

Horse Odds

There are three races that make up the Triple Crown event in American horse racing.

- The Kentucky Derby – was held in Louisville, Kentucky on May 5th. *Justify* is the horse that won that race.
- The Preakness – was held on May 19th at Pimlico raceway in Baltimore, Maryland. *Justify* won that race as well.
- The Belmont Stakes will take place on June 9th in Elmont, New York.

Now I don't know much about horse racing or how to bet on horses or figure their odds of winning but I was just wondering what the odds would be for a horse to win the Triple Crown if his/her chances were totally random. Evidently horses need speed to win any race and for the Belmont Stakes, the longest of the three races, they also need stamina.

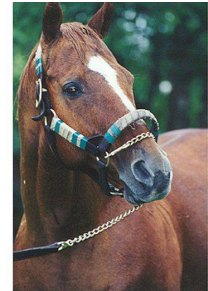
I imagine that there is nothing random about these races but I still thought that I would consider the odds of winning the Triple Crown randomly. Suppose I put all of the horses' names in a hat and just drew the winning horse ... not nearly as exciting as a real race. I think that would make the odds more even. After all, unexpected horses sometimes win. Let's try it.

There were 19 horses in the **Kentucky Derby**. It was on May 5th this year and was 1-¼ miles long or 10 furlongs*. This is how the horses actually finished.

| Finish | Horse | Jockey |
|--------|--------------------|---------------------|
| 1 | Justify | Mike Smith |
| 2 | Good Magic | Jose Ortiz |
| 3 | Audible | Javier Castellano |
| 4 | Instilled Regard | Drayden Van Dyke |
| 5 | My Boy Jack | Kent Desormeaux |
| 6 | Bravazo | Luis Contreras |
| 7 | Hofburg | Irada Ortiz, Jr. |
| 8 | Lone Sailor | James Graham |
| 9 | Vino Rosso | John Velazquez |
| 10 | Solomini | Flavien Prat |
| 11 | Firenze Fire | Paco Lopez |
| 12 | Bolt d'Orro | Victor Espinoza |
| 13 | Flameaway | Jose Lezcano |
| 14 | Enticed | Junior Alvarado |
| 15 | Promises Fulfilled | Corey Lanerie |
| 16 | Free Drop Billy | Robby Albarado |
| 17 | Noble Indy | Florent Geroux |
| 18 | Combatant | Ricardo Santana Jr. |
| 19 | Magnum Moon | Luis Saez |



Justify



Affirmed



Seattle Slew



Secretariat

*What's a furlong? 1/8th of a mile, 220 yards, 5 furlongs are about kilometer

1. If I had just pulled one of those horses' names out of a hat, what would have been the probability of my choosing *Justify*?

The second race was the **Preakness** held on May 19th. This second race is a slightly shorter race than the Kentucky Derby. The Preakness is 9.5 furlongs and these were the actual horses that ran and how they finished.

| Finish | Horse | Jockey |
|--------|-----------------|-------------------|
| 1 | Justify | Mike Smith |
| 2 | Bravazo | Luis Saez |
| 3 | Tenfold | Ricardo Santana |
| 4 | Good Magic | Jose Ortiz |
| 5 | Lone Sailor | Irada Ortiz |
| 6 | Sporting Chance | Luis Contreras |
| 7 | Diamond King | Javier Castellano |
| 8 | Quip | Florent Geroux |

2. If I had drawn these eight names from a hat, what would have been the probability that *Justify* would be the winner of my hat draw?

Now here's the tricky part. What would the probability be that I drew *Justify* from the hat both times? Let's figure it out.

- Count the number of ways horse's names could have appeared in both races.

| Kentucky Derby winner | Preakness winner | Kentucky Derby winner | Preakness winner | Kentucky Derby winner | Preakness winner | Kentucky Derby winner | Preakness winner |
|-----------------------|------------------|-----------------------|------------------|-----------------------|------------------|-----------------------|------------------|
| Justify | Justify | Good Magic | Justify | Audible | Justify | Instilled Regard | Justify |
| Justify | Bravazo | Good Magic | Bravazo | Audible | Bravazo | Instilled Regard | Bravazo |
| Justify | Tenfold | Good Magic | Tenfold | Audible | Tenfold | Instilled Regard | Tenfold |
| Justify | Good Magic | Good Magic | Good Magic | Audible | Good Magic | Instilled Regard | Good Magic |
| Justify | Lone Sailor | Good Magic | Lone Sailor | Audible | Lone Sailor | Instilled Regard | Lone Sailor |
| Justify | Sporting Chance | Good Magic | Sporting Chance | Audible | Sporting Chance | Instilled Regard | Sporting Chance |
| Justify | Diamond King | Good Magic | Diamond King | Audible | Diamond King | Instilled Regard | Diamond King |
| Justify | Quip | Good Magic | Quip | Audible | Quip | Instilled Regard | Quip |

| Kentucky Derby winner | Preakness winner | Kentucky Derby winner | Preakness winner | Kentucky Derby winner | Preakness winner | Kentucky Derby winner | Preakness winner |
|-----------------------|------------------|-----------------------|------------------|-----------------------|------------------|-----------------------|------------------|
| My Boy Jack | Justify | Bravazo | Justify | Hofburg | Justify | Lone Sailor | Justify |
| My Boy Jack | Bravazo | Bravazo | Bravazo | Hofburg | Bravazo | Lone Sailor | Bravazo |
| My Boy Jack | Tenfold | Bravazo | Tenfold | Hofburg | Tenfold | Lone Sailor | Tenfold |
| My Boy Jack | Good Magic | Bravazo | Good Magic | Hofburg | Good Magic | Lone Sailor | Good Magic |
| My Boy Jack | Lone Sailor | Bravazo | Lone Sailor | Hofburg | Lone Sailor | Lone Sailor | Lone Sailor |
| My Boy Jack | Sporting Chance | Bravazo | Sporting Chance | Hofburg | Sporting Chance | Lone Sailor | Sporting Chance |
| My Boy Jack | Diamond King | Bravazo | Diamond King | Hofburg | Diamond King | Lone Sailor | Diamond King |
| My Boy Jack | Quip | Bravazo | Quip | Hofburg | Quip | Lone Sailor | Quip |

| Kentucky Derby winner | Preakness winner | Kentucky Derby winner | Preakness winner | Kentucky Derby winner | Preakness winner | Kentucky Derby winner | Preakness winner |
|-----------------------|------------------|-----------------------|------------------|-----------------------|------------------|-----------------------|------------------|
| Vino Rosso | Justify | Solomini | Justify | Firenze Fire | Justify | Bolt d'Orro | Justify |
| Vino Rosso | Bravazo | Solomini | Bravazo | Firenze Fire | Bravazo | Bolt d'Orro | Bravazo |
| Vino Rosso | Tenfold | Solomini | Tenfold | Firenze Fire | Tenfold | Bolt d'Orro | Tenfold |
| Vino Rosso | Good Magic | Solomini | Good Magic | Firenze Fire | Good Magic | Bolt d'Orro | Good Magic |
| Vino Rosso | Lone Sailor | Solomini | Lone Sailor | Firenze Fire | Lone Sailor | Bolt d'Orro | Lone Sailor |
| Vino Rosso | Sporting Chance | Solomini | Sporting Chance | Firenze Fire | Sporting Chance | Bolt d'Orro | Sporting Chance |
| Vino Rosso | Diamond King | Solomini | Diamond King | Firenze Fire | Diamond King | Bolt d'Orro | Diamond King |
| Vino Rosso | Quip | Solomini | Quip | Firenze Fire | Quip | Bolt d'Orro | Quip |

| Kentucky Derby winner | Preakness winner | Kentucky Derby winner | Preakness winner | Kentucky Derby winner | Preakness winner | Kentucky Derby winner | Preakness winner |
|-----------------------|------------------|-----------------------|------------------|-----------------------|------------------|-----------------------|------------------|
| Flameaway | Justify | Enticed | Justify | Promises Fulfilled | Justify | Free Drop Billy | Justify |
| Flameaway | Bravazo | Enticed | Bravazo | Promises Fulfilled | Bravazo | Free Drop Billy | Bravazo |
| Flameaway | Tenfold | Enticed | Tenfold | Promises Fulfilled | Tenfold | Free Drop Billy | Tenfold |
| Flameaway | Good Magic | Enticed | Good Magic | Promises Fulfilled | Good Magic | Free Drop Billy | Good Magic |
| Flameaway | Lone Sailor | Enticed | Lone Sailor | Promises Fulfilled | Lone Sailor | Free Drop Billy | Lone Sailor |
| Flameaway | Sporting Chance | Enticed | Sporting Chance | Promises Fulfilled | Sporting Chance | Free Drop Billy | Sporting Chance |
| Flameaway | Diamond King | Enticed | Diamond King | Promises Fulfilled | Diamond King | Free Drop Billy | Diamond King |
| Flameaway | Quip | Enticed | Quip | Promises Fulfilled | Quip | Free Drop Billy | Quip |

| Kentucky Derby winner | Preakness winner | Kentucky Derby winner | Preakness winner | Kentucky Derby winner | Preakness winner |
|-----------------------|------------------|-----------------------|------------------|-----------------------|------------------|
| Noble Indy | Justify | Combatant | Justify | Magnum Moon | Justify |
| Noble Indy | Bravazo | Combatant | Bravazo | Magnum Moon | Bravazo |
| Noble Indy | Tenfold | Combatant | Tenfold | Magnum Moon | Tenfold |
| Noble Indy | Good Magic | Combatant | Good Magic | Magnum Moon | Good Magic |
| Noble Indy | Lone Sailor | Combatant | Lone Sailor | Magnum Moon | Lone Sailor |
| Noble Indy | Sporting Chance | Combatant | Sporting Chance | Magnum Moon | Sporting Chance |
| Noble Indy | Diamond King | Combatant | Diamond King | Magnum Moon | Diamond King |
| Noble Indy | Quip | Combatant | Quip | Magnum Moon | Quip |

Aren't you glad that I made these charts instead of you having to make them?

3. How many ways could horses finish in first place in these two races?
4. So, what is the probability that *Justify* could have been drawn to win both races.

5. How could you have found that probability without making this huge chart? Please explain.

Only 12 horses have ever won all three races in the Triple Crown. In 1919, *Sir Barton* was the first horse to win the trophy. In 2015, *American Pharoah* was the last horse to win the Triple Crown.

| Year | Name |
|------|------------------|
| 1919 | Sir Barton |
| 1930 | Gallant Fox |
| 1935 | Omaha |
| 1937 | War Admiral |
| 1941 | Whirlaway |
| 1943 | Count Fleet |
| 1946 | Assault |
| 1948 | Citation |
| 1973 | Secretariat |
| 1977 | Seattle Slew |
| 1978 | Affirmed |
| 2015 | American Pharoah |



Triple Crown Trophy

Since 1978 only 23 horses have won the first two of the three races. If *Justify* doesn't win the Belmont then there will be 24 two-race winners. Will *Justify* become the next Triple Crown winner? Let's look at the probability.

The **Belmont Stakes** will be the last race in the Triple Crown to be run. The race is on Saturday, June 9th, 2018 and it is 12 furlongs long. There will be **10** horses running. It is predicted that these are the most probable horses to run in the Preakness. We'll know exactly which 10 horses will run closer to June 9th.

| |
|-----------------|
| Bandua |
| Blended Citizen |
| Bravazo |
| Free Drop Billy |
| Gronkowski |
| Hofburg |
| Justify |
| Noble Indy |
| Restoring Hope |
| Tenfold |
| Vino Rosso |

- Again, let's just consider the random drawing of a horse winner. What is the probability that *Justify* will win the Belmont Stakes?
- Without making a chart can you figure out (in this random, hat-drawing way) what the probability is for *Justify* to win all three races?
- What factors do you think make real horse racing probability different from the random way that we've figured these odds? Explain your reasoning.

On Saturday, June 9th, it will be interesting to see what happens at the Belmont. Stay tuned!

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Sources: <http://horseracing.about.com/od/kentuckyderby//aa052101a.htm>
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<https://www.courier-journal.com/story/sports/horses/horse-racing/2018/05/20/possible-horses-justify-running-belmont/627211002/>