

**Table 4 - Target parameters**

| Target Parameter | Description |
|---|---|
| Target Shape | Three options: Circle, Rectangle, IPSC |
| Target Width/Radius | Enter the width of the Rectangle target (or the radius if using Circle target) |
| Target Height | Enter the height of the Rectangle target (not used for Circle) |

### *5.2 Results*

Once the calculate button is pressed, the tool produces a probability of hit calculation at the bottom of the System Variable section; it also generates one of five graphs, which can be selected using the drop-down menu at the top of the right-hand side of the screen.

The first is called *Probability of Hit*, and it shows the estimated probability of hit out to the entered target range.

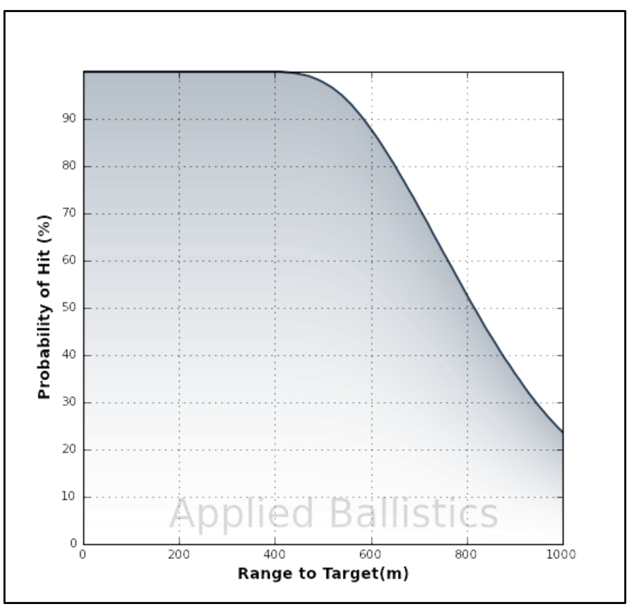



**Figure 26 – Probability of hit graph**

Two other options are labeled *Vertical Uncertainty* and *Horizontal Uncertainty*; these two graphs show how the uncertainties in the individual error sources contribute to the overall uncertainty in hit point. The contributions are ranked from highest to lowest, and their magnitudes shown as bar graphs. The red line along the top of the graph shows how the parameters contribute to the overall uncertainty. In the example of Figure , muzzle velocity dominates the overall error, contributing approximately 92% of the total uncertainty in the bullet's vertical point of impact. Due to the way that the errors contribute to the overall uncertainty, it takes significant changes in the smaller contributors to have any influence on the overall performance of the system.

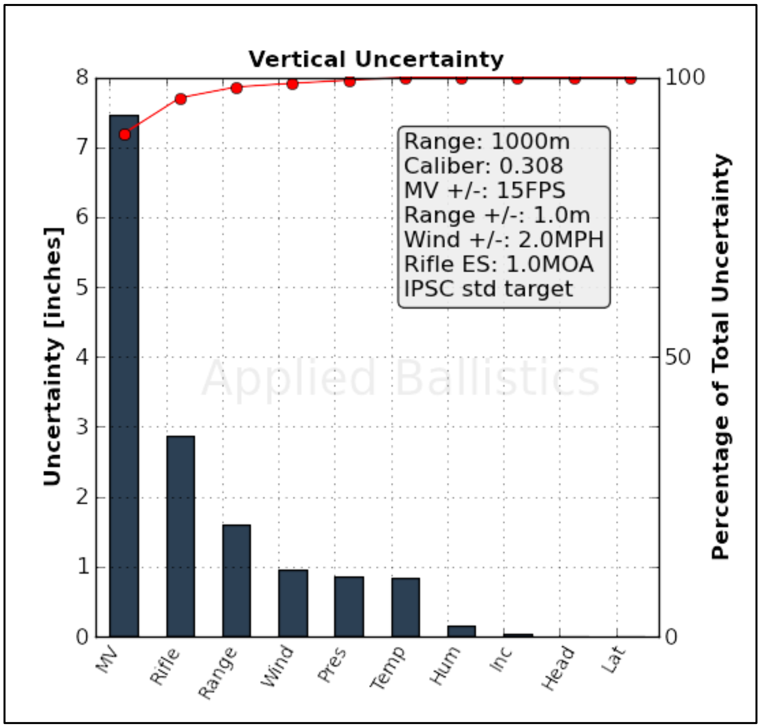



**Figure 27 – The WEZ tool breaks down how individual parameters contribute to overall system performance.**

The WEZ tool also includes a *Shot Simulation* graph, which presents a sample bullet spread overlaid on the specified target, which is helpful for visualizing the system performance.

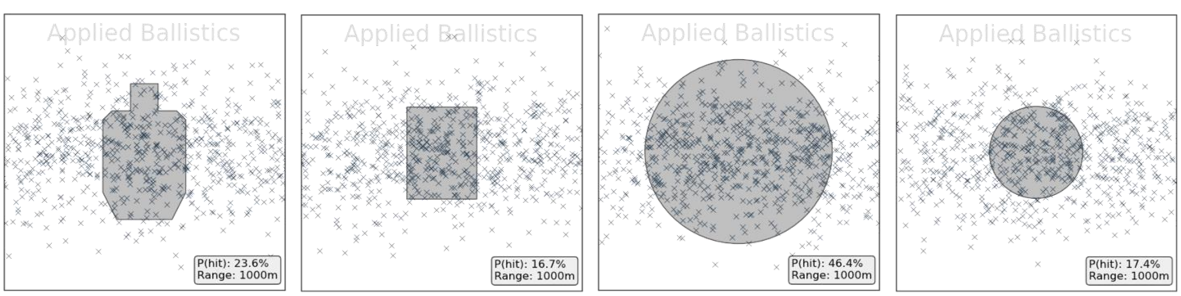



**Figure 28 – Example of shot simulation graphs**

## 6.0 Wind Profile Analysis

To use the Wind Profile Analysis tool[2], simply click on the Wind Profile Analysis tab to access the screen in Figure 29. Wind profile analysis allows you to put varying winds, at different ranges to the target. This allows you to have winds of different directions along the bullets flight path. If you enter wind in to the wind profile analysis, it will use this wind to calculate firing solutions, instead of the average wind that was input in the Ballistic Configuration Tab.

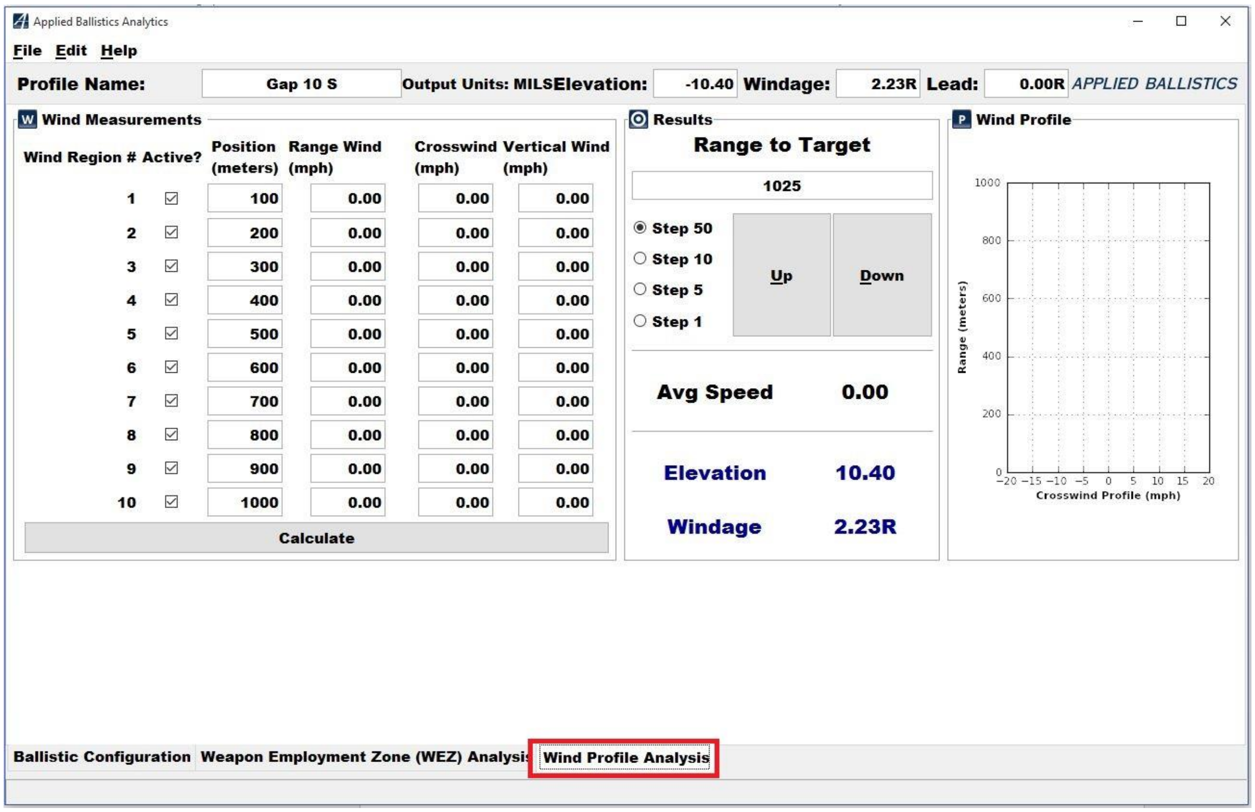



**Figure 29 Wind Profile Analysis Screen**

[2] Further discussion on the concept of Weapon Employment Zone and how it can be applied to shooting scenario can be found in Litz's *Accuracy and Precision for Long Range Shooting.*

## 6.1 Wind Measurements

The wind measurement input section allows for 10 different winds, at ranges you select. The first input is the range from the shooter. This is perfect for days when you might have alternating winds during the bullets flight path to the target. You can input wind in any direction, allowing you to adjust for shifts in direction at certain points, or areas with higher/lower winds than during the rest of the bullets flight path.

Range Wind can be either a head wind or a tail wind. If the wind is coming from behind to the shooter to the target, then it should be positive. From the target to the shooter should be negative.

Crosswinds from left are negative and from the right are positive.

Vertical winds going up are positive and going down are negative.

**Wind Measurements**

| Wind Region # | Active? | Position (meters) | Range Wind (mph) | Crosswind (mph) | Vertical Wind (mph) |
|---|---|---|---|---|---|
| 1 | ☑ | 100 | 0.00 | 0.00 | 0.00 |
| 2 | ☑ | 200 | 0.00 | 0.00 | 0.00 |
| 3 | ☑ | 300 | 0.00 | 0.00 | 0.00 |
| 4 | ☑ | 400 | 0.00 | 0.00 | 0.00 |
| 5 | ☑ | 500 | 0.00 | 0.00 | 0.00 |
| 6 | ☑ | 600 | 0.00 | 0.00 | 0.00 |
| 7 | ☑ | 700 | 0.00 | 0.00 | 0.00 |
| 8 | ☑ | 800 | 0.00 | 0.00 | 0.00 |
| 9 | ☑ | 900 | 0.00 | 0.00 | 0.00 |
| 10 | ☑ | 1000 | 0.00 | 0.00 | 0.00 |

Calculate

**Figure 30 Wind Measurement Inputs**

### 6.2 Results

Input the range to the target here, then select the step size you wish to use for the up/down movement. This will automatically re-calculate the solution for you each time you press up/down. Here you will see the corrected average wind speed based on the inputs you placed in Wind Measurement section. You will also see a firing solution based on these inputs.


**Figure 31 Results**

### 6.3 Wind Profile

The wind profile section shows you a graph based on the inputs in the Wind Measurements section.

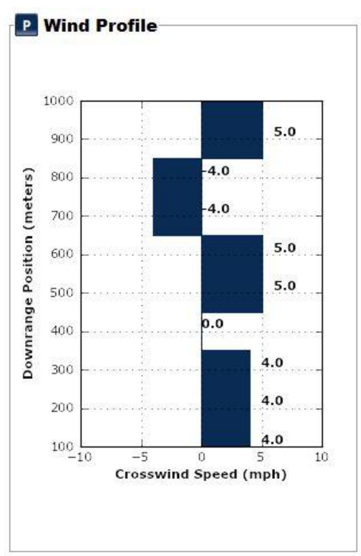
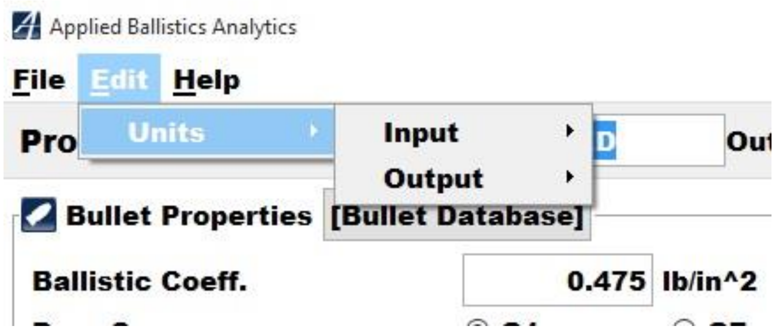



**Figure 32 Wind Profile Graph**

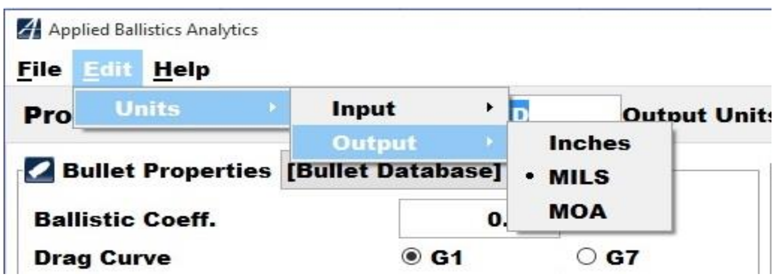
## 7.0 Input/Output Unit Settings

At the top of the screen, under the Edit function. You can change your input and output variables. Simply click on the function you wish to change, select the new variable you want to use. Once it is complete recalculate.

Edit function allows you to select units, and then which units you wish to input.




Changing the output units, will change from MILS to MOA (True MOA) or IPHY (Inches Per Hunderd Yards aka Shooters MOA). Note: WEZ will always be in meters.




Chaning the input units, will change the input parameters on the Ballistic Configuration Screen.