KATHOLIEKE UNIVERSITEIT
LEUVEN

A Statistical Evaluation of the Decathlon Scoring Systems

2011-2012

DE RIJDT Annelin

One of the most challenging disciplines in sports???

End of the decathlon at the Olympic Games in Beijing (2008)

Challenges to develop a scoring system?

- 10 different disciplines => 1 final score
- Results expressed in time units and results expressed in distance units
- Maximization problems versus minimization problems
- Balanced rewarding the different skills needed:
  - Speed
  - Power
  - Technique
  - Endurance

Presentation Overview

1) Decathlon in General
2) Decathlon Scoring Systems in History
   - Position-based ranking
   - Linear scoring system
   - Exponential scoring systems
3) Current Scoring System for Multi Event Competitions
   - Principles
   - Correlations between event groups and final score
   - Stepwise regression analysis
   - Fairness Analysis
4) Conclusion

Decathlon in General

The Decathlon

- Introduced as an Olympic discipline in 1912
- Decathletes: combination of speed, power, technique and endurance (= skills)
- 10 disciplines (= events)
- 2 consecutive days

HARDEE Trey at the 2009 World Athletic Championship in Berlin

The Decathlon

- Day 1: 100 meter, long jump, shot put, high jump and 400 meters => focus on condition

- Day 2: 110 meters hurdles, discus throw, pole vault, javelin throw and 1500 meters => technical day

Methodology

- 150 best performances of 2011
- Scoring systems evaluated for differences with current scoring
- Testing of fairness of current scoring system tested based on
  - Correlations of event groups with final score
  - Stepwise regression analysis to identify events or combination of events that best explain differences in final scoring
  - Percentage contribution of events in final score
  - Percentage contribution of skills in final score

Decathlon Scoring Systems in History

…-1884: Position-based Scoring System

Ranking based on positions achieved during the 10 events

+ Accepted for its simplicity
- No comparisons possible between competitions
- The difference between decathlete performances is NOT taken into account

1884-1934: Linear Scoring Principles

A unit gain in performance is rewarded with a constant rise in points.

$$S(P_i) = (P_i in\ cm - a) * b \qquad \text{For field events}$$

$$S(P_i) = (a - P_i\ in\ s) * b \qquad \text{For track events}$$

where P_i = Athlete's performance

a = performance rewarded with 0 points

b = point gain per unit.

\+ Simplicity

\+ Possibility to compare performances of different competitions

\- Did not take into account the limitations of the human body

\- Specialization

Rankings according to the different scoring systems

Decathlete	Competition	Ranking CSS	Position-Based Ranking	Ranking LSP
EATON Ashton	Eugene	1	3	9
HARDEE Trey	Gotzis	2	2	1
HARDEE Trey	Daegu	3	1	2
EATON Ashton	Daegu	4	5	13
SUAREZ Leonel	Daegu	5	4	5
SUAREZ Leonel	Gotzis	6	9	7
PAHAHILL Mikk	Gotzis	7	11	3
GARCIA Yordani	La habana	8	6	8
SUAREZ Leonel	Guadalajara	9	10	10
DROZDOV Aleksey	Cheboksary	10	28	4
DROZDOV Aleksey	Daegu	11	21	6
ERINS Edgar	Valmiera	12	14	32
SINTNICOLAAS Eelco	Gotzis	13	16	20
BOURAADA Lardi	Ratingen	14	15	39
SINTNICOLAAS Eelco	Daegu	15	12	25
KNOBEL Jan Felix	Gotzis	16	33	11
FREIMUTH Rico	Ratingen	17	8	23
DUDAS Mihail	Daegu	18	13	31
KASYANOV Oleksiy	Gotzis	19	7	36
BEHRENBRUCH Pascal	Ratingen	20	34	16

1934-1950: First Exponential Scoring System

The improvement of a performance gets harder when the initial performance is better.

+ Limitations of the decathletes physical abilities
+ Specialization is discouraged

Was unsustainable with ever improving results after WWII (better food, more time, better schedules…)

1950-1962: Second Exponential Scoring System

The progressive character of the scoring tables increased, compared to the 1934 scoring system.

+ Adapted for better performances
- Specialization is profitable

1962-1984: Third Exponential Scoring System

Track event scoring is progressive in nature, field event scores are regressive in nature.

+ Progressive nature of the track events decreased again
- Decathletes complained against the regressive nature of field event scores

Rankings according to the different scoring systems

Decathlete	Competition	Ranking CSS	Position-Based Ranking	Ranking LSP	Ranking 1932 scoring	Ranking 1952 scoring	Ranking 1962 scoring
EATON Ashton	Eugene	1	3	9	2	1	1
HARDEE Trey	Gotzis	2	2	1	1	2	2
HARDEE Trey	Daegu	3	1	2	3	3	3
EATON Ashton	Daegu	4	5	13	4	4	4
SUAREZ Leonel	Daegu	5	4	5	5	6	5
SUAREZ Leonel	Gotzis	6	9	7	7	7	7
PAHAHILL Mikk	Gotzis	7	11	3	7	12	8
GARCIA Yordani	La habana	8	6	8	6	8	6
SUAREZ Leonel	Guadalajara	9	10	10	10	10	10
DROZDOV Aleksey	Cheboksary	10	28	4	11	11	11
DROZDOV Aleksey	Daegu	11	21	6	14	5	16
ERINS Edgar	Valmiera	12	14	32	12	15	9
SINTNICOLAAS Eelco	Gotzis	13	16	20	20	22	14
BOURAADA Lardi	Ratingen	14	15	39	22	14	12
SINTNICOLAAS Eelco	Daegu	15	12	25	19	21	15
KNOBEL Jan Felix	Gotzis	16	33	11	15	20	20
FREIMUTH Rico	Ratingen	17	8	23	16	17	13
DUDAS Mihail	Daegu	18	13	31	24	27	18
KASYANOV Oleksiy	Gotzis	19	7	36	21	19	17
BEHRENBRUCH Pascal	Ratingen	20	34	16	9	18	22

Current Scoring System for Multi-Event Competitions

Principles of Current Scoring System

- Comparable results for different disciplines have to be scored with same amount of points.
- All-round athletes should perform better than specialized athletes.
- End-scores should remain approximately the same => comparability reasons
- Slightly progressive nature in all disciplines

Scoring equations

- Running events

$$Points = a * (b - T)^c$$

With T = time in seconds

- Jumping events

$$Points = a * (M - b)^c$$

With M = distance in centimeters

- Throwing events

$$Points = a * (D - b)^c$$

With D = distance in meters

Correlations Event Groups – Final Score

Coefficient of Correlation	*Run-Total*	*Run/1500m-Total*	*Jump-Total*	*Throw-Total*
Linear Scoring	0,052516	0,05981	0,523015	0,759195
1934 Scoring	0,348927	0,353087	0,414451	0,648576
1952 Scoring	0,514406	0,52127	0,545594	0,46561
1962 Scoring	0,46932	0,434486	0,498688	0,487032
Current Scoring	0,428048	0,39338	0,54603	0,508997

- In Linear scoring and 1934 scoring: Throwing events were heavily correlated with final scores
- Correlation coefficients become more equal over time

Stepwise Regression Analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
_110M	2.568561	0.157433	16.31529	0.0000
JT	0.994091	0.102582	9.690737	0.0000
LJ	1.949701	0.138394	14.08808	0.0000
PV	1.306722	0.103718	12.59880	0.0000
SP	1.726681	0.124095	13.91414	0.0000
_1500M	1.265155	0.107980	11.71655	0.0000

R-squared	0.781603	Mean dependent var	7985.260
Adjusted R-squared	0.774020	S.D. dependent var	225.0507
S.E. of regression	106.9832	Akaike info criterion	12.22240
Sum squared resid	1648139.	Schwarz criterion	12.34282
Log likelihood	-910.6799	Hannan-Quinn criter.	12.27132
Durbin-Watson stat	1.987635		

Selection Summary

Added _110M
Added JT
Added LJ
Added PV
Added SP
Added _1500M

Output for 6 regressors

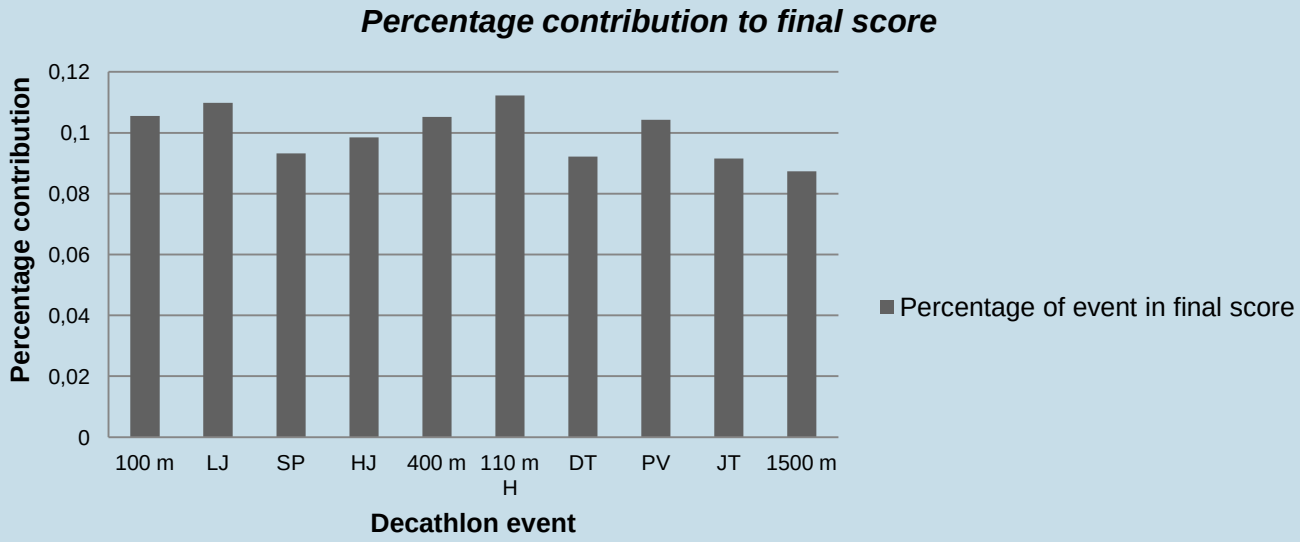
- Including 6 events allow us to explain more than 75% of the differences in the final scores
- 5 events only 57% explanatory power
- Most important events are driven by technical skills
- Importance of technique to be confirmed by fairness analysis

Fairness Analysis

- BASED ON EVENTS

  => Each event contributes for +/- 10% of final score

  - Analysis based on average scores
  - Very unequal score composition

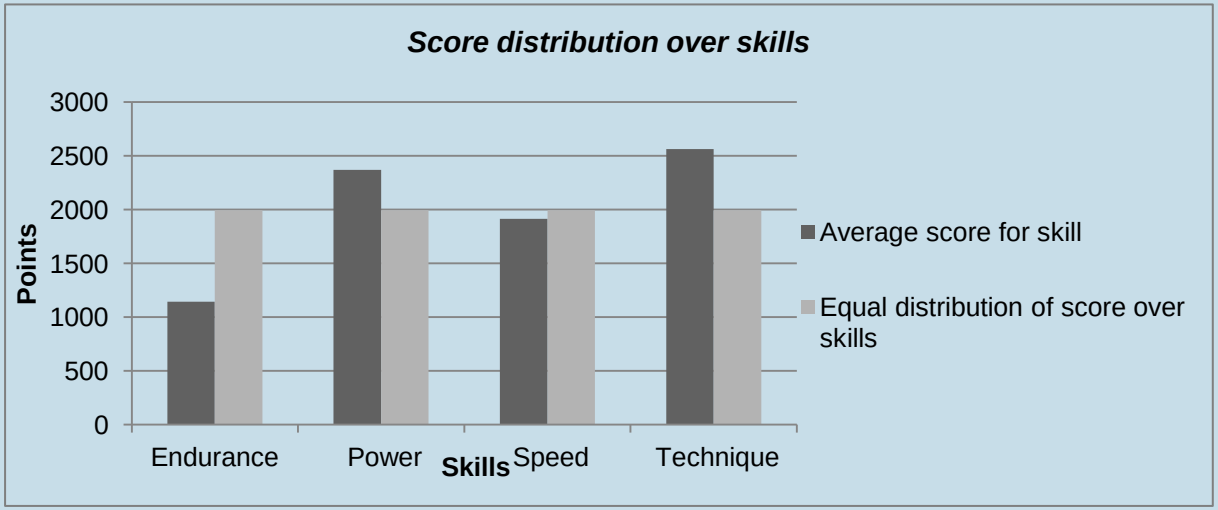


Fairness Analysis (ctd.)

- BASED ON SKILLS

  => Every skill needed to perform in a decathlon contributes 25% of the final score.

  - Analysis based on table of F. Vandaele (1999)
  - Technique has highest impact, endurance lowest
  - 64% of score on 1500 meters is attributed to endurance



Conclusion for current scoring system

- Correlation analysis shows that the different event groups are almost equally correlated with final scores
- Stepwise regression shows that 6 events are needed to explain 78% of the differences in final scores
- High scores for the 110 m H and the long jump events, while scores for the 1500 meter event are low
- Technical skills contribute most to final scores, whereas endurance is undervalued in the current scoring system

General Conclusion

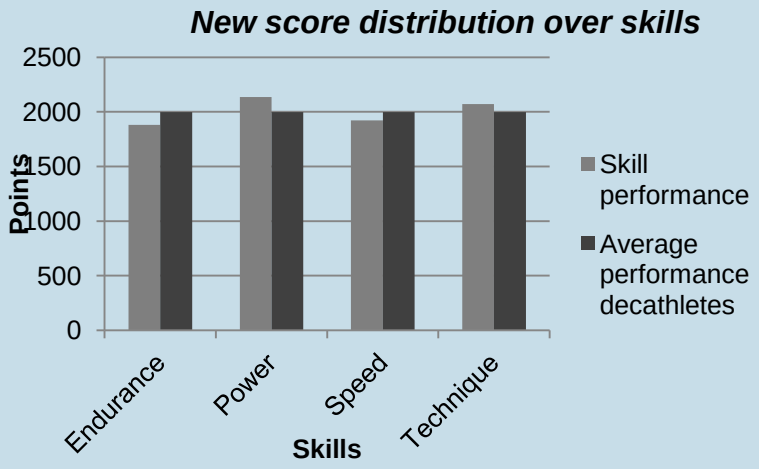
Conclusion

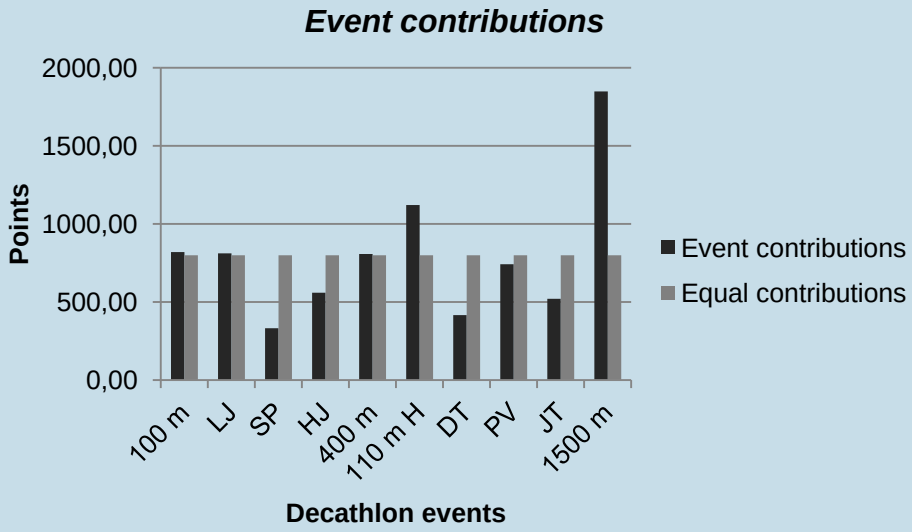
- Most recent scoring systems (exponential systems) result in fairly similar rankings.

- Still looking for “perfect” scoring systems because current system is still imperfect as certain events are still advantaged with regards to scoring.

Conclusion (ctd.)

- Implementing the notion of skill fairness in the scoring system
  - Would require to increase endurance in final score
  - Would therefore need to increase weighting of the 1500 meters score
  - Would change type of athlete
  - BUT, most all-round athlete?





Further research

Combine event with skill fairness

=> need to introduce intervals of event and skill contributions

But, even then, troubles with the contribution of the final event as endurance is the most important factor here.

Thank you for your attention.

Questions?