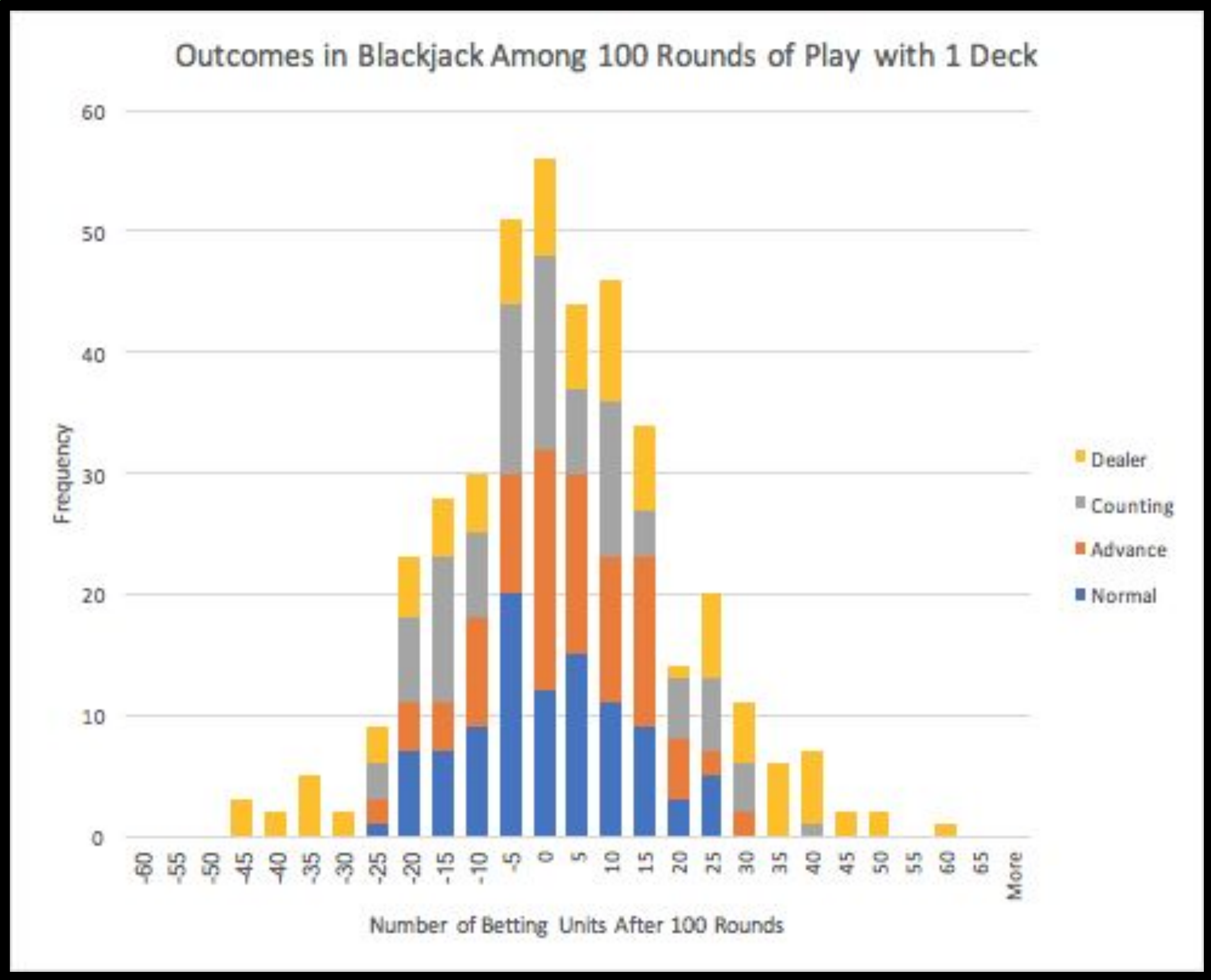




Modeling Blackjack Strategies in Netlogo

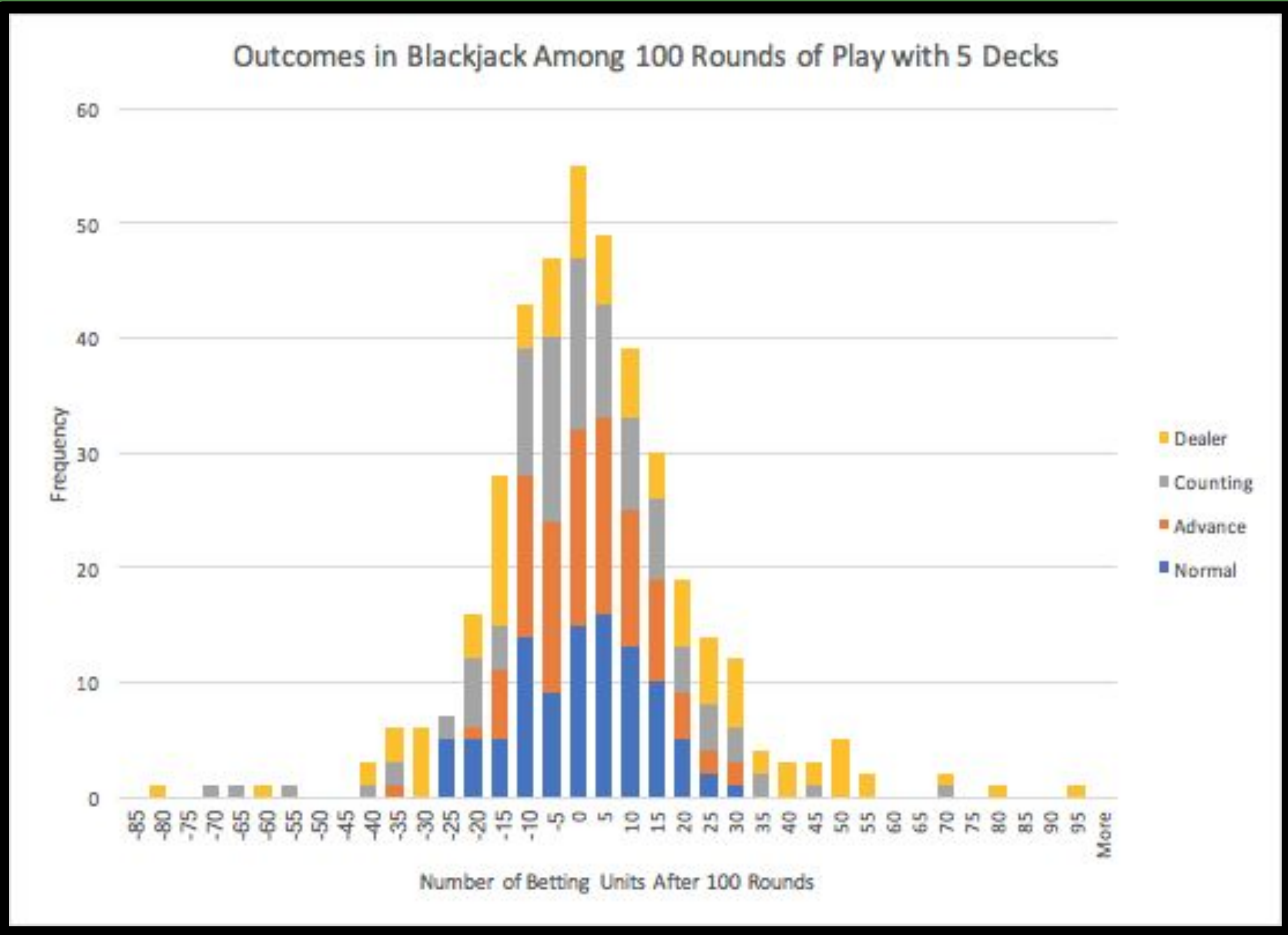


By Evan Goldberg, Sarah Lamie, and Michael Somkuti



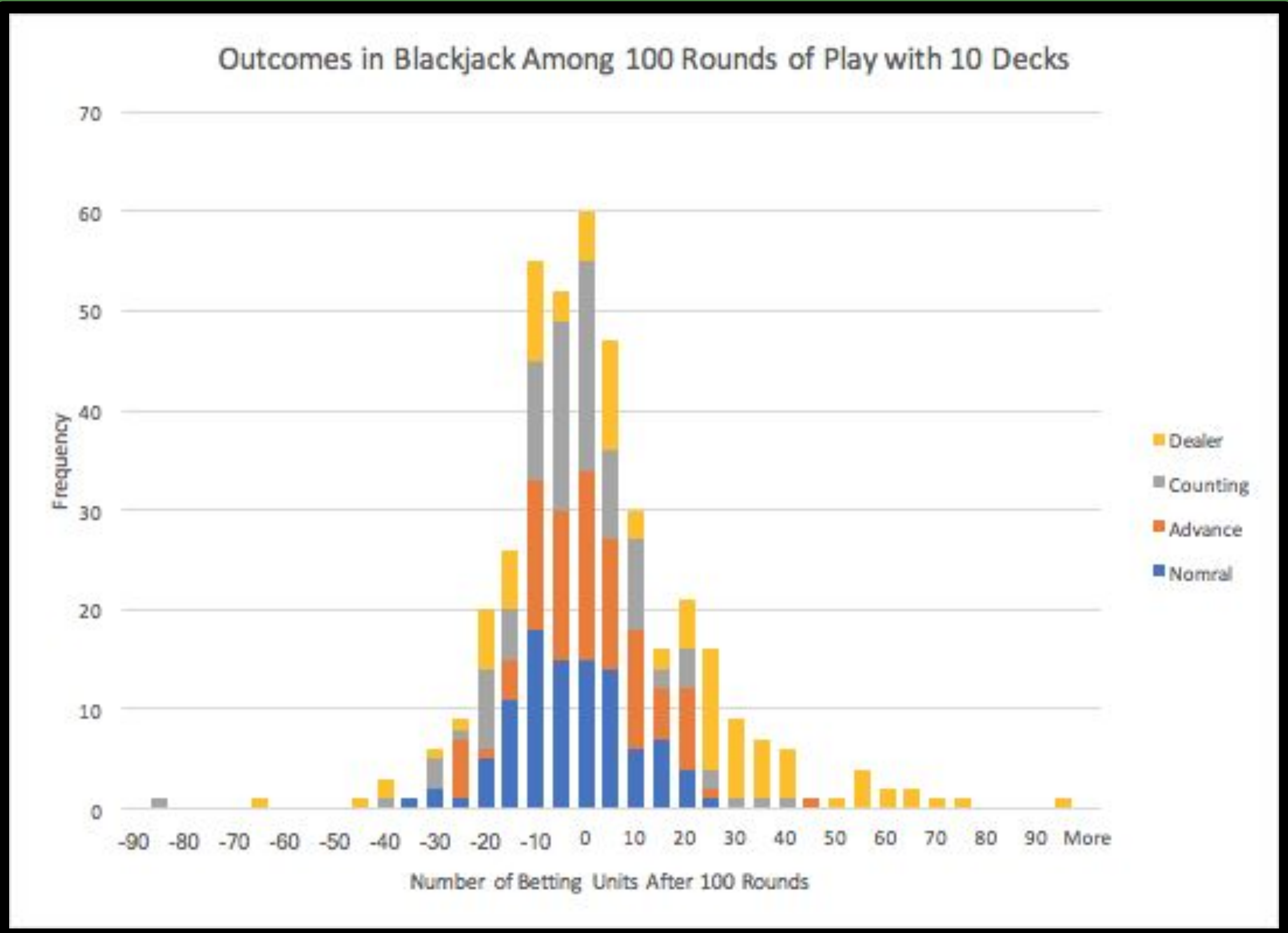
t-Test: Two-Sample Assuming Unequal Variances		
1 Deck		
	Advance	Counting
Mean	0.83	-1.39
Variance	144.0011111	223.4322222
Observations	100	100
Hypothesized Mean Difference	0	
df	189	
t Stat	1.158147031	
P(T<=t) one-tail	0.124132709	
t Critical one-tail	1.652955802	
P(T<=t) two-tail	0.248265418	
t Critical two-tail	1.972595079	

Our null hypothesis is that that the difference between the mean outcome for the Advance player and the mean outcome of the counting cards player is 0. Our alternative hypothesis is that the counting strategy mean is significantly greater than the advance strategy mean. Since our found t-score, 1.1581 is less than the t-critical score 1.553, we fail to reject our Null Hypothesis that there is no difference between the two playstyles for 1 deck of cards.



t-Test: Two-Sample Assuming Unequal Variances		
5 Decks		
	Advance	Counting
Mean	-0.44	-2.39
Variance	126.7539394	414.9877778
Observations	100	100
Hypothesized Mean Difference	0	
df	154	
t Stat	0.837796364	
P(T<=t) one-tail	0.201721726	
t Critical one-tail	1.654808385	
P(T<=t) two-tail	0.403443452	
t Critical two-tail	1.975488058	

Our null hypothesis is that that the difference between the mean outcome for the Advance player and the mean outcome Our alternative hypothesis is that the counting strategy mean is significantly greater than the advance strategy mean. Since our found t-score, 0.8378 is less than the t-critical score 1.6548, we fail to reject our Null Hypothesis that there is no difference between the two playstyles for 5 decks of cards.



t-Test: Two-Sample Assuming Unequal Variances		
10 Decks		
	Advance	Counting
Mean	-1.5	-5.04
Variance	155.7272727	255.6751515
Observations	100	100
Hypothesized Mean Difference	0	
df	187	
t Stat	1.745298996	
P(T<=t) one-tail	0.041287708	
t Critical one-tail	1.653042889	
P(T<=t) two-tail	0.082575416	
t Critical two-tail	1.972731033	

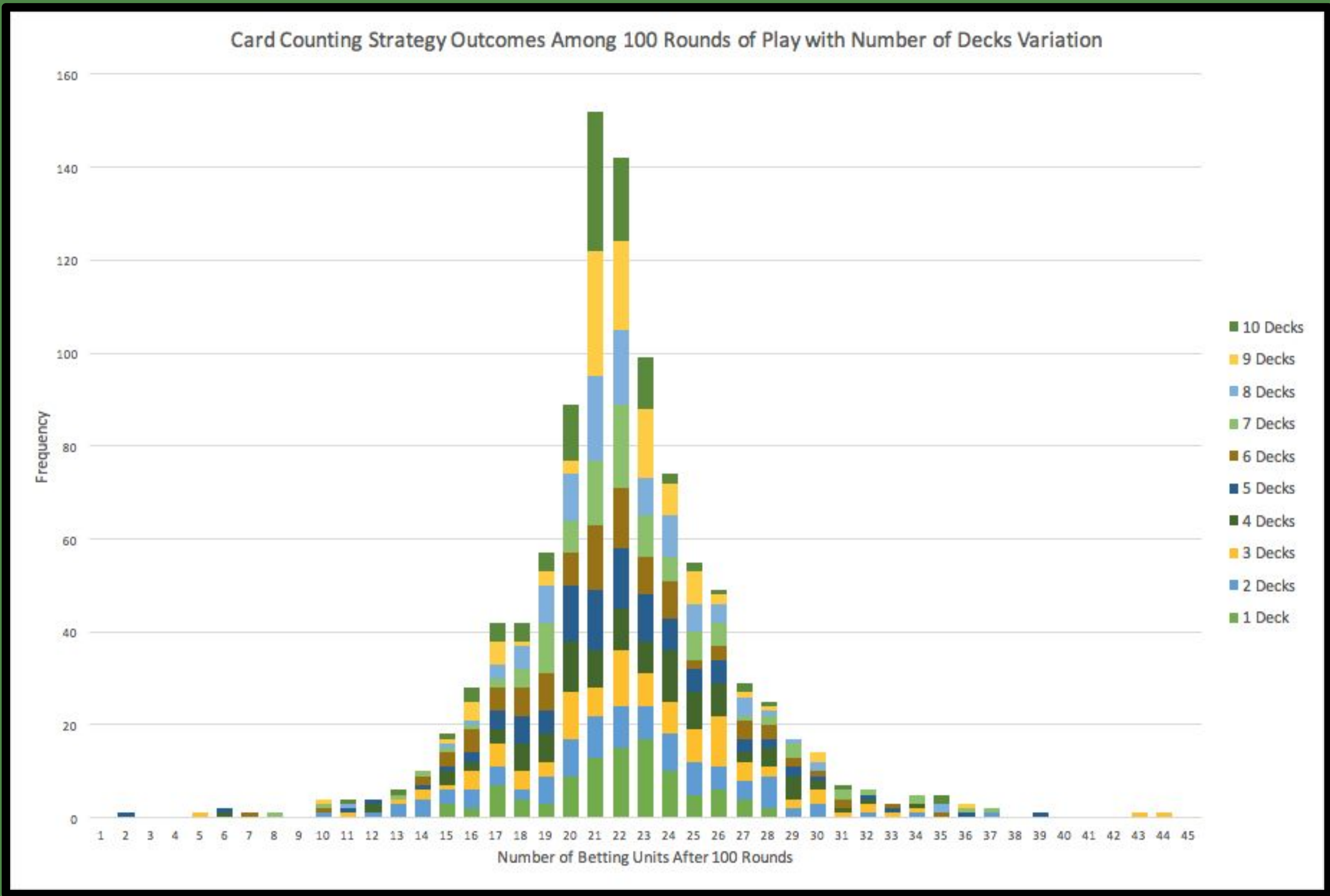
Our null hypothesis is that that the difference between the mean outcome for the Advance player and the mean outcome of the counting cards player is 0. Our alternative hypothesis is that the counting strategy mean is significantly greater than the advance strategy mean. Since our found t-score, 1.7453 is greater than the t-critical score 1.653, we reject our Null Hypothesis that there is no difference between the two playstyles for 10 decks of cards.

RULES OF BLACKJACK & OUR MODEL

The goal of the game is to get your hand to 21. Players start with two cards each, number cards worth their value, J Q K worth ten points, and Aces either worth 11 or 1. Players “hit” to get another card, or “stay” to keep their score. The goal of the game is to beat the dealer’s score by getting as close to 21 as possible without going over. If a player draws 21 from their first two cards, it’s called a Blackjack and is considered an automatic win. A player can choose to “double”, which means they double their bet and are electing to take only one card more. If during play the player’s hand total goes over 21 points, the player busts and loses.

Card Counting is a popular strategy in attempting to “beat the house,” or win more money in play using a technique of keeping track of which cards have been in play, thus monitoring the odds of certain cards to come up, in the hopes of increasing their chances of beating the dealer.

In our model, setting up the game generates the dealers and players with their respective strategies. The observer can also specify the number of rounds per game played. After dealing the cards, the model runs one simulation of the given number of rounds per tick, updating the amount of money of each turtle. One can also simulate one round at a time to observe precise outcomes.



Las Vegas Multiple Deck											
		Dealer's Up Card									
Your Hand		2	3	4	5	6	7	8	9	10	A
8		H	H	H	H	H	H	H	H	H	H
9		H	D	D	D	D	H	H	H	H	H
10		D	D	D	D	D	D	D	D	H	H
11		D	D	D	D	D	D	D	D	D	H
12		H	H	S	S	S	H	H	H	H	H
13		S	S	S	S	S	H	H	H	H	H
14		S	S	S	S	S	H	H	H	H	H
15		S	S	S	S	S	H	H	H	H	H
16		S	S	S	S	S	H	H	H	H	H
17		S	S	S	S	S	S	S	S	S	S
A,2		H	H	H	D	D	H	H	H	H	H
A,3		H	H	H	D	D	H	H	H	H	H
A,4		H	H	D	D	D	H	H	H	H	H
A,5		H	H	D	D	D	H	H	H	H	H
A,6		H	D	D	D	D	H	H	H	H	H
A,7		S	D	D	D	S	S	H	H	H	H
A,8		S	S	S	S	S	S	S	S	S	S
A,9		S	S	S	S	S	S	S	S	S	S
A,A		P	P	P	P	P	P	P	P	P	P
2,2		H	H	P	P	P	P	H	H	H	H
3,3		H	H	P	P	P	P	H	H	H	H
4,4		H	H	H	H	H	H	H	H	H	H
6,6		H	P	P	P	P	H	H	H	H	H
7,7		P	P	P	P	P	H	H	H	H	H
8,8		P	P	P	P	P	P	P	P	P	P
9,9		P	P	P	P	P	P	P	S	S	S
10,10		S	S	S	S	S	S	S	S	S	S

(3)

Anova: Single Factor					
SUMMARY					
Groups	Count	Sum	Average	Variance	
1 Deck	100	-139	-1.39	223.43222	
2 Decks	100	36.5	0.365	767.12553	
3 Decks	100	120.5	1.205	755.08129	
4 Decks	100	-331	-3.31	531.05444	
5 Decks	100	-239	-2.39	414.98778	
6 Decks	100	-667.5	-6.675	555.66856	
7 Decks	100	-158.5	-1.585	463.52048	
8 Decks	100	-99.5	-0.995	411.14391	
9 Decks	100	-558.5	-5.585	389.92957	
10 Decks	100	-504	-5.04	255.67515	

Our null hypothesis is that that average outcome for the counting strategy player amongst different amounts of decks is the same. Our alternative hypothesis is that at least one average outcome is different from the others. Since our found F-Score of 1.4058 is less than our F-Critical Score of 1.8893, we fail to reject our null hypothesis.

WHAT WE COULD IMPROVE

If a player is dealt two of the same cards, they can split their hand by doubling their bet, and continue with each card as though it were a separate hand. In future versions of this model, we could implement this feature. One could also implement a factor where the number of bet units placed by a player is based upon their win/loss record. Alternatively, the players could be changed to reflect more realistic budgets and bets.

CONCLUSION

Although our statistical findings concluded that the counting strategy is not statistically more effective than the advance strategy, this is most likely due certain features lacking from our model, as well as the overall randomness of blackjack. Card counting is actually a fairly simple and effective strategy and almost anyone can learn how to count cards and boost their chances at making gains. However, one must also have a good understanding of the most opportune times to hit, split, and double in order to maximize their gains

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