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Monte Carlo Simulation: When Should a Contestant Stop Spinning?

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By

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WHEN SHOULD A CONTESTANT STOP SPINNING?

Abstract

Every episode of the popular game show *The Price Is Right* contains two rounds called The Showcase Showdown or The Big Wheel. During these rounds, three contestants spin a large wheel that consists of monetary values from five cents through one dollar in 5 cent increments. The object of this game is to get closest to one dollar without going over in one or a combination of two spins. The two winners of these rounds get to compete for the most valuable prizes at the end of each show. Monte Carlo simulation will be used to find the range of values in which the first spinner has the highest probability to beat the next two spinners as well as what range of values the second spinner would need in order to beat the final spinner. In the event of a tie the contestants have a one-round spin-off, where the highest spin wins. Another goal is to discover which values either the second or third contestants should utilize a second spin in order to break a tie and avoid a spin-off. These results from the Monte Carlo simulation and actual results from the show will be compared. The simulated results will also be compared to those found using probabilistic or game theory methods.

Hypothesis

One might believe that a contestant should stop spinning and not utilize their second spin when beginning with 50 cents. They might believe the risk of spinning and acquiring a total over one dollar is greater than the potential benefit from increasing their score and getting closer to one dollar. People thinking like this might say if a contestant spins at least 50 cents on their first spin, then they should stop spinning. Others may believe that a contestant should stop if they achieve a higher total than 50 cents believing that the other spinner or spinners will have at least two spins a piece to achieve a greater score and their probability of getting a total greater than 50 cents is fairly high. People with this thought process would say if a contestant spins 50 cents on their first spin, then they should spin again. But, what nickel value is the point in which a contestant truly should stop spinning in order to achieve the highest probability of winning? What range of nickel values should the contestant utilize their second spin? My hypothesis is a contestant should stop spinning if he or she has 70 cents or higher. This is consistent with the article "To Spin or Not to Spin? Natural and Laboratory Experiments from The Price Is Right," which states "Contestant 1 spins again if she gets 65 or fewer points on her first spin. Contestant 2 spins again if she gets 50 or fewer points on her first spin, if she gets 65 or fewer points on her first spin and her score equals Contestant 1's score, or if failing to utilize her second spin guarantees losing. Contestant 3 spins again if she gets 50 or fewer points on her first spin and ties one other contestant, if she gets 65 or fewer points on her first spin and ties the two contestants, or if failing to utilize the second pin guarantees losing". [1] These authors conducted a laboratory experiment in which they reproduced the basic conditions of "The Big Wheel" but because this experiment lacked the

excitement factor of the game show, they wished to explore the extent to which the excitement factor mattered. They conducted two experiments, one in which there were no bonus payments for spinning 100 cents and another where there were bonus payments. The Contestant 3 equilibrium without bonus payments was determined as Contestant 3 takes her first spin and either takes the lead, is behind the leader(s) or is tied with the other leader(s). Contestant 3 must spin again when behind the leader, will forgo her second spin when she takes the lead and the decision made when tied depends upon the number of players in which she is tied and the tying score as well. In a two-way tie, Contestant 3 will spin again if the score is less than or equal to 50 cents because this gives her a better than 50% chance of winning. In the event of a three-way tie, Contestant 3 will spin again only if the tying score is less than or equal to 65 cents by using the same logic for the winning probability in the spinoff. As for the strategy of Contestant 2, after using her first spin she is either ahead/tied with Contestant 1or behind. If she is behind, Contestant 2 must spin again. On the other hand, if Contestant 2 is tied, she will not spin again if the score is greater than 65 cents because the score is high enough to potentially beat Contestant 3, but it is too much of a risk of totaling higher than 100 cents and eliminating herself. Now, when Contestant 2 spins a total higher than Contestant 1, she does not necessarily relinquish her second spin since she wants to give herself the best chance of beating Contestant 3 while keeping her probability of self-elimination low. [1] The authors found, by using numerical computations that Contestant 2 maximizes her probability of winning if she does not use her second spin when totaling greater than 55 cents and scoring higher than Contestant 1. These calculations were done using the percentage of the total permutations Contestant 2 wins under those circumstances against the ones in which she loses. The authors found that Contestant 1has an optimal strategy of spinning again when totaling 65 cents or fewer and relinquishing her second spin when

scoring 70 cents or greater. The authors conducted the same experiment, but offered monetary bonuses that were much lower in scale to the ones contestants would receive while playing The Price Is Right. They were scaled down by a factor of 5000 to 1 and the subjects of this experiment earned $19.42 on average with a maximum of $29.50 and a minimum of $4.00. Their results were identical to those found when no bonus payments were offered with one exception. The exception was Contestant 2 spins again if she gets 55 or fewer points (as opposed to 50) on her first spin, if she gets 65 or fewer points on her first spin and her score equals Contestant 1's score, or if failing to utilize her second spin guarantees losing. The winning percentages for the contestants without bonus payments were: Contestant 1 wins 30.82% of the time, Contestant 2 wins 32.96% of the time and Contestant 3 wins 36.22% of the time. The winning percentages for the contestants with bonus payments were: Contestant 1 wins 30.86% of the time, Contestant 2 wins 32.95% of the time and Contestant 3 wins 36.19% of the time. The authors discuss how Contestant 2 faces a tradeoff between risking self-elimination for a chance at a bonus payment and how Contestant 1 benefits slightly because of it. However, the percentage only increases by four hundredths of a percent for Contestant 1.

Another article titled "The Showcase Showdown" has data located under a table labeled as "Table 3: The Probability of the First Player Winning in a Three-Player Game" and the results are the following:

t	First spin(s)	Prob. Of winning if player 1 stops	Prob. Of winning if player 1 spins again
1	5	0.00034	0.20595
2	10	0.00121	0.20589
3	15	0.00285	0.20574
4	20	0.0054	0.20547
5	25	0.00906	0.20502
6	30	0.01415	0.20431
7	35	0.02101	0.20326
8	40	0.03009	0.20176
9	45	0.0419	0.19966
10	50	0.05704	0.19681
11	55	0.08346	0.19264
12	60	0.11829	0.18672
13	65	0.16319	0.17856
14	70	0.21563	0.16778
15	75	0.28416	0.15357
16	80	0.36818	0.13517
17	85	0.4699	0.11167
18	90	0.59169	0.08209
19	95	0.73606	0.04528
20	100	0.90567	0

[2]. The authors of “Optimal Stopping in “The Showcase Showdown”” obtained the previous results using conditional probability. They used summations to figure out all of the ways in which the players could win as well as lose in order to obtain their results. The authors assumed the contestants would make the best decision in every scenario. Their results are as follows: The optimal strategy for player 1 is to spin again when the first spin is less than or equal to 65 cents. They also noted that player 1 has a winning probability of less than .5 when spinning fewer than 90 cents, but player 1 is still better off stopping whenever they total greater than 65 cents. As for player 2, the authors discovered the optimal strategy is to spin again when trailing player 1 or to spin again on ties of 65 cents or fewer. If player 2 has taken the lead over contestant 1 at 50 cents or fewer, it is best for player 2 to spin again. As for player 3, the optimal strategy is certainly to

stop after one spin when taking the lead. Player 3 should also stop after one spin in a two-way tie at a total that is greater than 50 cents. Player 3 should stop in a three-way tie at a total that is greater than 65 cents. This is true because the probability of winning the spinoff is greater than the probability of spinning an amount that increases the total score and does not cause player 3 to go over 100 cents and be disqualified. As one can see from the above table, if contestant 1 spins again after spinning 60 cents on the first spin, there is a higher probability of winning. One can also see the same idea holds true if contestant 1 had spun 65 cents on the first spin. However, if the contestant spins 70 cents on the first spin, then the probability of winning drops when a second spin is used. This also seems to be fairly consistent with the implications in which the current host, Drew Carey makes by his actions when a contestant does spin 70 cents and there is no one in the lead with a higher total. Drew does not tell the contestants what to do, but often comments after the contestant has made a decision saying things such as “That’s what I would have done” or “Most contestants do not spin again with that score”. The goal is to find the answers to these questions by using Monte Carlo Simulation.

Procedure

For an easy to follow and complete walkthrough of each column and the formula used, please refer to Appendix A. The initial idea in order to begin this experiment was to create twenty different tabs in Microsoft Excel. One tab for each of the different nickel increments in which contestant one could achieve after using the first spin. This means there was a tab where contestant one always spun 5 cents for their first spin, another tab where their first spin was always 10 cents, the next tab always had contestant one’s first spin as 15 cents and so on until the twentieth tab had contestant one spinning one dollar (100 cents) on their first spin. This made up

the second column of the excel spreadsheet (column B) titled “Contestant #1 (spin 1)” because the first column (A) was used to represent the trial numbers. I decided to do 10,000 trials for each of the starting values. After this, the next column (C) titled “Spin #2” used the formula =RandBetween(1,20)*5 which gave the output of the twenty possible nickel values in which a contestant could spin on any given spin. The next column (D) titled “Total” used the formula =SUM(B2:C2) to add the first two columns together and find the sum of the contestant’s two spins. For the next row, the formula is =SUM(B3:C3) and the numbers just represent the rows for the data. For example, the last row for trial number 10,000 was =SUM(B10001:C10001) since rows 2 through 10,001 give 10,000 total trials. The formulas given for the rest of this paper will reflect the first row and the first trial. So, the next column (E) titled “Over?” was used to determine contestant one’s actual spin total because if they spun a total greater than 100 cents, they went over and were disqualified from winning The Showcase Showdown. The formula used for this column was =IF(D2>100,"over",D2). This gives important information and tells me to create another column (F) titled “Actual #1 total” and used the formula =IF(E2="over",0,E2). This column (F) gives contestant one’s actual score. If they went over, they essentially had spun 0 cents and if they did not go over 100 cents, they have their total from column E. All of these columns combine to calculate the total in which contestant one had at the end of his or her two spins. The following displays the output of the first five trials under the tab in which contestant #1 began with 50 cents:

Trial Number	Contestant #1 (Spin 1)	Spin #2	Total	Over?	Actual #1 Total
1	50	80	130	over	0
2	50	90	140	over	0
3	50	20	70	70	70
4	50	40	90	90	90
5	50	95	145	over	0

According to the small sample above, it looks like it may have been a mistake for those contestants to spin again because three of the five contestant s totaled greater than 100 cents, went over and were disqualified. However, over the 10,000 trials the final totals were as follows:

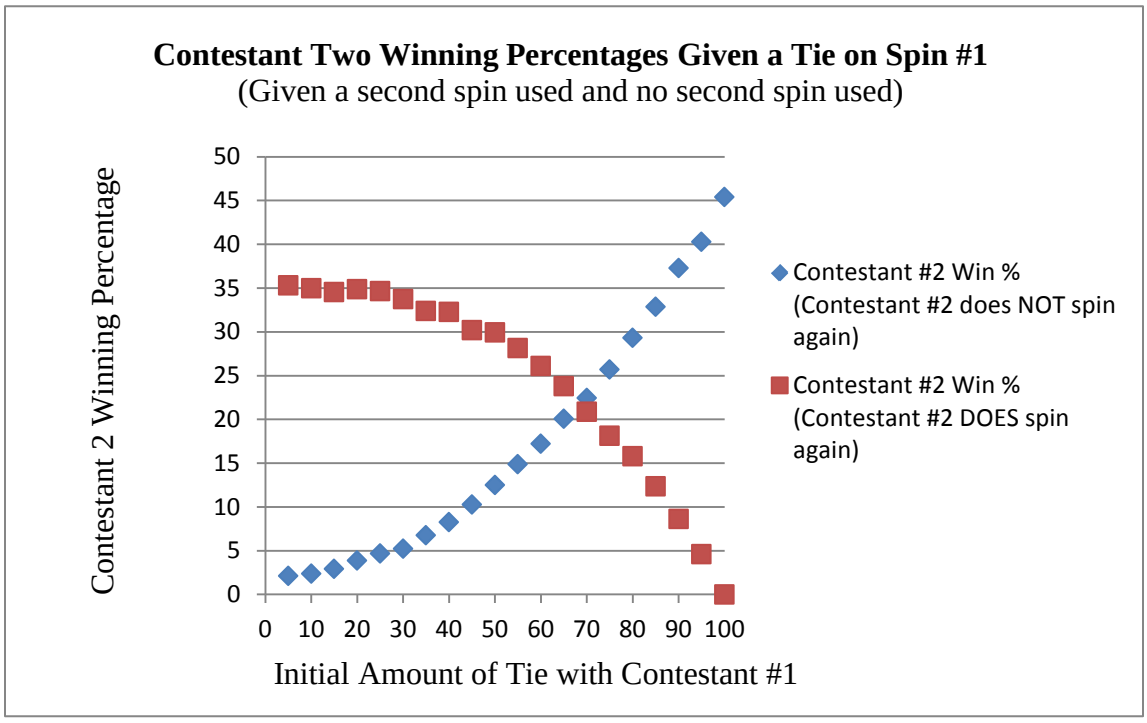
not over	5010
over	4990
% over	49.90%

Since exactly half of the totals on the big wheel would make the contestant total greater than 100 cents and the other half would increase their score and therefore their chances of winning the The Showcase Showdown, it makes sense that the actual totals are as they were (close to 50-50).

Now, to simulate contestant number two I created column (G) titled “Contestant #2 (spin #1)” with the formula =RANDBETWEEN(1,20)*5 because this will give them one of the twenty possible nickel increments in which they could spin. Then, this amount was compared to contestant one’s actual score from column F by using the formula in column (J) titled “Spin Again?” =IF(G2>=F2,0,"spin again"). This means if they spun a total higher than or the same as contestant one’s actual score on their first spin, to put a 0 in this column (J) but if they had a lower score they would obviously have to utilize their second spin and spin again to increase their actual score because they are behind the leading amount and would automatically lose otherwise. However, it is in contestant two’s best interest to use the second spin on ties up to and including 65 cents. A separate simulation was conducted in a similar manner to confirm this result. However, this simulation started with contestant 1 and 2 tying on the first spin of contestant 2. The following table (Table 1) and graph show the percentages in which contestant two would win given a tie on the first spin (at all possible nickel values) and having contestant 3 to follow:

Table 1 – When Should Contestant 2 Spin Again to Break a Tie With Contestant 1?

Contestants #1 and #2 initially tie at	Contestant #2 Win % (Contestant #2 does NOT spin again)	Contestant #2 Win % (Contestant #2 DOES spin again)
5	2.11	35.32
10	2.36	34.98
15	2.93	34.54
20	3.86	34.87
25	4.68	34.64
30	5.23	33.73
35	6.76	32.39
40	8.25	32.29
45	10.26	30.2
50	12.49	29.95
55	14.87	28.14
60	17.23	26.1
65	20.07	23.79
70	22.43	20.88
75	25.69	18.14
80	29.33	15.8
85	32.85	12.34
90	37.3	8.62
95	40.27	4.61
100	45.4	0

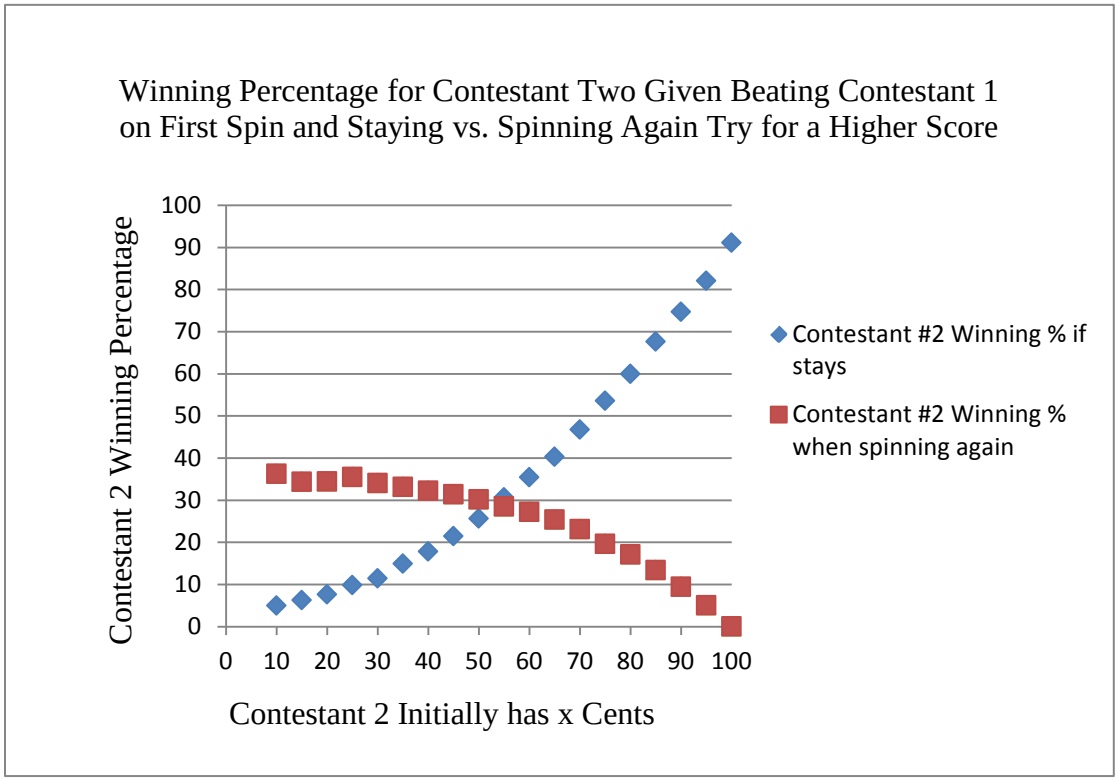


By looking at the table and the graph, we can determine one important thing. That is if contestant #2 is tied at 65 cents and a second spin is used, the contestant has a 23.79% chance to win whereas not spinning again yields a 20.07% chance to be victorious. Now, if contestant #2 is tied with contestant #1 at 70 cents and spins again, there is a 20.88% chance for that contestant to win, while staying on 70 cents will result in a 22.43% chance to win. Therefore, if contestant #2 ties with contestant #1 on the range of values where $5 \le x \le 65$ a second spin would be beneficial and will help improve the contestant's chances of winning. But, over the range of values where $70 \le x \le 100$, the contestant's best option is to stay, hope contestant #3 does not achieve a higher total and try to win the spinoff.

Note: I skipped a couple columns initially thinking I might have had to add a few more formulas to input, but did not want to shift the columns to the left because it may have affected some of the calculations I had already done after the experiment. The next column (K) titled "Contestant #2 (spin #2)" used the formula =IF(J2="spin again",RANDBETWEEN(1,20)*5,0) which means contestant 2 would get another nickel increment between 5 and 100 cents if the previous cell says "spin again" and a 0 in this column if they matched or exceeded contestant one's score on their first spin. Now contestant two's score was calculated in column (L) titled "Contestant #2 Total" using the formula =IF(E2="over",G2,G2+K2). The first part =IF(E2="over",G2 means since the first contestant was disqualified for spinning over 100 cents, contestant 2 would automatically take what they spun in their first spin. However, this could cause an issue when Contestant 2 is now in the lead, but with a low score. So, another simulation was conducted and was labeled "What values should Contestant #2 use a second spin when beating Contestant #1 after first spin." Please refer to Appendix B to see the detailed formulas used. The results are as follows in Table 2 and the accompanying graph.

Table 2 – When Should Contestant 2 Spin Again After Beating Contestant 1 on First Spin?

Contestant #2 Beats #1 with	Contestant #2 Winning % if stays	Contestant #2 Winning % when spinning again
10	4.99	36.27
15	6.24	34.32
20	7.59	34.4
25	9.84	35.52
30	11.4	34.03
35	14.95	33.15
40	17.79	32.26
45	21.48	31.36
50	25.61	30.15
55	30.61	28.49
60	35.45	27.19
65	40.28	25.4
70	46.73	23.12
75	53.57	19.64
80	59.91	17.1
85	67.59	13.42
90	74.67	9.41
95	82.04	5.07
100	91.07	0



By looking at Table 2 above, we can see when Contestant #2 beats Contestant #1 with 50 cents and does not spin again, the probability of winning is 25.61%. However, when a second spin is used the probability of winning increases to 30.15%. But, if Contestant #2 had spun 55 cents on the first spin, the probability of winning is 30.61%. Now, when a second spin is used, the probability of winning decreases to 28.49%. This tells us Contestant #2 should use the second spin when beating Contestant #1 with 50 cents or fewer, but to stop with 55 cents or greater and hope Contestant #3 does not spin a higher total.

Now, heading back to the original Monte Carlo Simulation, the total input into column L would be the sum of contestant two's first and second spins. Similar to what was done for contestant one's actual total, in column (M) titled "Over?" used the formula =IF(L2>100,"over",L2) and column N titled "Actual #2 Total" used the formula =IF(M2="over",0,M2). These two columns were used to determine contestant two's actual final score. Five sample rows are as follows:

Contestant #2 (spin #1)			Spin Again?	Contestant #2 (spin #2)	Contestant #2 Total	Over?	Actual #2 Total
65			spin again	10	75	75	75
55			spin again	35	90	90	90
70			0	0	70	70	70
40			0	0	40	40	40
35			spin again	80	115	over	0

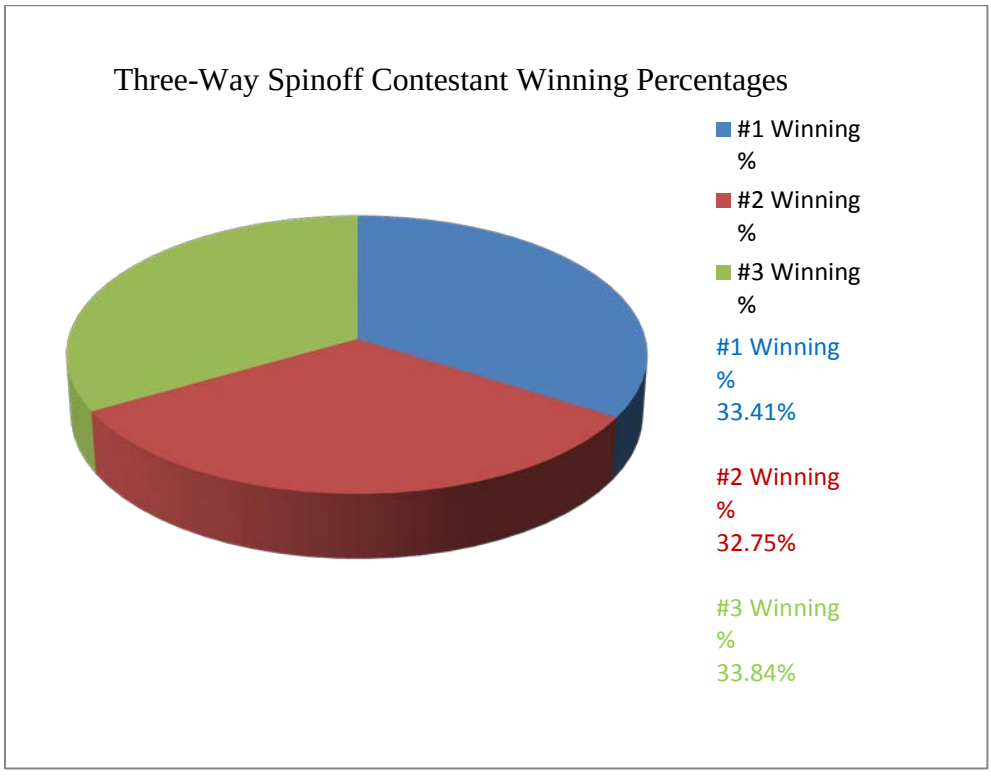
Now I wanted to determine if the first two contestants were tied and created column (O) titled "Tie?" in order to find where the first two contestants were in fact tied by using the formula =IF(E2=M2,"tie"). Instead of using columns E and M, I could have also used F and N, but either way I can now see which trials have the first two contestants tied. So, the next column (P) titled "Leader" was used to determine which contestant was in the lead by using the formula =IF(F2>N2,1,2). This gives the contestant number of the highest score, but also puts a 2 in the

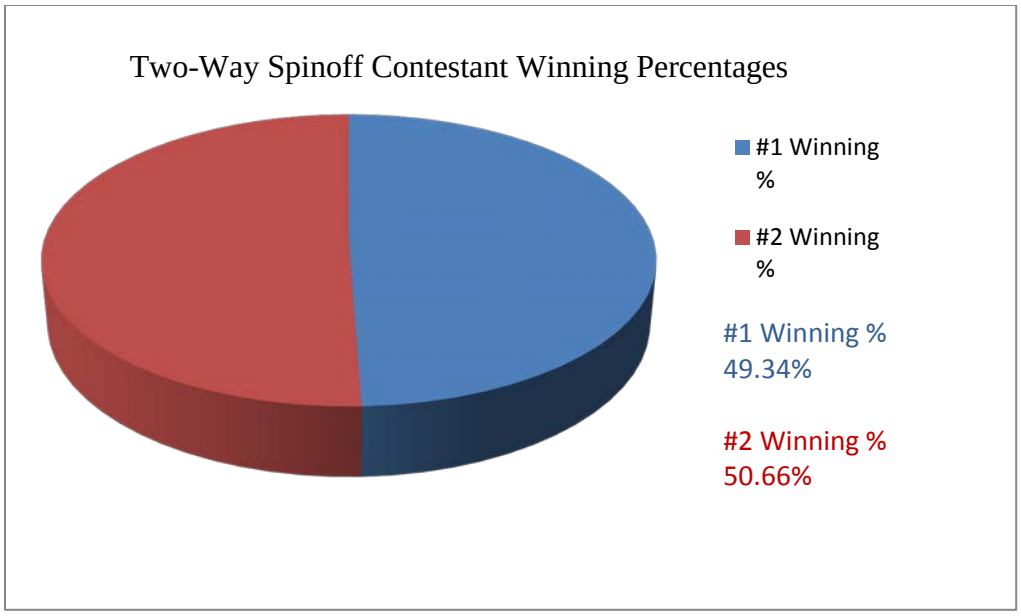
cells where they are tied. This issue that arises due to this will be dealt with a little bit later when I calculated exactly which contestant(s) matched the winning total. The next column (Q) titled "Leading Amount" displays what amount is currently in the lead by using the formula =IF(N2>F2,N2,F2). Columns N and F display the final amounts for contestant 2 and contestant 1 respectively. So, the higher of the two scores will be input into the cells for column Q and if they are tied, it does not matter because both scores in F and N are the same at this point and putting either score into column Q would not be different. This finishes contestant 2 and his or her spin(s). The following displays the data for five trials:

Tie?	Leader	Leading amount
0	2	85
tie	2	55
0	1	90
0	1	90
0	2	100

Now contestant 3 has his or her first spin put into column (R) titled "Contestant #3 (spin #1)" by using the formula =RANDBETWEEN(1,20)*5 again to yield one of the twenty possible nickel increments in which a contestant could possibly spin. The next column (S) titled "Tie?" was used to determine if contestant 3 had tied the leading amount by using the formula =IF(R2=Q2,"tie",0). Since column R calculates the first spin amount for contestant 3 and column Q displays the leading amount after the first two contestants are finished, this would allow us to see if contestant 3 has already tied the leader(s) or if another spin is required. Next, Column (T) titled "Spin Again?" used the formula =IF(R2>=Q2,0,"spin again") which means contestant 3 would stop if he or she were tied with the leading spinner or stop if he or she were ahead and win the showdown, but would utilize the second spin if they had a score lower than the leading amount. But, another issue arises when Contestant #3 happens to be tied with a fairly low

amount. So, what range of values should Contestant #3 use a second spin in order to break a two-way or three-way tie? These questions were answered two other simulations. The first one was titled “Two and Three-Way Spinoff Simulations” where I wanted to verify my intuition was correct when I believed each player had a 50% chance to win in a two-way spinoff and about a 33.33% chance to win a three-way spinoff. The details of the simulations can be found in Appendices C and D, titled “Walkthrough Table to Construct Your Own Microsoft Excel Monte Carlo Simulation for a Three-Way Spinoff” and “Walkthrough Table to Construct Your Own Microsoft Excel Monte Carlo Simulation for a Two-Way Spinoff” respectively. The following pie charts will show the results of this simulation with the simulated winning percentages as well:

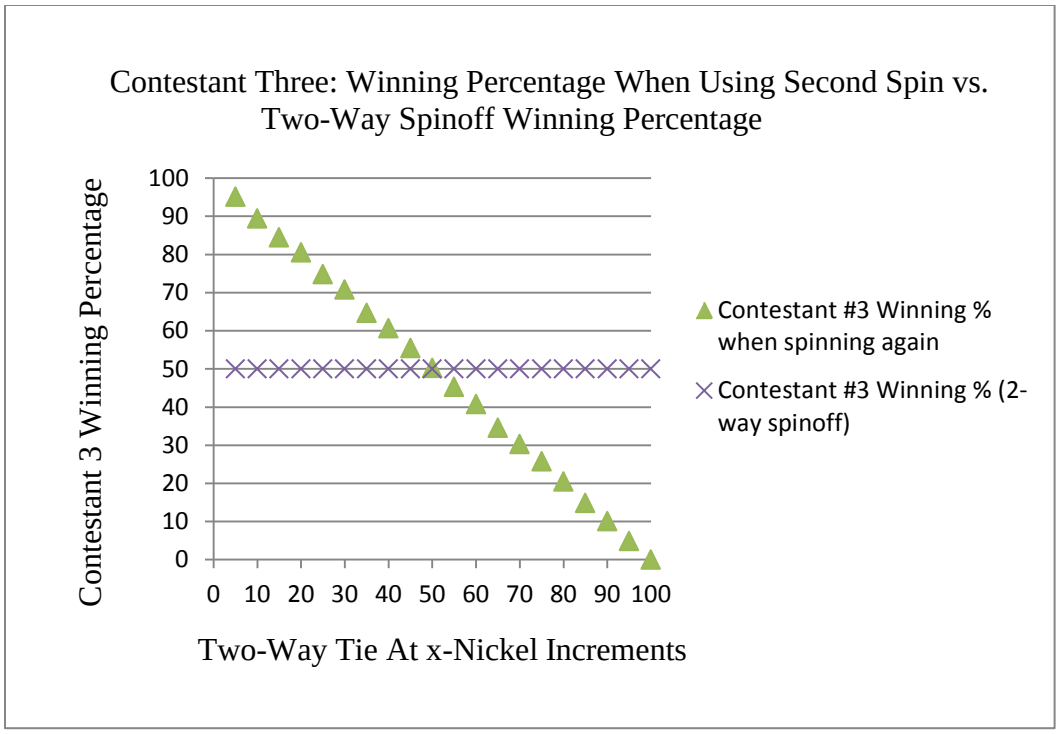


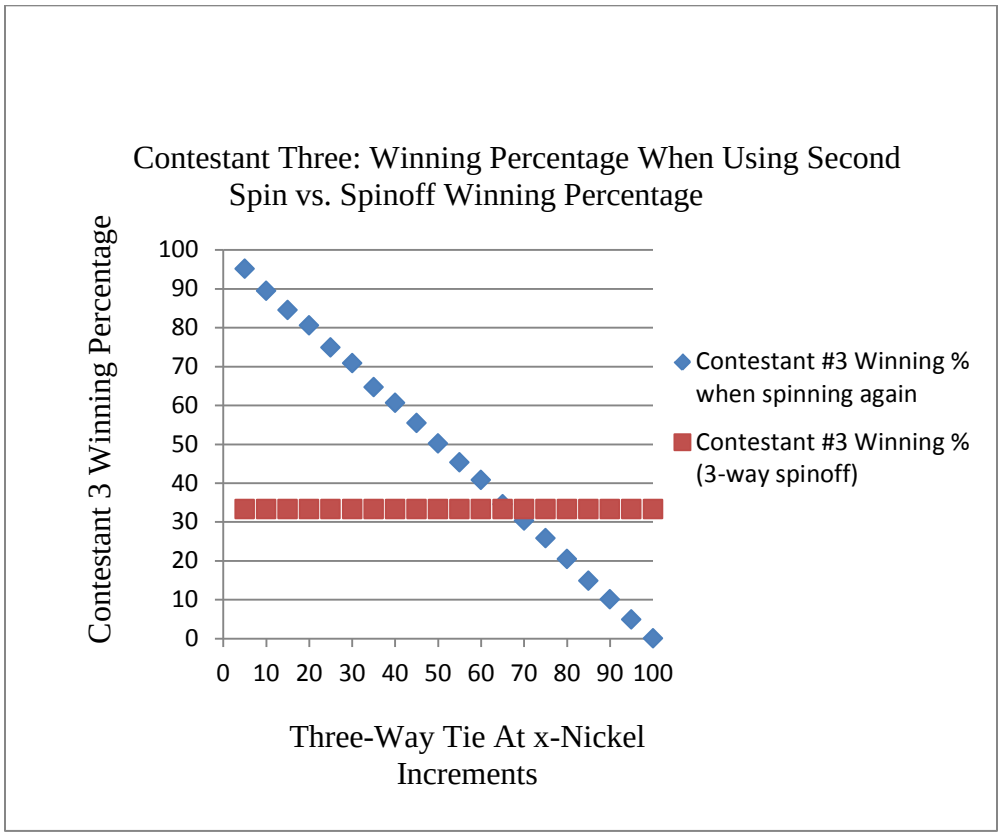


By looking at the previous pie charts and the winning percentages that are listed, one should be able to determine that their intuition is correct. That means any player has the same chance to win regardless of order since each player only gets one spin and takes that value. With this holding true, another experiment was conducted, titled “Which Values Should Contestant 3 Spin Again In Order To Break a Tie With One or Two Other Contestants (Given a Tie on The First Spin)” and the details, including all of the formulas used during the experiment are located in Appendix E. The results are shown below (using the intuitive winning percentages) in Table 3 and the accompanying graphs.

Table 3 – Contestant 3 Ties One or Both Contestants, When Should Another Spin Be Used?

Contestant #3 ties with	Contestant #3 Winning % when spinning again	Contestant #3 Winning % (2-way spinoff)	Contestant #3 Winning % (3-way spinoff)
5	95.1	50	33.33
10	89.45	50	33.33
15	84.48	50	33.33
20	80.53	50	33.33
25	74.83	50	33.33
30	70.79	50	33.33
35	64.69	50	33.33
40	60.6	50	33.33
45	55.4	50	33.33
50	50.2	50	33.33
55	45.33	50	33.33
60	40.77	50	33.33
65	34.52	50	33.33
70	30.31	50	33.33
75	25.78	50	33.33
80	20.47	50	33.33
85	14.88	50	33.33
90	10.06	50	33.33
95	4.9	50	33.33
100	0	50	33.33


Contestant Three: Winning Percentage When Using Second Spin vs. Two-Way Spinoff Winning Percentage
Contestant 3 Winning Percentage
100
90
80
70
60
50
40
30
20
10
0
0 10 20 30 40 50 60 70 80 90 100
Two-Way Tie At x-Nickel Increments
Contestant #3 Winning % when spinning again
Contestant #3 Winning % (2-way spinoff)


Contestant Three: Winning Percentage When Using Second Spin vs. Spinoff Winning Percentage
Contestant 3 Winning Percentage
100
90
80
70
60
50
40
30
20
10
0
0 10 20 30 40 50 60 70 80 90 100
Three-Way Tie At x-Nickel Increments
Contestant #3 Winning % when spinning again
Contestant #3 Winning % (3-way spinoff)

By looking at table 3, one can see that their intuition again would be correct. One should believe that if Contestant #3 is tied at 40 cents, then they have a 60% chance of increasing their score without going over and the simulation gave the probability of 60.6%. So, this means that Contestant #3 should spin again with 65 cents or fewer when breaking a three-way tie and go to a three-way spinoff when tied with Contestants #1 and #2 on values of 70 cents or greater. But, to break a tie with just one other contestant, if there is a tie at 50 cents it is a tossup. So, Contestant #3 should use the second spin if tied with one other contestant at 45 cents or fewer. But, should go to the spinoff with 55 cents or greater. Again, at 50 cents Contestant #3 realistically has the same probability of winning the spinoff as he or she does by using the second spin.

Now heading back to the original simulation, column (U) was titled “Contestant #3 (spin #2)” and used the formula =IF(T2="spin again",RANDBETWEEN(1,20)*5,0). This means they would spin another nickel increment in the event that they were behind the leader or they would not have to spin again and a value of 0 cents would be put into the cell for column U. Similar to what was used for contestant 2, the final score for contestant 3 was calculated in column (V), titled “Contestant #3 Total” by using the formula =IF(R2>=Q2,R2,R2+U2). This means if contestant 3 matched or exceeded the leading score located in column Q on the first spin, they would accept that amount as the final score for contestant 3. If they were behind after the first spin, then add the two spins together from columns R and U. Now, column (W) titled “Over?” used the formula =IF(V2>100,"over",V2) and this was used to determine if contestant 3 exceeded the one dollar maximum or not. Finally, contestant 3 has his or her actual score input into column (X), titled “Actual #3 Total” by using the formula =IF(W2="over",0,W2). Again, anything over 100 cents from the combination of two spins disqualifies the contestant and a score of 0 is input into the cell for this column. The following displays the data for five trials:

Contestant #3 (spin #1)	Tie?	Spin Again?	Contestant #3 (spin #2)	Contestant #3 Total	Over?	Actual #3 Total
15	0	spin again	5	20	20	20
15	0	spin again	85	100	100	100
40	0	spin again	70	110	over	0
60	0	spin again	10	70	70	70
95	0	0	0	95	95	95

The next three columns were used to determine who the winner was or who was tied and had to utilize a one-spin round called a spinoff to determine the winner. These columns were (Y),(Z) and (AA) and were titled “#3 wins”, “#2 wins” and “#1 wins” respectively. The next column, (AB) was titled “Winning Amount” and used the formula =IF(Q2>X2,Q2,X2). The score in column Q was the leading amount for the first two contestants and the score in column X was the final score for the third contestant. Now, going back to the columns Y, Z and AA to figure out which contestant won or which contestants tied the formula used for column Y (contestant #3 wins) was =IF(X2=AB2,1,0). A number 1 put into the cell means contestant 3 won or tied whereas a 0 means contestant 3 lost. For column Z (contestant #2 wins), the formula =IF(N2=AB2,1,0) was used where a 1 again means contestant #2 won or tied and a 0 means contestant #2 lost. Similarly, the formula used for column AA (contestant #1 wins) was =IF(F2=AB2,1,0). The columns X, N and F were the total scores for contestants 3, 2 and 1 respectively and the AB column had the winning amount, so if any of those scores in X, N or F equaled the winning total, then that contestant had won or tied. Now, the next four columns in the excel spreadsheet were used to determine where there were ties. Column (AC) titled “#1 and #2 tie” uses the formula =IF(SUM(AA2+Z2=2),1,0). This simply states that if columns AA and Z both have a 1 in them, then contestants 1 and 2 would both have the winning amount and would have tied. Similarly, column (AD) was titled “#1 and #3 tie” and used the formula

=IF(SUM(AA2+Y2=2),1,0) with the same reasoning as was used when I determined which trials contestants 1 and 2 tied. Again, another column (AE) titled “#2 and #3 Tie” and used the formula =IF(SUM(Y2+Z2=2),1,0). Finally, column (AF) titled “All Tie” used the formula =IF(Y2+Z2+AA2=3,1,0). This would only happen if all three contestants had the same value at the end of their spins and would result in a three-way spinoff to see which contestant would go on to the final round at the end of the show. The following displays the data for five trials:

#3 wins	#2 wins	#1 wins	Winning Amount	#1 and #2 tie	#1 and #3 tie	#2 and #3 tie	All tie
0	1	0	95	0	0	0	0
0	1	0	90	0	0	0	0
0	1	1	90	1	0	0	0
0	0	1	90	0	0	0	0
0	0	1	90	0	0	0	0

By looking at the table above, you can see in the third trial there was a tie between contestant #1 and contestant #2. They would have to settle their tie with a single spin each where the high spinner would be declared the winner.

This essentially ends the initial simulation, however I also created another block of columns to help compare what would have happened if contestant #1 had not utilized a second spin. Therefore, in column (AH) (the next column used for data) titled “If #1 stayed” the total from column B is put here with the formula =B2. The next column (AI) is titled “#2 first spin” and simply has the same value as what was in column G with the formula =G2. The next column (AJ) was titled “spin again?” and used the formula =IF(AI2>=AH2,0,"spin again"). This would tell excel that contestant #2 would stop and not utilize another spin if he or she had a total greater than or equal to contestant #1 and would put a 0 in this column. Otherwise, they would have to utilize their second spin and this column would be filled with the words “spin again.” Next,

column (AK) titled “#2 Second Spin” and used the formula =IF(AJ2="spin again",RANDBETWEEN(1,20)*5,0) to give contestant #2 another nickel value if they had to utilize their second spin or a 0 if they did not. Now, column (AL) was titled “#2 total” and had the formula =SUM(AI2+AK2) where contestant 2 had his or her two spin totals added together. The next column (AM) was titled “#2 over?” and used the formula =IF(AL2>100,"over",AL2) in order to input the final score for contestant #2 or the word “over” if they were disqualified for obtaining a total that was greater than 100 cents. The next column (AN) was titled “#2 actual total” and used the formula =IF(AM2="over",0,AM2) which just uses the total score from column AM or the value of 0 if they were over 100 cents. Next, column (AO) was titled “Leading amount” and used the formula =IF(AH2>AN2,AH2,AN2) which compares the first spin from contestant #1 and the one or two spin final value of contestant #2. The following displays the data for five trials:

If #1 stayed	#2 first spin	Spin again?	#2 second spin	#2 total	#2 over?	#2 actual total	Leading amount
50	95	0	0	95	95	95	95
50	10	spin again	70	80	80	80	80
50	20	spin again	50	70	70	70	70
50	35	spin again	45	80	80	80	80
50	70	0	0	70	70	70	70

Next, player #3 comes into play with column (AP), titled “#3 first spin” and this was already obtained in column R, so we use the formula =R2. Next, in column (AQ) which is titled “Spin again?” we use the formula =IF(AP2>=AO2,0,"spin again") to see if contestant #3 has to spin again or not. If they do not have to spin again, they receive a 0 in that cell. But, if they have to spin another time due to being behind the leading amount from column AO, then they will have to utilize their second spin. Next, in column (AR) which is titled “#3 second spin” the formula

=IF(AQ2="spin again",RANDBETWEEN(1,20)*5,0) is used. If they have to utilize their second spin, they will spin a nickel value from 5 to 100 cents and if not, they would stop and get a 0 input into this cell. The last three columns from this block of cells are titled “#3 total”, “#3 over?” and “#3 actual total” and just as for contestant #2 they were calculated as follows: column (AS) used the formula =SUM(AP2+AR2), which could lead to scores higher than 100 cents. Since this is true, column (AT) used the formula =IF(AS2>100,"over",AS2) to show if contestant #3 had gone over 100 cents and the word “over” was put into this cell or just put the score from column AS if they had not gone over. Finally, column (AU) used the formula =IF(AT2="over",0,AT2) to give contestant #3 an actual score of 0 if they had gone over 100 cents or the score they had from column AT. The following displays the data for five trials:

#3 first spin	Spin again?	#3 second spin	#3 total	#3 over?	#3 actual total
30	spin again	85	115	over	0
90	0	0	90	90	90
85	0	0	85	85	85
75	spin again	80	155	over	0
55	spin again	20	75	75	75

Now, I wanted to check and see what would have happened if contestant one had stayed and accepted their total after their first spin and had made the choice not to utilize their opportunity for a second spin. Therefore, in column (AW) titled “Winning Value if #1 stayed” the formula =IF(AO2>AU2,AO2,AU2) was used. This figures out if the total from column AO (the leading amount from the first two spinners with contestant one only using his or her initial amount) or if contestant three had a higher total by using the value from column AU. The next column (AX) titled “#1 wins” used the formula =IF(AH2=AW2,1,0). The AH column was equal to column B and just used the nickel increments from 5 to 100 depending on what tab in excel was being used at the time. Excel would input a 1 into the cell if contestant 1 had a total matching the winning

total or a 0 if he or she did not. The next column (AY) was titled “#2 wins” and used the formula =IF(AN2=AW2,1,0). The amount in column AN was the final score for contestant two if contestant 1 did not spin a second time. Again a 1 put into any cell in this column meant contestant 2 had a total matching the winning total or a 0 if he or she did not. The next column (AZ) was titled “#3 wins” and used the formula =IF(AU2=AW2,1,0). This compared the winning total from AW to the final score for contestant 3 in column AU. Again a 1 put into any cell in this column meant contestant 3 had a total matching the winning total or a 0 if he or she did not. The next four columns BA through BD were used in order to find any two-way or three-way ties between contestants. Column (BA) was titled “#1 and #2 tie” and used the formula =IF(SUM(AX2+AY2=2),1,0). This simply means that in order for contestants 1 and 2 to tie there would have to be a 1 in columns AX and AY as well as in the same row. If that is true, those two cells would add up to 2 and a tally would be marked down in column BA by using a 1, but otherwise a 0 would be put into column BA. Similarly, column (BB) titled “#1 and #3 tie” used the formula =IF(SUM(AX2+AZ2=2),1,0). By summing the numbers in each row for columns AX and AZ, contestants 1 and 3 were tested to see if they had tied. Next, column (BC) was titled “#2 and #3 tie” and used the formula =IF(SUM(AY2+AZ2=2),1,0). By using columns AY and AZ, contestants 2 and 3 were tested to see if they had tied. Finally, column (BD) titled “All tie” used the formula =IF(AX2+AY2+AZ2=3,1,0). This shows that a success would require all three columns AX, AY and AZ to have a 1 in the same row. This would mean that contestant #1, contestant #2 and contestant #3 all had scores in which were equal to the winning score. Therefore, all three contestants had the same score and all tied which would produce a rare three-contestant spin-off. . The following displays the data for five trials:

Winning value if #1 stayed	#1 wins	#2 wins	#3 wins	#1 and #2 tie	#1 and #3 tie	#2 and #3 tie	All tie
55	0	1	0	0	0	0	0
100	0	1	0	0	0	0	0
75	0	1	0	0	0	0	0
70	0	1	1	0	0	1	0
50	1	1	1	1	1	1	1

The fourth trial from the previous table shows contestants 2 and 3 tied and would determine the winner with a spin-off where they each spin the wheel one time and the highest amount wins. The fifth row from the previous table shows a three-way tie between the contestants. Similar to a two-contestant spin-off, each contestant spins the wheel one time. Again the contestant with the highest amount would win. The three-way tie occurred in 1135 out of the 200,000 total rounds that were simulated. This means a three-contestant tie would occur only

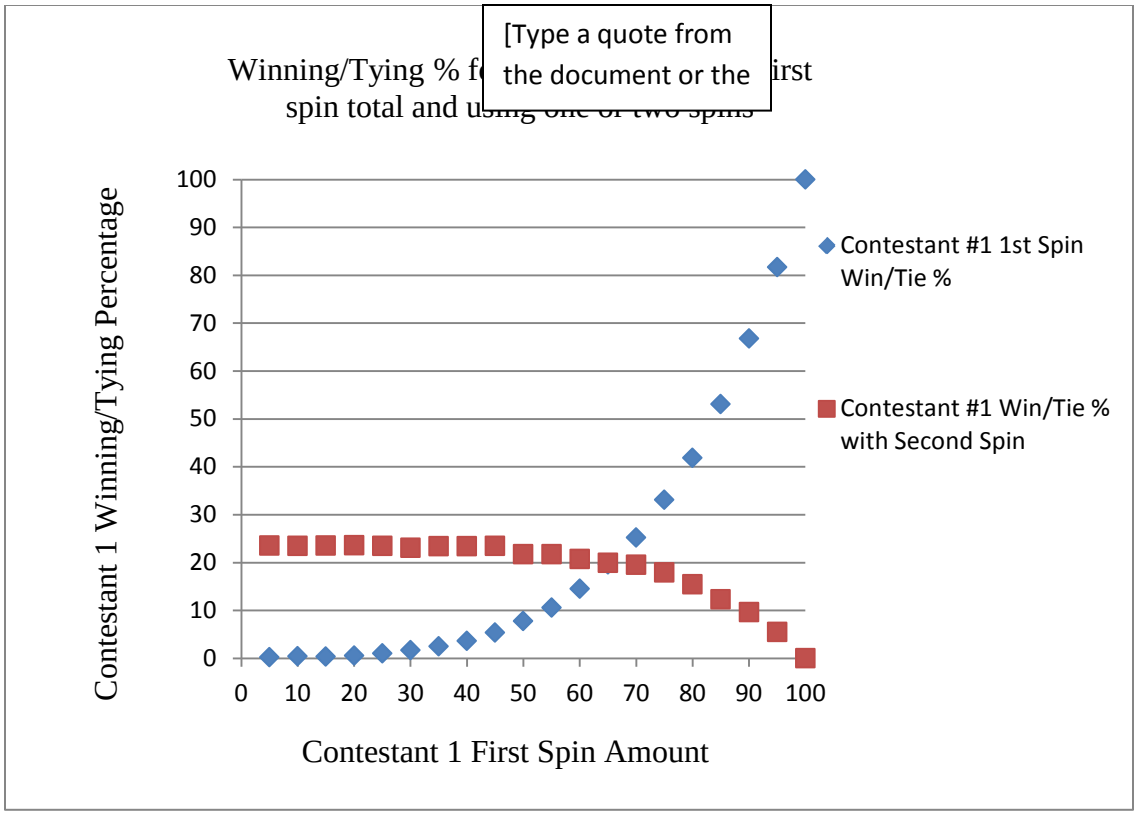
$\frac{1,135}{200,000} = 0.005675 = 0.5675\%$ of the time. Since there are two Showcase Showdowns per episode, this would occur fewer than once out of eighty-eight episodes. Therefore, you should see a three-contestant spinoff roughly three times per year.

Results (Data)

After gathering all of the data through the various simulations, the overall results are determined and described as follows:

Table 4 – Overall Winning/Tying Percentages for Contestant #1

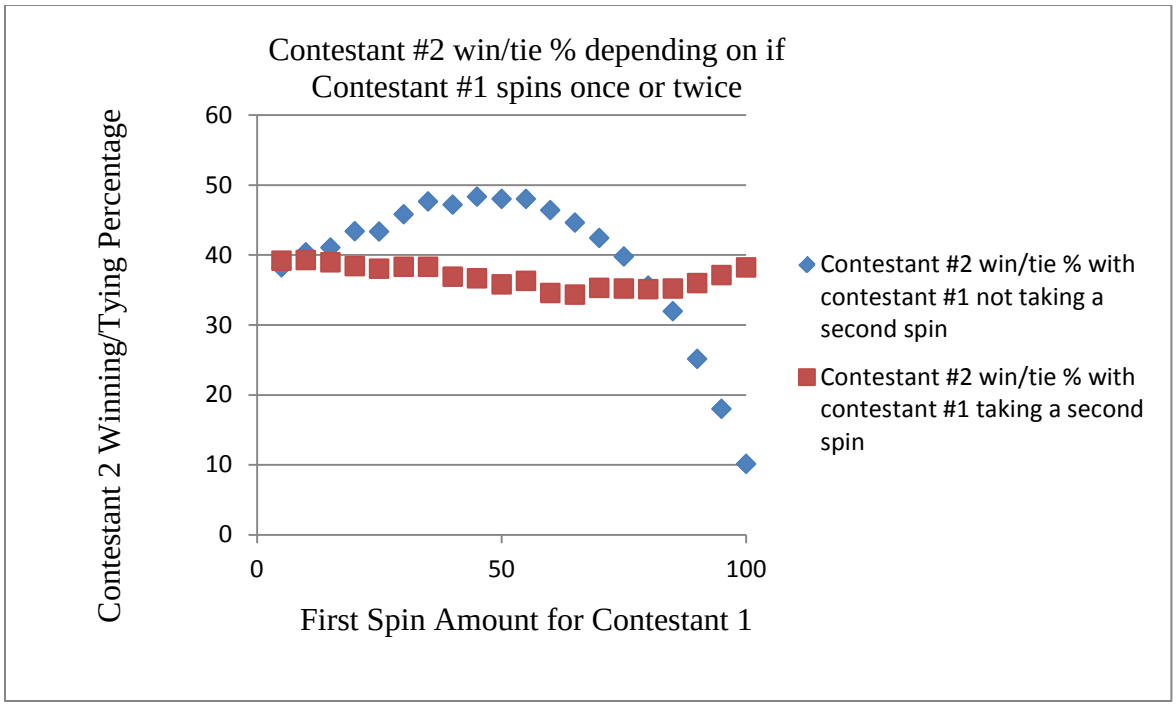
Starting Spin Total	Contestant #1 1st spin win/tie % if staying with initial total	Contestant #1 win/tie % with second spin
5	0.24	23.58
10	0.4	23.46
15	0.38	23.58
20	0.57	23.61
25	1.02	23.47
30	1.71	23.09
35	2.49	23.42
40	3.65	23.44
45	5.34	23.48
50	7.78	21.77
55	10.61	21.75
60	14.53	20.72
65	19.59	19.95
70	25.2	19.52
75	33.1	17.92
80	41.86	15.43
85	53.06	12.3
90	66.77	9.63
95	81.67	5.49
100	100	0



As one can see by looking at table 4 and the graph above, Contestant 1 benefits by using a second spin over the range of 5 cents to 60 cents. If Contestant 1 spins 65 cents on the first spin, it becomes the tipping point between the probability of staying versus the probability of spinning again. However, if Contestant 1 spins 70 cents or greater on the first spin, spinning again would certainly reduce the probability of winning for Contestant 1. Therefore, Contestant 1 should stop and keep any total over the range of 70 cents to 100 cents and has the option to stay or spin again when starting with 65 cents without affecting one's own probability of winning very much.

Table 5 – Winning/Tying Percentages for Contestant 2 Based On the Number of Spins Contestant 1 Takes

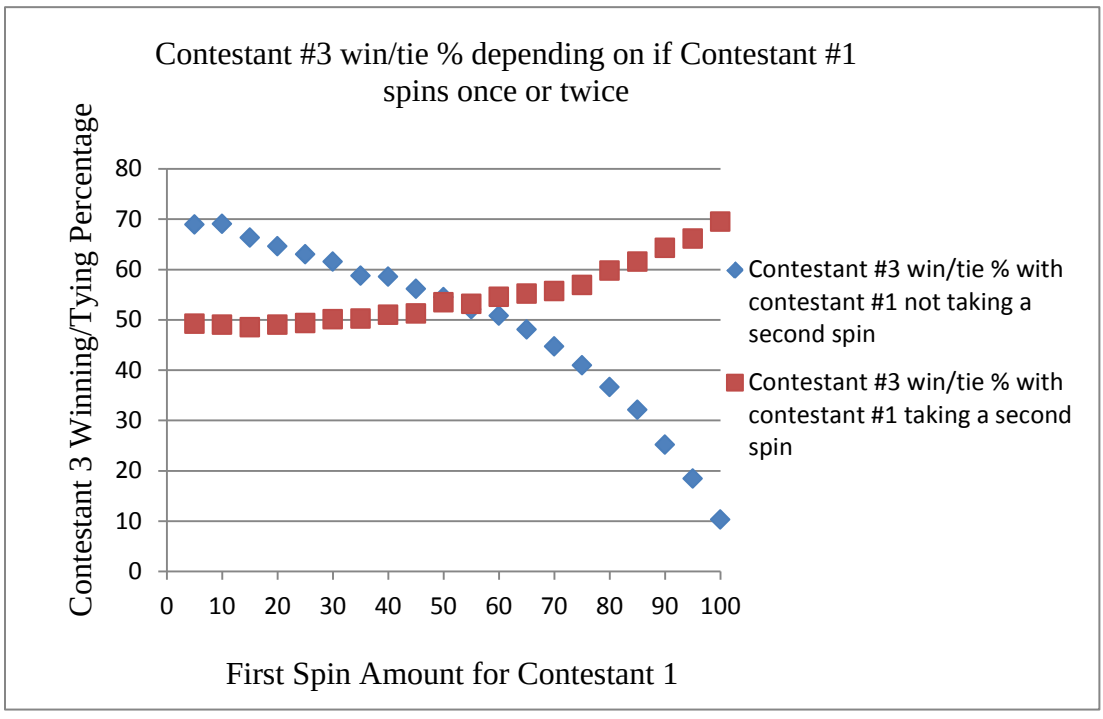
Spin Total with which contestant #1 begins	Contestant #2 win/tie % with contestant #1 not taking a second spin	Contestant #2 win/tie % with contestant #1 taking a second spin
5	38.21	39.17
10	40.37	39.25
15	41.03	38.92
20	43.38	38.39
25	43.31	38.04
30	45.78	32.87
35	47.61	38.29
40	47.17	36.86
45	48.31	36.66
50	47.99	35.78
55	48	36.3
60	46.39	34.55
65	44.63	34.34
70	42.4	35.28
75	39.77	35.18
80	35.62	35.1
85	31.92	35.2
90	25.14	35.99
95	18.01	37.12
100	10.1	38.22



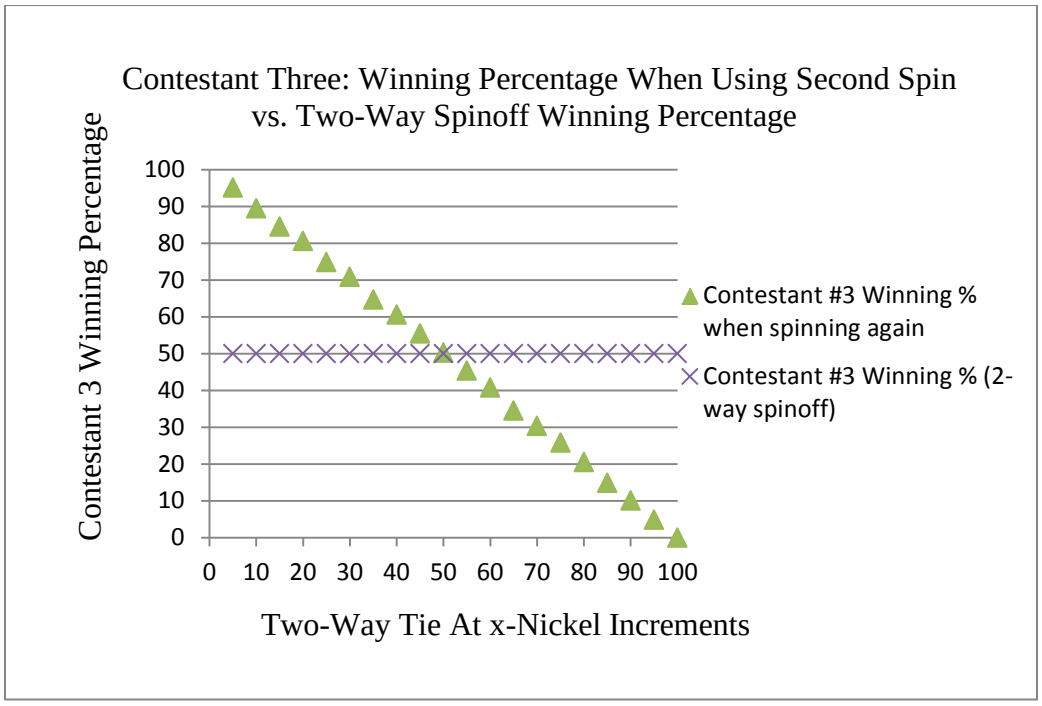
By looking at the graph and table 5 above, one can conclude Contestant 2 is not affected much by what Contestant 1 does. Obviously, Contestant 2 would like to witness Contestant 1 go over 100 cents and be eliminated from contention, but by looking at the graph, Contestant 2 almost has a linear and nearly horizontal winning percentage. This leads me to believe that Contestant 3 is affected more by the actions of Contestants 1 and 2 due to the fact that Contestant 2 does not witness much change in winning percentage based on the actions taken by Contestant 1.

Table 6 - Winning Percentages for Contestant 3 Based On the Number of Spins Contestant 1 Takes

Spin Total with which contestant #1 begins	Contestant #3 win/tie % with contestant #1 not taking a second spin	Contestant #3 win/tie % with contestant #1 taking a second spin
5	68.89	49.22
10	69.02	49.03
15	66.28	48.51
20	64.59	49.02
25	63.02	49.35
30	61.51	50.1
35	58.71	50.22
40	58.55	50.96
45	56.14	51.2
50	54.44	53.46
55	52.07	53.14
60	50.79	54.54
65	48.02	55.19
70	44.7	55.68
75	40.91	56.89
80	36.61	59.73
85	32.06	61.5
90	25.17	64.25
95	18.4	66.12
100	10.3	69.48

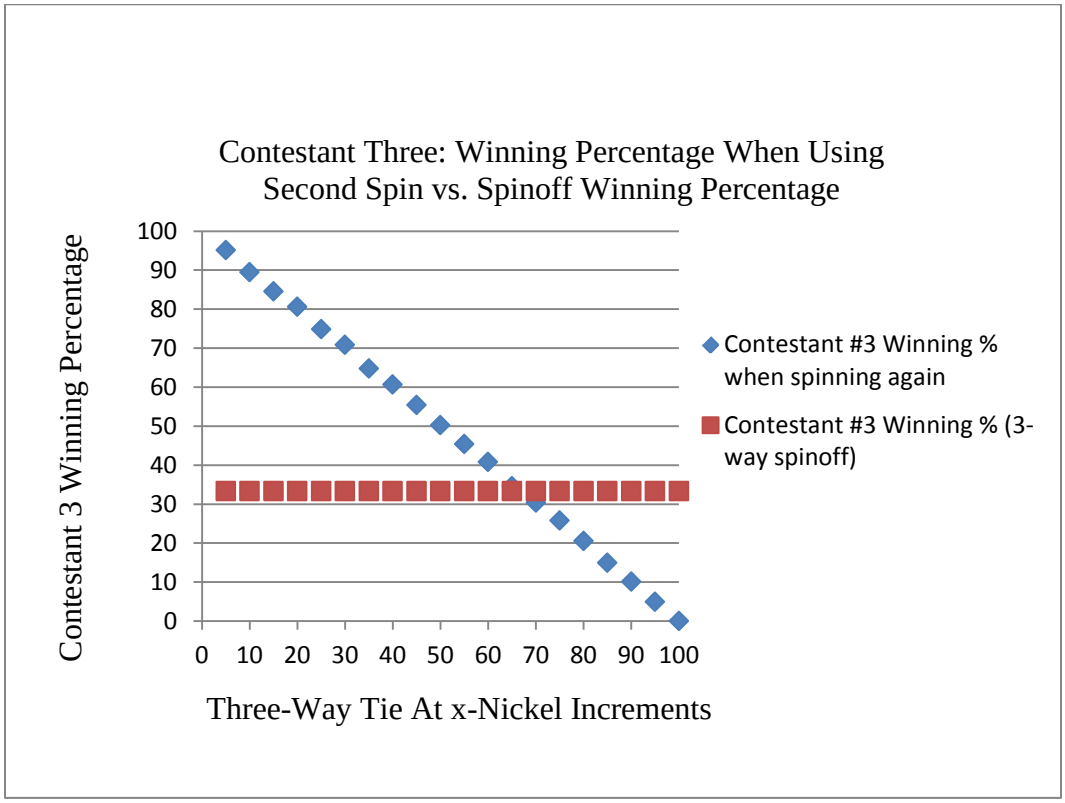


As one can see by the graph and table 6 above, Contestant 3 benefits when Contestant 1 spins again. One can see that the winning percentage for Contestant 3 is fairly linear, but it has a positive slope. This appears to be true due to the cases where Contestant 1 goes over 100 cents and is automatically eliminated from contention. Contestant 3 is the lucky one that typically does not have to make any choices. If they are losing, they spin again. If they are winning, they stop and take the win. The only choice they ever have to make is when deciding on breaking a two-way or three-way tie and either avoid a spinoff or head to a spinoff to determine the winner. This scenario brought upon the simulation that goes along with Table 3:

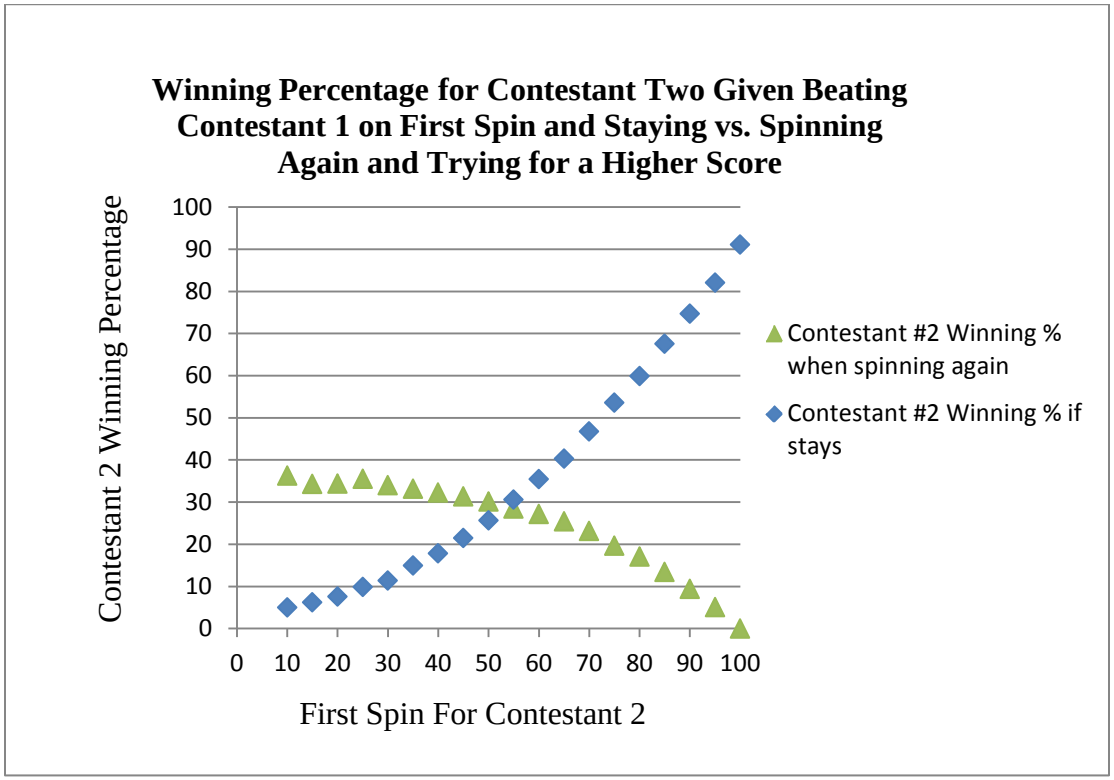


One's intuition would be exactly correct in these situations. First, let's discuss the results for when Contestant 3 is attempting to avoid a two-way spinoff. As one would expect and by looking at the graph directly above as well as table 3, the chances of winning a two-way spinoff would be 50% for each player. Therefore, if Contestant 3 is faced with the decision to head to a spinoff or spin again over the range of 5 cents to 45 cents, it would make sense for Contestant 3

to avoid the spinoff and take the second spin. If it came down to making a decision in which there is a two-way tie at 50 cents, it is a virtual toss-up and Contestant 3 has a 50% chance to win either way. However, if there is a tie over the range of 55 cents to 100 cents, it would be in the best interest for Contestant 3 to take the spinoff because the chances of winning by using another spin are always lower than 50%.



Now, what happens when Contestant 3 is faced with the situation in which there would be a three-way tie if a second spin is not used? One's intuition would be correct in this scenario as well. By looking at the graph above and table 7, one can see that if Contestant 3 chooses to head to a three-way spinoff, the probability of winning would be about 33.33%. Therefore, it would be wise for Contestant 3 to spin again over the values of 5 cents to 65 cents. But, if there is a three-way tie over the values of 70 cents to 100 cents, taking the spinoff would be the most prudent move.



Now, what happens when Contestant 2 is faced with the tough decision such as Contestant 1 has a fairly low score and Contestant 2 beats that score on the first spin? When should Contestant 2 be content and when should another spin be used? By looking at table 2 and the graph above, we can see Contestant 2 should spin again over the range of values from 10 cents to 50 cents, but when beating Contestant 1 with 55 cents or greater, Contestant 2 should stay because another spin will lower the probability of winning due to the possibility of spinning over 100 cents and being automatically disqualified.

Conclusions

Many factors have to be taken into account when determining what a particular contestant should do when it comes to spinning The Big Wheel on The Price Is Right. However, by using Monte Carlo simulation, it has been shown that Contestant 1 should spin again if the first spin was below 70 cents, where the change in probability when starting with 65 cents is slight, but it increases when using a second spin. Contestant 1 should certainly stop over the range of 70 cents to 100 cents. This is consistent with the article "To Spin or Not to Spin? Natural and Laboratory Experiments from The Price Is Right" as well as another article titled "Optimal Stopping in "The Showcase Showdown"" which used other methods and came up with similar results. This helps me confirm my hypothesis which was a contestant should stop spinning if he or she has 70 cents or higher. Again, according to my experiment when Contestant 1 spins 65 cents on the first spin, stopping at 65 cents results in an overall win/tie % of 19.59% and spinning again yields a win/tie % of 19.95%. Contestant 1 can choose either route while the probability of winning does not change by much, but spinning again does increase the probability of winning by 0.36%. To coincide with the results of the experiment, one should conclude that Contestant 1 is better off when spinning again over the range of 5 cents to 65 cents and staying over the range of 70 cents to 100 cents. These results are identical to both "To Spin or Not to Spin? Natural and Laboratory Experiments from The Price Is Right" and "Optimal Stopping in "The Showcase Showdown.""

The next question was what range of values would Contestant #2 need to beat the final spinner? Contestant #2 would certainly have to beat or tie Contestant #1 on the first spin. If not, a second spin would definitely be used. Therefore, the main question that would arise is what should Contestant #2 do if he beats Contestant #1 with a fairly low amount and has an option to spin

again? This is easily answered by looking at Table 2. If Contestant #2 beats Contestant #1 with an amount over the range of 5 to 50 cents, using the second spin is recommended. However, if Contestant #2 takes the lead with 55 cents or higher, using another spin lowers the probability of winning for Contestant #2. Now, if Contestant #2 has to decide whether or not to use the second spin in order to break a tie with Contestant #1, Table 1 shows a second spin should be used when there is a tie over the range of 5 cents to 65 cents. However, spinning again at 70 cents or higher certainly decreases the overall probability of winning for Contestant #2. Again, these results are consistent with those found by the authors of "To Spin or Not to Spin? Natural and Laboratory Experiments from The Price Is Right" as well as the results found by the authors of "Optimal Stopping in "The Showcase Showdown"" with one exception. In "To Spin or Not to Spin? Natural and Laboratory Experiments from The Price Is Right" when they did their experiment including bonus payments Contestant #2 found their equilibrium value to be spin again with 55 cents or fewer after spinning a greater score than Contestant 1 (as opposed to 50 cents or fewer).

Now, when Contestant #3 spins for the first time and trails the leading contestant(s), it is obvious that the second spin must be taken. If Contestant #3 takes the lead after the first spin, it would also be obvious that using a second spin would be a ridiculous move because stopping would guarantee a win. But, if Contestant #3 ties after using the first spin, a decision must be made. But, the decision to be made would depend on whether it is a tie with one or both contestants. One's intuition as well as Table 3 shows if Contestant #3 is tied with one other contestant over the range of 5 cents to 45 cents, using another spin is the prudent move. Being tied with one other contestant at 50 cents is a transitional value and Contestant #3 has a 50% chance to win either way. But, when tied with one other contestant over the range of 55 cents to 100 cents, it would be best for Contestant #3 to choose to stay and head to a spinoff. Now, Table 3 and one's

intuition also shows that when Contestant #3 is tied with both of the other contestants over the range of 5 cents to 65 cents, the best move and the highest probability of winning occurs when a second spin is used. However, when faced with a potential three-way tie at 70 cents to 100 cents, it is certainly best for Contestant #3 to head to a three-way spinoff to determine the victor. Both of these findings are accurate with those found by the authors of "To Spin or Not to Spin? Natural and Laboratory Experiments from The Price Is Right" as well as the results found by the authors of "Optimal Stopping in "The Showcase Showdown"".

During the period of time between December 2, 2013 and June 18, 2014 the actual data from the Showcase Showdowns from the show The Price Is Right was recorded. Over this period of time, there were 284 Showcase Showdowns and 852 total spinners of The Big Wheel. During $\frac{267}{284} \approx .940$ of the showdowns, all contestants made proper spinning decisions. During $\frac{13}{284} \approx .046$ of the showdowns, one or more contestants made incorrect decisions and lost. That means that during $\frac{4}{284} \approx .014$ of the showdowns, a contestant made an incorrect decision and won. Contestants only made incorrect spinning/stopping decisions during 6% of the showdowns. Some other interesting details from the actual spinners of the show are $\frac{20}{852} \approx .023$ of all spinners fell down after spinning the heavy wheel. Contestant 3 had automatic wins due to both Contestant 1 and Contestant 2 spinning over 100 cents $\frac{7}{284} \approx .025$ or about 2.5% of the time. There were 32 total spinoffs, 29 of which were two-way spinoffs and the other 3 were three-way spinoffs. Of these, 7 were between Contestants 1 and 2 where Contestant 1 won 3 and Contestant 2 won 4 of them. Now, 9 of these two-way spinoffs were between Contestants 1 and 3 where

Contestant 1 won 6 and Contestant 3 won 3 of them. The final 13 two-way spinoffs were between Contestants 2 and 3. Of these, Contestant 2 won 7 and Contestant 3 won 6. There were 3 three-way spinoffs and each contestant won 1 of them. Some other interesting things that occurred were Contestant 2 once won $10,000 on a bonus spin by spinning 5 cents, but lost the spinoff to Contestant 3 due to a spin of 55 cents. One time Contestant 1 did not spin all the way around during a spinoff after tying with 100 cents and was automatically eliminated from winning bonus money. However, she was allowed to spin again and was still eligible to win the Showcase Showdown; she spun 100 cents and won. But, again she lost out on the $25,000 bonus for spinning 100 cents. During one episode, Drew Carey gave some advice to Contestant 1 which was “Never stay on a 10 when you’re first! You can take that to the bank everybody”! During another episode, Contestant 2 received a marriage proposal before spinning in the Showcase Showdown, accepted and won the showdown. One contestant fell down and hit her head on the wheel. One episode, Contestant 3 fell down twice (on both spins). During another episode, Contestant 3 fell down, won the Showcase Showdown and came back on crutches. One time, Contestant 1 had no official spin twice in a row due to the wheel not going all the way around, but then with Drew’s help for extra spinning power, she spun 30 cents, followed by 70 cents for 100 cents. Then, she spun 100 cents on the bonus spin and got an additional $25,000 bonus! During one episode, Contestant 3 won with 25 cents after Contestant 2 correctly spun again with a first spin of 40 cents, but went over 100 cents. Another time, Contestant 3 won with 35 cents after Contestant 2 correctly spun again with 45 cents and went over. One time during a spinoff, Contestant 1 beat Contestant 3 10 cents to 5 cents. Finally, during another episode Contestant 1 fell down during her first spin, spun a total of 100 cents with her second spin and proceeded to do cartwheels. She then spun 5 cents on her bonus spin, won an additional $10,000 and kissed

Drew. Many fun and exciting things happened during these showdowns that cannot be simulated. However, one can see the overall results are always very similar regardless of the process used to gather any data.

Appendix A. Walkthrough Table to Construct Your Own Microsoft Excel Monte Carlo Simulation

Column A	Column B	Column C	Column D
Trial Number	**Contestant #1 (Spin 1)**	**Contestant #1 (Spin 2)**	**Total**
1	50	=RANDBETWEEN(1,20)*5	=SUM(B3:C3)

Column E	Column F	Column G	**Column H**	**Column I**
Over?	**Actual #1 Total**	**Contestant #2 (spin #1)**	**(left blank)**	**(left blank)**
=IF(D3>100,"over",D3)	=IF(E3="over",0,E3)	=RANDBETWEEN(1,20)*5		

Column J	Column K	Column L
Spin Again?	**Contestant #2 (spin #2)**	**Contestant #2 Total**
=IF(G3>=F3,0,"spin again")	=IF(J3="spin again",RANDBETWEEN(1,20)*5,0)	=IF(E3="over",G3,G3+K3)

Column M	Column N	Column O	Column P
Over?	**Actual #2 Total**	**Tie?**	**Leader**
=IF(L3>100,"over",L3)	=IF(M3="over",0,M3)	=IF(E3=M3,"tie",0)	=IF(F3>N3,1,2)

Column Q	Column R	Column S	Column T
Leading amount	**Contestant #3 (spin #1)**	**Tie?**	**Spin Again?**
=IF(N3>F3,N3,F3)	=RANDBETWEEN(1,20)*5	=IF(R3=Q3,"tie",0)	=IF(R3>=Q3,0,"spin again")

Column U	Column V	Column W
Contestant #3 (spin #2)	**Contestant #3 Total**	**Over?**
=IF(T3="spin again",RANDBETWEEN(1,20)*5,0)	=IF(R3>=Q3,R3,R3+U3)	=IF(V3>100,"over",V3)

Column X	Column Y	Column Z	Column AA
Actual #3 Total	**#3 wins**	**#2 wins**	**#1 wins**
=IF(W3="over",0,W3)	=IF(X3=AB3,1,0)	=IF(N3=AB3,1,0)	=IF(F3=AB3,1,0)

Column AB	Column AC	Column AD	Column AE
Winning Amount	**#1 and #2 tie**	**#1 and #3 tie**	**#2 and #3 tie**
=IF(F3=AB3,1,0)	=IF(SUM(AA3+Z3=2),1,0)	=IF(SUM(AA3+Y3=2),1,0)	=IF(SUM(Y3+Z3=2),1,0)

Column AF	**Column AG**	Column AH	Column AI	Column AJ
All tie	**(left blank)**	**If #1 stayed**	**#2 first spin**	**Spin again?**
=IF(Y3+Z3+AA3=3,1,0)		=B3	=G3	=IF(AI3>=AH3,0,"spin again")

Column AK	Column AL	Column AM
#2 second spin	**#2 total**	**#2 over?**
=IF(AJ3="spin again",RANDBETWEEN(1,20)*5,0)	=SUM(AI3+AK3)	=IF(AL3>100,"over",AL3)

Column AN	Column AO	Column AP	Column AQ
#2 actual total	**Leading amount**	**#3 first spin**	**Spin again?**
=IF(AM3="over",0,AM3)	=IF(AH3>AN3,AH3,AN3)	=R3	=IF(AP3>=AO3,0,"spin again")

Column AR	Column AS	Column AT
#3 second spin	**#3 total**	**#3 over?**
=IF(AQ3="spin again",RANDBETWEEN(1,20)*5,0)	=SUM(AP3+AR3)	=IF(AS3>100,"over",AS3)

Column AU		Column AW	Column AX
#3 actual total		**Winning Value if #1 stayed**	**#1 wins**
=IF(AT3="over",0,AT3)		=IF(AO3>AU3,AO3,AU3)	=IF(AH3=AW3,1,0)

Column AY	Column AZ	Column BA	Column BB
#2 wins	**#3 wins**	**#1 and #2 tie**	**#1 and #3 tie**
=IF(AN3=AW3,1,0)	=IF(AU3=AW3,1,0)	=IF(SUM(AX3+AY3=2),1,0)	=IF(SUM(AX3+AZ3=2),1,0)

Column BC	Column BD
#2 and #3 tie	**all tie**
=IF(SUM(AY3+AZ3=2),1,0)	=IF(AX3+AY3+AZ3=3,1,0)

Appendix B. Walkthrough Table to Construct Your Own Microsoft Excel Monte Carlo Simulation for Finding What Values Contestant #2 Should Use a Second Spin (After Beating Contestant 1 with Various Values)

Column A	Column B	Column C	Column D
Trial Number	**Contestant 2 Takes Lead With**	**Spins Again**	**Total**
1	50	=RANDBETWEEN(1,20)*5	=SUM(B2:C2)

Column E	Column F	Column G
Over?	**Contestant #3 (spin #1)**	**Spin 2 Needed?**
=IF(D2>100,0,D2)	=RANDBETWEEN(1,20)*5	=IF(F2>=E2,F2,"spin again")

Column H	Column I	Column J	Column K
#3 (spin #2)	**#3 Total**	**Over?**	**#3 Actual Total**
=IF(G2="spin again",RANDBETWEEN(1,20)*5,0)	=SUM(F2:H2)	=IF(I2>100,0,I2)	=J2

Column L	Column M	Column N	**Column O**	Column P
Winning Amount	**#3 Wins**	**#2 Wins**	**(left blank)**	**#3 Spin #1**
=IF(K2>=E2,K2,E2)	=IF(L2=K2,1,0)	=IF(L2=E2,1,0)		=F2

Column Q	Column R	Column S
Spin #2 Needed?	**#3 (spin #2)**	**#3 Total**
=IF(P2>=B2,0,"spin again")	=IF(Q2="spin again",RANDBETWEEN(1,20)*5,0)	=SUM(P2:R2)

Column T	Column U	Column V
Over?/Actual Total	**#2 Wins Without 2nd Spin**	**#3 Wins Without #2 Spinning Again**
=IF(S2>100,0,S2)	=IF(B2>=T2,1,0)	=IF(T2>=B2,1,0)

Appendix C. Walkthrough Table to Construct Your Own Microsoft Excel Monte Carlo Simulation For a Three-Way Spinoff

Column A	Column B	Column C	Column D
Trial #	**Player one (Spinoff Amount)**	**Player Two Spinoff Amount**	**Leading Amount**
1	=RANDBETWEEN(1,20)*5	=RANDBETWEEN(1,20)*5	=IF(B2>C2,B2,C2)

Column E	Column F	Column G	Column H	Column I
Player Three Spinoff Amount	**Winning Amount**	**#1 Wins**	**#2 Wins**	**#3 Wins**
=RANDBETWEEN(1,20)*5	=IF(E2>D2,E2,D2)	=IF(F2=B2,1,0)	=IF(F2=C2,1,0)	=IF(F2=E2,1,0)

Appendix D. Walkthrough Table to Construct Your Own Microsoft Excel Monte Carlo Simulation for a Two-Way Spinoff

Column A	Column B	Column C
Trial #	**Player one (Spinoff Amount)**	**Player Two Spinoff Amount**
1	=RANDBETWEEN(1,20)*5	=RANDBETWEEN(1,20)*5

Column D	Column E	Column F
Winning Amount	**#1 Wins**	**#2 Wins**
=IF(B2>C2,B2,C2)	=IF(D2=B2,1,0)	=IF(D2=C2,1,0)

Appendix E. Which Values Should Contestant 3 Spin Again In Order To Break a Tie with One or Two Other Contestants (Given a Tie on the First Spin)?

Column A	Column B	Column C	Column D
Trial Number	**Contestant 3 Ties on 1st Spin With**	**Spins Again**	**Total**
1	50	=RANDBETWEEN(1,20)*5	=SUM(B2:C2)

Column E	Column F
Over?	**Contestant #3 wins?**
=IF(D2>100,0,D2)	=IF(E2>B2,1,0)

References

[1] Rafael Tenorio; Timothy N. Cason, To Spin or Not to Spin? “Natural and Laboratory Experiments from The Price Is Right: The Economic Journal, Vol. 112, No. 476 (Jan. 2002), pp. 170-195.

[2] Paul R. Coe; William Butterworth, Optimal Stopping in “The Showcase Showdown”: The American Statistician, Vol. 49, No. 3 (Aug. 1995), pp. 271-275.