

PowerBall and PowerPlay Probability Calculations

For New Game Matrix (5/5/59 and 1/1/39)

Refer to the Multi-State Lottery Association, webpage

http://www.powerball.com/powerball/pb_howtoplay.asp

How to Play Powerball and PowerPlay










Powerball is a lotto game which is a combined large jackpot game and a cash game. Every Wednesday and Saturday night at 10:59 p.m. Eastern Time, we draw five white balls out of a drum with 59 balls and one red ball (Powerball) out of a drum with 39 red balls.

Players win by matching one of the [9 Ways to Win](#). The jackpot (won by matching all five white balls in any order and the red PowerBall) is either an annuitized prize paid out over 29 years (30 payments) or a lump sum payment. Each ticket costs \$1. If the winner chooses the annuity, the annual payment will be increased each year by the percentage set out in the Powerball game rules.

The second prize (won by matching five white balls in any order) is \$200,000 paid in cash and any time you match the red PowerBall, you win. The overall odds of winning a prize in the game are 1 in 35.11.

Power Play is a special feature that allows a winner to multiply the original prize amount. Powerball players can multiply their Powerball prizes by 2,3,4 or 5 times (does not include the jackpot). The second prize of \$200,000 for matching five white balls is always multiplied by the multiplier 5 for a total prize of \$1,000,000 which is paid in cash. For all other prize levels, we pick the Power Play multiplier number, at random before each draw. A player must choose the Power Play option when they buy their Powerball ticket, and to win one of the lower tier prizes before the multiplier takes effect.

Powerball Prizes and Odds

Match	Prize	Odds
	Grand Prize	1 in 195,249,054.00
	\$200,000	1 in 5,138,133.00
	\$10,000	1 in 723,144.64
	\$100	1 in 19,030.12
	\$100	1 in 13,644.24
	\$7	1 in 359.06
	\$7	1 in 787.17
	\$4	1 in 123.48
	\$3	1 in 61.74

The overall odds of winning a prize are 1 in 35.11.
The odds presented here are based on a \$1 play (rounded to two decimal places).

Probability Calculations

PowerBall Game Probability

The two sets of numbers, the 5 of 59 white and one of 39 red balls, are selected at random. The total number of ways that sets of numbers can be selected is:

$$\text{Total Number of Ways} = \text{COMBIN}(59,5) * \text{COMBIN}(39,1) = 195,249,054$$

Using the Microsoft EXCEL notation, the function COMBIN(n,k) is the number of combinations of n items taken k at a time. This formula is sometimes called: Combination formula or the Binomial formula. The COMBIN function is defined as:

$$\text{COMBIN}(n,k) = n! / (k! * (n-k)!)$$

Here the notation **m!** is called m factorial and is equal to $m*(m-1)*(m-2)*(m-3)*...*2*1$ and by definition $0!=1$.

Probability is defined as the number of ways a match can be made divided by the Total Number of Ways. For example, there is only 1 way to match 5 white balls and the Powerball. Therefore, the probability to match 5 white balls and the Powerball is 1 in 195,249,054.

The general formula of ways to match **w** white hits and **p** Powerball hits is:

$$\text{Ways}\{w \text{ and } p\} = [\text{COMBIN}(5, w) * \text{COMBIN}(59-5, 5-w)] * [\text{COMBIN}(1, p) * \text{COMBIN}(39-1, 1-p)], \text{ or}$$

$$\text{Ways}\{w \text{ and } p\} = [\text{COMBIN}(5, w) * \text{COMBIN}(54, 5-w)] * [\text{COMBIN}(1, p) * \text{COMBIN}(38, 1-p)].$$

The variable **w** has six values (5,4,3,2,1,0) and the variable **p** has two values (1,0). All possible combinations of these values define the total number of possible tiers, $6*2=12$. Nine ways are winning tiers and 3 are not.







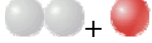
The Reciprocal Probability or 1/Probability for each tier is:




$$1/\text{Probability}\{w \text{ and } p\} = \text{Total Ways} / \text{Ways}\{w \text{ and } p\}$$

The following table describes the formulas and count of all the ways to win and lose and their corresponding reciprocal probability

PowerBall Winning Tiers Probabilities			
Tier	Formula	Ways	1/Probability
1	$(\text{COMBIN}(5,5) * \text{COMBIN}(54,0) * (\text{COMBIN}(1,1) * \text{COMBIN}(38,0)))$	1	195,249,054.00
2	$(\text{COMBIN}(5,5) * \text{COMBIN}(54,0) * (\text{COMBIN}(1,0) * \text{COMBIN}(38,1)))$	38	5,138,133.00
3	$(\text{COMBIN}(5,4) * \text{COMBIN}(54,1) * (\text{COMBIN}(1,1) * \text{COMBIN}(38,0)))$	270	723,144.64
4	$(\text{COMBIN}(5,4) * \text{COMBIN}(54,1) * (\text{COMBIN}(1,0) * \text{COMBIN}(38,1)))$	10,260	19,030.12
5	$(\text{COMBIN}(5,3) * \text{COMBIN}(54,2) * (\text{COMBIN}(1,1) * \text{COMBIN}(38,0)))$	14,310	13,644.24
6	$(\text{COMBIN}(5,3) * \text{COMBIN}(54,2) * (\text{COMBIN}(1,0) * \text{COMBIN}(38,1)))$	543,780	359.06
7	$(\text{COMBIN}(5,2) * \text{COMBIN}(54,3) * (\text{COMBIN}(1,1) * \text{COMBIN}(38,0)))$	248,040	787.17
8	$(\text{COMBIN}(5,1) * \text{COMBIN}(54,4) * (\text{COMBIN}(1,1) * \text{COMBIN}(38,0)))$	1,581,255	123.48
9	$(\text{COMBIN}(5,0) * \text{COMBIN}(54,5) * (\text{COMBIN}(1,1) * \text{COMBIN}(38,0)))$	3,162,510	61.74
Total Ways and Overall Ways to Win:		5,560,464	35.11

Power Play Prizes and Odds

Match	Prize	Multiplier of 2 (Odds 1:4)	Multiplier of 3 (Odds 1:4)	Multiplier of 4 (Odds 1:4)	Multiplier of 5 (Odds 1:4)
	Jackpot	--	--	--	--
	\$200,000*	-	-	-	\$1,000,000*
	\$10,000	\$20,000	\$30,000	\$40,000	\$50,000
	\$100	\$200	\$300	\$400	\$500
	\$100	\$200	\$300	\$400	\$500
	\$7	\$14	\$21	\$28	\$35
	\$7	\$14	\$21	\$28	\$35

 + 	\$4	\$8	\$12	\$16	\$20
	\$3	\$6	\$9	\$12	\$15

***The second tier prize for matching 5 white balls is always multiplied by 5 with a Powerball wager.**