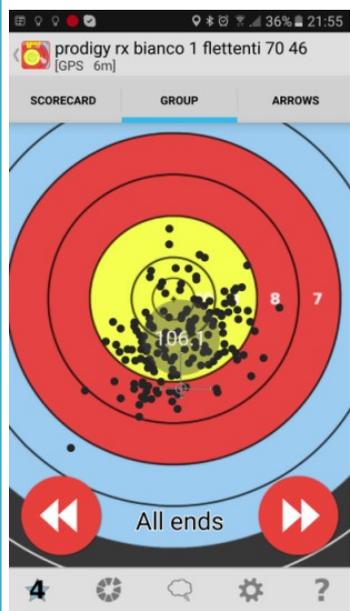




Preparing for the Rio 2016 Olympics

Suppose you have a few sets of Easton X10's (30 arrows in total). They are all cut to length, new points installed and freshly fletched. And suppose you are in the final preparation week for the Rio 2016 Olympic Games. All your arrows are prepared and shoot fine, but which ones are the ones you are going to use in competition? And does it matter? Can you simply pick a random set of 6 arrows from the 30 in your quiver or should you be more specific?

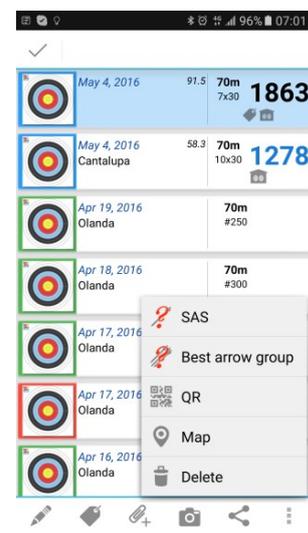


Question; which 6 arrows should you use in the Rio 2016 ranking round?

In the months before the 2016 Olympics, Italy's head coach Wietse van Alten preparing top-international archer David Pasqualucci asked this question. He participated in developing and testing an experimental feature of Artemis; how to select the best grouping arrows from a set of 30 arrows?

It started with creating a match consisting of 7 ends of 30 arrows, then shoot and plot every arrow single each end. This match was shot in an indoor 70m range without sight adjustments and plotted including identifying every arrow. The resulting group can be seen in the top left screenshot¹ The group is low because the sight was not adjusted during shooting. It needs to stay the same throughout this procedure!

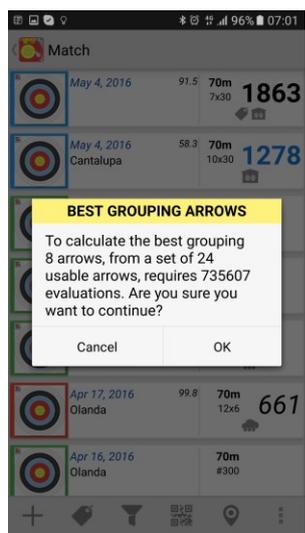
Artemis' new feature can compute which 8 arrows are the best grouping set of arrows from the complete set of arrows. Artemis' default is to choose 8 arrows instead of 6 to account for arrow loss during competition, so 6 plus 2 spare.



¹ In fact, the screenshot does not show the exact result of all 30 different arrows. The screenshots for this example were made after the Olympics with a production version of Artemis (version 3.9). Not an experimental version. But the actual data from Pasqualucci's tests is used, only for 24 arrows. The experimental version needed extreme computational power for such large arrowsets (30 arrows). The number of combinations to evaluate when selecting 15 arrows from a set of 30 is 155.117.520 (115 million)! This is the reason that Artemis version 3.9 can only be used for a maximum of 24 arrows.



How does the algorithm work?



From the plotted results, Artemis starts with selecting a set of 8 arrows numbered 1, 2, 3, 4, 5, 6, 7 and 8 and evaluates their grouping pattern. In the Pasqualucci example, it evaluates a group of 56 shots; i.e. the 8 selected arrows which have all been shot 7 times.

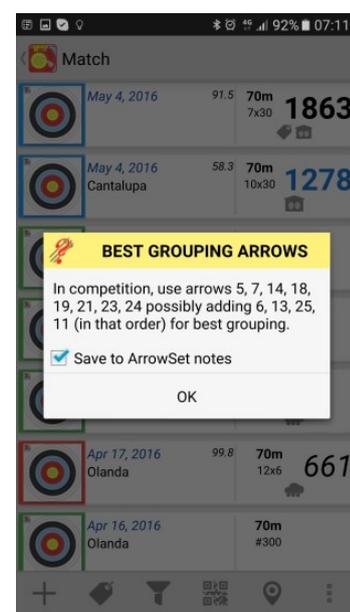
The group performance is determined by calculating the ASL (a measure of group size) of the group *independent* of where the group is on the target face. The algorithm doesn't care where the center of the group was on the target face, just how small it was.

Then it again selects a set of arrows, but this time a slightly different set. For example 1, 2, 3, 4, 5, 6, 7 and 9. It computes the group size again and compares it with the previous set's group size.

Artemis iterates over **all** possible combinations of (in this case) 8 arrows out of 24 arrows, to find the best group. This means it has to evaluate **735.471** different combinations! So it takes a few minutes to compute.

When finished, a dialog shows the results; the 8 arrows that performed best (have the best/smallest group). It is this set of arrows which is best to use in competition!

The result is also saved to the notes-section of the quiver/arrow-set for later reference.



Did it help?

What is interesting is to estimate the difference, in points gained, between the 'best' 8 arrows compared to a randomly picked set of 8 arrows from the test data. Although this particular set of data is relatively small, we can still use Artemis to get a rough impression.

Using Artemis' Analysis, the **group** (not the score!) of the 8 best-grouping arrows is compared with a group of 8 randomly picked arrows from the same arrow-set and plot on two different targets. See the screenshot on the next page.



The 8 randomly picked arrows grouped with an ASL of 104.8 which is *equivalent* to a 70m round score of 672.

However, the 8 best grouping arrows had an ASL of 113.8 which is *equivalent* to a 70m round score of 690.

Again, a small dataset, so perhaps not statistically relevant, but still reason enough to put some effort in selecting your best grouping arrows, a few days before any important competition.

David Pasqualucci shot the 3rd highest score in the Rio 2016 ranking round, a score of 685, which is pretty close to the predicted score of 690 😊

Your steps to use this new feature in Artemis

There are several different ways to use this new feature, but suppose you have (as most of us) a set of 'only' 12 arrows and it is a couple of days before a 70m (720 round) competition. It is nice weather (no wind) and you have already warmed-up, and your sight is more or less correct. The following procedure will result in a 'best grouping arrowset' selection.

1. Create a Match (Type: plot, tuning, 70m, 122cm target face) of 16 ends of 6 arrows.
2. Fill your quiver with 6 arrows in the upper tube and 6 arrows in the bottom tube.
3. Before you start the match, set the options
 - a. 'Default shot rating' to 5 stars
 - b. Check 'Rate your shot'
 - c. Check 'Identify arrow'
4. Start the match and make sure the star-rating symbol in the menu indicates '3'. So only plots rated 3 and above will be shown. And since you set the default to '5', all shots will be shown. The star-rating is used by the 'best arrow group'-computation, for it will only take shots into account that have a rating equal or higher than set.



5. Now shoot the match and plot each arrow by number. Shoot your upper tube of arrows in all even ends and the bottom tube of arrows in all uneven ends. This way you shoot all 12 arrows 8 times. Do **not** change your sight during the 16 ends. If you have an arrow which was really badly executed, then this arrow will influence the result for the wrong reasons, so mark that specific shot with a single star (1 star). All normal executed shots remain 5 stars.
6. When the match is finished, long-select the match from the matchlist and select the 'best grouping arrow set'-function. The algorithm will take into account all shots of all arrows that;
 - a. Have been shot more than 3 times (in this case they should all been shot and plotted 8 times),
 - b. with a shot rating higher than the indicated shot rating.
7. Computation of best groups of 8 arrows from a set of 12 will be almost instant (only 495 different combinations possible).
8. Use the advised set of arrows for your upcoming competition.

