

RECURVE ARCHERY

Training and Tournament Two sides of the same medal

Part 3
WA-1440 Performance Forecast
Women (AUT, GER: plus Master 1)

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Training and Tournament

In the first part on "Training and Tournament - Two Sides of the Same Medal", the WA-1440 Performance Forecast for Men was compiled (Edition.). Now the focus is on the **women** (AUT, GER plus Senior Class 1 / Master Class). They shoot in the WA 1440 Round on the distances 70m, 60m, 50m and 30m.

What result could the women achieve with their training performance in a classic tournament like the WA 1440 Round? What scores can be forecasted for the various distances and for the total round?

The following graphs and tables give the answer. From these, the WA-1440 scores for every other shooting distance can be read according to the training result on a specific shooting distance.

The forecast refers primarily to the 4 distances of the WA 1440. However, values are also shown for the 10m and 18m shooting distances. In addition, the table values show a so-called confidence interval (\pm) for a training sample of 36 arrows, within which the estimated true parameter is lying with 68% probability. However, a training sample-size of 144 arrows is recommended on one of the classic WA 1440 distances, preferably 50m or 70m. Then the confidence interval is reduced to half of the stated values and the prognosis becomes more accurate.

The logical background for the transferring the training performance on one shooting distance to other shooting distances is the fact that the skill level for an archer is equally reflected in all shooting distances.

The shown graphs and tables serve archers and coaches for performance classification according to international standard of a WA 1440 Round.

For the interested reader and for a better understanding of how to handle the table of performance forecast and also the tables for miss and hit probability I refer to the 2 other posts on the subject "Training and Tournament - Two sides of the same medal":

-  [Part 1 WA-1440 Performance Forecast - Men](#)
-  [Part 2 Probability for Hits and Misses – Men](#)

WA 1440 Performance Forecast

Women (AUT/GER: plus Masters 1)

70m, 60m, 50m, 30m

The graph "WA 1440 Performance Forecast 70m, 60m, 50m, 30m (Women)" shows the Scores of each of the 4 WA 1440 Rounds plus the WA 1440 total (plus 10m) for decreasing skill levels (from left to right).

- Target faces: 122cm für 70m und 60m; 80z für 50m und 30m

Data Background:

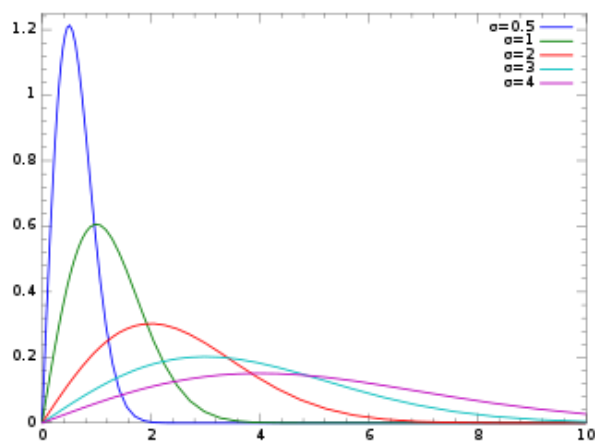
The scores in the graphic and in the table stem from a complex computer application. The algorithmic approach for the forecasting model is based on Rayleigh's probability distribution (see graph below, https://en.wikipedia.org/wiki/Rayleigh_distribution). The performance forecast (prognosis) for various shooting distances is done via sigma following the intercept theorem. According to J. L. Park studies the standard deviation is divided into a linear and quadratic error proportion based on the shooting distance ([James L. Park, Modeling Archer's scores at different shooting distances to quantify score loss due to equipment selection and technique, Formula 7, Journal of Sports Engineering and Technology](#)).

The Skill Level Index was also calculated according to James L. Park ([James L. Parks, James E. Larven, Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology, Vol. 228, 2: pp. 86-94., First Published January 28, 2014; Source: ArtemisLite](#)).

Also included for the different shooting distances are the different target faces/sizes and the WA rule for touched rings, and a 0.5 cm arrow shaft diameter.

Rayleigh probability density function as a function of σ

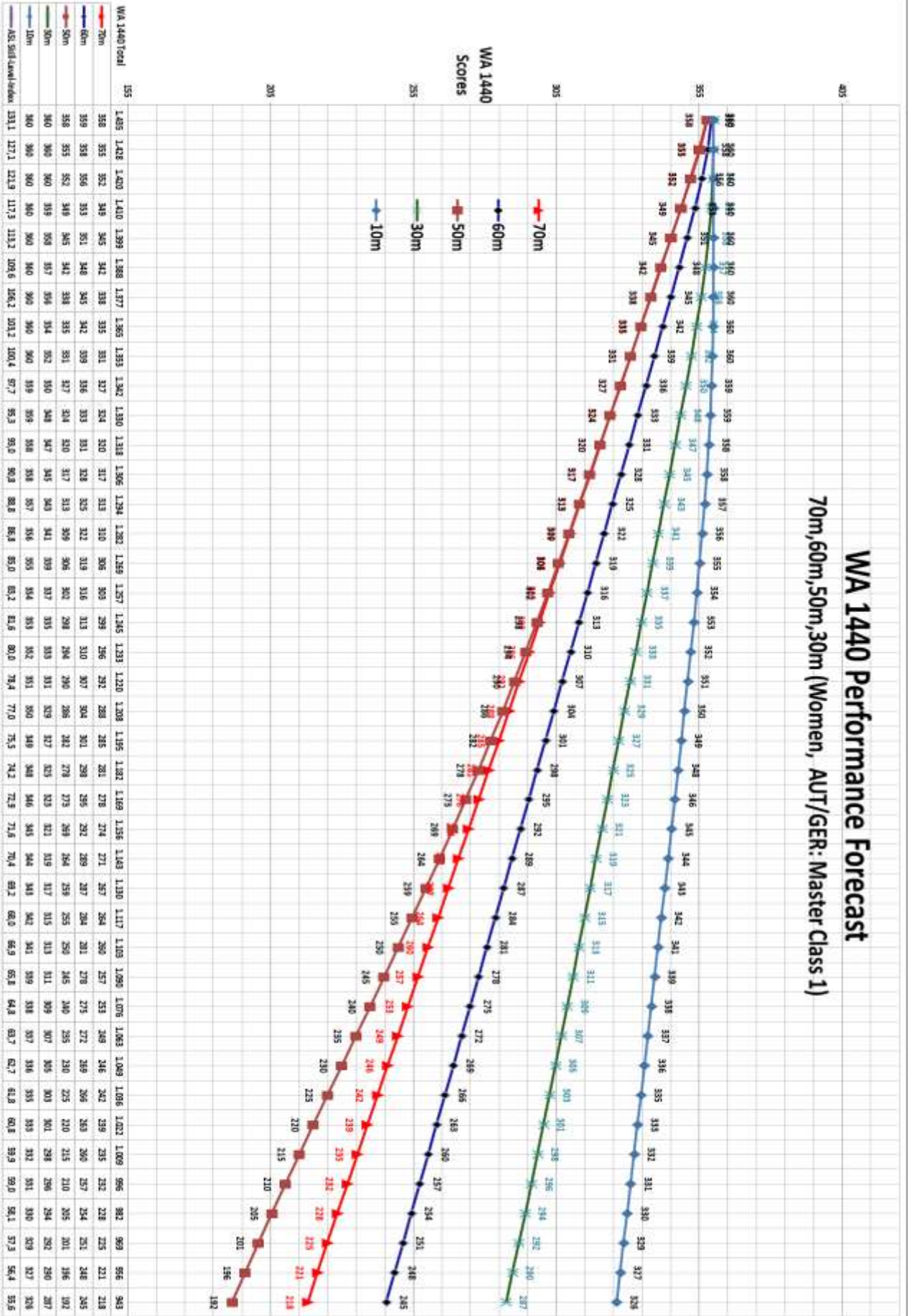
Different standard deviations result in different probability distributions. They represent different skill levels of the archers. The narrower the curve of the distribution is the higher is the skill level.



Graphs: StefanPohl [CC BY-SA 3.0 (<https://creativecommons.org/licenses/by-sa/3.0/>)], from Wikimedia Commons

All data of the graphic can be found in the following table again. The table also contains so-called **confidence intervals**. The meaning and use of these confidence intervals is described under "How can the Performance Table be used?"

WA 1440 Performance Forecast 70m,60m,50m,30m (Women, AUT/GER: Master Class 1)



H i e r a b t r e n n e

For reading, one looks for the value on the graph, which corresponds with the training result on the shooting distance. All vertical values above and below are the performance levels and expected score results for the WA 1440.

Shooting-Performance Table

Shooting Scores for each WA 1440-Shooting Range including Confidence-Intervals

- Number of arrows: 70,60,50,30m: 36 arrows; 18m: 60 arrows
- Probability for the confidence interval: P=68%
- Target face: 70m, 60m: 122cm; 50m, 30m: 80z; 18m, 10m: 40cm [10-6]

ASL Skill- Level-Index	Training		Indoor		WA 1440 - 70m, 60m, 50m, 30m (Women, AUT/GER: Master 1)								WA 1440 TOTAL	
	10m	confidence interval ±	18m	confidence interval ±	30m	confidence interval ±	50m	confidence interval ±	60m	confidence interval ±	70m	confidence interval ±	TOTAL	±
133,1	360	0	600	0	360	0	358	1	359	1	358	1	1.435	2
127,1	360	0	600	0	360	0	355	2	358	1	355	2	1.428	3
121,9	360	0	599	1	360	1	352	3	356	2	352	3	1.420	4
117,3	360	0	598	1	359	1	349	3	353	2	349	3	1.410	5
113,2	360	0	596	2	358	1	345	3	351	3	345	3	1.399	6
109,6	360	0	593	2	357	2	342	4	348	3	342	4	1.388	6
106,2	360	0	590	3	356	2	338	4	345	3	338	4	1.377	7
103,2	360	0	587	3	354	2	335	4	342	4	335	4	1.365	8
100,4	360	1	584	4	352	3	331	5	339	4	331	4	1.353	8
97,7	359	1	580	4	350	3	327	5	336	4	327	5	1.342	9
95,3	359	1	577	4	348	3	324	5	333	4	324	5	1.330	9
93,0	358	1	573	4	347	3	320	5	331	5	320	5	1.318	10
90,8	358	1	569	5	345	3	317	6	328	5	317	6	1.306	11
88,8	357	2	566	5	343	4	313	6	325	5	313	6	1.294	11
86,8	356	2	562	5	341	4	309	6	322	5	310	6	1.282	12
85,0	355	2	558	6	339	4	306	7	319	6	306	7	1.269	12
83,2	354	2	554	6	337	4	302	7	316	6	303	7	1.257	13
81,6	353	2	551	6	335	4	298	8	313	6	299	7	1.245	13
80,0	352	3	547	6	333	4	294	8	310	6	296	7	1.233	14
78,4	351	3	543	7	331	5	290	9	307	7	292	8	1.220	14
77,0	350	3	539	7	329	5	286	9	304	7	288	8	1.208	15
75,5	349	3	535	7	327	5	282	10	301	7	285	8	1.195	16
74,2	348	3	531	8	325	5	278	11	298	7	281	9	1.182	16
72,9	346	3	527	8	323	5	273	11	295	8	278	9	1.169	17
71,6	345	3	523	8	321	5	269	12	292	8	274	9	1.156	17
70,4	344	3	519	9	319	6	264	13	289	8	271	10	1.143	18
69,2	343	4	515	9	317	6	259	13	287	8	267	10	1.130	18
68,0	342	4	511	10	315	6	255	14	284	9	264	10	1.117	19
66,9	341	4	506	11	313	6	250	15	281	9	260	11	1.103	20
65,8	339	4	501	11	311	6	245	15	278	9	257	11	1.090	20
64,8	338	4	496	12	309	6	240	16	275	9	253	11	1.076	21
63,7	337	4	491	13	307	7	235	16	272	10	249	11	1.063	21
62,7	336	4	486	14	305	7	230	17	269	10	246	12	1.049	22
61,8	335	4	481	14	303	7	225	17	266	10	242	12	1.036	22
60,8	333	4	476	15	301	7	220	18	263	10	239	12	1.022	23
59,9	332	5	470	16	298	8	215	18	260	11	235	13	1.009	23
59,0	331	5	464	17	296	8	210	19	257	11	232	13	996	24
58,1	330	5	458	17	294	8	205	19	254	11	228	13	982	24
57,3	329	5	453	18	292	9	201	19	251	11	225	13	969	25
56,4	327	5	446	19	290	9	196	20	248	12	221	14	956	26
55,6	326	5	440	19	287	9	192	20	245	12	218	14	943	26

All values are rounded to onces digit!

How can the Performance Table be used?

Examples

Example 1:

The archer Maria shoots - as recommended - 4 x 36 noted training arrows at 50m distance. For example, this results in an average of 290 rings for 36 arrows for them. Which scores can be expected in a WA 1440 round with 68% probability on the other shooting distances?

In the table, we look up the ring value 290 in the 50m column and read the corresponding values for the other distances 30m, 60m, 70m and the WA 1440 round totally. The confidence interval (9) to the right of the score represents the skill level fluctuation with a probability of P = 68% and with 36 arrows.

Since the exercise sample is 4 times bigger as the table based values (based on 36 arrows), namely 144 arrows, the confidence interval can be halved (4,5). Thus, for the WA 1440 round, the range values given in the right-hand column result, within which the scores will lie with 68% probability.

WA 1440 Shooting-Range	Archer Maria	Confidence Intervall (144 Arrows)	Confidence Interval Limits	
	Score	±	Lower End	Upper End
70m	292		288	296
60m	307		304	310
50m - Trainings-Sample (144 arrows)	290	4,5	285,5	294,5
30m	331		329	333
WA 1440 total	1220		1206,5	1234

Example 2:

The archer Maria shoots again 3 months later 4 x 36 training arrows at 50m. She achieves on an average a score of **302** for 36 arrows, 12 score points more than 3 months earlier. Is this a variation within her skill level or an actual performance increase?

The new score of **302** has a confidence interval of 3.5 (half of 7 of the table). The score-plus between the two training samples (12) is greater than the sum of both confidence intervals (8). Maria has achieved with a high probability (over 68%) a performance increase in the 3 months.

Training 50m	Archer Maria	Confidence Intervall (144 Arrows)	Confidence Interval Limits	
	Score	±	Lower End	Upper End
On April 1st	290	4,5	294,5	
On July 1st	302	3,5		298,5
Score-Plus	12	8		

Probability for Misses and Hits

Miss

WA 1440 - 70m, 60m, 50m, 30m - Number of Misses								ASL Skill- Level- Index
WA 1440 TOTAL	10m	18m	30m	50m	60m	70m	WA 1440 MISSES TOTAL	
1.435	0	0	0	0	0	0	0	133,1
1.428	0	0	0	0	0	0	0	127,1
1.420	0	0	0	0	0	0	0	121,9
1.410	0	0	0	0	0	0	0	117,3
1.399	0	0	0	0	0	0	0	113,2
1.388	0	0	0	0	0	0	0	109,6
1.377	0	0	0	0	0	0	0	106,2
1.365	0	0	0	0	0	0	0	103,2
1.353	0	0	0	0	0	0	0	100,4
1.342	0	0	0	0	0	0	0	97,7
1.330	0	0	0	0	0	0	0	95,3
1.318	0	0	0	0	0	0	0	93,0
1.306	0	0	0	0	0	0	0	90,8
1.294	0	0	0	0	0	0	0	88,8
1.282	0	0	0	0	0	0	0	86,8
1.269	0	0	0	0	0	0	0	85,0
1.257	0	0	0	0	0	0	0	83,2
1.245	0	0	0	0	0	0	0	81,6
1.233	0	0	0	0	0	0	0	80,0
1.220	0	0	0	0	0	0	0	78,4
1.208	0	0	0	0	0	0	0	77,0
1.195	0	0	0	1	0	0	1	75,5
1.182	0	0	0	1	0	0	1	74,2
1.169	0	0	0	1	0	0	1	72,9
1.156	0	0	0	1	0	0	1	71,6
1.143	0	0	0	2	0	0	2	70,4
1.130	0	0	0	2	0	0	2	69,2
1.117	0	0	0	2	0	0	2	68,0
1.103	0	1	0	3	0	0	3	66,9
1.090	0	1	0	3	0	0	3	65,8
1.076	0	1	0	4	0	0	4	64,8
1.063	0	1	0	4	0	0	4	63,7
1.049	0	2	0	5	0	0	5	62,7
1.036	0	2	0	5	0	0	5	61,8
1.022	0	2	0	6	0	0	6	60,8
1.009	0	3	0	6	0	0	7	59,9
996	0	3	0	7	0	0	7	59,0
982	0	4	0	7	0	0	8	58,1
969	0	4	0	8	0	0	9	57,3
956	0	5	0	8	0	1	9	56,4
943	0	5	0,4	9	0	1	10	55,6

Appearances of Miss from 1 onwards are highlighted in orange!

Misses occur in shooting performances below the score of 1200 in a WA 1440, primarily on the 80z target face of 50m distance. At the 70m shooting distance, the misses occur at a score of 956. On the 40 cm indoor target face (6-10), misses happen to archers at a WA 1440 score of 1100.

The number of misses already provides information about the performance level: 3 misses at 50m correspond to a WA 1440 performance level of 1100 and 6-7 misses correspond around a score of 1000.

Hit Probability

The tables below show the probabilities (in percentage) and the number of hits for each of the 10 rings.

- ✚ Shown are 4 score levels of the WA 1440 Round: 1000, 1100, 1200, and 1300.
- ✚ Target faces are framed.
- ✚ Hit values from 1% (rounded) onward are highlighted in color.
- ✚ The difference to 100% at the score level 1000 on the 50m and 70m shooting distances are due to misses outside the target.

Hit Probability								ASL (Skill)	Hit Probability								ASL (Skill)
Ring	10m	18m	30m	50m	60m	70m	1.000	59,3		10m	18m	30m	50m	60m	70m	1.100	66,7
10s	39%	13%	16%	5%	7%	5%	8%	GOLD	10s	53%	19%	22%	7%	11%	7%	12%	GOLD
9s	44%	27%	32%	13%	18%	13%	19%	27%	9s	40%	34%	39%	18%	24%	18%	25%	37%
8s	15%	27%	28%	17%	22%	18%	21%		8s	7%	27%	26%	22%	27%	22%	24%	
7s	2%	18%	16%	18%	20%	18%	18%		7s	0%	13%	10%	20%	20%	20%	18%	
6s	0%	9%	6%	16%	15%	16%	13%		6s	0%	4%	2%	15%	11%	15%	11%	
5s	0%	4%	2%	12%	9%	12%	9%		5s	0%	1%	0%	9%	5%	9%	6%	
4s	0%	1%	0%	8%	5%	8%	5%		4s	0%	0%	0%	5%	2%	5%	3%	
3s	0%	0%	0%	5%	2%	5%	3%		3s	0%	0%	0%	2%	0%	2%	1%	
2s	0%	0%	0%	3%	1%	3%	2%		2s	0%	0%	0%	1%	0%	1%	0%	
1s	0%	0%	0%	1%	0%	1%	1%		1s	0%	0%	0%	0%	0%	0%	0%	
	100%	100%	100%	99%	100%	99%	100%			100%	100%	100%	100%	100%	100%	100%	

Hit Probability								ASL (Skill)	Hit Probability								ASL (Skill)
	10m	18m	30m	50m	60m	70m	1.200	76		10m	18m	30m	50m	60m	70m	1.300	89,8
10s	71%	30%	34%	12%	17%	12%	19%	GOLD	10s	93%	53%	59%	24%	32%	24%	35%	GOLD
9s	28%	42%	45%	26%	34%	27%	33%	52%	9s	7%	40%	38%	40%	45%	41%	41%	76%
8s	1%	22%	18%	27%	28%	28%	25%		8s	0%	6%	4%	25%	19%	26%	18%	
7s	0%	5%	3%	19%	14%	19%	14%		7s	0%	0%	0%	9%	3%	8%	5%	
6s	0%	1%	0%	10%	5%	10%	6%		6s	0%	0%	0%	2%	0%	2%	1%	
5s	0%	0%	0%	4%	1%	4%	2%		5s	0%	0%	0%	0%	0%	0%	0%	
4s	0%	0%	0%	1%	0%	1%	1%		4s	0%	0%	0%	0%	0%	0%	0%	
3s	0%	0%	0%	0%	0%	0%	0%		3s	0%	0%	0%	0%	0%	0%	0%	
2s	0%	0%	0%	0%	0%	0%	0%		2s	0%	0%	0%	0%	0%	0%	0%	
1s	0%	0%	0%	0%	0%	0%	0%		1s	0%	0%	0%	0%	0%	0%	0%	
	100%	100%	100%	100%	100%	100%	100%			100%	100%	100%	100%	100%	100%	100%	

How can the Probability Tables are used by Archers and Coaches to roughly Estimate the Performance in a WA 1440 Round

The listed probabilities refer to "infinite" many shots. In a training sample with limited arrow passes, the hit probabilities will only approximate. This should be kept in mind when using the tables.

And so the tables are used:

Depending on the training shooting distance and personal achievement goal setting the appropriate table is used. For example, if the objective is a score of 1100 for a WA 1440 round and one exercises on 50m shooting distance and on the 80z target face, approx. 8% misses (ring 4: 5%, ring 3: 2%, ring 2: 1%) is well within the normal range (Tab. top right). The archer does not have to be discouraged!

On the other hand, the archer should be able to place about $\frac{1}{4}$ of his arrows on the 50m shooting distance into the gold, to achieve a WA 1440 score of 1100.

The observation of the gold hits

The easiest way is - and I'm talking to archer who don't like writing during practicing archery - using the tables to control only the gold hits.

Examples

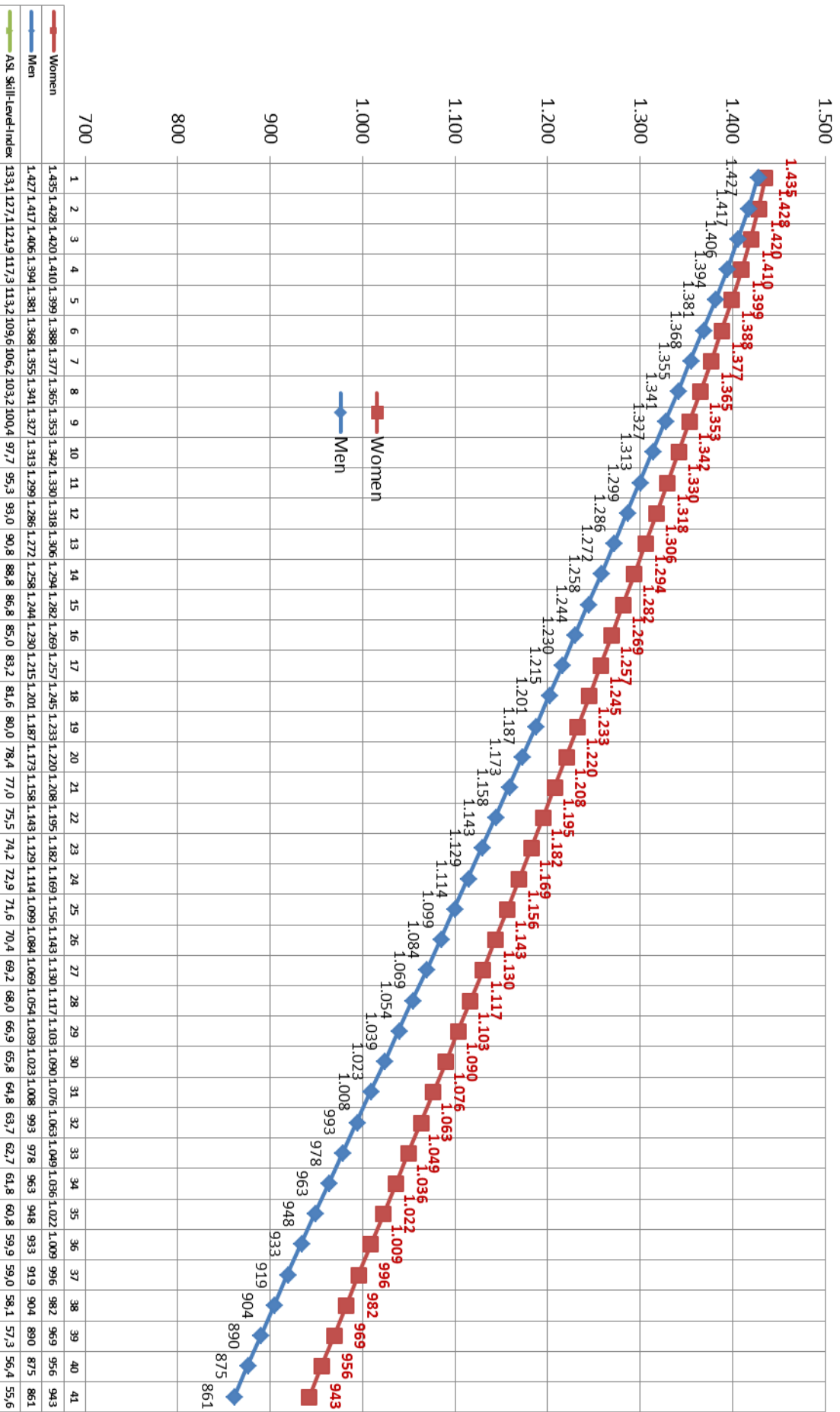
With an envisaged goal of 1100, every 4th arrow on the 70m shooting distance should be a gold hit (see table: 7% + 18% = 25%).

With an envisaged goal of 1200 rings, every 2nd arrow on the 60m shooting distance should be a gold hit (see table: 17% + 34% = 51%) etc.

WA 1440 Score Comparison - Women with Man having the same Skill-Index

Such a comparison may not seem legitimate. However, it is always interesting, because with the same score on the shooting distances 30m, 50m and 70m between men and women, i.e. the same skill level index, there is a difference in the total WA-1440 score between women and men. The difference between female and male archers is the score difference between the men's 90m score and the women's 60m score. It's the bonus to the female archers also called handicap!

WA 1440 Score Comparison between Women and Men having the same Skill Level



The graph shows men and women each with the same skill level index facing each other. The women achieve a higher WA total score than the men. The higher the skill level in general, the lower the WA total score difference between a man and a woman. The lower the skill level, the bigger the WA total score difference

A **female archer**, for example, reaches a score of **1220 in a WA 1440 Round**. The **male archer** with the same Skill-Index achieves (only) **1173** in the same WA 1440 Round (see table in the graph). The total score difference is 47 rings.

Is this handicap value justified? Should both now to be classified as equal in performance? In terms of the Skill Level Index they are. Or has the female archer, referred to her weaker physical constitution at the same skill level with the man yet performed a higher performance, which is just "rewarded" with a higher overall WA-1440 score? Would there be another better performance comparison option between men and women, which combines skill and different physical performance potential between a man and a woman? And what would this solution look like? A lot of questions! I leave it to readers to think about it!

THE END
