REPORT

EVALUATION OF WILKS, IPF, DOTS AND GOODLIFT FORMULAS FOR CALCULATING RELATIVE SCORES IN IPF POWERLIFTING COMPETITIONS

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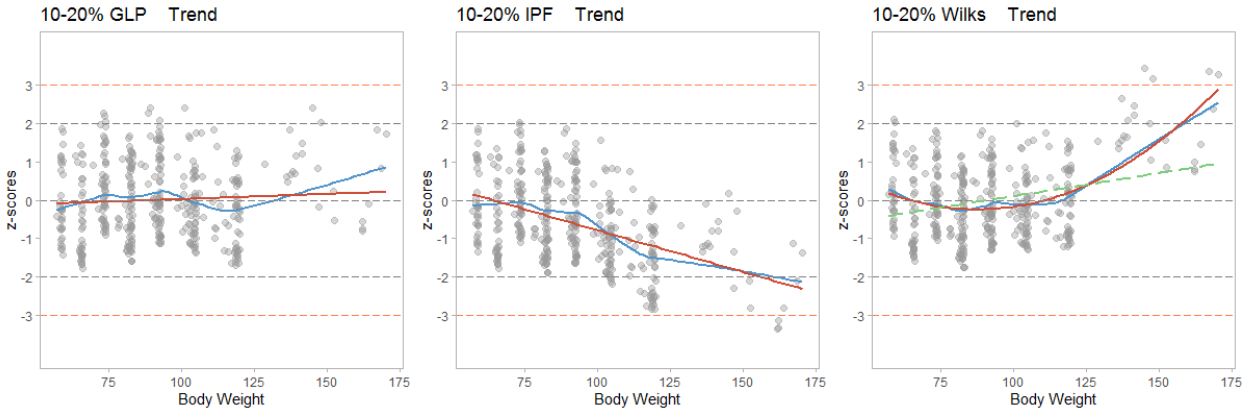

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I. Statistical Evaluation

I.1. Introductory Remarks

The key idea underlying the creation of any formula for scaling strength performance is that the same achievements of athletes of different body weights should correspond to equivalent efforts. Therefore, for an acceptable evaluation of the formula, it is necessary to highlight data sets containing results that are *homogeneous* in terms of strength performance and, therefore, with approximately equivalent achievements.

The metric available to us is the distance between the athlete's result and the record (*Record Distance, RD*) in a particular weight class. The results of athletes of different weight classes, who are at the same distance from the respective records, should be equivalent. If for each weight class we select the data of those athletes, whose results are within a certain range of distances from the record relevant for the weight class and combine these data into one data set, we get a fairly homogeneous sample of athletes with approximately the same level of strength performance. Let us call this sample *Strength Performance Layer (SPL)*.

Let us divide all available data into separate performance layers with a relative *RD* interval of 10%. As a result, we get samples for athletes, whose results are in the ranges of *equal relative record distance*: 0% – 10%, 10% – 20%, etc. For the samples, data are used, which have been selected according to the results of all IPF world and European championships, starting from 2011. These data do not represent the population of all competing athletes, but make it possible to break down data into performance layers from 0 to 50% – in the range from exceptional to mediocre efficiency. This is quite enough for a *comparative evaluation* of the formula for calculating relative scores under the same conditions[1].

We will evaluate the formulas for each layer separately and according to the total average value for all layers. Based on the overall values, we will assign points to each formula: 1 point for the first place, 2 points for the second and 3 points for the third. After individual types of evaluation, we will combine all the points obtained in the summary table. A formula with a lower total score should be considered preferable in terms of statistical evaluation criteria.

[1] One can refer to the Pareto rule, interpreted based on the objectives of our study: 20% of the best results will provide 80% of the information about the investigated phenomenon, 50% will provide 95% of the information.

I.2. Comparing Coefficients of Variation. Homogeneity of Relative Scores

I.2.1. Key Points

Since we need to compare different formulas obtained at different times and using different data sets, as well as having different levels of values of the relative scores obtained, we will use the method of comparing the coefficients of variation.

Coefficient of variation *(CV)* is a measure of the relative deviation of a random variable. It shows what proportion the average deviation of a random variable makes from the average of that variable. In the general case, the coefficient of variation is used to determine the variance of values without reference to the level of the measured variable and units of measurement.

In our case, the closer the *CV* is to zero, the more typical are the average *Relative Scores (RS)* for each weight class to the average *RS* for the entire strength performance layer. The smaller the differences in the coefficient values for different weight classes, the more the coefficients are homogeneous, and the less is the likelihood to give preference to any group of weight classes (light, middle, heavy) when calculating relative points.

Method

For each layer of strength performance, the average value of relative scores for each weight class is calculated. This value of score is entered in the table cell corresponding to the weight class and formula. Next is the coefficient of variation for the values corresponding to all performance layers for each formula. The results are entered in the summary cells for each formula.

The overall table shows the coefficients of variation for each formula by performance layers and the average values of the coefficients for the formulas. We propose two summary tables. The first compares five formulas – GOODLIFT (GL), IPF vs. Wilks, Wilks v.2 and DOTS. The second shows the differences between the GL formula and the IPF formula.

Interpretation

A lower value is better. The common rule is as follows: less than 10% – weak variability; 10-25% – moderate variability; over 25% – high variability.

Highlighting for cells with coefficient values by layers of strength performance is as follows: green – the best value, yellow – the averaged value, red – the worst value.

I.2.2. Comparison of GL, IPF, Wilks, Wilks v.2 and DOTS formulas

Table I.2.1 Overall Table, Men's Equipped Powerlifting

SPL	GL	IPF	WILKS	WILKS-2	DOTS
0-10%	1,765%	3,328%	3,419%	2,281%	2,027%
10-20%	1,485%	2,178%	2,997%	2,319%	1,957%
20-30%	1,840%	1,639%	3,344%	2,733%	2,457%
30-40%	1,941%	1,684%	3,253%	2,749%	2,520%
40-50%	2,143%	1,737%	3,065%	2,813%	2,629%
mean=	1,835%	2,113%	3,216%	2,579%	2,318%

SPL	GL	IPF
0-10%	1,765%	3,328%
10-20%	1,485%	2,178%
20-30%	1,840%	1,639%
30-40%	1,941%	1,684%
40-50%	2,143%	1,737%
mean=	1,835%	2,113%

Table I.2.2 Overall Table, Men's Classic Powerlifting

SPL	GL	IPF	WILKS	WILKS-2	DOTS
0-10%	2,627%	5,730%	5,251%	4,061%	4,106%
10-20%	2,149%	3,250%	3,650%	2,651%	2,368%
20-30%	2,880%	2,614%	4,272%	3,424%	3,140%
30-40%	3,261%	2,826%	4,184%	3,519%	3,334%
40-50%	2,881%	2,468%	3,669%	2,993%	2,814%
mean=	2,760%	3,378%	4,205%	3,330%	3,153%

SPL	GL	IPF
0-10%	2,627%	5,730%
10-20%	2,149%	3,250%
20-30%	2,880%	2,614%
30-40%	3,261%	2,826%
40-50%	2,881%	2,468%
mean=	2,760%	3,378%

Table I.2.3 Overall Table, Women's Equipped Powerlifting

SPL	GL	IPF	WILKS	WILKS-2	DOTS
0-10%	2,627%	3,254%	4,298%	2,650%	3,497%
10-20%	3,170%	3,265%	3,658%	2,908%	3,093%
20-30%	2,380%	2,556%	3,669%	2,264%	2,583%
30-40%	3,215%	3,140%	3,792%	3,000%	3,025%
40-50%	3,538%	3,505%	3,444%	3,296%	3,085%
mean=	2,986%	3,144%	3,772%	2,823%	3,057%

SPL	GL	IPF
0-10%	2,627%	3,254%
10-20%	3,170%	3,265%
20-30%	2,380%	2,556%
30-40%	3,215%	3,140%
40-50%	3,538%	3,505%
mean=	2,986%	3,144%

Table I.2.4 Overall Table, Women's Classic Powerlifting

SPL	GL	IPF	WILKS	WILKS-2	DOTS
0-10%	3,663%	6,491%	3,212%	4,195%	4,534%
10-20%	1,802%	4,427%	1,601%	2,226%	2,389%
20-30%	2,219%	4,711%	1,155%	2,634%	1,823%
30-40%	2,069%	5,535%	0,891%	2,557%	2,023%
40-50%	3,118%	7,354%	1,701%	3,726%	3,078%
mean=	2,574%	5,704%	1,712%	3,068%	2,770%

SPL	GL	IPF
0-10%	3,663%	6,491%
10-20%	1,802%	4,427%
20-30%	2,219%	4,711%
30-40%	2,069%	5,535%
40-50%	3,118%	7,354%
mean=	2,574%	5,704%

Table I.2.5 Overall Table, Men's Equipped Bench Press

SPL	GL	IPF	WILKS	WILKS-2	DOTS
0-10%	3,057%	5,194%	5,693%	5,781%	5,366%
10-20%	3,666%	5,176%	5,792%	5,869%	5,487%
20-30%	3,739%	4,761%	5,949%	5,995%	5,619%
30-40%	3,600%	4,472%	5,893%	6,017%	5,656%
40-50%	3,578%	4,126%	6,201%	6,495%	6,167%
mean=	3,528%	4,746%	5,905%	6,031%	5,659%

SPL	GL	IPF
0-10%	3,057%	5,194%
10-20%	3,666%	5,176%
20-30%	3,739%	4,761%
30-40%	3,600%	4,472%
40-50%	3,578%	4,126%
mean=	3,528%	4,746%

Table I.2.6 Overall Table, Men's Classic Bench Press

SPL	GL	IPF	WILKS	WILKS-2	DOTS
0-10%	7,410%	11,532%	8,224%	7,839%	7,779%
10-20%	4,913%	8,280%	5,725%	5,288%	5,092%
20-30%	5,266%	8,603%	6,372%	5,862%	5,690%
30-40%	5,237%	7,337%	6,227%	5,754%	5,530%
40-50%	5,574%	8,270%	6,968%	6,386%	6,249%
mean=	5,680%	8,804%	6,703%	6,226%	6,068%

SPL	GL	IPF
0-10%	7,410%	11,532%
10-20%	4,913%	8,280%
20-30%	5,266%	8,603%
30-40%	5,237%	7,337%
40-50%	5,574%	8,270%
mean=	5,680%	8,804%

Table I.2.7 Overall Table, Women's Equipped Bench Press

SPL	GL	IPF	WILKS	WILKS-2	DOTS
0-10%	2,988%	3,413%	3,420%	3,166%	2,795%
10-20%	2,244%	2,983%	2,280%	2,491%	2,627%
20-30%	2,575%	2,062%	2,525%	2,852%	2,567%
30-40%	2,091%	2,083%	2,520%	2,398%	2,441%
40-50%	2,980%	1,510%	2,641%	3,322%	3,110%
mean=	2,576%	2,410%	2,677%	2,846%	2,708%

SPL	GL	IPF
0-10%	2,988%	3,413%
10-20%	2,244%	2,983%
20-30%	2,575%	2,062%
30-40%	2,091%	2,083%
40-50%	2,980%	1,510%
mean=	2,576%	2,410%

Table I.2.8 Overall Table, Women's Classic Bench Press

SPL	GL	IPF	WILKS	WILKS-2	DOTS
0-10%	4,650%	7,848%	8,245%	6,586%	8,195%
10-20%	3,182%	6,598%	6,720%	5,009%	6,608%
20-30%	3,985%	6,758%	6,777%	5,314%	6,574%
30-40%	4,835%	7,421%	7,079%	5,946%	7,057%
40-50%	4,032%	6,329%	5,984%	4,804%	5,627%
mean=	4,137%	6,991%	6,961%	5,532%	6,812%

SPL	GP	IPF
0-10%	4,650%	7,848%
10-20%	3,182%	6,598%
20-30%	3,985%	6,758%
30-40%	4,835%	7,421%
40-50%	4,032%	6,329%
mean=	4,137%	6,991%

I.2.2. Conclusion for Comparing Coefficients of Variation.

Table I.2.1 Overall Models' Scores by Coefficient of Variation

	GL	IPF	WILKS	WILKS-2	DOTS
Men's Equipped Powerlifting	1	2	5	4	3
Men's Classic Powerlifting	1	4	5	3	2
Women's Equipped Powerlifting	2	4	5	1	3
Women's Classic Powerlifting	2	5	1	4	3
Men's Equipped Bench Press	1	2	4	5	3
Men's Classic Bench Press	1	5	4	3	2
Women's Equipped Bench Press	2	1	3	5	4
Women's Classic Bench Press	1	5	4	2	3
Overall Scores	**11**	**28**	**31**	**27**	**23**

I.3. Comparing Rank Correlations. Orderliness of Relative Scores

I.3.1. Key Points

As already noted at the beginning, the fundamental idea when creating any system for scaling strength performance is that same achievements require equivalent efforts of lifters. Relative score should express this kind of equivalence, i.e. be about the same for equivalent results. Therefore, if you order among themselves, for example, the metrics available for calculation — the record distance of the results *(RD)*, then the ordered series of relative scores for all weight classes should to some extent correspond to the order of the *RD* series. If we calculate the distances from the best achievement for each value of the result and then compare the ranks of these *RD* and the ranks of *RS*, then the closer is the value to 1, the more the two series will coincide. It is clear that the correlation will be the opposite – the more the result is distant from the record, the less relative scores it should receive.

Method

The values of the relative record distances of each result are found in the corresponding weight classes (in percentage terms):

$$RD = \left(1 - \frac{Result}{Record}\right) * 100\%$$

Relative scores are also calculated for each result according to each of the formulas under consideration. Then, for each layer of strength performance, the Spearman rank correlation coefficient (r_s) for distances (*RD*) and relative scores (*RS*) for each formula is considered. The coefficient value is entered in the table. At the end of the procedure, for each formula, the resulting cell with the average value of the correlation coefficient for each of the considered formulas is added to the table.

Interpretation

A higher value is better. The maximum absolute value is 1, the minimum value is 0.

Highlighting for cells with coefficient values by layers of strength performance is as follows: green – the best value, yellow – the averaged value, red – the worst value.

I.3.2. Comparison of GL, IPF, Wilks, Wilks-2 and DOTS formulas

Men's Equipped Powerlifting

SPL	GL, r_s	IPF, r_s	Wilks, r_s	Wilks-2, r_s	DOTS, r_s
0-10%	-0,9128	-0,7088	-0,9005	-0,9112	-0,9210
10-20%	-0,8998	-0,7927	-0,8451	-0,8799	-0,8875
20-30%	-0,8964	-0,8319	-0,8563	-0,8756	-0,8814
30-40%	-0,8979	-0,8790	-0,8401	-0,8657	-0,8729
40-50%	-0,8926	-0,8534	-0,8456	-0,8654	-0,8714
mean=	**-0,8999**	**-0,8132**	**-0,8575**	**-0,8796**	**-0,8868**

Men's Classic Powerlifting

SPL	GL, r_s	IPF, r_s	Wilks, r_s	Wilks-2, r_s	DOTS, r_s
0-10%	-0,7869	-0,6646	-0,6731	-0,7239	-0,7504
10-20%	-0,8211	-0,7070	-0,6888	-0,7490	-0,7670
20-30%	-0,8470	-0,7792	-0,7541	-0,8077	-0,8177
30-40%	-0,7823	-0,7932	-0,7028	-0,7597	-0,7666
40-50%	-0,7959	-0,8296	-0,7487	-0,7959	-0,8025
mean=	**-0,8066**	**-0,7547**	**-0,7135**	**-0,7672**	**-0,7808**

Women's Equipped Powerlifting

SPL	GL, r_s	IPF, r_s	Wilks, r_s	Wilks-2, r_s	DOTS, r_s
0-10%	-0,7364	-0,6154	-0,8984	-0,8049	-0,8112
10-20%	-0,6375	-0,5138	-0,9019	-0,7241	-0,7633
20-30%	-0,7281	-0,5892	-0,9037	-0,7982	-0,8071
30-40%	-0,7718	-0,6617	-0,8942	-0,8233	-0,8277
40-50%	-0,7703	-0,6817	-0,9067	-0,8119	-0,8297
mean=	**-0,7288**	**-0,6124**	**-0,9010**	**-0,7925**	**-0,8078**

Women's Classic Powerlifting

SPL	GL, r_s	IPF, r_s	Wilks, r_s	Wilks-2, r_s	DOTS, r_s
0-10%	-0,9165	-0,8151	-0,8842	-0,9309	-0,9062
10-20%	-0,8374	-0,5589	-0,8373	-0,8041	-0,7725
20-30%	-0,8600	-0,5965	-0,8819	-0,8291	-0,8291
30-40%	-0,8201	-0,5637	-0,8864	-0,7833	-0,7994
40-50%	-0,8281	-0,6075	-0,8759	-0,8037	-0,8149
mean=	**-0,8524**	**-0,6283**	**-0,8731**	**-0,8302**	**-0,8244**

Men's Equipped Bench Press

SPL	GL, r_s	IPF, r_s	Wilks, r_s	Wilks-2, r_s	DOTS, r_s
0-10%	-0,6803	-0,3928	-0,5690	-0,5538	-0,5747
10-20%	-0,7568	-0,6056	-0,5514	-0,5049	-0,5211
20-30%	-0,7229	-0,5671	-0,6137	-0,5921	-0,6100
30-40%	-0,7690	-0,5883	-0,6412	-0,6137	-0,6290
40-50%	-0,7946	-0,6495	-0,6987	-0,6866	-0,6992
mean=	**-0,7447**	**-0,5607**	**-0,6148**	**-0,5902**	**-0,6068**

Men's Classic Bench Press

SPL	GL, r_s	IPF, r_s	Wilks, r_s	Wilks-2, r_s	DOTS, r_s
0-10%	-0,7939	-0,5280	-0,7731	-0,8034	-0,8109
10-20%	-0,7915	-0,6600	-0,7824	-0,8122	-0,8186
20-30%	-0,5947	-0,4231	-0,5559	-0,5767	-0,5844
30-40%	-0,5484	-0,3281	-0,4449	-0,4800	-0,4838
40-50%	-0,6336	-0,5797	-0,6327	-0,6375	-0,6471
mean=	**-0,6724**	**-0,5038**	**-0,6378**	**-0,6620**	**-0,6690**

Women's Equipped Bench Press

SPL	GL, r_s	IPF, r_s	Wilks, r_s	Wilks-2, r_s	DOTS, r_s
0-10%	-0,8807	-0,7128	-0,8093	-0,8828	-0,8156
10-20%	-0,7609	-0,5380	-0,7152	-0,7314	-0,7487
20-30%	-0,8064	-0,7491	-0,7916	-0,7738	-0,7748
30-40%	-0,8705	-0,7904	-0,8384	-0,8571	-0,8336
40-50%	-0,8487	-0,8440	-0,8462	-0,8323	-0,8364
mean=	**-0,8334**	**-0,7269**	**-0,8001**	**-0,8155**	**-0,8018**

Women's Classic Bench Press

SPL	GL, r_s	IPF, r_s	Wilks, r_s	Wilks-2, r_s	DOTS, r_s
0-10%	-0,7451	-0,5167	-0,3908	-0,4558	-0,4197
10-20%	-0,7915	-0,4614	-0,4586	-0,5539	-0,4779
20-30%	-0,7318	-0,4593	-0,5072	-0,6148	-0,5159
30-40%	-0,6729	-0,5505	-0,5500	-0,6171	-0,5749
40-50%	-0,7698	-0,5922	-0,6200	-0,7055	-0,6523
mean=	**-0,7422**	**-0,5160**	**-0,5053**	**-0,5894**	**-0,5281**

I.3.3. Comparison of GL and IPF formulas

Men's Equipped Powerlifting

SPL	GL, r_s	IPF, r_s
0-10%	-0,9128	-0,7088
10-20%	-0,8998	-0,7927
20-30%	-0,8964	-0,8319
30-40%	-0,8979	-0,8790
40-30%	-0,8926	-0,8534
mean=	**-0,8999**	**-0,8132**

Men's Classic Powerlifting

SPL	GL, r_s	IPF, r_s
0-10%	-0,7869	-0,6646
10-20%	-0,8211	-0,7070
20-30%	-0,8470	-0,7792
30-40%	-0,7823	-0,7932
40-30%	-0,7959	-0,8296
mean=	**-0,8066**	**-0,7547**

Women's Equipped Powerlifting

SPL	GL, r_s	IPF, r_s
0-10%	-0,7364	-0,6154
10-20%	-0,6375	-0,5138
20-30%	-0,7281	-0,5892
30-40%	-0,7718	-0,6617
40-30%	-0,7703	-0,6817
mean=	**-0,7288**	**-0,6124**

Women's Classic Powerlifting

SPL	GL, r_s	IPF, r_s
0-10%	-0,9165	-0,8151
10-20%	-0,8374	-0,5589
20-30%	-0,8600	-0,5965
30-40%	-0,8201	-0,5637
40-30%	-0,8281	-0,6075
mean=	**-0,8524**	**-0,6283**

Men's Equipped Bench Press

SPL	GL, r_s	IPF, r_s
0-10%	-0,6803	-0,3928
10-20%	-0,7568	-0,6056
20-30%	-0,7229	-0,5671
30-40%	-0,7690	-0,5883
40-30%	-0,7946	-0,6495
mean=	**-0,7447**	**-0,5607**

Men's Classic Bench Press

SPL	GL, r_s	IPF, r_s
0-10%	-0,7939	-0,5280
10-20%	-0,7915	-0,6600
20-30%	-0,5947	-0,4231
30-40%	-0,5484	-0,3281
40-30%	-0,6336	-0,5797
mean=	**-0,6724**	**-0,5038**

Women's Equipped Bench Press

SPL	GL, r_s	IPF, r_s
0-10%	-0,8807	-0,7128
10-20%	-0,7609	-0,5380
20-30%	-0,8064	-0,7491
30-40%	-0,8705	-0,7904
40-30%	-0,8487	-0,8440
mean=	**-0,8334**	**-0,7269**

Women's Classic Bench Press

SPL	GL, r_s	IPF, r_s
0-10%	-0,7451	-0,5167
10-20%	-0,7915	-0,4614
20-30%	-0,7318	-0,4593
30-40%	-0,6729	-0,5505
40-30%	-0,7698	-0,5922
mean=	**-0,7422**	**-0,5160**

I.3.4. Conclusions for Comparing Rank Correlations

Table I.3.1 Overall Models' Scores by rank correlation

	GL	IPF	WILKS	WILKS-2	DOTS
Men's Equipped Powerlifting	1	5	4	3	2
Men's Classic Powerlifting	1	4	5	3	2
Women's Equipped Powerlifting	4	5	1	3	2
Women's Classic Powerlifting	2	5	1	3	4
Men's Equipped Bench Press	1	5	2	4	3
Men's Classic Bench Press	1	5	4	3	2
Women's Equipped Bench Press	1	5	4	2	3
Women's Classic Bench Press	1	4	5	2	3
Overall Scores	**12**	**38**	**26**	**23**	**21**

I.4. Summary

Table 1.4.1 Overall Models' Scores

	GL	IPF	WILKS	WILKS-2	DOTS
Scores by Coefficient of Variation	11	28	31	27	23
Scores by Rank Correlation	12	38	26	23	21
Overall scores	**23**	**66**	**57**	**50**	**44**

If we assume the adequacy of the proposed statistical verification criteria and the evaluation procedure, we can conclude that the GOODLIFT (GL) formula is in the lead, the DOTS formula ranks second by a large margin. The Wilks formulas in both versions follow them. And the IPF formula officially approved now is in the end of the list.