EVERY SHOT COUNTS

USING THE REVOLUTIONARY STROKES GAINED APPROACH TO IMPROVE YOUR GOLF PERFORMANCE AND STRATEGY

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Table 1.1. Analysis of PGA Tour tournament winners from 2004 to 2012. Putting refers to the PGA Tour's main putting stat, strokes gained putting. Ranks are relative to all golfers who earn prize money (i.e., those who make the cut).

	Putting	Driving distance	Driving accuracy	Greens in regulation (GIR)
Average winner rank	14	26	28	14
Fraction of winners in top 10	58%	32%	31%	58%

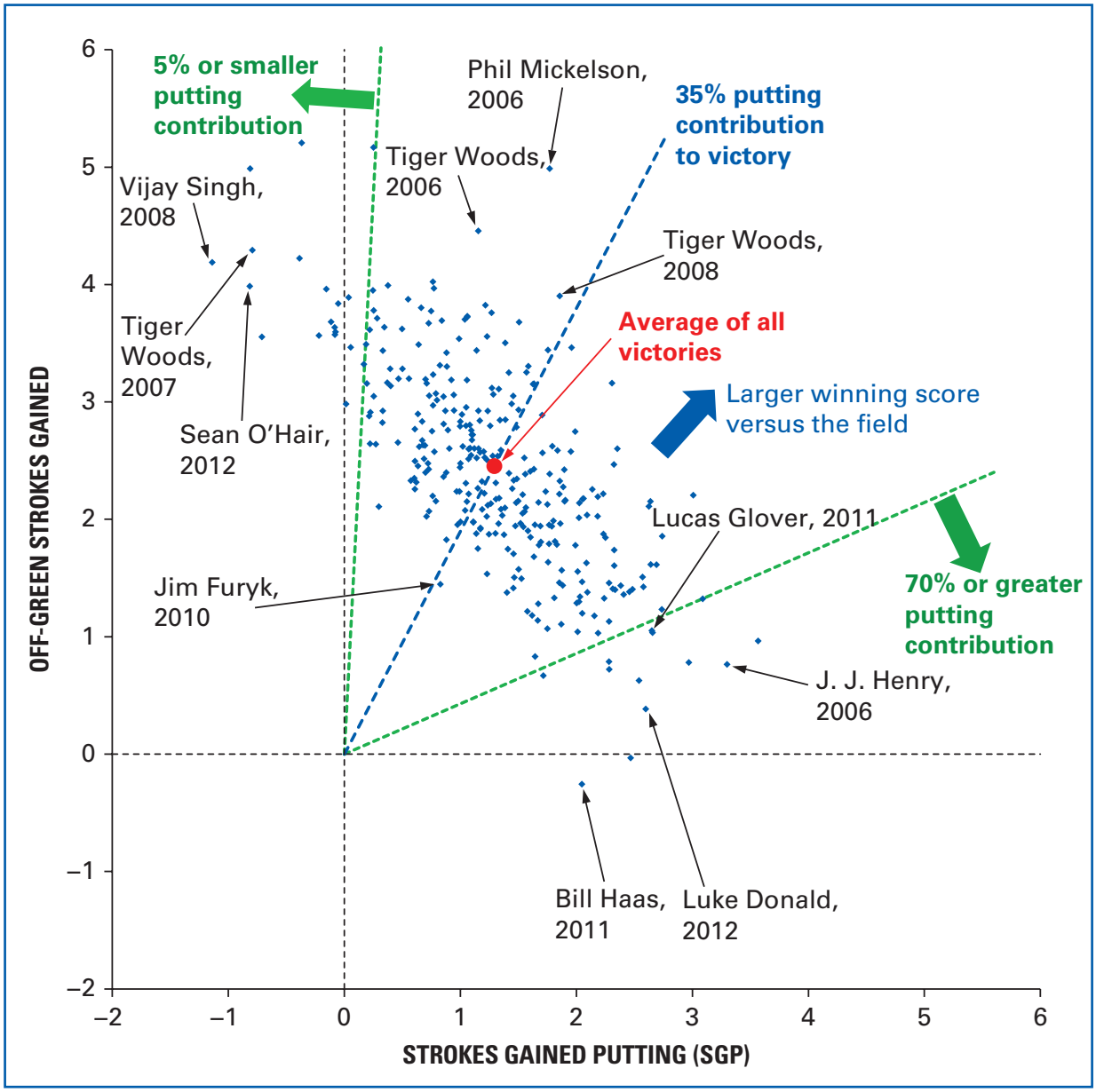


Figure 2.1. Winners' off-green strokes gained per round plotted against strokes gained putting per round (SGP). Off-green strokes gained is the winner's score versus the field (SVF) minus strokes gained putting (SGP). The putting contribution to victory is the ratio SGP/SVF. The average putting contribution to victory for these 315 victories was 35%.

Table 2.1. Selected PGA Tour tournament winners ranked by putting contribution to victory. Results from 315 PGA Tour tournament winners from 2004 to 2012. Putting performance is measured by strokes gained putting (SGP) per round. Winning performance is measured by the winner's average score versus the field (SVF) per round. The putting contribution to victory is the ratio SGP/SVF. Off-green strokes gained is the score versus the field (SVF) minus strokes gained putting (SGP). The top eight golfers won because of their putting. The middle eight are representative of typical putting contributions to victory. The bottom eight golfers won in spite of their putting.

Rank	Player name	Year	Event	Strokes gained putting (SGP)	Off-green strokes gained	Winning score versus field (SVF)	Putting contribution to victory (SGP/SVF)
1	Bill Haas	2011	TOUR Championship	2.05	-0.26	1.79	114%
2	Daniel Chopra	2008	Mercedes-Benz	2.47	-0.03	2.44	101%
3	Luke Donald	2012	Transitions	2.60	0.38	2.98	87%
4	J. J. Henry	2006	Buick Championship	3.30	0.76	4.06	81%
5	Matt Kuchar	2009	Turning Stone Resort	2.54	0.63	3.17	80%
6	Vijay Singh	2006	Barclays Classic	2.97	0.78	3.75	79%
7	Ben Curtis	2006	Booz Allen	3.57	0.96	4.53	79%
8	Wes Short Jr.	2005	Michelin	2.28	0.72	3.01	76%
154	Vijay Singh	2004	Chrysler Championship	1.63	3.15	4.78	34%
155	Rory Sabbatini	2009	Byron Nelson	1.50	2.93	4.43	34%
156	Adam Scott	2006	TOUR Championship	1.19	2.32	3.51	34%
157	Ernie Els	2004	Memorial	1.76	3.44	5.20	34%
158	Fred Funk	2004	Southern Farm Bureau	1.15	2.26	3.42	34%
159	Geoff Ogilvy	2005	Chrysler Tucson	1.00	1.98	2.98	34%
160	John Senden	2006	John Deere Classic	1.28	2.54	3.82	33%
161	Joey Sindelar	2004	Wachovia	1.04	2.08	3.12	33%
308	Mark Hensby	2004	John Deere Classic	-0.22	3.57	3.35	-7%
309	Vijay Singh	2004	Deutsche Bank	-0.37	5.21	4.84	-8%
310	Jason Dufner	2012	Byron Nelson	-0.39	4.22	3.84	-10%
311	Steve Flesch	2007	Reno-Tahoe Open	-0.81	4.99	4.18	-19%
312	Tiger Woods	2007	WGC-CA	-0.79	4.29	3.50	-23%
313	Sergio Garcia	2004	Byron Nelson	-0.71	3.55	2.84	-25%
314	Sean O'Hair	2009	Quail Hollow	-0.82	3.99	3.17	-26%
315	Vijay Singh	2008	WGC-Bridgestone	-1.14	4.19	3.05	-37%

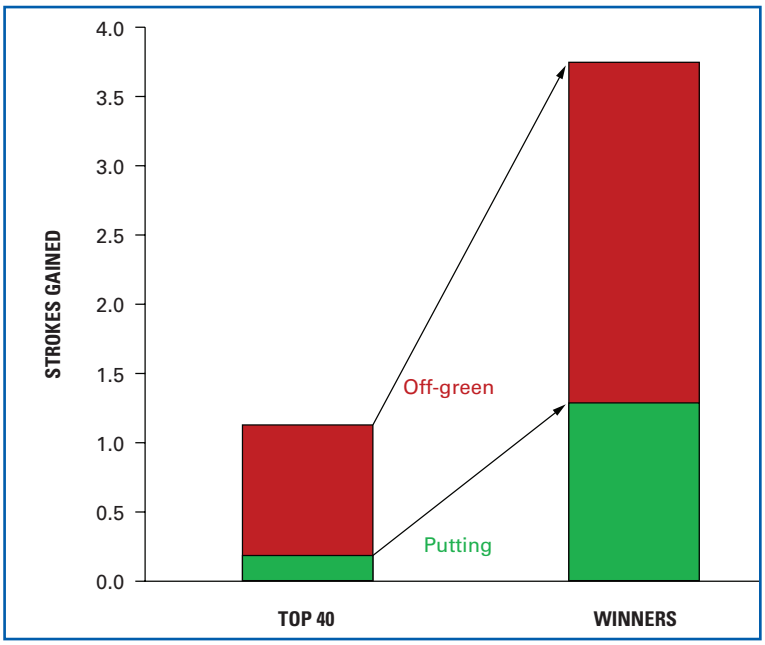
Table 2.2. Putting contribution to victory of golfers. Results ranked by putting contribution to victory and only include golfers with three or more wins in PGA Tour tournaments from 2004 to 2012.

Rank	Player name	Number of wins	Strokes gained putting (SGP)	Off-green strokes gained	Winning score versus field (SVF)	Putting contribution to victory (SGP/SVF)
1	Matt Kuchar	3	2.17	1.12	3.29	66%
2	Ben Curtis	3	2.67	1.53	4.20	64%
3	Bill Haas	3	1.84	1.12	2.96	62%
4	Stewart Cink	3	2.15	1.45	3.60	60%
5	Luke Donald	3	1.96	1.52	3.48	56%
6	Hunter Mahan	4	1.77	1.86	3.63	49%
7	Aaron Baddeley	3	1.94	2.06	4.00	48%
8	Bart Bryant	3	1.71	2.09	3.80	45%
9	Ben Crane	3	1.56	1.97	3.52	44%
10	Stuart Appleby	5	1.65	2.18	3.83	43%
11	K. J. Choi	6	1.61	2.15	3.76	43%
12	Geoff Ogilvy	4	1.28	1.76	3.04	42%
13	Brandt Snedeker	3	1.40	1.93	3.33	42%
14	Justin Rose	4	1.60	2.24	3.84	42%
15	Jim Furyk	7	1.52	2.18	3.70	41%
16	Carl Pettersson	5	1.57	2.31	3.88	41%
17	Mark Wilson	3	1.30	1.95	3.24	40%
18	Jonathan Byrd	4	1.28	2.07	3.35	38%
19	Anthony Kim	3	1.43	2.45	3.88	37%
20	Adam Scott	7	1.47	2.69	4.15	35%
21	Ryan Palmer	3	1.17	2.15	3.32	35%
22	Kenny Perry	7	1.34	2.57	3.91	34%
23	David Toms	3	1.61	3.10	4.71	34%
24	Stephen Ames	4	1.26	2.54	3.79	33%
25	Camilo Villegas	3	1.18	2.40	3.58	33%
26	Zach Johnson	7	1.24	2.65	3.89	32%
27	Ernie Els	5	1.17	2.81	3.98	29%
28	Steve Flesch	3	1.06	2.61	3.67	29%
29	Steve Stricker	9	1.10	2.76	3.86	29%
30	Nick Watney	4	1.08	2.73	3.81	28%
31	Tiger Woods	24	1.14	2.94	4.09	28%
32	Justin Leonard	3	1.15	3.01	4.16	28%
33	Phil Mickelson	11	1.10	3.02	4.12	27%
34	Rory Sabbatini	4	1.04	2.88	3.92	26%
35	Dustin Johnson	4	0.76	2.73	3.49	22%
36	Heath Slocum	4	0.67	2.72	3.39	20%
37	Vijay Singh	17	0.77	3.15	3.92	20%
38	Bubba Watson	3	0.44	3.22	3.66	12%
39	Sergio Garcia	4	0.36	2.98	3.34	11%
40	Sean O'Hair	4	0.26	2.94	3.19	8%

Table 2.3. Putting contribution to scores (PCS) for pros: top 40 golfers in total strokes gained on the PGA Tour from 2004 through 2012. Ranks are out of 240 golfers with at least 200 rounds during 2004–2012 (also included is Rory McIlroy with only 120 rounds). Total strokes gained per round is the golfer's average score relative to the field. Off-green strokes per round is obtained by subtracting strokes gained putting per round from total strokes gained per round.

	Rank			Strokes gained per round			
Golfer	**Total**	**Off-green**	**Putt**	**Total**	**Off-green**	**Putt**	**PCS**
Tiger Woods	1	1	3	2.79	2.16	0.63	23%
Jim Furyk	2	7	19	1.84	1.44	0.40	22%
Luke Donald	3	10	1	1.82	1.11	0.71	39%
Phil Mickelson	4	3	86	1.70	1.57	0.14	8%
Rory McIlroy*	5	3	153	1.66	1.72	-0.07	-4%
Vijay Singh	5	2	193	1.58	1.76	-0.18	-11%
Ernie Els	6	4	164	1.43	1.52	-0.08	-6%
Sergio Garcia	7	5	156	1.43	1.50	-0.07	-5%
Steve Stricker	8	26	13	1.34	0.85	0.49	37%
Adam Scott	9	6	178	1.33	1.45	-0.12	-9%
Zach Johnson	10	31	16	1.24	0.79	0.45	36%
Pádraig Harrington	11	18	50	1.17	0.93	0.23	20%
David Toms	12	16	62	1.15	0.95	0.20	18%
Justin Rose	13	8	140	1.15	1.18	-0.03	-2%
Retief Goosen	14	23	45	1.13	0.88	0.26	23%
Stewart Cink	15	50	12	1.09	0.59	0.50	46%
Geoff Ogilvy	16	36	34	1.05	0.71	0.34	32%
K. J. Choi	17	28	64	1.02	0.82	0.20	20%
Rickie Fowler	18	27	77	1.02	0.85	0.17	17%
Robert Allenby	19	9	191	1.00	1.17	-0.18	-18%
Tim Clark	20	30	60	0.99	0.79	0.21	21%
Kenny Perry	21	11	180	0.98	1.11	-0.12	-13%
Bo Van Pelt	22	32	79	0.95	0.78	0.17	17%
Scott Verplank	23	17	130	0.94	0.95	0.00	0%
Lee Westwood	24	14	160	0.92	1.00	-0.08	-8%
Dustin Johnson	25	13	165	0.92	1.01	-0.09	-10%
Webb Simpson	26	70	22	0.90	0.51	0.39	43%
Paul Casey	27	49	42	0.88	0.59	0.29	33%
Bubba Watson	28	15	176	0.88	1.00	-0.12	-13%
Jason Day	29	74	24	0.87	0.49	0.39	44%
Brandt Snedeker	30	93	10	0.87	0.31	0.56	64%
Rory Sabbatini	31	22	146	0.85	0.89	-0.04	-5%
Matt Kuchar	32	66	38	0.85	0.52	0.33	39%
John Senden	33	21	152	0.83	0.89	-0.07	-8%
Charles Howell III	34	43	78	0.81	0.64	0.17	21%
Ben Crane	35	110	9	0.80	0.24	0.56	70%
Anthony Kim	36	51	58	0.80	0.59	0.21	27%
Nick Watney	37	38	91	0.79	0.68	0.11	14%
Davis Love III	38	25	159	0.78	0.86	-0.07	-9%
Arron Oberholser	39	40	88	0.78	0.66	0.12	16%
Ian Poulter	40	54	59	0.78	0.57	0.21	27%
Top 40 average	20	29	87	1.13	0.95	0.17	15%

Figure 2.2. Putting contribution of the top 40 golfers and tournament winners: off-green strokes gained per round and strokes gained putting per round for the top 40 golfers in 2004–2012 and tournament winners in the same time period. Putting contributed 15% to the scoring advantage of the top 40 golfers and 35% to the scoring advantage of tournament winners.



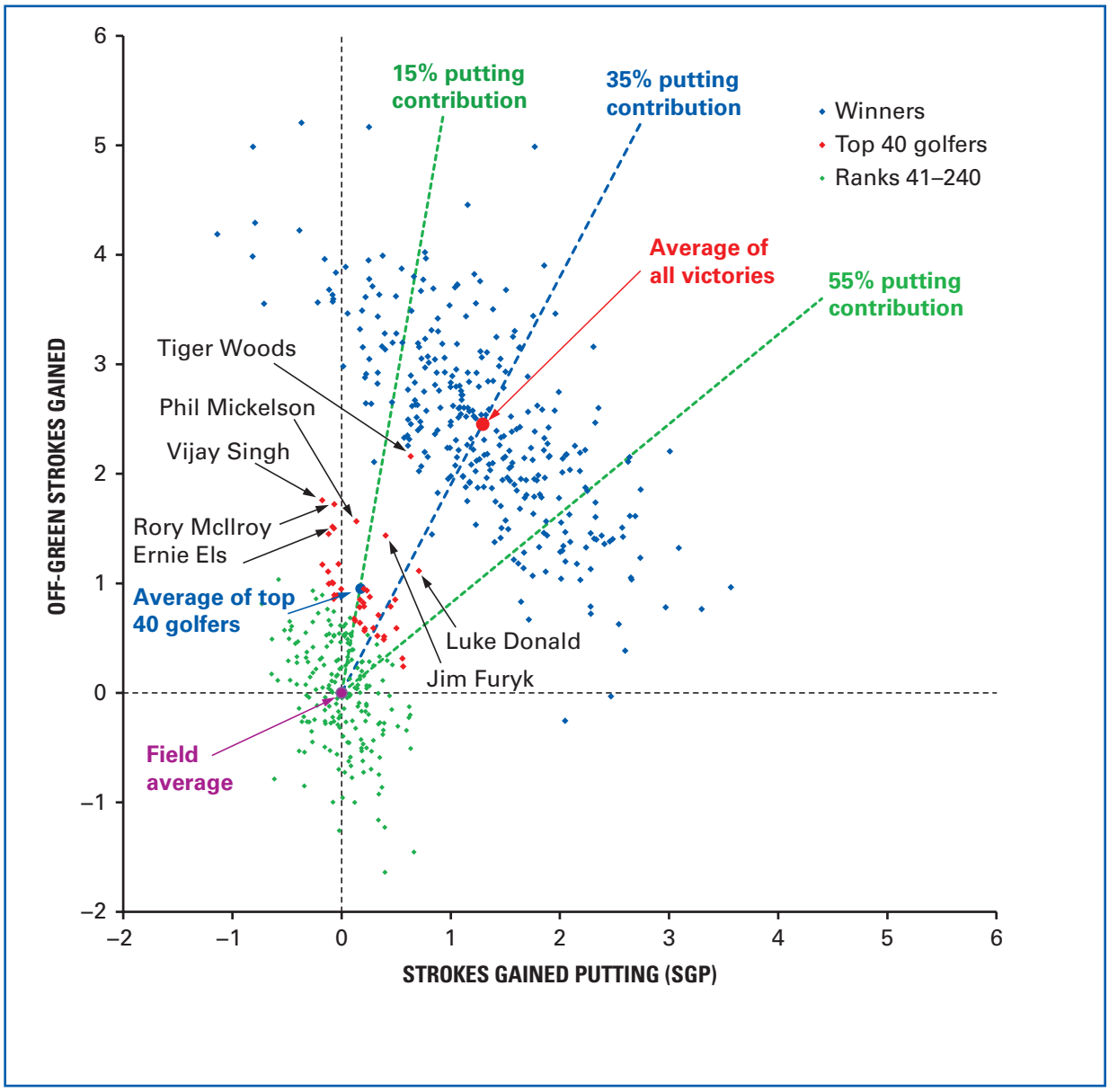


Figure 2.3. Tournament winners and 240 golfers in 2004–2012: off-green strokes gained per round plotted against strokes gained putting per round (SGP). The 240 red and green diamonds represent career average results of individual golfers with at least 200 rounds played in 2004–2012 (plus Rory McIlroy with 120 rounds). The red diamonds represent golfers ranked 1 through 40 and the green diamonds correspond to ranks 41 through 240. The blue diamonds represent the results of tournament winners in the week of their victory. Tiger Woods gained 2.8 strokes per round from 2004 to 2012, with 2.2 strokes from off-green shots and 0.6 from putting. He is the closest to the average 3.7 strokes gained per round for all victories. The chart shows many victories where putting contributed 55% or more, but only two golfers in the top 40 had putting contributions of 55% or more. The average putting contribution for these 315 victories was 35%. The average putting contribution for the top 40 golfers was 15%.

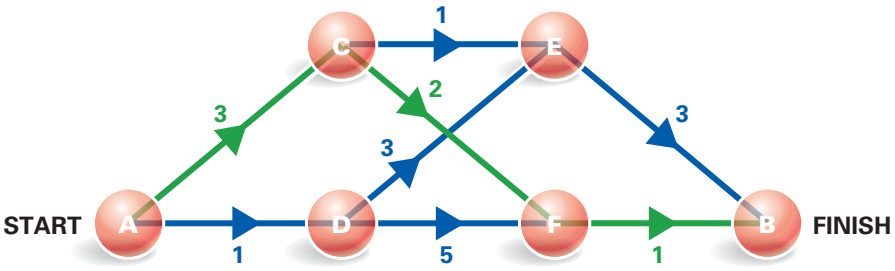


Figure 3.1. The shortest path problem: The shortest time to travel from A to B is six hours on the path A-C-F-B, while all other paths from A to B take 7 hours. Finding the shortest path through larger networks is more complicated, but can be solved using dynamic programming techniques. In this example, the shortest path takes the longer road from A to C, with a travel time of 3 hours, rather than the 1-hour trip on the road from A to D. In golf, it is sometimes better to take a longer route to the hole, for example, not cutting off distance on a dogleg hole or using a fairway wood off the tee rather than a driver.

Figure 3.2. The tour average from 33 feet is two putts. A one-putt from 33 feet gains one stroke compared to the tour average. The tour average from eight feet is 1.5 putts. A one-putt from eight feet gains one-half a stroke compared to the tour average. Both golfers take one putt, so a simple count of putts suggests no difference in putting performance. The strokes gained stat properly reflects and quantifies the better outcome of sinking a 33-foot putt compared to an eight-foot putt.

Table 3.1. One-putt probability, three-putt probability, and average number of putts to hole out for PGA Tour golfers by distance from the hole. The average putts column is the PGA Tour putting benchmark used in the strokes gained putting computations. The values in the table are based on an analysis of nearly four million putts on the PGA Tour from 2003 to 2012.

Distance (feet)	One-putt probability	Three-putt probability	Average putts
2	99%	0.0%	1.01
3	96%	0.1%	1.04
4	88%	0.3%	1.13
5	77%	0.4%	1.23
6	66%	0.4%	1.34
7	58%	0.5%	1.42
8	50%	0.6%	1.50
9	45%	0.7%	1.56
10	40%	0.7%	1.61
15	23%	1.3%	1.78
20	15%	2.2%	1.87
30	7%	5.0%	1.98
40	4%	10.0%	2.06
50	3%	17.0%	2.14
60	2%	23.0%	2.21
90	1%	41.0%	2.40

Table 3.2. Putting results for Tiger Woods in round one of the 2011 Frys.com Open at CordeValle. Woods's overall strokes gained putting of -1.3 indicates a worse-than-average putting performance. Starting from Tiger's initial putt distances, the tour average number of putts is 25.7. Tiger took 27 putts, so his strokes gained putting is -1.3, or 1.3 putts worse than the tour average. The average initial distance of Tiger's putts was 11 feet, compared to the field average of 20 feet for this round. Tiger's 27 putts was less than the tour average of 29 because he started, on average, closer to the hole, not because he putted better. (The numbers in the table are rounded.)

Hole	1	2	3	4	5	6	7	8	9	Out
Distance (feet)	4	3	3	3	1	6	22	45	6	
Tour avg putts	1.1	1.0	1.0	1.0	1.0	1.3	1.9	2.1	1.3	11.9
Woods's putts	1	1	2	1	1	1	2	2	2	13.0
Strokes gained	0.1	0.0	-1.0	0.0	0.0	0.3	-0.1	0.1	-0.7	-1.1

Hole	10	11	12	13	14	15	16	17	18	In	Total
Distance (feet)	12	4	42	15	6	5	4	13	13		
Tour avg putts	1.7	1.1	2.1	1.8	1.3	1.2	1.1	1.7	1.7	13.8	25.7
Woods's putts	1	2	2	2	1	1	1	2	2	14.0	27
Strokes gained	0.7	-0.9	0.1	-0.2	0.3	0.2	0.1	-0.3	-0.3	-0.2	-1.3

Table 3.3. Putting results for Bobby Jones in the first qualifying round for the British Open in 1926 at Sunningdale. His strokes gained putting was -0.7 relative to the PGA Tour benchmark from 2004 to 2012. Starting from his initial putt distances, the tour average number of putts is 32.3. His 33 putts represented at loss of 0.7 (32.3 minus 33) relative to the tour average. Exact putt distances are unknown for holes 1, 2, and 14 and are set to 35 feet.

Hole	1	2	3	4	5	6	7	8	9	Out
Distance (feet)	35	35	5	25	25	18	10	40	5	
Tour avg putts	2.0	2.0	1.2	1.9	1.9	1.8	1.6	2.1	1.2	15.9
Jones's putts	2	2	2	2	1	2	2	2	2	17.0
Strokes gained	0.0	0.0	-0.8	-0.1	0.9	-0.2	-0.4	0.1	-0.8	-1.1

Hole	10	11	12	13	14	15	16	17	18	In	Total
Distance (feet)	30	7	30	6	35	12	40	30	30		
Tour avg putts	2.0	1.4	2.0	1.3	2.0	1.7	2.1	2.0	2.0	16.4	32.3
Jones's putts	2	1	2	1	2	2	2	2	2	16.0	33
Strokes gained	0.0	0.4	0.0	0.3	0.0	-0.3	0.1	0.0	0.0	0.4	-0.7

Table 3.4. Putting results for Paul Goydos in round one of the 2010 John Deere Classic at TPC Deere Run. His strokes gained putting of 7.5 was the second-best single-round putting performance in 2003–2012.

Hole	1	2	3	4	5	6	7	8	9	Out
Distance (feet)	10	6	45	18	54	18	12	36	22	
Tour avg putts	1.6	1.3	2.1	1.8	2.2	1.8	1.7	2.0	1.9	16.5
Goydos's putts	2	1	2	1	2	1	1	2	2	14.0
Strokes gained	-0.4	0.3	0.1	0.8	0.2	0.8	0.7	0.0	-0.1	2.5

Hole	10	11	12	13	14	15	16	17	18	In	Total
Distance (feet)	6	40	20	25	6	6	0	11	8		
Tour avg putts	1.3	2.1	1.9	1.9	1.3	1.3	0.0	1.6	1.5	13.0	29.5
Goydos's putts	1	1	1	1	1	1	0	1	1	8.0	22
Strokes gained	0.3	1.1	0.9	0.9	0.3	0.3	0.0	0.6	0.5	5.0	7.5

Table 3.5. Putting results for Joe Durant in round two of the 2008 Wachovia Championship at Quail Hollow. Durant lost 9.8 strokes to the tour average, the worst strokes gained putting round on the PGA Tour in 2003–2012.

Hole	1	2	3	4	5	6	7	8	9	Out
Distance (feet)	1	17	5	55	8	13	13	3	15	
Tour avg putts	1.0	1.8	1.2	2.2	1.5	1.7	1.7	1.0	1.8	14.0
Durant's putts	1	2	2	3	2	3	2	2	2	19.0
Strokes gained	0.0	-0.2	-0.8	-0.8	-0.5	-1.3	-0.3	-1.0	-0.2	-5.0

Hole	10	11	12	13	14	15	16	17	18	In	Total
Distance (feet)	20	49	14	14	20	60	8	20	5		
Tour avg putts	1.9	2.1	1.7	1.7	1.9	2.2	1.5	1.9	1.2	16.2	30.2
Durant's putts	2	2	2	2	2	4	2	3	2	21.0	40
Strokes gained	-0.1	0.1	-0.3	-0.3	-0.1	-1.8	-0.5	-1.1	-0.8	-4.8	-9.8

Table 3.6. Courses ranked by putting difficulty as measured by average strokes gained putting using ShotLink data from 2003 to 2011. Only courses with at least 12 rounds of ShotLink data are included. Pebble Beach was the hardest course to putt and Colonial was the easiest.

Rank	Course	Average SGP	Rank	Course	Average SGP
1	Pebble Beach	-0.77	24	En-Joie	-0.03
2	Westchester	-0.73	25	TPC Four Seasons	-0.02
3	Kapalua	-0.63	26	La Cantera	0.00
4	Quail Hollow	-0.52	27	Warwick Hills	0.01
5	TPC Sugarloaf	-0.43	28	Brown Deer Park	0.03
6	Riviera	-0.37	29	PGA West Palmer	0.04
7	Congressional	-0.35	30	TPC Southwind	0.05
8	Torrey Pines South	-0.31	31	Waialae	0.08
9	Montreux	-0.24	32	Cog Hill	0.08
10	Atunyote	-0.20	33	Firestone South	0.09
11	The Classic Club	-0.19	34	Magnolia	0.09
12	TPC Sawgrass	-0.19	35	Redstone: Tournament Course	0.09
13	Muirfield Village	-0.17	36	PGA National	0.10
14	Tucson National	-0.15	37	Forest Oaks	0.13
15	Bay Hill	-0.13	38	TPC Louisiana	0.15
16	Sedgefield	-0.13	39	East Lake	0.17
17	Innisbrook-Copperhead	-0.12	40	TPC Scottsdale	0.18
18	Glen Abbey	-0.10	41	TPC Boston	0.19
19	TPC River Highlands	-0.08	42	TPC Summerlin	0.21
20	Nemacolin–Mystic Rock	-0.08	43	TPC Deere Run	0.22
21	Harbour Town	-0.05	44	Doral Blue Monster	0.24
22	Redstone: Jacobsen/Hardy	-0.05	45	Colonial	0.26
23	Annandale	-0.03			

Table 3.7. Top 50 putters on the PGA Tour from 2004 through August 2012. Only golfers with at least 120 rounds are included in the ranking. Strokes gained putting (SGP) results are per round and relative to the average PGA Tour field (as discussed in the appendix).

Rank	Golfer	SGP	Rank	Golfer	SGP
1	Luke Donald	0.70	26	Parker McLachlin	0.40
2	Brad Faxon	0.64	27	Nathan Green	0.39
3	Tiger Woods	0.64	28	Webb Simpson	0.39
4	Aaron Baddeley	0.64	29	Jeff Quinney	0.38
5	Greg Chalmers	0.63	30	Scott McCarron	0.38
6	Jesper Parnevik	0.62	31	Jason Day	0.38
7	Brian Gay	0.62	32	Brent Geiberger	0.38
8	Loren Roberts	0.62	33	Matt Gogel	0.38
9	Bryce Molder	0.58	34	Shigeki Maruyama	0.38
10	Ben Crane	0.56	35	Richard S. Johnson	0.36
11	Brandt Snedeker	0.54	36	Geoff Ogilvy	0.35
12	Dean Wilson	0.52	37	Eric Axley	0.35
13	Steve Stricker	0.50	38	Blake Adams	0.35
14	Stewart Cink	0.49	39	Stephen Ames	0.34
15	José María Olazábal	0.48	40	Marc Turnesa	0.34
16	Fredrik Jacobson	0.47	41	Daniel Chopra	0.34
17	Michael Thompson	0.46	42	Bob Tway	0.34
18	Charlie Wi	0.45	43	Gavin Coles	0.32
19	Chad Collins	0.45	44	Ryan Moore	0.32
20	Zach Johnson	0.44	45	Jeff Klauk	0.31
21	Corey Pavin	0.44	46	Matt Kuchar	0.31
22	Carl Pettersson	0.43	47	David Mathis	0.30
23	Jim Furyk	0.41	48	Darren Clarke	0.30
24	Len Mattiace	0.40	49	Bob Heintz	0.29
25	Mark O'Meara	0.40	50	Kevin Na	0.29

Table 3.8. Number of putts by putt distance for PGA Tour golfers.

	Total	0–2 feet	3–6 feet	7–21 feet	22 feet and over
Number of putts	29.2	8.9	7.0	8.0	5.3
Fraction of putts	100%	30%	24%	27%	18%

Table 3.9. Strokes gained putting per round in 2011, broken down into three distance categories: short putts (0–6 feet), medium-length putts (7–21 feet), and long putts (22 feet and over). Ranks are out of the 204 golfers with at least 30 rounds in 2011.

	Rank				Strokes gained putting per round			
Golfer	**All**	**0–6 ft**	**7–21 ft**	**22+ ft**	**Total**	**0–6 ft**	**7–21 ft**	**22+ ft**
Luke Donald	1	2	4	41	0.95	0.40	0.46	0.09
Steve Stricker	2	12	2	36	0.87	0.27	0.49	0.10
Charlie Wi	3	11	5	34	0.82	0.27	0.44	0.11
Bryce Molder	4	29	1	76	0.76	0.21	0.51	0.04
Kevin Na	5	8	23	26	0.68	0.30	0.25	0.13
Fredrik Jacobson	6	3	22	68	0.68	0.37	0.25	0.05
Jason Day	7	40	16	19	0.65	0.19	0.31	0.15
Brandt Snedeker	8	25	24	12	0.64	0.23	0.24	0.18
Greg Chalmers	9	10	20	38	0.64	0.28	0.26	0.10
Zach Johnson	10	16	3	167	0.63	0.26	0.47	-0.10
				Average	0.73	0.28	0.37	0.08
Top five 0–6 feet								
Jeff Quinney	15	1	34	192	0.58	0.56	0.20	-0.18
Luke Donald	1	2	4	41	0.95	0.40	0.46	0.09
Fredrik Jacobson	6	3	22	68	0.68	0.37	0.25	0.05
Geoff Ogilvy	14	4	12	163	0.59	0.36	0.32	-0.09
Will Strickler	62	5	134	134	0.22	0.33	-0.07	-0.04
Top five 7–21 feet								
Bryce Molder	4	29	1	76	0.76	0.21	0.51	0.04
Steve Stricker	2	12	2	36	0.87	0.27	0.49	0.10
Zach Johnson	10	16	3	167	0.63	0.26	0.47	-0.10
Luke Donald	1	2	4	41	0.95	0.40	0.46	0.09
Charlie Wi	3	11	5	34	0.82	0.27	0.44	0.11
Top five 22+ feet								
Matt McQuillan	33	113	65	1	0.39	-0.02	0.11	0.30
Tim Petrovic	77	58	183	2	0.15	0.12	-0.27	0.30
Paul Casey	32	92	80	3	0.39	0.04	0.08	0.28
Graeme McDowell	60	105	126	4	0.23	0.00	-0.04	0.26
Hunter Haas	38	148	31	5	0.34	-0.11	0.20	0.25
Notable golfers								
Vijay Singh	131	141	143	43	-0.08	-0.09	-0.08	0.09
Bubba Watson	139	134	145	79	-0.11	-0.07	-0.09	0.04
Phil Mickelson	140	18	188	148	-0.11	0.25	-0.31	-0.06
Adam Scott	149	165	101	113	-0.16	-0.16	0.02	-0.02
Dustin Johnson	180	195	138	115	-0.47	-0.38	-0.07	-0.02
Ernie Els	194	200	195	15	-0.66	-0.49	-0.34	0.16

Table 3.10. One-putt probability, three-putt probability, and average number of putts to hole out for PGA Tour golfers, scratch golfers, and 90-golfers.

Distance (feet)	One-putt probability			Three-putt probability		
	Tour pro	Scratch golfer	90-golfer	Tour pro	Scratch golfer	90-golfer
2	99%	99%	95%	0%	< 1%	< 1%
3	96%	93%	84%	0%	< 1%	< 1%
4	88%	80%	65%	0%	< 1%	< 1%
5	77%	66%	50%	0%	< 1%	< 1%
6	66%	55%	39%	0%	< 1%	1%
7	58%	47%	32%	1%	1%	1%
8	50%	41%	27%	1%	1%	2%
9	45%	36%	23%	1%	1%	2%
10	40%	33%	20%	1%	1%	2%
15	23%	21%	11%	1%	2%	5%
20	15%	14%	6%	2%	4%	8%
30	7%	6%	2%	5%	9%	18%
40	4%	2%	< 1%	10%	15%	30%
50	3%	1%	< 1%	17%	23%	41%
60	2%	< 1%	< 1%	23%	30%	51%

Distance (feet)	Average number of putts		
	Tour pro	Scratch golfer	90-golfer
2	1.01	1.01	1.06
3	1.04	1.07	1.17
4	1.13	1.20	1.36
5	1.23	1.34	1.51
6	1.34	1.45	1.62
7	1.42	1.54	1.69
8	1.50	1.60	1.75
9	1.56	1.65	1.79
10	1.61	1.68	1.82
15	1.78	1.81	1.94
20	1.87	1.89	2.02
30	1.98	2.03	2.16
40	2.06	2.14	2.30
50	2.14	2.22	2.41
60	2.21	2.30	2.51

Table 4.1. Average scores of golfers playing a challenging 6,500-yard course under several scramble formats. Column "All" is the format described in the chapter in which the best or worst of two balls is played for every shot. Column "Off green" means that two balls are played until the best or worst of two balls finishes on the green. From there the golfer putts one ball into the hole. Column "Tee only" means that two balls are played on the tee shot of each hole. After choosing the best or worst of the two tee shots, the golfer plays one ball into the hole. The worst-of-two scramble results for the 100-golfer aren't given because of the torture it would be for the group playing behind.

		Worst-of-two scramble			Best-of-two scramble		
Golfer	**One ball**	**All**	**Off green**	**Tee only**	**Tee only**	**Off green**	**All**
PGA Tour pro	68	78	76	71	66	63	60
80-golfer	80	97	93	83	77	73	70
90-golfer	90	112	107	93	86	82	78
100-golfer	100	-	-	-	95	90	85

Table 4.2. Average scores of teams of two golfers playing in better-ball and worst-ball formats. In better ball, the best of two scores on each hole is counted. In worst ball, the worst of two scores on each hole is counted.

		Teams of two	
Golfer	**One ball**	**Better ball**	**Worst ball**
70-golfer	70	64	76
80-golfer	80	73	87
90-golfer	90	81	99
100-golfer	100	89	111

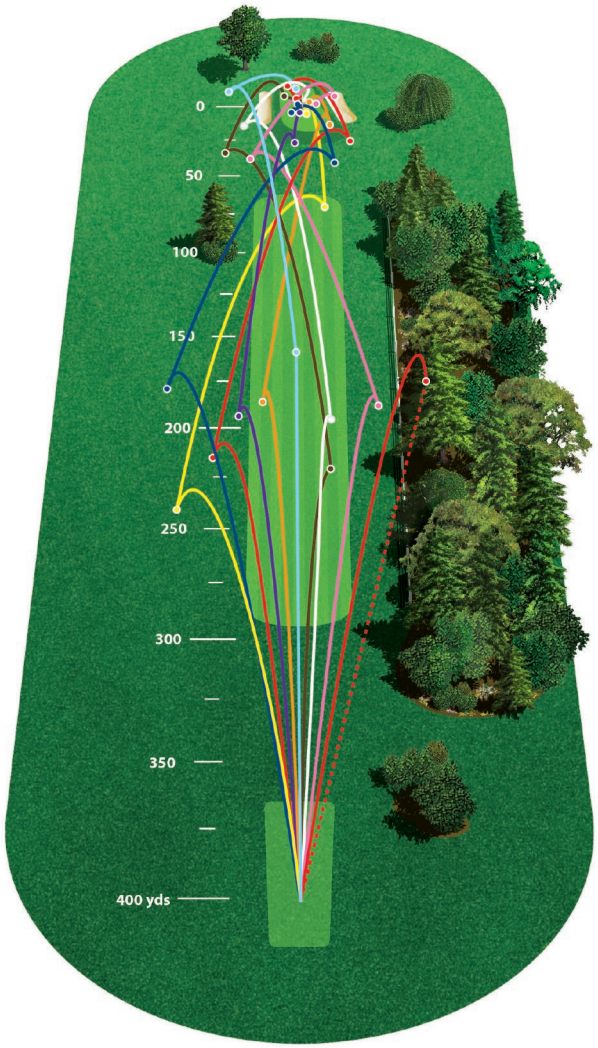


Figure 4.1. Simulation of plays of a par-four hole by a 90-golfer. In a real experiment, hundreds or thousands of plays of a hole would be simulated to determine the fraction of fairways hit, fraction of shots hit out of bounds, average hole score, fraction of birdies, pars, bogeys, and other quantities of interest. The simulation model is built from real data, but can be used to analyze a golfer's play on a new hole, say a longer or shorter hole, or a hole with a different-width fairway.

Table 4.3. Average scores for teams of amateur and PGA Tour golfers. Pro-long/Am-short means the PGA Tour pro golfer plays long shots that start outside of 100 yards from the hole and the amateur golfer plays all shots and putts starting within 100 yards of the hole. If the PGA Tour golfer plays the long shots and the 90-golfer plays the short shots on the 6,500-yard course, their average score will be 74. However, if the 90-golfer plays the long shots and the PGA Tour golfer plays the short shots on the same course, their average score will be 81, or seven strokes higher. In all cases, the average score of the Pro-long/Am-short team is lower than that of the Am-long/Pro-short team. The difference is larger for less-skilled amateur golfers. The Pro-long/Am-short teams do relatively better on the longer 7,200-yard course.

	6,500-yard course			7,200-yard course		
Am golfer	**Pro-long / Am-short**	**Am-long / Pro-short**	**Difference**	**Pro-long / Am-short**	**Am-long / Pro-short**	**Difference**
80-golfer	70	74	4	73	78	5
90-golfer	74	81	7	77	86	9
100-golfer	77	87	10	80	93	13

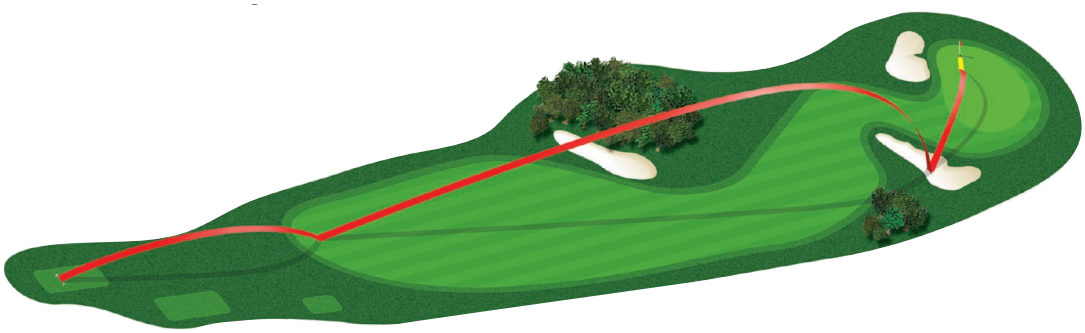


Figure 5.1. Jason Day's play on the par-four 13th hole at Kapalua.

Table 5.1. For each of the four shots, rate the shot as better or worse than an average pro shot. Then estimate the strokes gained for each shot.

Shot	Distance to hole (start)	End location	Distance to hole (end)	Shot quality (better or worse than average?)	Strokes gained
1	394 (yards)	Fairway	278 (yards)		
2	278 (yards)	Sand	62 (yards)		
3	62 (yards)	Green	17 (feet)		
4	17 (feet)	Hole	0		

Table 5.2. Pro baseline: average strokes to hole out by distance. For example, starting from the tee 400 yards from the hole, PGA Tour pros average 3.99 strokes to hole out. Starting on the green eight feet from the hole, the PGA Tour average strokes to hole out is 1.50. Note that the "fairway" category also includes the "fairway fringe" or "first cut." A *recovery* is an obstructed shot to the hole, e.g., a shot from behind a tree that forces a pitch back to the fairway. For more information on the treatment of recovery shots, penalty shots, and out of bounds shots in strokes gained computations, see Broadie, M., 2012, "Assessing Golfer Performance on the PGA TOUR," *Interfaces*, Vol. 42, No. 2, 146–65.

Distance (yards)	Tee	Fairway	Rough	Sand	Recovery
20		2.40	2.59	2.53	
40		2.60	2.78	2.82	
60		2.70	2.91	3.15	
80		2.75	2.96	3.24	
100	2.92	2.80	3.02	3.23	3.80
120	2.99	2.85	3.08	3.21	3.78
140	2.97	2.91	3.15	3.22	3.80
160	2.99	2.98	3.23	3.28	3.81
180	3.05	3.08	3.31	3.40	3.82
200	3.12	3.19	3.42	3.55	3.87
220	3.17	3.32	3.53	3.70	3.92
240	3.25	3.45	3.64	3.84	3.97
260	3.45	3.58	3.74	3.93	4.03
280	3.65	3.69	3.83	4.00	4.10
300	3.71	3.78	3.90	4.04	4.20
320	3.79	3.84	3.95	4.12	4.31
340	3.86	3.88	4.02	4.26	4.44
360	3.92	3.95	4.11	4.41	4.56
380	3.96	4.03	4.21	4.55	4.66
400	3.99	4.11	4.30	4.69	4.75
420	4.02	4.15	4.34	4.73	4.79
440	4.08	4.20	4.39	4.78	4.84
460	4.17	4.29	4.48	4.87	4.93
480	4.28	4.40	4.59	4.98	5.04
500	4.41	4.53	4.72	5.11	5.17
520	4.54	4.66	4.85	5.24	5.30
540	4.65	4.78	4.97	5.36	5.42
560	4.74	4.86	5.05	5.44	5.50
580	4.79	4.91	5.10	5.49	5.55
600	4.82	4.94	5.13	5.52	5.58

Distance (feet)	Green
3	1.04
4	1.13
5	1.23
6	1.34
7	1.42
8	1.50
9	1.56
10	1.61
15	1.78
20	1.87
30	1.98
40	2.06
50	2.14
60	2.21
90	2.40

Table 5.3. Strokes gained example: Jason Day at Kapalua. The decrease in the average number of strokes to hole out is the "average strokes to hole out at the start of the shot" minus the "average strokes to hole out at the end of the shot." This decrease minus one (to account for the shot itself) is the strokes gained of the shot. The example shows Jason Day's play on the 13th hole of the second round at the 2011 Hyundai Tournament of Champions.

Shot	Distance to hole (start)	End location	Distance to hole (end)	Average strokes to hole out (start)	Average strokes to hole out (end)	Strokes gained
1	394 (yards)	Fairway	278 (yards)	4.0	3.7	-0.7
2	278 (yards)	Sand	62 (yards)	3.7	3.2	-0.5
3	62 (yards)	Green	17 (feet)	3.2	1.8	0.4
4	17 (feet)	Hole	0	1.8	0.0	0.8
					Total	0.0

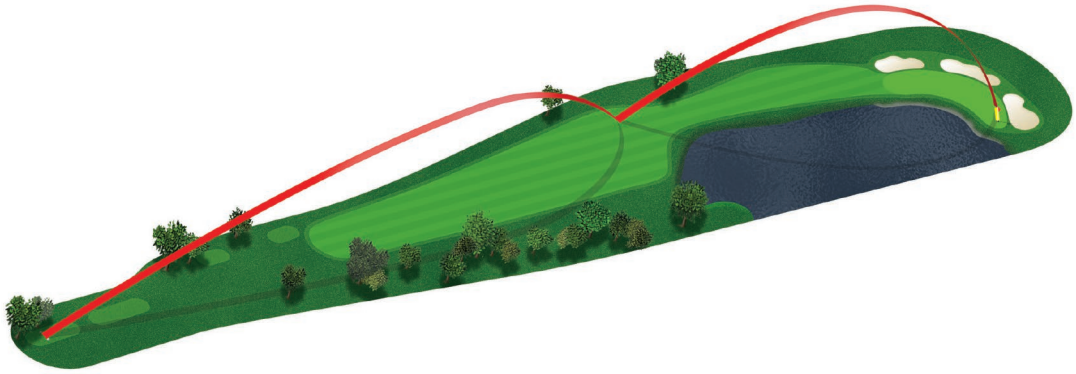


Figure 5.2. Tiger Woods's play on the par-four 18th hole at Bay Hill.

Table 5.4. Strokes gained example: Tiger Woods at Bay Hill. The decrease in the average number of strokes to hole out is the "average strokes to hole out at the start of the shot" minus the "average strokes to hole out at the end of the shot." This decrease minus one (to account for the shot itself) is the strokes gained of the shot. The example shows Tiger Woods's play on the 18th hole of the fourth round of the 2008 Arnold Palmer Bay Hill Invitational.

Shot	Distance to hole (start)	End location	Distance to hole (end)	Average strokes to hole out (start)	Average strokes to hole out (end)	Strokes gained
1	452 (yards)	Fairway	164 (feet)	4.1	3.0	0.1
2	164 (yards)	Green	24 (yards)	3.0	1.9	0.1
3	24 (feet)	Hole	0	1.9	0.0	0.9
					Total	1.1

Table 5.5. Strokes gained driving (SGD) per round: top 40 drivers on the PGA Tour from 2004 through 2012. Ranks are out of 240 golfers with at least 200 rounds during 2004–2012, with the exception of Rory McIlroy, who has only 120 rounds of ShotLink data (and so has an asterisk by his name). The 75% driving distance measures the length of good drives: One out of four drives travels longer than the 75% distance. The penalty column reports the fraction of tee shots hit into a penalty situation.

Rank	Golfer	SGD	Average distance	75% distance	Accuracy in degrees	Fairway and first cut	Penalty
1	Rory McIlroy*	0.98	295	312	3.01	63%	1.8%
1	Bubba Watson	0.91	301	324	3.53	61%	1.7%
2	J. B. Holmes	0.84	302	323	3.78	56%	2.2%
3	Boo Weekley	0.82	287	302	2.83	72%	0.8%
4	Dustin Johnson	0.81	300	320	3.56	61%	3.1%
5	Charles Warren	0.70	290	307	3.07	68%	1.2%
6	Kenny Perry	0.64	287	303	3.04	72%	0.7%
7	Robert Garrigus	0.64	297	317	3.54	61%	1.9%
8	Brett Wetterich	0.64	294	313	3.34	63%	2.2%
9	Vijay Singh	0.64	291	306	3.24	67%	1.1%
10	Lee Westwood	0.62	290	303	3.09	66%	1.0%
11	Joe Durant	0.62	278	292	2.69	80%	0.5%
12	Josh Teater	0.61	292	308	3.23	68%	0.9%
13	Tiger Woods	0.58	289	309	3.49	64%	0.7%
14	Adam Scott	0.56	290	307	3.37	66%	1.1%
15	Angel Cabrera	0.54	294	313	3.68	59%	1.6%
16	Lucas Glover	0.54	287	305	3.17	69%	1.2%
17	Rickie Fowler	0.54	287	303	3.16	66%	1.2%
18	Martin Laird	0.53	291	309	3.26	66%	1.3%
19	Sergio Garcia	0.52	287	304	3.31	66%	1.1%
20	Charley Hoffman	0.50	290	306	3.45	64%	1.4%
21	John Rollins	0.49	286	302	3.06	72%	1.2%
22	Nick Watney	0.48	289	307	3.41	68%	1.3%
23	D. J. Trahan	0.47	285	301	3.31	71%	1.5%
24	Nicholas Thompson	0.46	287	302	3.45	71%	1.3%
25	Sean O'Hair	0.45	287	304	3.31	68%	1.3%
26	Hunter Mahan	0.45	286	301	3.01	72%	1.0%
27	Bo Van Pelt	0.45	285	302	3.12	70%	0.9%
28	John Senden	0.44	284	301	3.17	71%	0.8%
29	Robert Allenby	0.44	284	300	3.08	71%	0.8%
30	Kevin Streelman	0.44	284	301	3.45	72%	1.0%
31	Davis Love III	0.43	288	307	3.30	66%	1.1%
32	Ernie Els	0.43	285	301	3.36	66%	0.9%
33	Mathew Goggin	0.43	286	301	3.24	67%	1.5%
34	Chris Smith	0.43	287	304	3.29	69%	0.9%
35	Bill Haas	0.42	288	305	3.32	68%	1.0%
36	Greg Owen	0.42	281	296	3.24	70%	1.0%
37	Steve Marino	0.40	288	303	3.46	64%	1.0%
38	Fred Couples	0.39	289	303	3.54	63%	1.8%
39	Chris Couch	0.39	289	306	3.33	66%	1.4%
40	Phil Mickelson	0.39	292	308	3.58	62%	1.8%
	Top 40 average	0.54	289	306	3.30	67%	1.3%
	PGA Tour average	0.00	281	296	3.40	69%	1.2%

Table 5.6. Total strokes gained per round broken down by shot category: top 40 golfers in total strokes gained on the PGA Tour from 2004 through 2012. Ranks are out of 240 golfers with at least 200 rounds during 2004–2012 (also included is Rory McIlroy with only 120 rounds). "Appr & short" refers to approach shots and short-game shots, that is, shots that are neither drives nor putts.

	Rank				Strokes gained per round			
Golfer	Total SG	Drive	Appr & short	Putt	Total SG	Drive	Appr & short	Putt
Tiger Woods	1	13	1	3	2.79	0.58	1.58	0.63
Jim Furyk	2	9	4	19	1.84	0.27	1.17	0.40
Luke Donald	3	29	2	1	1.82	-0.09	1.21	0.71
Phil Mickelson	4	14	3	86	1.70	0.39	1.18	0.14
Rory McIlroy*	5	1	6	153	1.66	0.98	0.75	-0.07
Vijay Singh	5	19	5	193	1.58	0.64	1.12	-0.18
Ernie Els	6	6	6	164	1.43	0.43	1.09	-0.08
Sergio Garcia	7	3	8	156	1.43	0.52	0.98	-0.07
Steve Stricker	8	32	7	13	1.34	-0.23	1.08	0.49
Adam Scott	9	10	9	178	1.33	0.56	0.89	-0.12
Zach Johnson	10	40	34	16	1.24	0.29	0.50	0.45
Pádraig Harrington	11	1	11	50	1.17	0.09	0.85	0.23
David Toms	12	59	18	62	1.15	0.22	0.73	0.20
Justin Rose	13	11	10	140	1.15	0.30	0.88	-0.03
Retief Goosen	14	4	21	45	1.13	0.20	0.68	0.26
Stewart Cink	15	28	26	12	1.09	-0.02	0.61	0.50
Geoff Ogilvy	16	7	48	34	1.05	0.27	0.44	0.34
K. J. Choi	17	31	22	64	1.02	0.15	0.67	0.20
Rickie Fowler	18	41	74	77	1.02	0.54	0.32	0.17
Robert Allenby	19	23	16	191	1.00	0.44	0.73	-0.18
Tim Clark	20	48	15	60	0.99	0.05	0.74	0.21
Kenny Perry	21	5	41	180	0.98	0.64	0.47	-0.12
Bo Van Pelt	22	15	69	79	0.95	0.45	0.34	0.17
Scott Verplank	23	16	12	130	0.94	0.13	0.82	0.00
Lee Westwood	24	72	60	160	0.92	0.62	0.38	-0.08
Dustin Johnson	25	27	97	165	0.92	0.81	0.20	-0.09
Webb Simpson	26	17	49	22	0.90	0.08	0.43	0.39
Paul Casey	27	25	53	42	0.88	0.17	0.42	0.29
Bubba Watson	28	8	122	176	0.88	0.91	0.09	-0.12
Jason Day	29	89	100	24	0.87	0.30	0.19	0.39
Brandt Snedeker	30	2	47	10	0.87	-0.13	0.44	0.56
Rory Sabbatini	31	97	25	146	0.85	0.28	0.61	-0.04
Matt Kuchar	32	116	35	38	0.85	0.02	0.50	0.33
John Senden	33	26	46	152	0.83	0.44	0.45	-0.07
Charles Howell III	34	83	38	78	0.81	0.16	0.48	0.17
Ben Crane	35	22	111	9	0.80	0.10	0.14	0.56
Anthony Kim	36	51	66	58	0.80	0.24	0.35	0.21
Nick Watney	37	37	98	91	0.79	0.48	0.20	0.11
Davis Love III	38	101	52	159	0.78	0.43	0.43	-0.07
Arron Oberholser	39	38	31	88	0.78	0.13	0.53	0.12
Ian Poulter	40	36	54	59	0.78	0.15	0.42	0.21
Top 40 average	20	32	38	87	1.13	0.32	0.64	0.17
	Top 40 average, fraction of total				100%	28%	57%	15%

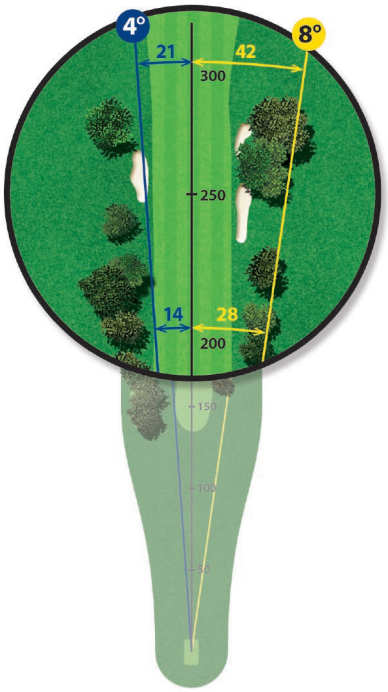


Figure 6.1. Measuring offline shots in degrees. A 300-yard drive that is eight degrees offline finishes twice as far from the target line as one that is four degrees offline.

All measurements in yards unless indicated otherwise

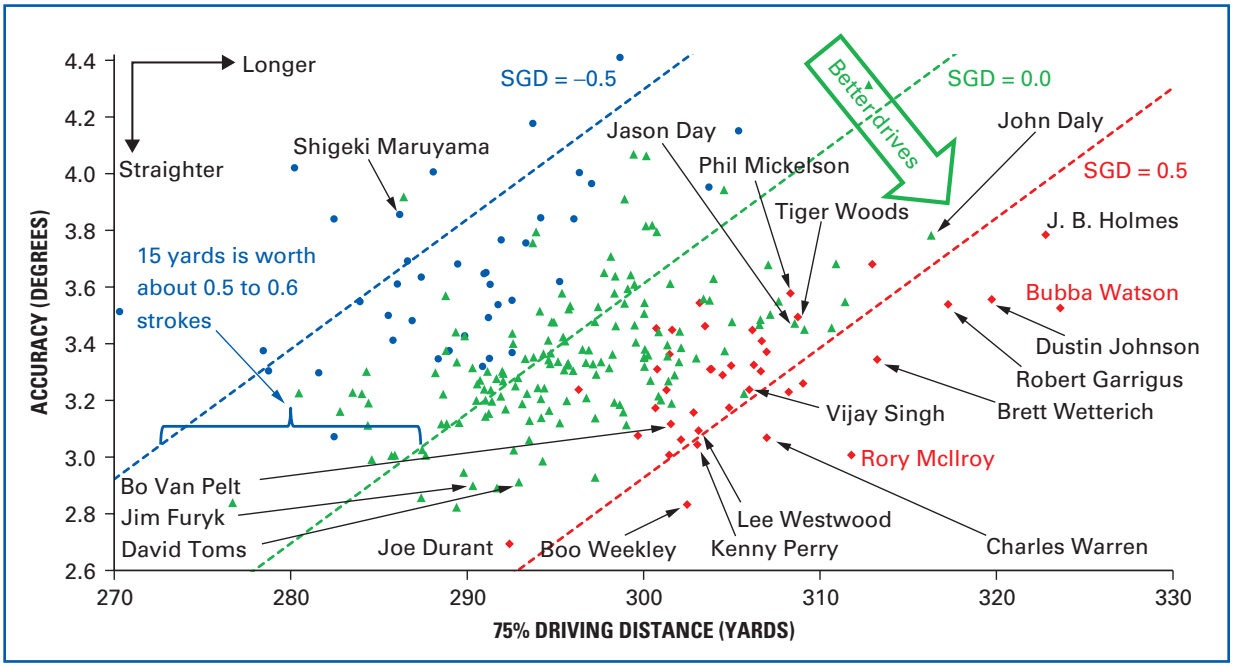


Figure 6.2. PGA Tour pro driving distance and accuracy: results for approximately 240 PGA Tour golfers with at least 200 ShotLink rounds from 2004 through 2012 (also included is Rory McIlroy with only 120 rounds). Red diamond markers represent golfers in the top 40 of strokes gained driving (SGD). Their average SGD is 0.5 strokes per round. Blue circular markers represent golfers in the bottom 40 of SGD. Their average SGD is -0.5 strokes per round. Green triangular markers represent the remaining golfers in the middle of SGD, with an average SGD of zero. The 75% driving distance measures the length of good drives: One out of four drives travels longer than the 75% distance. Accuracy is measured in degrees. Dashed lines show distance-accuracy combinations with approximately equal SGD. The best drivers, both long and straight, are found near the bottom right of the chart. The top-ranked golfers in SGD are Rory McIlroy and Bubba Watson.

Table 6.1. The impact of driving distance and accuracy on scores: For a 20-yard increase in driving distance, a typical 100-golfer's score will decrease by an average of 2.3 strokes per round. For a one-degree improvement in accuracy, a typical 100-golfer's score will decrease by an average of one stroke per round. Extra driving distance is worth more to high-scoring golfers than low-scoring golfers. Results are based on simulation analysis in a 2013 Columbia Business School working paper by Broadie and Ko.

	PGA Tour	80-golfer	90-golfer	100-golfer	115-golfer
Strokes per 20 yards	0.8	1.3	1.6	2.3	2.7
Strokes per degree	0.8	0.9	0.9	1.0	1.1

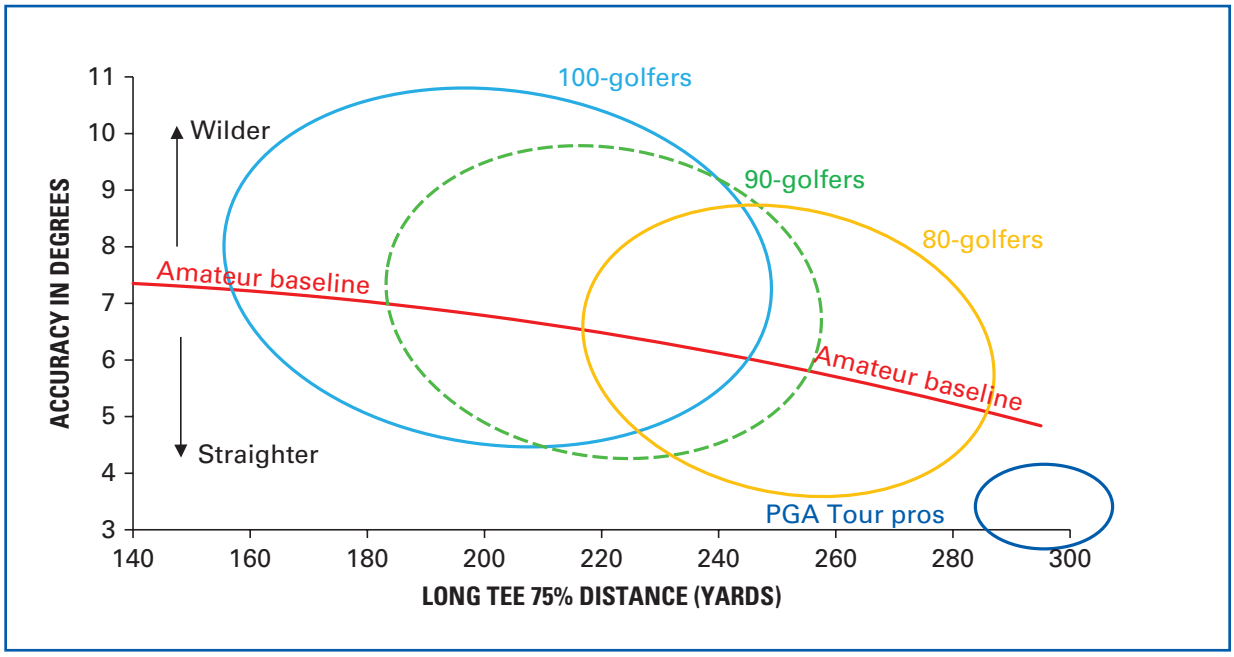


Figure 6.3. Longer hitters tend to be straighter: Driving distance and driving accuracy improve with golfer skill. The red line shows the average trend across golfers. The 75% driving distance measures the length of good drives: One out of four drives travels longer than the 75% distance. Accuracy is measured in degrees.

Table 6.2. Strokes gained approach (SGA) per round: top 40 golfers in SGA on the PGA Tour from 2004 through 2012. Approach shots are all shots over 100 yards from the hole, except for tee shots on par-four and par-five holes. Ranks are out of 240 golfers with at least 200 rounds from 2004 to 2012, with the exception of Rory McIlroy, who has only 120 rounds of ShotLink data (and so has an asterisk by his name). The median leave is the value such that half of shots finish closer to the hole.

Rank	Golfer	SGA	100–150 Median leave	150–200 Median leave	200–250 Median leave	100–150 Green and fringe	150–200 Green and fringe
1	Tiger Woods	1.28	4.9%	5.2%	6.2%	80%	75%
2	Robert Allenby	0.88	5.2%	5.5%	6.4%	83%	72%
3	Jim Furyk	0.78	5.1%	5.4%	6.6%	84%	73%
4	Ernie Els	0.77	5.6%	5.5%	6.5%	80%	69%
5	Sergio Garcia	0.75	5.5%	5.7%	6.6%	80%	70%
6	Rory McIlroy*	0.73	5.5%	5.7%	6.5%	79%	68%
6	Phil Mickelson	0.72	5.3%	5.7%	6.8%	80%	68%
7	Adam Scott	0.72	5.4%	5.5%	6.9%	82%	69%
8	Vijay Singh	0.71	5.2%	5.5%	6.7%	80%	70%
9	Luke Donald	0.70	5.1%	5.7%	7.3%	81%	69%
10	Chad Campbell	0.65	5.2%	5.4%	6.8%	81%	72%
11	Tom Lehman	0.61	5.3%	5.4%	7.1%	84%	73%
12	Scott Verplank	0.60	4.6%	5.3%	7.1%	83%	69%
13	Joey Sindelar	0.58	5.7%	5.4%	7.2%	82%	70%
14	Kenny Perry	0.57	5.4%	5.4%	6.5%	82%	71%
15	Lee Westwood	0.57	5.5%	5.8%	6.4%	79%	70%
16	Kris Blanks	0.56	5.3%	5.5%	6.5%	82%	70%
17	David Toms	0.56	5.0%	5.5%	6.7%	84%	70%
18	Paul Casey	0.55	5.7%	5.6%	6.9%	79%	70%
19	Tim Clark	0.53	4.9%	5.3%	6.6%	82%	70%
20	Justin Rose	0.52	5.4%	5.5%	6.7%	81%	69%
21	John Senden	0.51	5.5%	5.7%	6.9%	82%	73%
22	Alex Cejka	0.49	5.0%	5.2%	6.9%	82%	69%
23	Camilo Villegas	0.47	5.2%	5.8%	7.0%	83%	69%
24	Brendon de Jonge	0.47	5.0%	5.5%	7.0%	83%	69%
25	Davis Love III	0.46	5.7%	5.8%	6.7%	80%	68%
26	Steve Stricker	0.46	5.0%	5.8%	7.0%	82%	68%
27	Stewart Cink	0.45	5.5%	5.8%	7.0%	81%	69%
28	Ricky Barnes	0.43	5.4%	5.4%	8.0%	78%	66%
29	Joe Durant	0.42	5.1%	5.3%	6.9%	83%	72%
30	Zach Johnson	0.42	5.1%	5.6%	6.9%	82%	70%
31	Heath Slocum	0.41	5.2%	5.4%	6.7%	82%	71%
32	Trevor Immelman	0.40	5.4%	5.8%	7.2%	81%	69%
33	Retief Goosen	0.40	5.7%	5.7%	6.6%	80%	67%
34	Boo Weekley	0.39	5.3%	5.7%	6.5%	81%	69%
35	Jeff Sluman	0.38	5.0%	5.5%	7.1%	86%	70%
36	Briny Baird	0.38	5.4%	5.9%	7.2%	83%	71%
37	Jason Bohn	0.38	5.2%	5.7%	6.8%	81%	69%
38	Stephen Ames	0.37	5.4%	5.6%	7.3%	82%	70%
39	K. J. Choi	0.37	5.3%	5.7%	7.0%	81%	70%
40	Dudley Hart	0.36	5.3%	6.1%	7.9%	77%	65%
	Top 40 average	0.55	5.3%	5.6%	6.9%	82%	70%
	PGA Tour average	0.00	5.5%	5.9%	7.3%	80%	67%

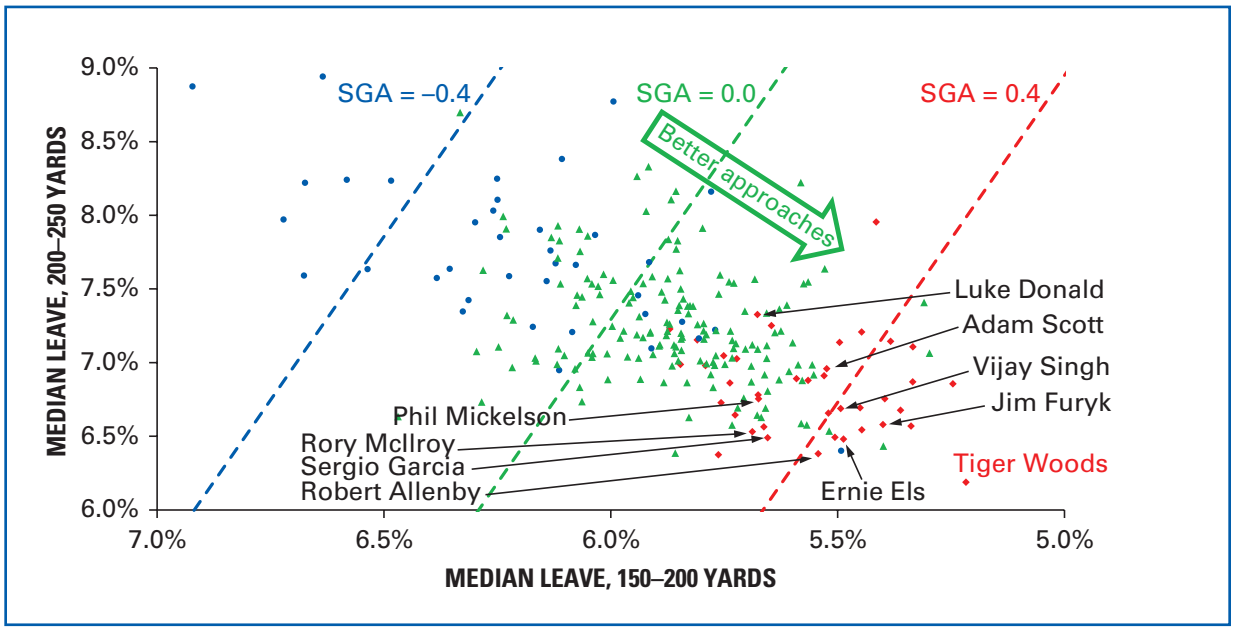


Figure 6.4. PGA Tour approach shots, 150 to 250 yards: results for approximately 240 PGA Tour golfers with at least 200 ShotLink rounds from 2004 through 2012 (also included is Rory McIlroy with only 120 rounds). Red diamond markers represent golfers in the top 40 of strokes gained approach (SGA). Their average SGA is 0.55 strokes per round. Blue circular markers represent golfers in the bottom 40 of SGA, with an average SGA of -0.4 strokes per round. Green triangular markers represent the remaining golfers in the middle of SGA. A shot from 100 yards that finishes five yards from the hole represents a leave of 5%, i.e., the final distance to the hole relative to the initial distance. The median leave is the value such that half of shots finish closer to the hole. Dashed lines show median leave combinations with approximately equal SGA. The golfers with the best approach shots between 150 and 250 yards are found near the bottom right of the chart. Tiger Woods leads in SGA with a gain of 1.3 strokes per round. Half of Tiger Woods's shots from 150 to 200 yards finish within 5.2% of the initial distance (e.g., nine yards on a 175-yard shot). Half of his shots from 200 to 250 yards finish within 6.2% of the initial distance (e.g., 14 yards on a 225-yard shot).

Table 6.3. Strokes gained short game (SGS) per round: top 40 golfers in SGS on the PGA Tour from 2004 through 2012. Short-game shots are all shots starting within 100 yards from the hole, except for putts on the green. Ranks are out of 240 golfers with at least 200 rounds from 2004 to 2012. The median leave is the value such that half of shots finish closer to the hole. The 0–100, 0–20, 20–60, and 60–100 shot groups exclude sand shots and putts. Greenside sand shots start from the sand within 50 yards of the hole.

Rank	Golfer	SGS	0–100 Median leave	0–20 Median leave	20–60 Median leave	60–100 Median leave	Greenside sand median leave
1	Steve Stricker	0.63	7.8%	11.7%	8.2%	4.8%	14.3%
2	Corey Pavin	0.54	8.4%	11.5%	9.1%	5.4%	13.2%
3	Chris Riley	0.52	9.1%	11.7%	9.5%	5.8%	12.4%
4	Luke Donald	0.51	9.4%	12.6%	9.9%	5.7%	12.6%
5	Mike Weir	0.50	9.3%	12.9%	9.5%	5.8%	11.8%
6	Pádraig Harrington	0.50	9.1%	11.6%	9.6%	5.3%	13.9%
7	Phil Mickelson	0.46	9.2%	12.5%	9.0%	6.2%	13.9%
8	Vijay Singh	0.42	9.5%	12.9%	9.7%	6.4%	13.6%
9	Justin Leonard	0.41	8.6%	11.8%	9.1%	5.4%	15.3%
10	Brian Gay	0.39	8.6%	12.1%	9.9%	5.3%	14.3%
11	Ryuji Imada	0.39	9.3%	12.1%	9.7%	5.8%	13.0%
12	Jim Furyk	0.39	8.5%	11.4%	9.3%	5.5%	14.8%
13	Nick O'Hern	0.38	9.0%	12.2%	9.9%	5.7%	13.5%
14	Kevin Na	0.38	9.7%	12.7%	9.4%	6.0%	14.2%
15	Shigeki Maruyama	0.37	10.2%	12.9%	10.3%	6.8%	12.6%
16	Justin Rose	0.36	9.5%	13.1%	9.7%	5.7%	13.2%
17	Stuart Appleby	0.36	9.3%	12.6%	9.3%	5.8%	14.4%
18	Todd Fischer	0.35	9.1%	11.5%	9.6%	6.6%	18.4%
19	Rory Sabbatini	0.34	9.5%	13.1%	9.7%	5.9%	13.1%
20	Ian Poulter	0.33	10.2%	12.7%	11.0%	6.3%	14.5%
21	Ernie Els	0.32	9.6%	12.8%	9.9%	5.5%	15.3%
22	Aaron Baddeley	0.30	10.2%	13.0%	10.4%	6.9%	14.4%
23	K. J. Choi	0.30	9.8%	13.2%	10.8%	6.1%	13.3%
24	Tiger Woods	0.30	9.8%	13.5%	9.7%	6.2%	14.9%
25	Rod Pampling	0.30	9.9%	12.5%	11.1%	6.3%	13.4%
26	Kirk Triplett	0.29	8.3%	11.0%	10.6%	5.6%	16.9%
27	Arron Oberholser	0.28	9.5%	11.9%	9.5%	6.5%	14.2%
28	Retief Goosen	0.28	9.8%	12.7%	10.5%	6.2%	14.7%
29	Kevin Sutherland	0.28	9.9%	12.1%	10.8%	6.4%	13.9%
30	Matt Kuchar	0.28	9.4%	12.7%	9.5%	5.9%	14.6%
31	Bob Heintz	0.27	8.9%	12.6%	10.0%	5.6%	17.5%
32	Brandt Snedeker	0.27	9.6%	13.2%	10.3%	6.1%	15.1%
33	Bryce Molder	0.27	9.2%	12.7%	10.6%	5.7%	16.4%
34	Jonathan Byrd	0.27	9.5%	12.3%	9.7%	5.9%	14.3%
35	Webb Simpson	0.27	10.2%	14.4%	10.5%	6.7%	13.5%
36	Geoff Ogilvy	0.26	10.0%	13.5%	11.1%	6.2%	13.4%
37	Omar Uresti	0.26	9.1%	12.7%	9.8%	6.0%	19.3%
38	Glen Day	0.26	8.8%	12.7%	9.3%	5.4%	15.6%
39	Tom Pernice Jr.	0.26	9.8%	12.8%	10.3%	5.9%	15.0%
40	Tim Petrovic	0.25	9.6%	12.2%	10.2%	6.2%	16.8%
	Top 40 average	0.35	9.4%	12.5%	9.9%	5.9%	14.5%
	PGA Tour average	0.00	10.2%	13.6%	10.9%	6.3%	16.1%

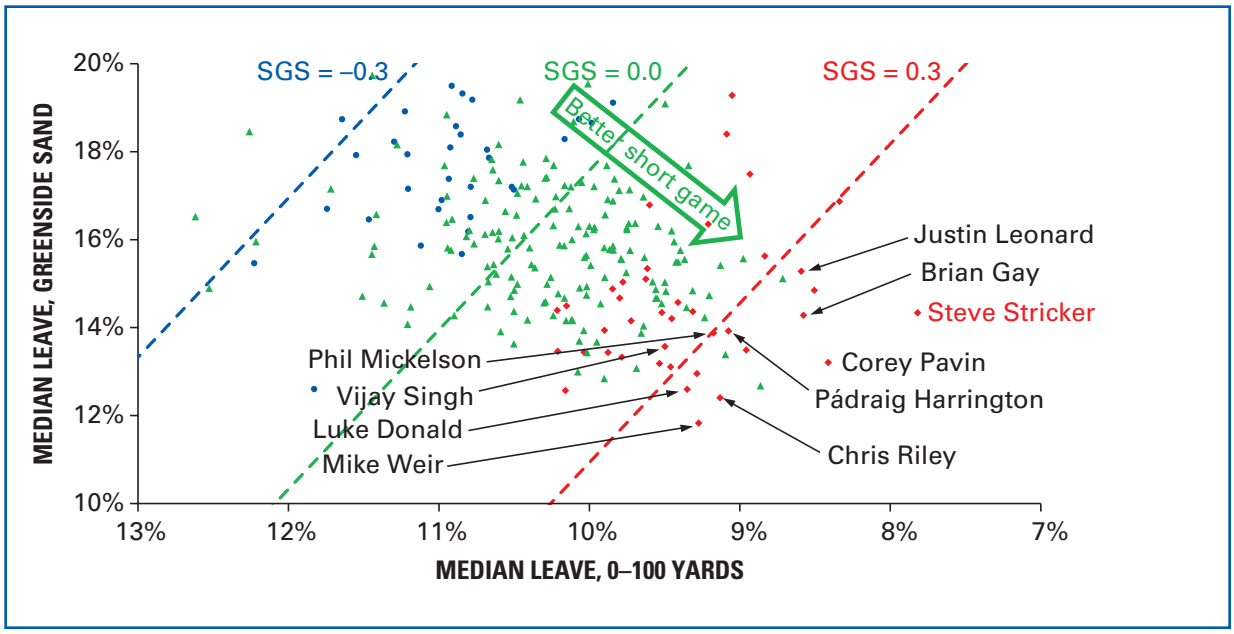


Figure 6.5. PGA Tour pro short game: results for approximately 240 PGA Tour golfers with at least 200 ShotLink rounds from 2004 through 2012. Red diamond markers represent golfers in the top 40 of strokes gained short game (SGS). Their average SGS is 0.35 strokes per round. Blue circular markers represent golfers in the bottom 40 of SGS, with an average SGS of -0.3 strokes per round. Green triangular markers represent the remaining golfers in the middle of SGS. Dashed lines show median leave combinations with approximately equal SGS. The golfers with the best short games are found near the bottom right of the chart. Steve Stricker leads in SGS with a gain of 0.6 strokes per round. Half of Stricker's shots from zero to 100 yards (excluding shots from the sand and putts on the green) finish within 7.8% of the initial distance. Half of his greenside sand shots from zero to 50 yards finish within 14% of the initial distance.

Table 6.4. Total strokes gained per round broken down by shot category: top 40 golfers in total strokes gained on the PGA Tour from 2004 through 2012. Ranks are out of 240 golfers with at least 200 rounds from 2004 to 2012 (also included is Rory McIlroy with only 120 rounds).

	Rank					Strokes gained per round				
Golfer	**Total**	**Drive**	**Appr**	**Short**	**Putt**	**Total**	**Drive**	**Appr**	**Short**	**Putt**
Tiger Woods	1	13	1	24	3	2.79	0.58	1.28	0.30	0.63
Jim Furyk	2	59	3	12	19	1.84	0.27	0.78	0.39	0.40
Luke Donald	3	158	9	4	1	1.82	-0.09	0.70	0.51	0.71
Phil Mickelson	4	40	6	7	86	1.70	0.39	0.72	0.46	0.14
Rory McIlroy*	5	1	6	124	153	1.66	0.98	0.73	0.02	-0.07
Vijay Singh	5	9	8	8	193	1.58	0.64	0.71	0.42	-0.18
Ernie Els	6	32	4	21	164	1.43	0.43	0.77	0.32	-0.08
Sergio Garcia	7	19	5	47	156	1.43	0.52	0.75	0.23	-0.07
Steve Stricker	8	198	26	1	13	1.34	-0.23	0.46	0.63	0.49
Adam Scott	9	14	7	68	178	1.33	0.56	0.72	0.17	-0.12
Zach Johnson	10	51	30	101	16	1.24	0.29	0.42	0.08	0.45
Pádraig Harrington	11	108	41	6	50	1.17	0.09	0.35	0.50	0.23
David Toms	12	72	17	67	62	1.15	0.22	0.56	0.17	0.20
Justin Rose	13	48	20	16	140	1.15	0.30	0.52	0.36	-0.03
Retief Goosen	14	76	33	28	45	1.13	0.20	0.40	0.28	0.26
Stewart Cink	15	138	27	71	12	1.09	-0.02	0.45	0.16	0.50
Geoff Ogilvy	16	57	93	36	34	1.05	0.27	0.17	0.26	0.34
K. J. Choi	17	91	39	23	64	1.02	0.15	0.37	0.30	0.20
Rickie Fowler	18	17	68	102	77	1.02	0.54	0.24	0.08	0.17
Robert Allenby	19	29	2	189	191	1.00	0.44	0.88	-0.15	-0.18
Tim Clark	20	124	19	56	60	0.99	0.05	0.53	0.21	0.21
Kenny Perry	21	6	14	173	180	0.98	0.64	0.57	-0.10	-0.12
Bo Van Pelt	22	27	46	125	79	0.95	0.45	0.33	0.01	0.17
Scott Verplank	23	97	12	54	130	0.94	0.13	0.60	0.21	0.00
Lee Westwood	24	10	15	202	160	0.92	0.62	0.57	-0.19	-0.08
Dustin Johnson	25	4	73	137	165	0.92	0.81	0.22	-0.02	-0.09
Webb Simpson	26	110	96	35	22	0.90	0.08	0.16	0.27	0.39
Paul Casey	27	83	18	181	42	0.88	0.17	0.55	-0.12	0.29
Bubba Watson	28	1	89	169	176	0.88	0.91	0.18	-0.09	-0.12
Jason Day	29	49	129	90	24	0.87	0.30	0.07	0.12	0.39
Brandt Snedeker	30	169	95	32	10	0.87	-0.13	0.17	0.27	0.56
Rory Sabbatini	31	56	57	19	146	0.85	0.28	0.28	0.34	-0.04
Matt Kuchar	32	130	75	30	38	0.85	0.02	0.22	0.28	0.33
John Senden	33	28	21	151	152	0.83	0.44	0.51	-0.06	-0.07
Charles Howell III	34	88	70	44	78	0.81	0.16	0.23	0.24	0.17
Ben Crane	35	106	156	66	9	0.80	0.10	-0.04	0.17	0.56
Anthony Kim	36	65	82	74	58	0.80	0.24	0.19	0.16	0.21
Nick Watney	37	22	67	144	91	0.79	0.48	0.24	-0.04	0.11
Davis Love III	38	31	25	143	159	0.78	0.43	0.46	-0.04	-0.07
Arron Oberholser	39	100	64	27	88	0.78	0.13	0.25	0.28	0.12
Ian Poulter	40	92	124	20	59	0.78	0.15	0.09	0.33	0.21
Top 40 average	20	64	44	71	87	1.13	0.32	0.45	0.19	0.17
		Top 40 average, fraction of total				100%	28%	40%	17%	15%

Table 6.5. Tiger Woods's strokes gained by year: total strokes gained and breakdown by shot category from 2003 through 2012. Ranks each year are out of approximately 200 golfers with at least 30 rounds of PGA Tour ShotLink data in the year.

	Rank					Strokes gained per round					
Year	Total	Drive	Appr	Short	Putt	Total	Drive	Appr	Short	Putt	Rounds
2012	2	9	1	37	27	2.80	0.74	1.39	0.26	0.42	49
2011	29	136	4	89	49	1.09	-0.15	0.88	0.09	0.28	19
2010	48	123	4	160	91	0.71	-0.08	0.91	-0.20	0.08	29
2009	1	15	1	4	2	3.71	0.53	1.48	0.71	0.99	48
2008	1	8	1	3	4	4.14	0.61	2.01	0.67	0.85	11
2007	1	4	1	35	2	3.68	0.81	1.77	0.30	0.80	43
2006	1	4	1	23	21	3.78	0.92	1.98	0.39	0.49	37
2005	1	2	3	89	4	2.82	1.09	0.89	0.10	0.75	55
2004	1	21	5	9	3	3.06	0.48	1.12	0.51	0.95	54
2003	1	6	1	1	18	3.71	0.87	1.60	0.70	0.54	46

Table 6.6. Comparison of a typical 90-golfer and a typical PGA Tour pro. "Greens hit" includes the green and the fringe of the green.

		90-golfer	Pro golfer
Average score	Par-3 holes	3.9	3.1
	Par-4 holes	5.2	4.1
	Par-5 holes	6.0	4.7
Driving	75% driving distance	225 yards	295 yards
	Driving accuracy	6.5 degrees	3.4 degrees
Approach	Median leave, 100–150 yards	12%	5.5%
	Median leave, 150–200 yards	14%	5.9%
	Greens hit, 100–150 yards	46%	80%
	Greens hit, 150–200 yards	26%	67%
Short game	Median leave, 0–20 yards	21%	14%
	Median leave, 20–60 yards	17%	11%
	Median leave, 60–100 yards	13%	6%
	Median leave sand, 0–50 yards	39%	16%
	Greens hit, 0–20 yards	93%	97%
	Greens hit, 20–60 yards	80%	91%
	Greens hit, 60–100 yards	64%	86%
	Greens hit sand, 0–50 yards	69%	92%

Table 6.7. Performance of amateur golfers: where strokes are gained between typical amateur golfers of different skill levels. For a typical amateur golfer to lower his score by 10 strokes requires, on average, a 2.8-stroke improvement in drives, 3.9-stroke improvement in approach shots, a 1.9-stroke improvement in short-game shots, and a 1.3-stroke improvement in putting. The long game, consisting of driving and approach shots, explains 67% of the difference in scores between a typical 100-golfer and a typical 90-golfer; the remaining 33% is explained by the short game and putting. Results are based on simulation analysis in Broadie and Ko (2013).

From	To	Driving	Approach	Short	Putt
90	80	2.5	4.0	2.1	1.4
100	90	2.6	4.0	2.0	1.4
110	100	3.4	3.7	1.7	1.2
	Average	2.8	3.9	1.9	1.3
	Fraction of total	28%	39%	19%	14%

Table 7.1. Level green distances. The left panel shows the level green distances for a 20-foot putt by green slope (measured in degrees) and green speed (measured by the Stimpmeter, in feet). All putts are assumed to be straight uphill or straight downhill. Positive slopes indicate uphill putts; negative slopes indicate downhill putts. The right panel shows initial putt velocities in miles per hour for a putt to travel 20 feet for a given slope and Stimp reading. The velocities show that uphill putts need to be hit harder than downhill putts. Putts on slow greens need to be hit harder than putts on fast greens.

		Level green distance for a 20-foot putt				**Velocity in mph for a putt to travel 20 feet**			
		Stimp reading				**Stimp reading**			
	Slope	7	9	11	13	7	9	11	13
Uphill	2	26	28	30	32	8.0	7.2	6.7	6.4
	1	23	24	25	26	7.5	6.7	6.2	5.8
Level	0	20	20	20	20	6.9	6.1	5.5	5.1
	-1	17	16	15	14	6.4	5.5	4.8	4.3
Downhill	-2	14	12	10	8	5.8	4.7	3.9	3.3
Up-down ratio		1.9	2.3	3.0	4.0				

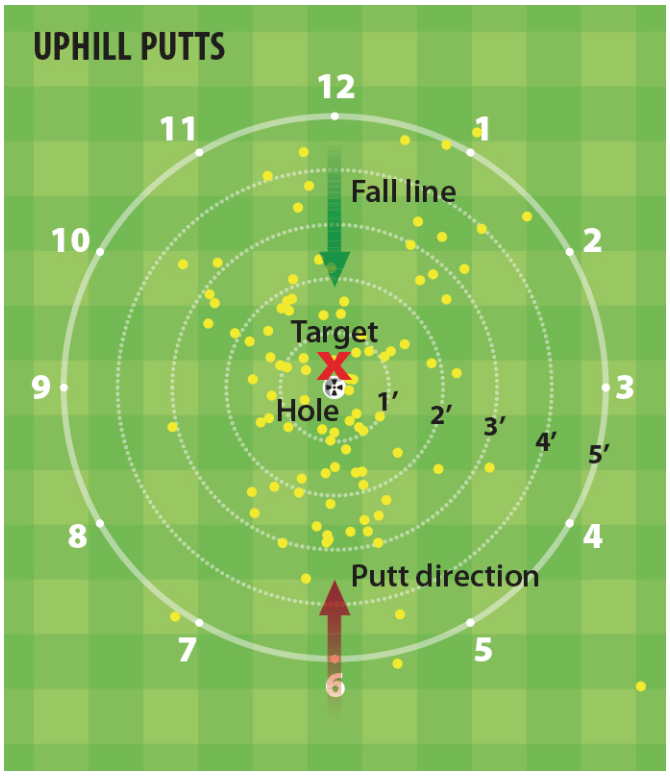


Figure 7.1. Scatter pattern of a sample of 100 missed 30-foot uphill putts for PGA Tour pros on greens between one and two degrees of slope, with an average slope of 1.4 degrees. The middle of the scatter pattern, or target, is marked with an X, which is centered almost exactly on the hole. This reveals the "average" putting strategy for PGA Tour pros on 30-foot uphill putts is to lag it to the hole.

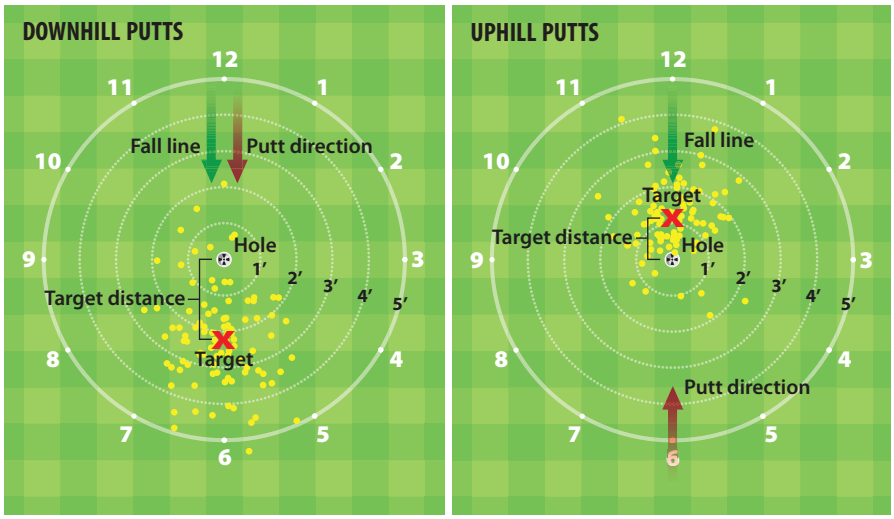


Figure 7.2. Scatter patterns of missed four-foot putts for PGA Tour pros on greens between one and two degrees of slope, with an average slope of 1.4 degrees. The left green shows downhill putts, with a target 2.2 feet beyond the hole. The right green shows uphill putts, with a target 1.2 feet beyond the hole. PGA Tour pros sink 87% of the four-foot downhill putts and leave 1.0% short; they sink 89% of the uphill putts and leave 1.2% short.

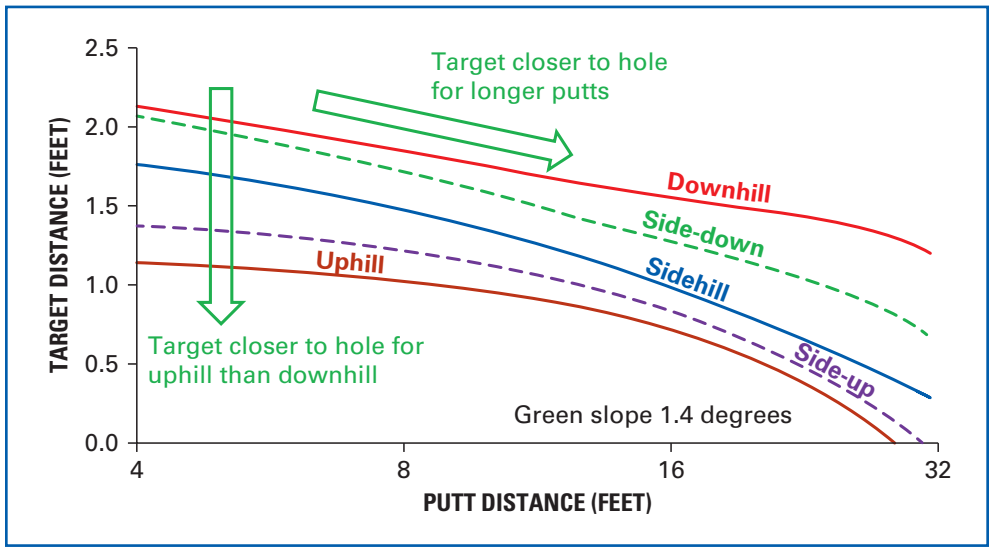


Figure 7.3. Target distances for PGA Tour pros on greens with slopes between one and two degrees at the hole and an average slope of 1.4 degrees. The target is farther from the hole on downhill putts than uphill. The target is farther from the hole on shorter putts than longer putts.

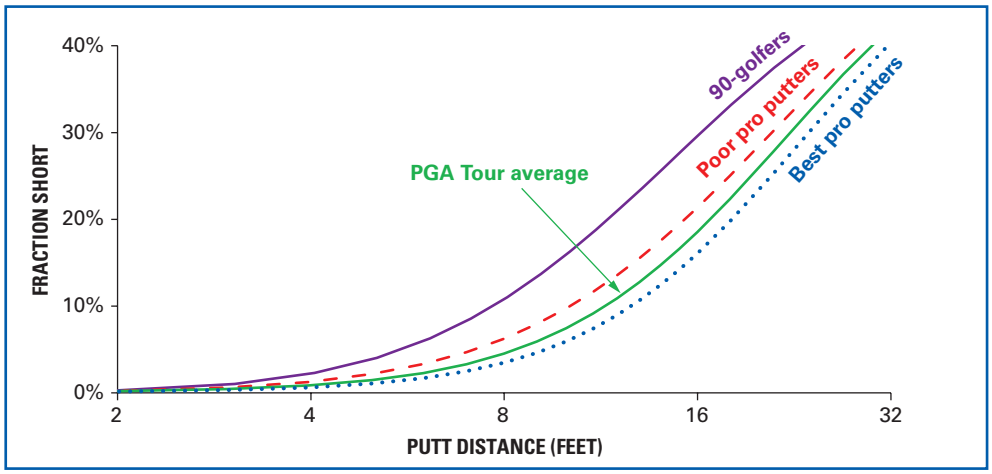


Figure 7.4. Fraction of putts left short by PGA Tour pros and amateur golfers. Poor putters leave more putts short than better putters. All golfers leave more putts short, on average, as the putt distance increases. Tour pros with strokes gained putting (SGP) of 0.5 putts per round or better are placed in the "best pro putters" category. These represent, approximately, the best 20 putters on tour in each year. Tour pros with SGP of -0.5 putts per round or less are placed in the "poor pro putters" category.

Table 7.2. Fraction of putts left short by PGA Tour pros and amateurs. For putts 15 feet and under, amateurs leave two to four times as many putts short as the best pro putters.

Putt distance	Best pro putters	PGA Tour average	Poor pro putters	90-golfer
4	1%	1%	1%	2%
5	1%	2%	2%	4%
6	2%	2%	3%	6%
7	3%	3%	4%	8%
8	3%	4%	6%	11%
9	5%	6%	8%	13%
10	6%	7%	9%	16%
11	8%	9%	12%	19%
12	9%	11%	14%	21%
13	11%	13%	15%	23%
15	14%	17%	20%	28%
17	18%	20%	23%	31%
20	23%	26%	28%	36%

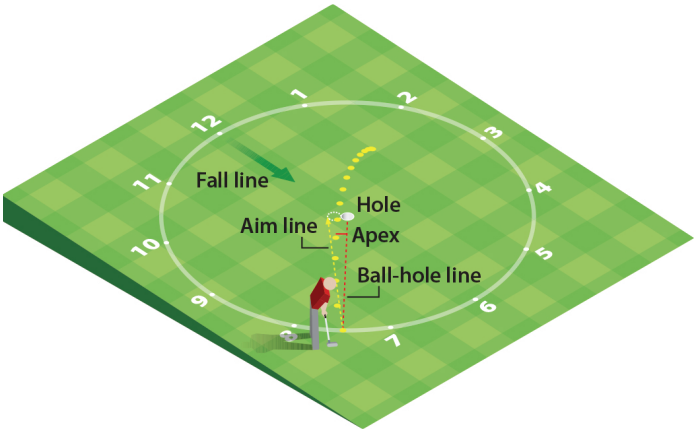


Figure 7.5. A five-foot sidehill-uphill putt that missed on the high side and finished three feet from the hole. The golfer hit the putt too hard for one cup of break.

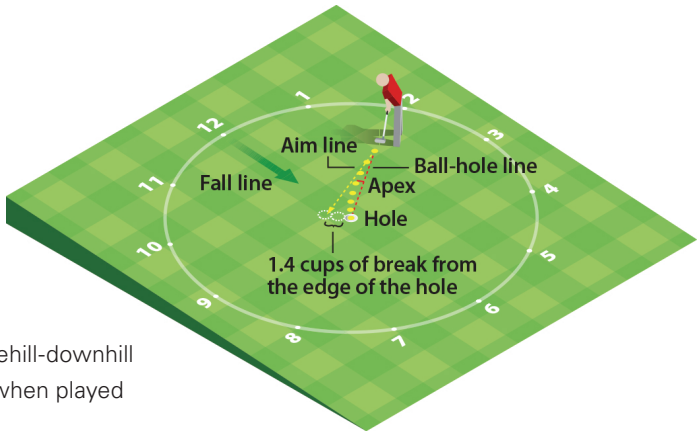


Figure 7.6. A three-foot sidehill-downhill putt that goes in the heart when played with 1.4 cups of break.

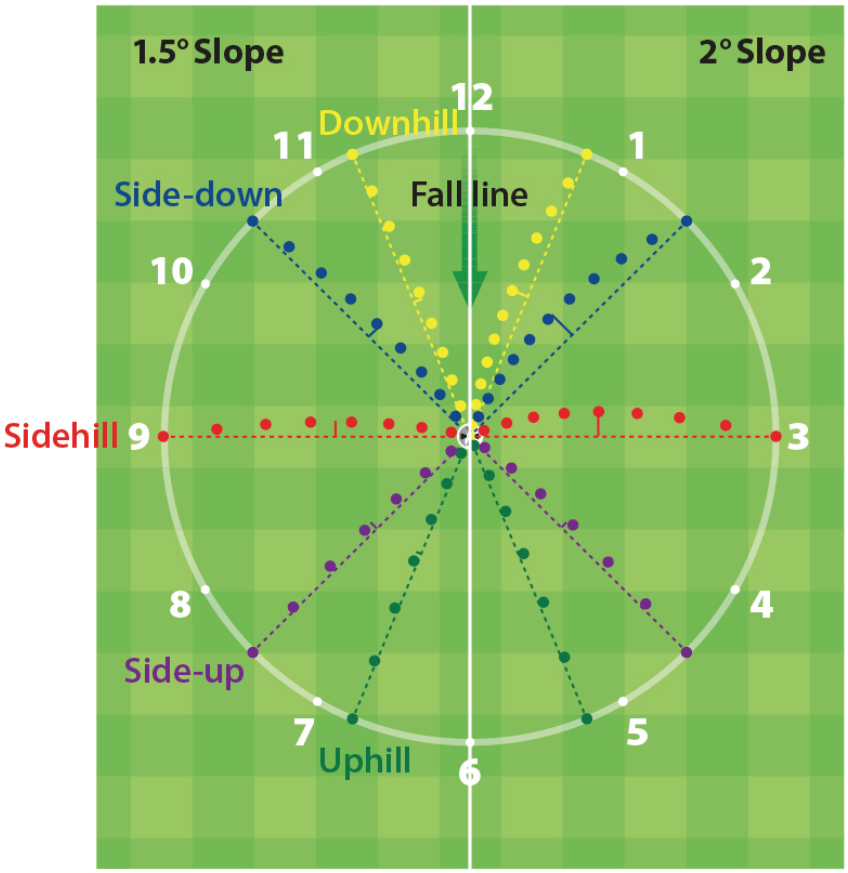


Figure 7.7. The putting wheel: Five-foot putt trajectories are illustrated. The left half-green has 1.5 degrees of slope and the right half-green has 2.0 degrees of slope. Downhill putts break more than uphill putts. Putts break more on steeper greens than on flatter greens. Similarly, though this is not shown, putts break more on faster greens than on slower greens.

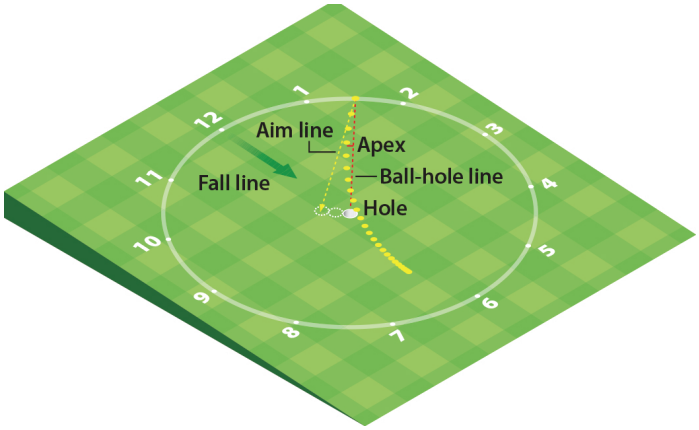


Figure 7.8. A five-foot downhill right-to-left putt that missed on the low side and finished three feet from the hole.

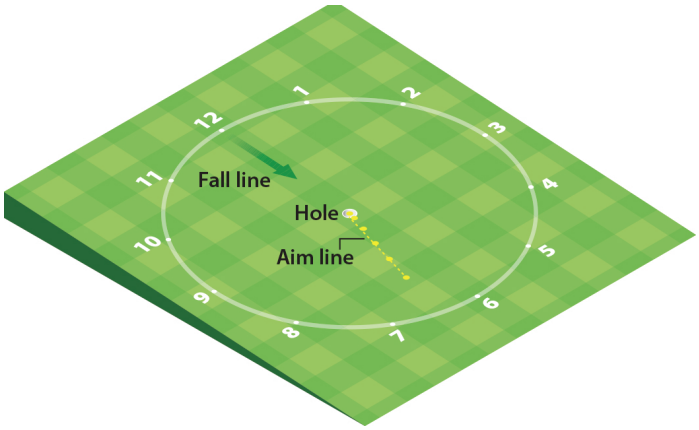


Figure 7.9. A three-foot putt from 6:30 that goes in the heart when played left-center.

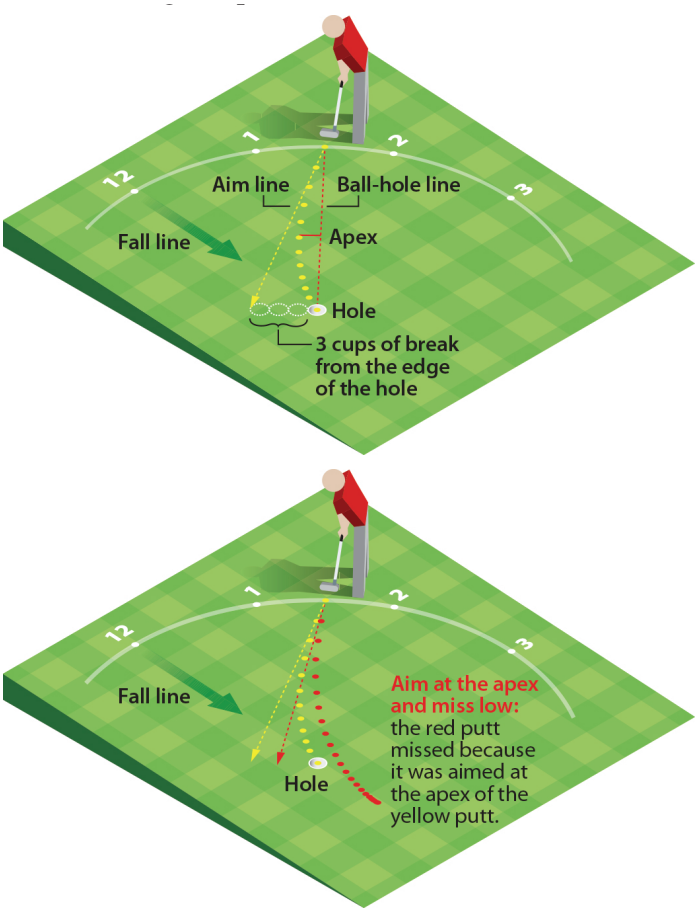


Figure 7.10. Breaking putts illustrated. The fall line is the straight downhill direction. The putts start at 1:30 and break from right to left. The top green shows the path, in yellow, of a putt with three cups of break, measured from the edge of the hole. The path of the putt is always below the aim line, except at the starting point. The bottom green shows the path of a putt in red that misses low because it was aimed at the apex of the yellow putt.

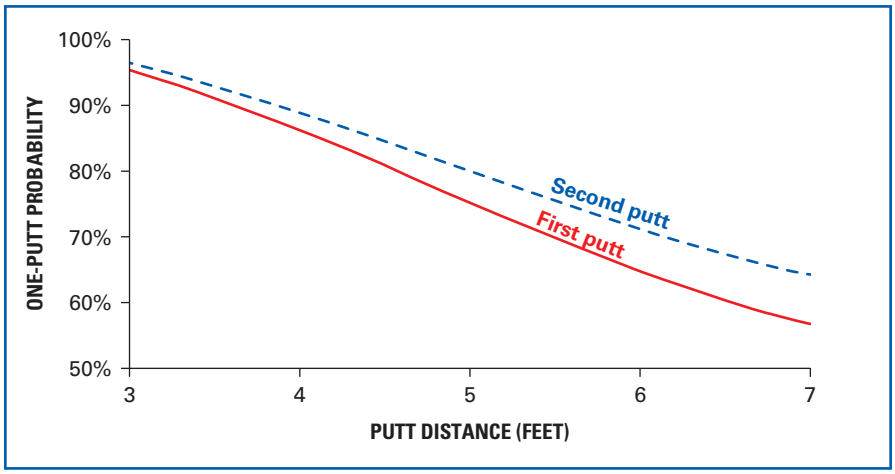


Figure 7.11. Pros sink many more second putts than first putts, and this illustrates the importance of green reading in putting performance.

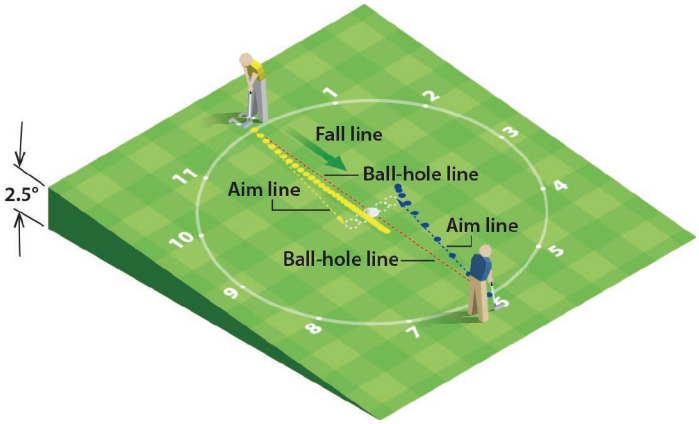


Figure 7.12. Paths of five-foot uphill and downhill putts on a green with 2.5 degrees of slope. Both putts are mistakenly hit two cups outside the right edge of the hole. The downhill putt just misses on the right edge while the uphill putt misses the hole by more than two cups from the right edge. Gravity helps downhill putts hold their line. Gravity magnifies direction errors on uphill putts. The downhill putt takes much more time to travel the same distance than the uphill putt.

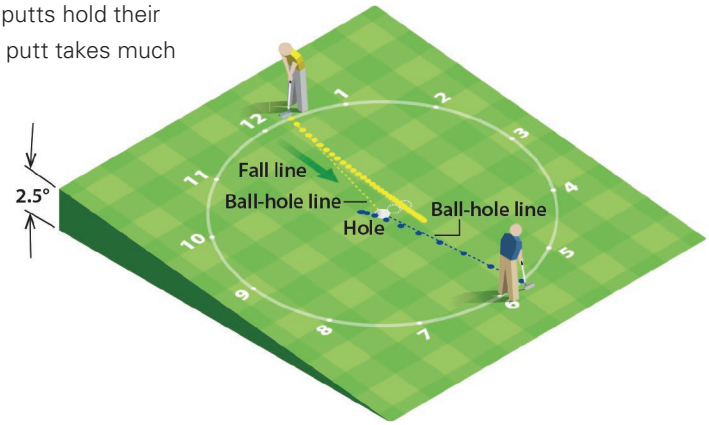


Figure 7.13. Paths of five-foot uphill and downhill putts on a green with 2.5 degrees of slope. The paths illustrate the effects of green-reading error for putts that are hit with no direction error. Both putts are hit directly at the hole in the mistaken belief that the putts are directly on the fall line. The downhill putt misses by more than one cup outside the left edge of the hole. The uphill putt barely misses on the left edge. Green-reading errors affect downhill putts more than uphill putts.

Table 7.3. One-putt probability, three-putt probability, and average number of putts by PGA Tour pros for uphill and downhill putts. The data are for green slopes between one and two degrees, with an average green slope of 1.4 degrees. Downhill putts start between 11:00 and 1:00; uphill putts start between 5:00 and 7:00. Pros make more uphill putts than downhill (until 15 feet), they three-putt uphill putts less often, and they average fewer putts to hole out on uphill than downhill putts from each distance. In short, uphill putts are easier for pros than downhill putts.

Putt distance	One-putt probability		Three-putt probability		Average number of putts	
	Downhill	Uphill	Downhill	Uphill	Downhill	Uphill
3	96%	96%	0%	0%	1.04	1.04
4	87%	89%	1%	0%	1.14	1.11
5	75%	80%	1%	0%	1.26	1.20
6	64%	69%	1%	0%	1.37	1.31
7	56%	62%	1%	0%	1.45	1.38
8	48%	53%	1%	0%	1.53	1.47
9	41%	48%	1%	0%	1.60	1.53
10	38%	43%	1%	0%	1.63	1.57
11	33%	36%	2%	0%	1.69	1.64
12	30%	33%	2%	0%	1.72	1.67
13	27%	29%	3%	0%	1.76	1.72
15	23%	25%	3%	0%	1.79	1.75
17	19%	19%	3%	1%	1.84	1.82
20	15%	15%	4%	1%	1.89	1.86

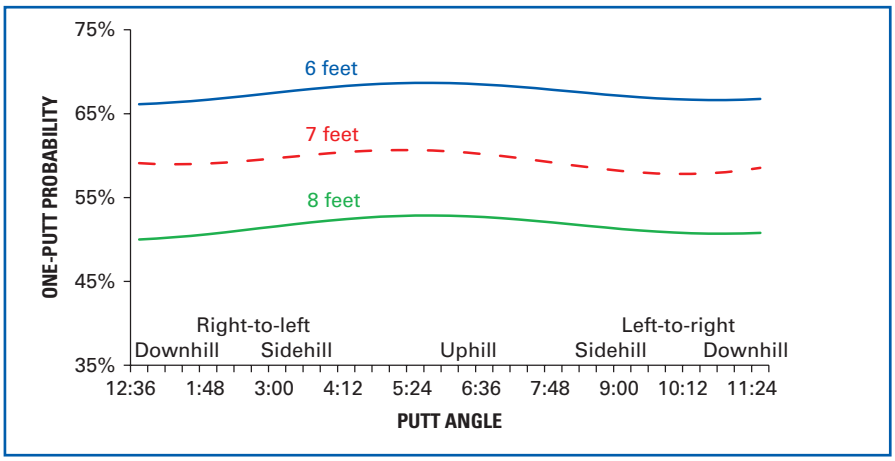


Figure 7.14. One-putt probabilities for PGA Tour pros for greens with slopes less than one degree at the hole (42% of hole locations are in this range), with an average slope of 0.7 degrees. On relatively flat greens, a six-foot sidehill putt is much easier than an eight-foot uphill putt. Putt angles are measured in hours and minutes on the clock face.

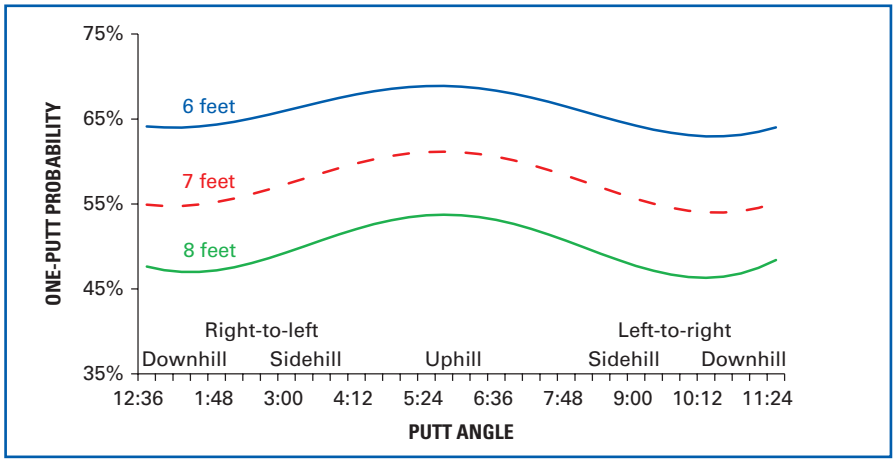


Figure 7.15. One-putt probabilities for PGA Tour pros for greens with slopes between one and two degrees at the hole (54% of hole locations are in this range), with an average slope of 1.4 degrees. On a moderately sloped green, a six-foot sidehill putt is easier than an eight-foot uphill putt. Putt angles are measured in hours and minutes on the clock face.

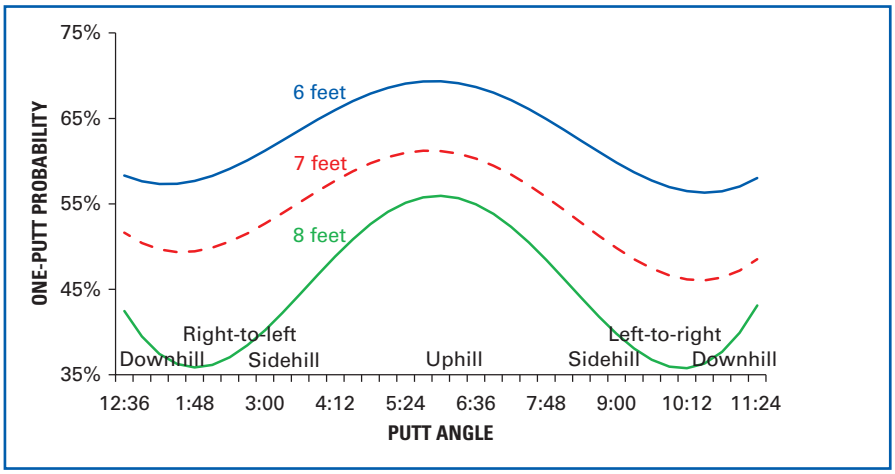


Figure 7.16. One-putt probabilities for PGA Tour pros for greens with slopes greater than two degrees at the hole (4% of hole locations are in this range), with an average slope of 2.3 degrees. On a steep green, a six-foot sidehill putt is more difficult than a seven-foot uphill putt but is still easier than an eight-foot uphill putt.

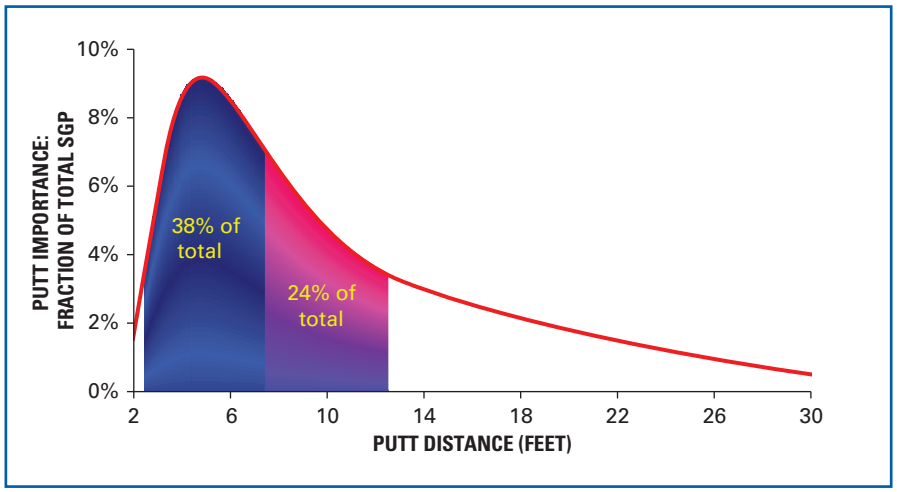


Figure 7.17. Putt importance is proportional to the product of strokes gained difference per putt and the number of putts per round. For a putt to be important, there needs to be a significant performance difference (that is, a difference in strokes gained per putt) and a large number of putts per round. The putt importance curve peaks at five feet: This distance accounts for 9% of the total strokes gained of the best putters against the tour average.

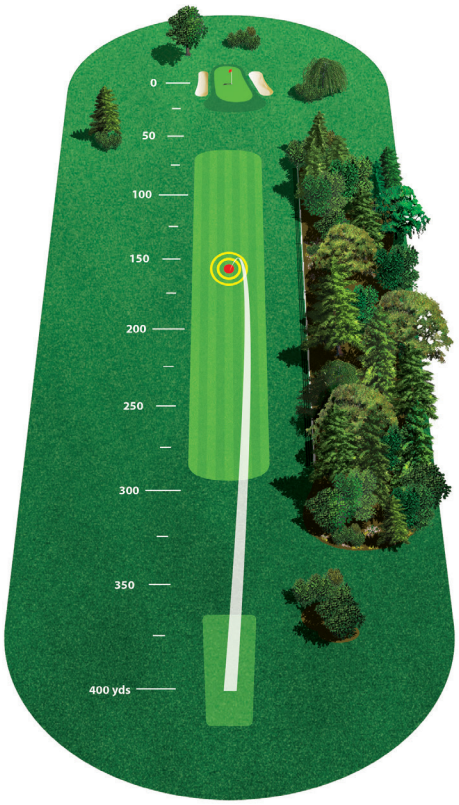


Figure 8.1. 400-yard par-four hole: The hole has out of bounds (OB) down the entire right side of the hole beyond the fence, and has rough on the left side of the hole. The figure shows the most likely drive when the target is the middle of the fairway.

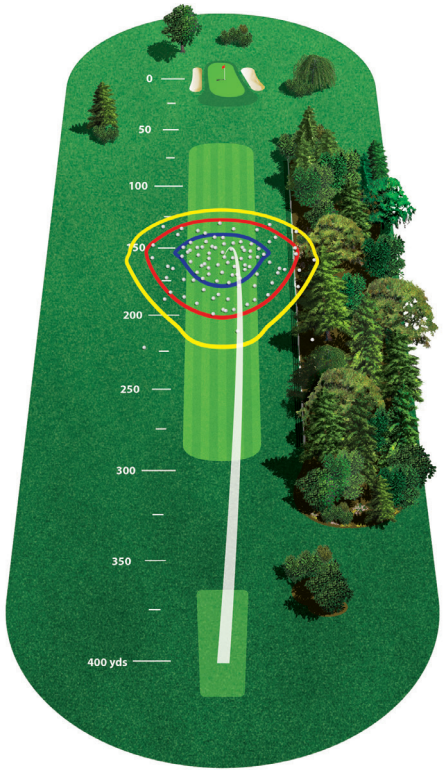


Figure 8.2. 80-golfer shot pattern: The shot pattern of a typical 80-golfer with a target in the middle of the fairway. The shot pattern is summarized by three contours. The blue inner contour contains 50% of the tee shots. The red middle contour contains 90% of the tee shots, and the yellow outer contour contains 98% of the tee shots. With the target in the middle of the fairway, the average score is 4.7, with 7% of tee shots finishing out of bounds.

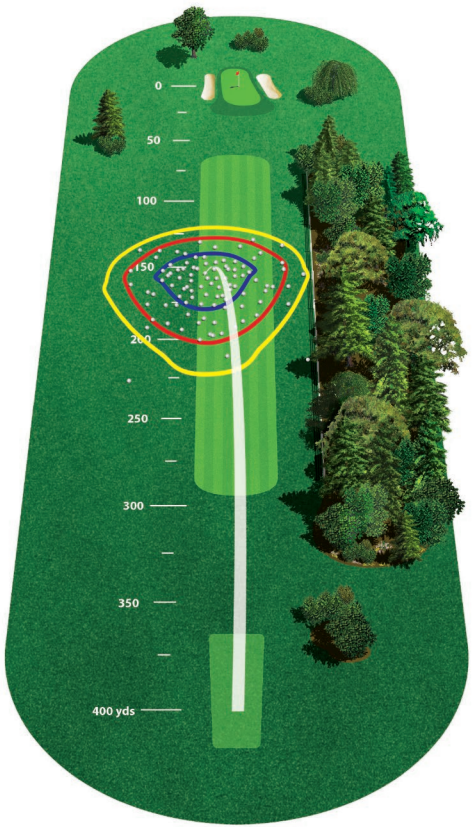


Figure 8.3. 80-golfer optimal target: The optimal target for a typical 80-golfer is near the left edge of the fairway. With this target choice, the average score is 4.6, compared with 4.7 when the target is the middle of the fairway. Only 1.5% of tee shots finish out of bounds, compared with 7% when the target is the middle of the fairway.

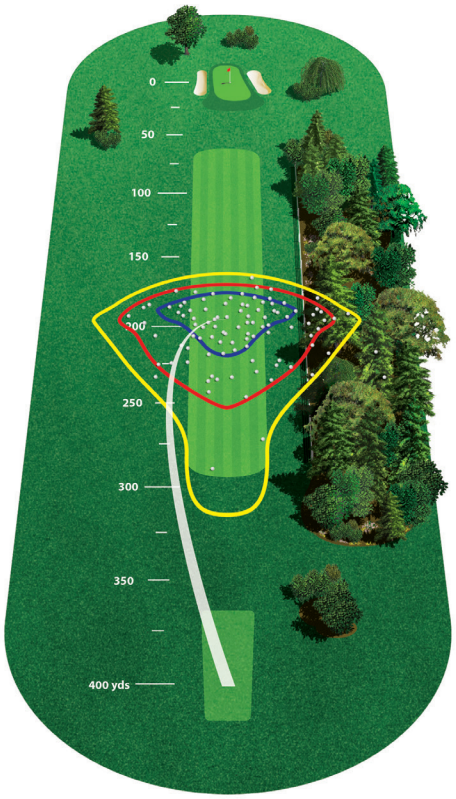


Figure 8.4. 100-golfer shot pattern: The shot pattern of a typical 100-golfer with a target in the middle of the fairway. The shot pattern is summarized by three contours. The blue inner contour contains 50% of the tee shots. The red middle contour contains 90% of the tee shots, and the yellow outer contour contains 98% of the tee shots. With the target in the middle of the fairway, the average score is 5.9, with 15% of tee shots finishing out of bounds.

Figure 8.5. 100-golfer optimal target: The optimal target for a typical 100-golfer is a few yards into the left rough. With this target choice, the average score is 5.7, compared with 5.9 when the target is the middle of the fairway. Only 2% of tee shots finish out of bounds, compared with 15% when the target is the middle of the fairway.

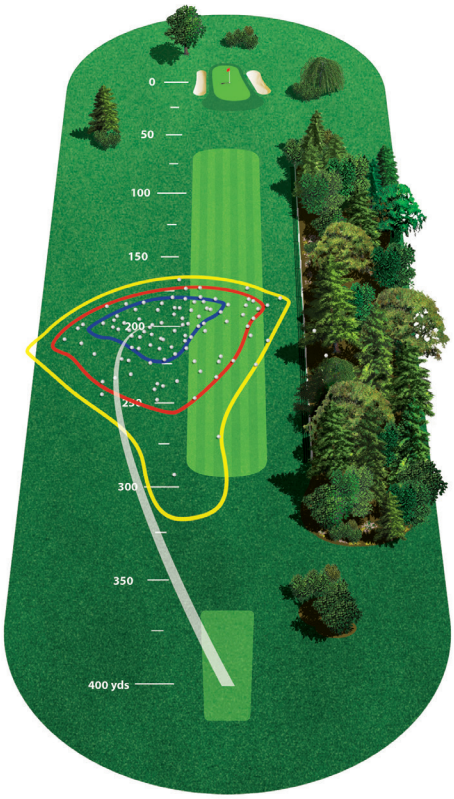


Figure 8.6. Pro golfer shot pattern: The shot pattern of a pro golfer with a target in the middle of the fairway. The shot pattern is summarized by three contours. The blue inner contour contains 50% of the tee shots. The red middle contour contains 90% of the tee shots, and the yellow outer contour contains 98% of the tee shots. With the target in the middle of the fairway, the average score is 4.15, with 4% of tee shots finishing out of bounds.

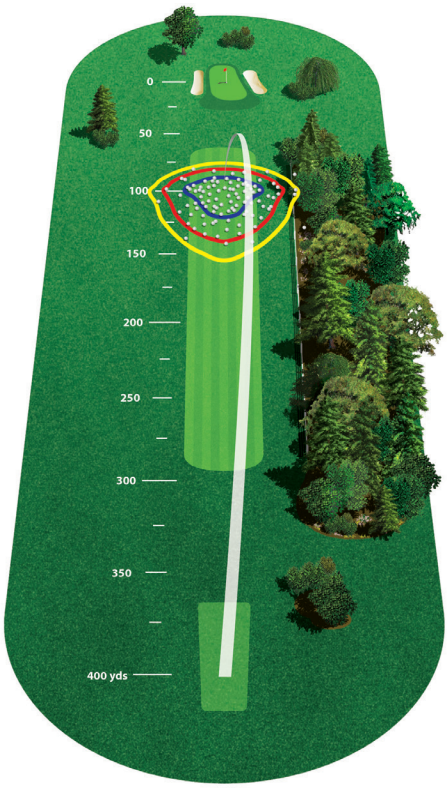


Figure 8.7. Optimal targets: The left illustration shows the optimal target for a typical pro golfer in the left-center of the fairway. With this target choice, the average score is 4.05, compared with 4.15 when the target is the middle of the fairway. Only 0.7% of tee shots finish out of bounds, compared with 4% when the target is the middle of the fairway. The right illustration shows the optimal targets for the pro, 80-golfer, and 100-golfer.

Table 8.1. Are golfers good strategists? The table shows the percentage of shots that finish out of bounds by the golfer, by the target, and in the data. "Target middle" means the target is in the middle of the fairway. On this hole, amateur golfers hit four to seven times more shots out of bounds than is optimal. Pros play optimal, or nearly optimal, strategies on this type of hole (the difference between 0.5% and 0.7% is not statistically significant).

Golfer group	Target middle	Target optimal	Data
Pro golfer	4%	0.7%	0.5%
80-golfer	7%	1.5%	6%
100-golfer	15%	2.0%	14%

Table 8.2. Average number of strokes for golfers to complete a hole from 30 and 80 yards. Results from the rough do not include shots from behind trees or other obstacles. For each golfer category except pros, the average number of strokes to finish a hole is higher from 80 yards in the fairway than from 30 yards in the rough. These results suggest that laying up to 30 yards is usually a better strategy than laying up to 80 yards.

	30 yards to the hole		80 yards to the hole	
Golfer group	**Fairway**	**Rough**	**Fairway**	**Rough**
PGA Tour pro	2.5	2.7	2.7	3.0
80-golfer	2.7	2.8	3.1	3.2
90-golfer	2.9	3.1	3.4	3.5
100-golfer	3.1	3.4	3.7	3.8
110-golfer	3.3	3.7	3.9	4.1

Table 9.1. Points for the 10-foot putting games: Putt from 10 feet (and nine and 11 feet), starting from different positions on the clock face (uphill, downhill, and sidehill). Note: The same point system will be used for five- and 15-foot putts.

Outcome	**Points**
One-putt	2
Two putts, first putt long	0
Two putts, first putt short	-1
Three or more putts	-3

Table 9.2. 10-foot-10-point grading scorecard.

Golfer group	**Median holes to win**
Best tour putter	11
Average tour putter	14
Worst tour putter	17
80-golfer	24
90-golfer	43
100-golfer	loses more often than wins
110-golfer	loses more often than wins

Table 9.3. 10-foot-10-hole grading scorecard.

Golfer group	Average points
Best tour putter	8
Average tour putter	7
Worst tour putter	6
80-golfer	4
90-golfer	2
100-golfer	-1
110-golfer	-3

Table 9.4. 5-, 10-, and 15-foot grading scorecard.

	Median holes to win			Average points in 10 holes		
Golfer group	5-foot 15-point	10-foot 10-point	15-foot 5-point	5-foot	10-foot	15-foot
Best tour putter	10	11	11	16	8	4
Average tour putter	10	14	14	15	7	3
Worst tour putter	11	17	18	14	6	1
80-golfer	13	24	21	12	4	0
90-golfer	14	43	NA	10	2	-2
100-golfer	18	NA	NA	8	-1	-4
110-golfer	23	NA	NA	6	-3	-6

Table 9.5. Spiral game grading scorecard.

	Median number of misses until win				
Golfer group	2-feet to 6-feet	2-feet to 7-feet	2-feet to 8-feet	2-feet to 9-feet	2-feet to 10-feet
Best tour putter	0	0	1	3	7
Average tour putter	0	1	2	4	12
Worst tour putter	0	1	3	8	23
80-golfer	1	3	11	40	>100
90-golfer	2	5	19	60	>100
100-golfer	3	14	50	>100	>100
110-golfer	4	15	77	>100	>100

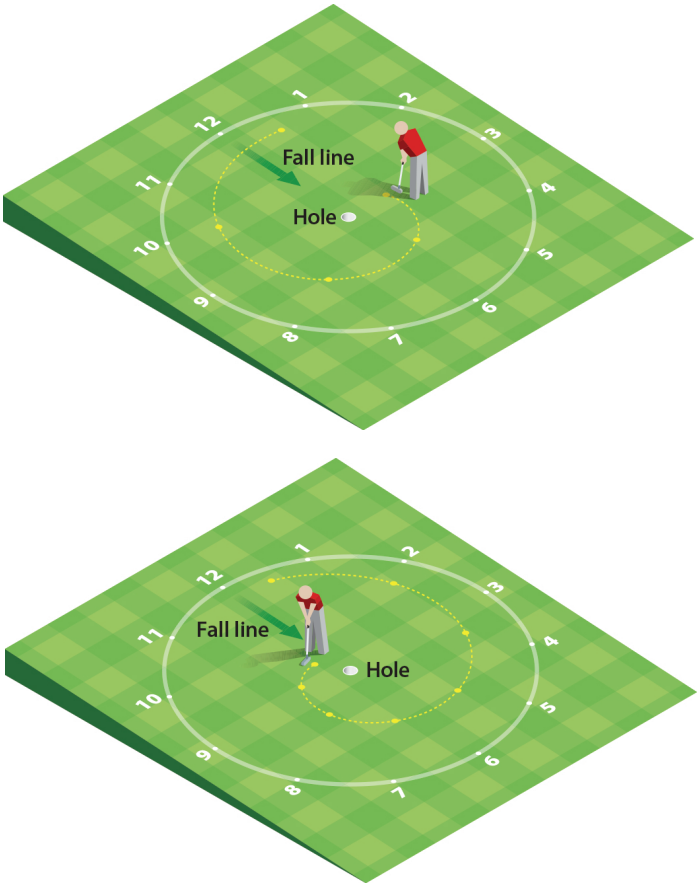


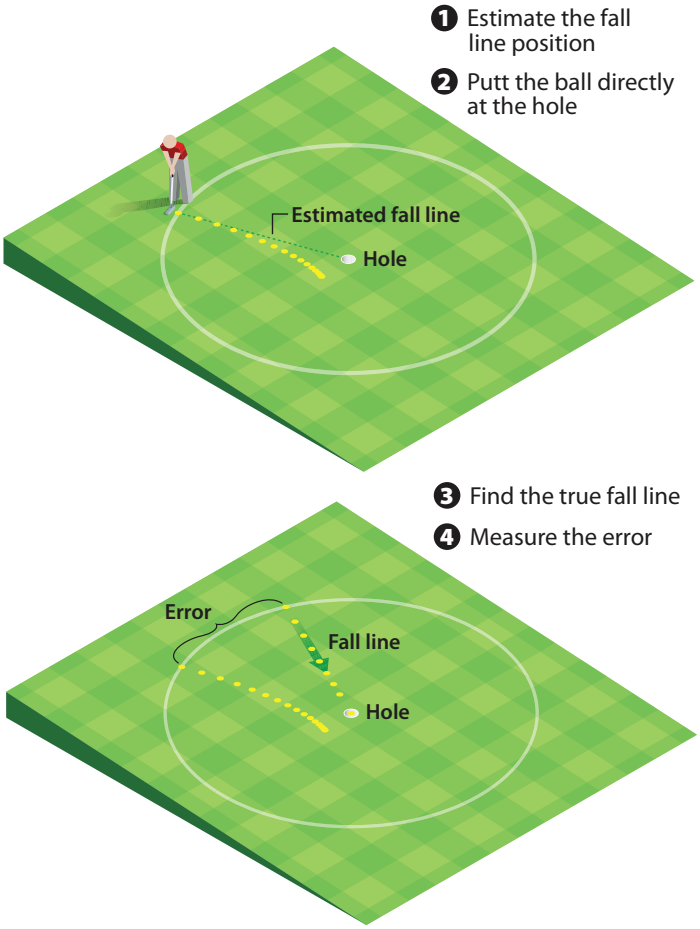
Figure 9.1. Spiral game illustrated. The top green shows putts in a clockwise spiral from two feet through six feet, starting at 3:00. The bottom green shows putts in a counterclockwise spiral from two feet through nine feet, starting at 11:00. The clock face is oriented so 12:00 represents the straight downhill direction illustrated by the fall line.

Table 9.6. Points for the 20-, 30-, and 40-foot putting games.

Outcome	Points
One-putt	5
Two putts, first putt within 3 feet	1
Two putts, first putt outside 3 feet	0
Three or more putts	-3

Table 9.7. 20-, 30-, and 40-foot grading scorecard.

	Median holes to win			Average points in 10 holes		
Golfer group	20-foot 15-point	30-foot 10-point	40-foot 5-point	20-foot	30-foot	40-foot
Best tour putter	10	11	7	15	10	5
Average tour putter	11	12	8	14	8	4
Worst tour putter	12	14	10	12	7	2
80-golfer	15	18	NA	10	4	-1
90-golfer	20	29	NA	7	0	-5
100-golfer	35	NA	NA	3	-4	-9
110-golfer	42	NA	NA	-1	-7	-14



Figures 9.2.
Fall line drill. The top green shows the first two steps: estimating the position of the fall line and then putting directly at the hole to see any break. The bottom green shows the final two steps: finding the true fall line and then measuring the error.

Table 9.8. Points for the 10- to 40-yard games.

Outcome	Points
Hole out	5
Within 6 feet	2
Between 6 and 12 feet	1
On green, outside 12 feet	0
Miss green	-1

Table 9.9. Fairway 10- to 40-yard grading scorecard.

Golfer group	Average number of points in 5 shots			
	10 yards	20 yards	30 yards	40 yards
Best tour short game	10	8	6	5
Average tour short game	9	7	5	4
Worst tour short game	8	6	4	3
80-golfer	7	5	3	2
90-golfer	6	4	2	1
100-golfer	5	3	1	0
110-golfer	4	2	0	-1

Table 9.10. Rough 10- to 40-yard grading scorecard.

Golfer group	Average number of points in 5 shots			
	10 yards	20 yards	30 yards	40 yards
Best tour short game	8	5	4	3
Average tour short game	7	4	3	2
Worst tour short game	6	4	2	1
80-golfer	5	3	1	0
90-golfer	4	2	0	-1
100-golfer	3	1	-1	-2
110-golfer	2	0	-2	-3

Table 9.11. Sand 10- to 40-yard grading scorecard.

Golfer group	Average number of points in 5 shots			
	10 yards	20 yards	30 yards	40 yards
Best tour short game	6	6	4	3
Average tour short game	5	5	3	2
Worst tour short game	4	4	3	1
80-golfer	1	1	1	0
90-golfer	1	0	-1	-2
100-golfer	0	-1	-2	-3
110-golfer	-3	-3	-4	-5

Table 9.12. Fairway median-leave game grading scorecard.

Distance to hole (yards)	Median remaining distance (feet)					
	Very best pro	Average pro	80-golfer	90-golfer	100-golfer	110-golfer
10	3	4	5	6	6	7
20	5	6	7	10	11	12
30	6	8	12	16	19	22
40	8	10	16	21	24	26
50	9	12	20	23	28	34
60	10	13	21	25	31	40
70	10	13	23	31	37	41
80	12	14	24	33	39	43
90	12	15	26	35	41	44
100	13	16	28	37	46	56
110	15	17	29	44	53	57
120	15	18	31	47	58	63
130	17	19	35	49	63	76
140	18	21	39	50	66	86
150	21	23	42	56	73	93
160	22	25				
170	25	28				
180	27	31				
190	31	34				
200	34	37				
210	37	42				
220	41	47				

Table 9.13. Rough median-leave game grading scorecard.

Distance to hole (yards)	Median remaining distance (feet)					
	Very best pro	Average pro	80-golfer	90-golfer	100-golfer	110-golfer
10	4	5	6	8	10	11
20	8	9	11	15	19	21
30	10	12	16	20	24	29
40	11	15	17	25	31	37
50	14	17	21	28	35	41
60	15	19	22	33	40	42
70	16	21	27	36	44	53
80	18	22	28	37	46	54
90	19	24	29	40	50	57
100	24	26	32	41	52	64
110	26	28	37	43	58	75
120	29	31	38	50	66	86
130	31	33	40	51	70	91
140	32	35	41	56	75	96
150	37	38	47	57	88	110

Table 9.14. Sand median-leave game grading scorecard.

Distance to hole (yards)	Median remaining distance (feet)					
	Very best pro	Average pro	80-golfer	90-golfer	100-golfer	110-golfer
10	5	7	17	19	22	26
20	6	8	18	24	29	34
30	9	11	20	31	41	48
40	11	16	34	52	62	67

Table 9.15. Grading scorecard for fairway and rough. Note: the median leave is expressed as a fraction of the initial distance.

	Fairway					
	Median leave: remaining distance relative to the initial distance					
Distance to hole (yards)	Very best pro	Average pro	80-golfer	90-golfer	100-golfer	110-golfer
10–20	9%	11%	13%	17%	20%	22%
20–60	7%	9%	13%	16%	20%	23%
60–100	5%	6%	10%	13%	16%	19%
100–150	4%	5%	9%	13%	16%	19%
150–200	5%	6%	10%	14%	18%	23%

	Rough					
	Median leave: remaining distance relative to the initial distance					
Distance to hole (yards)	Very best pro	Average pro	80-golfer	90-golfer	100-golfer	110-golfer
10–20	14%	17%	19%	26%	32%	36%
20–60	10%	13%	16%	22%	27%	30%
60–100	7%	9%	12%	16%	20%	23%
100–150	8%	8%	10%	13%	18%	25%
150–200	9%	9%	13%	18%	25%	34%

Table 9.16. GIR and GIRP scorecard: GIR is the number of greens hit in regulation per round. GIRP is the number of greens and fringe hit in regulation plus one stroke per round. Hitting a green on a par-five hole in three or fewer strokes counts as a green in regulation (GIR). Hitting the green or fringe on a par-five hole in four or fewer strokes counts as a "green or fringe in regulation plus one" (GIRP). The table gives average values for GIR and GIRP per round by golfer group. Amateurs scoring 85 or above would do better to track their GIRPs.

Golfer group	GIR	GIRP
PGA Tour pro	11.6	17.3
75-golfer	8.9	17.0
80-golfer	7.0	15.4
85-golfer	5.3	13.8
90-golfer	3.9	12.3
95-golfer	2.8	10.8
100-golfer	1.9	9.5
105-golfer	1.2	8.1
110-golfer	0.8	6.8

Table 9.17. Awful shot scorecard: Off-green strokes lost per round to awful shots. Count one for each awful shot and count two for each double-awful shot and add the numbers to get your awful total. The long-game and short-game columns break the awful total down by where the awful shots occur, outside 100 yards from the hole or inside 100 yards (excluding putts on the green).

Golfer group	Awful total	Long game	Short game
PGA Tour pro	0.7	0.5	0.2
75-golfer	1.4	1.1	0.3
80-golfer	2.5	1.7	0.8
85-golfer	3.9	2.6	1.3
90-golfer	5.6	3.8	1.8
95-golfer	7.5	5.1	2.4
100-golfer	9.7	6.7	3.0
105-golfer	12.1	8.5	3.6
110-golfer	14.8	10.6	4.2

Table A-1. Tiger Woods's putting contribution to victory (PCV). Tiger's average strokes gained putting in his victories is 1.14 putts. His average margin of victory is 4.09 strokes versus the field. Tiger's average putting contribution to victory is 28% (1.14/4.09). Putting contributed slightly less to Tiger's victories than the overall average PCV of 35%. Put another way, Tiger's off-green play contributed more to his victories than the average victory.

Rank	Year	Tournament	Strokes gained putting (SGP)	Off-green strokes gained	Winning score versus field (SVF)	Putting contribution to victory (SGP/SVF)
1	2009	Arnold Palmer	1.87	1.57	3.44	54%
2	2009	AT&T National	1.89	2.28	4.16	45%
3	2005	Buick Invitational	1.75	2.13	3.88	45%
4	2007	Wachovia	1.95	2.58	4.53	43%
5	2007	Buick Invitational	1.33	1.96	3.29	40%
6	2007	TOUR Championship	1.55	2.52	4.08	38%
7	2007	BMW Championship	1.48	2.79	4.27	35%
8	2009	WGC-Bridgestone	1.32	2.54	3.86	34%
9	2012	Arnold Palmer	1.44	2.98	4.43	33%
10	2008	Buick Invitational	1.86	3.90	5.76	32%
11	2009	Buick Open	1.07	2.51	3.59	30%
12	2006	Buick Open	1.28	3.06	4.35	30%
13	2006	WGC-Bridgestone	1.07	2.60	3.67	29%
14	2009	BMW Championship	1.51	3.68	5.19	29%
15	2008	Arnold Palmer	1.00	2.44	3.44	29%
16	2006	Buick Invitational	0.73	2.07	2.80	26%
17	2005	Ford at Doral	1.14	3.44	4.58	25%
18	2006	Ford at Doral	0.86	2.81	3.67	23%
19	2005	WGC-NEC	0.61	2.26	2.87	21%
20	2006	Deutsche Bank	1.15	4.46	5.61	21%
21	2007	WGC-Bridgestone	0.76	4.02	4.79	16%
22	2009	Memorial	0.55	3.87	4.42	12%
23	2012	Memorial	0.04	3.89	3.93	1%
24	2007	WGC-CA	-0.79	4.29	3.50	-23%
		Average	1.14	2.94	4.09	28%

Table A-2. Vijay Singh's and Phil Mickelson's putting contribution to victory (PCV). Vijay's average putting contribution to victory is 20% (0.77/3.92). Phil's average putting contribution to victory is 27% (1.10/4.12). Both are less than the overall average PCV of 35%. Vijay's wins typically occur in spite of his putting.

Rank	Golfer	Year	Tournament	Strokes gained putting (SGP)	Off-green strokes gained	Winning score versus field (SVF)	Putting contribution to victory (SGP/SVF)
1	Vijay Singh	2006	Barclays Classic	2.97	0.78	3.75	79%
2	Vijay Singh	2004	New Orleans	2.48	1.40	3.89	64%
3	Vijay Singh	2007	Mercedes-Benz	1.36	2.03	3.39	40%
4	Vijay Singh	2004	Chrysler Championship	1.63	3.15	4.78	34%
5	Vijay Singh	2007	Arnold Palmer	1.26	2.80	4.05	31%
6	Vijay Singh	2005	Buick Open	1.33	3.11	4.44	30%
7	Vijay Singh	2005	Sony Open	0.89	2.76	3.65	24%
8	Vijay Singh	2005	Wachovia	1.04	3.70	4.74	22%
9	Vijay Singh	2004	Buick Open	0.99	3.54	4.53	22%
10	Vijay Singh	2008	Barclays	0.30	2.11	2.41	12%
11	Vijay Singh	2004	Bell Canadian Open	0.34	3.64	3.98	9%
12	Vijay Singh	2008	Deutsche Bank	0.38	3.99	4.37	9%
13	Vijay Singh	2004	LUMBER Classic	-0.08	3.57	3.49	-2%
14	Vijay Singh	2005	Shell Houston Open	-0.08	3.63	3.55	-2%
15	Vijay Singh	2004	Shell Houston Open	-0.16	3.96	3.81	-4%
16	Vijay Singh	2004	Deutsche Bank	-0.37	5.21	4.84	-8%
17	Vijay Singh	2008	WGC-Bridgestone	-1.14	4.19	3.05	-37%
			Average	0.77	3.15	3.92	20%
1	Phil Mickelson	2009	TOUR Championship	1.62	1.18	2.80	58%
2	Phil Mickelson	2005	BellSouth Classic	1.58	1.90	3.48	45%
3	Phil Mickelson	2005	FBR Open	1.57	3.25	4.82	33%
4	Phil Mickelson	2008	Colonial	1.11	2.72	3.83	29%
5	Phil Mickelson	2006	BellSouth Classic	1.77	4.99	6.76	26%
6	Phil Mickelson	2009	Northern Trust Open	0.78	2.58	3.35	23%
7	Phil Mickelson	2008	Northern Trust Open	0.92	3.19	4.11	22%
8	Phil Mickelson	2007	Deutsche Bank	0.76	2.97	3.74	20%
9	Phil Mickelson	2007	PLAYERS	0.77	3.23	4.00	19%
10	Phil Mickelson	2011	Shell Houston Open	0.77	3.97	4.74	16%
11	Phil Mickelson	2009	WGC-CA	0.47	3.20	3.66	13%
			Average	1.10	3.02	4.12	27%

Table A-3. Top 25 PGA Tour tournament winners ranked by putting contribution to victory. These golfers won largely because of their putting. Putting performance is measured by strokes gained putting (SGP) per round. Winning performance is measured by the winner's average score versus the field (SVF) per round. The putting contribution to victory is the ratio SGP/SVF. Off-green strokes gained is the score versus the field (SVF) minus strokes gained putting (SGP).

Rank	Golfer	Year	Tournament	Strokes gained putting (SGP)	Off-green strokes gained	Winning versus field (SVF)	Putting contribution to victory (SGP/SVF)
1	Bill Haas	2011	TOUR Championship	2.05	-0.26	1.79	114%
2	Daniel Chopra	2008	Mercedes-Benz	2.47	-0.03	2.44	101%
3	Luke Donald	2012	Transitions	2.60	0.38	2.98	87%
4	J. J. Henry	2006	Buick Championship	3.30	0.76	4.06	81%
5	Matt Kuchar	2009	Turning Stone Resort	2.54	0.63	3.17	80%
6	Vijay Singh	2006	Barclays Classic	2.97	0.78	3.75	79%
7	Ben Curtis	2006	Booz Allen	3.57	0.96	4.53	79%
8	Wes Short Jr.	2005	Michelin	2.28	0.72	3.01	76%
9	Kenny Perry	2008	John Deere Classic	2.28	0.79	3.07	74%
10	Stuart Appleby	2004	Mercedes	2.66	1.03	3.69	72%
11	Geoff Ogilvy	2010	Tournament of Champions	1.72	0.67	2.38	72%
12	Lucas Glover	2011	Wells Fargo	2.65	1.05	3.70	72%
13	Jeff Maggert	2006	FedEx St. Jude	3.09	1.32	4.41	70%
14	Nick Watney	2011	AT&T National	2.74	1.23	3.97	69%
15	Steve Flesch	2007	Turning Stone Resort	2.19	1.03	3.22	68%
16	Jerry Kelly	2009	New Orleans	2.28	1.13	3.41	67%
17	Stuart Appleby	2005	Mercedes	1.64	0.83	2.48	66%
18	Luke Donald	2011	Children's Miracle Network	2.01	1.04	3.05	66%
19	Stewart Cink	2004	MCI Heritage	2.16	1.18	3.33	65%
20	Carl Pettersson	2006	Memorial	2.58	1.42	4.00	64%
21	Stewart Cink	2004	WGC-NEC	2.46	1.38	3.84	64%
22	Jim Furyk	2006	Canadian Open	2.41	1.36	3.77	64%
23	Vijay Singh	2004	New Orleans	2.48	1.40	3.89	64%
24	K. J. Choi	2011	PLAYERS	2.05	1.20	3.25	63%
25	Aaron Baddeley	2006	Heritage	2.57	1.51	4.08	63%

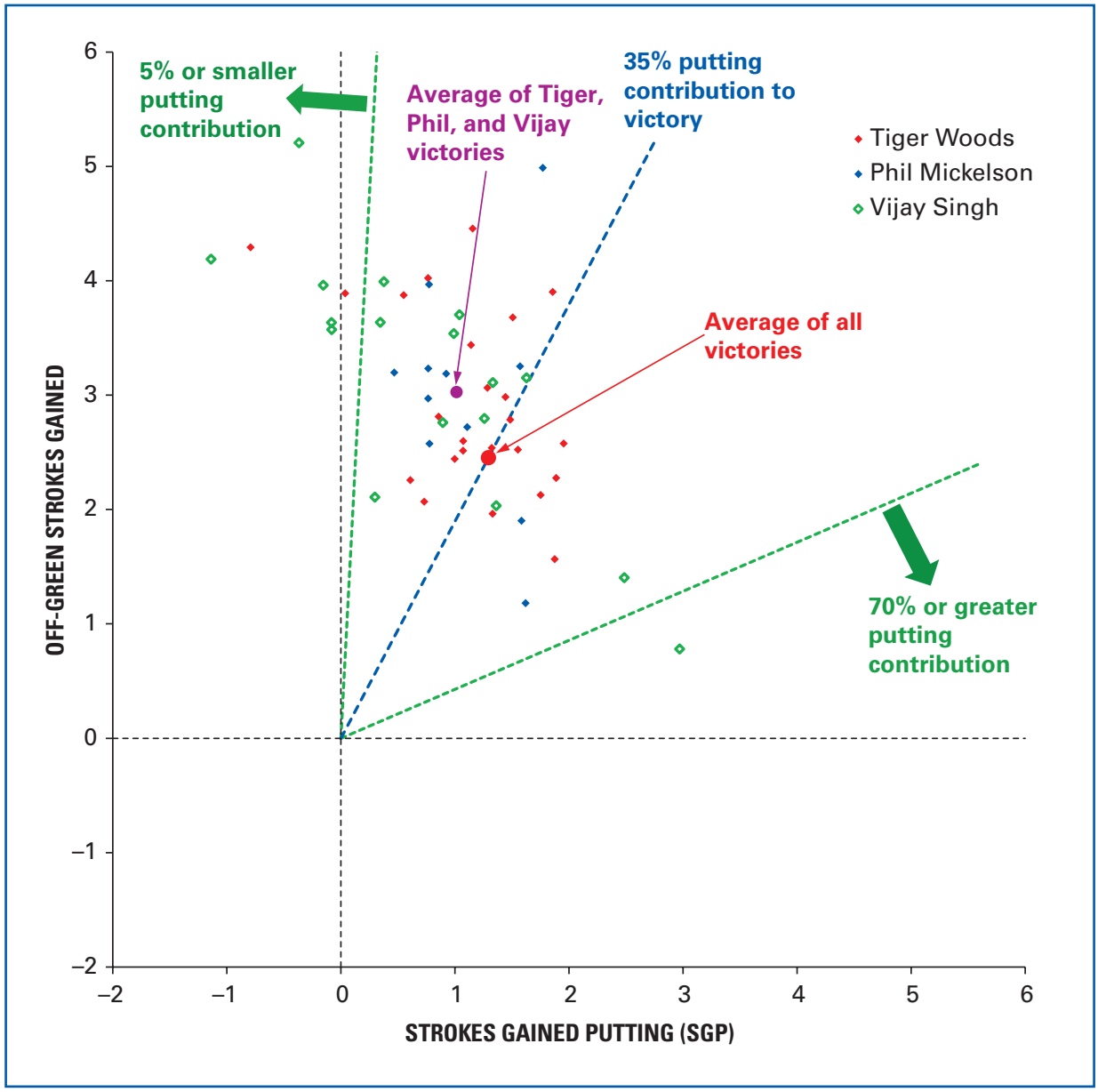


Figure A-1. Victories of Tiger Woods, Vijay Singh, and Phil Mickelson: off-green strokes gained per round plotted against strokes gained putting per round (SGP). The sum of off-green strokes gained and strokes gained putting is the winner's average score versus the field (SVF), or total strokes gained per round versus the field. The putting contribution to victory is the ratio SGP/SVF. The average putting contribution to victory for these 61 victories was 25%.

Table A-4. Bottom 25 PGA Tour tournament winners ranked by putting contribution to victory. These golfers won in spite of their putting. Putting performance is measured by strokes gained putting (SGP) per round. Winning performance is measured by the winner's average score versus the field (SVF) per round. The putting contribution to victory is the ratio SGP/SVF. Off-green strokes gained is the score versus the field (SVF) minus strokes gained putting (SGP).

Rank	Golfer	Year	Tournament	Strokes gained putting (SGP)	Off-green strokes gained	Winning score versus field (SVF)	Putting contribution to victory (SGP/SVF)
291	Scott Stallings	2011	Greenbrier Classic	0.21	2.88	3.09	7%
292	Nick Watney	2009	Buick Invitational	0.25	3.78	4.03	6%
293	Bubba Watson	2011	Farmers Insurance	0.25	3.95	4.20	6%
294	Sergio Garcia	2004	Buick Classic	0.19	3.16	3.35	6%
295	Jason Gore	2005	LUMBER Classic	0.22	3.61	3.83	6%
296	Rory Sabbatini	2006	Nissan Open	0.19	3.49	3.68	5%
297	Dustin Johnson	2012	FedEx St. Jude	0.17	3.32	3.49	5%
298	Woody Austin	2007	St. Jude Championship	0.25	5.17	5.42	5%
299	Chris Couch	2006	New Orleans	0.05	3.47	3.52	2%
300	Tiger Woods	2012	Memorial	0.04	3.89	3.93	1%
301	Ben Crane	2010	Farmers Insurance	0.02	2.98	3.00	1%
302	Scott Verplank	2007	Byron Nelson	-0.05	3.84	3.79	-1%
303	Sean O'Hair	2011	Canadian Open	-0.08	3.60	3.52	-2%
304	Vijay Singh	2004	LUMBER Classic	-0.08	3.57	3.49	-2%
305	Vijay Singh	2005	Shell Houston Open	-0.08	3.63	3.55	-2%
306	Brett Wetterich	2006	Byron Nelson	-0.11	3.68	3.57	-3%
307	Vijay Singh	2004	Shell Houston Open	-0.16	3.96	3.81	-4%
308	Mark Hensby	2004	John Deere Classic	-0.22	3.57	3.35	-7%
309	Vijay Singh	2004	Deutsche Bank	-0.37	5.21	4.84	-8%
310	Jason Dufner	2012	Byron Nelson	-0.39	4.22	3.84	-10%
311	Steve Flesch	2007	Reno-Tahoe Open	-0.81	4.99	4.18	-19%
312	Tiger Woods	2007	WGC-CA	-0.79	4.29	3.50	-23%
313	Sergio Garcia	2004	Byron Nelson	-0.71	3.55	2.84	-25%
314	Sean O'Hair	2009	Quail Hollow	-0.82	3.99	3.17	-26%
315	Vijay Singh	2008	WGC-Bridgestone	-1.14	4.19	3.05	-37%

Table A-5. Middle 25 PGA Tour tournament winners ranked by putting contribution to victory. Putting performance is measured by strokes gained putting (SGP) per round. Winning performance is measured by the winner's average score versus the field (SVF) per round. The putting contribution to victory is the ratio SGP/SVF. Off-green strokes gained is the score versus the field (SVF) minus strokes gained putting (SGP).

Rank	Golfer	Year	Tournament	Strokes gained putting (SGP)	Off-green strokes gained	Winning score versus field (SVF)	Putting contribution to victory (SGP/SVF)
145	David Toms	2006	Sony Open	1.96	3.46	5.42	36%
146	Trevor Immelman	2006	Western Open	1.31	2.31	3.62	36%
147	Jonathan Byrd	2011	Tournament of Champions	1.11	1.97	3.09	36%
148	Fred Funk	2005	PLAYERS	1.11	1.98	3.09	36%
149	Ryan Palmer	2004	FUNAI Classic	1.21	2.22	3.43	35%
150	Tiger Woods	2007	BMW Championship	1.48	2.79	4.27	35%
151	Zach Johnson	2008	Valero Texas Open	1.35	2.59	3.94	34%
152	Tiger Woods	2009	WGC-Bridgestone	1.32	2.54	3.86	34%
153	Parker McLachlin	2008	Legends Reno-Tahoe Open	1.63	3.15	4.79	34%
154	Vijay Singh	2004	Chrysler Championship	1.63	3.15	4.78	34%
155	Rory Sabbatini	2009	Byron Nelson	1.50	2.93	4.43	34%
156	Adam Scott	2006	TOUR Championship	1.19	2.32	3.51	34%
157	Ernie Els	2004	Memorial	1.76	3.44	5.20	34%
158	Fred Funk	2004	Southern Farm Bureau	1.15	2.26	3.42	34%
159	Geoff Ogilvy	2005	Chrysler Tucson	1.00	1.98	2.98	34%
160	John Senden	2006	John Deere Classic	1.28	2.54	3.82	33%
161	Joey Sindelar	2004	Wachovia	1.04	2.08	3.12	33%
162	Hunter Mahan	2010	Phoenix Open	0.98	1.95	2.93	33%
163	Mark Wilson	2007	Honda Classic	1.06	2.15	3.21	33%
164	Ernie Els	2010	WGC-CA	1.23	2.51	3.74	33%
165	Harrison Frazar	2011	FedEx St. Jude	1.39	2.85	4.24	33%
166	Geoff Ogilvy	2008	WGC-CA	1.07	2.22	3.29	33%
167	Tiger Woods	2012	Arnold Palmer	1.44	2.98	4.43	33%
168	Phil Mickelson	2005	FBR Open	1.57	3.25	4.82	33%
169	Ryan Palmer	2008	Ginn sur Mer Classic	0.88	1.83	2.71	33%

Table A-6. Putting results for J. J. Henry in round two of the 2006 FBR Open at the TPC Scottsdale Stadium course. He gained 8.6 strokes relative to the PGA Tour benchmark while the field gained 0.3 strokes. His strokes gained putting versus the field of 8.3 was the best single-round putting performance in 2003–2012.

Hole	1	2	3	4	5	6	7	8	9	Out	
Distance (feet)	29	26	31	16	42	6	5	6	8		
Tour avg putts	2.0	1.9	2.0	1.8	2.1	1.3	1.2	1.4	1.5	15.2	
Henry's putts	1	2	2	1	2	1	1	1	1	12	
Strokes gained	1.0	-0.1	0.0	0.8	0.1	0.3	0.2	0.4	0.5	3.2	

Hole	10	11	12	13	14	15	16	17	18	In	Total
Distance (feet)	8	16	28	2	27	26	13	27	9		
Tour avg putts	1.5	1.8	2.0	1.0	2.0	1.9	1.7	1.9	1.6	15.4	30.6
Henry's putts	1	1	1	1	1	1	2	1	1	10	22
Strokes gained	0.5	0.8	1.0	0.0	1.0	0.9	-0.3	0.9	0.6	5.4	8.6

SGP to benchmark	8.6
Field average SGP	0.3
SGP to field	8.3

Table A-7. Best 40 putting rounds in the ShotLink era from 2003 through August 2012. Rounds are ranked by strokes gained putting to the field (SGP) in the rightmost column.

Rank	Date	Golfer	Avg distance of first putt (feet)	Putts	Strokes gained putting (SGP)
1	2/3/2006	J. J. Henry	18.0	22	8.32
2	7/8/2010	Paul Goydos	19.9	22	7.36
3	8/27/2005	Darron Stiles	19.8	25	6.96
4	3/18/2012	Scott Piercy	17.2	23	6.93
5	7/26/2012	Charl Schwartzel	17.0	24	6.81
6	7/31/2011	J. P. Hayes	16.2	23	6.79
7	2/24/2005	Steve Stricker	15.5	22	6.66
8	10/1/2004	Woody Austin	12.6	22	6.64
9	9/15/2005	Mark O'Meara	14.4	21	6.62
10	6/10/2004	David Frost	21.4	26	6.60
11	10/24/2009	Matt Bettencourt	14.0	22	6.58
12	7/8/2010	Steve Stricker	20.8	25	6.58
13	3/22/2012	Chris Stroud	18.9	25	6.51
14	9/23/2005	Dan Forsman	22.3	26	6.51
15	3/31/2011	Jimmy Walker	17.3	23	6.45
16	7/7/2011	Kris Blanks	20.6	25	6.42
17	8/23/2007	Brian Gay	12.6	20	6.40
18	10/31/2004	Joe Durant	22.0	25	6.38
19	10/27/2005	Dean Wilson	19.3	24	6.36
20	7/23/2009	Kevin Na	15.9	24	6.35
21	10/7/2011	Nathan Green	23.7	27	6.34
22	6/29/2007	Kenny Perry	14.4	22	6.29
23	9/5/2005	Tim Herron	21.2	25	6.28
24	4/30/2005	Daniel Chopra	13.4	22	6.26
25	1/26/2003	Pat Bates	22.3	26	6.25
26	3/31/2012	Hunter Mahan	21.4	26	6.17
27	7/10/2008	Chris Riley	14.4	23	6.16
28	3/17/2006	Mark O'Meara	18.8	24	6.15
29	3/5/2006	Fredrik Jacobson	18.0	24	6.14
30	11/1/2007	J. P. Hayes	18.4	25	6.12
31	10/12/2007	John Daly	17.5	24	6.12
32	8/24/2012	Charl Schwartzel	20.0	26	6.12
33	8/22/2003	Guy Boros	13.0	22	6.11
34	1/26/2012	Marc Turnesa	17.3	25	6.08
35	10/2/2003	Heath Slocum	15.9	23	6.07
36	8/29/2008	Mike Weir	12.3	21	6.07
37	5/5/2005	Fred Funk	19.7	25	6.06
38	4/30/2010	J. P. Hayes	16.3	25	6.02
39	10/21/2010	Robert Garrigus	20.6	26	6.02
40	9/30/2004	Brenden Pappas	18.8	24	6.01

Table A-8. Frequency of SGP to the field for individual professional putting rounds. For example, a putting round that gains 1.5 strokes against the field is better than 81% of rounds on the PGA Tour. A putting round that loses 2.5 strokes to the field is better than only 8% of rounds on the PGA Tour, that is, it is worse than 92% of rounds.

Strokes gained putting (SGP)	Fraction of rounds worse	Strokes gained putting (SGP)	Fraction of rounds worse
5.5	99.9%	-0.5	38%
5.0	99.8%	-1.0	28%
4.5	99.5%	-1.5	19%
4.0	99%	-2.0	12%
3.5	98%	-2.5	8%
3.0	96%	-3.0	4%
2.5	93%	-3.5	2%
2.0	88%	-4.0	1%
1.5	81%	-4.5	0.6%
1.0	72%	-5.0	0.3%
0.5	61%	-5.5	0.1%
0.0	50%		

Table A-9. Most improved putters from 2011 to September 2012 as measured by SGP.

			SGP Improvement		
Rank	Golfer	Total SGP improvement	0–6 ft	7–21 ft	22+ ft
1	Derek Lamely	1.00	0.29	0.41	0.30
2	Jeff Maggert	0.90	0.43	0.32	0.14
3	Phil Mickelson	0.79	0.00	0.54	0.24
4	Dustin Johnson	0.76	0.44	0.25	0.07
5	Ernie Els	0.70	0.48	0.41	-0.19
6	Tom Gillis	0.69	0.47	-0.09	0.31
7	Bo Van Pelt	0.68	0.35	0.22	0.11
8	James Driscoll	0.62	0.19	0.08	0.34
9	Sergio Garcia	0.61	0.27	0.24	0.09
10	Jim Furyk	0.59	0.44	0.22	-0.08
	Average	0.73	0.34	0.26	0.13

Table A-10. Tiger Woods strokes gained by year: total strokes gained and breakdown by shot category from 2003 through 2012. Ranks each year are out of approximately 200 golfers with at least 30 rounds of PGA Tour ShotLink data in the year.

	Rank					Strokes gained per round					
Year	Total	Drive	Appr	Short	Putt	Total	Drive	Appr	Short	Putt	Rounds
2012	2	9	1	37	27	2.80	0.74	1.39	0.26	0.42	49
2011	29	136	4	89	49	1.09	-0.15	0.88	0.09	0.28	19
2010	48	123	4	160	91	0.71	-0.08	0.91	-0.20	0.08	29
2009	1	15	1	4	2	3.71	0.53	1.48	0.71	0.99	48
2008	1	8	1	3	4	4.14	0.61	2.01	0.67	0.85	11
2007	1	4	1	35	2	3.68	0.81	1.77	0.30	0.80	43
2006	1	4	1	23	21	3.78	0.92	1.98	0.39	0.49	37
2005	1	2	3	89	4	2.82	1.09	0.89	0.10	0.75	55
2004	1	21	5	9	3	3.06	0.48	1.12	0.51	0.95	54
2003	1	6	1	1	18	3.71	0.87	1.60	0.70	0.54	46

Table A-11. Jim Furyk strokes gained by year: total strokes gained and breakdown by shot category from 2003 through 2012.

	Rank					Strokes gained per round					
Year	Total	Drive	Appr	Short	Putt	Total	Drive	Appr	Short	Putt	Rounds
2012	5	53	4	22	22	2.09	0.27	1.01	0.33	0.48	66
2011	36	84	9	47	134	0.94	0.10	0.71	0.23	-0.10	70
2010	3	63	11	2	22	2.03	0.23	0.67	0.64	0.49	60
2009	3	80	14	6	4	2.13	0.15	0.65	0.53	0.80	65
2008	6	46	13	76	28	1.62	0.33	0.71	0.13	0.44	75
2007	10	53	10	9	105	1.68	0.31	0.74	0.59	0.04	66
2006	2	17	3	14	3	2.94	0.58	1.10	0.45	0.81	68
2005	4	68	1	4	31	2.26	0.21	1.11	0.55	0.39	68
2004	22	29	42	101	16	1.49	0.41	0.43	0.05	0.60	31
2003	4	43	11	7	13	2.55	0.39	0.99	0.58	0.59	59

Table A-12. Luke Donald strokes gained by year: total strokes gained and breakdown by shot category from 2003 through 2012.

	Rank					Strokes gained per round					
Year	Total	Drive	Appr	Short	Putt	Total	Drive	Appr	Short	Putt	Rounds
2012	3	124	11	3	2	2.21	-0.06	0.77	0.58	0.91	48
2011	1	89	1	6	1	2.71	0.08	1.18	0.49	0.95	52
2010	5	175	3	10	1	1.95	-0.38	0.92	0.45	0.96	53
2009	13	182	23	12	1	1.48	-0.47	0.51	0.42	1.03	61
2008	2	164	47	1	2	1.96	-0.25	0.40	0.89	0.92	28
2007	18	84	46	30	20	1.36	0.13	0.39	0.34	0.49	50
2006	4	84	8	1	12	2.43	0.13	0.87	0.83	0.61	43
2005	5	59	4	1	17	2.23	0.23	0.86	0.64	0.50	40
2004	21	102	20	24	57	1.50	0.11	0.72	0.40	0.27	60
2003	95	151	93	39	84	0.25	-0.25	0.09	0.31	0.10	63

Table A-13. Phil Mickelson strokes gained by year: total strokes gained and breakdown by shot category from 2003 through 2012.

	Rank					Strokes gained per round					
Year	Total	Drive	Appr	Short	Putt	Total	Drive	Appr	Short	Putt	Rounds
2012	8	110	20	4	7	1.86	0.00	0.66	0.55	0.64	60
2011	6	51	2	9	140	1.63	0.28	1.03	0.44	-0.11	58
2010	10	38	8	15	117	1.49	0.40	0.75	0.39	-0.05	57
2009	19	20	48	7	119	1.29	0.52	0.31	0.50	-0.05	48
2008	1	17	6	9	50	2.25	0.51	0.91	0.54	0.27	59
2007	3	43	7	5	59	2.06	0.38	0.77	0.69	0.23	52
2006	5	11	6	44	66	2.13	0.65	0.99	0.29	0.20	49
2005	8	41	22	9	47	1.81	0.38	0.61	0.52	0.30	50
2004	10	8	15	31	125	1.80	0.67	0.81	0.36	-0.04	50
2003	47	89	101	22	60	0.82	0.11	0.02	0.44	0.24	50

Table A-14. Rory McIlroy strokes gained by year: total strokes gained and breakdown by shot category from 2009 through 2012.

	Rank					Strokes gained per round					
Year	Total	Drive	Appr	Short	Putt	Total	Drive	Appr	Short	Putt	Rounds
2012	1	2	2	35	73	2.97	1.22	1.34	0.27	0.15	40
2011	12	1	50	101	139	1.42	1.14	0.35	0.04	-0.11	18
2010	22	3	19	158	125	1.19	0.90	0.57	-0.19	-0.09	40
2009	67	38	36	116	155	0.47	0.39	0.40	0.00	-0.32	22

Table A-15. Vijay Singh strokes gained by year: total strokes gained and breakdown by shot category from 2003 through 2012.

	Rank					Strokes gained per round					
Year	Total	Drive	Appr	Short	Putt	Total	Drive	Appr	Short	Putt	Rounds
2012	43	33	22	39	179	0.91	0.41	0.61	0.25	-0.37	82
2011	40	37	52	43	131	0.86	0.36	0.34	0.25	-0.08	72
2010	30	25	2	33	195	1.05	0.49	0.93	0.31	-0.68	57
2009	70	33	30	68	186	0.40	0.40	0.46	0.14	-0.61	51
2008	4	3	7	7	177	1.80	0.80	0.80	0.57	-0.38	63
2007	9	12	17	19	107	1.75	0.63	0.64	0.45	0.03	82
2006	6	25	10	8	90	2.07	0.53	0.86	0.57	0.10	84
2005	2	3	7	5	64	2.58	1.04	0.79	0.55	0.20	84
2004	2	1	3	7	126	2.85	1.10	1.17	0.62	-0.04	85
2003	2	1	12	8	66	3.07	1.36	0.95	0.54	0.21	64

Table A-16. Ernie Els strokes gained by year: total strokes gained and breakdown by shot category from 2003 through 2012.

	Rank					Strokes gained per round					
Year	Total	Drive	Appr	Short	Putt	Total	Drive	Appr	Short	Putt	Rounds
2012	35	51	19	89	101	1.01	0.28	0.67	0.05	0.00	65
2011	71	69	8	55	194	0.48	0.18	0.76	0.20	-0.66	59
2010	7	44	9	37	28	1.75	0.35	0.71	0.28	0.42	55
2009	16	25	6	24	152	1.37	0.46	0.88	0.33	-0.30	54
2008	25	80	2	43	190	1.10	0.14	1.14	0.28	-0.46	36
2007	2	17	2	27	104	2.16	0.57	1.20	0.35	0.04	44
2006	8	18	24	2	96	1.94	0.57	0.55	0.74	0.07	51
2005	3	5	10	36	29	2.37	0.97	0.74	0.27	0.40	30
2004	3	3	12	6	78	2.47	0.81	0.84	0.65	0.16	41
2003	10	9	9	25	159	1.90	0.77	1.00	0.42	-0.29	32

Table A-17. Sergio Garcia strokes gained by year: total strokes gained and breakdown by shot category from 2003 through 2012.

	Rank					Strokes gained per round					
Year	Total	Drive	Appr	Short	Putt	Total	Drive	Appr	Short	Putt	Rounds
2012	14	31	43	25	19	1.64	0.43	0.39	0.32	0.50	44
2011	19	12	37	33	123	1.31	0.66	0.41	0.30	-0.07	45
2010	92	47	74	93	166	0.21	0.34	0.18	0.05	-0.36	36
2009	28	23	8	150	113	1.08	0.48	0.77	-0.15	-0.01	44
2008	2	10	3	21	111	1.95	0.55	1.04	0.39	-0.04	56
2007	4	82	3	21	39	1.97	0.14	1.07	0.43	0.33	55
2006	21	28	5	105	148	1.43	0.49	1.00	0.07	-0.13	43
2005	6	1	11	28	159	1.95	1.10	0.72	0.32	-0.19	52
2004	8	7	1	28	200	1.94	0.73	1.33	0.37	-0.49	50
2003	112	39	63	120	196	0.04	0.44	0.29	-0.03	-0.67	28

Table A-18. Steve Stricker strokes gained by year: total strokes gained and breakdown by shot category from 2003 through 2012.

	Rank					Strokes gained per round					
Year	Total	Drive	Appr	Short	Putt	Total	Drive	Appr	Short	Putt	Rounds
2012	12	45	8	16	57	1.75	0.32	0.83	0.40	0.21	54
2011	2	76	34	2	2	2.18	0.17	0.43	0.72	0.87	53
2010	1	52	4	3	15	2.36	0.30	0.87	0.64	0.55	56
2009	2	46	5	3	56	2.23	0.33	0.88	0.72	0.30	62
2008	14	173	43	1	26	1.31	-0.32	0.43	0.75	0.46	58
2007	5	117	5	6	25	1.96	-0.04	0.91	0.68	0.41	65
2006	17	145	65	3	20	1.47	-0.09	0.32	0.73	0.50	54
2005	129	216	160	3	9	-0.05	-1.16	-0.19	0.61	0.68	59
2004	144	216	137	10	12	-0.22	-1.27	-0.08	0.48	0.66	61
2003	141	201	102	5	97	-0.32	-0.99	0.02	0.63	0.02	45

Table A-19. Strokes gained approach (SGA) per round broken down by shot category: top 40 golfers in SGA on the PGA Tour from 2004 through 2012. Ranks are out of 240 golfers with at least 200 rounds from 2004 to 2012, with the exception of Rory McIlroy, who has only 120 rounds of ShotLink data (and so has an asterisk by his name). Approach shot categories 100–150, 150–200, and 200–250 do not include sand shots or recovery shots, or shots greater than 250 yards from the hole. These "other" approach shots are not included for space reasons.

	Rank				Strokes gained per round			
Golfer	Total SGA	100–150	150–200	200–250	Total SGA	100–150	150–200	200–250
Tiger Woods	1	10	1	1	1.28	0.20	0.62	0.30
Robert Allenby	2	5	5	3	0.88	0.23	0.35	0.23
Jim Furyk	3	7	2	11	0.78	0.21	0.38	0.17
Ernie Els	4	17	8	10	0.77	0.15	0.34	0.17
Sergio Garcia	5	20	11	9	0.75	0.14	0.28	0.17
Rory McIlroy*	6	2	12	12	0.73	0.27	0.27	0.17
Phil Mickelson	6	4	19	40	0.72	0.24	0.23	0.10
Adam Scott	7	21	13	12	0.71	0.14	0.25	0.16
Vijay Singh	8	6	7	77	0.70	0.21	0.35	0.06
Luke Donald	9	30	4	28	0.65	0.12	0.36	0.11
Chad Campbell	10	27	3	55	0.61	0.13	0.37	0.08
Tom Lehman	11	1	17	86	0.60	0.29	0.24	0.06
Scott Verplank	12	72	6	17	0.58	0.07	0.35	0.13
Joey Sindelar	13	31	9	16	0.57	0.12	0.31	0.13
Kenny Perry	14	106	21	2	0.57	0.04	0.23	0.23
Lee Westwood	15	59	14	19	0.56	0.08	0.25	0.13
Kris Blanks	16	2	29	38	0.56	0.26	0.18	0.10
David Toms	17	108	10	15	0.55	0.04	0.30	0.13
Paul Casey	18	11	30	14	0.53	0.19	0.18	0.15
Tim Clark	19	41	23	20	0.52	0.10	0.22	0.13
Justin Rose	20	84	27	4	0.51	0.06	0.19	0.20
John Senden	21	16	15	94	0.49	0.16	0.25	0.05
Alex Cejka	22	12	57	26	0.47	0.18	0.13	0.11
Camilo Villegas	23	23	43	42	0.47	0.14	0.16	0.10
Brendon de Jonge	24	121	35	8	0.46	0.03	0.18	0.17
Davis Love III	25	15	54	110	0.46	0.16	0.14	0.03
Steve Stricker	26	28	28	59	0.45	0.12	0.19	0.08
Stewart Cink	27	58	18	95	0.43	0.08	0.24	0.05
Ricky Barnes	28	32	20	58	0.42	0.12	0.23	0.08
Joe Durant	29	22	25	32	0.42	0.14	0.20	0.11
Zach Johnson	30	51	16	45	0.41	0.08	0.25	0.09
Heath Slocum	31	49	45	34	0.40	0.09	0.16	0.10
Trevor Immelman	32	126	52	13	0.40	0.02	0.14	0.15
Retief Goosen	33	56	83	6	0.39	0.08	0.09	0.18
Boo Weekley	34	43	38	81	0.38	0.10	0.17	0.06
Jeff Sluman	35	36	32	54	0.38	0.11	0.18	0.08
Briny Baird	36	46	67	27	0.38	0.09	0.12	0.11
Jason Bohn	37	67	22	114	0.37	0.07	0.23	0.02
Stephen Ames	38	91	33	96	0.37	0.06	0.18	0.05
K. J. Choi	39	52	12	136	0.36	0.08	0.25	0.00
Dudley Hart	40	9	78	62	0.35	0.20	0.10	0.08
				Top 40 average	0.55	0.13	0.24	0.12

Table A-20. Strokes gained short game (SGS) per round broken down by shot category: top 40 golfers in SGS on the PGA Tour from 2004 through 2012. Ranks are out of 240 golfers with at least 200 rounds from 2004 to 2012. Shot categories 0–20, 20–60, and 60–100 do not include putts or sand shots. Sand shots 50–100 yards from the hole are not included for space reasons.

	Rank					Strokes gained per round				
Golfer	Total SGS	0–20	20–60	60–100	Sand 0–50	Total SGS	0–20	20–60	60–100	Sand 0–50
Steve Stricker	1	3	1	1	69	0.63	0.17	0.21	0.18	0.05
Corey Pavin	2	1	14	12	16	0.54	0.23	0.10	0.09	0.12
Chris Riley	3	6	3	59	3	0.52	0.16	0.14	0.04	0.18
Luke Donald	4	2	51	26	2	0.51	0.19	0.06	0.06	0.20
Mike Weir	5	57	9	21	1	0.50	0.08	0.12	0.07	0.24
Pádraig Harrington	6	7	6	7	31	0.50	0.16	0.13	0.12	0.09
Phil Mickelson	7	11	7	27	17	0.46	0.15	0.12	0.06	0.12
Vijay Singh	8	21	12	44	14	0.42	0.12	0.10	0.05	0.12
Justin Leonard	9	10	5	9	92	0.41	0.16	0.13	0.10	0.03
Brian Gay	10	32	43	5	34	0.39	0.11	0.07	0.13	0.09
Ryuji Imada	11	20	18	46	13	0.39	0.13	0.10	0.04	0.12
Jim Furyk	12	12	19	22	38	0.39	0.15	0.09	0.07	0.08
Nick O'Hern	13	54	30	8	20	0.38	0.08	0.08	0.11	0.11
Kevin Na	14	13	16	87	25	0.38	0.14	0.10	0.02	0.11
Shigeki Maruyama	15	75	2	35	23	0.37	0.06	0.14	0.05	0.11
Justin Rose	16	28	60	36	7	0.36	0.11	0.05	0.05	0.14
Stuart Appleby	17	23	8	75	28	0.36	0.12	0.12	0.03	0.10
Todd Fischer	18	9	4	13	168	0.35	0.16	0.13	0.09	-0.03
Rory Sabbatini	19	56	32	37	10	0.34	0.08	0.07	0.05	0.13
Ian Poulter	20	4	80	98	19	0.33	0.17	0.03	0.01	0.11
Ernie Els	21	30	24	20	63	0.32	0.11	0.09	0.07	0.06
Aaron Baddeley	22	19	29	173	24	0.30	0.13	0.08	-0.02	0.11
K. J. Choi	23	14	100	128	5	0.30	0.14	0.02	0.00	0.14
Tiger Woods	24	41	10	30	98	0.30	0.09	0.11	0.06	0.03
Rod Pampling	25	33	94	95	4	0.30	0.10	0.03	0.02	0.15
Kirk Triplett	26	36	142	6	37	0.29	0.10	0.00	0.12	0.08
Arron Oberholser	27	59	15	78	46	0.28	0.08	0.10	0.02	0.08
Retief Goosen	28	16	67	99	36	0.28	0.14	0.04	0.01	0.08
Kevin Sutherland	29	15	79	157	15	0.28	0.14	0.03	-0.01	0.12
Matt Kuchar	30	63	23	66	35	0.28	0.07	0.09	0.03	0.08
Bob Heintz	31	18	138	42	27	0.27	0.13	0.00	0.05	0.10
Brandt Snedeker	32	35	21	29	121	0.27	0.10	0.09	0.06	0.01
Bryce Molder	33	24	145	15	54	0.27	0.12	0.00	0.08	0.07
Jonathan Byrd	34	22	35	63	84	0.27	0.12	0.07	0.03	0.04
Webb Simpson	35	105	42	32	18	0.27	0.03	0.07	0.05	0.12
Geoff Ogilvy	36	58	119	40	11	0.26	0.08	0.01	0.05	0.13
Omar Uresti	37	65	92	34	26	0.26	0.07	0.03	0.05	0.10
Glen Day	38	70	39	17	65	0.26	0.06	0.07	0.07	0.06
Tom Pernice Jr.	39	31	37	132	50	0.26	0.11	0.07	0.00	0.07
Tim Petrovic	40	8	57	81	124	0.25	0.16	0.05	0.02	0.01
					Top 40 average	0.35	0.12	0.08	0.05	0.10

Table A-21. Strokes gained for tournament winners, strokes gained for top 40 golfers, and the PGA Tour average number of shots by shot category. Strokes gained for winners are computed for play during the tournament win. Tournament winners gain an average of 3.7 strokes per round versus the field. The top 40 golfers gain an average of 1.1 strokes per round versus an average PGA Tour field. Approach shots contribute 40% of this gain. Putting accounts for 41% of pro shots, but only 15% of the strokes gained of the top 40 golfers. Approach shots account for 26% of shots, but 40% of the strokes gained of the top forty golfers. Putts in the 0 to 6 foot range account for 22% of all shots. Though not shown in the table, putts in the 0 to 2 feet range account for 13%; putts in 3 to 6 feet account for 9%.

	Winners		Top 40		Tour average	
	SG	Fraction	SG	Fraction	Number of shots	Fraction
Drive	0.7	18%	0.3	28%	13.9	20%
Appr	1.3	34%	0.4	40%	18.5	26%
Short	0.5	14%	0.2	17%	9.4	13%
Putt	1.3	34%	0.2	15%	29.2	41%
Total	3.7	100%	1.1	100%	71.0	100%

		Winners		Top 40		Tour average	
		SG	Fraction	SG	Fraction	Number of shots	Fraction
	Drive	0.7	18%	0.32	28%	13.9	20%
Approach	**100–150**	0.3	9%	0.10	9%	5.0	7%
	150–200	0.5	14%	0.18	16%	7.0	10%
	200–250	0.3	7%	0.10	9%	3.6	5%
	Other appr	0.2	4%	0.06	5%	2.9	4%
Short	**0–20**	0.2	7%	0.05	5%	4.0	6%
	20–60	0.1	3%	0.04	4%	2.1	3%
	60–100	0.1	2%	0.04	3%	1.4	2%
	Sand 0–50	0.1	2%	0.05	5%	1.7	2%
	Other short	0.0	0%	0.00	0%	0.2	0%
Putt	**0–6 ft**	0.3	8%	0.06	5%	16.0	22%
	7–21 ft	0.7	19%	0.07	6%	7.9	11%
	22+ ft	0.3	7%	0.05	4%	5.4	8%
	Total	3.7	100%	1.13	100%	71.0	100%

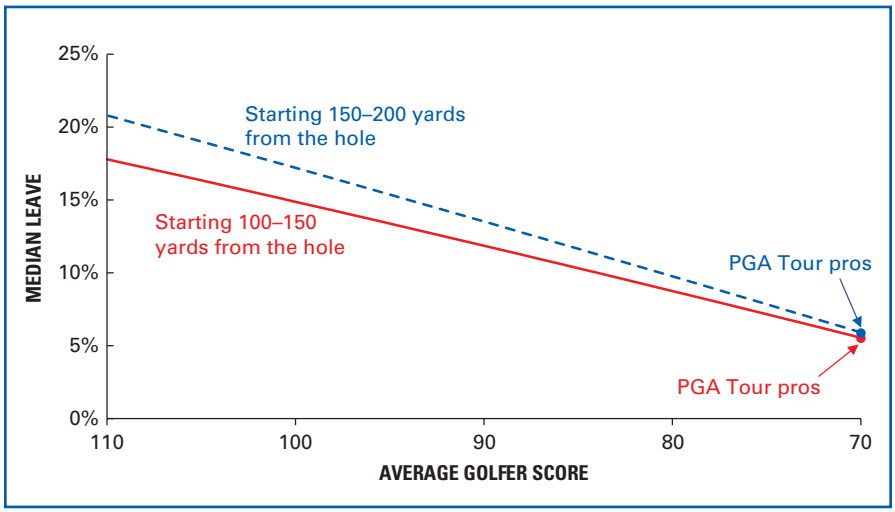


Figure A-2. Median leave (in percent) versus average golfer score. The median leave is the distance from the hole that half of shots fall within. PGA Tour pros hit half of their shots from 100 to 150 yards to within 5.5% of the initial distance to the hole; a typical 90-golfer hits half to within 12%. From 150 to 200 yards, PGA Tour pros hit half of their shots to within 5.9% of the initial distance to the hole; a typical 90-golfer hits half to within 14%. The gap between pros and amateurs increases with longer shots.

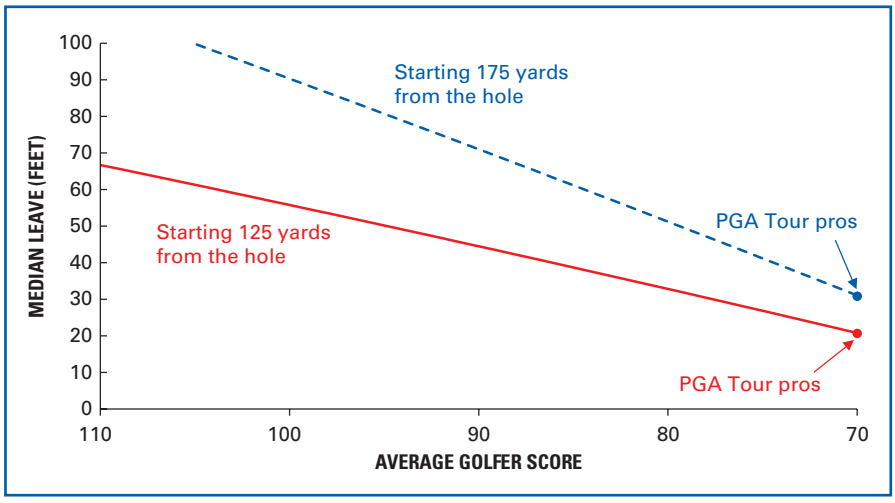


Figure A-3. Median leave (in feet) versus average golfer score. The median leave is the distance from the hole that half of shots fall within. PGA Tour pros hit half of their 125-yard shots to within 21 feet of the hole; a typical 90-golfer hits half within 45 feet. From 175 yards, PGA Tour pros hit half of their shots to within 31 feet of the hole; a typical 90-golfer hits half to within 71 feet. The gap between pros and amateurs increases with longer shots.

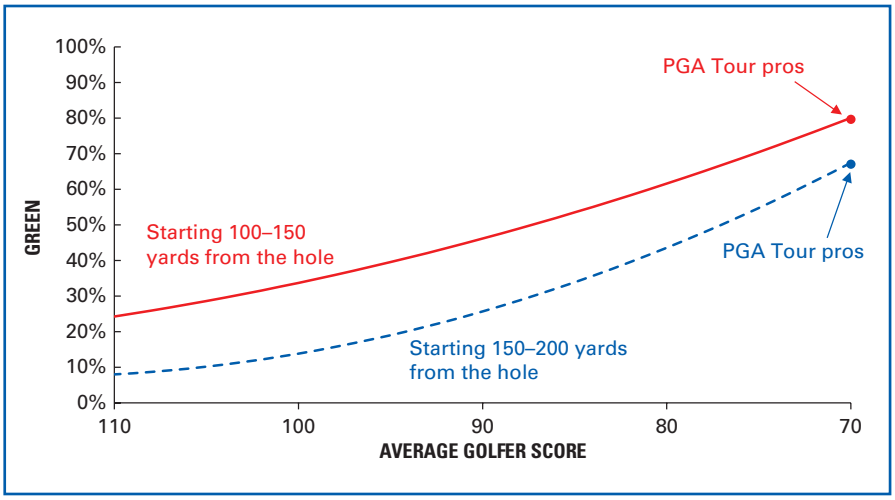


Figure A-4. Green hit fraction versus average golfer score. "Green" refers to the fraction of shots that finish on the green or the fringe of the green. PGA Tour pros hit the green or fringe 80% of the time starting from 100 to 150 yards from the hole; a typical 90-golfer hits the green or fringe 46% of the time. Starting from 150 to 200 yards from the hole, PGA Tour pros hit the green or fringe 67% of the time; a typical 90-golfer hits the green or fringe 26% of the time.

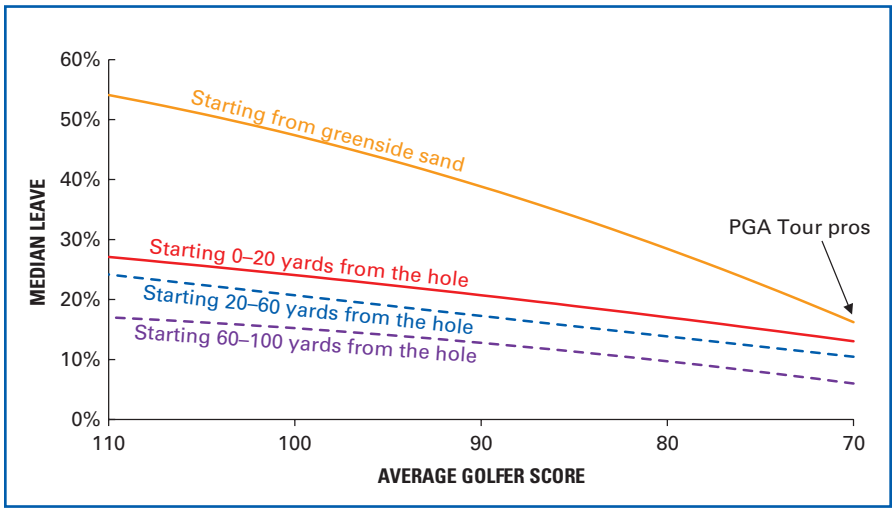


Figure A-5. Median leave (in percent) versus average golfer score. The median leave is the distance from the hole that half of shots fall within.

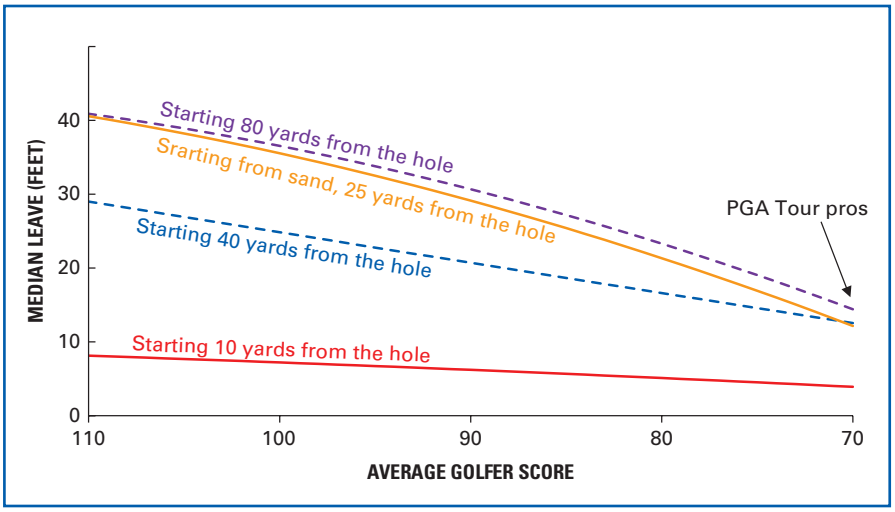


Figure A-6. Median leave (in feet) versus average golfer score. The median leave is the distance from the hole that half of shots fall within.

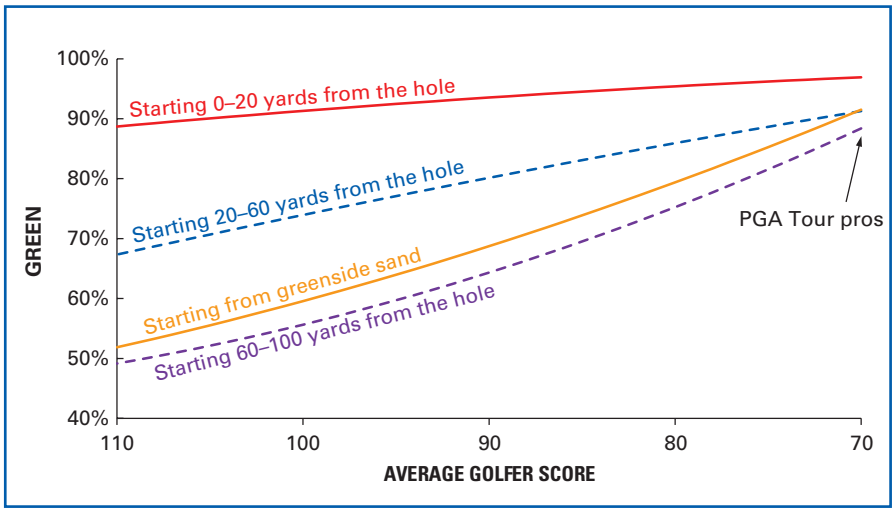


Figure A-7. Green hit fraction versus average golfer score. "Green" refers to the fraction of shots that finish on the green or the fringe of the green.

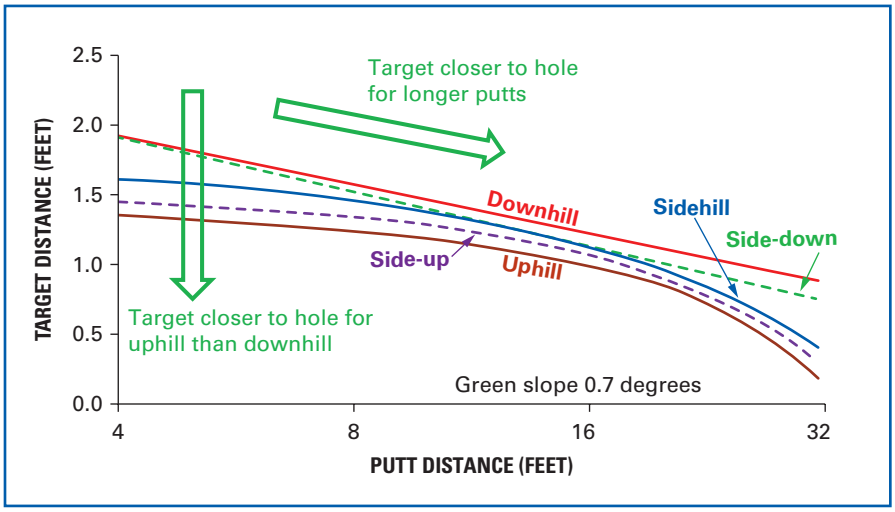


Figure A-8. Target distances for PGA Tour pros as estimated by the middle of scatter patterns of missed putts. Greens have slopes between zero and one degrees at the hole, with an average slope of 0.7 degrees. The target is farther from the hole on downhill putts than on uphill putts. The target is farther from the hole on shorter putts than on longer putts.

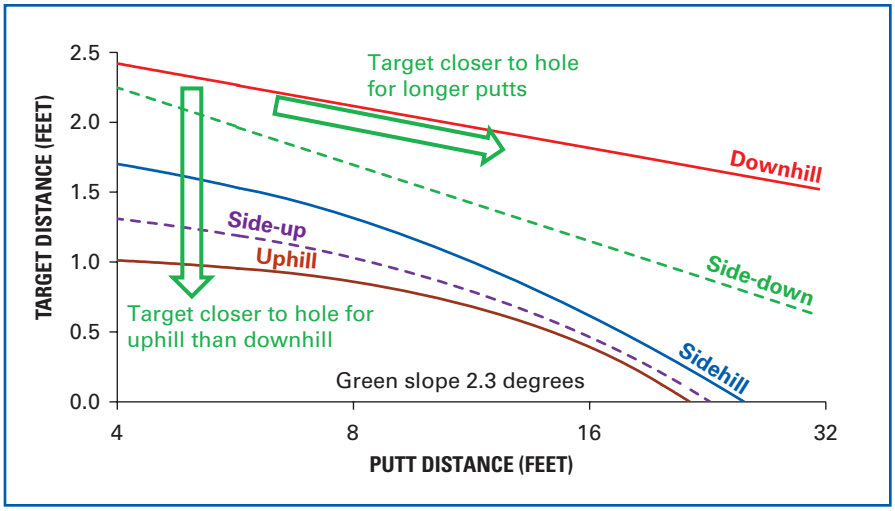


Figure A-9. Target distances for PGA Tour pros on greens with slopes greater than two degrees at the hole and an average slope of 2.3 degrees. The target is farther from the hole on downhill putts than on uphill putts. The target is farther from the hole on shorter putts than on longer putts. For long uphill, side-up, and sidehill putts, the target is slightly short of the hole and pros leave 50% to 60% of these putts short.

Table A-22. Putt importance results. One-putt probabilities by distance are given for the best tour putters, average tour putters, and 90-golfers. The putt importance is proportional to the product of the skill difference and the number of putts per round. For clarity, skill differences are measured using one-putt probabilities. The correct way to measure the skill difference is by using strokes gained, but the two measures give very similar results. For both pros and amateur golfers, short putts are the most important. For pros, the single most important putt distance is five feet; for amateurs, it's four feet.

Putt distance	Golfer group		Best-Tour difference	Putts per round	Putt importance
	Best	Tour			
3	98%	96%	1%	2.8	0.037
4	91%	88%	3%	1.8	0.058
5	82%	77%	5%	1.3	0.064
6	72%	67%	6%	1.0	0.057
7	63%	58%	5%	0.9	0.046
8	55%	50%	5%	0.8	0.038
9	50%	45%	5%	0.7	0.039
10	45%	40%	5%	0.7	0.035
11	39%	35%	4%	0.6	0.025
12	36%	31%	5%	0.6	0.027
13	33%	28%	5%	0.5	0.025
14	29%	25%	4%	0.5	0.019
15	27%	23%	3%	0.5	0.016
16	24%	21%	3%	0.4	0.015

Putt distance	Golfer group		Tour-90 difference	Putts per round	Putt importance
	Tour	90-golfer			
3	96%	87%	10%	2.8	0.27
4	88%	67%	21%	1.8	0.39
5	77%	51%	26%	1.3	0.34
6	67%	41%	26%	1.0	0.27
7	58%	33%	25%	0.9	0.22
8	50%	28%	22%	0.8	0.18
9	45%	24%	20%	0.7	0.15
10	40%	21%	19%	0.7	0.13
11	35%	18%	16%	0.6	0.10
12	31%	16%	15%	0.6	0.09
13	28%	14%	14%	0.5	0.08
14	25%	13%	13%	0.5	0.06
15	23%	11%	12%	0.5	0.06
16	21%	10%	11%	0.4	0.05

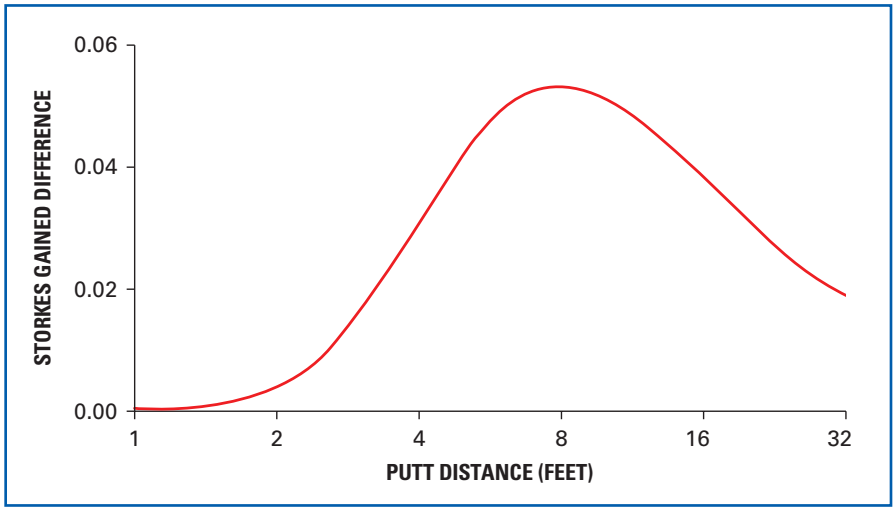


Figure A-10. Difference in strokes gained per putt between the best and average PGA Tour putters by putt distance (shown in log scale for clarity). The largest difference in strokes gained is for five- to 10-foot putts, where the difference is about 0.05. This is consistent with a 5% difference in one-putt probability. For example, the best tour putters sink about 55% from eight feet while the PGA Tour average is about 50%.

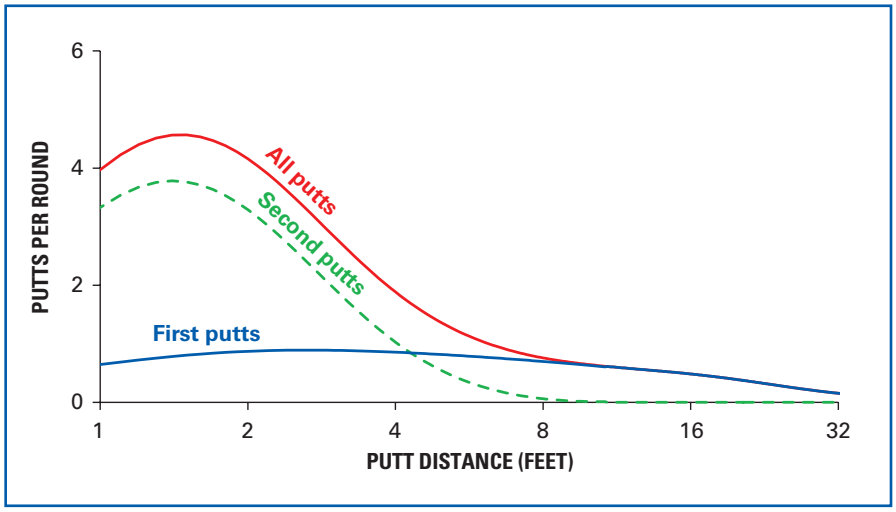


Figure A-11. Number of putts per round for PGA Tour pros by putt distance (shown in log scale for clarity). One-and-a-half-foot putts happen the most often and most of those are second putts. There are almost no second putts longer than 10 feet.

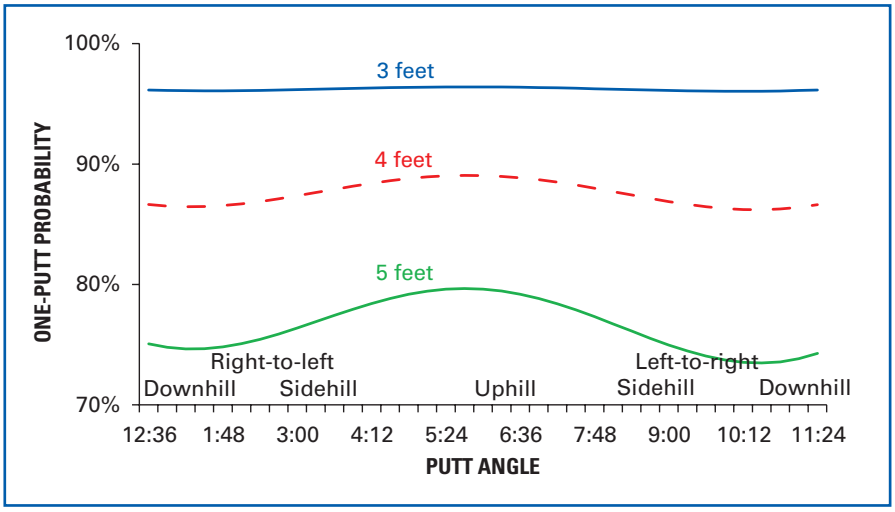


Figure A-12. One-putt probabilities for PGA Tour pros for greens with slopes between one and two degrees at the hole (54% of hole locations are in this range), with an average slope of 1.4 degrees.

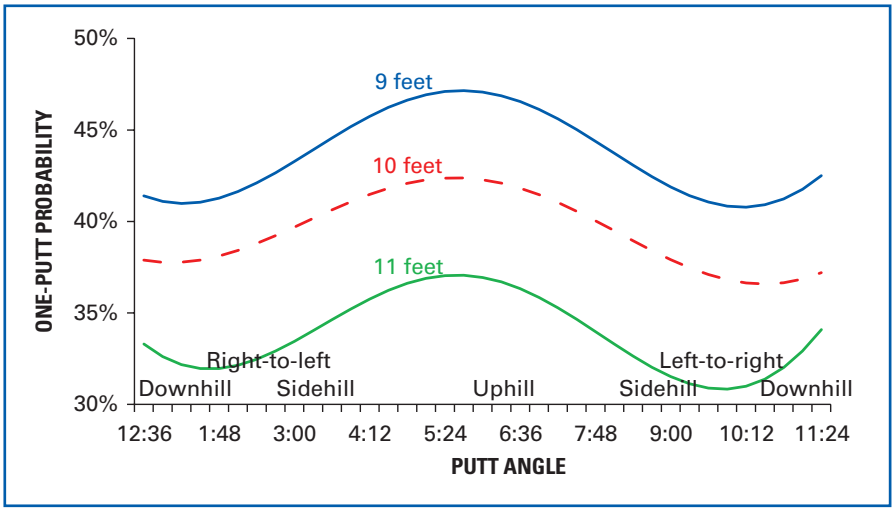


Figure A-13. One-putt probabilities for PGA Tour pros for greens with slopes between one and two degrees at the hole (54% of hole locations are in this range), with an average slope of 1.4 degrees.

Table A-23. Up-and-down fraction and average strokes to hole out by distance for PGA Tour pros.

Distance to hole	Fraction of shots	Up-and-down fraction			Average strokes to hole out		
		Fairway	Rough	Sand	Fairway	Rough	Sand
10	35%	79%	66%	55%	2.17	2.34	2.47
20	27%	63%	47%	50%	2.37	2.57	2.53
30	12%	52%	37%	40%	2.50	2.69	2.65
40	5%	44%	31%	30%	2.59	2.77	2.79
50	3%	39%	26%	18%	2.65	2.86	2.99
60	2%	36%	23%	10%	2.69	2.90	3.17
70	3%	34%	21%	10%	2.71	2.93	3.19
80	3%	32%	19%		2.74	2.96	
90	4%	30%	18%		2.76	2.98	
100	6%	28%	16%		2.79	3.01	
		Fraction of off-green shots inside 100 yards			69%	19%	12%