

# QUICKCRAPS 21

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## MATHEMATICAL ANALYSIS PREPARED FOR LUCKY GAMES L.L.C.

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*An analysis of the mathematics and statistics inherent to a proposed new casino table game.*

# QUICKCRAPS 21 MATHEMATICAL ANALYSIS

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*Prepared by Charles Mousseau, B.Sc. on 25 May 2009*

## **Introduction and general procedure:**

1. QuickCraps 21 is played with six standard 52-card decks of playing cards, and two six-sided dice.
2. At the beginning of each round, each player must place a bet on the main bet (hereafter referred to as the "21 Wager"), and if desired, on the side bet (hereafter referred to as the "Craps Wager").
3. Each player is dealt one card face up.
4. In turn, each player is given the opportunity to stand, or draw up to two additional cards.
  - a. If at any point the player's hand total is ten, that player may make an additional wager, hereafter referred to as the "Raise Wager", of up to 10 times the 21 Wager
5. Once all players have finished drawing, the dealer rolls two dice. Each player's hand total will consist of the totals of the two dice and any cards in their hand, calculated in the standard blackjack fashion, and compared to the following payable:
  - a. If the player's total is 19 or 20, the 21 Wager and Raise Wager will pay even money
  - b. If the player's total is 21, the 21 Wager and Raise wager will pay at a rate of 2:1
  - c. If the player's total is 16, 17 or 18, the 21 Wager and Raise Wager will push
  - d. Otherwise, the player's 21 Wager and Raise wager will lose
6. Finally, all players who made a Craps Wager will have it resolved according to the payable supplied in the Appendix.
7. All cards are removed and the round is ended.

## **Methodologies:**

1. A spreadsheet with an infinite deck model was created, analyzing all possible outcomes to determine the player's expectation on the 21 Wager and the Craps Wager.
2. A computer program was created in the C# programming language (VS 2008 standard) to simulate 1,000,000,000 hands of play and verify the results to within 0.1%
3. In all cases, the player is assumed to be playing with the optimal strategy on all bets wagered.

## **Results:**

1. On the 21 Wager, with optimal player strategy, the house will win, on average, ***an amount equal to 3.66% of the 21 Wager.***
2. On the Craps wager, using the main payable, the house will win, on average, ***an amount equal to 3.63% of the Craps Wager.***
3. For alternate paytables and their respective House Edges, please see the Appendix.

Report completed on 25 May 2009 by Charles Mousseau, B.Sc.

*Charles Mousseau*

Results are deemed reliable.

# QUICKCRAPS 21: APPENDIX OF TABLES

Table #1: 21 Wager breakdown.

Upcard	EV	P(Upcard)	Value
A:	0.166667	0.076923077	0.012821
2:	0.046022	0.076923077	0.00354
3:	0.066239	0.076923077	0.005095
4:	0.043228	0.076923077	0.003325
5:	-0.02548	0.076923077	-0.00196
6:	-0.1024	0.076923077	-0.00788
7:	-0.18475	0.076923077	-0.01421
8:	-0.26282	0.076923077	-0.02022
9:	-0.22222	0.076923077	-0.01709
X:	0	0.307692308	0
Sum:		1	-3.66%

Table #2: Craps Wager breakdown.

## Craps - Pay Table #1 – Main payable

First Card Only to Make Point

	p	EV	p * EV
Auto Win: 7-11	0.20513	1	0.20513
7 Match	0.01282	3	0.03846
11 Match	0.00427	11	0.04701
Auto Lose: 2-3-12	0.11111	-1	-0.11111
Make 10	0.02564	2	0.05128
Make 8 or 6	0.02137	6	0.12821
Make 9 or 5	0.01709	8	0.13675
Make 4	0.00641	10	0.06410
Lose Point	0.59615	-1	-0.59615
	1.00000		-3.63%

## Craps - Pay Table #2

First Card Only to Make Point

	p	EV	p * EV
Auto Win: 7-11	0.20513	1	0.20513
7 Match	0.01282	2	0.02564
11 Match	0.00427	11	0.04701
Auto Lose: 2-3-12	0.11111	-1	-0.11111
Make 10	0.02564	2	0.05128
Make 8 or 6	0.02137	6	0.12821
Make 9 or 5	0.01709	9	0.15385
Make 4	0.00641	10	0.06410
Lose Point	0.59615	-1	-0.59615
	1.00000		-3.21%

### Craps - Pay Table #3

First Card Only to Make Point

	p	EV	p * EV
Auto Win: 7-11	0.20513	1	0.20513
7 Match	0.01282	3	0.03846
11 Match	0.00427	11	0.04701
Auto Lose: 2-3-12	0.11111	-1	-0.11111
Make 10	0.02564	2	0.05128
Make 8 or 6	0.02137	5	0.10684
Make 9 or 5	0.01709	9	0.15385
Make 4	0.00641	10	0.06410
Lose Point	0.59615	-1	-0.59615
	1.00000		-4.06%

### Craps - Pay Table #4

First Card Only to Make Point

	p	EV	p * EV
Auto Win: 7-11	0.20513	1	0.20513
7 Match	0.01282	2	0.02564
11 Match	0.00427	11	0.04701
Auto Lose: 2-3-12	0.11111	-1	-0.11111
Make 10	0.02564	2	0.05128
Make 8 or 6	0.02137	5	0.10684
Make 9 or 5	0.01709	9	0.15385
Make 4	0.00641	10	0.06410
Lose Point	0.59615	-1	-0.59615
	1.00000		-5.34%

### Craps - Pay Table #5

First Card Only to Make Point

	p	EV	p * EV
Auto Win: 7-11	0.20513	1	0.20513
7 Match	0.01282	3	0.03846
11 Match	0.00427	11	0.04701
Auto Lose: 2-3-12	0.11111	-1	-0.11111
Make 10	0.02564	2	0.05128
Make 8 or 6	0.02137	5	0.10684
Make 9 or 5	0.01709	8	0.13675
Make 4	0.00641	10	0.06410
Lose Point	0.59615	-1	-0.59615
	1.00000		-5.77%

### Craps - Pay Table #6

*First Card Only to Make Point*

	p	EV	p * EV
Auto Win: 7-11	0.20513	1	0.20513
7 Match	0.01282	2	0.02564
11 Match	0.00427	11	0.04701
Auto Lose: 2-3-12	0.11111	-1	-0.11111
Make 10	0.02564	2	0.05128
Make 8 or 6	0.02137	7	0.14957
Make 9 or 5	0.01709	8	0.13675
Make 4	0.00641	10	0.06410
Lose Point	0.59615	-1	-0.59615
	1.00000		-2.78%