



GLI

**World Headquarters**

600 Airport Road  
Lakewood, NJ 08701

Phone: (732) 942-3999

Fax: (732) 942-0043

www.gaminglabs.com

**Worldwide Locations**

**World Headquarters**

Lakewood, New Jersey

**U.S. Regional Offices:**

Colorado

Nevada

**International Offices:**

GLI Africa®

GLI Australia® Pty Ltd

GLI Europe, B.V.®

April 18, 2008

Jack R. Chappell, President  
Play Craps, Inc.  
1350 E. Flamingo Road, Suite 629  
Las Vegas, Nevada 89119

Re: Review and Math Analysis of *Play Craps*

Dear Mr. Chappell;

As per Play Craps, Inc.'s request of March 14, 2008, please find **Gaming Laboratories International, Inc.'s (GLI)** mathematical analysis of the table game, *Play Craps*.

This report only verifies the mathematical aspects of this game and **DOES NOT** offer an opinion as to whether or not this game is currently authorized for use in any jurisdiction.

---

## Introduction

---

*Play Craps* is a new version of the popular dice game, *Craps*, that is played with cards instead of dice. The configuration of the *Play Craps* table resembles card games such as *Blackjack*, but the bets made are the same as in the dice version of the game. The purpose of this report is to analyze the odds of the bets in this game, and compare them with the odds of the standard version of the game played with dice.

---

## Game Description

---

*Play Craps* is played with a special type of deck. Each deck has 54 cards, nine sets of cards which show dice "pip" designs from 1 through 6. Pips are the markings on dice which show the number that side of the dice is supposed to represent. The game is intended to be played with six decks at a time in order to make the odds approximately close the odds of the dice version of the game. In this description a deal of two cards is described as a "roll".

As in the standard dice version of *Craps*, the game begins with a “Come Out” roll, where two cards are drawn and the numbers on each card are added together. Unlike the dice version, the dealer is always the “shooter”, or the one that draws the cards, and players do not touch the equipment. If the Come Out roll is 7 or 11, the hand is a winner. If the roll is 2, 3, or 12, the hand is a non-winner. If any of the other numbers is rolled, which are 4, 5, 6, 8, 9, and 10, that number is called the “point”, and additional hands of two cards are dealt until one of them either equals the point or equals 7. The hand wins if the point is rolled again and loses if a 7 is rolled.

Players have the opportunity to choose which “side” to place a bet. They can choose to bet that a hand may be a winner, called a “Pass Line” bet, or that it will be a non-winner, called a “Don’t Pass Line” bet. These bets pay even money, except in the case of an initial roll of 12 where the Don’t Pass Line bet pushes instead of winning.

In addition to the Pass Line and Don’t Pass Line bets, there are other side bets that may be made by players, which are further described below:

“Pass Line Odds” bets are placed after the point is established and will win if the point comes up before 7. This bet pays 2 to 1 odds if 4 or 10 is the point, 3 to 2 odds if 5 or 9 is the point, and 6 to 5 if 6 or 8 is the point. These bets can be favorable to the player when placed in isolation, but may only be made in conjunction with a Pass Line bet of equal value, so the overall expected return still favors the house.

“Don’t Pass Line Odds” bets are placed after the point is established and will win if a 7 comes up before the point. This bet pays 1 to 2 odds if 4 or 10 is the point, 2 to 3 odds if 5 or 9 is the point, and 5 to 6 odds if 6 or 8 is the point. Like the Pass Line Odds bet, these bets can be favorable to the player when placed in isolation, but may only be made in conjunction with a Don’t Pass Line bet of equal value, so the overall expected return still favors the house.

“Place to Win” bets work like Pass Line Odds bets, except that the bettor may choose which point to bet on and does not need to have placed a Pass Line bet. This bet pays 9 to 5 odds if 4 or 10 is the point, 7 to 5 odds if 5 or 9 is the point, and 7 to 6 odds if 6 or 8 is the point.

“Place to Lose” bets work like “Don’t Pass Line Odds” bets, except that the bettor may choose which point to bet against and does not need to have placed a Don’t Pass Line bet. This bet pays 5 to 11 odds if 4 or 10 is the point, 5 to 8 odds if 5 or 9 is the point, and 4 to 5 odds if 6 or 8 is the point.

“Buy” and “Lay” bets, work like Place to Win and Place to Lose bets, respectively, except that the odds payouts are different. The Buy bet pays 13 to 7 odds if 4 or 10 is the point, 29 to 21 odds if 5 or 9 is the point, 23 to 21 odds if 6 or 8 is the point. The Lay bet pays 19 to 41 odds if 4 or 10 is the point, 19 to 31 odds if 5 or 9 is the point, 19 to 25 odds if 6 or 8 is the point.

“Hard Way” bets win only if the point is made with a “doubles roll”. They are a 2-2 for a point of 4, 3-3 for a point of 6, 4-4 for a point of 8, and 5-5 for a point of 10. This bet pays 7 to 1 odds when the point is 4 or 10, and pays 9 to 1 odds when the point is 6 or 8. If a 7 is made before the point, or if the point is made with two unequal numbers, this bet loses.

“One Hand” bets are side bets that win if particular totals come up on the next roll. One may bet on the individual totals of 2, 3, 7, 11, and 12. For this bet a 2 pays 30 to 1, a 3 pays 15 to 1, a 7 pays 4 to 1, a 11 pays 15 to 1, and a 12 pays 30 to 1. There are also combination bets for “Any Craps” which win if a 2, 3, or 12 is rolled and is paid 7 to 1 odds, “Horn” bets which is the same as placing four simultaneous bets on 2, 3, 11, and 12, and “Field” bets which loses on 5, 6, 7, and 8, pays even money on 3, 4, 9, 10, and 11, and pays 2 to 1 odds on 2, and pays either 2 to 1 or 3 to 1 on 12 depending on local rules.

---

## Mathematical Analysis

---

The math included in this submission assumes that the odds for all bets are the same as for the dice version of *Craps*, but this is incorrect because when two cards are dealt at the same time, the probability of getting a given number on the second card depends on what the first card was, while dice probabilities are independent. When playing with six decks, there are initially 54 cards of each denomination, so the probability of getting a 6 on the first card is  $54/324 = 1/6 = 16.667\%$ , but if the first card was a 6 then the probability of getting a 6 on the second card is only  $53/323 = 16.409\%$ . Thus the chance of rolling a 12 is not  $1/36 = 2.778\%$ , as it is with dice, but rather  $53/(6*323) = 2.735\%$ .

Since the odds depend on the exact composition of the deck, we assumed that a continuous shuffling machine will be used, so that only two cards at a time are selected without replacement. A workbook of spreadsheets was created that calculates the probability of each two-card total from 2 through 12 by counting the number of two-card combinations with that total in a deck which contains 54 cards of each denomination. The odds and edge for each bet were calculated using these probabilities; in parallel, the “dice” odds were calculated in the same way from the dice probabilities for each total from 2 through 12.

The first worksheet in the workbook assumes that six decks are used. Later worksheets repeat the calculations for 1, 2, 3, 4, 5, 8, and 12 decks. The last worksheet assumes that the cards are not reshuffled each roll, generates a random 6-deck shuffle, and shows what the odds are when a given point in the shoe has been reached. One only needs to try a few scenarios to see that occasionally bets arise which are favorable to the player and unfavorable to the house. Therefore, a “card counter” would have an opportunity to beat the game unless a continuous shuffling machine is used.

A copy of this workbook is attached hereto as Appendix A. Please feel free to contact us if there are any questions.

---

## Summary

---

Using a six-deck shoe with a continuous shuffler, we find the following values for player return on money bet. The negative percentage numbers indicate a house advantage:

**Table 1. Six-deck "Play Craps" Calculations**

Six decks		Place to Win	Buy	Don't Pass Line	Place to Lose	Lay	Hard Way		One Hand Bets
Any	-1.368%			-1.366%				2	-15.222%
4	-0.412%	-7.052%	-5.155%	0.412%	-2.830%	-2.238%	-12.577%	3	-10.836%
5	0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7	-16.409%
6	-0.202%	-1.714%	-4.955%	0.202%	-1.653%	-3.838%	-10.624%	11	-10.836%
8	-0.202%	-1.714%	-4.955%	0.202%	-1.653%	-3.838%	-10.624%	12	-15.222%
9	0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps	-11.662%
10	-0.412%	-7.052%	-5.155%	0.412%	-2.830%	-2.238%	-12.577%	Horn	-13.029%
								Field (12x2)	-5.779%
								Field (12x3)	-3.044%

**Table 2. Traditional "Dice Craps" Calculations**

Dice odds	Point	Pass Line	Place to Win	Buy	Don't Pass Line	Place to Lose	Lay	Hard Way		One Hand Bets
		-1.414%			-1.364%				2	-13.889%
	4	0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	3	-11.111%
	5	0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7	-16.667%
	6	0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	11	-11.111%
	8	0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	12	-13.889%
	9	0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps	-11.111%
	10	0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	Horn	-12.500%
									Field (12x2)	-5.556%
									Field (12x3)	-2.778%

Mr. Chappell  
Play Craps  
April 18, 2008  
Page 5

The percentages for the classic Pass Line and Don't Pass Line bets are very close. For dice, a Pass bet gives a house edge of 1.414% and a Don't Pass bet gives a house edge of 1.364%. For cards, a Pass bet gives a house edge of 1.368% and a Don't Pass bet gives a house edge of 1.366%. The largest odds discrepancies arise for the "Hard Way" bets, which involve the doubles rolls that are most directly affected by the non-independence of the cards from each other.

Although the Don't Pass Line Odds bet for a point of 4, 6, 8, or 10 actually have a positive average return to the player, this is not a bet that can be made independently. It must be made in conjunction with a Don't Pass Line bet of equal value which has a negative return that outweighs the positive return of the additional odds bet. If the player always makes this additional bet, his total return on money bet will be  $(-1.366\% + (1/4 * 0.412\%) + (5/12 * 0.202\%))/2 = -0.590\%$ , compared with a total return of  $(-1.364\%/2) = -0.682\%$  in the traditional dice version of the game..

Please refer to the attached Terms and Conditions which apply to the information being provided herein.

Should you have any questions or need any additional information, please feel free to contact our office.

Sincerely,  
GAMING LABORATORIES INTERNATIONAL, INC.



Christine M. Gallo  
Sr. Director of Technical Compliance & Quality Assurance

Enclosures

MA-00-PCI-08-01

cg/ss

---

## Terms and Conditions

---

This Report has been prepared and submitted at the request of Play Craps, Inc. (the “Recipient”), is issued solely for the benefit of the Recipient and no other party and may not be relied upon for any reason by any person or entity other than the Recipient.

In this regard, the Recipient will be deemed to have acknowledged that nothing in this Report is intended to create, nor shall it be deemed or construed to create, any relationship between **Gaming Laboratories International, Inc. (GLI)** and the Recipient other than that of independent entities contracting with each other solely for the purpose of the preparation and submission of the Report. Neither GLI nor the Recipient, nor any of their respective employees or representatives, shall be construed to be an agent, employer or representative of the other.

The analysis provided by this Report applies exclusively to tests conducted using current and retrospective methodology developed by GLI on the specific hardware and software submitted by the Recipient. It is the responsibility of the manufacturer and/or developer of the subject hardware and software to apply for, obtain and maintain all necessary gaming licensure in each jurisdiction in which they do business, including state and tribal jurisdictions, where applicable. During the course of testing, GLI inspects for marks or symbols indicating that a device has undergone product safety compliance testing. GLI also performs, where practicable, a cursory review of submissions and information contained therein related to Electromagnetic Interference (EMI), Radio Frequency Interference (RFI), Magnetic Interference, Liquid Spills, Power Fluctuations and Environmental conditions. Electrostatic Discharge Testing is intended only to simulate techniques observed in the field being used to attempt to disrupt the integrity of Electronic Gaming Devices. Compliance with any such regulations related to the aforementioned design is the sole responsibility of the device manufacturer; GLI accepts no responsibility, makes no representations and disclaims any liability with respect to all such non-gaming testing. The actual data showing the test performed by GLI, and the excluded tests, are available to the Recipient upon written request.

With respect to analysis of new tables games, new paytables for electronic devices and other undertakings where GLI provides a mathematical review, the Recipient agrees to and acknowledges that due to complex mathematical processes, approximations and rounding errors that necessarily occur during any mathematical review, the results herein shall be understood by the recipient to be approximations and may fall within a range approximating the true mathematical results. Recipient hereby agrees that he is responsible to review such work, analyze it for accuracy and report deficiencies immediately to GLI. GLI has undertaken such work based on our understanding of the game submitted as documented in our report. Should our understanding of the game be incorrect as written in our report, Recipient is required to notify GLI immediately.

GLI WARRANTS TO THE RECIPIENT THAT ALL SERVICES PROVIDED BY GLI HEREUNDER HAVE BEEN PERFORMED IN ACCORDANCE WITH ESTABLISHED AND RECOGNIZED TESTING PROCEDURES AND WITH REASONABLE CARE IN ACCORDANCE WITH APPLICABLE LAWS. GLI DOES NOT MAKE, AND EXPRESSLY DISCLAIMS, ALL OTHER WARRANTIES OF ANY KIND, EXPRESSED OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, SUITABILITY OR FITNESS FOR A PARTICULAR PURPOSE. WITHOUT LIMITING ANY OF THE FOREGOING, UNDER NO CIRCUMSTANCES SHOULD THE ANALYSIS PROVIDED BY THIS REPORT BE CONSTRUED TO IMPLY ANY ENDORSEMENT OR WARRANTY REGARDING THE FUNCTIONALITY, QUALITY OR PERFORMANCE OF THE SUBJECT HARDWARE OR SOFTWARE, AND NO PERSON OR PARTY SHALL STATE OR IMPLY ANYTHING TO THE CONTRARY. THE LIABILITY AND OBLIGATIONS OF GLI HEREUNDER, AND THE REMEDY OF THE RECIPIENT, UNDER OR IN CONNECTION WITH THIS AGREEMENT SHALL BE LIMITED TO, AT GLI'S OPTION, REPLACEMENT OF THE SERVICES PROVIDED OR THE REFUND BY GLI OF ANY MONIES RECEIVED BY IT FOR THE SERVICES PROVIDED. IN NO EVENT SHALL GLI BE RESPONSIBLE TO THE RECIPIENT OR ANY THIRD PARTY FOR ANY CONSEQUENTIAL, INCIDENTAL, DIRECT, INDIRECT OR SPECIAL DAMAGES, INCLUDING WITHOUT LIMITATION DAMAGES FOR LOST PROFITS OR REVENUE, BUSINESS INTERRUPTION, OR PUNITIVE DAMAGES, EVEN IF GLI HAD BEEN ADVISED OF THE POTENTIAL FOR SUCH DAMAGES AND WHETHER SUCH DAMAGES ARISE IN CONTRACT, NEGLIGENCE, TORT, UNDER STATUTE, IN EQUITY, AT LAW OR OTHERWISE. ALL RIGHTS AND REMEDIES OF THIRD PARTIES RELATING TO THE PRODUCTS AND SERVICES THAT ARE THE SUBJECT OF THE ANALYSIS PROVIDED BY THIS REPORT ARE PROVIDED SOLELY BY THE RECIPIENT AND NOT BY GLI AND GLI EXPRESSLY DISCLAIMS ANY LIABILITY WHATSOEVER IN CONNECTION WITH SUCH THIRD PARTY RIGHTS AND REMEDIES. GLI AND RECIPIENT ACKNOWLEDGE AND AGREE THAT THE SERVICES PROVIDED BY GLI HEREUNDER COULD NOT BE RENDERED BY GLI UNDER THE TERMS PROVIDED HEREIN WITHOUT AN INCREASE IN COST IF GLI WAS REQUIRED TO PROVIDE ANY WARRANTIES IN ADDITION TO, OR IN LIEU OF, OR WAS REQUIRED TO ASSUME ANY LIABILITY IN EXCESS OF, THE FOREGOING.

# Appendix A

# Decks	piPs	cards	roll	combins	new prob	dice prob	Card odds: 1 deck	
	1	1	9	2	36	0.02515723	Point	
		2	9	3	81	0.055555556	Any	
# Cards		3	9	4	117	0.08176101	4	
	54	4	9	5	162	0.11320755	5	
		5	9	6	198	0.138888889	6	
		6	9	7	243	0.166666667	8	
				8	198	0.13836478	9	
				9	162	0.11320755	10	
				10	117	0.08176101		
				11	81	0.055555556		
				12	36	0.02515723		
							Dice odds	
							Point	
			Natural		0.22641509	0.222222222		
			Craps		0.10691824	0.111111111	4	
							5	
			4 before 7*		0.325	0.333333333	6	
			5 before 7*		0.4	0.4	8	
			6 before 7*		0.44897959	0.454545455	9	
					0	0	10	
			8 before 7*		0.44897959	0.454545455		
			9 before 7*		0.4	0.4		
			10 before 7*		0.325	0.333333333		
			*assumes reshuffle after each 2 cards					
			Pass		0.49437171	0.492929293		
			Boxcars		0.02515723	0.027777778		
			Don't Pass		0.48047106	0.479292929		
			Hard 4	36	0.02515723	0.027777778		
			Hard 6	36	0.02515723	0.027777778		
			Hard 8	36	0.02515723	0.027777778		
			Hard 10	36	0.02515723	0.027777778		

Pass line	Place to win	Buy	Don't pass line	Place to lose	Lay	Hard Way	One Hand bets
-1.126%			-1.390%				2 -22.013%
-2.500%	-9.000%	-7.143%	2.500%	-1.818%	-1.220%	-20.000%	3 -9.434%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7 -15.094%
-1.224%	-2.721%	-5.928%	1.224%	-0.816%	-3.020%	-18.367%	11 -9.434%
-1.224%	-2.721%	-5.928%	1.224%	-0.816%	-3.020%	-18.367%	12 -22.013%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps -14.465%
-2.500%	-9.000%	-7.143%	2.500%	-1.818%	-1.220%	-20.000%	Horn -15.723%
							Field (12x2) -6.918%
							Field (12x3) -4.403%

Pass line	Place to win	Buy	Don't pass line	Place to lose	Lay	Hard Way	One Hand bets
-1.414%			-1.364%				2 -13.889%
0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	3 -11.111%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7 -16.667%
0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	11 -11.111%
0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	12 -13.889%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps -11.111%
0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	Horn -12.500%
							Field (12x2) -5.556%
							Field (12x3) -2.778%

# Decks	piPs	cards	roll	combins	new prob	dice prob	Card odds: 2 decks	
	2	1	18	2	153	0.02647975	Point	
		2	18	3	324	0.05607477	Any	
# Cards		3	18	4	477	0.08255452	4	
	108	4	18	5	648	0.11214953	5	
		5	18	6	801	0.13862928	6	
		6	18	7	972	0.1682243	8	
				8	801	0.13862928	9	
				9	648	0.11214953	10	
				10	477	0.08255452		
				11	324	0.05607477		
				12	153	0.02647975		
			Natural			0.22429907		
			Craps			0.10903427		
			4 before 7*			0.32919255		
			5 before 7*		0.4	0.4		
			6 before 7*		0.45177665	0.45454545		
					0	0		
			8 before 7*		0.45177665	0.45454545		
			9 before 7*		0.4	0.4		
			10 before 7*		0.32919255	0.33333333		
			*assumes reshuffle after each 2 cards					
			Pass			0.4936303		
			Boxcars			0.02647975		
			Don't Pass			0.47988995		
			Hard 4		153	0.02647975		
			Hard 6		153	0.02647975		
			Hard 8		153	0.02647975		
			Hard 10		153	0.02647975		

Pass line	Place to win	Buy	Don't pass line	Place to lose	Lay	Hard Way	One Hand bets
-1.274%			-1.374%				2 -17.913%
-1.242%	-7.826%	-5.945%	1.242%	-2.428%	-1.833%	-15.528%	3 -10.280%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7 -15.888%
-0.609%	-2.115%	-5.342%	0.609%	-1.320%	-3.513%	-13.706%	11 -10.280%
-0.609%	-2.115%	-5.342%	0.609%	-1.320%	-3.513%	-13.706%	12 -17.913%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps -12.773%
-1.242%	-7.826%	-5.945%	1.242%	-2.428%	-1.833%	-15.528%	Horn -14.097%
							Field (12x2) -6.231%
							Field (12x3) -3.583%

Pass line	Place to win	Buy	Don't pass line	Place to lose	Lay	Hard Way	One Hand bets
-1.414%			-1.364%				2 -13.889%
0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	3 -11.111%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7 -16.667%
0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	11 -11.111%
0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	12 -13.889%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps -11.111%
0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	Horn -12.500%
							Field (12x2) -5.556%
							Field (12x3) -2.778%

# Decks	piPs	cards	roll	combins	new prob	dice prob	Card odds: 3 decks	
	3	1	27	2	351	0.02691511	Point	
		2	27	3	729	0.05590062	Any	
# Cards		3	27	4	1080	0.08281573	4	
	162	4	27	5	1458	0.11180124	5	
		5	27	6	1809	0.13871636	6	
		6	27	7	2187	0.16770186	8	
				8	1809	0.13871636	9	
				9	1458	0.11180124	10	
				10	1080	0.08281573		
				11	729	0.05590062		
				12	351	0.02691511		
							Dice odds	
							Point	
			Natural		0.22360248	0.22222222		
			Craps		0.10973085	0.11111111	4	
							5	
			4 before 7*		0.33057851	0.33333333	6	
			5 before 7*		0.4	0.4	8	
			6 before 7*		0.4527027	0.45454545	9	
					0	0	10	
			8 before 7*		0.4527027	0.45454545		
			9 before 7*		0.4	0.4		
			10 before 7*		0.33057851	0.33333333		
			*assumes reshuffle after each 2 cards					
			Pass		0.49339222	0.49292929		
			Boxcars		0.02691511	0.02777778		
			Don't Pass		0.47969266	0.47929292		
			Hard 4	351	0.02691511	0.02777778		
			Hard 6	351	0.02691511	0.02777778		
			Hard 8	351	0.02691511	0.02777778		
			Hard 10	351	0.02691511	0.02777778		

Pass line	Place to win	Buy	Don't pass line	Place to lose	Lay	Hard Way	One Hand bets
-1.322%			-1.370%				2 -16.563%
-0.826%	-7.438%	-5.549%	0.826%	-2.630%	-2.036%	-14.050%	3 -10.559%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7 -16.149%
-0.405%	-1.914%	-5.148%	0.405%	-1.486%	-3.676%	-12.162%	11 -10.559%
-0.405%	-1.914%	-5.148%	0.405%	-1.486%	-3.676%	-12.162%	12 -16.563%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps -12.215%
-0.826%	-7.438%	-5.549%	0.826%	-2.630%	-2.036%	-14.050%	Horn -13.561%
							Field (12x2) -6.004%
							Field (12x3) -3.313%

Pass line	Place to win	Buy	Don't pass line	Place to lose	Lay	Hard Way	One Hand bets
-1.414%			-1.364%				2 -13.889%
0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	3 -11.111%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7 -16.667%
0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	11 -11.111%
0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	12 -13.889%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps -11.111%
0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	Horn -12.500%
							Field (12x2) -5.556%
							Field (12x3) -2.778%

# Decks	piPs	cards	roll	combins	new prob	dice prob	Card odds: 4 decks	
# Cards	4	1	36	2	630	0.02713178	0.027777778	Point
		2	36	3	1296	0.05581395	0.055555556	Any
		3	36	4	1926	0.08294574	0.083333333	4
		4	36	5	2592	0.11162791	0.111111111	5
		5	36	6	3222	0.13875969	0.138888889	6
		6	36	7	3888	0.16744186	0.166666667	8
	216			8	3222	0.13875969	0.138888889	9
				9	2592	0.11162791	0.111111111	10
				10	1926	0.08294574	0.083333333	
				11	1296	0.05581395	0.055555556	
				12	630	0.02713178	0.027777778	
								Dice odds
			Natural		0.22325581	0.222222222	Point	
			Craps		0.11007752	0.111111111	4	
			4 before 7*		0.33126935	0.333333333	5	
			5 before 7*		0.4	0.4	6	
			6 before 7*		0.45316456	0.454545455	8	
					0	0	9	
			8 before 7*		0.45316456	0.454545455	10	
			9 before 7*		0.4	0.4		
			10 before 7*		0.33126935	0.333333333		
			*assumes reshuffle after each 2 cards					
			Pass		0.49327485	0.492929293		
			Boxcars		0.02713178	0.027777778		
			Don't Pass		0.47959337	0.479292929		
			Hard 4	630	0.02713178	0.027777778		
			Hard 6	630	0.02713178	0.027777778		
			Hard 8	630	0.02713178	0.027777778		
			Hard 10	630	0.02713178	0.027777778		

Pass line	Place to win	Buy	Don't pass line	Place to lose	Lay	Hard Way	One Hand bets
-1.345%			-1.368%				2 -15.891%
-0.619%	-7.245%	-5.352%	0.619%	-2.730%	-2.137%	-13.313%	3 -10.698%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7 -16.279%
-0.304%	-1.814%	-5.051%	0.304%	-1.570%	-3.757%	-11.392%	11 -10.698%
-0.304%	-1.814%	-5.051%	0.304%	-1.570%	-3.757%	-11.392%	12 -15.891%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps -11.938%
-0.619%	-7.245%	-5.352%	0.619%	-2.730%	-2.137%	-13.313%	Horn -13.295%
							Field (12x2) -5.891%
							Field (12x3) -3.178%

Pass line	Place to win	Buy	Don't pass line	Place to lose	Lay	Hard Way	One Hand bets
-1.414%			-1.364%				2 -13.889%
0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	3 -11.111%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7 -16.667%
0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	11 -11.111%
0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	12 -13.889%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps -11.111%
0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	Horn -12.500%
							Field (12x2) -5.556%
							Field (12x3) -2.778%

# Decks	piPs	cards	roll	combins	new prob	dice prob	Card odds: 5 decks	
	5	1	45	2	990	0.02726146	Point	
		2	45	3	2025	0.05576208	Any	
# Cards		3	45	4	3015	0.08302354	4	
	270	4	45	5	4050	0.11152416	5	
		5	45	6	5040	0.13878563	6	
		6	45	7	6075	0.16728625	8	
				8	5040	0.13878563	9	
				9	4050	0.11152416	10	
				10	3015	0.08302354		
				11	2025	0.05576208		
				12	990	0.02726146		
			Natural		0.22304833	0.22222222		
			Craps		0.11028501	0.11111111	4	
			4 before 7*		0.33168317	0.33333333	5	
			5 before 7*		0.4	0.4	6	
			6 before 7*		0.4534413	0.45454545	8	
					0	0	9	
			8 before 7*		0.4534413	0.45454545	10	
			9 before 7*		0.4	0.4		
			10 before 7*		0.33168317	0.33333333		
			*assumes reshuffle after each 2 cards					
			Pass		0.49320495	0.49292929		
			Boxcars		0.02726146	0.02777778		
			Don't Pass		0.47953359	0.47929292		
			Hard 4	990	0.02726146	0.02777778		
			Hard 6	990	0.02726146	0.02777778		
			Hard 8	990	0.02726146	0.02777778		
			Hard 10	990	0.02726146	0.02777778		

Pass line	Place to win	Buy	Don't pass line	Place to lose	Lay	Hard Way	One Hand bets
-1.359%			-1.367%				2 -15.489%
-0.495%	-7.129%	-5.233%	0.495%	-2.790%	-2.198%	-12.871%	3 -10.781%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7 -16.357%
-0.243%	-1.754%	-4.993%	0.243%	-1.619%	-3.806%	-10.931%	11 -10.781%
-0.243%	-1.754%	-4.993%	0.243%	-1.619%	-3.806%	-10.931%	12 -15.489%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps -11.772%
-0.495%	-7.129%	-5.233%	0.495%	-2.790%	-2.198%	-12.871%	Horn -13.135%
							Field (12x2) -5.824%
							Field (12x3) -3.098%

Pass line	Place to win	Buy	Don't pass line	Place to lose	Lay	Hard Way	One Hand bets
-1.414%			-1.364%				2 -13.889%
0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	3 -11.111%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7 -16.667%
0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	11 -11.111%
0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	12 -13.889%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps -11.111%
0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	Horn -12.500%
							Field (12x2) -5.556%
							Field (12x3) -2.778%

# Decks	piPs	cards	roll	combins	new prob	dice prob	Card odds: 8 decks	
	8	1	72	2	2556	0.02745553	Point	
		2	72	3	5184	0.05568445	Any	
# Cards		3	72	4	7740	0.08313998	4	
	432	4	72	5	10368	0.11136891	5	
		5	72	6	12924	0.13882444	6	
		6	72	7	15552	0.16705336	8	
				8	12924	0.13882444	9	
				9	10368	0.11136891	10	
				10	7740	0.08313998		
				11	5184	0.05568445		
				12	2556	0.02745553		
							Dice odds	
							Point	
			Natural		0.22273782	0.22222222		
			Craps		0.11059551	0.11111111	4	
							5	
			4 before 7*		0.33230294	0.33333333	6	
			5 before 7*		0.4	0.4	8	
			6 before 7*		0.45385588	0.45454545	9	
					0	0	10	
			8 before 7*		0.45385588	0.45454545		
			9 before 7*		0.4	0.4		
			10 before 7*		0.33230294	0.33333333		
			*assumes reshuffle after each 2 cards					
			Pass		0.49310084	0.49292929		
			Boxcars		0.02745553	0.02777778		
			Don't Pass		0.47944363	0.47929292		
			Hard 4	2556	0.02745553	0.02777778		
			Hard 6	2556	0.02745553	0.02777778		
			Hard 8	2556	0.02745553	0.02777778		
			Hard 10	2556	0.02745553	0.02777778		

Pass line	Place to win	Buy	Don't pass line	Place to lose	Lay	Hard Way	One Hand bets
-1.380%			-1.366%				2 -14.888%
-0.309%	-6.955%	-5.056%	0.309%	-2.880%	-2.288%	-12.210%	3 -10.905%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7 -16.473%
-0.152%	-1.665%	-4.906%	0.152%	-1.694%	-3.879%	-10.240%	11 -10.905%
-0.152%	-1.665%	-4.906%	0.152%	-1.694%	-3.879%	-10.240%	12 -14.888%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps -11.524%
-0.309%	-6.955%	-5.056%	0.309%	-2.880%	-2.288%	-12.210%	Horn -12.896%
							Field (12x2) -5.723%
							Field (12x3) -2.978%

Pass line	Place to win	Buy	Don't pass line	Place to lose	Lay	Hard Way	One Hand bets
-1.414%			-1.364%				2 -13.889%
0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	3 -11.111%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7 -16.667%
0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	11 -11.111%
0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	12 -13.889%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps -11.111%
0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	Horn -12.500%
							Field (12x2) -5.556%
							Field (12x3) -2.778%

# Decks	piPs	cards	roll	combins	new prob	dice prob	Card odds: 12 decks	
	12	1	108	2	5778	0.02756311	Point	
		2	108	3	11664	0.05564142	Any	
# Cards		3	108	4	17442	0.08320453	4	
	648	4	108	5	23328	0.11128284	5	
		5	108	6	29106	0.13884596	6	
		6	108	7	34992	0.16692427	8	
				8	29106	0.13884596	9	
				9	23328	0.11128284	10	
				10	17442	0.08320453		
				11	11664	0.05564142		
				12	5778	0.02756311		
			Natural			0.22256569	Dice odds	
			Craps			0.11076765	Point	
			4 before 7*			0.33264676	4	
			5 before 7*		0.4	0.4	5	
			6 before 7*		0.45408593	0.45454545	6	
					0	0	8	
			8 before 7*		0.45408593	0.45454545	9	
			9 before 7*		0.4	0.4	10	
			10 before 7*		0.33264676	0.33333333		
			*assumes reshuffle after each 2 cards					
			Pass			0.49304339		
			Boxcars			0.02756311		
			Don't Pass			0.4793935		
			Hard 4		5778	0.02756311		
			Hard 6		5778	0.02756311		
			Hard 8		5778	0.02756311		
			Hard 10		5778	0.02756311		

Pass line	Place to win	Buy	Don't pass line	Place to lose	Lay	Hard Way	One Hand bets
-1.391%			-1.365%				2 -14.554%
-0.206%	-6.859%	-4.958%	0.206%	-2.930%	-2.339%	-11.843%	3 -10.974%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7 -16.538%
-0.101%	-1.615%	-4.858%	0.101%	-1.735%	-3.919%	-9.857%	11 -10.974%
-0.101%	-1.615%	-4.858%	0.101%	-1.735%	-3.919%	-9.857%	12 -14.554%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps -11.386%
-0.206%	-6.859%	-4.958%	0.206%	-2.930%	-2.339%	-11.843%	Horn -12.764%
							Field (12x2) -5.667%
							Field (12x3) -2.911%

Pass line	Place to win	Buy	Don't pass line	Place to lose	Lay	Hard Way	One Hand bets
-1.414%			-1.364%				2 -13.889%
0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	3 -11.111%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7 -16.667%
0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	11 -11.111%
0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	12 -13.889%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps -11.111%
0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	Horn -12.500%
							Field (12x2) -5.556%
							Field (12x3) -2.778%

# Decks	piPs	cards	roll	combins	new prob	dice prob	Card odds: 6 decks
	<b>6</b>	1	39	2	741	0.02966848	0.02777778
Cards dealt		2	36	3	1404	0.05621397	0.05555556
	<b>100</b>	3	32	4	1878	0.07519218	0.08333333
Cards left		4	39	5	2673	0.10702274	0.11111111
	224	5	40	6	3460	0.13853299	0.13888889
		6	38	7	4170	0.16696028	0.16666667
Press F9 to recalculate				8	3389	0.13569026	0.13888889
				9	2776	0.1111467	0.11111111
				10	2262	0.09056694	0.08333333
				11	1520	0.06085842	0.05555556
				12	703	0.02814702	0.02777778
			Natural			0.22781871	0.22222222
			Craps			0.11402947	0.11111111
			4 before 7*			0.31051587	0.33333333
			5 before 7*			0.39061815	0.4
			6 before 7*			0.45347313	0.45454545
						0	0
			8 before 7*			0.44833973	0.45454545
			9 before 7*			0.39965448	0.4
			10 before 7*			0.3516791	0.33333333
			*approximate				
			Pass			0.4928992	0.49292929
			Boxcars			0.02814702	0.02777778
			Don't Pass			0.47895378	0.47929293
			Hard 4	630	0.02522422	0.02777778	
			Hard 6	496	0.01985906	0.02777778	
			Hard 8	741	0.02966848	0.02777778	
			Hard 10	780	0.03122998	0.02777778	

Card odds: 6 decks  
Point  
Any

4  
5  
6  
8  
9  
10

Dice odds  
Point

4  
5  
6  
8  
9  
10

Pass line	Place to win	Buy	Don't pass line	Place to lose	Lay	Hard Way	One Hand bets
-1.420%			-1.395%				2 -8.028%
-6.845%	-13.056%	-11.281%	6.845%	0.289%	0.900%	-16.667%	3 -10.058%
-2.345%	-6.252%	-6.996%	2.345%	-0.975%	-1.713%		7 -16.520%
-0.236%	-1.747%	-4.987%	0.236%	-1.625%	-3.811%	-34.993%	11 -2.627%
-1.365%	-2.860%	-6.062%	1.365%	-0.701%	-2.908%	-1.971%	12 -12.744%
-0.086%	-4.083%	-4.844%	0.086%	-2.444%	-3.170%		Any craps -8.776%
5.504%	-1.530%	0.480%	-5.504%	-5.699%	-5.124%	-2.985%	Horn -8.364%
							Field (12x2) -3.860%
							Field (12x3) -1.045%

Pass line	Place to win	Buy	Don't pass line	Place to lose	Lay	Hard Way	One Hand bets
-1.414%			-1.364%				2 -13.889%
0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	3 -11.111%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		7 -16.667%
0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	11 -11.111%
0.000%	-1.515%	-4.762%	0.000%	-1.818%	-4.000%	-9.091%	12 -13.889%
0.000%	-4.000%	-4.762%	0.000%	-2.500%	-3.226%		Any craps -11.111%
0.000%	-6.667%	-4.762%	0.000%	-3.030%	-2.439%	-11.111%	Horn -12.500%
							Field (12x2) -5.556%
							Field (12x3) -2.778%

1	0.032838	296
2	0.040948	292
3	0.913084	25
4	0.53629	140
5	0.907009	28
6	7.66E-05	312
7	0.826133	52
8	0.549338	135
9	0.38138	185
10	0.042228	290
11	0.762932	63
12	0.644071	103
13	0.399305	183
14	0.910487	27
15	0.839288	50
16	0.363747	190
17	0.106156	267
18	0.08741	280
19	0.170275	245
20	0.485803	159
21	0.102005	270
22	0.031461	297
23	0.676036	89
24	0.724037	82
25	0.154023	251
26	0.014383	302
27	0.842649	48
28	0.989526	2
29	0.140105	258
30	0.122497	262
31	0.166596	247
32	0.510871	150
33	0.382523	184
34	0.939246	19
35	0.747528	67
36	0.000893	311
37	0.905505	29
38	0.898409	33
39	0.803396	59
40	0.119986	263
41	0.535629	141
42	0.015436	300
43	0.56345	129
44	0.505627	153
45	0.092306	277
46	0.730209	77
47	0.100644	271
48	0.186314	236
49	0.8479	47
50	0.195335	234
51	0.146005	255
52	0.504868	154

53	0.278159	216
54	0.628645	107
55	0.964233	13
56	0.409965	180
57	0.780242	61
58	0.147829	254
59	0.724202	81
60	0.42392	177
61	0.311237	206
62	0.439906	172
63	0.051363	287
64	0.519182	147
65	0.725146	80
66	0.337992	199
67	0.426543	176
68	0.369201	188
69	0.062987	285
70	0.366814	189
71	0.485308	160
72	0.223797	225
73	0.466389	164
74	0.881875	36
75	0.925087	23
76	0.03597	295
77	0.473725	162
78	0.983261	8
79	0.098185	272
80	0.740339	74
81	0.848814	46
82	0.585406	121
83	0.158406	249
84	0.003859	309
85	0.041206	291
86	0.295216	211
87	0.037098	294
88	0.564806	127
89	0.809891	58
90	0.938729	20
91	0.686771	87
92	0.697375	84
93	0.440251	170
94	0.751121	66
95	0.260446	222
96	0.896149	34
97	0.015885	299
98	0.15744	250
99	0.696755	85
100	0.673109	90
101	0.556083	132
102	0.029805	298
103	0.184127	237
104	0.881231	37

105	0.448958	169
106	0.010217	305
107	0.755478	65
108	0.623228	112
109	0.773933	62
110	0.153403	253
111	0.182743	239
112	0.145295	256
113	0.986725	4
114	0.592147	119
115	0.336469	200
116	0.560796	131
117	0.929849	21
118	0.744483	72
119	0.745099	70
120	0.190285	235
121	0.952575	16
122	0.564389	128
123	0.646516	101
124	0.355114	192
125	0.920086	24
126	0.109173	266
127	0.206987	229
128	0.271787	218
129	0.325815	203
130	0.614839	114
131	0.360997	191
132	0.929582	22
133	0.41029	179
134	0.561429	130
135	0.570115	124
136	0.003896	308
137	0.342895	195
138	0.17563	241
139	0.115218	265
140	0.989234	3
141	0.963201	14
142	0.747273	69
143	0.525131	144
144	0.267839	221
145	0.902438	31
146	0.511672	148
147	0.9976	1
148	0.342776	196
149	0.33313	201
150	0.50112	155
151	0.067058	283
152	0.269743	220
153	0.856413	43
154	0.983899	7
155	0.497159	157
156	0.511374	149

157	0.50772	151
158	0.651154	100
159	0.175328	242
160	0.592734	118
161	0.81416	55
162	0.003682	310
163	0.011832	303
164	0.544062	138
165	0.624586	110
166	0.951356	17
167	0.903493	30
168	0.198411	232
169	0.43004	174
170	0.911064	26
171	0.86426	42
172	0.528449	143
173	0.327881	202
174	0.123162	261
175	0.594776	117
176	0.116172	264
177	0.743326	73
178	0.899293	32
179	0.671854	91
180	0.852091	45
181	0.303914	208
182	0.092042	278
183	0.456637	168
184	0.874106	41
185	0.852547	44
186	0.139712	259
187	0.292473	213
188	0.252443	223
189	0.735526	75
190	0.090371	279
191	0.297473	209
192	0.353763	193
193	0.811588	57
194	0.63985	105
195	0.461472	166
196	0.209788	228
197	0.984801	6
198	0.21749	226
199	0.004012	307
200	0.468463	163
201	0.197399	233
202	0.31695	205
203	0.876873	40
204	0.552526	134
205	0.73372	76
206	0.038855	293
207	0.343808	194
208	0.620735	113

209	0.667573	94
210	0.575013	123
211	0.879662	38
212	0.098091	273
213	0.284602	215
214	0.548415	136
215	0.821271	54
216	0.055362	286
217	0.178018	240
218	0.09763	274
219	0.583934	122
220	0.063087	284
221	0.567079	126
222	0.457115	167
223	0.656951	98
224	0.638857	106
225	0.211479	227
226	0.841724	49
227	0.094214	275
228	0.608216	115
229	0.14508	257
230	0.747508	68
231	0.962277	15
232	0.092375	276
233	0.601474	116
234	0.981798	9
235	0.129226	260
236	0.014674	301
237	0.421427	178
238	0.624468	111
239	0.009177	306
240	0.10594	268
241	0.879047	39
242	0.54703	137
243	0.985335	5
244	0.170374	244
245	0.886464	35
246	0.687545	86
247	0.205968	230
248	0.65366	99
249	0.538764	139
250	0.729605	78
251	0.076942	281
252	0.463826	165
253	0.657278	97
254	0.553842	133
255	0.426609	175
256	0.488949	158
257	0.381013	186
258	0.627409	108
259	0.010782	304
260	0.755616	64

261	0.821469	53
262	0.726488	79
263	0.981636	10
264	0.174681	243
265	0.64595	102
266	0.978906	11
267	0.505854	152
268	0.625569	109
269	0.285651	214
270	0.964923	12
271	0.669462	92
272	0.828165	51
273	0.042494	289
274	0.407777	181
275	0.686416	88
276	0.744895	71
277	0.27153	219
278	0.375268	187
279	0.182853	238
280	0.201111	231
281	0.105658	269
282	0.159003	248
283	0.320974	204
284	0.245108	224
285	0.528593	142
286	0.65816	96
287	0.481759	161
288	0.569879	125
289	0.791127	60
290	0.498027	156
291	0.169899	246
292	0.440078	171
293	0.045511	288
294	0.948835	18
295	0.720355	83
296	0.341803	197
297	0.523114	145
298	0.64116	104
299	0.072872	282
300	0.34078	198
301	0.812433	56
302	0.522341	146
303	0.668682	93
304	0.591307	120
305	0.407715	182
306	0.306902	207
307	0.1535	252
308	0.277496	217
309	0.292988	212
310	0.436985	173
311	0.662016	95
312	0.296138	210