Olympic games gymnastics team competition grading rules equity standardization research based on sports competition equity criterion

Tao Zhang

Department of Physical Education, Northwest A & F University, Yangling, Shaanxi, China
_____

ABSTRACT

Through researching Olympic Games gymnastics team competition grading rules, discuss gymnastics team competition equity , find grading rule is not fully conform to four criterions in some conditions, grading equity is different and has some shortcomings. To perfect grading rules equity, make it meanwhile meet four criterions, propose a grading rule according to integral function. Olympic Games grading rules have four items, combining with Olympic Games grading examples, discuss grading rules have shortcomings examples in some conditions. And according to 2008 Beijing Olympic Games and 2012 London Olympic Games, men gymnastics event score table, put forward improvement rules targeting with grading rules shortcoming aspects. Carry out inhomogeneous difference handling with men gymnastics scores, fit out men gymnastics integral function. Make grades with fitted men gymnastics integral function. Fitted function refines different sections grades 'score, according to competition different grades' ranks corresponding score difficulty and easiness extend, convert difficulty and easiness into scores, and similarly also record into grades. In this way it can avoid grades inequity due to different difficulty and easiness extent grades. Grading rules after improvement is conform to four judge criterions; it has higher equity than original criterion.

Key words: equity, grading rules, inhomogeneous difference handling, men gymnastics integral function
_____

INTRODUCTION

Olympic Games is a platform for athletes come from different areas of the world carrying out competition, score is a way judging individual and team ability. Therefore Olympic Games grading equity is very important. When Olympic Games hold competition, they all have certain grading rules, grading rules should conform to equity criterion and different competitions have different grading rules [1-3]. However, not all grading rules can conform to all equity criterions. When grading rules cannot meet all criterions, grading can only be done to meet most of equity criterions. It makes Olympic Games equity have some shortcomings [4-6]. In Olympic Games, athletes get any one more score should make greater efforts. And the higher grade is, one more score achieving should make greater efforts. That is to say, different grades phase scores possess different values. It is partial to judge athletes' competitive ability only according to grades. Especially in team competitions, utilize grades additive to judge team is success or failure. Ignore high scores and low scores members efforts differences, such grading way is inequity [7].

In 2009, international gymnastics federation men technical committee approved new grading rule, revising completion status scores into score E, except for landing and falling down as well as apparatus foul deduction changes, other postures, techniques and arts mistakes deductions largely follow grading rule in 2006 [1, 8]. In gymnastics competition, referee grading objectiveness has decisive influence on competition results. Athletes' daily hard training whether can get approval by referee or not, whether get good results in competition or not, the key is depending on competition participating members' on site play extent and referee scores scientifically. Whether referee can ensure grades equity, reasonability would direct relate to athletes' performance as well as future gymnastics

_____

development directions.

Improved grading rules, when grading, carry out inhomogeneous difference handling with men gymnastics team competition performance, establish integral functions. Convert different grades sections scores difficulty and easiness extent into scores, make scores represents scores and also difficulties. More concrete reflect scores representing athletes' efforts they made and their ability. Compare with original grading rules, improved rules not only conform to four equity criterions, but also can reflect athletes' individual ability and more equity.

SPORTS COMPETITION GRADING EQUITY RULES
Four equity criterions
Criterion one: Binary Independence
A and B two teams relative sequence should not rely on any other teams' performance. Two teams' ranks should be decided by two teams' strength, not related to other teams' performance.   But many competitions don't conform to binary independence. Especially ball kind competitions sometimes seriously rely on other teams' performance.

Criterion two: Condorcet Criterion
One team if win in paired duel with every one team, then the team should be the whole competition winner. So-called paired duel refers to after whole competition ending, if rejecting other teams, only rank A and B two teams. In paired duel, A would always win with any one team competition. Then A should be winner. If suffering the third team adding influences, though win in paired duel, A would not be winner. If binary independence is false, Condorcet criterion may not meet.

Criterion three: Monotonicity criterion
If team A is winner in one competition, in case that all competition participating team and members don't change in another competition, team A's one member an improved rank, and other all participating members relative sequence not change, then team A is still the winner. As an equity competition rule, it must meet monotonicity criterion.
Criterion Four: Pareto condition

If A and B two teams each has m members participate competition, and it has $a_i < b_i (i = 1, 2, \cdots, m)$, then team A rank should be superior to team B. As an equity rule, criterion three and four should be met.

Rule one: (m, l) **Rule**

In each competition, $m + 1$ members participate competition, take previous m members' rank sequence sum as the team scores. For example, (5, 2) rule let one competition totally has 33 teams 231 members participating, every team 7 people, from which 3 teams' performance as following:

Team A:	1	2	3	8	27	36	45	Top five total ranks41
Team B:	4	12	15	24	35	49	55	Top five total ranks 90
Team C:	10	11	13	28	30	43	69	Top five total ranks 92

According to grading rule, A, B, C three teams rank should be A first, B second, C third.

If in competition team A is disqualified because of some reasons, then B and C two team's performance would change as following:

Team B:	1	8	11	20	30	42	48	Top five total ranks 70
Team C:	6	7	9	23	25	37	62	Top five total ranks 70

In this way team B and C performance become the same.
If exclude all other teams, only see B and C two teams performance, performance ranks as following:

Team B:	1	4	6	7	10	12	13	Top five total ranks 28
Team C:	2	3	5	8	9	11	14	Top five total ranks 27

It is clear that team B performance exceeds team C.

From above inference process, it is clear the rule does not meet binary independence.

Promote: For team competition according to team participating competition member ranking, when more teams participate competition, binary independence is hard to ensure.

___

Similarly can proof in some conditions, Rule (m, l) is also not meet Condorcet Criterion but meet Monotonicity criterion and Pareto condition.

Rule two: Ranking weighting (m, l)
Ranking gets closer to top, ranking difference would become larger that is carrying out difference inhomogeneous handling with ranking. Utilize same theory as above, it can proof the rule is not meet binary independence, Condorcet criterion, but meet Monotonicity criterion and Pareto condition.

Rule three: Iteration (m, 0) Rule
Every time eliminate last team, and then calculate ranking again. Such as, there are 3 teams participating competition, adopt iteration (5, 0) rule. When competition carry out by half, performance as following:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
C1	C2	A1	A2	A3	B1	B2	B3	B4	B5	A4	C3	C4	C5	A5

Three teams current scores: A:38, B:40, C:42 eliminate C, performance change into:

1	2	3	4	5	6	7	8	9	10
A1	A2	A3	B1	B2	B3	B4	B5	A4	A5

The second round scores are: A: 25, B: 30, team A wins.

In competition process, member A4 in team A puts in excellent performance, is performance advancing, performance changes into:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
C1	C2	A1	A2	A3	A4	B1	B2	B3	B4	B5	C3	C4	C5	A5

Calculate scores: A: 33, B: 45, C: 42. Team B performance falls behind, gets eliminated, redo performance ranking:

1	2	3	4	5	6	7	8	9	10
C1	C2	A1	A2	A3	A4	C3	C4	C5	A5

Competition result: A: 28 C: 27, Team C wins.

Conclusions: iteration (m, 0) rule meet Condorcet criterion and Pareto condition, but not meet Monotonicity criterion and binary independence.

Rule four: Sequence Condorcet rule
According to random sequenc, the previous two teams duel, winner would make duel with next team, continue to implement as such procedures, finally left one is the winning team. For example, 4 teams join one competition, adopt sequence Condorcet rule, utilize (3, 0) rule in paired duel. Competition result is: assume paired duel sequence is ABCD.

1	2	3	4	5	6	7	8	9	10	11	12
C1	B1	A1	B2	A2	A3	D1	D2	D3	C2	C3	B3

When A、B two teams make duel: Team A members' ranking respectively are 2, 4, 5, team B members' ranking respectively are 1, 3, 6, total performance A: B=11:10, competition result is that team B wins.

Similarly, When B、C two teams make duel, total performance B:C=11:10, competition result is that team C wins. When C、D two teams make duel, total performance C:D=12:9, competition result is that team D wins.

And if make comparison of team A and team D performance, we notice that team D members rankings are rank 7、8、9, team A members rankings are rank 3、5、6,team A rankings all are superior   to team D, total performance team A is superior to team D. But according to competition rule, competition results that team A ranking may inferior to team D. Therefore the rule has serious flaws.

What problems would new rules implementation generate, how to improve and perfect. This paper takes 39th world championship as an example, on the basis of fully researching whole competition data, explore world men

_____

gymnastics development structure after new rules implementation, make clear Chinese men team positions in world gymnastics structure, reveal gymnastic competition some winning rules, provide reference ideas for Chinese competitive gymnastics sustainable development.

Table 1: Each performance contrast

Ranking	Country	Pommeled horse	Hanging bar	Parallel bars	Vaulting Horse	Floor Exercise	Horizontal Bar	Total score
1	China	44.775	47.625	47.125	48.9	44.575	44.775	277.775
2	Russia	45.35	46.325	46.9	47.9	44.125	44.6	275.4
3	Japan	44.775	47.15	46.225	47.175	44.425	45.05	274.8
4	Romania	44.7	45.175	44.975	48.5	46.175	42.7	272.775
5	Belarus	44.125	46.45	46.1	47	45.325	43.05	272.05
6	Canada	42.725	44.575	44.725	48.825	46.05	43.45	270.35
7	Germany	44.45	45.3	44.975	47.375	44.625	43.3	270.025
8	Switzerland	42.875	44.55	43.875	47.675	44.75	44.3	268.025

From Table 1 data, it is clear that Chinese team in 18 events sub team finals, basically play into normal level, fault rate relatively lower, final total score exceeds average value 5.125 score, from which rings, vaulting horse and parallel bars 3 items all ranking first, pummeled horse and horizontal bar respectively ranking at second ,third, only floor exercise plays not good enough, finally it wins team champion by exceeding Russian team 2.375score; Russian team has faults in floor exercise, only can rank second; while Japanese team in vaulting horse and floor exercise, Belarus team in rings and parallel bars are relative weaker   that influence team ranking , respectively ranking in the third and fourth.

From above analysis, it is clear that team strength is Asian Chinese and Japanese team are the strongest , the next is European Russian and Belarus team so that construct world men gymnastics team China, Japan, Russia three strongest lead situation.

RULE AFTER IMPROVEMENT –PERFORMANCE SEQUENCE RULE
Match principal with training difficulty and score difficulty. One team performance should reflect required training difficulty to get such performance. According each team top m members competition performance carry out ranking. It is easily proofed the rule meet whole equity criterion.

Discuss performance sequence rule rationality improvement: Because human physical ability is finite, more efforts should be made for athletes to highly improve same performance level .The more difficult motion is ,the more efforts athletes should make, which is different scores sections scores values are different. Established grading rules should reflect different sections scores values.

We according to previous four grading rules flaws, propose a new rule: one team performance should reflect required training difficulty to get such performance.

To athletics events, international athletics federation given "Athletics event score table" can objective and fair reflect athletes' training difficulty, full score is 1400.

We take over 2008 Beijing Olympic Games and 2012 London Olympic Games "Athletics event score table" men 200 meters event grading data, take gymnastics 17 scores as full scores 1400 scores, use 5 scores as lowest score to fit a gymnastics event standard score conversion function $y = 9.722x^2 - 97.22x + 243.056$, function figure as following Figure 1.
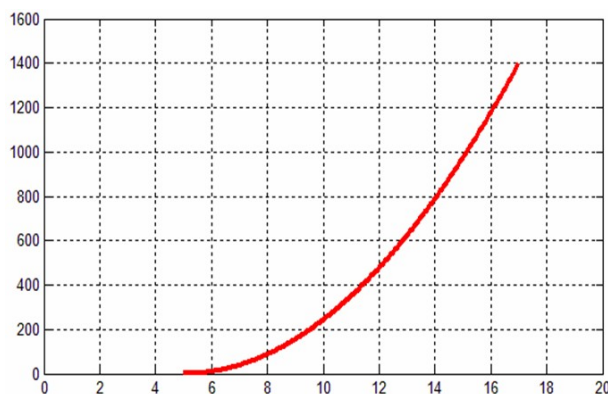

Figure 1: Gymnastics event standard score conversion function figure

_____

CONCLUSION

The paper according to Olympic Games four rules, give corresponding examples. Respectively explain four rules only lay particular importance on players' final score as well as team scores, ignoring that players efforts in gaining top score and low score are in different levels , high score and low score every score value also are different. Four grading rule equity is deficient. And according to four grading rules shortcomings, propose according to efforts different levels, reflect scores value in grades. Establish men gymnastics integral function, input judges' grades into function, and calculate integral. Through contrasting integral, define team ranking. Improved grades rule conforms to four items equity, and compare with original rules, grades are more equity.

REFERENCES

[1] Xu Rui-fang. *Sports Sciences Researches*, **2009**, 13(3), 50-51.
[2] WEI Deng-yun. *China Sport Science and Technology*, **2000**, 36(7).
[3] WEI Deng-yun. *China Sport Science and Technology*, **2000**, 36(7), 23-25.
[4] LIU Qin-long. *Journal of Hubei Sports Science*, **2004**, 23(1), 66-68.
[5] LI Liang-ping, WANG Yun-liang, SUN Jian. *China Sport Science and Technology*, **2006**, 42(4), 70-71.
[6] Zhang B., Zhang S. and Lu G.. *Journal of Chemical and Pharmaceutical Research*, **2013**, 5(9), 256-262.
[7] Zhang B.. *International Journal of Applied Mathematics and Statistics*, **2013**, 44(14), 422-430.
[8] Zhang B., Yue H.. *International Journal of Applied Mathematics and Statistics*, **2013**, 40(10), 469-476.