

Trip length, stride length, or stride frequency? Insights from Total Performance Data

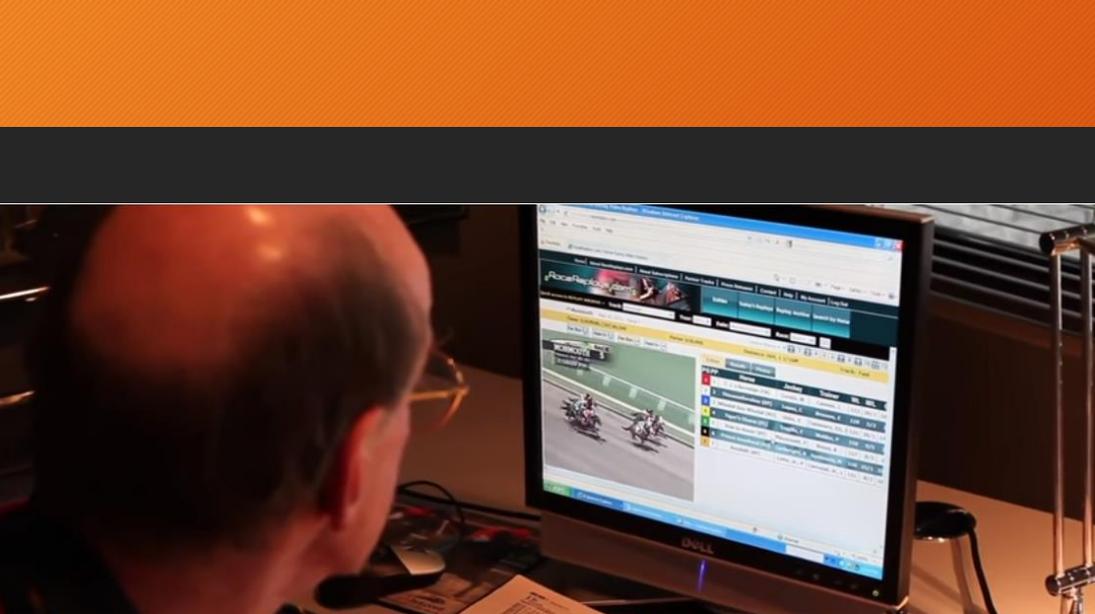
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Why do some horses finish sooner than others?

$$\textit{Finish time} = \frac{\textit{Trip length}}{\textit{Stride length} \times \textit{Stride frequency}}$$

- Which variable matters the most?
- We've never had good data on this before.



The Stride of a Champion: How does American Pharoah compare to Secretariat?

June 12, 2015 Authored by - Byron Rogers

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Stride frequency



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Trip length



CHURCHILL DOWNS - May 2, 2009 - Race 11
STAKES Kentucky Derby Presented by Yum! Brands Grade 1 - For Thoroughbred Three Year Old
 One And One Fourth Miles On The Dirt **Track Record:** (Secretariat - 1:59.40 - May 5, 1973)
Purse: \$2,000,000 Guaranteed
Available Money: \$2,177,200
Value of Race: \$2,177,200 1st \$1,417,200, 2nd \$400,000, 3rd \$200,000, 4th \$100,000, 5th \$60,000
Weather: Cloudy **Track:** Sloppy (Sealed)
Off at: 6:28 **Start:** Good for all

Last Raced	Pgm	Horse Name (Jockey)	Wgt	M/E	PP	1/4	1/2	3/4	1m	Str	Fin	Odds	Comments
29Mar09 ¹² SUN ⁴	8	Mine That Bird (Borel, Calvin)	126	LA f	8	19	19	19	12 ^{1/2}	1	1 ^{6 3/4}	50.60	bold inside run
4Apr09 ⁶ SA ¹	16	Pioneerof the Nile (Gomez, Garrett)	126	LA	15	3 ^{1/2}	4 ^{1/2}	3 ^{1/2}	2 ^{Head}	2 ^{1/2}	2 ^{Nose}	6.30	brushed, led, drft out
4Apr09 ⁷ HAW ¹	2	Musket Man (Coa, Eibar)	126	LA f	2	8 ^{Head}	7 ¹	8 ^{1/2}	7 ¹	4 ¹	3 ^{Head}	19.00	lost footing, bumped
11Apr09 ¹¹ OP ¹	7	Papa Clem (Bejarano, Rafael)	126	L	7	5 ¹	3 ^{Head}	6 ^{1/2}	4 ¹	3 ^{1 1/2}	4 ⁶	12.20	steadying restraint
4Apr09 ⁶ SA ²	11	Chocolate Candy (Smith, Mike)	126	L	11	17 ^{1/2}	15 ^{1/2}	12 ^{Head}	8 ¹	7 ³	5 ^{Head}	10.00	squeezed start
11Apr09 ¹¹ OP ³	17	Summer Bird (Rosier, Chris)	126	LA	16	16 ^{1/2}	16 ^{Head}	16 ²	15 ²	9 ¹	6 ^{1 1/4}	43.60	good 7 wide run
11Apr09 ⁹ KEE ⁵	9	Join in the Dance (DeCarlo, Christopher)	126	LA	9	1 ^{1/2}	1 ^{1 1/2}	1 ¹	1 ^{1/2}	5 ^{Head}	7 ^{1/2}	51.40	brushed, pace, tired
28Mar09 ⁹ NAD ¹	10	Regal Ransom (Garcia, Alan)	126	L	10	2 ^{1 1/2}	2 ¹	2 ^{1/2}	3 ^{1/2}	6 ²	8 ^{3/4}	22.60	off rail, bid,gave way
4Apr09 ⁹ AQU ²	1	West Side Bernie (Elliott, Stewart)	126	LA	1	13 ^{1 1/2}	14 ¹	17 ^{Head}	17 ^{1/2}	13 ^{Head}	9 ²	32.40	inside to stretch
11Apr09 ⁹ KEE ¹	12	General Quarters (Leparoux, Julien)	126	L	12	12 ¹	11 ^{1/2}	13 ²	10 ^{Head}	10 ^{1 1/2}	10 ^{1 1/2}	10.30	steadied twice
28Mar09 ¹⁰ GP ²	15	Dunkirk (Prado, Edgar)	126	LA	14	9 ²	9 ^{Head}	10 ^{1 1/2}	11 ^{Head}	12 ^{1 1/2}	11 ^{1 1/2}	5.20	stumbled, steadied
11Apr09 ⁹ KEE ²	5	Hold Me Back (Desormeaux, Kent)	126	LA	5	14 ^{Head}	13 ¹	5 ^{Head}	5 ^{1 1/2}	8 ^{1 1/2}	12 ^{1/2}	12.70	bumped, squeezed st
18Apr09 ⁹ KEE ¹	4	Advice (Douglas, Rene)	126	LA	4	15 ³	17 ²	15 ¹	13 ²	14 ^{1/2}	13 ^{3/4}	49.00	squeezed, steadied 3/4
28Mar09 ⁹ NAD ²	19	Desert Party (Dominguez, Ramon)	126	L	18	4 ^{Head}	5 ^{Head}	4 ^{Head}	6 ^{Head}	11 ^{Head}	14 ^{1 1/4}	14.80	bumped st, 4 wide
4Apr09 ⁶ SA ³	3	Mr. Hot Stuff (Velazquez, John)	126	L	3	18 ⁶	18 ³	18 ²	16 ^{1/2}	16 ³	15 ^{8 1/2}	28.40	bumped, squeezed st
4Apr09 ⁹ AQU ⁴	14	Atomic Rain (Bravo, Joe)	126	LA b	13	10 ²	10 ²	9 ^{Head}	9 ¹	15 ⁴	16 ^{3 1/2}	55.20	in tight, tired
4Apr09 ⁷ HAW ⁴	18	Nowhere to Hide (Bridgmohan, Shaun)	126	LA b	17	11 ^{Head}	12 ¹	14 ^{1/2}	18 ²	18 ²	17 ^{7 1/2}	45.50	hit gate, bumped
14Mar09 ⁹ FG ¹	6	Friesan Fire (Saez, Gabriel)	126	LA b	6	6 ^{Head}	6 ^{1/2}	7 ¹	14 ^{Head}	17 ^{1 1/2}	18 ^{1 1/4}	3.80*	bumped, squeezed
11Apr09 ¹¹ OP ⁵	20	Flying Private (Albarado, Robby)	126	LA b	19	7 ^{1/2}	8 ^{Head}	11 ^{1/2}	19	19	19	46.60	5 wide,stopped

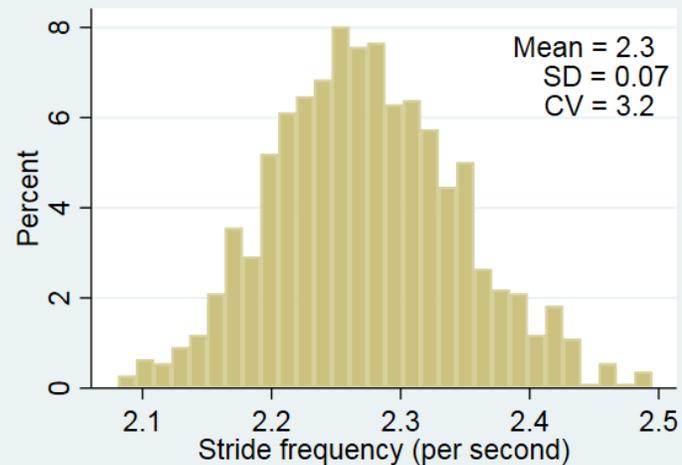
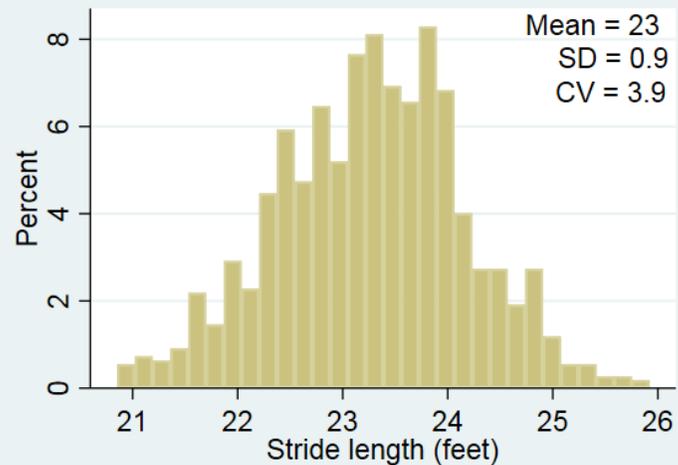
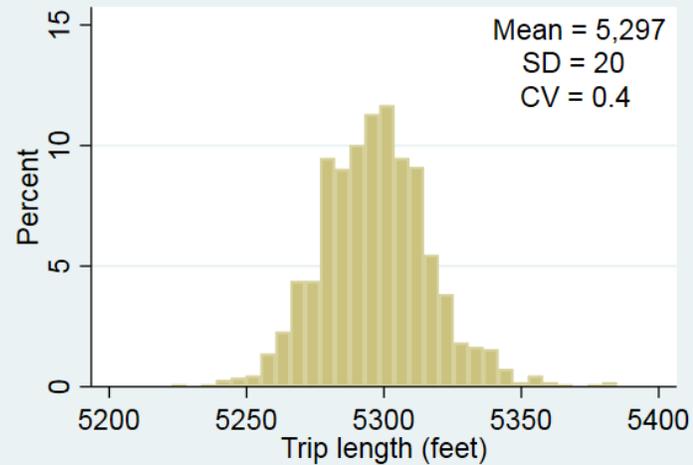
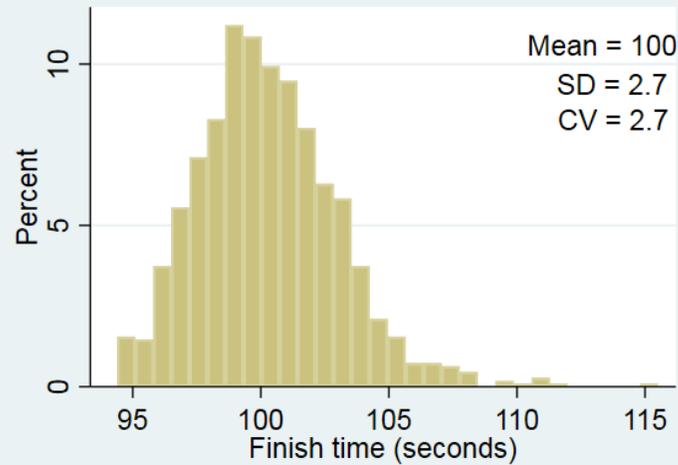
Fractional Times: 22.98 47.23 1:12.09 1:37.49
Split Times: (24:25) (24:86) (25:40) (25:17)
Run-Up: 34 feet
Final Time: 2:02.66

Footnotes
MINE THAT BIRD, bumped and in a bit tight at the break, was unhurried for a half while far back along the inside, settled with three furlongs to go, moved with a rush along the inside on the second turn, came around **ATOMIC RAIN** with a quarter mile to go, quickly angled back to the inside with three sixteenths to go, moved through a small opening inside **JOIN IN THE DANCE** approaching the furlong marker, took over for the final furlong and drew off under steady handling. **PIONEEROF THE NILE** brushed at the start, prompted the pace while three wide and under a rating hold, challenged once on the second turn, battled the leaders into the stretch, gained a short lead with three sixteenths to go, could not cope with the winner just inside the final furlong.

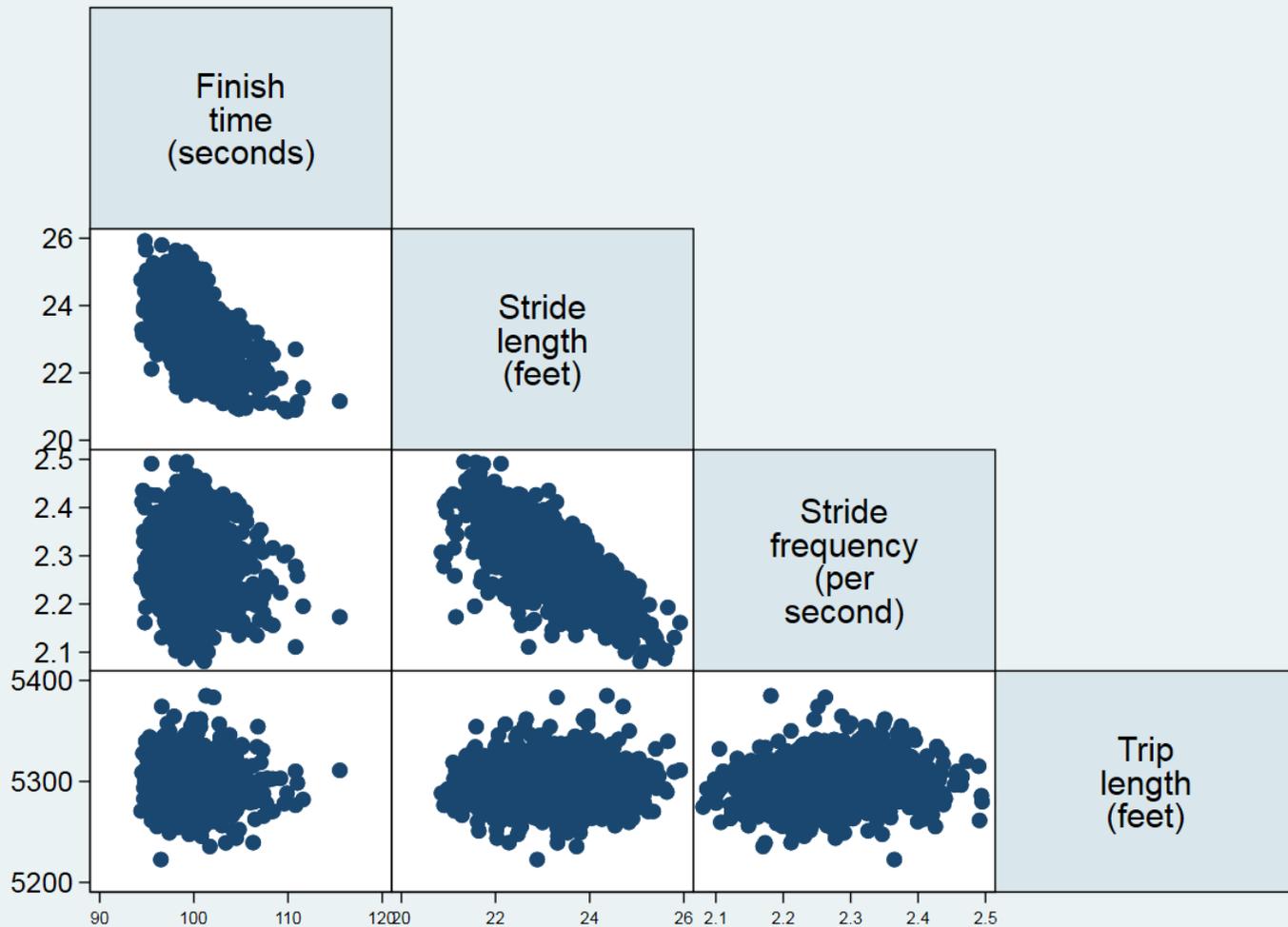
Data

- Over 20,000 starts
- Over 2,000 races
- Run at Laurel, Golden Gate, and Wolverhampton
- Focus today on 123 mile races at Laurel in 2017-18

What varies enough to explain finish times?



Which variables correlate with finish time? (and with each other)



Multiple regression

- Standardized weights
- All variables logged

<u><i>Predictors of finish time</i></u>	<u><i>Beta</i></u>
Stride length	-1.44
Strides per second	-1.18
Trip length	0.14

Future research

- Correlation of trip length with post position (.25)
- Consistency of stride length and stride frequency
 - Within races (pace), between races (consistency)
- Correlation of stride length with soundness

Why log the variables?

$$\textit{Finish time} = \frac{\textit{Trip length}}{\textit{Stride frequency} \times \textit{Stride length}}$$

- Log both sides:

$$\log(\textit{Finish time}) = \log(\textit{Trip length}) - \log(\textit{Stride frequency}) - \log(\textit{Stride length})$$

Application: Mid-race betting

