

# GSCalc (Version 1.11) OPERATOR'S MANUAL

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## GENERAL

*GSCalc* is software for the real shooter because it provides the fastest and most accurate way to store and analyze the on-target results you get from each of your important shooting projects. To use *GSCalc*, you'll need: a Windows-based PC; a scanner, including scanning and image editing software that will save images in Windows bit map format (".bmp" extension); and a printer.

Like virtually all software, you'll need to use *GSCalc* in a particular way and it will produce the results you want only if you use it in that way. If you will just work your way through this manual, using your own PC, scanner, and printer, you'll soon be obtaining, and storing, target results that extract all possible information from each target group. With this information, you'll be able to make realistic comparisons as to whether a load change has made a difference or not. You'll also be able to find, view, and print your stored targets full-size on screen and on paper.

At this time, please print this file out and then close or minimize your word processing software (get it off the screen). Refer to your hard copy of this document for the rest of your introduction to this software. This will allow you to make notes in the margins, as needed, and will keep you from having to try to read "around" the other things on the screen (or switch your word processor in from of the other items) in preparation for your next move. Keep your hard copy in a handy place so you can find important settings you have noted on it in the event that you have to reinstall the software.

## The Plan

It's always a good idea to take a look at the forest prior to looking at the trees or their leaves/needles.

So, here's the overall strategy. *GSCalc* can load either a scanned target image (in order to create a shot-location file ["gsc" file]) or it can load an existing shot-location file to show you a virtual image of your target and present crucial target statistics.

You'll use your scanner (properly set and adjusted) to create an image of your target. You'll then load that target image into *GSCalc* for viewing and will use your mouse to "click-in" the on-screen locations of your point-of-aim and of the target's several shot-impact locations. *GSCalc* records the location of each clicked-in shot for the group, recording the X,Y location of each shot relative to the location of the point-of-aim.

You can then save this shot X,Y location listing as a "gsc" file. At any time, you can load this saved gsc file into *GSCalc* to recreate a virtual image of your target. Therefore, after saving the gsc file, you no longer need the large scanned-in file of your target.

Alternatively, if you care more about group sizes, *per se*, than about their distance from the point-of-aim, you can ask *GSCalc* to recalculate the group as if the group's center-of-mass were its point-of-aim. You would then save THAT as your "gsc" (shot placement) file, and be able to load it and recreate the target image (showing dispersion of the shots around the group's center-of-mass) at any time desired. The software allows you to save both types of groups, if desired, as separate files.

Regardless of whether your "gsc" file records the shots relative to the point-of-aim or the group's center-of-mass, *GSCalc* provides valuable output regarding the group "size" (the center-to-center distance of the two most widely separated shots) and provides a far more valuable analysis in the form of two other parameters: the mean radius (from the group's center-of-mass); and the standard deviation of the radii (from the group's center-of-mass). These two values, as described herein, encapsulate nearly all the information that EACH shot has to offer, not just the information from the two most widely separated shots.

With *GSCalc*, you'll be able to recreate and print, at a one-to-one scale (or blown up or shrunk down, as needed to be clearly visible on the screen), every group you have scanned in. There just isn't any other means for storing such information that even comes close to what *GSCalc* can provide, in that regard, and it takes so very little time to scan in an important target that there's just no reason to put off enjoying these advantages. This is especially true regarding "proof" targets you shoot for the special handloads you develop that wring the best performance out of your firearms.

We wrote all portions of this manual in a way that is unlikely to leave a person stranded who has little familiarity with computers. For those of you who are quite adept at computer use, thanks for your patience with the detailed instructions.

The GENERAL section of this manual addresses the basic stuff you just have to know. The HANDY ADDITIONAL FEATURES AND CONSIDERATIONS section will inform you about special features that you'll want to know about once you're familiar with the basics. Let's get started.

## Installing *GSCalc*

Available on the *GSCalc* website (<http://rawilson.net/shareware/index.html>) are two similar zipped files ready for download - one is a standard "zip" file, the other a self-extracting "zip". Both contain identical versions of *GSCalc*, the choice is yours which to download. The former, the standard "zip," requires you to have **WinZip** or a similar program available on your PC in order to extract the program's files. The self-extracting zip is a little larger, but, as the name implies, is capable of extracting the files on your PC without the aid of additional tools. In either case, download the desired file to a temporary folder on your PC.

Following the instructions at the *GSCalc* website, you should have created a "**Targets**" folder on

your hard drive (e.g., C:\Targets) and have downloaded the following items to it: this document; the file **Greyback.jpg**; and the sample target scan image **44\_788.bmp**.

If you have chosen the standard zip file, using "**Start->Run->Browse**" (click the **Start** button, at the lower left of your screen, choose **Run**, then click on the **Browse** button) or **Windows Explorer**, find your way to the temporary folder to which you downloaded the program, locate the file "**gsc.zip**" and double click on the file. Assuming you have **WinZip** or a similar program, this will start up a **WinZip** window displaying the contents of the file. Click on the Extract button and accept the default destination. This will create a set of installation files (in particular "**setup.exe**") in the current folder. You can remove these files may after installing the program.

If you have chosen the self-extracting zip file, use "**Start->Run->Browse**" or **Windows Explorer** to locate the "**gsc.exe**" file and double-click on it. Accepting the defaults will create a set of installation files in a folder named "C:\usr\install\temp\gsc" (again, of particular interest is "**setup.exe**"). This folder and it's contents may safely be deleted after the program has been installed.

On most PCs, it's best, at this point, that you close all other applications running on your PC. Then, using "**Start->Run->Browse**" locate the "**setup.exe**" file described above, click on it once to "select" it (the icon darkens), and click the **Open** button and then the **OK** button. This installs the **GSCalc** program on your PC. Accepting the defaults will put the program and it's associated files in the C:\Program Files\GSCalc folder and place a **GSCalc** shortcut on your **Start** menu (under "**Programs**").

Once you have a successful installation, you no longer need the temporary installation files (including the initially downloaded zip file) so you can delete them.

**GSCalc** installs itself in the **Program Files** folder on your hard drive (C:\Program Files). To start **GSCalc**, you could go to the GSCalc folder in **Program Files** and then double-click on the target icon there. However, it's a good idea to access the **Program Files** folder as seldom as possible because it contains the special files your PC needs to run properly. Given its sensitive contents, it's not a good idea to "do work" in that folder. Therefore, we'll establish a pointer to the GSCalc folder that you can keep on your desktop. When you double click on this icon, it will find and start your **GSCalc** software without your having to enter the sensitive Program Files folder again.

Clear your screen of all files and programs you have open by closing or minimizing them. Use **My Computer** or **Windows Explorer** to find the **Program Files** folder off the root of the C: drive. Double-click on the **Program Files** folder to open it (if it gives you a warning, just click on the **show files** option), then find and double-click on the **GSCalc** folder. You should now be viewing the list of files contained in the **GSCalc** folder. If your **My Computer** or **Windows Explorer** frame covers the entire screen, then resize it so that you can see your PC's desktop. (HOW: if the middle of the three little buttons in the extreme upper right of the frame shows two frames, then click on it. This should shrink the size of the frame. However, if it still covers the entire screen, use your mouse to pull in the edges of the frame.)

Now scroll down, if necessary, until you find the icon that looks like a target and has the name, "**gscalculator.exe**" - this is the file for which you want to create a pointer. RIGHT-click once on this file's target icon and choose the **Create Shortcut** option. This will create a duplicate target icon named "**Shortcut to gscalculator.exe**". Left-click on the duplicate target icon and hold down your click as you move the icon out of the **My Computer** or **Windows Explorer** frame and drop it onto your PC's desktop (by releasing the mouse button). Now minimize or close your frame and you should find the duplicate target (for **GSCalc**) icon on your desktop. You can leave it there or (better yet) you can drag it down and drop it on your **Start** bar, in which case you'll have the icon both on your desktop and on your **Start** bar.

## Getting a Hard Copy

Since updates are made occasionally to *GSCalc* it is easiest (and cheapest) to acquire your copy of the program via the internet. However, if you do not have access to the internet you can request a "hard copy" (CD ROM) by sending \$15 (this includes the registration fee) to the address shown in the next section. This CD ROM contains the "unzipped" installation files and allows you to install *GSCalc* like you would any other program. Future updates to the program will be distributed via CD ROM only by specific request and will be subject to a \$5 shipping and handling charge (updates will always be free via the internet).

## Registering *GSCalc*

Several features of *GSCalc* are disabled until the program is registered - the most important of these is the ability to calibrate your system (set your **Magic Number**) for accurate measurements. Registration is still a snail-mail operation. Send \$10 (\$15 if requesting a CD version) in US funds to:

Ralph Wilson  
2000 N. Naperville Rd - 2F410  
Naperville, IL 60566

Prior to sending the registration fee in blindly, visit <http://rawilson.net> and use the email link therein to contact the author and double check that the above address is still valid. Include with your registration fee a sheet of paper with your name, email address, snail-mail address (especially if you're requesting a CD version) and which program you are registering (*GSCalc* in this case). As soon as your registration fee is received you will receive an email with the following information:

Your name: \_\_\_\_\_

Your email: \_\_\_\_\_

Your Registration code: \_\_\_\_\_

Write this information in the spaces above **exactly** as you receive them in the email. The registration program is both white space and case sensitive, so pay particular attention to those items as you write them down (we also recommend that you save this email where you can find it later if needed and print out a hard copy to keep with your manual's hard copy).

To register your copy of *GSCalc*, start the program. On startup the program will prompt you with a "nag screen" requesting that you register your program (by now, you're probably all too familiar with this nag screen and will be glad to know you're just about to kiss it goodbye for once and all). Click on the "Register My Copy of GSC" button<sup>1</sup>. This will start another window that has user entry fields for the three pieces of information you gathered above. Type your name, email address, and registration code into the appropriate boxes **exactly** as they appeared in the registration email you received. A handy way of doing this is to have the email open in one window while you're registering your copy of *GSCalc*. You can use your mouse to highlight each field in the email (click and hold down the left mouse button as you move the cursor across the appropriate text in the email), "Copy" the field onto your clipboard (type *control-c*), click your mouse in the appropriate text box of the registration window, and paste the information there (type *control-v*). After you have entered all three fields exactly as shown, click the "Register Now" button. If you have entered all the information correctly, you should get a pop-up window that says "Registration successful." If you are unsuccessful, double, triple and quadruple check that you entered the information **exactly** as

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1. You may also start the registration process any time the program is running by clicking on "Help->Register Group Size Calculator"

received. If you still have trouble, contact the author by visiting the website at <http://rawilson.net> and using the email link. Once you have registered, future updates to the program are free and your registration code will remain valid.

Once registered, the program will remember your favorite settings each time you exit and restart the program. But, more importantly, it will now allow you to calibrate your system by setting your Magic Number.

## Calibrate Your Scanner

Next, use the "**Set Magic Number**" feature, in *GSCalc*, to calibrate your scanned images such that the Shot Scanner will accurately measure your targets. Before the program will allow you to calibrate your system, you must have registered your copy of the program.

To calibrate your scanner/scanned images/display:

- 1) Start *GSCalc* then click on its **Options** tab and select either Metric or English units. [Hint: if it reads "**Metric**," then you are set up for English units and you would click on **Metric** to change to metric units. So, if you want English units (inches), this option should read "**Metric**."]
- 2) Click on the **Display** tab and select the **Set Magic Number** option. This will bring up a window for you to input your magic number. For now, set the magic number to 1 and click the **OK** button.
- 3) Boot up your scanning software and set it for black-and-white scanning at 72 dots per inch. Place an accurate ruler directly across the glass of your scanner (so that the scale will be horizontal in the resulting image) and scan in a picture of it. [Hint: for some scanners, or scanning software, it may be necessary to make sure the scan destination is set to the monitor screen]. Make NO changes to this image. Save it as a .bmp (Windows bit map) file by clicking on the **File** tab of your scanning program and selecting **Save As**, then name the file "ruler" and choose "Windows bit map (\*.bmp)" as the file type. [Hint: with some software, this file type is called "Windows or OS/2 bitmap (\*.bmp)]. Before saving it, be sure that its destination folder is the **Targets** folder you've created for your *GSCalc* work. Click the **Save** button. Your **ruler.bmp** image file is now saved to your **Targets** folder. [Hint: if your scanning-an-image editing program will not output files in bmp format, you'll need to get one that does - like *Jasc Paint Shop Pro*.]
- 4) Hold down the Alt key and hit the Tab key [abbreviated "Alt-Tab"] to return to *GSCalc*. Then open *GSCalc*'s Shot Scanner by clicking on the <GO> button (at the bottom of the frame), check that the **Files of type:** frame indicates **Scanned files (\*.bmp)**, and that the **Look in:** frame indicates the **Targets** folder, then find select (single-click on) your **ruler.bmp** file and click on the **Open** button to load the scanned target image into *GSCalc*. You should now be looking at an image of your scale, with *GSCalc*'s **Shot Scanner** utility, and the scale should extend horizontally across the page.
- 5) Using the **Shot Scanner**, first establish your "zero" reference mark by RIGHT-clicking exactly on the left-most inch/cm mark, then move to the right and LEFT-click on the next inch/cm mark. In the companion **Trajectory Results** frame, your first LEFT-click will show the X and Y coordinates of that location, compared to your 0,0 location (the 0 location on the scale, where you RIGHT-clicked). The "X" value (of the X, Y pair) will be your "Magic Number." In other words, the measure of 1 inch (or cm) on the 100% scale is the "Magic Number" for your particular system. A number in the range of 900 is typical. You can obtain a more accurate number by measuring a span of several inches/cm and

dividing the displayed number by the number of inches measured. Once you have determined your Magic Number, write it down here:

My Magic Number is: \_\_\_\_\_

- 6) Close **GSCalc**, then re-open it and re-set your Magic Number to this value [click on the **Display** tab, choose **Set Magic Number**, enter your number in the window, then click the **OK** button]. From now on, **GSCalc** will remember and use your Magic Number. The only reason you'd need to change it is if you change your computer monitor, or scanner, or your scanner's software.

**GSCalc** has a special way for processing small groups, such as the ones you'd expect to obtain using certain premium varmint or benchrest rifles. This will involve two more ruler-scans, using a special approach, to validate that you are doing everything right. We'll cover this later on in the **Tricks For Analyzing Small Groups** discussion in the **ADDITIONAL FEATURES AND CONSIDERATIONS** section. For now, let's go over how to input shots from a scanned target.

## Saving And Then Clicking-In A Scanned Target

*Note: Once you've worked your way through this document, you may have need for a short list of critical reminder points. In that case, look for the "Short-Cut" listing (see below) at the start of each topic heading. The first time through, just skip over all of the Short-Cut listings.*

**Short-Cut:** Let's assume you've already created a project folder and saved your target-scan bmp file there. In **Group Size Calculator**, import your target's bmp file. This opens the **Shot Scanner** window. Check the scale value (usually = **100%**). Choose a cursor that matches your shot holes as closely as feasible. First, **RIGHT**-click on your point-of-aim, and then **LEFT**-click each shot-hole, in turn and, last of all, hit the **Done** button. You see your target now as a virtual target. Save it as a gsc file. **GSCalc** can open up your gsc file at any time to give you your virtual target view and target statistics.

It is obvious that, before you can work with a scanned target image, you must scan that target. However, it'll be easier and faster for you to get familiar with **GSCalc** if we use an existing scanned target image, for now, and then address the subject of target scanning later on.

One of the files you were supposed to download (from the **GSCalc** website to your **Targets** folder) was **44\_788.bmp**. This is the target image we'll be using for your initial run-through with the software. However, it also serves as a good example of how you'll want your scanned target images to look - all bullet impact locations show up crisp and clear. Boot up your scanning software (or other image-editing software) and use it to open the file **44\_788.bmp**. Note how clearly you can see each of the 10 shot strike locations (shot with a Remington Model 788 rifle in 44 Magnum caliber at 100 yards). This is how your scanned targets should look. For now, let's assume that you've just scanned-in this image from your target.

**Create Project Folder** - Before you can save this target image (remember: we're pretending that you've just scanned it in), you must create a project folder, within the **Targets** folder, that will hold all of the image and other files for this project. Give your new project folder a name that will make sense months later when you see it again. Since our purpose, here, is to give you a few lessons on how to get the most out of **GSCalc**, let's name the new folder **Lessons**. [HOW: Using either **My Computer** or **Windows Explorer**, drive to the **Targets** folder and then tag the **File** tab and select **New**, and then choose **Folder**. A new folder icon will appear in the listing and you can type in its name (in this case, **Lessons**)].

**Save Scanned Target Image To Project Folder** - Use Alt-Tab to go back to your scanning program (it becomes the "active window," as indicated by its colored head-bar). Your target image is ready to save. We're pretending that you've just scanned it in, so let's save it, now, to your project folder (**Lessons**). Choose the **File** tab, then select **Save-As**. Options from here on are software-specific, but you'll need to: name the file [let's use "44\_788"]; choose the file format [always Windows bitmap (\*.bmp)]; designate the destination [in this case, the **Lessons** folder, located in the **Targets** folder]; and hit the **Save** (or **OK**) button. Your sample target is now a bmp file named **44\_788.bmp** in the **Lessons** folder. This is important: **close the image in your scanning software (hit the "X" in the image's upper right corner) so that the file is available for other software (e.g., GSCalc) to open.**

**Open The Target** - Open *GSCalc* (if it isn't already). If it is not maximized yet (doesn't cover the entire screen), then click the middle of the three little boxes in the upper right corner of the frame. . . *GSCalc* should now cover the entire screen. That's how you'll want to work with it from now on.

Load your saved target scan as follows: click on the <GO> button (center of bottom of the window) to bring up the file choice window; in the "Files of type:" frame, click the button on the right end and choose **Scanned files (\*.bmp)**; if necessary, click the button on the right side of the frame at the top of the window and move to the current project folder (in this case, the **Lessons** folder); find and select (single-click on) the **44\_788.bmp** file; and hit the **Open** button.

Note that you now have three *GSCalc* frames showing: the **Shot Scanner** window, which shows your scanned target image; the **Trajectory Results** window, which will record your shot-identification information; and the **Group Size Calculator** window (we won't use it again until after clicking-in the shots).

At the top of the **Shot Scanner** window will be a scale value. For most work, you'll want it to read "**Scale = 100%**" (as discussed later on, you only use the 200% and 400% settings for target images you've scanned in to produce a magnified view). If it doesn't read 100%, tag the **Scale** tab and choose **100%**.

**Choose Your Cursor** - Before clicking-in your strike points, it's best to change your cursor to a size that most accurately reflects that of your strike holes. In our sample case, choose the **Cursor** tab and pick **Duplex...** and then choose **Large Duplex**. You can try out the other cursor shapes and sizes on your own targets later.

**Establish Your Point-Of-Aim** - Before clicking-in your actual shots (using the usual left-click), you should first click-in your point-of-aim on the target using a **RIGHT**-click of your mouse. In our case, with the **44\_788** image, the point-of-aim was at the bottom of the black triangle that extends down from the top of the image. Go ahead and **RIGHT**-click once on this point-of-aim. Nothing appears to happen. However the location of each of your other shots will be given as relative to this point-of-aim location. If you don't like where you set the point of aim, or think you moved as you right-clicked, simply realign your cursor and **RIGHT**-click again.

**Click-In Your Shots** - Think of a sequence for clicking-in your shots so that you will be sure to avoid either clicking a given shot twice or leaving a shot un-clicked, then **LEFT**-click each strike-point in turn (one **LEFT**-click per strike-point). For purposes of our current target, let's start with the clump of four shots and then proceed clockwise around the pattern. As you click each shot in turn, note that its X,Y coordinates appear in a growing list in the **Trajectory Results** window. *GSCalc* uses the center of each shot for all calculations so be sure to center the cursor accurately prior to clicking the **LEFT** mouse button.

When you are done, count the number of X,Y locations shown, to be sure that you didn't miss any, and be sure you didn't sample any of them twice (i.e., for our sample target, you should have ten

X,Y data lines, each different from the others). A version of this X,Y listing will constitute your main file (called a "gsc file") for this target. . . **GSCalc** uses this information to draw your target and as the basis for recreating all Group Statistics values. If a shot is missing and you can determine which it is, simply align the cursor on the shot and LEFT click - it will be added to the list. If you can't figure out which is missing, or if you feel you have somehow messed up while clicking in the shots, simply click on the "Clear" tab and start over. Clicking-in takes very little time, so re-doing it is no problem (but don't forget to RIGHT-click on the point-of-aim before redoing your left-clicked strike locations).

If all is OK, then click the **Done** button at the bottom of the **Shot Scanner** window to complete the file.

**View Your Virtual Target & Target Statistics** - When you click on the **Done** button, the **Shot Scanner** window disappears, the **Trajectory Results** window changes to the **Group Statistics** window, and the **Group Size Calculator** window displays your target with a red circle centered on the point-of-aim, with a green X on the group's center-of-mass, and with each shot-strike location indicated by a circle.

We'll fix the hole caliber later but, except for that, the virtual target should now look just exactly like the one you shot, but it's on a grid background, the point-of-aim is shown, and the shots are red circles (not ragged holes). The text in the **Group Statistics** window will read something like the following, for our sample target (yours may vary a bit):

```
*****
file : D:\WPFILES\TargetAnalysis\Manual\Lessons\44_788.gsc
From 44_788.bmp (sample bmp for practice)
Number of Shots: 10
Number of Fliers: 0
Group Size: 4.151 in.
Average Radius: 1.291 in.
Radius Standard Deviation: 0.497 in.
Group Center: (-0.464, 1.282)
```

Note that the "Group Size" designation is the conventional center-to-center spread between the two most widely divergent shots. This standard parameter represents about the best possible way to throw away around 80% of the information your target can provide you.

A much more useful parameter than "Group Size" is the "Average Radius" [the average distance by which a shot misses the group center-of-mass =  $(\sum \text{radius}) / (\text{number\_of\_shots} - 1)$  ], because this includes consideration of the location of each shot in the group, not just the two most widely separated ones (i.e., the two oddest shots). It IS important to consider the two oddest shots in the group, but that's no excuse for ignoring the information that the more typical shots provide. Characterizing your load by reference only to its two oddest shots is like characterizing the human race by using Charles Manson and Adolf Hitler - neither a pretty picture nor an accurate one.

The "Radius Standard Deviation" (**RSD**) parameter is, roughly, the average variation in how much each shot's radius differs from the Average Radius. Mathematically, it looks like

this:  $\sqrt{(\sum (\text{radius} - \text{averageradius})^2) / (\text{number} - \text{of} - \text{shots} - 1)}$  , but don't let that throw you. . . . it's far easier

to use than to calculate, and **GSCalc** does all the heavy lifting for you. For most users, this parameter is useful for validating that you have a "typical" group. Most typical groups have a RSD that is around 1/4 to 1/2 of the group's Average Radius value. By contrast: a ring-shaped group (no holes in the center. . . indicating a action/barrel bedding or throating problem) will have an RDS value that is



<20% of the Average Radius value; and a group with lots of fliers (i.e., a good cluster in the center and then several widely-divergent shots, indicating either a bad load or bad bullets) will have an RSD that is >50%.

These proportion-limits are just general rules of thumb. In most cases, you'll be clicking-in only good normal groups that represent results from good loads shot from good pieces, so the RSD will be around 1/3 of the mean radius. However, if you are clicking-in an odd group from a troublesome rifle (perhaps to send, by e-mail, to your riflesmith), then don't be surprised if you get an RSD that is considerably larger or smaller than this.

The Group Center values are the X,Y coordinates of the group's center-of-mass, relative to the point-of-aim. This can be very useful for telling you how much to change your scope-setting so that you get the desired mean strike-point elevation above the point-of-aim at the distance at which you shot your reference target - typically, 100 yards. In our example, and assuming our scope has 1/2 minute-of-angle clicks (around 1/2" change per click at 100 yards), if we wanted the group to be centered and two inches over the point-of-aim at 100 yards, our Group Center values (-0.464, 1.282) indicate that we'd have to come right one click and come up two clicks. *[Note: this Group Center value is always 0.00, 0.00 if the group has been redrawn to show the aim point as the center-of-mass of the group, as discussed later.]*

**Adjust Caliber** - The default shot-strike diameter for the **Group Size Calculator** window is 30 caliber. If you shot your target with something other than a 30 caliber weapon, you'll need to adjust the displayed shot diameter. In our case, we want it to mimic 44 caliber (0.429") holes, so we adjust it as follows: choose the **Display** tab; pick the **Set caliber...** option; click on the warning's **OK** button (it says that the program will re-display the target after choosing. . . just what you want); pick the correct caliber (0.429", in this case); and click the **Done** button. Your target reappears and, now, should look "just right." *Note: Since GSCalc uses the center of each shot for all its calculations, the caliber has no affect whatsoever on the group statistics.*

**Save Your P.O.A. Target Analysis** - As of yet, there is no record of your target analysis, relative to your point-of-aim (**P.O.A.**) . . . it's all sitting in your PC's RAM chips! Let's save your work.

If you don't care about the point-of-aim reference point, but DO care about the group characteristics themselves, then go to the next section. If you are mainly interested (or are ALSO interested) in showing your group relative to your point-of-aim, then your present analysis is your desired view and you should save it as follows. In the **Group Size Calculator** window: choose the **File** tab; choose the "**Save .gsc**" option. This automatically saves the X,Y listing file you saw previously under the same name, and in the same folder, as the target file you used, but with a ".gsc" extension. *[Translation: For our sample target, it saves a file called 44\_788.gsc in your current folder (Lessons).]* If you wish to view or analyze this target again, you'll go to that project's folder [the **Lessons** folder, in this case] and open the **44-788.gsc** file.

**Blow Away The BMP File** - Unless you need to show proof to someone that your analysis really does represent the target you shot, you no longer have any need for the large .bmp target image file. If you always keep them, they'll eat up your hard drive space at an astounding rate. The trick, in most cases, is to delete this source file, after you click it in and save the gsc file. From then on, you can rely on the small, efficient .gsc file to recreate a virtual image of the target and its statistics (especially the valuable Average Radius parameter), whenever you wish.

The best time to eliminate your .bmp file is right after you've converted it to a saved .gsc file. In that case: find the file, with **My Computer** or **Windows Explorer**, then select it (single click), and hit the **Delete** key and answer **Yes** when asked if you want to send this file to the recycle bin. By operating in this way, you can store an almost unlimited number of targets without the slightest real encumbrance of your hard drive's storage room - the .gsc files take up almost no space at all, yet

contain all information necessary for you to recreate the target image, and its Group Statistics, at will.

**Recasting The COM As The POA** - Often, in load development, you'll have little concern about the target's point-of-aim (POA). Rather, you are concerned about the how widely the shots pattern around the group's center of mass (COM). In that case, you'll want to recast your analysis to base itself on the COM, rather than on the POA. To do that: in the **Group Size Calculator**, choose the **Run** tab; and choose the **Zero Group** option. This changes each X,Y coordinate (in the hidden .gsc file that is held in your PC's RAM) to be recast to represent the shot's location relative to the group's COM.

At this point, save your .gsc file as follows: in the **Group Size Calculator** window: choose the **File** tab; choose the "Save .gsc As" option. Unlike with the "Save .gsc" option, this brings up a window that lets you choose the file name and location. Given that you located your target source file (the .bmp target scan) in your project's folder (**Lessons**, in this case), you shouldn't have to change the destination. If you have NOT saved the POA-based file, then just hit the **Save** button and your file will have the same base-name as your .bmp target scan file (but with a .gsc extension). However, if you've already saved your POA-based analysis (e.g., "44\_788.gsc") then you'll need to give your new file a different name to avoid overwriting that file. In that case, one way is to just add "COM" to the end of the file name ("44\_788COM.gsc"), prior to saving it. It is important to leave the ".gsc" extension on the file name.

## Scanning Targets

**Short-Cut** - Create a uniquely-named folder for your project, within the **Targets** folder; reset your scanner to black and white and 72 lines per inch before scanning any target for analysis by *GSCalc*; always place your gray-colored target backer behind the target before scanning it; never "resize" the scanned image before saving it; and always save the target image in ".bmp" format to the folder you've created for that project. If your scanning & image editing program will not export bmp files, get one that will.

**Print And Use The Grey Target Backer Sheet** - Your scanning of targets will go much faster and easier if you place a piece of grey-colored material behind (facing the back of) your target. This will make the holes clearly visible regardless of whether they are in the white or black portions of the target. The file you'll use to create your backer sheet - **Greyback.jpg** - is one of the ones in the zipped file you downloaded from the GSCalc website, so you should find it in your **Targets** folder. If not, you can download another copy of the **Greyback.jpg** file (at <http://rawilson.net/shareware/Gsc/Greyback.jpg> ). You'll not be importing this file into *GSCalc*, so it is in the heavily-compressed jpg (JPEG) image format to make it quicker for you to download.

Most scanning software will allow you to import and view graphics files, including bmp files. Open your scanning software (or an alternative image viewing/editing package like **Windows Imaging**, that is on your system), then use it to open and then print **Greyback.jpg**, which you've downloaded to your **Targets** folder [chose the **File** tab and tag the **Open** option, then steer to your **Targets** folder, check to be sure that it is set to show either jpg files or "all files", then find and select the **Greyback.jpg** file and hit the **Open** button]. It may not look like much (just a colored image). That's OK. Just ask the program to print it (be sure your printer is ON, then chose the **File** tab and tag the **Print** option). The resulting hard copy will be a grey-colored sheet with a narrow white margin. Keep this sheet in a handy place so that you can find it whenever you scan targets. However, if it gets lost or damaged, you can always reprint another one.

**Scan and Save Your Target Image** - There are so many scanners available! Typically, each one

comes bundled with a piece of scanning software that acts as the interface between your scanner and the PC (without this software, the scanner would be useless). There are nearly as many brands of scanning software as there are of scanners. Therefore, it is up to you to become familiar with your scanner and its attendant software. Once you have become able to scan photos and drawings, with your setup, the following instructions will provide more than enough information for you to create target scans that will be useable by *GSCalc*.

Stick your target into your scanner and place your gray-colored target backer grey-side-down atop the back of your target. Set your scanner to scan a black-and-white image at 72 dots per inch (dpi). Scan the image and then save it without changing its dimensions at all. Before saving, it is OK to use your software's functions to: "**Sharpen**" the image; adjust the contrast and brightness; and crop the image so it shows only the group. Just BE SURE to avoid changing image dimensions or dots per inch (should be 72 dpi). All of these functions will be program-specific, but you should be using them for scanning photos and such too, so they should be second nature by now. Use the program's **Save As** function (under the **File** tab) to save it as a "Windows bit map (\*.bmp)" file to the project folder you have created for it in your **Targets** folder.

The image quality you should expect is best viewed by example (see instructions above for loading the "**44\_788.bmp**" file that you downloaded, as instructed, with your software). If your target bmp files make it easy to identify the separate strike-points, as shown in the sample **44\_788.bmp** file, you'll have no trouble in using the file to create a very accurate gsc file that will recreate your target pattern at will.

Nearly all image editing software will import an existing bmp files, like **44\_788.bmp**. However, to create your own target scan bmp files, you must be sure that your image scanning/editing software will export files in bmp format. Some "Limited Edition" versions of popular scanning-and-image-editing software will export only in one format (not bmp). These will not work with *GSCalc*.

To find out if your image scanning/editing software will export in bmp format, use it to open **44\_788.bmp** (open your imaging software and then tag the **File** tab, choose **Open**, and then "steer it" to your folder [in this case, C:\targets\lessons], tag the **44\_788.bmp** file, and hit the **Open** key). OK, so it imported the image file. Now well see if this dog can hunt: tag the **File** tab, choose **Save As**, then tag the tab button at the right end of the "**Save file as:**" frame. Look for an option like, "**Windows bit map (\*.bmp).**" If you find a Save As option that names the ".bmp" format, then your image scanning/editing software will work fine. If not, then you'll need to buy and install competent scanning/editing software - like **Jasc Paint Shop Pro**.

Once you have an accurately rendered gsc file, you'll have no more use for the large, cumbersome bmp scanned image. Therefore, typically, once you have a good gsc file of a target, it is wise to delete the scanned bmp image, given that it is just taking up valuable space. With a good gsc file, which takes almost no space, you can readily recreate your target pattern on-screen any time you want, and you can easily print it out too.

**Comment Your GSC File Immediately!** - The first line in a gsc file is a comment line and as it comes from *GSCalc* may not be particularly informative to you. It's a good idea to change this comment line to something meaningful quickly before you forget what this file relates to.

Your Windows installation includes a simple little text viewing/editing program called *Notepad* that you can find as follows: hit the **Start** button (lower left corner of your screen); select **Programs**; select **Accessories**. You will need to use *Notepad* frequently, so create a shortcut for it (in the same way as described, above, for the *GSCalc* program) and place it on your desktop and in your **Start** button bar, right next to your *GSCalc* button.

Boot up *Notepad* and load the gsc file you've just saved (**44\_788.gsc**, in this case), as follows. In *Notepad*: click on the **File** tab and choose **Open**; in the **Files of type:** frame (near the bottom of the

**Open** window), click on the button at the right of the frame and choose **All Files**; in the **Look in:** frame (at the top of the **Open** window), click on the button at the right of the frame and drive to the correct folder in the **Target** folder (in this case, the **Lessons** folder); single-click on the correct file (e.g., **44\_788.gsc**) and then click on the **Open** button. This loads the chosen file into *Notepad*.

Replace the entire first line of the file with a brief target description. In our case, substitute, "Sample 44mag 788 target showing POA".

Now, save the revised file either by hitting Cntrl-S or by tagging the **File** tab and choosing the **Save** option.

Good work. Now, go and do the same thing with your **44\_788COM.gsc** file (gsc file made with all shots recorded relative to the group center-of-mass). Once you have both files commented, go onto the next section, where you'll re-open and look at them using *GSCalc*.

## Viewing And Printing An Existing Gsc File

**Short-Cut:** In *GSCalc*, hit the <GO> button, find your target's project folder, then (in **File of type:** ) choose 'Group files (".gsc")', select your gsc target image file, and hit the **Open** button. Adjust the caliber, if necessary (under **Display** and **Set Caliber**). To print this virtual target and its statistics, first darken the target image (choose **File** then **Embolden Target**), check that the printer is ON, then hit Ctrl-P.

**Viewing A gsc File** - Once you have saved a gsc file, it is ready to be re-imported into *GSCalc*. Lets do this for the two gsc files we've created: **44\_788.gsc** and **44-788COM.gsc**.

Use Alt-Tab to return to *GSCalc*, then hit the <GO> button. This tells *GSCalc* that you are through with the current view and wish to either load a new scanned bmp target image (see start of this document) or load an existing gsc file and view the results. Hitting the <GO> button brings up the **Open** window.

In the **Files of type:** frame, click on the button at the right and choose 'Group files (".gsc")'. In the "**Look in:**" frame, be sure that the software is viewing the correct project folder (**Lessons**, in this case). At this point, you should see both of our sample files listed: **44\_788.gsc** and **44\_788COM.gsc**.

Highlight the desired gsc file (**44\_788.gsc**, in this case) and hit the **Open** button. This loads your cleaned-up point-of-aim based gsc target file into *GSCalc*.

**Is Caliber Correct?** - Given a successful loading, you'll see your sample target and its attendant Group Statistics. *GSCalc* will assume that the caliber of round you used on your target is either 30 (if you have just booted up the program) or is the same as you specified in the gsc file you just finished viewing. Therefore, if you've been looking at gsc files shot with a 45-70 and now open a gsc file shot with a 22, you'll need to change the shot-image caliber (choose **Display**, pick **Set Caliber**, pick the caliber, and hit the **Done** button).

**Printing Target & Stats** - If you want to print this material, be sure your printer is on, and then do as follows: darken the target image by selecting the **File** tab (in the **Group Size Calculator** window) and choosing the **Embold Target** option. Your target's lines, circle, and impact rings will now seem raaaather too bold; however, that is just what you need for clear printing. Before printing, always check to be sure your printer is turned on! Choose **File** and then **Print Target** (or use the Ctrl-P keyboard shortcut) and your target image AND its Group Statistics will both go to your printer. You'll find that your target is printed full-size (this can be changed by setting the "**Display Scale**" under the "**Display**" tab at the top of the main *GSCalc* window). Note that if the description in the top line of your gsc file is too long, it will just run off of the page (it doesn't wrap). THAT is why you want to

include a full description of "How The Cow Ate The Cabbage" in a **WORD** file that you place in each project's folder, as described later on. THAT is the place to get as gabby as you need to be. The description in the first line of the gsc file must be very brief.

Good. Now, go back and bring up and print the other practice file (**44\_788COM.gsc**). Always remember to embold the target prior to printing it.

## HANDY ADDITIONAL FEATURES AND CONSIDERATIONS

### Name Each Unique Project Folder Wisely

**Shortcut:** Organize and name your project folders so you can find your project, from among many others, long afterwards. One good way is to have one folder for each of your firearms (in the **Targets**) folder, and then create a project folder within that rifle's folder for each project you have for it.

The mechanics of creating a folder are included in the discussion of "**Saving And Then Clicking-In A Scanned Target**," above. However, a folder's name is virtually useless unless it will save time by making sense to you in the future. For one thing, it's wise to keep all target analysis project folders in the **Targets** folder, since each project folder will contain target analysis (.gsc) files. However, it's also important to realize that, after a while, you'll have LOTS of project folders in that parent folder. Therefore, the trick is to name each project folder such that you will have a good chance of recognizing it years from now, by its name and location alone. In addition, in each project folder, it's wise to have a **WORD** (or other word processor) file that describes the project in more detail. That way, in the future, you can quickly home in on a group of two or three project folders. You then can use the project description file in each folder to identify which one of the several folders is the one you are after.

We suggest the following two-level approach to naming your project files, plus the addition of a narrative description file in each folder, containing a short description of the purpose of that project and the date, or dates, on which its experiment was carried out, plus a list of the loads tried and your opinions of each. It just takes one line per load that you tried.

At this point, you should be capable of creating folders at will for storage on your hard drive. If not, then please reread the material above.

We suggest that the first "level" of folders should be the guns themselves and the second level should be the projects you carry out with each gun. Therefore, if you have a Remington 788 in 30-30 chambering, you could create a folder named "**788\_3030**" in your **Targets** folder. If you did an accuracy work-up using Lyman 31141 cast bullets in February of 2002 with it, you could name the project file "**L31141\_Feb02**". If you did another project with that same rifle and bullet later that same February, it could have a folder named "**L31141\_Feb02b**". This project folder, and all others for that rifle, would be in the **788\_3030** folder, and would have gsc files for every important target that you shot for that project. As you can see, with this approach, it's easy to create a new folder with a location and name that will make it easy to locate in the future. . . you just go to that rifle's folder, look for a file that matches the bullet used and, if there are several, pick the one in the right date range. However, as described below, putting a date on the project folder is only a good idea when you are unlikely to do further work on that project subject.

An alternative way would be to organize your load project folders (within a given rifle's folder) just by bullet, with no date in the folder name. Then, within that bullet's folder, put all the final-load reference targets for each powder you've found works well with that rifle/bullet combination. The

**WORD** file in that folder would list all the loads you'd tried under each powder. . . you could show your favored loads, for each powder, in bold type, in addition to giving it praise in the text. The trick is to organize it like you would a regular set of files in a file cabinet.

Given the above-described project, you should create a Microsoft **WORD** file (or whatever your word processing software is) that described the goal of the project, lists the bad loads tried, and lists the final load or loads and any conclusions (e.g., "This rifle requires all cast bullet loads to be jammed firmly into the throating. Otherwise, it just won't shoot well."). This file, and your notes in it, will save you lots of time later because it will memorialize your loads-tried and conclusions.

Note that most targets you shoot, during load work-up, would be 3- or 5-shot groups and would NOT be scanned-in and then clicked-in. After all, bad loads seldom shoot well, so will give themselves away quickly, whereas good loads seldom shoot a bad 3- or 5-shot group. Using just a few shots per test load makes sense.

Your gsc files would be only for the final load(s), for each of which you would shoot a group with at least ten shots (see the discussion of "Sample Size," below). However, your **WORD** file will list all loads tried and any relevant problems noted, like: "22.5gr of H322 = 2300fps/80sd: velocity highly variable". Reading through this file, before going out and trying some new loads for that bullet and rifle, will save you lots of time.

This will be the only **WORD** file in that folder, so it'll be very easy to find it whenever you poke around in that folder. If you extend that project later (e.g., you try a powder with that rifle and bullet), you can update the **WORD** project description file and re-save it. Such a file becomes the key to your understanding this folder's contents in the future. . . it's a quick way to record everything you've done with that rifle and bullet.

## Sample Size

**Shortcut:** For any record target (for an important load) shoot at least ten shots.

For load-development projects, it only makes sense to go to the trouble to record your final loads. For comparisons between two components (say, a softer versus a harder cast bullet of the same design), you'll first develop the best load for each and then shoot a target for record, using that load.

Given how much trouble you've gone to, it's important to know how to obtain a group that provides the most accurate and complete reflection of your final load's capabilities. You may have several powders that work well, each with their own bullet, in that rifle. In that case you'll need to have a gsc file for each final load. Likewise, for exploratory projects (e.g., "How does one bullet stack up against another, in this rifle?), you'll end up with just a few key targets, each in their own bullet-specific folder, that you'll want to print out and compare with each other. You should include a blurb about each of these targets in your **WORD** project description file, and you should include a relevant very-short note in the top line of each gsc file itself, as described above.

Given that you'll only be using **GSCalc** on those few targets that represent milestones in your load development or testing, it is extremely important that you understand the concept of **sample size**! Whether you like it or not, in doing these target analyses under **GSCalc**, you are applying statistics to your shooting. For your target actually to represent your load, it must have a "sample size" (number of shots on the target) that is large enough to make it very unlikely that you are misled by the results - the larger the sample size, the more reliable the results.

Generally speaking a sample size of 10 is the minimum (10 shots of that load on that target). Larger can be better, but the benefits start really dropping off at a sample size of 20. **GSCalc** will allow a sample size of up to 32. For most purposes, you get the biggest "bang for the bang" with a sample

size of between 10 and 15. Use your three- or five-shot groups for load development, given the assumption that good loads won't shoot large three- or five-shot groups.

Once you find the load that is "the bees knees," test it with a 10-to-15 shot group. If it doesn't work out, then keep looking. If it does give you a nice tight group, then mark and keep that target as your reference target for work-up with *GSCalc*. With a carefully-shot group with a sample size of between 10 and 15, you can depend on the resulting Group Statistics to provide a viable indication of your load's capabilities in THAT rifle, when shot in THAT manner (i.e., from the bench, or from a given field position. . . however you shot that group). That leads us to discussing field positions.

## Duplicating Field Conditions

**Shortcut:** How you shoot a load off the bench is no indication as to how well you'll be able to place your shots with it from various field positions. After you develop your load and shoot a reference group for it, shoot another reference group for each of the field positions you are likely to use with it. That way, you can tell you and your load's actual field performance.

Once you have a load that is just right for your purpose, when shot from the bench, it is important to realize that there are very few hunting situations in which such a bench is available. Therefore, please consider shooting a 10-round group, with that load and rifle, from each of the field positions you are likely to use it with. Take each such target back and run it through *GSCalc*. For example, for a varmint load, shoot a reference group from the portable bench or cross-sticks you use in the field. This really helps.

The **Average Radius** readout is extremely valuable, in this regard. For example, as more fully explained under the **Statistical Considerations For Everyone** section, if it is a varmint load and has a mean radius of 0.2", from the bench (for a 100 yard group), but 1.0" from a given shooting stance (for example, from the sitting position) then, if you are shooting at a 2" wide ground squirrel, it works out that you'll miss around 1/3 of the time (from that position [sitting] at that distance [100 yards]). From your portable shooting bench, let's say that same load gives you a mean radius of 0.3". In that case you'd miss the standing squirrel around 1/3 of the time only when they are at a distance of 330 yards, assuming no crosswind problems. It is these sort of considerations you must ponder when bringing up and viewing your position-specific groups with *GSCalc*.

The above rule of thumb applies to tall-and-narrow animals, whether they are standing or on all-fours. If, however, you are working with a ROUND target, such as the 8" diameter quick-kill-zone for a deer, then the "miss" rate (for that kill zone only) is around 1/2 of the shots at a circle having a diameter of twice your reference group's mean radius. In other words, if your mean radius is 2" - at a given distance, for that load and shooting position - then you'll hit a 4" diameter about half the time at that distance, from that position.

By comparison, what will your "Group Size" parameter (distance between the two most widely separated shots in the group) tell you? Damn little, that's what, but it's a popular mode of measurement, so *GSCalc* provides it in the Group Statistics.

One good way to get a visual idea of the hit reliance of your load is to print out the target and then hold up a scaled-down kill zone against it. For the printout of the **44\_788.gsc** target you have, your average radius is 1.3", so hold up a finger-spread twice that wide (2.6" across) centered on the group and you'll see that, for a standing prairie dog that wide, around 1/3 of the shots would miss at 100 yards and around 1/2 of this shots would miss a circular 2.6" wide target at that distance. To see how it would do at 200 yards, hold up a 1.3" wide strip (the 200 yard 2.6"-wide prairie dog's equivalent width at 100 yards), and you'll see that the load would miss around 2/3's of the time. Remember,

though that your rifle will never again shoot that exact same shot distribution. . . it's just a sample. So, once again, the larger the sample size the more value you can extract from the target. Three- and five-shot groups are for load work-up; ten- to fifteen-shot groups are for record.

For yet another twist on estimating your group's capabilities at distances other than the one at which you shot the group, see **Guessing Accuracy At Different Distances**, under the **Statistical Considerations For Everyone** heading, towards the end of the manual.

## Tricks For Analyzing Small Groups

**Shortcut:** *GSCalc* offers a special way to magnify small groups so that you can tell where each shot went. For most applications, the 2X option (using bmp images scanned at 144 dpi) works best. For a finished small-group gsc file, you can view/print the group magnified 2X or 4X.

For small targets, *GSCalc* has a special feature in the **Shot Scanner** window (the one you use for clicking-in shots while viewing your bmp file). *GSCalc*'s view, in the **Shot Scanner** window, is based on the number of lines in the image, and it assumes that your Magic Number will give you 72 dots per inch of target image. Therefore, if you scan your target image at 144 dpi (twice the usual line density), the **Shot Scanner** will show it magnified twice. Similarly, if you scan in a very small target image at 288 dpi (four times the usual line density), the **Shot Scanner** will show it magnified four times.

This magnification allows you to see your small group more accurately. There's an even better trick, though. Before clicking-in your shots, in the **Shot Scanner** window, first tag the **Scale** tab and choose either **200%** (for a 144 dpi target bmp image) or **400%** (for a 288 dpi target bmp image). Also, before clicking-in, choose a cursor that gives the best fit for your shot diameter, as it appears in the magnified image (tag the **Cursor** tab and try various cursors. . . you'll need a bigger cursor to match your shot diameter than you'd need at a 1X scale).

With your **Scale** set to match your magnified image's dpi (i.e., for a 144 dpi image, you have chosen the **200%** scale setting), *GSCalc* will then record your ACTUAL click X,Y locations. In other words, you click-in on the magnified image, but *GSCalc* recalculates and records your click-locations at a 1X scale. For very small target groups, this feature allows you to obtain a more accurate location for each shot.

One thing to consider is that each click-in cursor image (e.g., circles) has only one screen size, no matter the magnification of the target image. Therefore, one must use a small caliber rifle for the 400% (4X-magnification at 288 dpi) setting; otherwise, there will not be a click-in cursor large enough to provide a good match with the holes in the target. This is less a factor with the 200% (2X magnification at 144 dpi) setting, so it is the most useful of the two magnified target click-in options.

In order to keep things straight, when using a line density larger than the standard 72 dpi setting, it is best to add an "X2" to the end of the file name of a target scanned for 200% viewing (at 144 dpi) and to add an "X4" for a 400% blow-up (target scanned at 288 dpi). This way, you'll have a clear hint to reset your **Scale** function to 200% or 400% prior to clicking-in that image. *GSCalc*'s default **Scale** setting (when you boot-up the program) is 100%. However, once you reset the **Scale** setting to **200%** or **400%**, it will remain there until you either change it again or close down the program. The current **Scale** setting appears at the top of the **Shot Scanner** window. Be sure to check this every time, prior to clicking in, to be sure that the **Scale** setting matches the target image with which you are about to work. Otherwise, you could end up producing bad data very carefully - most irritating!

The gsc file you produce with these magnified **Scale** settings represents full scale measurements, the same as if you'd clicked-in on an image scanned at 72 dpi (for the **100% Scale** setting). Therefore,



you'll want to remove the "X2" or "X4" from the back end of the file name prior to saving your clicked-in data as a gsc file. The easiest way to do this, once you've clicked-in your target and clicked **Done**, is to choose the **Save gsc As:** option (under the **File** tab in the **Group Size Calculator**) and then eliminate the "X2" or "X4" prior to saving the raw gsc file.

If you want to try this option, then validate your understanding of it first by scanning and saving bmp images of your horizontal (X-scale) ruler at 144 dpi (200% ) and 288 (400%). Bring up the ruler image in *GSCalc*, set the **Scale** function appropriately, and then click-in on the even inch marks. The resulting X values (in successive X,Y pairs in **Group Statistics** or the gsc file) should read 1" apart. Otherwise, you are doing something wrong.

In addition to clicking-in your small-group targets under magnification, you can also view your small group's virtual target (from the gsc file) magnified. When you bring up a small target that has been scanned using this method and then saved as a gsc file, remember that the imported gsc file will default to the 100% scale unless you've been viewing other targets magnified. First, check to be sure that the target is displaying in the correct caliber (**Display** and **Set Caliber...**). To magnify the target image, if desired, tag the **Display** tab, choose **Set Display Scale...**, and choose either the **2"=1"** option (for 2X magnification) or the **4"=1"** option (for 4X magnification). Note that the printed grid becomes twice as loose with the 2X compression and four times as loose with the 4X compression. The distance between each pair of adjacent lines still represents an inch. This doesn't affect the **Target Statistics** output.

You can print this magnified view just like any other (**File** tab and then **Print Target**). Remember, though, that it often helps to make the view darker, prior to printing (**File** tab and then **Embold Target**).

## Tricks For Analyzing Large Groups

**Shortcut:** There's a way you can hand tally the X,Y locations of shots in groups too large to scan. Using the hand-typed gsc file, you can view/print the group shrunk 2X or 4X to fit on your screen/paper.

Believe it or not, there are a number of situations where you could want to use *GSCalc*, but the group is just too darned big to fit into your scanner. For example, let's say that you're trying to see how well you can keep your shots within a 10" quick-kill-zone at 150 yards, using your favorite big-bore revolver and heavy cast bullet load from a sitting position. Out of 12 shots, you got eight within this zone but, overall, the impacted area of the target is too big to fit into your flatbed scanner. Another example would be targets you'll have while working up loads for 1000 yard shooting.

In such a case, you can work up your gsc file by hand, rather than by using the **Shot Scanner** on a bmp file. It's relatively simple to determine the X,Y positions, type them into *NotePad*, and save it as a gsc file. It just takes longer than if you could click-in the shots.

You'll need a thumbtack, some carbon paper, tape, a pair of scissors, a sized cartridge case (same caliber that you used to fire the target), and gridded engineering paper (1" bold marks and 0.2" light marks) large enough to cover your group; you can get this paper in a variety of sizes from an engineering/drafting supply store.

Stick your thumbtack down through your target's point-of-aim (**POA**), then pull it back out. Figure how you'll want to position your engineering paper so that it will underlay your group. With the grid paper roughly in place above the target, pick the heavy 1"-grid intersection that is nearest to the target's POA and stick the thumbtack down through it and pull it back out again. This intersection will be the 0,0 position for all shot-location X,Y measurements.

Re-insert the thumbtack into the hole you've just made in the engineering paper, but from the bottom up, and lay this assembly point-up on a flat surface. Position your target face-up so that the thumbtack sticking up (through the engineering paper) enters the target's POA perforation. Rotate the target as necessary to make its horizontal and vertical lines match the engineering paper's grids.

Your target and the engineering paper are now registered, one with the other, because: **1)** the X and Y directions of both papers are parallel; and **2)** the "0.00, 0.00" X,Y location on the engineering paper is directly underneath the target's POA.

Hold the two papers together as you move the top end to hang over the edge of the table. Use the scissors to cut through both papers to remove the overlapping paper and to cut off as little as possible of the one that's not overhanging the other. Put tape around the edge (from one paper to the other) in at least two locations along this cut edge. Remove the thumbtack.

Don't worry. . . You'll do all of the above twice in the time it took to read about it. Your papers are now locked in registration with one another. Insert a carbon paper **carbon side DOWN** between the papers so that it underlies some of the holes. For all holes that have the carbon paper underlying them (you can see it through the holes), use the mouth of the sized case to mark the underlying engineering paper by overlying the casemouth over the hole and pressing down while rotating. Check each hole off (on the target) as you complete its transfer. Move the carbon paper around as needed to do all of the holes, then remove the carbon paper, lift the target sheet and validate that you have a clean, clear transfer for each shot (e.g., count the shots). Remove the target. From now on, you work only with the engineering paper.

Using the 0,0 point as a reference, write down each shot's X,Y coordinates next to its hole: X values are positive to the right of the 0,0 location and negative to the left; Y values are positive above the 0,0 location and negative below.

Create an appropriately-named project folder in this rifle's folder (which is located in the **Targets** folder on your hard drive). Now you have a place to put your gsc file once you've created it. Boot up **NotePad**, enter a short basic load/distance description on the first line, hit the Enter key (Return), and enter all of your X,Y values, hitting the Enter key after each one and **inserting a comma** and one-or-more blank spaces between the X and Y value on each line (the comma is the trick, the space or spaces just make it easier for you to view). Upon entering the last X,Y pair you can either stop there or hit the hard return just once.

Use **NotePad's Save As** function (under the **File** tab) to name the file with a .gsc extension and save it to the folder you've created for this project, as follows. In **NotePad's Save As** window, be sure that: the **File name:** frame contains a file name that makes sense and that ends with ".gsc"; the **Save as type:** frame indicates "All Files" (this prevents **NotePad** from adding a ".txt" to the end of your file, in addition to the ".gsc" extension you've already placed there); and the **Encoding** frame indicates "ANSI". Hit the **Save** button. That's it.

You should have no trouble bringing in your gsc file just like you would any other gsc file. Check to be sure, under **Display** and **Set Caliber**, that you are displaying at the correct caliber. The **Group Statistics** will be correct, but you probably won't be able to see many of your shots on the screen. To fix that, tag the **Display** tab, choose **Set Display Scale...**, and choose either the **1/2"=1"** option (for 2X compressed viewing) or the **1/4"=1"** option (for 4X compressed viewing). Note that the printed grid becomes twice as tight with the 2X compression and four times as tight with the 4X compression. The distance between each pair of adjacent lines still represents an inch.

You can print this compressed view just like any other (**File** tab and then **Print Target**). Remember, though, that it often helps to use make the view darker, prior to printing (**File** tab and then **Embold Target**).

## Backing Up Your Target Files

**Shortcut:** Get a CD-ROM Burner and back up all critical files on a data CD. Redo it from time to time to include all your new work. Install good a good anti-virus program and keep it's virus-sample listing updated frequently.

If you have done all the work necessary to record your experimental projects and have also recorded the performance all of your most seminal handloads, over the years, you simply **MUST** be sure that this information is not subject to being lost through a hard disk crash or computer virus attack. The best way to assure this is to install a CD-ROM "burner" (creator) in your PC and then "burn" CDs to store all of your critical data **AWAY** from your PC. In that case, if you have a catastrophic occurrence (e.g., hard drive crash or virus attack), you just fix the problem (replace or reformat your hard drive), reinstall your software, including *GSCalc*, upload your critical files from the CD-ROM you've created, and proceed. Remember that a CD-ROM burner can also back up your other critical files, such as family photos and your letters. You can always re-install your software - in fact, that's the only way you can get it back, so it makes no sense to "back up" your program files - it is the files that you've created with these programs that you cannot replace. Therefore, it's a good idea to know where you keep your photo and document files and to back them up, along with your **Target** folder, from time to time. The blank CD-ROMs cost well under 50 cents apiece and hold over 600 Mega Bytes. That's hard to beat.

Until you can get a CD-ROM burner drive installed, you can back-up your compact gsc files readily on 3.5" floppies.

A second important step is to purchase and install a competent anti-virus program. Once you have it installed, download all the new virus definitions and re-do this downloading at least every other week. Set your anti-virus program to validate each file that comes in by e-mail or disk. Nevertheless, it's always possible that you'll get blasted with a brand-new virus or that your hard drive will crash. The trick is to **HAVE A GOOD FILE-BACKUP PLAN AND THEN STICK TO IT!** Remember: " 'Tis far better to be prepared than to be repaired!"

## Exporting Your *GSCalc* Target Image

**Shortcut:** You can use your keyboard's "Print Scrn" key to capture a screen image, drop it into your image editor, crop the target image, reset the scale, and then save it as a compact JPEG file ideal as an e-mail attachment. Grabbing the **Group Statistics**, for including in an e-mail, is as easy as doing a mouse-sweep and Ctrl-S (in the **Group Statistics** window); and then (in the e-mail) Ctrl-V. You can also save your **Group Statistics** as a file and then attach it to an e-mail, just as you did with the target image.

If you are a gun writer, or just wish to send a copy of a nice target you've shot to a friend, via e-mail, you'll need to know how to capture the target image. Here's one way that will work, most likely, with the software you have on hand.

You're going to rely on those inch/cm grid lines on the **Group Size Calculator** image of your target. Therefore the **Embold Target** function that is handy for direct printing of the target image, but is **NOT** needed when you are capturing it as follows.

Let's say that you've either processed your scanned target or have opened up an existing gsc file and you are now looking at the image of that target, in the full-screen size (maximized) **Group Size Calculator** window and, floating over it is the **Group Statistics** window. Use Alt-Tab (hold down the Alt key and hit the Tab key) to bring the **Group Size Calculator** window to the front (now all you

see is the target). Find and strike the **Print Scrn** key on your keyboard (often just to the right of the function keys). This places an image of the screen on your PC's clipboard. Open your scanning-and-image-editing software (e.g., *Adobe Photoshop* or *Jasc Paint Shop Pro*) and paste in the image [usually, hit Ctrl-V, or tag the **Edit** tab and choose **Paste** (or possibly **Paste As New Image**). . . however, with some software, you have to create a new blank document before you can paste in the image from your PC's clipboard].

The screen image will appear, ready for editing. Click on the magnifier glass tool and click it in the dead center of your group. Do this repeatedly, until the target image, including each of its inch/cm grid lines, is clear. Now click on the "Cropping" tool (sometimes called the "Marquee Tool") and lay out a cropping box that lies on grid lines surrounding your group. Don't be worried about it, just rough it in. Now adjust the edges of your cropping box to exactly overlay the inch/cm grid lines, as follows: pass the cursor over the edge of the box; when the cursor changes to left/right arrows (for the sides of the cropping box) or up/down arrows (for the top & bottom of the cropping box), use your mouse to click-and-drag the cropping box's edge so that it is exactly over its respective grid line; and when it's correct, release the mouse key. Once all four box sides are dead-on their grid lines, crop out everything out side the box [usually, tag the **Image** tab and choose **Crop** (or **Crop Image**)].

The rest of the image disappears and you are left only with your group image, with edges cut along the target grid lines. Therefore, you know how far across and how tall the image SHOULD be (actually, you'll get a good outcome if so long as **EITHER** the left-right **OR** the up-down edges of the image are bounded by grid lines, but getting all four boundaries on-grid looks best). However, it is not currently the correct size.

Now resize the image [usually, choose the **Image** tab and choose **Resize** (or **Image Size**)]. This will bring up an image attributes window. Be sure that the box is checked that says to keep the image's shape unchanged [the box will say something like, "**Maintain aspect ratio**," or "**Constrain Proportions**"]. Check that the **Units** frame (NOT the resolution, but the X and Y units of measure) is set at either **inches** or **centimeters**, to match the spacing of gridlines on your target image. Typically, the **Resolution** frame will show 72 pixels/inch (or 28.4 pixels/cm). This is way too coarse for your purposes. Change it to 200 pixels/inch (or 78.7 pixels/cm). This resolution gives the best balance between clarity and file size. It is important to do this resolution change **BEFORE** resetting the image width/height.

Lastly, count the number of spaces between gridlines, across the image, and change the number in the **Width** frame to match that even number. The number in the **Height** frame should change accordingly and indicate an even number (or very close to it) that matches the number of inches/cm of target image height. To finalize the changes, hit the **OK** button. The image attributes window disappears and your image is now properly scaled again and has a pixel density that will give a clear rendition when printed.

Save your image as follows. Tag the **File** tab and select **Save As**. This brings up the **Save As** window. Be sure that the destination folder is correct (C:\targets\lessons, in our case) and adjust it appropriately, if needed. In the **File name:** frame, type in a useful name (no file extension [e.g., .bmp], just the file name). In the **Save as type:** frame, click on the tab at the right of the frame, then find and choose the JPEG option [it might look like "**JPEG - JFIF Compliant (\*.jpg, \*.jif, \*.jpeg)**"].

With JPEG chosen, if you can find an **Options** button in the **Save As** window, punch it and choose a JPEG compression factor somewhere between 33 and 50, then hit the **OK** button to return to the **Save As** window. This JPEG compression setting gives an good balance between image clarity and file size. The setting will remain for future JPEG saves until you change it again.

Lastly, hit the **Save** button and your properly scaled target image will be saved in JPEG format. You can test-print this image right from your scanning/editing program by simply hitting Ctrl-P (or tagging the **File** tab and choosing **Print**). As you'll see, it prints at the right scale, just as it will for any friend you send it to by e-mail.

Let's say that you named the file "Bragger". In that case the folder (**Lessons**, in this case) would have a file now named **Bragger.jpg**. It will take up only around 20 KB or so, whereas the scanned bmp image of your target required at least 120 KB. Therefore, your JPEG target image is seriously compact and will work well as an e-mail attachment (big files clog up the e-mail lines). Check to see if your file is in the right folder. If you have a **My Computer** or **Windows Explorer** window already open for that folder and it doesn't show this file yet, just tag the **View** tab and choose **Refresh** (this forces the software to reassess and redisplay the listing of files in that folder).

To send this target image to a friend, by e-mail, boot up your e-mail program, open a new e-mail and fill out the **To:** part (choose your friend's e-mail address). Insert your target image as an attachment to your e-mail as follows:

- If you are using *Outlook Express*, click the **Format** tab on your message window and be sure that the **Send Pictures With Message** option is checked (this shows a view, within the e-mail your friend receives, of each attached image). If your e-mail program doesn't offer such an option, then skip this step;
- Mouse-tag the **Attach** button to bring up the **Insert Attachment** window;
- In the **Files of type:** frame, choose "**All files (\*.\*)**";
- In the "**Look in:**" frame, hit the tab and "drive" to your project folder (**Lessons**, in this case);
- Find and single-click on your target image (**Bragger.jpg**, in this case); and
- Click on the **Attach** button.

The **Insert Attachment** window closes and your e-mail now shows an attachment window that shows the file icon. Write up your target brag note and send it all off to your friend. . . Hey! What are friends FOR, after all?!

**Saving Your Group Statistics Output** - Normally, there's no need to save your **Group Statistics** output, given that *GSCalc* will recreate it each time you open that target's cleaned-up gsc file. However, you may wish to send a copy of your **Group Statistics**, for a given target, inside the message text of the e-mail that brings your target image to your friend (see above). The easiest way to do that is to grab all of the text within the **Group Statistics** window and paste it into the body of your e-mail, as follows:

- Tag the **Edit** tab and choose **Select All**;
- Tag the **Edit** tab and choose **Copy**. The file's contents are now copied to your PC's clipboard;
- Use Alt-Tab to move to your e-mail;
- Insert your cursor at the location in your e-mail's text where you want to paste the Group Statistics output; and
- Hit Ctrl-P (or click the **Edit** tab and select **Paste**). Your group statistics now appear within your message.

If you'd prefer, you can save the entire **Group Statistics** file as a text file (i.e., with a ".txt" file extension, and in a format can be read by *NotePad* or by any word processor), as follows:

- In the **Group Statistics** window, click on the **File** tab and choose **Save As**; and
- Type in an appropriate file name in the **File name:** frame and hit the **Save** button.

*NotePad*'s default output format it as a txt file (with a ".txt" extension), and *NotePad*'s default desti-

nation folder is the same one from which you opened the gsc file. Therefore, you'll find your text file in the same project folder in which you've been working with (**Lessons**, in this case). Don't forget to hit **View** (tab) and **Refresh**, if your **My Computer** or **Windows Explorer** window fails to show the presence of the new file. You can attach it to your e-mail in just the same way that you did with the target image (see above). Your friend can bring up this .txt file in any word processing software or with *NotePad*.

## Designating Fliers

**Shortcut:** RIGHT-click on any wide shots in the **Group Size Calculator** window (they go blue and are ignored when you redo the group (tag **Run** and then choose **Recalculate & Recenter**). Such flier-tagging cannot be saved.

*GSCalc* will let you designate wide-flying shots as fliers. All you need to do is to RIGHT-click on the divergent shot(s) in the **Group Size Calculator** window. Upon being so tagged, the shot's color will change to blue. Now hit the **Run** tab and select the **Recalculate & Recenter** option.

Both the **Group Size Calculator** and the **Group Statistics** windows will be redone as follows. In the **Groups Size Calculator**, the red ball will still show the POA (or, if you've run the **Zero Group** option, the overall group center), but the diagonal X will mark the adjusted center of the group [ignoring the flier(s)]. The **Group Statistics** will be recalculated to ignore the flier shot(s) and will also list the number of designated fliers.

You cannot save this group-showing-fliers (next time, it will come up in *GSCalc* with no fliers shown), but it is a handy way to see the effect of a divergent shot. Remember, unless you actually pulled that shot, there is no reason to throw it out. . . that load just tends to give you fliers from time to time. If you don't like that, then change the load, improve the piece's barrel/action bedding; or take other actions, but DO accept all the input your piece has given you.

One exception to this is in a case where you are using cast bullets and you suspect that some of them got through the process with a little vug (cavity) in their base. If the flier is caused by a bad bullet, then you can re-shoot the group or add an extra shot. However, you'll have to answer the question for yourself as to whether that is really being truthful. I mean, unless you are going to shoot better-quality cast bullets, in normal use, than you did in your testing (raaaather odd!), then the occasional flier IS reality for that load.

The best approach is to accept all shots unless you know you pulled that shot. Look at the bright side: this makes it more feasible to beat your top load's accuracy during further load development.

## Statistical Considerations For Everyone

**Shortcut:** The group's Average Radius value is the best indicator of accuracy. It's also the best value for making an initial comparison between groups shot with two loads, but if the two loads have roughly the same Average Radius, the best is the one with the smallest Radius Standard Deviation. Twice the Average Radius is the diameter of round target you'll miss around half the time at the reference distance. To estimate a load's Average Radius at a different distance, divide the Average Radius by the number of yards at which it was shot, then multiply that number by the number of yards for the different distance - don't extrapolate far.

**Your Best Accuracy Indicators** - For just comparing groups, the Average Radius value in the **Group Statistics** output is by far the most valuable measure of accuracy. For most uses, a glance at the Average Radius value of two groups is all you need to see which one is the most accurate. If you

want to do a more advanced statistical analysis, and have the software to do it, then you'll need to read and consider the material in the next section (**Hard-Core Statistics-Junkie Considerations**). The Radius Standard Deviation value comes in handy if you are comparing two loads with substantially the same Average Radius value. . . in that case, the best load is the one with the smallest Radius Standard Deviation. Of course, this rule doesn't count unless both groups look typical. . . the unnaturally-small Radius Standard Deviation of a ring-shaped group is a warning sign, not a gold star.

**Fifty Percent Hit Diameter** - Multiplying the Average Radius by two produces a valuable number: the Fifty Percent Hit Diameter. This is an estimate of the diameter of round object that is so small that you will "hit" it (i.e., the center of your shot will be in that circle) only around half of the time, at that distance, under the conditions in which you shot the reference group (i.e., same shooting position, distance, etc.). However, this value (50%) goes up to around 66% for a tall narrow target [e.g., a standing ground squirrel] whose width is twice the Average Radius.

The reason for this difference in hit percentages is that, when dealing with the radius as the basic measure of accuracy, you have no say as to along which radius, from the center, your shot will land. Therefore, on a standing ground squirrel, a center-aimed shot that lands further from the group center than the mean radius value will still be a serious hit if the error happens to fall more on the up/down (Y) axis than on the left/right (X) axis, because the squirrel's height is far greater than its width (i.e., you "missed" the circle but nailed the squirrel anyway). By comparison, for a center-aimed shot at a round target (with a diameter twice the Average Radius), if the shot's radius (from the intended center-strike point) is greater than the group's Average Radius, then that shot is a miss no matter where it lands around the circular target.

So, depending upon whether you have a tall skinny target or a round one, multiplying the Average Radius by two will give you the target diameter (or width) you'll hit between 1/2 and 2/3 of the time, given the same conditions as those under which you shot the your reference group. Now let's talk about how to make that apply to distances other than the one at which you shot your reference group.

**Guessing Accuracy At Different Distances** - Within reason, it is possible to gauge the **Average Radius** value you are likely to get at a different distance than that at which you shot your reference group. To do this, you use proportions. For example, if you shot your reference group at 200 yards and obtained an Average Radius of 0.50" and you wanted an estimate of what it would be at 350 yards, you'd divide your Average Radius value by the number of yards at which it was shot (in this case, divide 0.50" by 200) and then multiply the resulting number by the number of yards for the desired distance:  $(0.50"/200yards) \times 350yards = 0.875"$ . In this case the Fifty Percent Hit Diameter for this load at 350 yards would be 1.75" (because  $2 \times 0.875" = 1.75"$ ), so this would still be powerful ground squirrel medicine at 350 yards.

Alternatively, you might want to know the distance that represents the outer practical bounds for that load, for a given application (say, for hitting a standing 2" wide ground squirrel at least half the time using the same position you used to fire the reference group). Lets say that you'd shot it at 100 yards and had obtained an Average Radius of 0.43". In that case, multiply the load's Average Radius value by two (to get your fifty percent hit diameter at 100 yards) and divide that into the width of your target (2"), then multiply the answer by the distance at which you shot your reference group (100 yards). For our sample, we'd have:  $100 \text{ yards} \times (2" / (2 \times 0.43")) = 230 \text{ yards}$ . Since this is a tall skinny target, we'll hit it around 2/3 of the time at that distance (or, if it were a 2" diameter ball, you'd smack it about half the time).

The trick with this is not to extend your distance any further than the load's accurate range. Realize, too, that this estimate does not factor in the effect of such things as field shooting positions or wind

conditions. Nevertheless, it's one more really-handy thing you can do with your Average Radius readout that would be meaningless if applied to the usual "group size" parameter.

### **Hard-Core Statistics-Junkie Considerations**

*{Translation: most users will want to skip this section.}*

**Shortcut:** There **IS** no shortcut, but here's a synopsis. You can get hip-deep into statistics, if you want, but you'll find that the **Average Radius** value still tells you 90% of what you'll ever know about a given load's capabilities or how it shapes up relative to other loads. However, to be comparable, both groups must have been shot at the same distance and under similar conditions (e.g., both off the bench).

**Exporting Your X,Y Coordinates** - If you have statistical software, like **MINITAB**, and want to do statistical analysis of your target data, then you'll need to know how to export the X,Y coordinates relative to the group center of mass (**COM**). That's easy, as follows.

Load your gsc file into **Notepad**, as described earlier. Be careful to use only those gsc files that you have converted to make the center of aim be equal to the COM (in our example, we added "COM" to the end of the file name, for that one, yielding **44\_788COM.gsc**). This makes the mean X value 0.00 and the mean Y value 0.00. . . just what you need.

Ignore the first line and select all of the X,Y data (insert the cursor at the left end of the first data line, then hold down the Shift key and click at the end of the last line). All the data pairs (X,Y coordinates) will show up as dark, when selected. Now copy them to your PC's clipboard by either hitting Ctrl-C or tagging the **Edit** tab and selecting **Copy**.

Now open another copy of **Notepad** [*note that it usually opens up right over the other copy of **Notepad**, so you'll need to move the new copy to the side*] then click in the new copy's window and paste the data in by either hitting Ctrl-V or tagging the **Edit** tab and selecting **Paste**. You now have just the data pairs, but you'll want to replace the comma and multiple spaces between each X,Y data pair with a single space, given that most statistical programs can import "space delimited data" (i.e., there is a single space between each datum in the line and a hard return separating successive lines of data).

We'll use the **Replace** function to do this. Tag the **Edit** tab and select **Replace**. In the **Find what:** frame, insert your cursor and type two spaces, then insert the cursor into the **Replace with:** frame and type in a single space. Now tag the **Replace All** button and you'll see that your X,Y data pairs are now all separated only by a comma and a single space. Clear the **Find What:** frame and put a single comma in it. Clear the **Replace with:** frame such that it contains nothing. Once again tag the **Replace All** button and you'll see that your X,Y data pairs are now all separated by only a single space. Click on the **Cancel** button to close-out the **Replace** window.

Your data is now suitable for being imported into your statistics program: in **Notepad**, tag the **Edit** tab and hit the **Select All** option (all the data is now highlighted); copy the data onto the clipboard by hitting Ctrl-C (or tagging the **Edit** tab and choosing **Copy**); go to your statistics program, select two adjacent columns (this may require you to select the number of lines to fill too) and paste in the data (typically, just hit Ctrl-V and then choose the "space delimited data" option).

**Special Statistical Concerns** - For comparing two targets, using statistical software, you can either use the radius of each shot (radius = the square root of the sum of  $X^2 + Y^2$  for each data pair), relative to the target's center-of-mass or you can compare the raw X values for horizontal variation and the raw Y values for vertical variation. Both approaches have their advantages and problems.

The advantage of the compare-radiuses approach is that it is conceptually simple and requires only



one analysis. The problem with using the radii, besides having to calculate them individually, is that they do NOT exhibit a "normal" (bell-shaped curve) population distribution. Therefore, you can't use typical "parametric" (number comparison) statistical methods on it - like the handy t-test, for example - because such tests absolutely require normally distributed data. The trick, if using the radii of two targets, is to rank the radius data from both targets (say, for two 10-shot groups, the longest radius gets a "1", and the shortest gets rank "20"). You can then run a parametric test, like the t-test, on the ranks, rather than on the actual radius data, because the ranks will exhibit a very close-to-normal distribution. Are we having fun yet?

The advantage of comparing the X (horizontal variation) data for the two targets and then the Y (vertical variation) data is that you can use the handy t-test directly on the raw data because such data exhibits a close-to-normal distribution (or at least comes from a near-normal distribution). The disadvantage is that you need to run two analyses (one for the X's and one for the Y's). The simplest way around this is to stick to the most divergent comparison between the two targets (e.g., if both have small group width [X values], but one load has a larger height, then just compare the Y values). Given this approach, if the more divergent axis shows no statistical difference between the two targets, then there's no point in doing the other axis (it certainly will show no difference); and if the most divergent axis DOES show a statistically significant difference, then the two loads ARE different and there's still no point in checking out the other axis. Hmm! Sounds like a plan!

Most statistical tests come in one- and two-tailed versions. The one-tailed version puts all of the "power" in determining if the difference is in one direction (i.e., Is my new group more accurate than my reference load?), whereas the two-tailed version will just test for a difference between the two, in either direction. All tests have a "Null Hypothesis" - generally that there is no difference between the two targets. If the test shows a statistically significant difference, then one rejects this Null Hypothesis and accepts the Alternative Hypothesis - for a two-tailed test, that the targets differ or, for a one-tailed test, that the new load is better than the reference load.

The "Type I error rate" or "alpha level" (chance of rejecting the Null Hypothesis by chance, in a case where there is, in fact, no real difference between the loads) is something you set ahead of time. For most scientific work the standard Type I error rate is 5%, in which case you'd have a 95% certainty that your result is true (the analysis is at a 95% confidence level).

Generally speaking, you'll want to run a two-tailed test (to see if either target is more accurate than the other. . . you're just looking for a difference) at a 95% confidence level (Type I error rate is 5%), and a t-test, if handled as described above, will work fine for that, using ranked radius data or using raw X or Y data (with the X or Y measured from the group center-of-mass). The only exception to that would be the case where you have a solid reference target and you only want to know if your new load shoots **BETTER** than your reference load (otherwise, you don't care. . . you'd discard anything equal to or worse than your reference load). In that case, you'd run a one-tailed test (to see if the new load is more accurate) at a 95% confidence level (error rate is still 5%, but the power to detect an improvement is about twice what it'd be with the two-tailed version). However, in truth, the two targets have to show very obvious difference in accuracy level before the difference becomes statistically significant.

The use of "limit-based" statistical analyses (e.g., the upper 95% tolerance limit or upper 95% prediction limit) is handy for determining things like the diameter of target you would miss only 5% of the time, at that range, but such tests are far beyond the scope of this humble manual.

This all leads us back to just using the simple **Average Radius** parameter instead of doing all the fancy statistics. The **Average Radius** value is difficult to calculate, manually, but *GSCalc* outputs it as standard fare . . . sometimes the simplest way really IS the best way.

## Hey! Who Wrote This Stuff?

It's all done by serious shooters for serious shooters. That's why *GSCalc* gives you what you need, does it quickly, and does it right the first time.

**The Program** - Ralph Wilson designed and coded the *GSCalc* software. All questions concerning the program and the manual should go to him. Ralph is a hardware design manager for Agere Systems, Inc. and spends far too much time at work and not near enough time pulling the trigger of his latest acquisition. He's a member of GOA, SAS, the Illinois State Rifle Association, a Life Member of the NRA and a Life Member of the Aurora Sportsmen's Club. He's active in the monthly rifle/pistol matches at ASC, and manages their rifle/pistol web site (<http://aurorasc.org>). He's also basically lazy (but not stupid) and likes to make tools do the work for him. One day after a session at the range trying to figure out which brand of ammo worked best with his "new" Model 52, and after spending more time with a pair of calipers and a calculator than with the gun itself, he decided there had to be a better way. Enter the combination of flatbed scanner, PC, and Visual Basic<sup>®</sup>. A couple weeks later the initial version of *GSCalc* was born. He initially designed it simply for himself so paid little attention to the user interface. With the explosion of the internet he acquired his own web site and decided to make the program publicly available. Many thanks go to the many users of the program who have provided very useful suggestions for improvement to both the technical content and usability of the program.

In addition to *GSCalc*, he has also written an external ballistics calculator (<http://rawilson.net/shareware/Trajectory/index.html>) that is available as shareware, and makes available free a bore scope calculator for use in bore-sighting your gun (<http://rawilson.net/shareware/BoreScope/index.html>).

**The Manual** - The writer? He's a major *GSCalc* user named Ed Wosika. He is the New-Product Design & Development Chief for the shooter's tool company **The Hanned Line** [ <http://www.hanned.com/> ]. He writes frequent target-analysis-related articles for the **Cast Bullet Association's** members-only journal, *The Fouling Shot* [see: <http://www.castbulletassoc.org/>]. You can view his other articles under the "Guest Speakers" and "Back Issues" listings at **The Sixgunner** website [ <http://www.sixgunner.com/> ] and can view his handmade knives there too [look for **Zeek's Handmade Cutlery**, under the Businesses listing at The Sixgunner website]. He is also the co-editor of *The Shootists' Newsletter*. In his spare time, he works as a geologist for the State of California. Ed offered to write the manual because he knows the value of competent target analysis and wants you to get as much benefit, from using *GSCalc*, as he has.