# "Pass the Pigs[1]"

SCI 1100
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Topics: Probability, independence, expectation, mathematical modeling

Overview:

- The rules of "Pass the Pigs"
- Playing the game
- Analyzing the game; Decision making
- Introduction: Probability, independence, expectation
- Estimating the probabilities of the outcomes of piggy pair throws
- Computing the expected value of a turn
- The "St. Petersburg Game" – Shortcomings of the concept of expectation

[1] © David Moffat Enterprises. You can play an online version of "Pass the Pigs" at http://www.fontface.com/games/pigs/ and other sites on the web.

## Playing "Pass the Pigs"

- <u>Objective</u>

  The objective of this game is to be the first player who rolls a total of 100 points.

- <u>How to Play</u>

  Follow these steps to play the game.

  1. Roll the pigs.
     The pigs land a certain way giving you a score for that roll. See the scoring table below for all possible rolls.

  2. Decide to **roll again** and try to get more points, or **Pass the Pigs** to the next player if you are satisfied with your roll.
- <u>The Rules</u>
  1. **If you roll a "Pig Out" your turn is over and you lose all your points for that turn.**
  2. If you roll an "Oinker" you lose all of your points, including any accrued from previous turns.
  3. See below for a chart explaining all point values.

| Roll | Value |
|---|---|
| Sider | 1 point |
| Razorback | 5 points |
| Trotter | 5 points |
| Snouter | 10 points |
| Leaning Jowler | 15 points |
| Double Razorback | 20 points |

| Roll | Value |
|---|---|
| Double Trotter | 20 points |
| Double Snouter | 40 points |
| Double Leaning Jowler | 60 points |
| Mixed Combo | Combined score |
| Pig Out | Back to zero for turn |
| Oinker | Back to zero for game |

<u>Score Sheet</u>

| PLAYER 1 | PLAYER 2 | PLAYER 3 | PLAYER 4 |
| --- | --- | --- | --- |
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Observed Outcome Frequencies

| Position | Tallying | Totals | Points |
|---|---|---|---|
| Sider | | | 1 |
| Razorback (RB)<br>Trotter (TR) | | | 5 |
| Snouter (SN),<br>RB+TR | | | 10 |
| Leaning Jowler (LJ),<br>RB+SN<br>TR+SN | | | 15 |
| RB+RB,<br>TR+TR,<br>RB+LJ,<br>TR+LJ | | | 20 |
| SN+LJ | | | 25 |
| SN+SN | | | 40 |
| LJ+LJ | | | 60 |
| Pig Out | | | - |
| Oinker | | | - |
| | **Total:** | | |

**Names:** ______________________________________________

1. Let $x$ be the number of points accumulated by the player before the next throw. Compute the expected value of the player's next throw.

2. When should the player stop playing?

**Names:** ______________________________________________

The St. Petersburg Game[2]:

> *The St. Petersburg game is played by flipping a fair coin until it comes up tails, and the total number of flips, n, determines the prize, which equals $\$2^n$. Thus if the coin comes up tails the first time, the prize is $\$2^1 = \$2$, and the game ends. If the coin comes up heads the first time, it is flipped again. If it comes up tails the second time, the prize is $\$2^2$, = $4, and the game ends. If it comes up heads the second time, it is flipped again. And so on.*

1. How much money would YOU be willing to pay upfront to get a chance to play this game? (Don't do any math, just think about how much money you would be willing to put down!)

2. Compute the "expected pay-off" of the game. Hint: With probability ½ the game ends after 1 toss of the coin. What is the payoff if the game ends after one toss? With probability ¼ the game ends after exactly two tosses of the coin. With probability 1/8 the game ends after exactly three tosses of the coin. And so on.

3. Does the computation in Part 2 of this worksheet change your answer to Question 1? Explain in a couple of sentences!

[2] The mathematician Nicolas Bernoulli suggested to his colleague Pierre Rémond de Montmort to analyze this game. Montmort is the author of the book *"Essay d'analyse sur les jeux de hazard"*, one of the first mathematical treatments of games of chance, written in 1708.