A Terrible Statistical Analysis of *Pass the Pigs*

DYLAN BLACK[1,2], OLD MAJOR[2,*], AND NAPOLEON[2]

[1] *Publications Department, The Games for Children Society (GCS), 2010 Massachusetts Avenue NW, Washington D.C., 20036*
[2] *Institute of Porcine Studies, University of Pig Technology, 2000 J St. NW, Washington DC, 20036*
[*] *Corresponding author: oldmajor1984@pigmail.com*

Compiled December 30, 2017

We present for the first time a semi-rigorous statistical analysis of *Pass the Pigs*. After conducting minimal probabilistic modeling of the pig dice, using both experimental methods and Monte Carlo simulations, we find that passing the pigs after achieving a score of 28-30 on a single turn gives the highest expected value for score per turn.

OCIS codes:

http://dx.doi.org/10.1364/ao.XX.XXXXXX

1. INTRODUCTION

Pass the Pigs is, simply put, a game of unfair dice. The dice themselves are pigs in miniature, (See Fig. 1), and each die can land in one of six possible orientations. If the pig lands on its side (Fig. 1, Sider panel), it may either land on the dotted side (Fig. 1, Snouter panel) or the blank side (Fig. 1, Leaning Jowler panel). Both of these rolls are known as "siders." It may land on its snout (a "snouter"), its ear (a "leaning jowler"), its back, (a "razorback"), or its feet (a "trotter," for an example see Mixed Combo panel in Fig. 1). A player rolls two of these dice, and calculates his score based on the table shown in Figure 1. For example, If player 1 rolls a sider and a snouter, that is worth 10 points. A roll of a razorback and a snouter would be worth 15 points. The player may continue to roll the dice as many times as they wish, accruing more points, or choose to "pass the pigs" to the next player. However, if the player, at any point, rolls a "pig out," (consisting of siders with opposite parity, *i.e.* a blank pig and a dotted pig) or a "makin' bacon," (two pigs touching each other) the player receives no points for his turn and must immediately pass the pigs to the next player. The object of the game is to get the most number of points. Generally, the game is played such that the first person who reaches some arbitrary number of points wins. For large point goals, the game thus reduces to a single question: At what score per turn is it optimal to pass the pigs? This letter seeks to answer this question.

Fig. 1. The official scoring system of *Pass the Pigs*. Note that for some reason, a trotter is not mentioned in the scoring list. For the purposes of this paper, a trotter will be considered to be scored like a snouter (10 points), but as a distinct pig state (*i.e.* a roll of a trotter plus a snouter would be considered 20 points, not 40). This was chosen because the snouter and the trotter occurred with roughly the same probability in our trials.

2. EXPERIMENTAL DATA

Since these dice are manifestly unfair, it is necessary to create a probabilistic model of the different pig states. Since a full 3D modeling effort would be complicated, boring, and inaccurate, we constructed our pig state probability model (PSPM) by rolling a single pig die many times. The results are summarized in Table 1.

A. Pig State Probability

Table 1. Number of Occurrences

Pig State	N	% Total
sider	364	63.4%
razorback	152	26.5%
trotter	32	5.6%
snouter	23	4.0%
leaning jowler	3	0.5%
total	574	100%

Unfortunately, the leaning jowler is rare enough that it would take a couple orders of magnitude more rolls to be confident in these probabilities, and frankly we don't have the patience for that. We attempted to mimic the rolling technique that might occur in a real game of *Pass the Pigs*, by alternating rolling styles between a sideways throw and a vertical drop. It appeared as though the vertical drop had a higher rate of producing razorbacks than the sideways roll, but this effect was not quantified. Additionally, a trial was performed where many pig dice were rolled at once, and the frequency of makin' bacon (See Fig. 1) was assessed. This occurred so rarely that it was not included in the statistical analysis.

3. ANALYSIS

Since *Pass the Pigs* has no interaction between turns, the game can be reduced mathematically to the expected value of a single turn. In order to answer the fundamental question, "at what score per turn should I pass the pigs?," we implemented a Monte Carlo simulation (code available at imnotpostingthisawfulcode.com/passthepigs2017). In brief, the simulation generates two random rolls according to the probability distribution of Table 1, calculates the score based on Figure 1, then decides whether to roll again or pass the pigs based on the current turn score. We defined "cutoff score," where if the current turn score equaled or exceeded the cutoff score, the turn was terminated. A pig out at any point terminated the turn and the score for that turn was counted as a zero, and makin' bacon was not considered. Pig outs and siders were assumed to be equally probable, with a probability of 31.7% each. We then iterated the simulation over cutoff scores from 1 to 100, and calculated the expected value of each turn. The Results are plotted in Figure 2.

The curve is quite flat at the apex, varying only 0.02 points from 28 to 30. The expected score per turn is maximized at a cutoff score between 28 and 30, with an expected value of approximately 12.6 points per turn. Note also the step-like features of low cutoff scores and the general rippling. These are not numerical artifacts, we believe they result from the quantized scoring system, where a score of 5, requiring a single razorback roll with a probability of approximately 27%, is significantly more likely than a score of 4, requiring 4 sider rolls without a pig out, a probability of 0.317^4, or a 1% chance. The flat-tops of the steps occur at cutoff scores of (3,4,5), (8,9,10), (13,14,15), with jumps at 6, 11, and 16, lending support to the theory that the shape of this distribution is determined by scores appearing only in units of 1 or 5. The decline in score after the peak is approximately linear, with a slope of -0.1234.

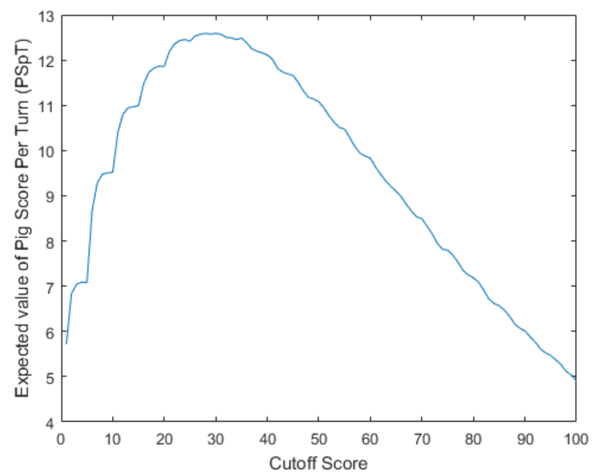

Fig. 2. The expected value of the score per turn plotted against a cutoff score.

4. CONCLUSION

In this letter, we have shown that the expected value of a turn in *Pass the Pigs* is maximized if a player passes the pigs after achieving a score greater than or equal to 28-30, and that the expected value of a player's score per turn decreases approximately linearly after this point. Future work will explore the unique shape of the distribution, and the effects on the expected value per turn of continuous and quantized scoring systems in *Pass the Pigs*.

REFERENCES

1. https://shop.chess.co.uk/Pass-the-Pigs-p/cb02969.htm