

Probability, Part II

2/1/16

Games of Pure Luck

Can they be fun?

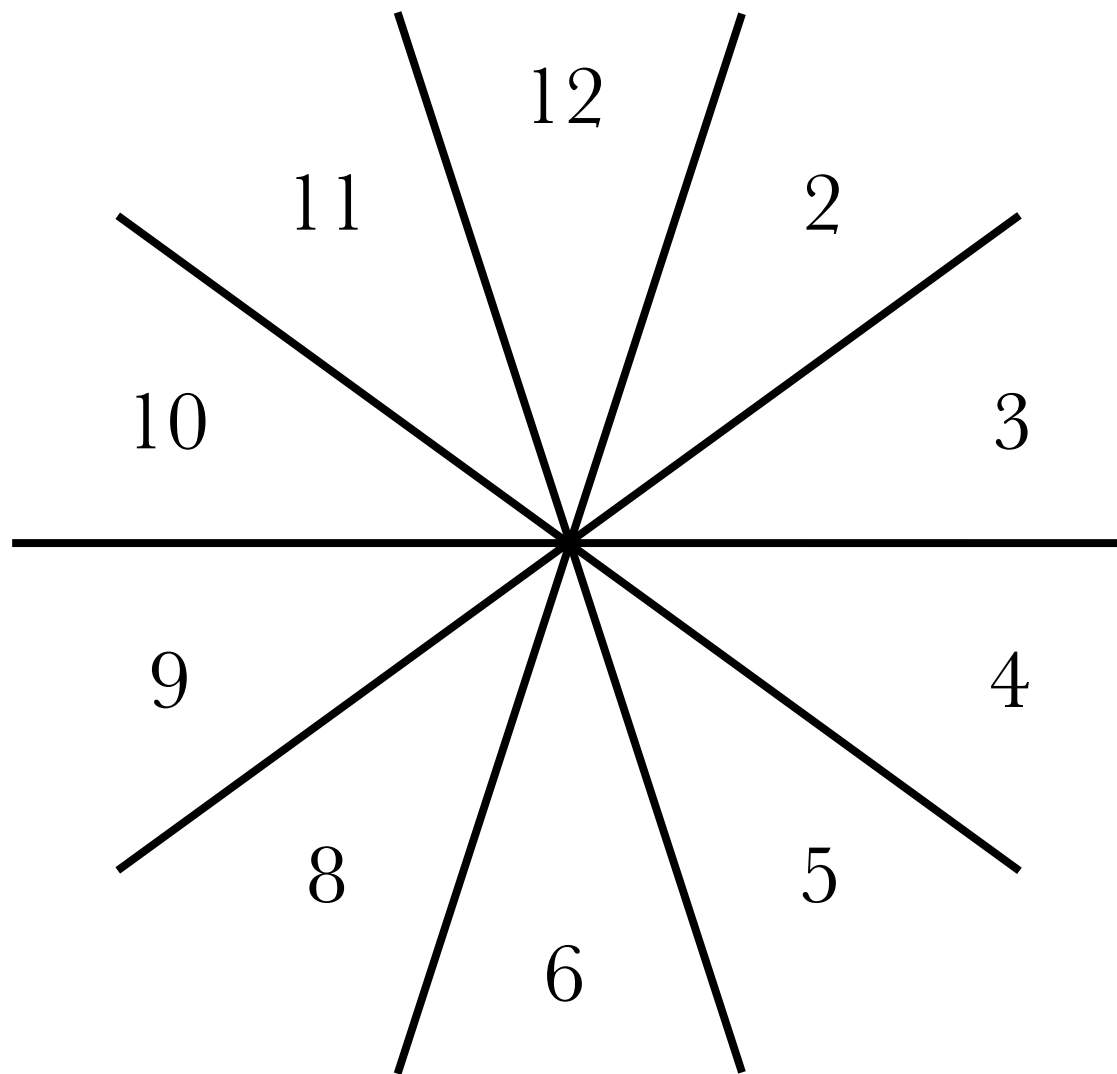
Put and Take (variant)

- All players start with 10 counters
- All players ante 1 chip per turn
- Roll 1 die:
 - 1 - put 1 counter in middle
 - 2 - put 2 counters in middle
 - 3 - all players put 1 counter in middle
 - 4 - take 1 counter
 - 5 - take 2 counters
 - 6 - take all counters
- Game ends when one player loses all counters
 - player with most counters wins

Boston

- Roll 3 dice - keep highest
- Re-roll other 2 - keep highest
- Re-roll final die, sum total
- Highest score of round wins 1 point for the round
- 2nd round worth 2 points, 3rd worth 3, etc.
- Play 10 rounds (55 points up for grabs)

Spider



Spider

- The first player to cross off all numbers (2-12) wins.
- Roll an uncrossed number: cross it off and continue.
- Roll a 7: cross off any number, end turn.
- Roll a crossed number: 1st player to left that can use it crosses it off, end turn.

Betting Games

know your odds...

Playing Environments

- Casino Games - Buy chips, play games run by a “banker” (dealer), sell chips (usually fewer), and leave
- Friendly Games - Meet with friends for fun with small stakes. One player brings chips, players take turn being the banker. See who came out the best
- Family Games - All players have same amount of chips from imaginary bank (chips have no monetary value). Player with most chips at end is the winner

What are the Odds?

- “3 *to* 1”
 - receive banker’s payment in addition to your stake
- “3 *for* 1”
 - how much you’re paid for your bet
- e.g., “5 for 2” = “3 to 2”

True Odds

- The “fair” payout that would keep the game balanced in the long run, without advantage to either side
- Inverse probability of “for” odds
 - Chance of rolling a 5 on a die?
 - $1/6 =$ “6 for 1”, or “5 to 1”
- “For” odds compare favorable outcomes with all outcomes
- “To” odds compare favorable outcomes to unfavorable outcomes

Jolly Seven

- Bet and throw

Under 7	7	Over 7
2 for 1	5 for 1	2 for 1

Analysis

- There are 6 ways to roll a 7, out of 36 possibilities, giving odds of 1 in 6
- True odds are 6 for 1, bank pays 5 for 1, bankers cut is therefore 16.67%
- Half of the remaining 30 rolls are below 7 (likewise for above) = 15/36
- True odds are 12 for 5, bank pays 10 for 5, bankers cut is 16.67%
- Moral: Don't play. Be the Banker.

Best Bet / Worst Bet?

	7 5 for 1		
UNDER 7 2 for 1	6 6 for 1	8 6 for 1	OVER 7 2 for 1
	5 7 for 1	9 7 for 1	
	4 10 for 1	10 10 for 1	
ODD 2 for 1	3 15 for 1	11 15 for 1	EVEN 2 for 1
	2 30 for 1	12 30 for 1	

Private Craps

2 Miss	3 Miss	4 5 6 Shooter's Point	7 Pass	8 9 10 Shooter's Point	11 Pass	12 Miss
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Side Bets

- Flat bet - before shooter begins, two players bet equal stakes against each other that the shooter will eventually pass or miss

Side Bets

- Point bet - after shooter reaches a point number, bet whether shooter will (or won't) reach point before rolling a 7

Point Bet	4 (10)	5 (9)	6 (8)
Favorable Outcomes	3	4	5
Unfavorable Outcomes	6	6	6
True Odds	6 to 3 2 to 1	6 to 4 3 to 2	6 to 5
Probability of Success	1/3	2/5	5/11

Side Bets

- Hard Way bet - after shooter reaches an even point value, bet as to whether or not the point will be reached “the hard way” (doubles)

Hard Way Bet	4 (10)	6 (8)
Favorable Outcomes	1	1
Unfavorable Outcomes	8	10
True Odds	8 to 1	10 to 1
Probability of Success	1/9	1/11

Side Bets

- Come bet - Start a new game with another player *at any stage in the “main game”*
- Shooter’s next throw becomes the first throw of your new “sub-game”
- Equivalent to flat bets (equal stakes)
- Come bets continue into the next game if the shooter wins “main” game before a decision is reached

Side Bets

- Proposition bet - any agreed upon bet and odds at any point in the game
- Most popular:
 - One Roll Bet - any bet on the outcome of the next throw - “any craps” is a bet that the next throw will be a 2,3 or 12
 - One Number Bet - a bet that a specific total will or will not be reached before a particular event

The Odds

- Somewhat more involved
- Bottom line, shooter has a 49.29% chance to pass (valid for Center, Flat, and Come Bets)
- Slight disadvantage, but most people consider it negligible for the fun of being in the “captain’s seat” (such as it is)



LOSE	2-5
10	
WIN	9-5

LOSE	LOSE	LOSE	LOSE	LOSE	LOSE
2-5	4-7	4-5	4-5	4-7	2-5
4	5	SIX	8	NINE	10
WIN	WIN	WIN	WIN	WIN	WIN
9-5	7-5	7-6	7-6	7-5	9-5

Don't Come Bar

One Number Bets

Hard Way

Note!

New!

One Roll Bets

Sucker!

Seven
5 FOR 1 5 FOR 1

10 FOR 1 8 FOR 1

10 FOR 1 8 FOR 1

15 - 1 30 - 1

30 - 1 15 - 1

Any Craps
8 FOR 1

COME

2 3 4 9 10 11 12

FIELD

Don't

6 8

PASS LINE

CREDITS
0.00

GAMES OPTIONS

BANK STATS

HELP EXPERT

1

- +

BET : 0.00 WIN : 0.00

UNDO REDO CLEAR REPEAT ROLL

Play the Boring Bets!

- Pass, don't pass, come, don't come - casino gets cut of $\sim 1.4\%$

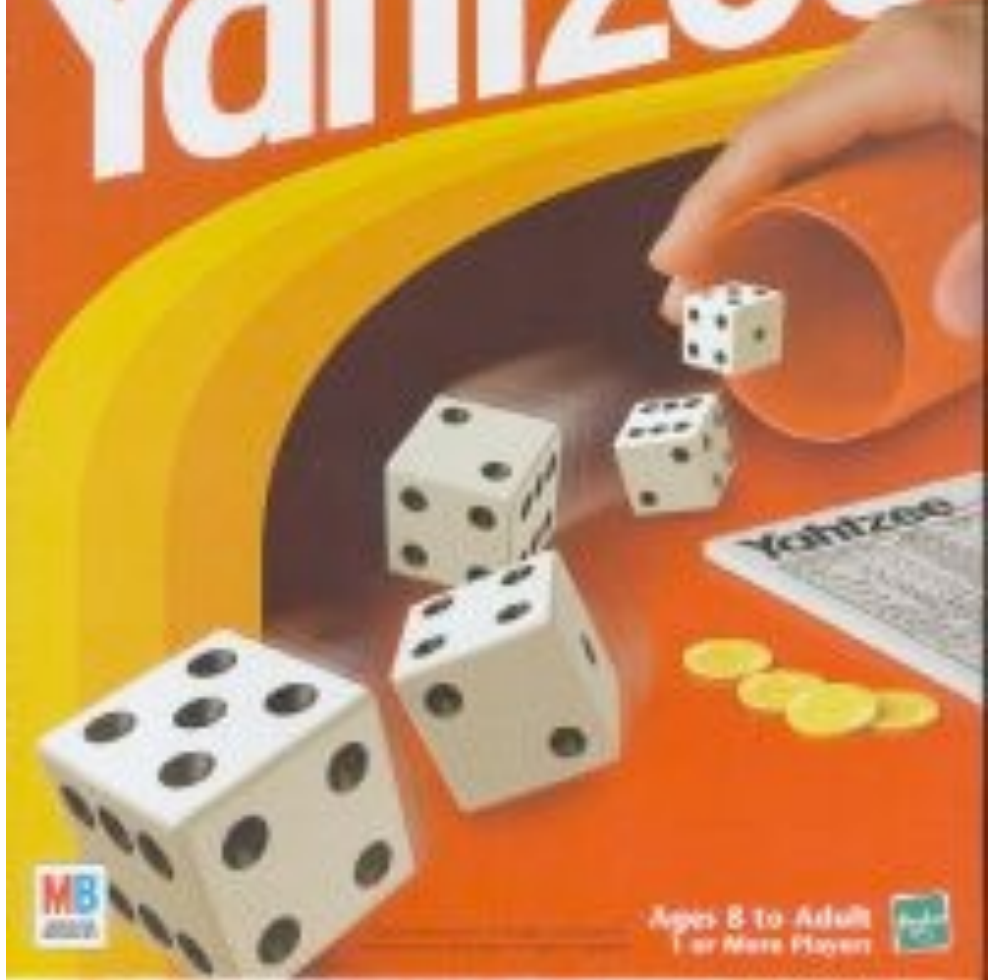
One Roll Bet	7	Craps	11	1-1	1-2
Favorable	6	4	2	1	2
Unfavorable	30	32	34	35	34
True Odds	30 to 6 5 to 1	32 to 4 8 to 1	34 to 2 17 to 1	35 to 1	34 to 2 17 to 1
Payout	4 to 1	7 to 1	15 to 1	30 to 1	15 to 1
Banker's Cut	1/6 16.67%	1/9 11.11%	1/9 11.11%	5/36 13.89%	1/9 11.11%

Category Games



The classic shake
and score dice game!

Yahtzee









Ages 8 to Adult
1 or More Players

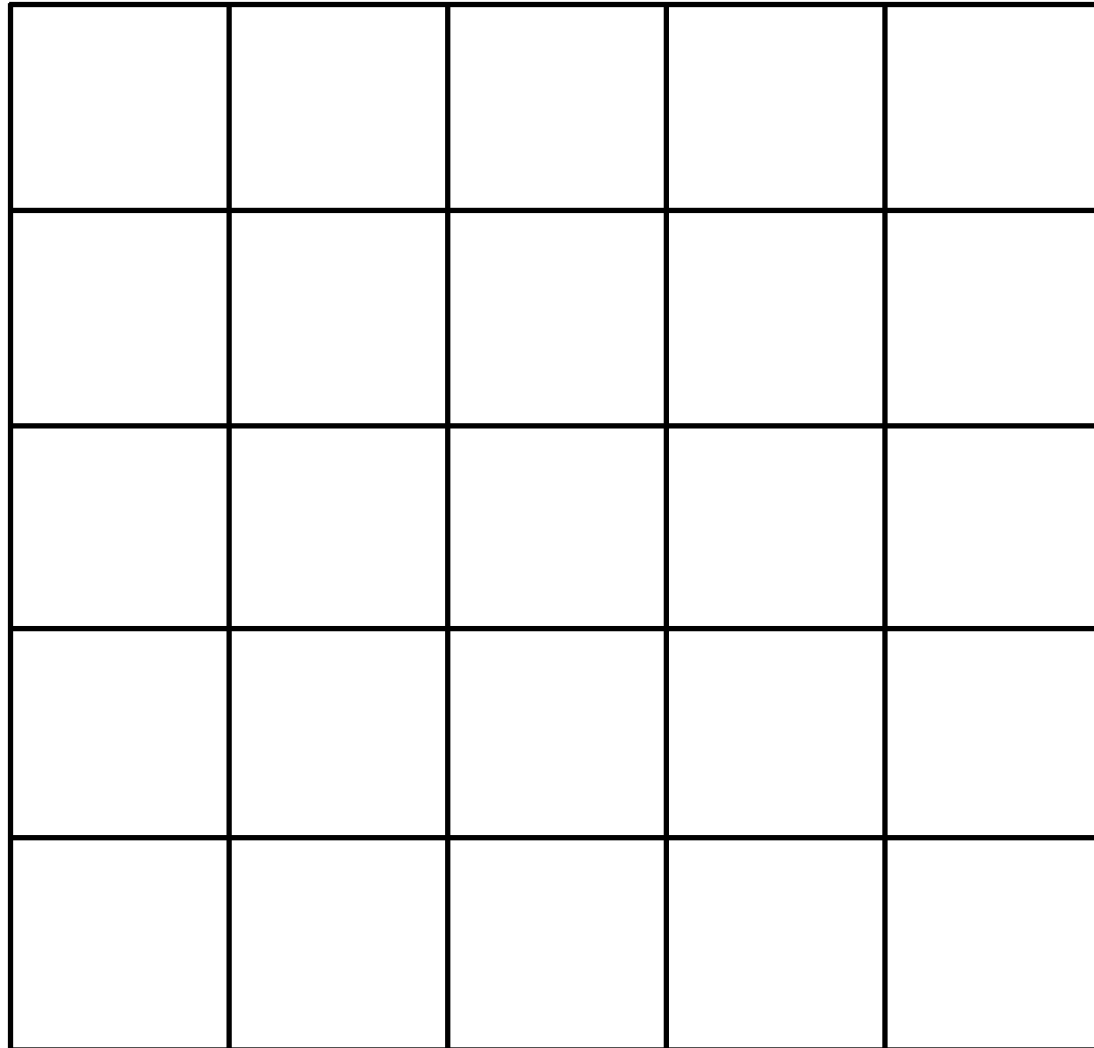


Yahtzee®

NAME _____

UPPER SECTION	HOW TO SCORE	GAME #1	GAME #2	GAME #3	GAME #4	GAME #5	GAME #6
Aces  = 1	Count and Add Only Aces						
Twos  = 2	Count and Add Only Twos						
Threes  = 3	Count and Add Only Threes						
Fours  = 4	Count and Add Only Fours						
Fives  = 5	Count and Add Only Fives						
Sixes  = 6	Count and Add Only Sixes						
TOTAL SCORE	→						
BONUS <small>If total score is 63 or over</small>	SCORE 35						
TOTAL <small>Of Upper Section</small>	→						
LOWER SECTION							
3 of a kind	Add Total Of All Dice						
4 of a kind	Add Total Of All Dice						
Full House	SCORE 25						
Sm. Straight <small>Sequence of 4</small>	SCORE 30						
Lg. Straight <small>Sequence of 5</small>	SCORE 40						
YAHTZEE <small>5 of a kind</small>	SCORE 50						
Chance	Score Total Of All 5 Dice						
YAHTZEE BONUS	✓ FOR EACH BONUS						
	SCORE 100 PER ✓						
TOTAL <small>Of Lower Section</small>	→						
TOTAL <small>Of Upper Section</small>	→						
GRAND TOTAL	→						

Criss-Cross



Mechanics

- 2d6 will be used to generate single numbers, 0-9 (10 = 0, 11 = 1, 12 = 2)
- Everybody rolls for their individual center square number
- Play proceeds clockwise, with each player rolling the dice, announcing the result to the group, and passing dice to the left
- After each throw, each player places the number in their grid where they see fit

After 4 Rounds

8				
		3		
	2	3		
8				

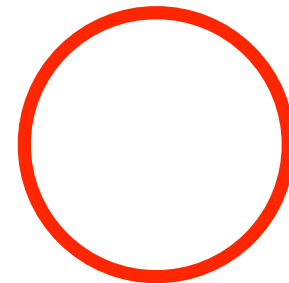
Scoring

- The idea is to align the numbers in valuable rows and columns to score maximum points
 - Five equal digits: n points (let's say 6 for now)
 - Four equal digits: m points (let's say 4)
 - Three equal digits: p points (let's say 2)
 - Two equal digits: q points (let's say 1)
 - Sequence of 5 consecutive digits (can be unordered): s points (let's say 4)
- 0s can be low or high
- Sequences can loop (e.g. 8-1-0-9-2 = s)
- It is possible to get more than one score in a line (e.g. full house = $p + q$ points) (so 3 in this case)

Sample Score

(assumes $5/k = 6\text{pts}$, $4/k = 4\text{pts}$, $3/k = 2\text{pts}$, $2/k = 1\text{ pt}$,
sequence = 4pts)

7	9	8	6	5
1	9	8	6	1
4	4	4	4	4
5	4	7	6	3
5	9	8	6	2



Exercise

- Make the scoring fair
 - 5 of kind = ? points
 - 4 of kind = ? points
 - 3 of kind = ? points
 - 2 of kind = ? points
 - Sequence = ? points
 - Should diagonals count?

	1	A	α	ℵ	अ	↯	RK
5/k	6	10	10	8	9	10	10
4/k	4	6	6	5	5	7	6
3/k	2	2	3	2	2	5	3
2/k	1	1	1	1	1	2	1
Seq.	3	5	15	7	4	13	5
Diag?	N	N	N	N	Y	N	Y

	1	A	α	\mathcal{N}	RK
5/k	6	10	8	20	10
4/k	4	7	5	11	6
3/k	2	5	3	5	3
2/k	1	2	2	2	1
Seq.	5	6	10	10	5
Diag?	N	N	N	N	Y

Variants

- Criss *and* Cross
 - You may only score the *lower* of the row and column scores
- Criss *vs.* Cross
 - Two players, one score sheet, alternate turns
 - One player is scoring the rows, the other the columns (madness!)

Homework (Extra Credit)

- Prove the dealer's cut on a "Miss" or a "Don't Come" bet is $\sim 1.4\%$ (Remember - boxcars don't count on first roll!)