A Tour of Some Disc Golf Statistics

Using Data from 262 Advanced Players at

PDGA Am Worlds 2014

Who All Played the Same 5 Courses

Under Similar Weather Conditions, and

Identifying the Top 3 and Bottom 3 Holes (plus Ties) as Examples

Updated March 24, 2015

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Code:

CP = C.P. Adams Park

KP = Kaposia Park

KB = Kenwood Trails, Blue Tees

OK = Oakwood Park

TV = The Valley

You'll be curious to see what kinds of holes stand out. To see course maps, visit http://2014amworlds.com/courses/

Average Score – Mean of all scores recorded. The bigger the number, the more difficult the hole.

KP15	Meyer Flyer to Bromley Boards	5.74
KB2b	Track Magnet	4.91
KP10	Golden Sunrise	4.73
OK14	Hang It Out To Fly	2.60
OK02	Hillside Pitcher	2.47
OK01	Fade Away	2.45

Highest Frequency – How common the most common score is. A hole that gives the same score to all players does nothing to sort players by skill, so lower is better.

TV11	Majestic Flight	32%
KP13	Streamline	35%
KB2b	Track Magnet	35%
CP15	Cranker Soarus	69%
TV18	Uff Dah!	70%
OK17	Humpback Whirl	73%

Mode – The most common score; the one with the highest frequency. Another measure of the difficulty of the hole. (All the other holes have a mode of 3 or 4).

KP15	Meyer Flyer to Bromley Boards	6
KB09	Right of Pathage	5
KP10	Golden Sunrise	5
KB2b	Track Magnet	5
KB2a	Teardrop Island	2
OK01	Fade Away	2
OK02	Hillside Pitcher	2

Value of Scoring Lower than the Mode. Shows how many throws a player can expect to gain on the field by scoring lower (better) than the mode. The fewer players that beat the mode, the more value to those players that do. A value of -1 means no one scored lower than the mode. If the Mode is also par, this the value of a birdie. (Shown as a negative because it reduces the player's score.)

OK02	Hillside Pitcher	-1.000
KP07	Kap-O-See-Ya	-1.000
KB2a	Teardrop Island	-0.996
OK01	Fade Away	-0.996
CP15	Cranker Soarus	-0.996
TV18	Uff Dah!	-0.996
OK09	Birdie Aviary	-0.515
KP10	Golden Sunrise	-0.515
OK04	Mound of Boon	-0.508
KB09	Right of Pathage	-0.508

Cost of Scoring Higher than the Mode - Shows how many throws a player can expect to lose against the field by scoring higher (worse) than the mode. The fewer the players who score worse than the mode, the more devastating to those players that do. A value of 1 means no one scored higher than the mode. If the Mode is also par, this the cost of a bogey.

OK14	Hang It Out To Fly	0.954
CP09	No Pic-a-Nic	0.950
CP16	Sunset Terrace	0.947
TV10	Hillside Angler	0.947
TV15	Big Bend	0.515
KB11	Right Angler	0.511
KB17	A. Crushinger	0.508

White to Blue Effectiveness – Shows how effectively a hole gives lower scores to higher rated players – within a limited range. It is computed as the ratio of the *slope* of the average score over the ratings range of 900 to 950, divided by the *expected slope* of the average score for a flat, wide-open hole of the same length.

KB09	Right of Pathage	284%
TV01	Diamond Cutter	256%
KP17	Skyway	226%
TV04	Four Flight	18%
OK02	Hillside Pitcher	17%
KB18	Cliff Diver	-4%

Scoring Spread Width – Shows the amount of information in the distribution of scores. Can be thought of as a way to count the number of different scores recorded on that hole and how evenly the scores were spread across players.

KB2b	Track Magnet	4.68
KB09	Right of Pathage	4.48
TV11	Majestic Flight	4.21
OK17	Humpback Whirl	2.17
CP15	Cranker Soarus	2.14
TV18	Uff Dah!	2.01

Extra Scoring Spread Width per Extra Throw – Shows the efficiency with which a hole provides information. A higher number indicates a hole that is more efficient at sorting players without simply being more difficult. ("Extra" throws and "extra" scoring spread width are anything larger than one. These are used because at least one throw must be thrown on every hole, and the minimum possible scoring spread width is one, so only the throws and scoring spread width above one mean anything.)

KP13	Streamline	1.17
TV01	Diamond Cutter	1.16
CP18	Guardin' Finish	1.03
CP03	Bye Bye Birdie	0.50
CP15	Cranker Soarus	0.49
TV18	Uff Dah!	0.44

Standardized Contribution to Scoring Spread Width of Tournament Totals – Shows how much information a hole added to the distribution of total scores.   A positive contribution means that more players have more information about how well they stack up against the field. A particular hole's Contribution is the difference between the scoring spread width of the total scores *with* vs. *without* the hole being examined. These figures are standardized by taking the average over many combinations of a standard 72 players on 18 holes.

TV11	Majestic Flight	8.52%
KB09	Right of Pathage	8.09%
KP15	Meyer Flyer to Bromley Boards	5.64%
OK02	Hillside Pitcher	1.47%
OK14	Hang It Out To Fly	1.47%
CP12	Rocky Horror Bogey Throw	1.27%

Lucklessness – The percentage of random allocations of a hole's scores that would produce a larger Standardized Contribution to Scoring Spread Width of Tournament Totals. A lower number means the hole did a better job of giving scores to the right players: less luck.

KB2b	Track Magnet	26.3%
TV11	Majestic Flight	27.9%
KB09	Right of Pathage	28.1%
CP16	Sunset Terrace	43.3%
TV05	See Der Tree	43.3%
OK02	Hillside Pitcher	43.4%
OK03	Shore-Tee	44.1%

Correlation to Ratings – Shows how closely a hole matches its scores to a linear function of the scores that would be expected based on the ratings of the players.

TV16	Hurlin' Tunnel	0.39943
KP14	Cherokee	0.38600
KP15	Meyer Flyer to Bromley Boards	0.37180
TV12	Turn It Down	0.06065
KB08	Squirrel Box	0.05724
KB10	Split Decision	0.04824

Correlation to Total Score - Shows how closely a hole matches its scores to a linear function of the Total Scores.

CP04	Big Fourking Deal	0.28671
CP01	Frozen Rope	0.26913
KP03	Pinball Alley Short	0.20771
TV10	Hillside Angler	-0.06155
KB03	Passage to In-da-woods	-0.08375
KP17	Skyway	-0.10647

Design Score – A well-designed hole will increase the scoring spread without simply dialing up the difficulty or randomly assigning extra throws. Design score assigns a value to this. It is the product of the Extra Scoring Spread Width per Extra Throw times the number of standard deviations by which the hole beats a luckiness of 50%. Here are the top ten and bottom 10.

KB2b	Track Magnet	0.60
TV11	Majestic Flight	0.56
KB09	Right of Pathage	0.56
KB2a	Teardrop Island	0.54
KP13	Streamline	0.40
TV01	Diamond Cutter	0.38
KP02	It's Saved!	0.38
OK13	Big Dipper	0.36
KP09	Not Oak Grove	0.36
KB11	Right Angler	0.34
CP03	Bye Bye Birdie	0.14
OK11	Timber Trap	0.13
CP09	No Pic-a-Nic	0.12
OK17	Humpback Whirl	0.11
CP14	Rolling Pin	0.11
OK03	Shore-Tee	0.11
TV05	See Der Tree	0.10
TV18	Uff Dah!	0.09
CP15	Cranker Soarus	0.09
CP16	Sunset Terrace	0.09

Ratings vs. Score

This departs from the other statistics in that it introduces another piece of data: the ratings of the players. A rating can be assigned to each possible score on a hole. This can be done by fitting the player ratings to the scores on a hole in a linear way that preserves the average and standard deviation of the player ratings.

We can infer some things about the hole by looking at the skills of the players and what scores those players get.

Beginner Friendliness – The negative of the slope of ratings as a function of scores. The bigger the number, the easier it is for lesser-skilled players to score well relative to higher-skilled players.

TV18	Uff Dah!	56.2
OK17	Humpback Whirl	54.8
OK02	Avoid the Parents	51.4
TV11	Majestic Flight	24.8
KB09	Y the Long Space?	24.8
KB2b	Track and Hilled	23.1

Skill for a 2 – The rating associated with scoring a 2. The higher the rating, the tougher it is to get a 2.

KP15	Meyer Flyer to Bromley Boards	1037
CP03	Bye Bye Birdie	1020
CP16	Sunset Terrace	1020
CP18	Guardin' Finish	952
TV01	Diamond Cutter	952
KB2a	Teardrop Island	946

Skill for a 3

KP15	Meyer Flyer to Bromley Boards	1008
TV08	A Fir Pitch	979
KP10	Golden Sunrise	979
OK14	Hang It Out To Fly	909
OK02	Avoid the Parents	901
OK01	Get Down, Get Down!	901

Skill for a 4

KP15	Meyer Flyer to Bromley Boards	979
KP10	Golden Sunrise	950
KB2b	Track and Hilled	949
OK14	Hang It Out To Fly	860
OK02	Avoid the Parents	850
OK01	Get Down, Get Down!	850

Slope at mid-ratings

Similar to Polytomous Item Response Theory. The decrease in average score per rating point at a rating which is typical of the group (900 in this case). Expressed as a positive number when the change in score goes in the expected direction.

KB06	Sick Steep Slope	0.0168
TV11	Majestic Flight	0.0166
KP15	Meyer Flyer to Bromley Boards	0.0148
CP13	Noroaditgo	-0.0007
OK03	Shore-Tee	-0.0014
KP04	Brotzler Hobby Farm	-0.0020

Stat Wars

A statistic should be judged by how well it picks "good" or "bad" holes. A hole functions as part of a course. An 18-hole course that comprises holes that have better stats should perform better than a course that comprises holes that have worse stats.

While there are many ways in which a course can perform better (draw more players, leave more smiles on their faces, get talked about, etc.) I chose to focus on sorting players by ability.

To rate players by ability a course needs to give out scores that are correlated with disc golf skill. Tow measures of disc golf skill are readily available: Ratings and the Total Score of the tournament.

The "tournament" in this case is the five rounds at five courses that 192 Advanced players completed during 2014 PDGA Am Worlds.

Besides ranking players by skill, a course can perform better if it gives out a greater number of distinct scores. Fewer ties is better.

I selected the 18 holes that had the best value for each statistic for one virtual course, and compared that to the virtual course made up of the 18 holes with the worst value for that statistic. The difference shows how well a statistic separates the good from the bad. (Actually, not-as-good. There were likely not any really bad holes used in the World Championships.)

When measured by ability to pick holes that produce a high correlation with Total Score, the stats rank as follows (the 100% is the score a course with all 90 holes would get):

Statistic	100.0% Correlation to Total Score		
	Best 18	Worst 18	Difference
-Correlation of Hole Score with Rating (Highest)	87.4%	56.2%	31.2%
900 Slope (Highest)	86.8%	56.4%	30.4%
Standardized Contribution to Tournament SSW (Highest)	86.5%	56.7%	29.8%
Correlation of Hole Score with Course Score (Highest)	87.8%	60.3%	27.6%
Slopes at 3 Ratings (Highest)	85.5%	62.2%	23.3%
White 4/9 Par (Highest)	84.9%	62.6%	22.3%
950 Slope (Highest)	86.0%	65.2%	20.9%
Contribution to Correlation of Course Score with Rating (Highest)	84.4%	63.6%	20.8%
Average Score (Hardest)	84.1%	63.5%	20.6%
% 2s (Lowest)	85.0%	66.5%	18.5%
% 4s (Highest)	85.7%	68.1%	17.6%
Drive Length (Longest)	84.1%	67.4%	16.7%
Standardized Contribution to Course SSW (Highest)	86.8%	72.7%	14.2%
Better than Luck, Course (Highest)	83.6%	70.4%	13.2%
Eff Length (Longest)	84.1%	71.5%	12.5%
Scoring Spread Width (Widest)	84.8%	73.7%	11.1%
Max Freq. (Lowest)	84.4%	73.6%	10.8%
% 3s (Lowest)	85.0%	74.5%	10.5%
Geo Ave. Slope (Highest)	86.4%	76.1%	10.3%
Trouble (Highest)	86.5%	76.6%	9.9%
Nice to top 4 (Highest)	84.4%	74.8%	9.6%
% 5s (Highest)	84.3%	74.7%	9.6%
Better than Luck, Tournament (Highest)	84.1%	74.6%	9.5%
Par Smear (Highest)	86.5%	78.3%	8.2%
Contribution to Correlation of Tournament Score with Rating (Highest)	80.3%	72.5%	7.8%
Cost of throwing Over Mode (Smallest)	81.9%	75.5%	6.4%
Design Score (Highest)	84.2%	79.5%	4.7%
Contribution to Tournament SSW (Highest)	82.8%	78.9%	3.8%
Correlation of Hole Score with Tournament Score (Highest)	77.5%	74.6%	3.0%
Extra Scoring Spread Width per Extra Throw (Lowest)	83.4%	80.5%	2.9%
Value of Throwing Under Mode (Smallest)	81.8%	80.5%	1.3%
850 Slope (Lowest)	79.8%	79.1%	0.6%

When measured by the ability to put together a course that produces scores the correlate with Ratings, the stats rank as follows (87.1% is the correlation of total scores to rating):

Statistic	Correlation to Expected Score (Rating) 81.7%		
	Best 18	Worst 18	Difference
-Correlation of Hole Score with Rating (Highest)	76.7%	33.8%	42.9%
Contribution to Correlation of Course Score with Rating (Highest)	77.4%	38.9%	38.5%
Contribution to Correlation of Tournament Score with Rating (Highest)	77.7%	43.3%	34.5%
900 Slope (Highest)	73.7%	41.8%	31.9%
Slopes at 3 Ratings (Highest)	74.3%	43.9%	30.3%
Standardized Contribution to Tournament SSW (Highest)	71.7%	42.8%	28.8%
Correlation of Hole Score with Course Score (Highest)	72.6%	46.9%	25.7%
950 Slope (Highest)	71.5%	46.3%	25.2%
Drive Length (Longest)	72.2%	50.9%	21.4%
White 4/9 Par (Highest)	69.2%	48.1%	21.2%
Average Score (Hardest)	68.7%	51.0%	17.7%
Geo Ave. Slope (Highest)	73.6%	56.1%	17.5%
% 4s (Highest)	71.3%	54.2%	17.1%
% 2s (Lowest)	70.6%	53.5%	17.1%
Better than Luck, Course (Highest)	68.8%	52.3%	16.4%
Standardized Contribution to Course SSW (Highest)	71.0%	55.5%	15.5%
Eff Length (Longest)	69.0%	56.5%	12.5%
Par Smear (Highest)	72.8%	62.6%	10.3%
% 3s (Lowest)	70.0%	60.4%	9.7%
Better than Luck, Tournament (Highest)	68.3%	58.7%	9.6%
Cost of throwing Over Mode (Smallest)	71.6%	62.5%	9.2%
Correlation of Hole Score with Tournament Score (Highest)	67.9%	59.3%	8.6%
Extra Scoring Spread Width per Extra Throw (Lowest)	72.1%	63.5%	8.6%
Scoring Spread Width (Widest)	68.9%	60.4%	8.5%
Trouble (Highest)	72.2%	64.6%	7.5%
% 5s (Highest)	68.1%	60.7%	7.4%
Nice to top 4 (Highest)	70.1%	62.7%	7.4%
Max Freq. (Lowest)	68.0%	61.0%	6.9%
Contribution to Tournament SSW (Highest)	70.0%	64.9%	5.1%
Design Score (Highest)	69.7%	67.6%	2.1%
Value of Throwing Under Mode (Smallest)	65.8%	70.8%	-5.0%
850 Slope (Lowest)	63.0%	68.5%	-5.5%

When measured by the ability to put together a course that spreads the final scores, the statistics rank as follows (56.82 is the Scoring Spread Width of all 90 holes together):

Statistic	56.82	Scoring Spread Width of Total Scores	
		Best 18	Worst 18	Difference
Standardized Contribution to Tournament SSW (Highest)		24.42	11.92	12.50
Better than Luck, Tournament (Highest)		23.29	12.90	10.40
Scoring Spread Width (Widest)		23.41	13.55	9.86
Average Score (Hardest)		23.05	13.40	9.65
White 4/9 Par (Highest)		22.28	13.03	9.25
Better than Luck, Course (Highest)		22.19	13.25	8.95
Standardized Contribution to Course SSW (Highest)		21.48	12.80	8.67
Trouble (Highest)		21.54	13.23	8.31
% 5s (Highest)		22.47	14.35	8.12
-Correlation of Hole Score with Rating (Highest)		21.45	13.42	8.03
Par Smear (Highest)		23.15	15.29	7.87
% 3s (Lowest)		21.73	13.86	7.87
Max Freq. (Lowest)		21.85	14.08	7.77
% 2s (Lowest)		20.37	13.31	7.06
900 Slope (Highest)		20.81	13.99	6.82
Design Score (Highest)		22.25	15.52	6.73
Slopes at 3 Ratings (Highest)		20.49	13.94	6.56
% 4s (Highest)		19.33	13.10	6.22
Contribution to Correlation of Course Score with Rating (Highest)		19.77	14.13	5.64
950 Slope (Highest)		20.93	15.36	5.57
Correlation of Hole Score with Course Score (Highest)		19.11	13.86	5.25
Cost of throwing Over Mode (Smallest)		18.30	13.64	4.65
Nice to top 4 (Highest)		19.29	15.92	3.37
Contribution to Tournament SSW (Highest)		18.33	15.51	2.81
Geo Ave. Slope (Highest)		20.62	17.84	2.78
Drive Length (Longest)		17.79	15.17	2.62
Eff Length (Longest)		19.33	16.99	2.33
Value of Throwing Under Mode (Smallest)		18.28	15.96	2.32
Contribution to Correlation of Tournament Score with Rating (Highest)		18.57	16.26	2.31
850 Slope (Lowest)		17.09	16.13	0.95
Correlation of Hole Score with Tournament Score (Highest)		16.59	17.33	-0.73
Extra Scoring Spread Width per Extra Throw (Lowest)		17.45	18.27	-0.83

Useful stats.

Some of the statistics above can only be used to assess performance after a tournament. Others can be derived from pre-tournament competitions.

One group of stats that consistently show the ability to separate good holes from bad are measures of hole difficulty. This supports Jussi Meresmaa's call for tougher courses.

However, other stats do a better job than just measuring difficulty. Three that seem to be winners are: Scoring Spread Width, Correlation of Hole Score with Ratings, and Better than Luck, Course.

To see if selecting holes by these stats can produce a good course, I ranked all the holes by all three stats. I then selected the holes that had high ranks for all of the three stats.

Because the choices for best stats were generally the mostly difficult holes, I compiled several courses for a range of pars. To lower par by a throw, I replaced a higher par hole with the next-best lower-par hole.

The following graphs show that by selecting holes based on these three stats, a better course can be put together for any level of difficulty. Or – more practically - to improve a course, you can change the holes that have the worst stats.

Scoring Spread Width by Par
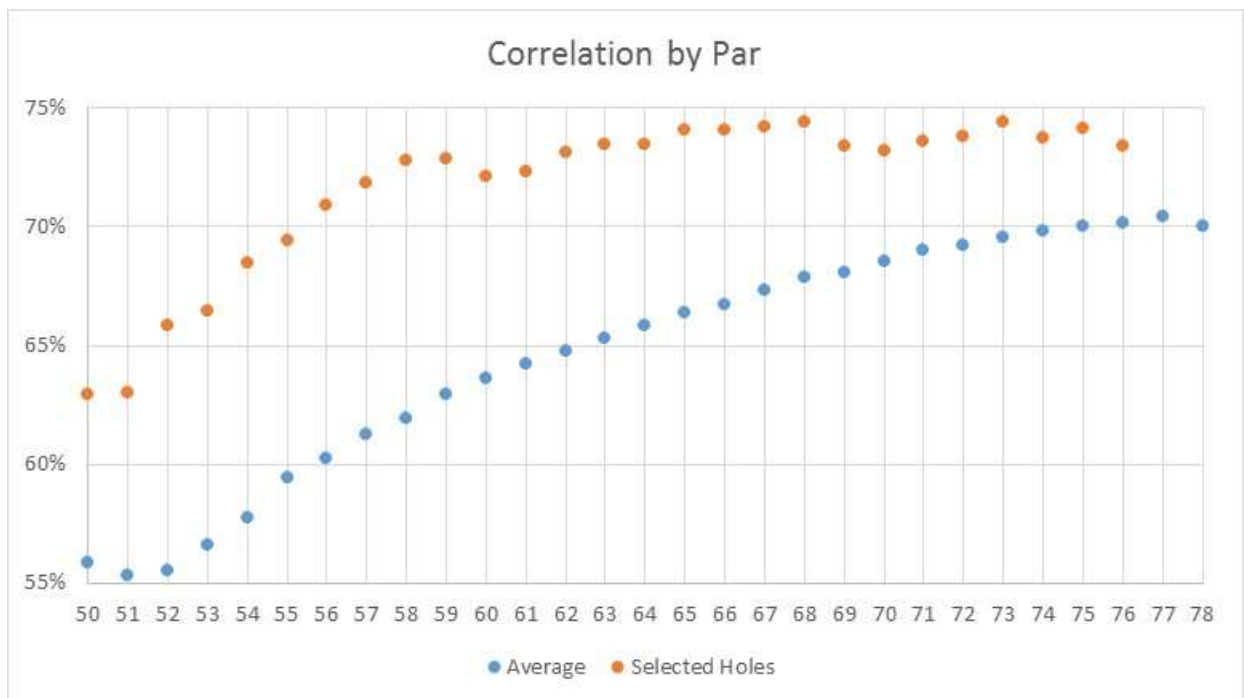
What can also be seen is that it is easier to put together a good difficult course. However, a good par 54 course can perform as well as an average course which has a par of 10-12 throws more difficulty.