15.S50 - Poker Theory and Analytics

Pre-flop Analysis

Pre-flop Analysis

- Motivator
- Range Definition
- Basic Assumptions
- Heads Up
- Other Positions

Motivator

- Why are we spending an entire day on pre-flop?
  - **In tournaments, most of your value will come from playing pre-flop close to optimally**
  - **Most live players are way off in their decision-making**
  - **Its easy to solve; fewer assumptions**

Scenario A

Massachusetts Institute of Technology

Scenario A

- No Limit Hold'em Tournament - 125/250 Blinds + 25
- trifluvian (BB): 1100 M = 2.59
- Hero (BTN/SB): 3400 M = 8
- Pre Flop: (425) Hero is BTN/SB with 9♠ 6♥
- Hero…

Scenario A

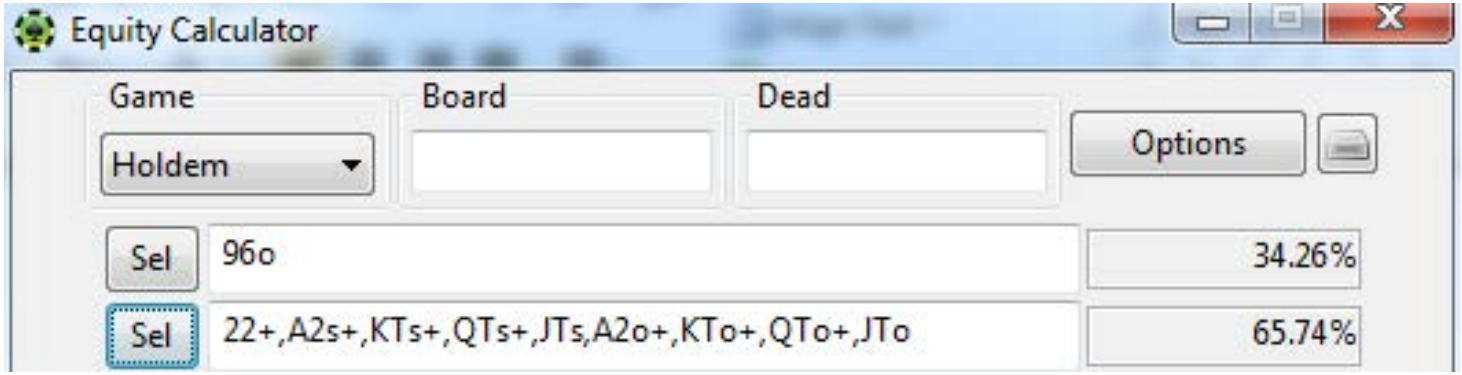
- No Limit Hold'em Tournament - 125/250 Blinds + 25
- trifluvian (BB): 1100 M = 2.59
- Hero (BTN/SB): 3400 M = 8
- Pre Flop: (425) Hero is BTN/SB with 9♠ 6♥

EV = (Pot * Fold%) + (1-Fold%) * (Win%*WinAmt - Lose%*LoseAmt)

Assume call range of 22+, A2+, JT+ (27.60%)
96o vs 22+, A2+, JT+ = ?

Scenario A

Assume call range of 22+, A2+, JT+ (27.60%)
96o vs 22+, A2+, JT+ = 34.26%



Scenario A

- No Limit Hold'em Tournament - 125/250 Blinds + 25
- trifluvian (BB): 1100 M = 2.59
- Hero (BTN/SB): 3400 M = 8
- Pre Flop: (425) Hero is BTN/SB with 9♠ 6♥

WinAmt = 4500 - (3400-(125+25)) = 1250

or

WinAmt = 125 + 25 + 25 + 250 + (1100-(250+25)) = 1250

LoseAmt = 1100 - (125+25) = 950

Scenario A - Solution

- No Limit Hold'em Tournament - 125/250 Blinds + 25
- trifluvian (BB): 1100 M = 2.59
- Hero (BTN/SB): 3400 M = 8
- Pre Flop: (425) Hero is BTN/SB with 9♠ 6♥

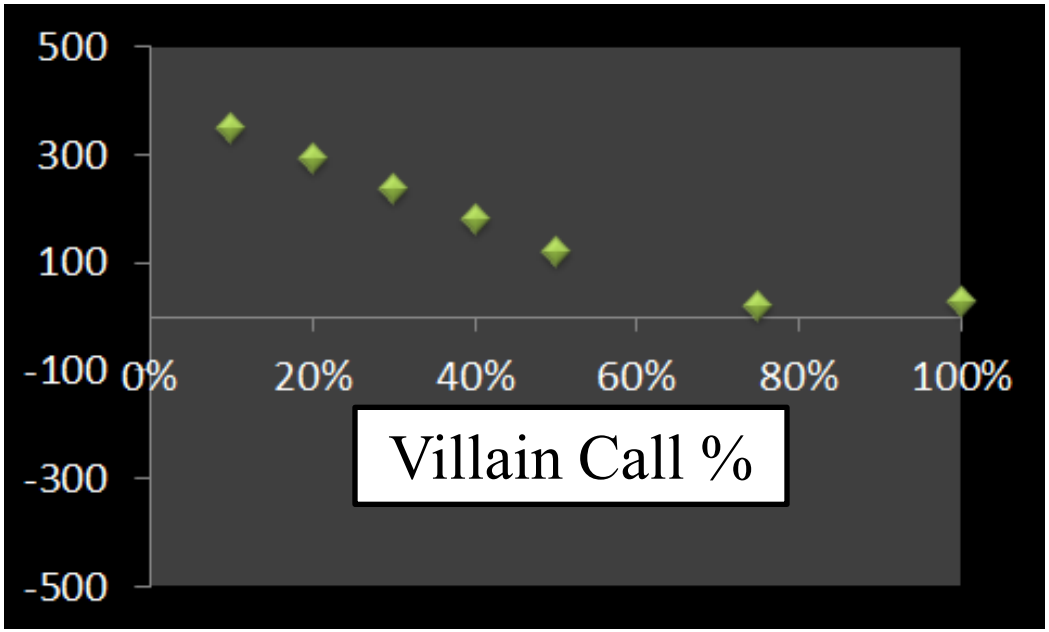
EV = (Pot * Fold%) + (1-Fold%) * (Win%*WinAmt - Lose%*LoseAmt)
Assume call range of 22+, A2+, JT+ (27.60%)
96o vs 22+, A2+, JT+ = 34.26%
EV of Fold = 0
EV of Push = (1-27.6%) * 425 + (27.6%)*[34.26%*1250 – 65.74% *950]
EV of Push = 307.7 - 54.2 = 253.5

Scenario A - Generalized

EV of Fold = 0

EV of Push = (1-F%) * 425 + (F%)*[W%*1250 – (1-W%) *950]

EV of Push

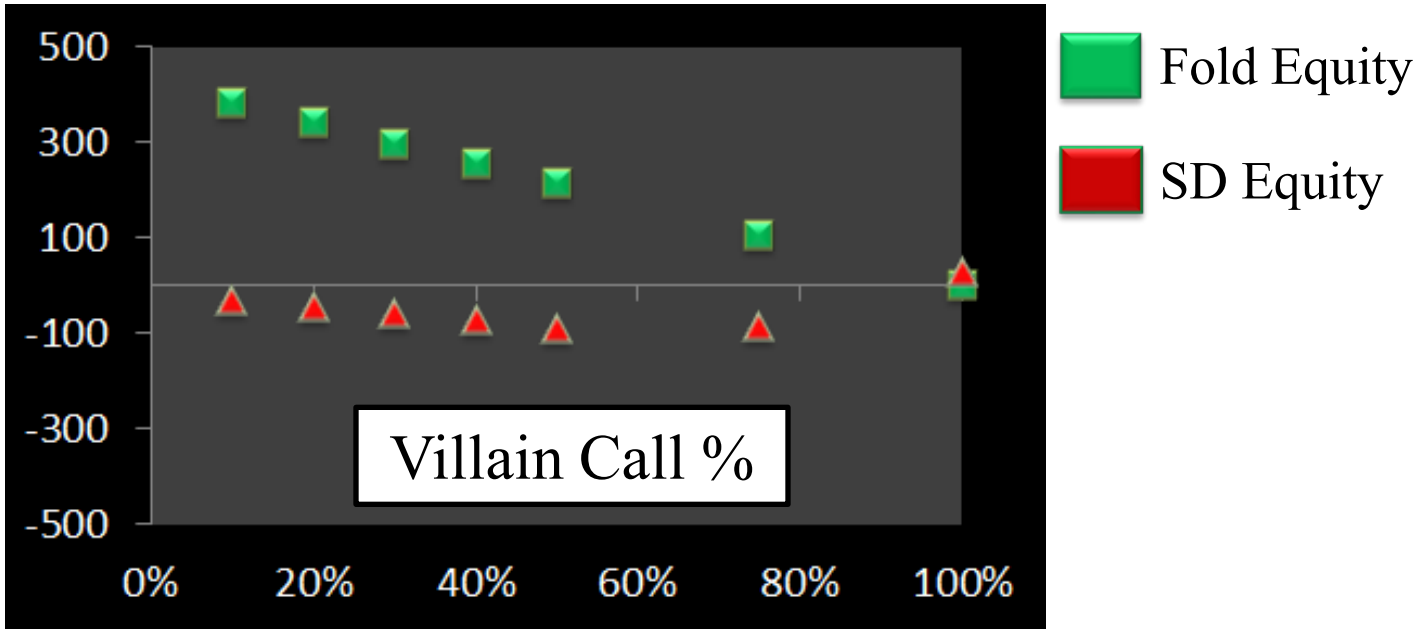


Scenario A - Generalized

EV of Fold = 0

EV of Push = (1-F%) * 425 + (F%)*[W%*1250 – (1-W%) *950]

EV of Push

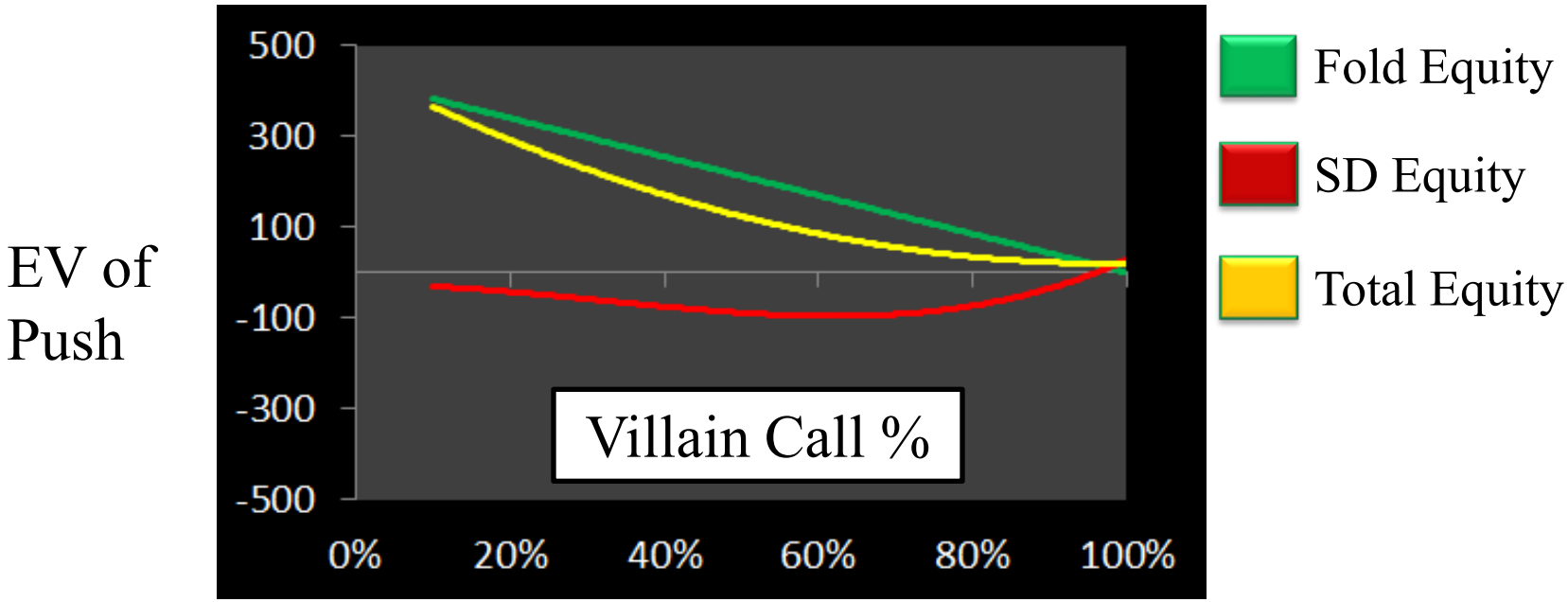


Massachusetts Institute of Technology

Scenario A - Generalized

EV of Fold = 0

EV of Push = (1-F%) * 425 + (F%)*[W%*1250 – (1-W%) *950]



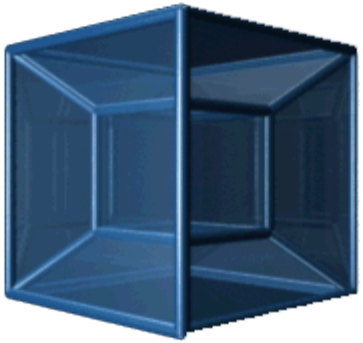
Scenario A

- No Limit Hold'em Tournament - 125/250 Blinds + 25
- trifluvian (BB): 1100 M = 2.59
- Hero (BTN/SB): 3400 M = 8
- Pre Flop: (425) Hero is BTN/SB with 9♠ 6♥
- **Hero pushes all-in regardless of Villain playing style**
- **Fold costs about 175 chips in EV**
  - **This is worse than calling all-in with 3♣ 4♦ vs A♠ K♠**
  - **1250 * 35.42% - 950 * 64.58% = -171**

Massachusetts Institute of Technology

De-Motivator

- These push/fold decisions are not very intuitive, so we need to solve it out beforehand
- Variables that impact our decision are
  - Our cards
  - Our position
  - Our stack
  - Villain's call range



- Our goal is to develop quick rules that work "for all call ranges" or "for any two cards" etc.

Pre-flop Analysis

- Motivator
- Range Definition
- Basic Assumptions
- Heads Up
- Other Positions

Range of Hands

- A **range** in poker is a set of hands
  - Suitedness can be represented by an *o* or *s* next to the hand
  - Here is PokerTracker's representation of 33+, A4s+, KTs+, A8o+

AA	AKs	AQs	AJs	ATs	A9s	A8s	A7s	A6s	A5s	A4s	A3s	A2s
AKo	KK	KQs	KJs	KTs	K9s	K8s	K7s	K6s	K5s	K4s	K3s	K2s
AQo	KQo	QQ	QJs	QTs	Q9s	Q8s	Q7s	Q6s	Q5s	Q4s	Q3s	Q2s
AJo	KJo	QJo	JJ	JTs	J9s	J8s	J7s	J6s	J5s	J4s	J3s	J2s
ATo	KTo	QTo	JTo	TT	T9s	T8s	T7s	T6s	T5s	T4s	T3s	T2s
A9o	K9o	Q9o	J9o	T9o	99	98s	97s	96s	95s	94s	93s	92s
A8o	K8o	Q8o	J8o	T8o	98o	88	87s	86s	85s	84s	83s	82s
A7o	K7o	Q7o	J7o	T7o	97o	87o	77	76s	75s	74s	73s	72s
A6o	K6o	Q6o	J6o	T6o	96o	86o	76o	66	65s	64s	63s	62s
A5o	K5o	Q5o	J5o	T5o	95o	85o	75o	65o	55	54s	53s	52s
A4o	K4o	Q4o	J4o	T4o	94o	84o	74o	64o	54o	44	43s	42s
A3o	K3o	Q3o	J3o	T3o	93o	83o	73o	63o	53o	43o	33	32s
A2o	K2o	Q2o	J2o	T2o	92o	82o	72o	62o	52o	42o	32o	22

Range of Hands

- A **range** in poker is a set of hands
  - Ranges are denoted by the lowest or highest cards in a series
  - For example, AA KK QQ would be written QQ+
  - Another example is AA KK AK AQ KQ would be written KK+, AQ+, KQ+
  - Less commonly, the best hand in a series is written with a -
  - For example, 55 44 33 22 54 53 52 43 42 could be written 55-, 54-, 43-

Range of Hands

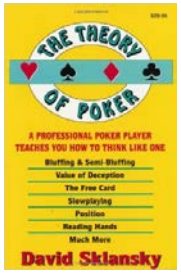
- We will use ranges for
  - Analyzing Opponents
    - Estimating equity against likely opponent cards
    - e.g. if we are holding AT, we are 63% vs ATC
  - Determining Our Plays
    - Developing range-based rules for our plays
    - e.g. we will push with AT+, 88+ and fold otherwise

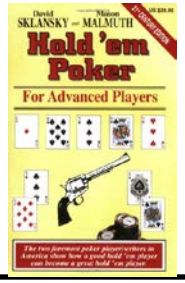
Range of Hands

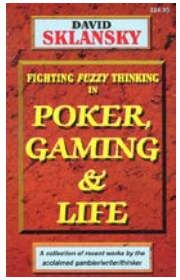
- We can also map percentiles to ranges based on hand value preflop
- Most commonly we use Sklansky-Karlson rankings, based on likelihood of being ahead preflop in a 2-player hand
- Top 10 hands are AA, KK, AKs, QQ, AKo, JJ, AQs, TT, AQo, 99

David Sklansky

- David Sklansky
  - Poker Theorist
  - Three WSOP Bracelets
  - One WPT Title
  - Studied at Wharton
- Authored 13 books published by TwoPlusTwo Publishing
- Active member of TwoPlusTwo Poker Community



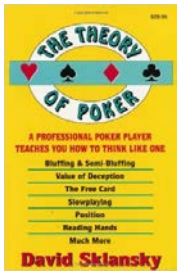




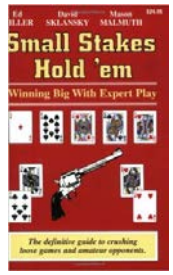
Massachusetts Institute of Technology

David Sklansky

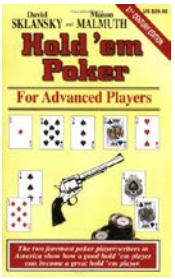
Buy at Amazon Sklansky, D. *The Theory of Poker: A Professional Poker Player Teaches You How To Think Like One*. Two Plus Two Pub, 1999.



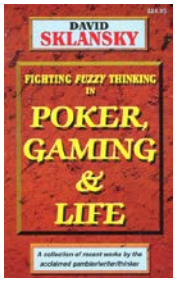
Buy at Amazon Miller, E. and D. Sklansky. *Small Stakes Hold'em: Winning Big With Expert Play*. Two Plus Two Pub, 2004.



Buy at Amazon Sklansky, D. and M. Malmuth. *Hold'em Poker: For Advanced Players*. Two Plus Two Pub, 1999.

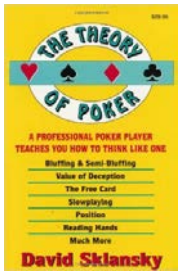


Buy at Amazon Sklansky, D. *Poker, Gaming & Life*. Two Plus Two Pub, 2009.



David Sklansky

Fundamental Theorem of Poker



Every time you play a hand differently from the way you would have played it if you could see all your opponents' cards, they gain; and every time you play your hand the same way you would have played it if you could see all their cards, they lose.

Sklansky-Karlson Rankings

- David Sklansky – Oct 04 ‘03 "Important No Limit Math Problem"
  - One and two dollar blinds. You are in the small blind. Everyone folds. Your hand is A8o. Your opponent in the two dollar big blind has more money than you.
  - You have only two options. Fold, or turn your cards face up and move in. He sees your A8 before he acts. You should not move in if your bankroll is above x dollars. What's x?
  - x ~ 70

Sklansky-Karlson Rankings

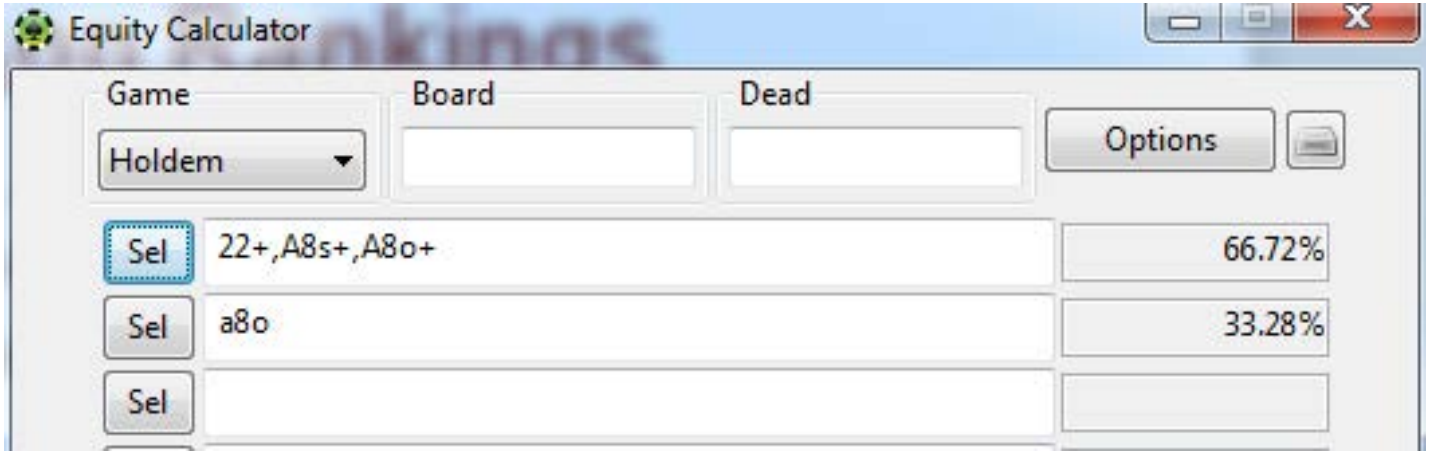
- David Sklansky – Oct 04 ‘03 "Important No Limit Math Problem”
  - 1/2 Blinds, Hero is SB with A8o
  - Hero bets *x* all in
  - BB will call at EV > 0
    - For simplicity, let’s say BB calls at Win% ≥ 50%
    - Minor differences in *x* will be caused by Villain’s calling behavior but it will generally not impact hand rankings

Sklansky-Karlson Rankings

- David Sklansky – Oct 04 ‘03 "Important No Limit Math Problem”
  - 1/2 Blinds, Hero is SB with A8o
  - Hero bets *x* all in
  - BB will call at EV > 0
    - For simplicity, let’s say BB calls at Win% ≥ 50%
    - BB calls with A8+, 22+, or 13.12%
  - Hero wins 33% vs this range

Sklansky-Karlson Rankings

- BB calls with A8+, 22+, or 13.12%
- Hero wins 33% vs this range



Sklansky-Karlson Rankings

- David Sklansky – Oct 04 ‘03 "Important No Limit Math Problem”
  - 1/2 Blinds, Hero is SB with A8o
  - Hero bets x all in
  - BB will call at EV > 0
    - For simplicity, let’s say BB calls at Win% ≥ 50%
    - BB calls with A8+, 22+, or 13.12%
  - Hero wins 33% vs this range
  - Hero EV = 87% * 3 + 13% * [33%*x + 67%*-(x-1)]
    - EV = 0 at $x \approx 62$
  - So at a stack of 62 or less, open-face all-in with A8o is +EV

Sklansky-Karlson Rankings

- David Sklansky - Oct 24 '03
  - What is the rating x for all hands?
  - Function of
    - Number of hands you are marginally better then
    - Chance of winning when you are behind
- Victor Chubukov (Karlson) – Oct 24 '03
  - AA ∞
  - KK 1290
  - You can check KK with
  - $0 = .9955 * 3 + .0045 * (.1805*x - .8195*(x-1))$ at $x \approx 1040$

Sklansky-Karlson Rankings

- David Sklansky - Oct 24 '03
  - What is the rating x for all hands?
  - Function of
    - Number of hands you are marginally better then
    - Chance of winning when you are behind
- Victor Chubukov (Karlson) – Oct 24 '03
  - AA ∞
  - KK 1290
  - You can check KK with
  - $0 = .9955 * 3 + .0045 * (.1805*x - .8195*(x-1))$ at $x \approx 1040$

Sklansky-Karlson Rankings

- For example, the top 1% of hands is AA
- The top 5% of hands is TT+, AQs+, AQo+
- The top 30% of hands is 22+, A2s+, K4s+, Q9s+, JTs, A2o+, K8o+, QJo

Range of Hands

- Simplified ranges you can memorize

- TT+, AQ+ = 5%
- 55+, **AT+** = 10%
- 22+, **A2+,** KQ = 20%
- 22+, A2+, **Broadway** = 30%
- Pairs and cards adding to **16** = 50%
- Any two cards = 100%

Range of Hands

AA	AKs	AQs	AJs	ATs	A9s	A8s	A7s	A6s	A5s	A4s	A3s	A2s
AKo	KK	KQs	KJs	KTs	K9s	K8s	K7s	K6s	K5s	K4s	K3s	K2s
AQo	KQo	QQ	QJs	QTs	Q9s	Q8s	Q7s	Q6s	Q5s	Q4s	Q3s	Q2s
AJo	KJo	QJo	JJ	JTs	J9s	J8s	J7s	J6s	J5s	J4s	J3s	J2s
ATo	KTo	QTo	JTo	TT	T9s	T8s	T7s	T6s	T5s	T4s	T3s	T2s
A9o	K9o	Q9o	J9o	T9o	99	98s	97s	96s	95s	94s	93s	92s
A8o	K8o	Q8o	J8o	T8o	98o	88	87s	86s	85s	84s	83s	82s
A7o	K7o	Q7o	J7o	T7o	97o	87o	77	76s	75s	74s	73s	72s
A6o	K6o	Q6o	J6o	T6o	96o	86o	76o	66	65s	64s	63s	62s
A5o	K5o	Q5o	J5o	T5o	95o	85o	75o	65o	55	54s	53s	52s
A4o	K4o	Q4o	J4o	T4o	94o	84o	74o	64o	54o	44	43s	42s
A3o	K3o	Q3o	J3o	T3o	93o	83o	73o	63o	53o	43o	33	32s
A2o	K2o	Q2o	J2o	T2o	92o	82o	72o	62o	52o	42o	32o	22

Range of Hands

A +EV range for a decision is profitable on average

An optimal range the most profitable set of hands in dollar terms

For example, vs. AQ, the range 55+, AT+ is profitable at 53% to win. But it's not optimal because AT and AJ lose to AQ

An optimal range is 22+ AQ+, which wins 60% of the time

If a range is optimal, then every hand in that range is +EV

Pre-flop Analysis

- Motivator
- Range Definition
- Basic Assumptions
- Heads Up
- Other Positions

Basic Assumptions

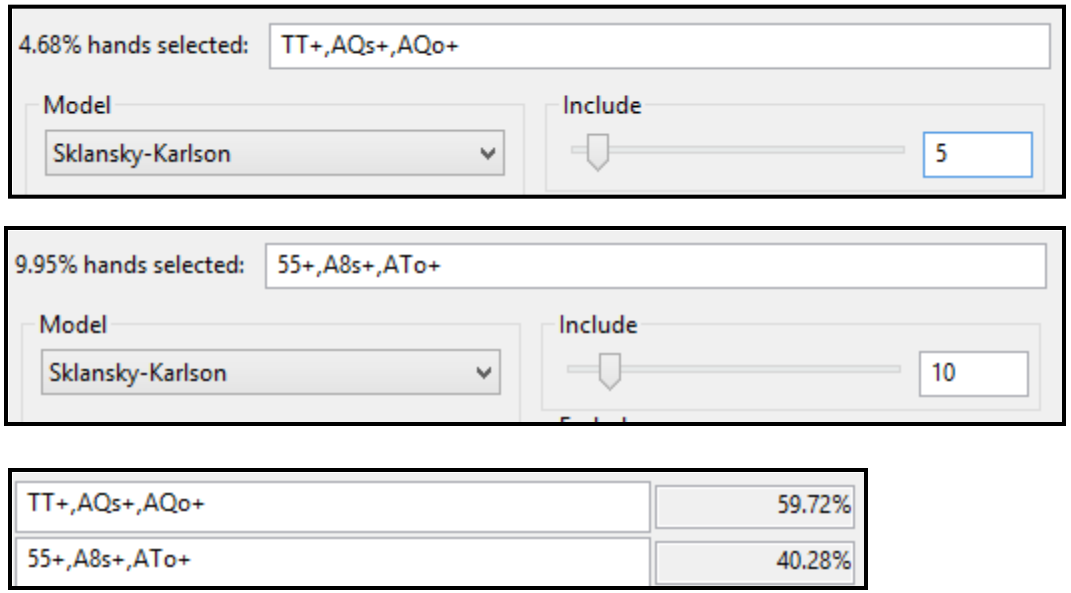
- Hero has effective M < 10
- Villain calling range is some top x% of hands and everyone generally agrees on the order of hand rankings
- ICM doesn't matter, just cEV
- M < 10 is basically push or fold
  - Why not raise? A bet of 3BB (i.e. 2 M) lets you fold to a re-raise if it's as much as 6M (i.e. giving you pot odds of 8 / 20 or 40%). You can fold 99- A5- K9- on a very small margin. Less than 4M remaining gives you pot odds of 4 / 12 or 30% which is basically always a call. So maximizing fold equity is most important

Preflop Strategy

Goal – Develop optimal push/call range for Ms up to 10 in blind vs blind

1. Build table of range vs range equities
2. Derive two-factor model to estimate range vs range equities
3. Develop EV model for semi-bluffs
4. For each M, find Nash Equilibrium if one exists
5. For unstable equilibriums, find reasonable ranges

Calculating top 5% vs top 10%



Range Table

Villain's Range

Hero's Range

	4.68%	9.95%	14.78%	19.91%	29.71%	39.67%	50.00%	74.66%	100.00%
4.68%	50%	60%	63%	66%	67%	69%	70%	72%	73%
9.95%	40%	50%	55%	56%	60%	62%	63%	66%	68%
14.78%	37%	45%	50%	52%	56%	58%	60%	63%	65%
19.91%	35%	44%	48%	50%	54%	57%	58%	61%	63%
29.71%	33%	40%	44%	46%	50%	53%	55%	59%	61%
39.67%	31%	38%	42%	43%	47%	50%	52%	57%	60%
50.00%	30%	37%	40%	42%	45%	48%	50%	55%	58%
74.66%	28%	34%	37%	39%	41%	43%	45%	50%	55%
100.00%	27%	32%	35%	37%	39%	40%	42%	45%	50%

Hero's Favor

Neutral

Villain's Favor

Hero Win % at Showdown

Preflop Strategy

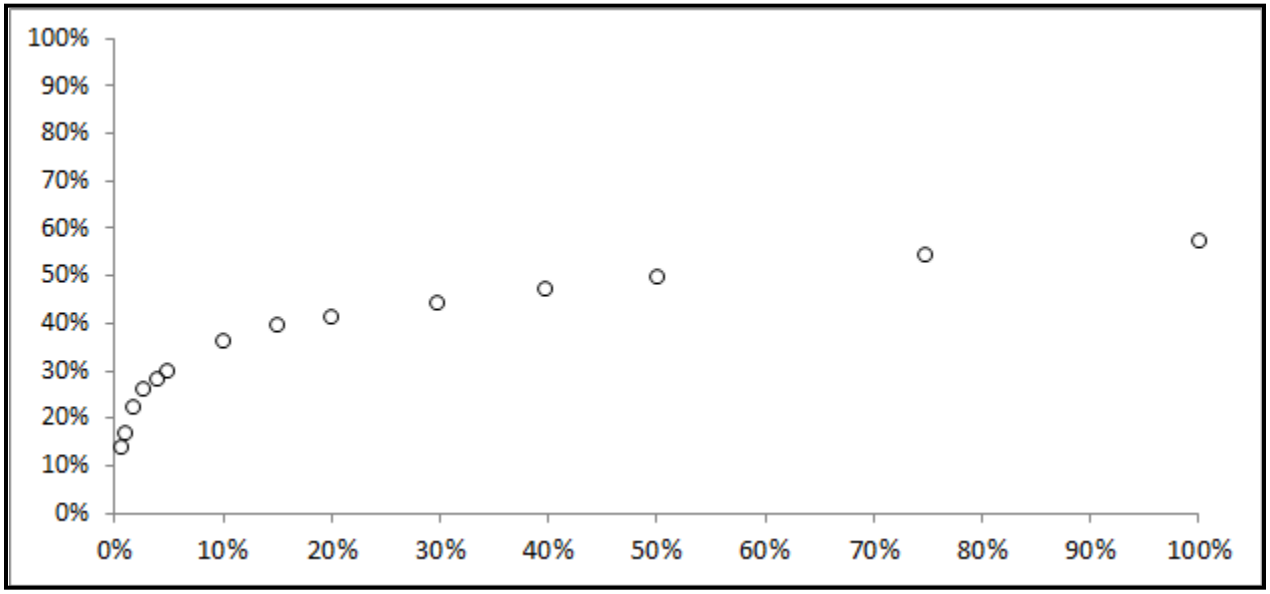
Goal – Develop optimal push/call range for Ms up to 10 in blind vs blind

1. Build table of range vs range equities
2. Derive two-factor model to estimate range vs range equities
3. Develop EV model for semi-bluffs
4. For each M, find Nash Equilibrium if one exists
5. For unstable equilibriums, find reasonable ranges

Range vs Range Model

Hero's Range = Top 50%

Hero's Win%

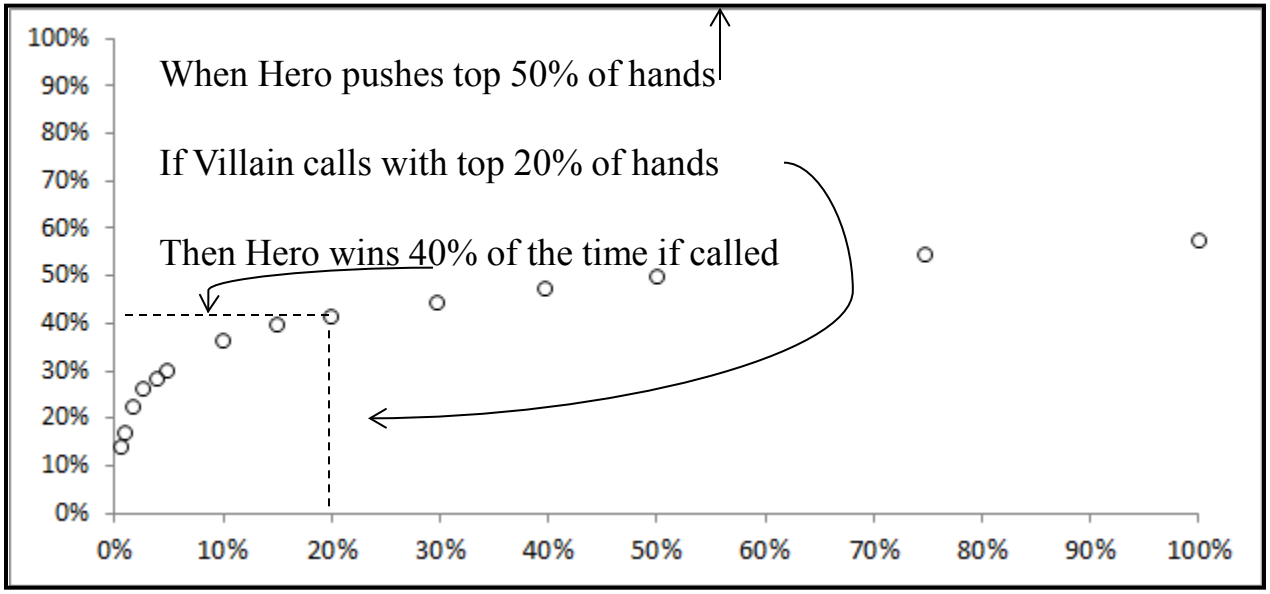


Villain's Range

Range vs Range Model

Hero's Range = Top 50%

Hero's Win%



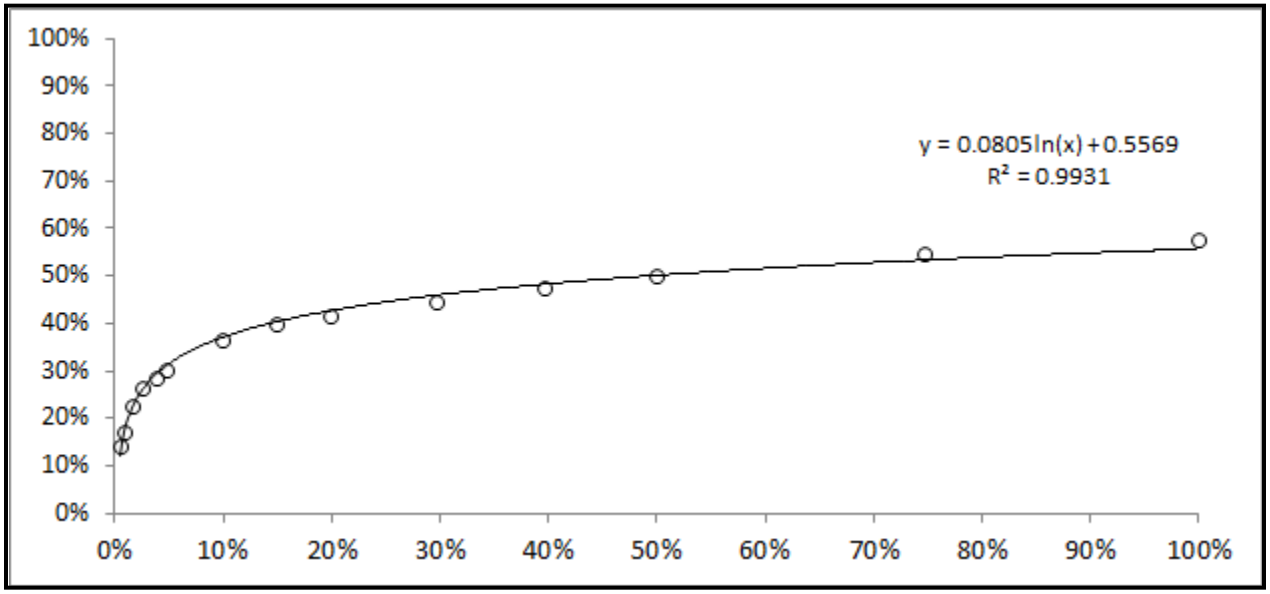
Villain's Range

Massachusetts Institute of Technology

Range vs Range Model

Hero's Range = Top 50%

Hero's Win%



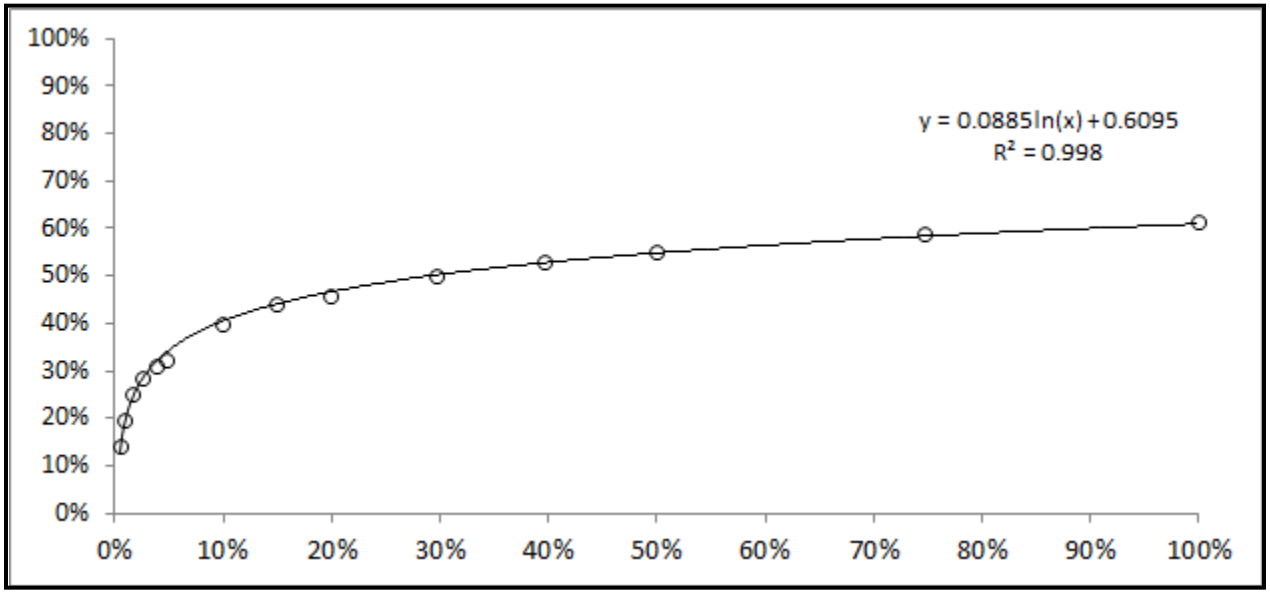
Villain's Range

Massachusetts Institute of Technology

Range vs Range Model

Hero's Range = Top 30%

Hero's Win%

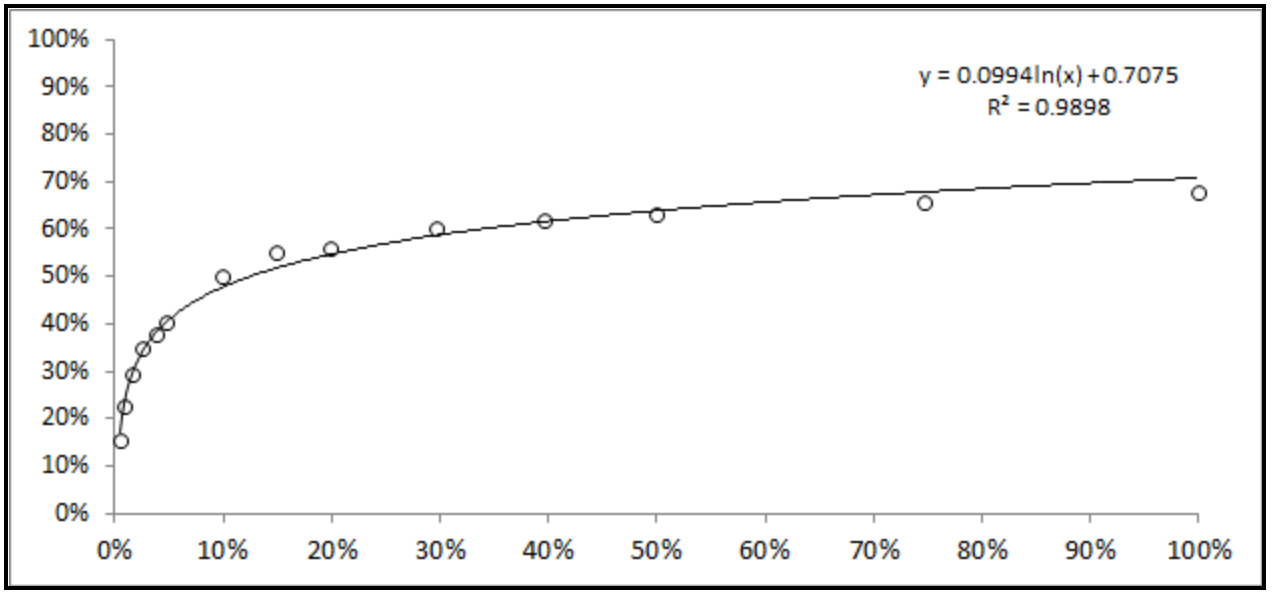


Villain's Range

Range vs Range Model

Hero's Range = Top 10%

Hero's Win%



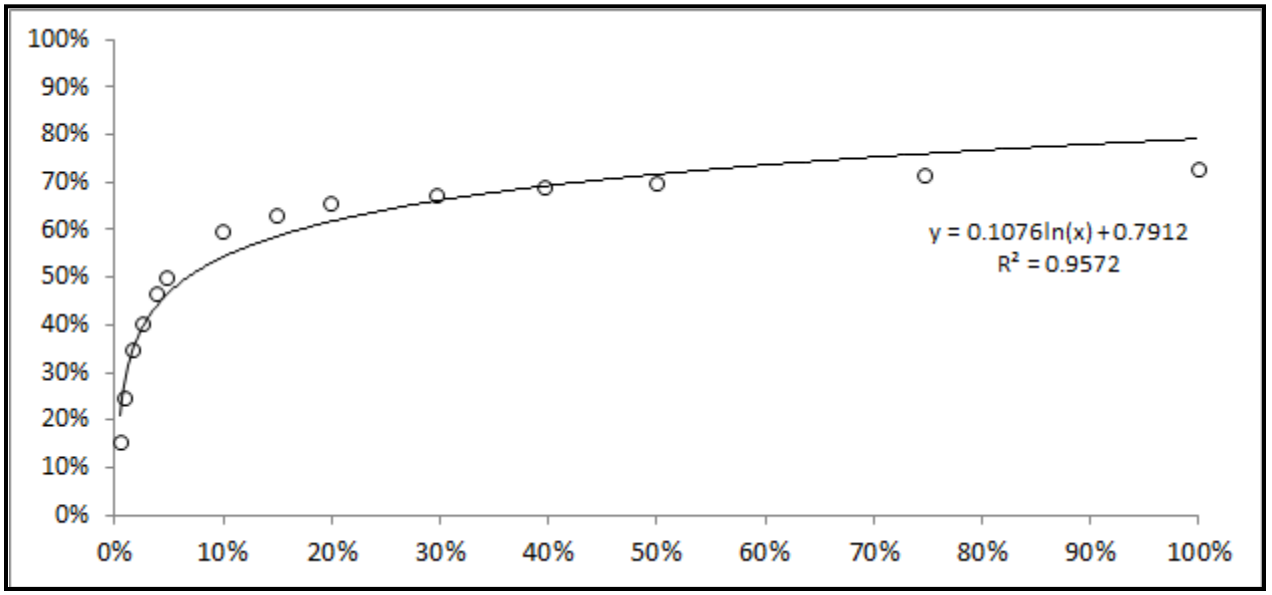
Villain's Range

Massachusetts Institute of Technology

Range vs Range Model

Hero's Range = Top 5%

Hero's Win%

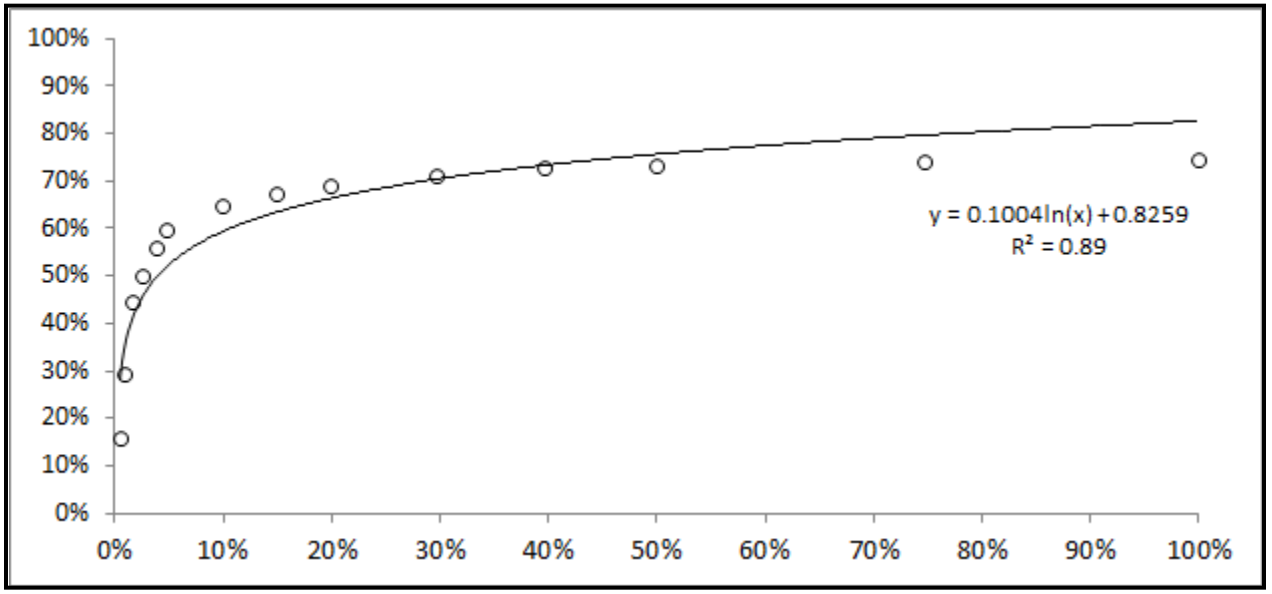


Villain's Range

Range vs Range Model

Hero's Range = Top 3%

Hero's Win%



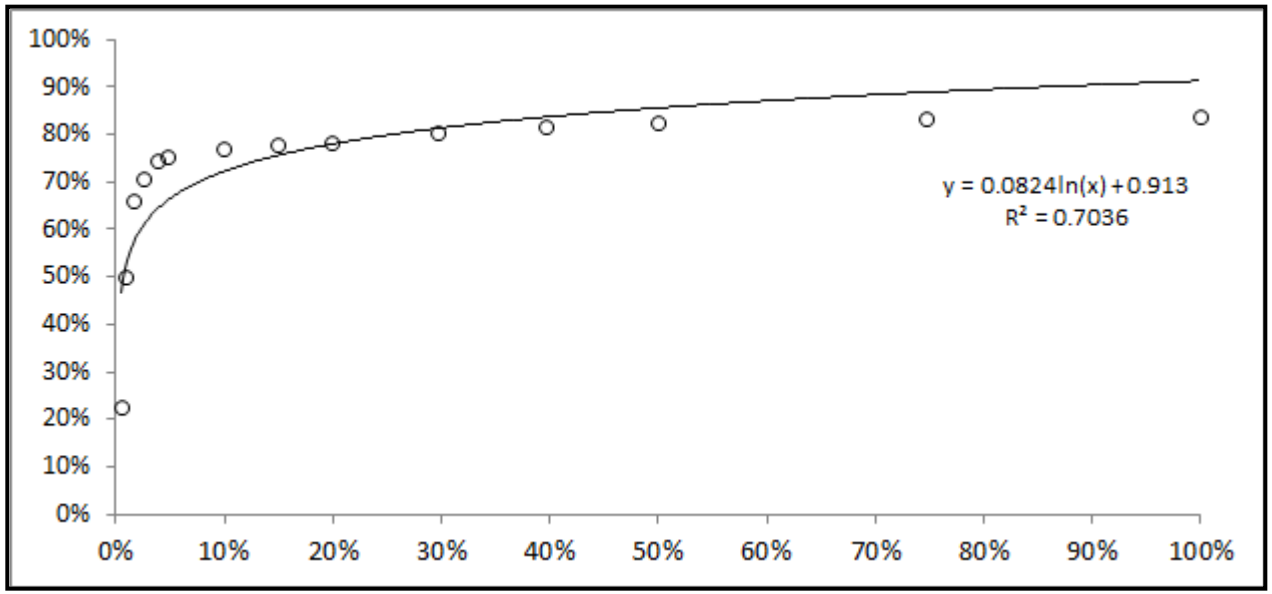
Villain's Range

Massachusetts Institute of Technology

Range vs Range Model

Hero's Range = Top 1%

Hero's Win%

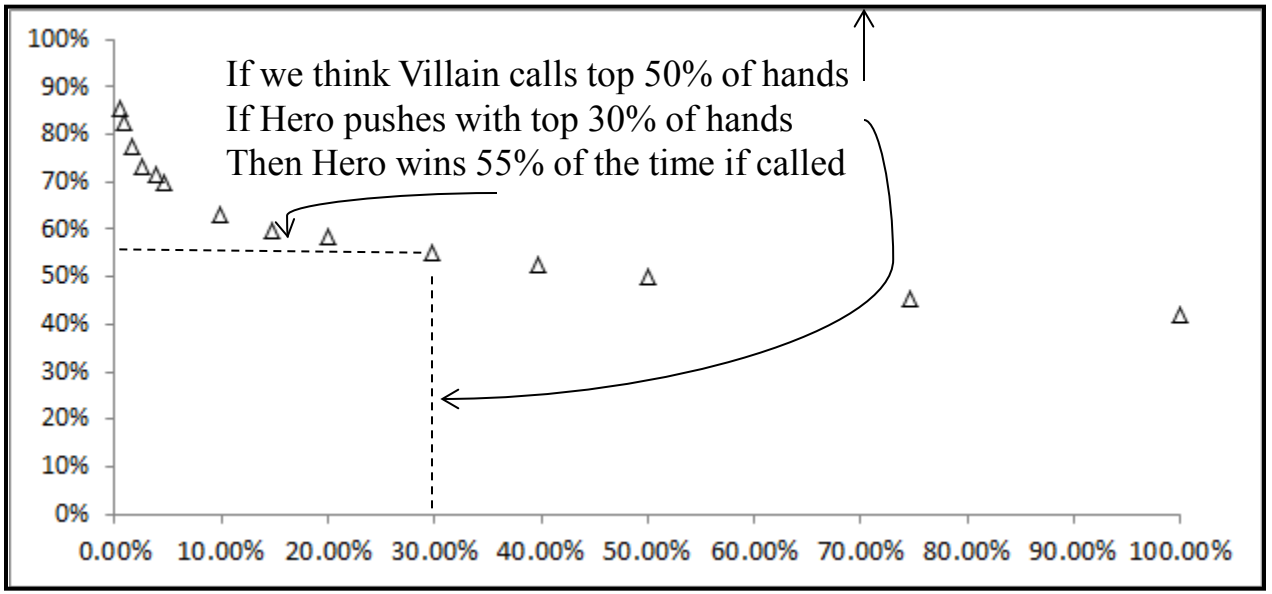


Villain's Range

Range vs Range Model

Villain's Range = Top 50%

Hero's Win%

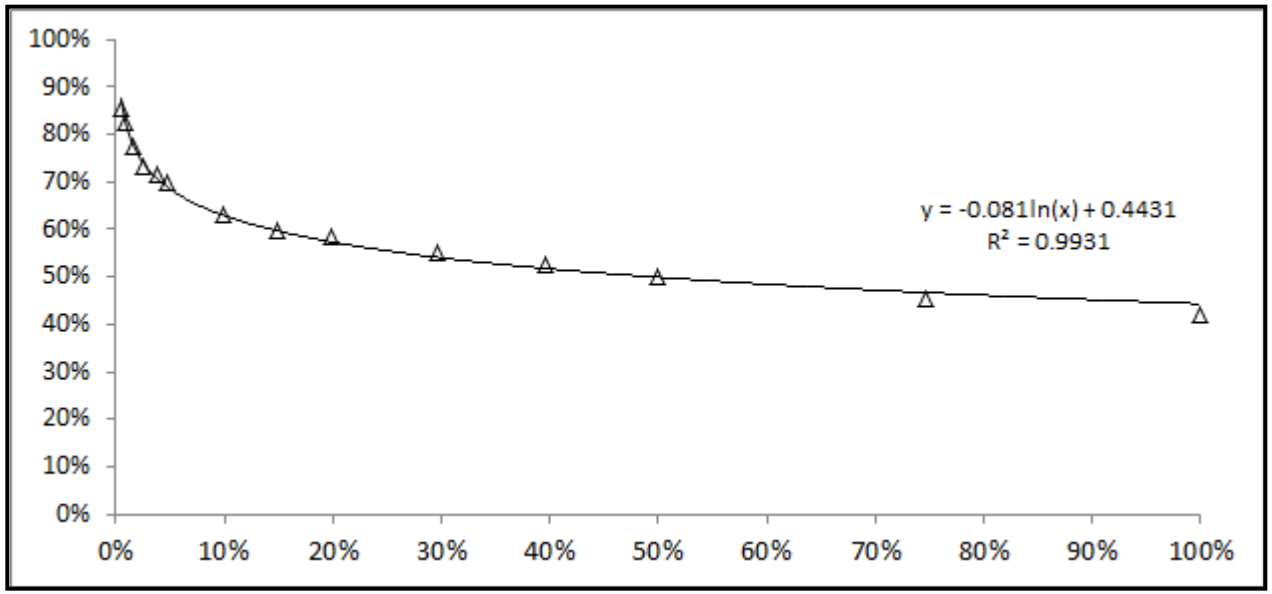


Hero's Range

Range vs Range Model

Villain's Range = Top 50%

Hero's Win%

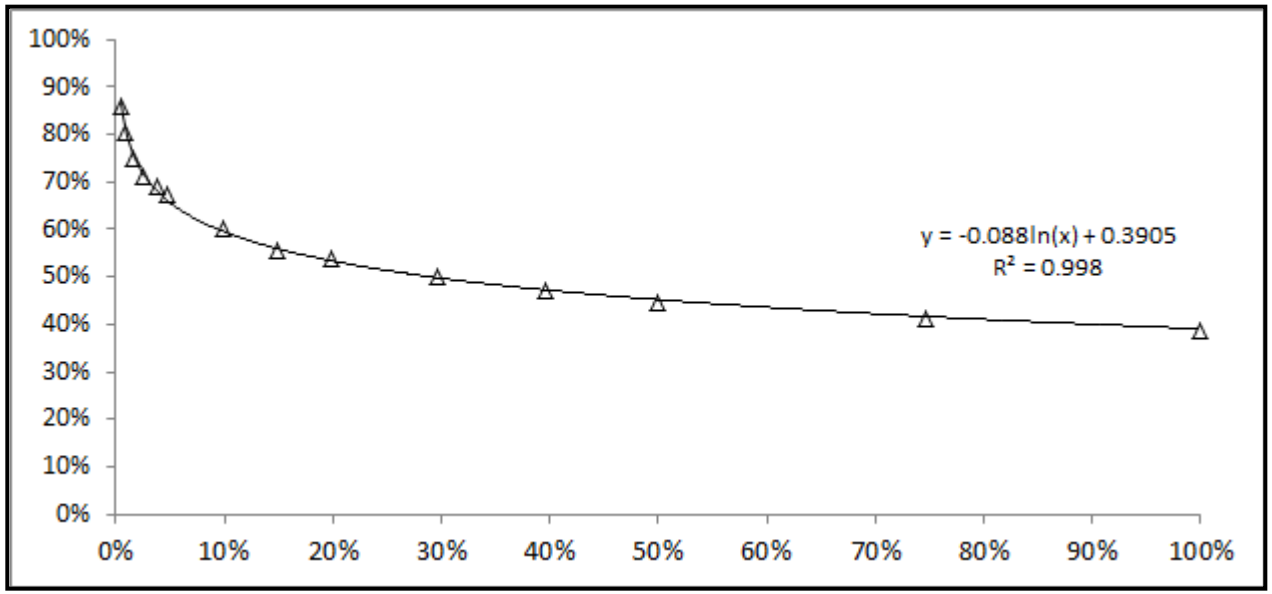


Hero's Range

Range vs Range Model

Villain's Range = Top 30%

Hero's Win%

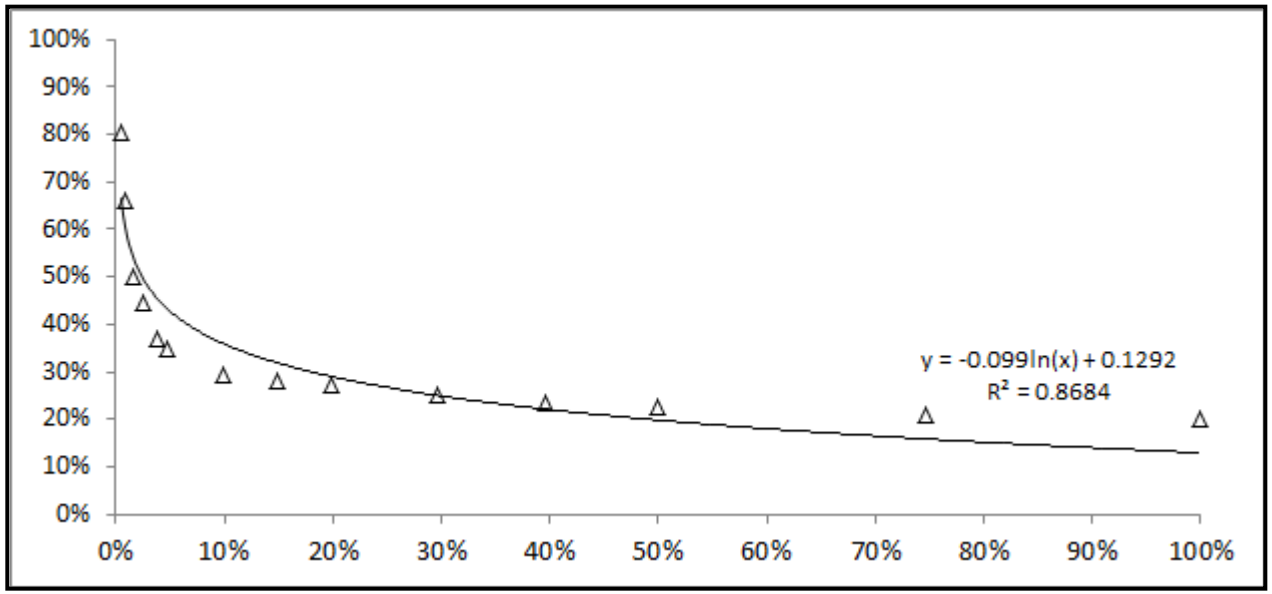


Hero's Range

Range vs Range Model

Villain's Range = Top 2%

Hero's Win%



Hero's Range

Range vs Range Model

Takeaway – range vs range equity relationship probably logarithmic, but not good in top 5%

Range vs Range Model

Villain's Range

Hero's Range	4.68%	9.95%	14.78%	19.91%	29.71%	39.67%	50.00%	74.66%	100.00%
4.68%	50%	60%	63%	66%	67%	69%	70%	72%	73%
9.95%	40%	50%	55%	56%	60%	62%	63%	66%	68%
14.78%	37%	45%	50%	52%	56%	58%	60%	63%	65%
19.91%	35%	44%	48%	50%	54%	57%	58%	61%	63%
29.71%	33%	40%	44%	46%	50%	53%	55%	59%	61%
39.67%	31%	38%	42%	43%	47%	50%	52%	57%	60%
50.00%	30%	37%	40%	42%	45%	48%	50%	55%	58%
74.66%	28%	34%	37%	39%	41%	43%	45%	50%	55%
100.00%	27%	32%	35%	37%	39%	40%	42%	45%	50%

Hero's Range

Hero Win % at Showdown

Hero's Favor

Neutral

Villain's Favor

Multiple Regression

	4.68%	9.95%	14.78%	19.91%	29.71%	39.67%	50.00%	74.66%	100.00%
4.68%	50%	60%	63%	66%	67%	69%	70%	72%	73%
9.95%	40%	50%	55%	56%	60%	62%	63%	66%	68%
14.78%	37%	45%	50%	52%	56%	58%	60%	63%	65%
19.91%	35%	44%	48%	50%	54%	57%	58%	61%	63%
29.71%	33%	40%	44%	46%	50%	53%	55%	59%	61%
39.67%	31%	38%	42%	43%	47%	50%	52%	57%	60%
50.00%	30%	37%	40%	42%	45%	48%	50%	55%	58%
74.66%	28%	34%	37%	39%	41%	43%	45%	50%	55%
100.00%	27%	32%	35%	37%	39%	40%	42%	45%	50%

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.99
R Square	0.98
Adjusted R Square	0.98
Standard Error	0.01
Observations	81

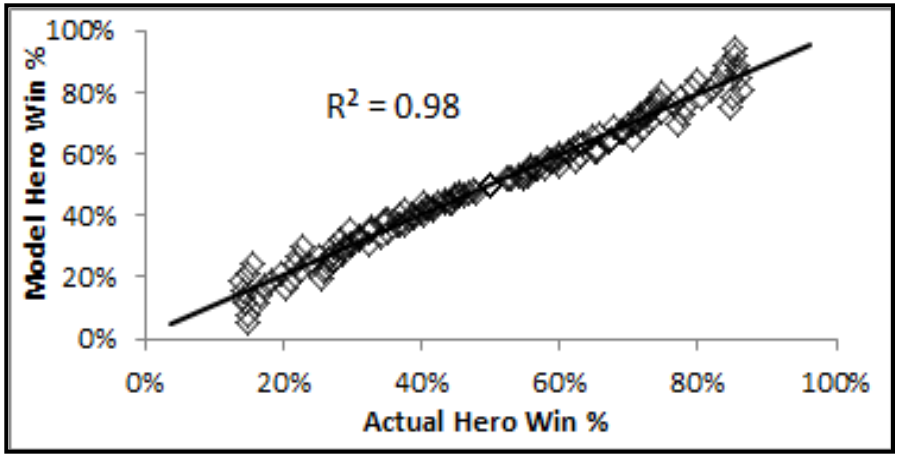
	Coefficients
Intercept	0.5
ln(H)	(0.085)
ln(V)	0.085

Multiple Regression

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.99
R Square	0.98
Adjusted R Square	0.98
Standard Error	0.01
Observations	81
	Coefficients
Intercept	0.5
ln(H)	(0.085)
ln(V)	0.085

Equity Model

$$HeroWin\% = 50\% + .085 * \ln(VillainRange) - .085 * \ln(HeroRange) + \varepsilon$$

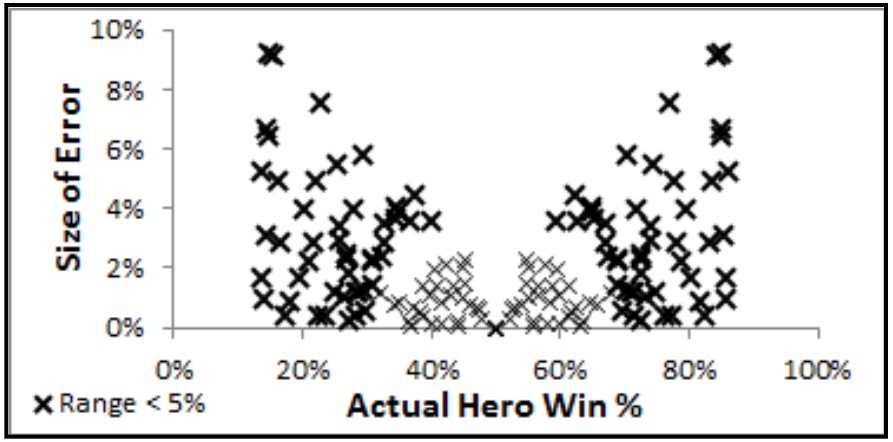


Error Analysis

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.99
R Square	0.98
Adjusted R Square	0.98
Standard Error	0.01
Observations	81
	Coefficients
Intercept	0.5
ln(H)	(0.085)
ln(V)	0.085

Equity Model

$$HeroWin\% = 50\% + .085 * \ln(VillainRange) - .085 * \ln(HeroRange) + \varepsilon$$



Range vs Range Model

Two-factor logarithmic model is good estimate for range vs range preflop equities

Error is large at ranges less than 5%, but tolerable otherwise

$$HeroWin\% = 50\% + .085 * \ln(VillainRange) - .085 * \ln(HeroRange) + \varepsilon$$

Preflop Strategy

Goal – Develop optimal push/call range for Ms up to 10 in blind vs blind

1. Build table of range vs range equities
2. Derive two-factor model to estimate range vs range equities
3. Develop EV model for semi-bluffs
4. For each M, find Nash Equilibrium if one exists
5. For unstable equilibriums, find reasonable ranges

EV Equation (Semi-Bluffs)

$$EV = FoldEquity + ShowdownValue$$

$$FoldEquity = Blinds * (1 - VillainCall\%)$$

EV Equation (Semi-Bluffs)

$$EV = FoldEquity + ShowdownValue$$

$$FoldEquity = 1 * (1 - VillainCall\%)$$

$$ShowdownValue = \\ VillainCall\% * [SDWinAmt * HeroWin\% - SDLoseAmt * HeroLose\%]$$

$$SDWinAmt = Stack + \frac{2}{3}$$

$$SDLoseAmt = Stack$$

$$HeroWin\% = 50\% + .085 * \ln(VillainCall\%) - .085 * \ln(HeroPush\%)$$

EV Equation (Semi-Bluffs)

$$EV = FoldEquity + ShowdownValue$$

$$FoldEquity = 1 * (1 - VillainCall\%)$$

$$ShowdownValue = VillainCall\% * [SDWinAmt * HeroWin\% - SDLoseAmt * HeroLose\%]$$

$$SDWinAmt = Stack + \frac{2}{3}$$

$$SDLoseAmt = Stack$$

$$HeroWin\% = 50\% + .085 * \ln(VillainCall\%) - .085 * \ln(HeroPush\%)$$

EV Equation (Semi-Bluffs)

$$EV = (1 - VillainCall\%) + VillainCall\% * \left[(Stack + \frac{2}{3}) * HeroWin\% - Stack * HeroLose\%\right]$$

$$HeroWin\% = 50\% + .085 * \ln(VillainCall\%) - .085 * \ln(HeroPush\%)$$

Preflop Strategy

Goal – Develop optimal push/call range for Ms up to 10 in blind vs blind

1. Build table of range vs range equities
2. Derive two-factor model to estimate range vs range equities
3. Develop EV model for semi-bluffs
4. For each M, find Nash Equilibrium if one exists
5. For unstable equilibriums, find reasonable ranges

EV when M = 20

SB's EV (in terms of M)

SB Picks

BB Picks

	5%	25.0%	50.0%	75.0%	100.0%
5%	0.05	0.17	0.29	0.39	0.47
25.0%	0.11	0.21	0.13	-0.06	-0.32
50.0%	0.23	0.46	0.33	-0.01	-0.49
75.0%	0.36	0.81	0.76	0.38	-0.22
100.0%	0.52	1.24	1.32	0.97	0.33

BB's Favor Neutral SB's Favor

SB loses .49M/hand

Massachusetts Institute of Technology

EV when M = 20

SB's EV (in terms of M)

SB Wants to Maximize EV

BB Wants to Minimize EV

	5%	25.0%	50.0%	75.0%	100.0%
5%	0.05	0.17	0.29	0.39	0.47
25.0%	0.11	0.21	0.13	-0.06	-0.32
50.0%	0.23	0.46	0.33	-0.01	-0.49
75.0%	0.36	0.81	0.76	0.38	-0.22
100.0%	0.52	1.24	1.32	0.97	0.33

BB's Favor Neutral SB's Favor

EV when M = 20

SB Picks

BB Picks

	5%	10.0%	15.0%	20.0%	25.0%	30.0%	35.0%	40.0%	45.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
5%	0.05	0.09	0.12	0.15	0.17	0.20	0.22	0.25	0.27	0.29	0.31	0.33	0.35	0.37	0.39	0.40	0.42	0.44	0.45	0.47
10.0%	0.06	0.09	0.12	0.14	0.16	0.17	0.18	0.19	0.19	0.20	0.20	0.20	0.20	0.20	0.20	0.19	0.19	0.18	0.17	0.16
15.0%	0.07	0.11	0.14	0.15	0.16	0.17	0.17	0.16	0.16	0.15	0.14	0.12	0.11	0.09	0.07	0.05	0.03	0.00	-0.02	-0.05
20.0%	0.09	0.13	0.16	0.17	0.18	0.18	0.17	0.16	0.15	0.13	0.11	0.08	0.05	0.02	-0.01	-0.05	-0.08	-0.12	-0.17	-0.21
25.0%	0.11	0.16	0.19	0.20	0.21	0.20	0.19	0.18	0.15	0.13	0.10	0.06	0.02	-0.02	-0.06	-0.11	-0.16	-0.21	-0.27	-0.32
30.0%	0.13	0.19	0.22	0.24	0.25	0.24	0.23	0.20	0.18	0.14	0.11	0.06	0.02	-0.03	-0.09	-0.15	-0.21	-0.27	-0.34	-0.41
35.0%	0.15	0.22	0.26	0.28	0.29	0.28	0.27	0.24	0.21	0.17	0.13	0.08	0.03	-0.03	-0.09	-0.16	-0.23	-0.30	-0.38	-0.46
40.0%	0.18	0.26	0.31	0.33	0.34	0.34	0.32	0.29	0.26	0.22	0.17	0.12	0.06	-0.01	-0.08	-0.15	-0.23	-0.31	-0.40	-0.49
45.0%	0.20	0.30	0.35	0.38	0.40	0.39	0.38	0.35	0.32	0.27	0.22	0.16	0.10	0.03	-0.05	-0.13	-0.22	-0.31	-0.40	-0.50
50.0%	0.23	0.34	0.40	0.44	0.46	0.46	0.44	0.42	0.38	0.33	0.28	0.22	0.15	0.07	-0.01	-0.09	-0.19	-0.28	-0.38	-0.49
55.0%	0.25	0.38	0.45	0.50	0.52	0.52	0.51	0.49	0.45	0.40	0.35	0.28	0.21	0.13	0.05	-0.04	-0.14	-0.24	-0.35	-0.46
60.0%	0.28	0.42	0.51	0.56	0.59	0.60	0.59	0.56	0.53	0.48	0.43	0.36	0.29	0.20	0.11	0.02	-0.08	-0.19	-0.30	-0.42
65.0%	0.31	0.46	0.56	0.62	0.66	0.67	0.67	0.65	0.61	0.57	0.51	0.44	0.37	0.28	0.19	0.09	-0.01	-0.13	-0.24	-0.37
70.0%	0.34	0.51	0.62	0.69	0.73	0.75	0.75	0.74	0.70	0.66	0.60	0.54	0.46	0.37	0.28	0.18	0.07	-0.05	-0.17	-0.30
75.0%	0.36	0.55	0.68	0.76	0.81	0.84	0.84	0.83	0.80	0.76	0.70	0.64	0.56	0.47	0.38	0.27	0.16	0.04	-0.09	-0.22
80.0%	0.39	0.60	0.74	0.83	0.89	0.93	0.94	0.93	0.90	0.86	0.81	0.74	0.66	0.58	0.48	0.37	0.26	0.14	0.01	-0.13
85.0%	0.42	0.65	0.80	0.91	0.98	1.02	1.03	1.03	1.01	0.97	0.92	0.85	0.78	0.69	0.59	0.48	0.37	0.24	0.11	-0.03
90.0%	0.45	0.70	0.87	0.98	1.06	1.11	1.13	1.13	1.12	1.08	1.03	0.97	0.90	0.81	0.71	0.60	0.49	0.36	0.23	0.08
95.0%	0.49	0.75	0.93	1.06	1.15	1.21	1.24	1.24	1.23	1.20	1.16	1.09	1.02	0.93	0.84	0.73	0.61	0.48	0.35	0.20
100.0%	0.52	0.80	1.00	1.14	1.24	1.31	1.34	1.36	1.35	1.32	1.28	1.22	1.15	1.07	0.97	0.86	0.74	0.62	0.48	0.33

BB's Favor Neutral SB's Favor

EV when M = 10

Hero's Push Range

Villain's Call Range

	5%	10.0%	15.0%	20.0%	25.0%	30.0%	35.0%	40.0%	45.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
5%	0.05	0.09	0.13	0.17	0.21	0.24	0.28	0.32	0.35	0.39	0.42	0.45	0.49	0.52	0.55	0.59	0.62	0.65	0.68	0.71
10.0%	0.05	0.09	0.13	0.16	0.19	0.22	0.25	0.28	0.31	0.33	0.35	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54
15.0%	0.06	0.10	0.14	0.17	0.19	0.22	0.24	0.26	0.28	0.30	0.31	0.33	0.34	0.36	0.37	0.38	0.39	0.40	0.41	0.42
20.0%	0.07	0.11	0.14	0.17	0.20	0.22	0.24	0.25	0.27	0.28	0.29	0.30	0.30	0.31	0.31	0.32	0.32	0.32	0.32	0.32
25.0%	0.08	0.12	0.16	0.19	0.21	0.23	0.24	0.25	0.26	0.27	0.27	0.28	0.28	0.28	0.28	0.27	0.27	0.26	0.25	0.25
30.0%	0.09	0.14	0.17	0.20	0.22	0.24	0.25	0.26	0.27	0.27	0.27	0.27	0.26	0.26	0.25	0.24	0.23	0.22	0.20	0.19
35.0%	0.10	0.15	0.19	0.22	0.24	0.26	0.27	0.27	0.28	0.28	0.27	0.27	0.26	0.25	0.24	0.22	0.20	0.19	0.16	0.14
40.0%	0.11	0.17	0.21	0.24	0.26	0.28	0.29	0.29	0.29	0.29	0.28	0.27	0.26	0.25	0.23	0.21	0.19	0.16	0.14	0.11
45.0%	0.12	0.18	0.23	0.26	0.29	0.30	0.31	0.32	0.32	0.31	0.30	0.29	0.27	0.25	0.23	0.21	0.18	0.15	0.12	0.09
50.0%	0.13	0.20	0.25	0.29	0.31	0.33	0.34	0.34	0.34	0.33	0.32	0.31	0.29	0.27	0.24	0.21	0.18	0.15	0.12	0.08
55.0%	0.14	0.22	0.28	0.32	0.34	0.36	0.37	0.37	0.37	0.36	0.35	0.33	0.31	0.29	0.26	0.23	0.19	0.16	0.12	0.08
60.0%	0.16	0.24	0.30	0.34	0.37	0.39	0.40	0.41	0.40	0.39	0.38	0.36	0.34	0.31	0.28	0.25	0.21	0.17	0.13	0.08
65.0%	0.17	0.26	0.33	0.37	0.41	0.43	0.44	0.44	0.44	0.43	0.41	0.39	0.37	0.34	0.31	0.27	0.23	0.19	0.14	0.09
70.0%	0.18	0.28	0.35	0.40	0.44	0.46	0.47	0.48	0.48	0.47	0.45	0.43	0.40	0.37	0.34	0.30	0.26	0.21	0.16	0.11
75.0%	0.20	0.31	0.38	0.44	0.47	0.50	0.51	0.52	0.52	0.51	0.49	0.47	0.44	0.41	0.38	0.33	0.29	0.24	0.19	0.13
80.0%	0.21	0.33	0.41	0.47	0.51	0.54	0.56	0.56	0.56	0.55	0.54	0.51	0.49	0.45	0.42	0.37	0.33	0.28	0.22	0.16
85.0%	0.23	0.35	0.44	0.50	0.55	0.58	0.60	0.61	0.61	0.60	0.58	0.56	0.53	0.50	0.46	0.42	0.37	0.32	0.26	0.20
90.0%	0.24	0.38	0.47	0.54	0.59	0.62	0.64	0.66	0.66	0.65	0.63	0.61	0.58	0.55	0.51	0.46	0.41	0.36	0.30	0.24
95.0%	0.26	0.40	0.50	0.58	0.63	0.67	0.69	0.70	0.71	0.70	0.69	0.66	0.64	0.60	0.56	0.51	0.46	0.41	0.35	0.28
100.0%	0.27	0.42	0.53	0.61	0.67	0.71	0.74	0.76	0.76	0.75	0.74	0.72	0.69	0.66	0.62	0.57	0.52	0.46	0.40	0.33

Villain's Favor Neutral Hero's Favor

EV when M = 1

Hero's Push Range

Villain's Call Range

	5%	10.0%	15.0%	20.0%	25.0%	30.0%	35.0%	40.0%	45.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
5%	0.05	0.10	0.14	0.19	0.24	0.28	0.33	0.38	0.42	0.47	0.52	0.56	0.61	0.66	0.70	0.75	0.80	0.84	0.89	0.93
10.0%	0.05	0.09	0.14	0.18	0.23	0.27	0.32	0.36	0.41	0.45	0.49	0.54	0.58	0.62	0.67	0.71	0.75	0.80	0.84	0.88
15.0%	0.05	0.09	0.14	0.18	0.22	0.26	0.31	0.35	0.39	0.43	0.47	0.51	0.55	0.59	0.64	0.68	0.72	0.76	0.80	0.84
20.0%	0.05	0.09	0.13	0.17	0.21	0.25	0.29	0.33	0.37	0.41	0.45	0.49	0.53	0.57	0.61	0.64	0.68	0.72	0.76	0.80
25.0%	0.05	0.09	0.13	0.17	0.21	0.25	0.29	0.32	0.36	0.40	0.43	0.47	0.51	0.54	0.58	0.62	0.65	0.69	0.72	0.76
30.0%	0.05	0.09	0.13	0.17	0.20	0.24	0.28	0.31	0.35	0.38	0.42	0.45	0.49	0.52	0.55	0.59	0.62	0.66	0.69	0.72
35.0%	0.05	0.09	0.12	0.16	0.20	0.23	0.27	0.30	0.34	0.37	0.40	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.66	0.69
40.0%	0.05	0.09	0.12	0.16	0.19	0.23	0.26	0.29	0.33	0.36	0.39	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.62	0.65
45.0%	0.05	0.08	0.12	0.16	0.19	0.22	0.25	0.28	0.32	0.34	0.37	0.40	0.43	0.46	0.49	0.51	0.54	0.57	0.60	0.62
50.0%	0.05	0.08	0.12	0.15	0.19	0.22	0.25	0.28	0.31	0.33	0.36	0.39	0.41	0.44	0.47	0.49	0.52	0.54	0.57	0.59
55.0%	0.05	0.08	0.12	0.15	0.18	0.21	0.24	0.27	0.30	0.32	0.35	0.37	0.40	0.42	0.45	0.47	0.49	0.52	0.54	0.56
60.0%	0.05	0.08	0.12	0.15	0.18	0.21	0.23	0.26	0.29	0.31	0.34	0.36	0.38	0.41	0.43	0.45	0.47	0.49	0.51	0.53
65.0%	0.05	0.08	0.12	0.15	0.18	0.20	0.23	0.25	0.28	0.30	0.32	0.35	0.37	0.39	0.41	0.43	0.45	0.47	0.49	0.51
70.0%	0.05	0.08	0.12	0.15	0.17	0.20	0.22	0.25	0.27	0.29	0.31	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.46	0.48
75.0%	0.05	0.08	0.11	0.14	0.17	0.20	0.22	0.24	0.26	0.28	0.30	0.32	0.34	0.36	0.38	0.39	0.41	0.42	0.44	0.45
80.0%	0.05	0.08	0.11	0.14	0.17	0.19	0.21	0.24	0.26	0.27	0.29	0.31	0.33	0.34	0.36	0.37	0.39	0.40	0.41	0.43
85.0%	0.05	0.08	0.11	0.14	0.17	0.19	0.21	0.23	0.25	0.27	0.28	0.30	0.31	0.33	0.34	0.36	0.37	0.38	0.39	0.40
90.0%	0.05	0.08	0.11	0.14	0.16	0.18	0.21	0.22	0.24	0.26	0.27	0.29	0.30	0.31	0.33	0.34	0.35	0.36	0.37	0.38
95.0%	0.05	0.08	0.11	0.14	0.16	0.18	0.20	0.22	0.23	0.25	0.26	0.28	0.29	0.30	0.31	0.32	0.33	0.34	0.35	0.36
100.0%	0.05	0.08	0.11	0.14	0.16	0.18	0.20	0.21	0.23	0.24	0.26	0.27	0.28	0.29	0.30	0.31	0.31	0.32	0.33	0.33

Villain's Favor Neutral Hero's Favor

Massachusetts Institute of Technology

EV when M = 1 (Equilibrium)

Hero's Push Range

Villain's Call Range

	90%	95%	100%
90%	0.360	0.370	0.379
95%	0.340	0.348	0.356
100%	0.321	0.327	0.333

Less EV

Villain Picks

More EV →

Hero Picks

Massachusetts Institute of Technology

EV when M = 2 (Equilibrium)

Hero's Push Range

Villain's Call Range

	75%	80%	85%	90%	95%	100%
75%	0.375	0.385	0.394	0.403	0.410	0.417
80%	0.365	0.373	0.381	0.388	0.393	0.398
85%	0.356	0.362	0.368	0.373	0.377	0.380
90%	0.347	0.352	0.357	0.360	0.362	0.364
95%	0.340	0.343	0.346	0.348	0.348	0.348
100%	0.333	0.335	0.336	0.336	0.335	0.333

Less EV

Villain Picks

More EV

Hero Picks

EV when M = 3 (Unstable Nash)

Hero's Push Range

Villain's Call Range

	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%
55.0%	0.35	0.36	0.38	0.39	0.40	0.42
60.0%	0.35	0.36	0.37	0.38	0.40	0.40
65.0%	0.34	0.36	0.37	0.38	0.39	0.39
70.0%	0.34	0.36	0.37	0.37	0.38	0.39
75.0%	0.35	0.35	0.36	0.37	0.38	0.38
80.0%	0.35	0.36	0.36	0.37	0.37	0.37
85.0%	0.35	0.36	0.36	0.37	0.37	0.37
90.0%	0.35	0.36	0.36	0.37	0.37	0.37
95.0%	0.36	0.36	0.37	0.37	0.37	0.36
100.0%	0.36	0.37	0.37	0.37	0.37	0.36

When Hero is SB (and first to act)

Goal: Determine optimal pushing ranges for likely scenarios

Methodology: For each column, identify max EV for the following scenarios

Average Case (No info about Villain's call range)

Worst Case (Villain has best response)

Tight Villain (Assumes 15% Calling Range) [33+,A4+,KT+]

Loose Villain (Assumes 80% Calling Range) [22+, T2+, 93+, etc]

EV when M = 1 to 10

1M

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
Average	0.05	0.09	0.12	0.16	0.19	0.22	0.25	0.28	0.31	0.34	0.37	0.39	0.42	0.45	0.47	0.50	0.52	0.55	0.57	0.60
Worst	0.05	0.08	0.11	0.14	0.16	0.18	0.20	0.21	0.23	0.24	0.26	0.27	0.28	0.29	0.30	0.31	0.31	0.32	0.33	0.33
Tight (15%)	0.05	0.09	0.14	0.18	0.22	0.26	0.31	0.35	0.39	0.43	0.47	0.51	0.55	0.59	0.64	0.68	0.72	0.76	0.80	0.84
Loose (80%)	0.05	0.08	0.11	0.14	0.17	0.19	0.21	0.24	0.26	0.27	0.29	0.31	0.33	0.34	0.36	0.37	0.39	0.40	0.41	0.43

Neutral

Hero's Favor

Best Pushing Range for SB

EV when M = 1 to 10

1M

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
Average	0.05	0.09	0.12	0.16	0.19	0.22	0.25	0.28	0.31	0.34	0.37	0.39	0.42	0.45	0.47	0.50	0.52	0.55	0.57	0.60
Worst	0.05	0.08	0.11	0.14	0.16	0.18	0.20	0.21	0.23	0.24	0.26	0.27	0.28	0.29	0.30	0.31	0.31	0.32	0.33	0.33
Tight (15%)	0.05	0.09	0.14	0.18	0.22	0.26	0.31	0.35	0.39	0.43	0.47	0.51	0.55	0.59	0.64	0.68	0.72	0.76	0.80	0.84
Loose (80%)	0.05	0.08	0.11	0.14	0.17	0.19	0.21	0.24	0.26	0.27	0.29	0.31	0.33	0.34	0.36	0.37	0.39	0.40	0.41	0.43

3M

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
Average	0.07	0.12	0.16	0.20	0.23	0.26	0.29	0.31	0.33	0.36	0.38	0.40	0.41	0.43	0.45	0.46	0.48	0.49	0.50	0.51
Worst	0.05	0.09	0.13	0.17	0.21	0.24	0.27	0.29	0.31	0.33	0.34	0.35	0.36	0.37	0.37	0.36	0.36	0.35	0.34	0.33
Tight (15%)	0.05	0.09	0.14	0.18	0.21	0.25	0.29	0.33	0.36	0.40	0.44	0.47	0.51	0.54	0.58	0.61	0.64	0.68	0.71	0.74
Loose (80%)	0.08	0.14	0.18	0.21	0.24	0.27	0.29	0.31	0.32	0.34	0.35	0.36	0.36	0.37	0.37	0.37	0.37	0.37	0.37	0.37

5M

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
Average	0.09	0.15	0.20	0.23	0.27	0.30	0.32	0.34	0.36	0.38	0.39	0.40	0.41	0.42	0.42	0.43	0.43	0.43	0.43	0.43
Worst	0.05	0.09	0.13	0.17	0.21	0.24	0.27	0.29	0.31	0.33	0.34	0.35	0.36	0.36	0.36	0.36	0.35	0.34	0.33	0.31
Tight (15%)	0.05	0.10	0.14	0.17	0.21	0.24	0.28	0.31	0.34	0.37	0.40	0.43	0.46	0.49	0.52	0.54	0.57	0.60	0.62	0.65
Loose (80%)	0.12	0.19	0.25	0.29	0.32	0.35	0.37	0.38	0.39	0.40	0.40	0.40	0.40	0.39	0.38	0.37	0.36	0.35	0.33	0.31

10M

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
Average	0.14	0.23	0.29	0.33	0.37	0.39	0.41	0.42	0.42	0.42	0.42	0.41	0.40	0.38	0.36	0.34	0.32	0.29	0.26	0.23
Worst	0.05	0.09	0.13	0.16	0.19	0.22	0.24	0.25	0.26	0.27	0.27	0.27	0.26	0.25	0.23	0.21	0.18	0.15	0.12	0.08
Tight (15%)	0.06	0.10	0.14	0.17	0.19	0.22	0.24	0.26	0.28	0.30	0.31	0.33	0.34	0.36	0.37	0.38	0.39	0.40	0.41	0.42
Loose (80%)	0.21	0.33	0.41	0.47	0.51	0.54	0.56	0.56	0.56	0.55	0.54	0.51	0.49	0.45	0.42	0.37	0.33	0.28	0.22	0.16

Massachusetts Institute of Technology

SB Rules of Thumb

If you think Villain is tight, top 100% is always optimal

In other scenarios, top 100% is optimal for M = 1, then optimal slowly drifts to top 50% for 10M

The biggest mistake would be pushing less often than 50% of hands

When Hero is BB (second to act)

Goal: Determine optimal calling ranges given SB's behavior

SB will always have an edge for M<10 because of fold equity

We want to develop a practical rule for our calling range

We want to make as few assumptions as possible

EV when M = 5

Villain's Push Range

Hero's Call Range

	5%	10.0%	15.0%	20.0%	25.0%	30.0%	35.0%	40.0%	45.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
5%	0.05	0.09	0.14	0.18	0.22	0.27	0.31	0.35	0.39	0.43	0.47	0.51	0.56	0.60	0.64	0.68	0.72	0.76	0.80	0.84
10.0%	0.05	0.09	0.13	0.17	0.21	0.25	0.29	0.32	0.36	0.40	0.43	0.47	0.50	0.53	0.57	0.60	0.63	0.67	0.70	0.73
15.0%	0.05	0.10	0.14	0.17	0.21	0.24	0.28	0.31	0.34	0.37	0.40	0.43	0.46	0.49	0.52	0.54	0.57	0.60	0.62	0.65
20.0%	0.06	0.10	0.14	0.17	0.21	0.24	0.27	0.30	0.33	0.35	0.38	0.40	0.43	0.45	0.48	0.50	0.52	0.54	0.56	0.58
25.0%	0.06	0.10	0.14	0.18	0.21	0.24	0.27	0.29	0.32	0.34	0.36	0.38	0.41	0.43	0.44	0.46	0.48	0.50	0.51	0.53
30.0%	0.06	0.11	0.15	0.18	0.21	0.24	0.27	0.29	0.31	0.33	0.35	0.37	0.39	0.40	0.42	0.43	0.45	0.46	0.47	0.48
35.0%	0.07	0.12	0.15	0.19	0.22	0.24	0.27	0.29	0.31	0.33	0.35	0.36	0.38	0.39	0.40	0.41	0.42	0.43	0.44	0.44
40.0%	0.07	0.12	0.16	0.20	0.22	0.25	0.27	0.29	0.31	0.33	0.34	0.35	0.37	0.38	0.38	0.39	0.40	0.40	0.41	0.41
45.0%	0.08	0.13	0.17	0.20	0.23	0.26	0.28	0.30	0.32	0.33	0.34	0.35	0.36	0.37	0.37	0.38	0.38	0.38	0.39	0.39
50.0%	0.08	0.14	0.18	0.21	0.24	0.27	0.29	0.31	0.32	0.33	0.34	0.35	0.36	0.36	0.37	0.37	0.37	0.37	0.37	0.36
55.0%	0.09	0.15	0.19	0.22	0.25	0.28	0.30	0.31	0.33	0.34	0.35	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.35	0.35
60.0%	0.10	0.15	0.20	0.24	0.27	0.29	0.31	0.33	0.34	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.35	0.35	0.34	0.33
65.0%	0.10	0.16	0.21	0.25	0.28	0.30	0.32	0.34	0.35	0.36	0.36	0.37	0.37	0.37	0.36	0.36	0.35	0.34	0.33	0.32
70.0%	0.11	0.17	0.22	0.26	0.29	0.32	0.34	0.35	0.36	0.37	0.37	0.38	0.38	0.37	0.37	0.36	0.35	0.34	0.33	0.31
75.0%	0.11	0.18	0.23	0.27	0.31	0.33	0.35	0.37	0.38	0.38	0.39	0.39	0.39	0.38	0.38	0.37	0.36	0.34	0.33	0.31
80.0%	0.12	0.19	0.25	0.29	0.32	0.35	0.37	0.38	0.39	0.40	0.40	0.40	0.40	0.39	0.38	0.37	0.36	0.35	0.33	0.31
85.0%	0.13	0.20	0.26	0.30	0.34	0.36	0.38	0.40	0.41	0.41	0.42	0.42	0.41	0.40	0.39	0.38	0.37	0.35	0.33	0.31
90.0%	0.13	0.21	0.27	0.32	0.35	0.38	0.40	0.42	0.43	0.43	0.43	0.43	0.43	0.42	0.41	0.39	0.38	0.36	0.34	0.32
95.0%	0.14	0.22	0.29	0.33	0.37	0.40	0.42	0.43	0.44	0.45	0.45	0.45	0.44	0.43	0.42	0.41	0.39	0.37	0.35	0.32
100.0%	0.15	0.23	0.30	0.35	0.39	0.42	0.44	0.45	0.46	0.47	0.47	0.47	0.46	0.45	0.44	0.42	0.40	0.38	0.36	0.33

Hero's Favor Neutral Villain's Favor

EV when M = 5 (steeper gradient)

Villain's Push Range

Hero's Call Range

	5%	10.0%	15.0%	20.0%	25.0%	30.0%	35.0%	40.0%	45.0%	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%	80.0%	85.0%	90.0%	95.0%	100.0%
5%	0.05	0.09	0.14	0.18	0.22	0.27	0.31	0.35	0.39	0.43	0.47	0.51	0.56	0.60	0.64	0.68	0.72	0.76	0.80	0.84
10.0%	0.05	0.09	0.13	0.17	0.21	0.25	0.29	0.32	0.36	0.40	0.43	0.47	0.50	0.53	0.57	0.60	0.63	0.67	0.70	0.73
15.0%	0.05	0.10	0.14	0.17	0.21	0.24	0.28	0.31	0.34	0.37	0.40	0.43	0.46	0.49	0.52	0.54	0.57	0.60	0.62	0.65
20.0%	0.06	0.10	0.14	0.17	0.21	0.24	0.27	0.30	0.33	0.35	0.38	0.40	0.43	0.45	0.48	0.50	0.52	0.54	0.56	0.58
25.0%	0.06	0.10	0.14	0.18	0.21	0.24	0.27	0.29	0.32	0.34	0.36	0.38	0.41	0.43	0.44	0.46	0.48	0.50	0.51	0.53
30.0%	0.06	0.11	0.15	0.18	0.21	0.24	0.27	0.29	0.31	0.33	0.35	0.37	0.39	0.40	0.42	0.43	0.45	0.46	0.47	0.48
35.0%	0.07	0.12	0.15	0.19	0.22	0.24	0.27	0.29	0.31	0.33	0.35	0.36	0.38	0.39	0.40	0.41	0.42	0.43	0.44	0.44
40.0%	0.07	0.12	0.16	0.20	0.22	0.25	0.27	0.29	0.31	0.33	0.34	0.35	0.37	0.38	0.38	0.39	0.40	0.40	0.41	0.41
45.0%	0.08	0.13	0.17	0.20	0.23	0.26	0.28	0.30	0.32	0.33	0.34	0.35	0.36	0.37	0.37	0.38	0.38	0.38	0.39	0.39
50.0%	0.08	0.14	0.18	0.21	0.24	0.27	0.29	0.31	0.32	0.33	0.34	0.35	0.36	0.36	0.37	0.37	0.37	0.37	0.37	0.36
55.0%	0.09	0.15	0.19	0.22	0.25	0.28	0.30	0.31	0.33	0.34	0.35	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.35	0.35
60.0%	0.10	0.15	0.20	0.24	0.27	0.29	0.31	0.33	0.34	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.35	0.35	0.34	0.33
65.0%	0.10	0.16	0.21	0.25	0.28	0.30	0.32	0.34	0.35	0.36	0.36	0.37	0.37	0.37	0.36	0.36	0.35	0.34	0.33	0.32
70.0%	0.11	0.17	0.22	0.26	0.29	0.32	0.34	0.35	0.36	0.37	0.37	0.38	0.38	0.37	0.37	0.36	0.35	0.34	0.33	0.31
75.0%	0.11	0.18	0.23	0.27	0.31	0.33	0.35	0.37	0.38	0.38	0.39	0.39	0.39	0.38	0.38	0.37	0.36	0.34	0.33	0.31
80.0%	0.12	0.19	0.25	0.29	0.32	0.35	0.37	0.38	0.39	0.40	0.40	0.40	0.40	0.39	0.38	0.37	0.36	0.35	0.33	0.31
85.0%	0.13	0.20	0.26	0.30	0.34	0.36	0.38	0.40	0.41	0.41	0.42	0.42	0.41	0.40	0.39	0.38	0.37	0.35	0.33	0.31
90.0%	0.13	0.21	0.27	0.32	0.35	0.38	0.40	0.42	0.43	0.43	0.43	0.43	0.43	0.42	0.41	0.39	0.38	0.36	0.34	0.32
95.0%	0.14	0.22	0.29	0.33	0.37	0.40	0.42	0.43	0.44	0.45	0.45	0.45	0.44	0.43	0.42	0.41	0.39	0.37	0.35	0.32
100.0%	0.15	0.23	0.30	0.35	0.39	0.42	0.44	0.45	0.46	0.47	0.47	0.47	0.46	0.45	0.44	0.42	0.40	0.38	0.36	0.33

Good Bad

EV when M = 1

Villain's Push Range

Hero's Call Range

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5%	0.05	0.10	0.14	0.19	0.24	0.28	0.33	0.38	0.42	0.47	0.52	0.56	0.61	0.66	0.70	0.75	0.80	0.84	0.89	0.93
10%	0.05	0.09	0.14	0.18	0.23	0.27	0.32	0.36	0.41	0.45	0.49	0.54	0.58	0.62	0.67	0.71	0.75	0.80	0.84	0.88
15%	0.05	0.09	0.14	0.18	0.22	0.26	0.31	0.35	0.39	0.43	0.47	0.51	0.55	0.59	0.64	0.68	0.72	0.76	0.80	0.84
20%	0.05	0.09	0.13	0.17	0.21	0.25	0.29	0.33	0.37	0.41	0.45	0.49	0.53	0.57	0.61	0.64	0.68	0.72	0.76	0.80
25%	0.05	0.09	0.13	0.17	0.21	0.25	0.29	0.32	0.36	0.40	0.43	0.47	0.51	0.54	0.58	0.62	0.65	0.69	0.72	0.76
30%	0.05	0.09	0.13	0.17	0.20	0.24	0.28	0.31	0.35	0.38	0.42	0.45	0.49	0.52	0.55	0.59	0.62	0.66	0.69	0.72
35%	0.05	0.09	0.12	0.16	0.20	0.23	0.27	0.30	0.34	0.37	0.40	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.66	0.69
40%	0.05	0.09	0.12	0.16	0.19	0.23	0.26	0.29	0.33	0.36	0.39	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.62	0.65
45%	0.05	0.08	0.12	0.16	0.19	0.22	0.25	0.28	0.32	0.34	0.37	0.40	0.43	0.46	0.49	0.51	0.54	0.57	0.60	0.62
50%	0.05	0.08	0.12	0.15	0.19	0.22	0.25	0.28	0.31	0.33	0.36	0.39	0.41	0.44	0.47	0.49	0.52	0.54	0.57	0.59
55%	0.05	0.08	0.12	0.15	0.18	0.21	0.24	0.27	0.30	0.32	0.35	0.37	0.40	0.42	0.45	0.47	0.49	0.52	0.54	0.56
60%	0.05	0.08	0.12	0.15	0.18	0.21	0.23	0.26	0.29	0.31	0.34	0.36	0.38	0.41	0.43	0.45	0.47	0.49	0.51	0.53
65%	0.05	0.08	0.12	0.15	0.18	0.20	0.23	0.25	0.28	0.30	0.32	0.35	0.37	0.39	0.41	0.43	0.45	0.47	0.49	0.51
70%	0.05	0.08	0.12	0.15	0.17	0.20	0.22	0.25	0.27	0.29	0.31	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.46	0.48
75%	0.05	0.08	0.11	0.14	0.17	0.20	0.22	0.24	0.26	0.28	0.30	0.32	0.34	0.36	0.38	0.39	0.41	0.42	0.44	0.45
80%	0.05	0.08	0.11	0.14	0.17	0.19	0.21	0.24	0.26	0.27	0.29	0.31	0.33	0.34	0.36	0.37	0.39	0.40	0.41	0.43
85%	0.05	0.08	0.11	0.14	0.17	0.19	0.21	0.23	0.25	0.27	0.28	0.30	0.31	0.33	0.34	0.36	0.37	0.38	0.39	0.40
90%	0.05	0.08	0.11	0.14	0.16	0.18	0.21	0.22	0.24	0.26	0.27	0.29	0.30	0.31	0.33	0.34	0.35	0.36	0.37	0.38
95%	0.05	0.08	0.11	0.14	0.16	0.18	0.20	0.22	0.23	0.25	0.26	0.28	0.29	0.30	0.31	0.32	0.33	0.34	0.35	0.36
100%	0.05	0.08	0.11	0.14	0.16	0.18	0.20	0.21	0.23	0.24	0.26	0.27	0.28	0.29	0.30	0.31	0.31	0.32	0.33	0.33

Good Bad

EV when M = 2

Villain's Push Range

Hero's Call Range

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5%	0.05	0.10	0.14	0.19	0.23	0.28	0.33	0.37	0.42	0.46	0.51	0.55	0.60	0.64	0.69	0.73	0.78	0.82	0.86	0.91
10%	0.05	0.09	0.14	0.18	0.22	0.27	0.31	0.35	0.39	0.44	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.76	0.80	0.85
15%	0.05	0.09	0.14	0.18	0.22	0.26	0.30	0.34	0.38	0.42	0.45	0.49	0.53	0.57	0.61	0.64	0.68	0.72	0.75	0.79
20%	0.05	0.09	0.13	0.17	0.21	0.25	0.29	0.33	0.36	0.40	0.43	0.47	0.50	0.54	0.57	0.61	0.64	0.68	0.71	0.74
25%	0.05	0.09	0.13	0.17	0.21	0.24	0.28	0.32	0.35	0.38	0.42	0.45	0.48	0.51	0.55	0.58	0.61	0.64	0.67	0.70
30%	0.05	0.09	0.13	0.17	0.21	0.24	0.27	0.31	0.34	0.37	0.40	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.63	0.66
35%	0.05	0.09	0.13	0.17	0.20	0.24	0.27	0.30	0.33	0.36	0.39	0.42	0.44	0.47	0.50	0.52	0.55	0.58	0.60	0.63
40%	0.05	0.09	0.13	0.17	0.20	0.23	0.26	0.29	0.32	0.35	0.38	0.40	0.43	0.45	0.48	0.50	0.53	0.55	0.57	0.59
45%	0.05	0.10	0.13	0.17	0.20	0.23	0.26	0.29	0.32	0.34	0.37	0.39	0.41	0.44	0.46	0.48	0.50	0.52	0.54	0.56
50%	0.06	0.10	0.13	0.17	0.20	0.23	0.26	0.28	0.31	0.33	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.53
55%	0.06	0.10	0.14	0.17	0.20	0.23	0.26	0.28	0.30	0.33	0.35	0.37	0.39	0.41	0.43	0.44	0.46	0.48	0.49	0.51
60%	0.06	0.10	0.14	0.17	0.20	0.23	0.25	0.28	0.30	0.32	0.34	0.36	0.38	0.40	0.41	0.43	0.44	0.46	0.47	0.48
65%	0.06	0.10	0.14	0.17	0.20	0.23	0.25	0.28	0.30	0.32	0.33	0.35	0.37	0.38	0.40	0.41	0.42	0.44	0.45	0.46
70%	0.06	0.11	0.14	0.17	0.20	0.23	0.25	0.27	0.29	0.31	0.33	0.34	0.36	0.37	0.39	0.40	0.41	0.42	0.43	0.44
75%	0.06	0.11	0.14	0.18	0.20	0.23	0.25	0.27	0.29	0.31	0.32	0.34	0.35	0.36	0.38	0.39	0.39	0.40	0.41	0.42
80%	0.07	0.11	0.15	0.18	0.21	0.23	0.25	0.27	0.29	0.31	0.32	0.33	0.34	0.36	0.36	0.37	0.38	0.39	0.39	0.40
85%	0.07	0.11	0.15	0.18	0.21	0.23	0.25	0.27	0.29	0.30	0.32	0.33	0.34	0.35	0.36	0.36	0.37	0.37	0.38	0.38
90%	0.07	0.12	0.15	0.18	0.21	0.23	0.25	0.27	0.29	0.30	0.31	0.32	0.33	0.34	0.35	0.35	0.36	0.36	0.36	0.36
95%	0.07	0.12	0.16	0.19	0.21	0.24	0.26	0.27	0.29	0.30	0.31	0.32	0.33	0.33	0.34	0.34	0.35	0.35	0.35	0.35
100%	0.07	0.12	0.16	0.19	0.22	0.24	0.26	0.27	0.29	0.30	0.31	0.32	0.32	0.33	0.33	0.34	0.34	0.34	0.34	0.33

Good Bad

EV when M = 3

Villain's Push Range

Hero's Call Range

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5%	0.05	0.09	0.14	0.19	0.23	0.28	0.32	0.36	0.41	0.45	0.50	0.54	0.58	0.63	0.67	0.71	0.76	0.80	0.84	0.88
10%	0.05	0.09	0.14	0.18	0.22	0.26	0.30	0.34	0.38	0.42	0.46	0.50	0.54	0.58	0.62	0.66	0.69	0.73	0.77	0.81
15%	0.05	0.09	0.14	0.18	0.21	0.25	0.29	0.33	0.36	0.40	0.44	0.47	0.51	0.54	0.58	0.61	0.64	0.68	0.71	0.74
20%	0.05	0.09	0.13	0.17	0.21	0.25	0.28	0.32	0.35	0.38	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69
25%	0.05	0.10	0.14	0.17	0.21	0.24	0.28	0.31	0.34	0.37	0.40	0.43	0.46	0.48	0.51	0.54	0.57	0.59	0.62	0.64
30%	0.05	0.10	0.14	0.17	0.21	0.24	0.27	0.30	0.33	0.36	0.39	0.41	0.44	0.46	0.49	0.51	0.53	0.56	0.58	0.60
35%	0.06	0.10	0.14	0.17	0.21	0.24	0.27	0.30	0.32	0.35	0.37	0.40	0.42	0.44	0.47	0.49	0.51	0.53	0.55	0.57
40%	0.06	0.10	0.14	0.18	0.21	0.24	0.27	0.29	0.32	0.34	0.36	0.39	0.41	0.43	0.45	0.47	0.48	0.50	0.52	0.53
45%	0.06	0.11	0.15	0.18	0.21	0.24	0.27	0.29	0.32	0.34	0.36	0.38	0.40	0.41	0.43	0.45	0.46	0.48	0.49	0.50
50%	0.06	0.11	0.15	0.18	0.21	0.24	0.27	0.29	0.31	0.33	0.35	0.37	0.39	0.40	0.42	0.43	0.44	0.46	0.47	0.48
55%	0.07	0.11	0.15	0.19	0.22	0.24	0.27	0.29	0.31	0.33	0.35	0.36	0.38	0.39	0.40	0.42	0.43	0.44	0.45	0.45
60%	0.07	0.12	0.16	0.19	0.22	0.25	0.27	0.29	0.31	0.33	0.35	0.36	0.37	0.38	0.40	0.40	0.41	0.42	0.43	0.43
65%	0.07	0.12	0.16	0.20	0.23	0.25	0.28	0.30	0.31	0.33	0.34	0.36	0.37	0.38	0.39	0.39	0.40	0.41	0.41	0.41
70%	0.08	0.13	0.17	0.20	0.23	0.26	0.28	0.30	0.32	0.33	0.34	0.36	0.37	0.37	0.38	0.39	0.39	0.39	0.40	0.40
75%	0.08	0.13	0.17	0.21	0.24	0.26	0.28	0.30	0.32	0.33	0.35	0.35	0.36	0.37	0.38	0.38	0.38	0.38	0.38	0.38
80%	0.08	0.14	0.18	0.21	0.24	0.27	0.29	0.31	0.32	0.34	0.35	0.36	0.36	0.37	0.37	0.37	0.37	0.37	0.37	0.37
85%	0.09	0.14	0.19	0.22	0.25	0.28	0.30	0.31	0.33	0.34	0.35	0.36	0.36	0.37	0.37	0.37	0.37	0.37	0.36	0.36
90%	0.09	0.15	0.19	0.23	0.26	0.28	0.30	0.32	0.33	0.34	0.35	0.36	0.36	0.37	0.37	0.37	0.36	0.36	0.35	0.35
95%	0.09	0.15	0.20	0.24	0.27	0.29	0.31	0.33	0.34	0.35	0.36	0.36	0.37	0.37	0.37	0.36	0.36	0.36	0.35	0.34
100%	0.10	0.16	0.21	0.24	0.27	0.30	0.32	0.33	0.35	0.36	0.36	0.37	0.37	0.37	0.37	0.36	0.36	0.35	0.34	0.33

Good Bad

EV when M = 4

Villain's Push Range

Hero's Call Range

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5%	0.05	0.09	0.14	0.18	0.23	0.27	0.31	0.36	0.40	0.44	0.48	0.53	0.57	0.61	0.65	0.69	0.74	0.78	0.82	0.86
10%	0.05	0.09	0.14	0.18	0.22	0.26	0.30	0.33	0.37	0.41	0.45	0.48	0.52	0.56	0.59	0.63	0.66	0.70	0.73	0.77
15%	0.05	0.09	0.14	0.17	0.21	0.25	0.28	0.32	0.35	0.39	0.42	0.45	0.48	0.51	0.55	0.58	0.61	0.64	0.67	0.70
20%	0.05	0.10	0.14	0.17	0.21	0.24	0.28	0.31	0.34	0.37	0.40	0.43	0.45	0.48	0.51	0.54	0.56	0.59	0.61	0.64
25%	0.06	0.10	0.14	0.17	0.21	0.24	0.27	0.30	0.33	0.36	0.38	0.41	0.43	0.46	0.48	0.50	0.52	0.54	0.57	0.59
30%	0.06	0.10	0.14	0.18	0.21	0.24	0.27	0.30	0.32	0.35	0.37	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.53	0.54
35%	0.06	0.11	0.15	0.18	0.21	0.24	0.27	0.29	0.32	0.34	0.36	0.38	0.40	0.42	0.43	0.45	0.46	0.48	0.49	0.51
40%	0.07	0.11	0.15	0.19	0.22	0.24	0.27	0.29	0.31	0.33	0.35	0.37	0.39	0.40	0.42	0.43	0.44	0.45	0.46	0.47
45%	0.07	0.12	0.16	0.19	0.22	0.25	0.27	0.30	0.32	0.33	0.35	0.36	0.38	0.39	0.40	0.41	0.42	0.43	0.44	0.44
50%	0.07	0.12	0.16	0.20	0.23	0.25	0.28	0.30	0.32	0.33	0.35	0.36	0.37	0.38	0.39	0.40	0.41	0.41	0.42	0.42
55%	0.08	0.13	0.17	0.21	0.24	0.26	0.28	0.30	0.32	0.34	0.35	0.36	0.37	0.38	0.38	0.39	0.39	0.40	0.40	0.40
60%	0.08	0.14	0.18	0.21	0.24	0.27	0.29	0.31	0.33	0.34	0.35	0.36	0.37	0.37	0.38	0.38	0.38	0.38	0.38	0.38
65%	0.09	0.14	0.19	0.22	0.25	0.28	0.30	0.32	0.33	0.34	0.35	0.36	0.37	0.37	0.38	0.38	0.38	0.37	0.37	0.37
70%	0.09	0.15	0.20	0.23	0.26	0.29	0.31	0.32	0.34	0.35	0.36	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.36	0.36
75%	0.10	0.16	0.20	0.24	0.27	0.30	0.32	0.33	0.35	0.36	0.37	0.37	0.37	0.38	0.38	0.37	0.37	0.36	0.36	0.35
80%	0.10	0.17	0.21	0.25	0.28	0.31	0.33	0.34	0.36	0.37	0.37	0.38	0.38	0.38	0.38	0.37	0.37	0.36	0.35	0.34
85%	0.11	0.17	0.22	0.26	0.29	0.32	0.34	0.36	0.37	0.38	0.38	0.39	0.39	0.39	0.38	0.38	0.37	0.36	0.35	0.34
90%	0.11	0.18	0.23	0.27	0.31	0.33	0.35	0.37	0.38	0.39	0.39	0.40	0.40	0.39	0.39	0.38	0.37	0.36	0.35	0.33
95%	0.12	0.19	0.24	0.28	0.32	0.34	0.36	0.38	0.39	0.40	0.40	0.41	0.41	0.40	0.39	0.39	0.38	0.36	0.35	0.33
100%	0.12	0.20	0.25	0.30	0.33	0.36	0.38	0.39	0.41	0.41	0.42	0.42	0.42	0.41	0.40	0.39	0.38	0.37	0.35	0.33

Good Bad

EV when M = 5

Villain's Push Range

Hero's Call Range

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5%	0.05	0.09	0.14	0.18	0.22	0.27	0.31	0.35	0.39	0.43	0.47	0.51	0.56	0.60	0.64	0.68	0.72	0.76	0.80	0.84
10%	0.05	0.09	0.13	0.17	0.21	0.25	0.29	0.32	0.36	0.40	0.43	0.47	0.50	0.53	0.57	0.60	0.63	0.67	0.70	0.73
15%	0.05	0.10	0.14	0.17	0.21	0.24	0.28	0.31	0.34	0.37	0.40	0.43	0.46	0.49	0.52	0.54	0.57	0.60	0.62	0.65
20%	0.06	0.10	0.14	0.17	0.21	0.24	0.27	0.30	0.33	0.35	0.38	0.40	0.43	0.45	0.48	0.50	0.52	0.54	0.56	0.58
25%	0.06	0.10	0.14	0.18	0.21	0.24	0.27	0.29	0.32	0.34	0.36	0.38	0.41	0.43	0.44	0.46	0.48	0.50	0.51	0.53
30%	0.06	0.11	0.15	0.18	0.21	0.24	0.27	0.29	0.31	0.33	0.35	0.37	0.39	0.40	0.42	0.43	0.45	0.46	0.47	0.48
35%	0.07	0.12	0.15	0.19	0.22	0.24	0.27	0.29	0.31	0.33	0.35	0.36	0.38	0.39	0.40	0.41	0.42	0.43	0.44	0.44
40%	0.07	0.12	0.16	0.20	0.22	0.25	0.27	0.29	0.31	0.33	0.34	0.35	0.37	0.38	0.38	0.39	0.40	0.40	0.41	0.41
45%	0.08	0.13	0.17	0.20	0.23	0.26	0.28	0.30	0.32	0.33	0.34	0.35	0.36	0.37	0.37	0.38	0.38	0.38	0.39	0.39
50%	0.08	0.14	0.18	0.21	0.24	0.27	0.29	0.31	0.32	0.33	0.34	0.35	0.36	0.36	0.37	0.37	0.37	0.37	0.37	0.36
55%	0.09	0.15	0.19	0.22	0.25	0.28	0.30	0.31	0.33	0.34	0.35	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.35	0.35
60%	0.10	0.15	0.20	0.24	0.27	0.29	0.31	0.33	0.34	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.35	0.35	0.34	0.33
65%	0.10	0.16	0.21	0.25	0.28	0.30	0.32	0.34	0.35	0.36	0.36	0.37	0.37	0.37	0.36	0.36	0.35	0.34	0.33	0.32
70%	0.11	0.17	0.22	0.26	0.29	0.32	0.34	0.35	0.36	0.37	0.37	0.38	0.38	0.37	0.37	0.36	0.35	0.34	0.33	0.31
75%	0.11	0.18	0.23	0.27	0.31	0.33	0.35	0.37	0.38	0.38	0.39	0.39	0.39	0.38	0.38	0.37	0.36	0.34	0.33	0.31
80%	0.12	0.19	0.25	0.29	0.32	0.35	0.37	0.38	0.39	0.40	0.40	0.40	0.40	0.39	0.38	0.37	0.36	0.35	0.33	0.31
85%	0.13	0.20	0.26	0.30	0.34	0.36	0.38	0.40	0.41	0.41	0.42	0.42	0.41	0.40	0.39	0.38	0.37	0.35	0.33	0.31
90%	0.13	0.21	0.27	0.32	0.35	0.38	0.40	0.42	0.43	0.43	0.43	0.43	0.43	0.42	0.41	0.39	0.38	0.36	0.34	0.32
95%	0.14	0.22	0.29	0.33	0.37	0.40	0.42	0.43	0.44	0.45	0.45	0.45	0.44	0.43	0.42	0.41	0.39	0.37	0.35	0.32
100%	0.15	0.23	0.30	0.35	0.39	0.42	0.44	0.45	0.46	0.47	0.47	0.47	0.46	0.45	0.44	0.42	0.40	0.38	0.36	0.33

Good Bad

EV when M = 6

Villain's Push Range

Hero's Call Range

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5%	0.05	0.09	0.14	0.18	0.22	0.26	0.30	0.34	0.38	0.42	0.46	0.50	0.54	0.58	0.62	0.66	0.70	0.73	0.77	0.81
10%	0.05	0.09	0.13	0.17	0.21	0.25	0.28	0.32	0.35	0.38	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69
15%	0.05	0.10	0.14	0.17	0.21	0.24	0.27	0.30	0.33	0.36	0.38	0.41	0.44	0.46	0.49	0.51	0.54	0.56	0.58	0.60
20%	0.06	0.10	0.14	0.17	0.21	0.23	0.26	0.29	0.31	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.53
25%	0.06	0.11	0.14	0.18	0.21	0.24	0.26	0.28	0.31	0.33	0.35	0.36	0.38	0.40	0.41	0.42	0.44	0.45	0.46	0.47
30%	0.07	0.11	0.15	0.19	0.21	0.24	0.26	0.28	0.30	0.32	0.34	0.35	0.36	0.37	0.39	0.40	0.40	0.41	0.42	0.42
35%	0.07	0.12	0.16	0.19	0.22	0.25	0.27	0.29	0.30	0.32	0.33	0.34	0.35	0.36	0.37	0.37	0.38	0.38	0.38	0.38
40%	0.08	0.13	0.17	0.20	0.23	0.26	0.28	0.29	0.31	0.32	0.33	0.34	0.35	0.35	0.35	0.36	0.36	0.36	0.35	0.35
45%	0.09	0.14	0.18	0.22	0.24	0.27	0.29	0.30	0.32	0.33	0.33	0.34	0.34	0.35	0.35	0.34	0.34	0.34	0.33	0.33
50%	0.09	0.15	0.19	0.23	0.26	0.28	0.30	0.31	0.32	0.33	0.34	0.34	0.34	0.34	0.34	0.34	0.33	0.32	0.32	0.31
55%	0.10	0.16	0.21	0.24	0.27	0.29	0.31	0.33	0.34	0.34	0.35	0.35	0.35	0.35	0.34	0.34	0.33	0.32	0.30	0.29
60%	0.11	0.17	0.22	0.26	0.29	0.31	0.33	0.34	0.35	0.36	0.36	0.36	0.36	0.35	0.35	0.34	0.33	0.31	0.30	0.28
65%	0.12	0.18	0.23	0.27	0.30	0.33	0.34	0.36	0.37	0.37	0.37	0.37	0.37	0.36	0.35	0.34	0.33	0.31	0.29	0.28
70%	0.12	0.19	0.25	0.29	0.32	0.35	0.36	0.38	0.38	0.39	0.39	0.39	0.38	0.37	0.36	0.35	0.33	0.32	0.30	0.27
75%	0.13	0.21	0.26	0.31	0.34	0.36	0.38	0.40	0.40	0.41	0.41	0.40	0.40	0.39	0.38	0.36	0.34	0.32	0.30	0.28
80%	0.14	0.22	0.28	0.32	0.36	0.38	0.40	0.42	0.43	0.43	0.43	0.42	0.42	0.40	0.39	0.37	0.35	0.33	0.31	0.28
85%	0.15	0.23	0.29	0.34	0.38	0.41	0.43	0.44	0.45	0.45	0.45	0.44	0.44	0.42	0.41	0.39	0.37	0.34	0.32	0.29
90%	0.16	0.25	0.31	0.36	0.40	0.43	0.45	0.46	0.47	0.48	0.47	0.47	0.46	0.44	0.43	0.41	0.39	0.36	0.33	0.30
95%	0.16	0.26	0.33	0.38	0.42	0.45	0.47	0.49	0.50	0.50	0.50	0.49	0.48	0.47	0.45	0.43	0.41	0.38	0.35	0.32
100%	0.17	0.27	0.35	0.40	0.44	0.48	0.50	0.51	0.52	0.53	0.53	0.52	0.51	0.49	0.47	0.45	0.43	0.40	0.37	0.33

Good Bad

EV when M = 7

Villain's Push Range

Hero's Call Range

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5%	0.05	0.09	0.14	0.18	0.22	0.26	0.30	0.34	0.38	0.41	0.45	0.49	0.53	0.57	0.60	0.64	0.68	0.71	0.75	0.79
10%	0.05	0.09	0.13	0.17	0.21	0.24	0.27	0.31	0.34	0.37	0.40	0.43	0.46	0.49	0.52	0.55	0.57	0.60	0.63	0.66
15%	0.05	0.10	0.14	0.17	0.20	0.23	0.26	0.29	0.32	0.34	0.37	0.39	0.41	0.44	0.46	0.48	0.50	0.52	0.54	0.56
20%	0.06	0.10	0.14	0.17	0.20	0.23	0.26	0.28	0.30	0.32	0.34	0.36	0.38	0.40	0.41	0.43	0.44	0.45	0.47	0.48
25%	0.07	0.11	0.15	0.18	0.21	0.23	0.26	0.28	0.30	0.31	0.33	0.34	0.35	0.37	0.38	0.39	0.40	0.40	0.41	0.42
30%	0.07	0.12	0.16	0.19	0.22	0.24	0.26	0.28	0.29	0.31	0.32	0.33	0.34	0.35	0.35	0.36	0.36	0.36	0.36	0.37
35%	0.08	0.13	0.17	0.20	0.23	0.25	0.27	0.28	0.30	0.31	0.32	0.32	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.32
40%	0.09	0.14	0.18	0.21	0.24	0.26	0.28	0.29	0.30	0.31	0.32	0.32	0.32	0.32	0.32	0.32	0.31	0.31	0.30	0.29
45%	0.09	0.15	0.19	0.23	0.25	0.28	0.29	0.31	0.32	0.32	0.33	0.33	0.33	0.32	0.32	0.31	0.30	0.29	0.28	0.27
50%	0.10	0.16	0.21	0.24	0.27	0.29	0.31	0.32	0.33	0.33	0.34	0.33	0.33	0.32	0.32	0.31	0.30	0.28	0.27	0.25
55%	0.11	0.18	0.22	0.26	0.29	0.31	0.33	0.34	0.34	0.35	0.35	0.35	0.34	0.33	0.32	0.31	0.29	0.28	0.26	0.24
60%	0.12	0.19	0.24	0.28	0.31	0.33	0.35	0.36	0.36	0.37	0.36	0.36	0.35	0.34	0.33	0.31	0.30	0.28	0.25	0.23
65%	0.13	0.20	0.26	0.30	0.33	0.35	0.37	0.38	0.38	0.39	0.38	0.38	0.37	0.36	0.34	0.32	0.30	0.28	0.26	0.23
70%	0.14	0.22	0.27	0.32	0.35	0.37	0.39	0.40	0.41	0.41	0.41	0.40	0.39	0.37	0.36	0.34	0.31	0.29	0.26	0.23
75%	0.15	0.23	0.29	0.34	0.37	0.40	0.42	0.43	0.43	0.43	0.43	0.42	0.41	0.39	0.38	0.35	0.33	0.30	0.27	0.24
80%	0.16	0.25	0.31	0.36	0.40	0.42	0.44	0.45	0.46	0.46	0.46	0.45	0.43	0.42	0.40	0.37	0.35	0.32	0.29	0.25
85%	0.17	0.26	0.33	0.38	0.42	0.45	0.47	0.48	0.49	0.49	0.48	0.47	0.46	0.44	0.42	0.40	0.37	0.34	0.30	0.27
90%	0.18	0.28	0.35	0.41	0.45	0.48	0.50	0.51	0.52	0.52	0.51	0.50	0.49	0.47	0.45	0.42	0.39	0.36	0.32	0.29
95%	0.19	0.29	0.37	0.43	0.47	0.51	0.53	0.54	0.55	0.55	0.55	0.54	0.52	0.50	0.48	0.45	0.42	0.39	0.35	0.31
100%	0.20	0.31	0.39	0.45	0.50	0.53	0.56	0.57	0.58	0.58	0.58	0.57	0.55	0.53	0.51	0.48	0.45	0.41	0.38	0.33

Good Bad

EV when M = 8

Villain's Push Range

Hero's Call Range

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5%	0.05	0.09	0.13	0.17	0.21	0.25	0.29	0.33	0.37	0.40	0.44	0.48	0.51	0.55	0.59	0.62	0.66	0.69	0.73	0.76
10%	0.05	0.09	0.13	0.17	0.20	0.23	0.27	0.30	0.33	0.36	0.39	0.41	0.44	0.47	0.49	0.52	0.54	0.57	0.59	0.62
15%	0.06	0.10	0.14	0.17	0.20	0.23	0.25	0.28	0.30	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.46	0.48	0.50	0.51
20%	0.06	0.11	0.14	0.17	0.20	0.23	0.25	0.27	0.29	0.31	0.32	0.34	0.35	0.37	0.38	0.39	0.40	0.41	0.42	0.43
25%	0.07	0.11	0.15	0.18	0.21	0.23	0.25	0.27	0.28	0.30	0.31	0.32	0.33	0.34	0.34	0.35	0.35	0.36	0.36	0.36
30%	0.08	0.13	0.16	0.19	0.22	0.24	0.26	0.27	0.29	0.30	0.30	0.31	0.31	0.32	0.32	0.32	0.32	0.31	0.31	0.31
35%	0.08	0.14	0.18	0.21	0.23	0.25	0.27	0.28	0.29	0.30	0.30	0.31	0.31	0.30	0.30	0.30	0.29	0.28	0.27	0.26
40%	0.09	0.15	0.19	0.22	0.25	0.27	0.28	0.29	0.30	0.31	0.31	0.31	0.30	0.30	0.29	0.28	0.27	0.26	0.25	0.23
45%	0.10	0.16	0.21	0.24	0.27	0.28	0.30	0.31	0.32	0.32	0.32	0.31	0.31	0.30	0.29	0.28	0.26	0.25	0.23	0.21
50%	0.11	0.18	0.22	0.26	0.29	0.30	0.32	0.33	0.33	0.33	0.33	0.33	0.32	0.31	0.29	0.28	0.26	0.24	0.22	0.19
55%	0.12	0.19	0.24	0.28	0.31	0.33	0.34	0.35	0.35	0.35	0.35	0.34	0.33	0.32	0.30	0.28	0.26	0.24	0.21	0.18
60%	0.13	0.21	0.26	0.30	0.33	0.35	0.36	0.37	0.38	0.37	0.37	0.36	0.35	0.33	0.31	0.29	0.27	0.24	0.21	0.18
65%	0.14	0.22	0.28	0.32	0.35	0.38	0.39	0.40	0.40	0.40	0.39	0.38	0.37	0.35	0.33	0.31	0.28	0.25	0.22	0.18
70%	0.15	0.24	0.30	0.35	0.38	0.40	0.42	0.43	0.43	0.43	0.42	0.41	0.39	0.37	0.35	0.32	0.30	0.26	0.23	0.19
75%	0.16	0.26	0.32	0.37	0.41	0.43	0.45	0.46	0.46	0.46	0.45	0.44	0.42	0.40	0.38	0.35	0.32	0.28	0.24	0.20
80%	0.18	0.27	0.34	0.40	0.43	0.46	0.48	0.49	0.49	0.49	0.48	0.47	0.45	0.43	0.40	0.37	0.34	0.30	0.26	0.22
85%	0.19	0.29	0.37	0.42	0.46	0.49	0.51	0.52	0.53	0.53	0.52	0.50	0.48	0.46	0.43	0.40	0.37	0.33	0.29	0.24
90%	0.20	0.31	0.39	0.45	0.49	0.53	0.55	0.56	0.56	0.56	0.55	0.54	0.52	0.50	0.47	0.44	0.40	0.36	0.32	0.27
95%	0.21	0.33	0.41	0.48	0.53	0.56	0.58	0.60	0.60	0.60	0.59	0.58	0.56	0.53	0.51	0.47	0.43	0.39	0.35	0.30
100%	0.22	0.35	0.44	0.51	0.56	0.59	0.62	0.63	0.64	0.64	0.63	0.62	0.60	0.57	0.55	0.51	0.47	0.43	0.38	0.33

Good Bad

EV when M = 9

Villain's Push Range

Hero's Call Range

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5%	0.05	0.09	0.13	0.17	0.21	0.25	0.29	0.32	0.36	0.40	0.43	0.47	0.50	0.54	0.57	0.60	0.64	0.67	0.70	0.74
10%	0.05	0.09	0.13	0.17	0.20	0.23	0.26	0.29	0.32	0.34	0.37	0.40	0.42	0.44	0.47	0.49	0.51	0.54	0.56	0.58
15%	0.06	0.10	0.14	0.17	0.20	0.22	0.25	0.27	0.29	0.31	0.33	0.35	0.37	0.38	0.40	0.41	0.43	0.44	0.45	0.46
20%	0.06	0.11	0.14	0.17	0.20	0.22	0.24	0.26	0.28	0.29	0.31	0.32	0.33	0.34	0.35	0.35	0.36	0.37	0.37	0.37
25%	0.07	0.12	0.15	0.18	0.21	0.23	0.25	0.26	0.27	0.28	0.29	0.30	0.30	0.31	0.31	0.31	0.31	0.31	0.31	0.30
30%	0.08	0.13	0.17	0.20	0.22	0.24	0.26	0.27	0.28	0.28	0.29	0.29	0.29	0.29	0.28	0.28	0.27	0.27	0.26	0.25
35%	0.09	0.14	0.18	0.21	0.24	0.25	0.27	0.28	0.28	0.29	0.29	0.29	0.28	0.28	0.27	0.26	0.25	0.23	0.22	0.20
40%	0.10	0.16	0.20	0.23	0.26	0.27	0.29	0.29	0.30	0.30	0.30	0.29	0.28	0.27	0.26	0.25	0.23	0.21	0.19	0.17
45%	0.11	0.17	0.22	0.25	0.28	0.29	0.31	0.31	0.32	0.31	0.31	0.30	0.29	0.28	0.26	0.24	0.22	0.20	0.18	0.15
50%	0.12	0.19	0.24	0.27	0.30	0.32	0.33	0.34	0.34	0.33	0.33	0.32	0.30	0.29	0.27	0.25	0.22	0.19	0.17	0.14
55%	0.13	0.21	0.26	0.30	0.32	0.34	0.36	0.36	0.36	0.36	0.35	0.34	0.32	0.30	0.28	0.25	0.23	0.20	0.16	0.13
60%	0.14	0.22	0.28	0.32	0.35	0.37	0.38	0.39	0.39	0.38	0.37	0.36	0.34	0.32	0.30	0.27	0.24	0.20	0.17	0.13
65%	0.16	0.24	0.30	0.35	0.38	0.40	0.41	0.42	0.42	0.41	0.40	0.39	0.37	0.34	0.32	0.29	0.25	0.22	0.18	0.14
70%	0.17	0.26	0.33	0.38	0.41	0.43	0.45	0.45	0.45	0.45	0.44	0.42	0.40	0.37	0.34	0.31	0.28	0.24	0.20	0.15
75%	0.18	0.28	0.35	0.40	0.44	0.47	0.48	0.49	0.49	0.48	0.47	0.45	0.43	0.41	0.38	0.34	0.30	0.26	0.22	0.17
80%	0.19	0.30	0.38	0.43	0.47	0.50	0.52	0.53	0.53	0.52	0.51	0.49	0.47	0.44	0.41	0.37	0.33	0.29	0.24	0.19
85%	0.21	0.32	0.40	0.46	0.51	0.54	0.56	0.57	0.57	0.56	0.55	0.53	0.51	0.48	0.45	0.41	0.37	0.32	0.27	0.22
90%	0.22	0.34	0.43	0.49	0.54	0.57	0.60	0.61	0.61	0.61	0.59	0.58	0.55	0.52	0.49	0.45	0.41	0.36	0.31	0.25
95%	0.23	0.36	0.46	0.53	0.58	0.61	0.64	0.65	0.65	0.65	0.64	0.62	0.60	0.57	0.53	0.49	0.45	0.40	0.35	0.29
100%	0.25	0.39	0.49	0.56	0.61	0.65	0.68	0.70	0.70	0.70	0.69	0.67	0.65	0.62	0.58	0.54	0.50	0.45	0.39	0.33

Good Bad

EV when M = 10

Good calling range

Villain's Push Range

Hero's Call Range

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5%		0.09	0.13	0.17	0.21	0.24	0.28	0.32	0.35	0.39	0.42	0.45	0.49	0.52	0.55	0.59	0.62	0.65	0.68	0.71
10%	0.05	0.09		0.16	0.19	0.22	0.25	0.28	0.31	0.33	0.35	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54
15%	0.06	0.10	0.14	0.17		0.22	0.24	0.26	0.28	0.30	0.31	0.33	0.34	0.36	0.37	0.38	0.39	0.40	0.41	0.42
20%	0.07	0.11	0.14	0.17	0.20		0.24	0.25	0.27	0.28	0.29	0.30	0.30	0.31	0.31	0.32	0.32	0.32	0.32	0.32
25%	0.08	0.12	0.16	0.19	0.21	0.23	0.24		0.26	0.27	0.27	0.28	0.28	0.28	0.28	0.27	0.27	0.26	0.25	0.25
30%	0.09	0.14	0.17	0.20	0.22	0.24	0.25	0.26	0.27		0.27	0.27	0.26	0.26	0.25	0.24	0.23	0.22	0.20	0.19
35%	0.10	0.15	0.19	0.22	0.24	0.26	0.27	0.27	0.28	0.28		0.26	0.25	0.24	0.22	0.20	0.19	0.16	0.14	
40%	0.11	0.17	0.21	0.24	0.26	0.28	0.29	0.29	0.29	0.29	0.28	0.27		0.25	0.23	0.21	0.19	0.16	0.14	0.11
45%	0.12	0.18	0.23	0.26	0.29	0.30	0.31	0.32	0.32	0.31	0.30	0.29	0.27	0.25		0.21	0.18	0.15	0.12	0.09
50%	0.13	0.20	0.25	0.29	0.31	0.33	0.34	0.34	0.34	0.33	0.32	0.31	0.29	0.27	0.24	0.21		0.15	0.12	0.08
55%	0.14	0.22	0.28	0.32	0.34	0.36	0.37	0.37	0.37	0.36	0.35	0.33	0.31	0.29	0.26	0.23	0.19	0.16		0.08
60%	0.16	0.24	0.30	0.34	0.37	0.39	0.40	0.41	0.40	0.39	0.38	0.36	0.34	0.31	0.28	0.25	0.21	0.17	0.13	0.08
65%	0.17	0.26	0.33	0.37	0.41	0.43	0.44	0.44	0.44	0.43	0.41	0.39	0.37	0.34	0.31	0.27	0.23	0.19	0.14	0.09
70%	0.18	0.28	0.35	0.40	0.44	0.46	0.47	0.48	0.48	0.47	0.45	0.43	0.40	0.37	0.34	0.30	0.26	0.21	0.16	0.11
75%	0.20	0.31	0.38	0.44	0.47	0.50	0.51	0.52	0.52	0.51	0.49	0.47	0.44	0.41	0.38	0.33	0.29	0.24	0.19	0.13
80%	0.21	0.33	0.41	0.47	0.51	0.54	0.56	0.56	0.56	0.55	0.54	0.51	0.49	0.45	0.42	0.37	0.33	0.28	0.22	0.16
85%	0.23	0.35	0.44	0.50	0.55	0.58	0.60	0.61	0.61	0.60	0.58	0.56	0.53	0.50	0.46	0.42	0.37	0.32	0.26	0.20
90%	0.24	0.38	0.47	0.54	0.59	0.62	0.64	0.66	0.66	0.65	0.63	0.61	0.58	0.55	0.51	0.46	0.41	0.36	0.30	0.24
95%	0.26	0.40	0.50	0.58	0.63	0.67	0.69	0.70	0.71	0.70	0.69	0.66	0.64	0.60	0.56	0.51	0.46	0.41	0.35	0.28
100%	0.27	0.42	0.53	0.61	0.67	0.71	0.74	0.76	0.76	0.75	0.74	0.72	0.69	0.66	0.62	0.57	0.52	0.46	0.40	0.33

Good Bad

EV when M = 10

Good calling range

Villain's Push Range

If SB Pushes Top 90%

Hero's Call Range

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5%	0.05	0.09	0.13	0.17	0.21	0.24	0.28	0.32	0.35	0.39	0.42	0.45	0.49	0.52	0.55	0.59	0.62	0.65	0.68	0.71
10%	0.05	0.09	0.13	0.16	0.19	0.22	0.25	0.28	0.31	0.33	0.35	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54
15%	0.06	0.10	0.14	0.17	0.19	0.22	0.24	0.26	0.28	0.30	0.31	0.33	0.34	0.36	0.37	0.38	0.39	0.40	0.41	0.42
20%	0.07	0.11	0.14	0.17	0.20	0.22	0.24	0.25	0.27	0.28	0.29	0.30	0.30	0.31	0.31	0.32	0.32	0.32	0.32	0.32
25%	0.08	0.12	0.16	0.19	0.21	0.23	0.24	0.25	0.26	0.27	0.27	0.28	0.28	0.28	0.28	0.27	0.27	0.26	0.25	0.25
30%	0.09	0.14	0.17	0.20	0.22	0.24	0.25	0.26	0.27	0.27	0.27	0.27	0.26	0.26	0.25	0.24	0.23	0.22	0.20	0.19
35%	0.10	0.15	0.19	0.22	0.24	0.26	0.27	0.27	0.28	0.28	0.27	0.27	0.26	0.25	0.24	0.22	0.20	0.19	0.16	0.14
40%	0.11	0.17	0.21	0.24	0.26	0.28	0.29	0.29	0.29	0.29	0.28	0.27	0.26	0.25	0.23	0.21	0.19	0.16	0.14	0.11
45%	0.12	0.18	0.23	0.26	0.29	0.30	0.31	0.32	0.32	0.31	0.30	0.29	0.27	0.25	0.23	0.21	0.18	0.15	0.12	0.09
50%	0.13	0.20	0.25	0.29	0.31	0.33	0.34	0.34	0.34	0.33	0.32	0.31	0.29	0.27	0.24	0.21	0.18	0.15	0.12	0.08
55%	0.14	0.22	0.28	0.32	0.34	0.36	0.37	0.37	0.37	0.36	0.35	0.33	0.31	0.29	0.26	0.23	0.19	0.16	0.12	0.08
60%	0.16	0.24	0.30	0.34	0.37	0.39	0.40	0.41	0.40	0.39	0.38	0.36	0.34	0.31	0.28	0.25	0.21	0.17	0.13	0.08
65%	0.17	0.26	0.33	0.37	0.41	0.43	0.44	0.44	0.44	0.43	0.41	0.39	0.37	0.34	0.31	0.27	0.23	0.19	0.14	0.09
70%	0.18	0.28	0.35	0.40	0.44	0.46	0.47	0.48	0.48	0.47	0.45	0.43	0.40	0.37	0.34	0.30	0.26	0.21	0.16	0.11
75%	0.20	0.31	0.38	0.44	0.47	0.50	0.51	0.52	0.52	0.51	0.49	0.47	0.44	0.41	0.38	0.33	0.29	0.24	0.19	0.13
80%	0.21	0.33	0.41	0.47	0.51	0.54	0.56	0.56	0.56	0.55	0.54	0.51	0.49	0.45	0.42	0.37	0.33	0.28	0.22	0.16
85%	0.23	0.35	0.44	0.50	0.55	0.58	0.60	0.61	0.61	0.60	0.58	0.56	0.53	0.50	0.46	0.42	0.37	0.32	0.26	0.20
90%	0.24	0.38	0.47	0.54	0.59	0.62	0.64	0.66	0.66	0.65	0.63	0.61	0.58	0.55	0.51	0.46	0.41	0.36	0.30	0.24
95%	0.26	0.40	0.50	0.58	0.63	0.67	0.69	0.70	0.71	0.70	0.69	0.66	0.64	0.60	0.56	0.51	0.46	0.41	0.35	0.28
100%	0.27	0.42	0.53	0.61	0.67	0.71	0.74	0.76	0.76	0.75	0.74	0.72	0.69	0.66	0.62	0.57	0.52	0.46	0.40	0.33

Good Bad

Optimal (Most in Favor of BB)

Then BB Should Call Top 50%

Massachusetts Institute of Technology

EV when M = 9

Good calling range

Villain's Push Range

Hero's Call Range

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5%	0.05	0.09	0.13	0.17	0.21	0.25	0.29	0.32	0.36	0.40	0.43	0.47	0.50	0.54	0.57	0.60	0.64	0.67	0.70	0.74
10%	0.05	0.09	0.13	0.17	0.20	0.23	0.26	0.29	0.32	0.34	0.37	0.40	0.42	0.44	0.47	0.49	0.51	0.54	0.56	0.58
15%	0.06	0.10	0.14	0.17	0.20	0.22	0.25	0.27	0.29	0.31	0.33	0.35	0.37	0.38	0.40	0.41	0.43	0.44	0.45	0.46
20%	0.06	0.11	0.14	0.17	0.20	0.22	0.24	0.26	0.28	0.29	0.31	0.32	0.33	0.34	0.35	0.35	0.36	0.37	0.37	0.37
25%	0.07	0.12	0.15	0.18	0.21	0.23	0.25	0.26	0.27	0.28	0.29	0.30	0.30	0.31	0.31	0.31	0.31	0.31	0.31	0.30
30%	0.08	0.13	0.17	0.20	0.22	0.24	0.26	0.27	0.28	0.28	0.29	0.29	0.29	0.29	0.28	0.28	0.27	0.27	0.26	0.25
35%	0.09	0.14	0.18						0.28	0.29	0.29	0.29	0.28	0.28	0.27	0.26	0.25	0.23	0.22	0.20
40%	0.10	0.16	0.20						0.30	0.30	0.30	0.29	0.28	0.27	0.26	0.25	0.23	0.21	0.19	0.17
45%	0.11	0.17	0.22						0.32	0.31	0.31	0.30	0.29	0.28	0.26	0.24	0.22	0.20	0.18	0.15
50%	0.12	0.19	0.24						0.34	0.33	0.33	0.32	0.30	0.29	0.27	0.25	0.22	0.19	0.17	0.14
55%	0.13	0.21	0.26	0.30	0.32	0.34	0.36	0.36	0.36	0.36	0.35	0.34	0.32	0.30	0.28	0.25	0.23	0.20	0.16	0.13
60%	0.14	0.22	0.28	0.32	0.35	0.37	0.38	0.39	0.39	0.38	0.37	0.36	0.34	0.32	0.30	0.27	0.24	0.20	0.17	0.13
65%	0.16	0.24	0.30	0.35	0.38	0.40	0.41	0.42	0.42	0.41	0.40	0.39	0.37	0.34	0.32	0.29	0.25	0.22	0.18	0.14
70%	0.17	0.26	0.33	0.38	0.41	0.43	0.45	0.45	0.45	0.45	0.44	0.42	0.40	0.37	0.34	0.31	0.28	0.24	0.20	0.15
75%	0.18	0.28	0.35	0.40	0.44	0.47	0.48	0.49	0.49	0.48	0.47	0.45	0.43	0.41	0.38	0.34	0.30	0.26	0.22	0.17
80%	0.19	0.30	0.38	0.43	0.47	0.50	0.52	0.53	0.53	0.52	0.51	0.49	0.47	0.44	0.41	0.37	0.33	0.29	0.24	0.19
85%	0.21	0.32	0.40	0.46	0.51	0.54	0.56	0.57	0.57	0.56	0.55	0.53	0.51	0.48	0.45	0.41	0.37	0.32	0.27	0.22
90%	0.22	0.34	0.43	0.49	0.54	0.57	0.60	0.61	0.61	0.61	0.59	0.58	0.55	0.52	0.49	0.45	0.41	0.36	0.31	0.25
95%	0.23	0.36	0.46	0.53	0.58	0.61	0.64	0.65	0.65	0.65	0.64	0.62	0.60	0.57	0.53	0.49	0.45	0.40	0.35	0.29
100%	0.25	0.39	0.49	0.56	0.61	0.65	0.68	0.70	0.70	0.70	0.69	0.67	0.65	0.62	0.58	0.54	0.50	0.45	0.39	0.33

Call% = Push% * 1/2

Good Bad

Optimal (Most in Favor of BB)

Massachusetts Institute of Technology

EV when M = 6

Good calling range

Villain's Push Range

Hero's Call Range

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5%	0.05	0.09	0.14	0.18	0.22	0.26	0.30	0.34	0.38	0.42	0.46	0.50	0.54	0.58	0.62	0.66	0.70	0.73	0.77	0.81
10%	0.05	0.09	0.13	0.17	0.21	0.25	0.28	0.32	0.35	0.38	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69
15%	0.05	0.10	0.14	0.17	0.21	0.24	0.27	0.30	0.33	0.36	0.38	0.41	0.44	0.46	0.49	0.51	0.54	0.56	0.58	0.60
20%	0.06	0.10	0.14	0.17	0.21	0.23	0.26	0.29	0.31	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.53
25%	0.06	0.11	0.14	0.18	0.21	0.24	0.26	0.28	0.31	0.33	0.35	0.36	0.38	0.40	0.41	0.42	0.44	0.45	0.46	0.47
30%	0.07	0.11	0.15	0.19	0.21	0.24	0.26	0.28	0.30	0.32	0.34	0.35	0.36	0.37	0.39	0.40	0.40	0.41	0.42	0.42
35%	0.07	0.12	0.16						0.30	0.32	0.33	0.34	0.35	0.36	0.37	0.37	0.38	0.38	0.38	0.38
40%	0.08	0.13	0.17						0.31	0.32	0.33	0.34	0.35	0.35	0.35	0.36	0.36	0.36	0.35	0.35
45%	0.09	0.14	0.18						0.32	0.33	0.33	0.34	0.34	0.35	0.35	0.34	0.34	0.34	0.33	0.33
50%	0.09	0.15	0.19						0.32	0.33	0.34	0.34	0.34	0.34	0.34	0.34	0.33	0.32	0.32	0.31
55%	0.10	0.16	0.21	0.24	0.27	0.29	0.31	0.33	0.34	0.34	0.35	0.35	0.35	0.35	0.34	0.34	0.33	0.32	0.30	0.29
60%	0.11	0.17	0.22	0.26	0.29	0.31	0.33	0.34	0.35	0.36	0.36	0.36	0.36	0.35	0.35	0.34	0.33	0.31	0.30	0.28
65%	0.12	0.18	0.23	0.27	0.30	0.33	0.34	0.36	0.37	0.37	0.37	0.37	0.37	0.36	0.35	0.34	0.33	0.31	0.29	0.28
70%	0.12	0.19	0.25	0.29	0.32	0.35	0.36	0.38	0.38	0.39	0.39	0.39	0.38	0.37	0.36	0.35	0.33	0.32	0.30	0.27
75%	0.13	0.21	0.26	0.31	0.34	0.36	0.38	0.40	0.40	0.41	0.41	0.40	0.40	0.39	0.38	0.36	0.34	0.32	0.30	0.28
80%	0.14	0.22	0.28	0.32	0.36	0.38	0.40	0.42	0.43	0.43	0.43	0.42	0.42	0.40	0.39	0.37	0.35	0.33	0.31	0.28
85%	0.15	0.23	0.29	0.34	0.38	0.41	0.43	0.44	0.45	0.45	0.45	0.44	0.44	0.42	0.41	0.39	0.37	0.34	0.32	0.29
90%	0.16	0.25	0.31	0.36	0.40	0.43	0.45	0.46	0.47	0.48	0.47	0.47	0.46	0.44	0.43	0.41	0.39	0.36	0.33	0.30
95%	0.16	0.26	0.33	0.38	0.42	0.45	0.47	0.49	0.50	0.50	0.50	0.49	0.48	0.47	0.45	0.43	0.41	0.38	0.35	0.32
100%	0.17	0.27	0.35	0.40	0.44	0.48	0.50	0.51	0.52	0.53	0.53	0.52	0.51	0.49	0.47	0.45	0.43	0.40	0.37	0.33

Call% = Push% * 2/3

Good Bad

Optimal (Most in Favor of BB)

Massachusetts Institute of Technology

EV when M = 4

Good calling range

Villain's Push Range

Hero's Call Range

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5%	0.05	0.09	0.14	0.18	0.23	0.27	0.31	0.36	0.40	0.44	0.48	0.53	0.57	0.61	0.65	0.69	0.74	0.78	0.82	0.86
10%	0.05	0.09	0.14	0.18	0.22	0.26	0.30	0.33	0.37	0.41	0.45	0.48	0.52	0.56	0.59	0.63	0.66	0.70	0.73	0.77
15%	0.05	0.09	0.14	0.17	0.21	0.25	0.28	0.32	0.35	0.39	0.42	0.45	0.48	0.51	0.55	0.58	0.61	0.64	0.67	0.70
20%	0.05	0.10	0.14	0.17	0.21	0.24	0.28	0.31	0.34	0.37	0.40	0.43	0.45	0.48	0.51	0.54	0.56	0.59	0.61	0.64
25%	0.06	0.10	0.14	0.17	0.21	0.24	0.27	0.30	0.33					.46	0.48	0.50	0.52	0.54	0.57	0.59
30%	0.06	0.10	0.14	0.18	0.21	0.24	0.27	0.30	0.32					.43	0.45	0.47	0.49	0.51	0.53	0.54
35%	0.06	0.11	0.15	0.18	0.21	0.24	0.27	0.29	0.32					.42	0.43	0.45	0.46	0.48	0.49	0.51
40%	0.07	0.11	0.15	0.19	0.22	0.24	0.27	0.29	0.31	0.33	0.35	0.37	0.39	0.40	0.42	0.43	0.44	0.45	0.46	0.47
45%	0.07	0.12	0.16	0.19	0.22	0.25	0.27	0.30	0.32	0.33	0.35	0.36	0.38	0.39	0.40	0.41	0.42	0.43	0.44	0.44
50%	0.07	0.12	0.16	0.20	0.23	0.25	0.28	0.30	0.32	0.33	0.35	0.36	0.37	0.38	0.39	0.40	0.41	0.41	0.42	0.42
55%	0.08	0.13	0.17	0.21	0.24	0.26	0.28	0.30	0.32	0.34	0.35	0.36	0.37	0.38	0.38	0.39	0.39	0.40	0.40	0.40
60%	0.08	0.14	0.18	0.21	0.24	0.27	0.29	0.31	0.33	0.34	0.35	0.36	0.37	0.37	0.38	0.38	0.38	0.38	0.38	0.38
65%	0.09	0.14	0.19	0.22	0.25	0.28	0.30	0.32	0.33	0.34	0.35	0.36	0.37	0.37	0.38	0.38	0.38	0.37	0.37	0.37
70%	0.09	0.15	0.20	0.23	0.26	0.29	0.31	0.32	0.34	0.35	0.36	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.36	0.36
75%	0.10	0.16	0.20	0.24	0.27	0.30	0.32	0.33	0.35	0.36	0.37	0.37	0.37	0.38	0.38	0.37	0.37	0.36	0.36	0.35
80%	0.10	0.17	0.21	0.25	0.28	0.31	0.33	0.34	0.36	0.37	0.37	0.38	0.38	0.38	0.38	0.37	0.37	0.36	0.35	0.34
85%	0.11	0.17	0.22	0.26	0.29	0.32	0.34	0.36	0.37	0.38	0.38	0.39	0.39	0.39	0.38	0.38	0.37	0.36	0.35	0.34
90%	0.11	0.18	0.23	0.27	0.31	0.33	0.35	0.37	0.38	0.39	0.39	0.40	0.40	0.39	0.39	0.38	0.37	0.36	0.35	0.33
95%	0.12	0.19	0.24	0.28	0.32	0.34	0.36	0.38	0.39	0.40	0.40	0.41	0.41	0.40	0.39	0.39	0.38	0.36	0.35	0.33
100%	0.12	0.20	0.25	0.30	0.33	0.36	0.38	0.39	0.41	0.41	0.42	0.42	0.42	0.41	0.40	0.39	0.38	0.37	0.35	0.33

Call% = Push%

Good Bad

Optimal (Most in Favor of BB)

Massachusetts Institute of Technology

EV when M = 2

Good calling range

Villain's Push Range

Hero's Call Range

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5%	0.05	0.10	0.14	0.19	0.23	0.28	0.33	0.37	0.42	0.46	0.51	0.55	0.60	0.64	0.69	0.73	0.78	0.82	0.86	0.91
10%	0.05	0.09	0.14	0.18	0.22	0.27	0.31	0.35	0.39	0.44	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.76	0.80	0.85
15%	0.05	0.09	0.14	0.18	0.22	0.26	0.30	0.34	0.38	0.42	0.45	0.49	0.53	0.57	0.61	0.64	0.68	0.72	0.75	0.79
20%	0.05	0.09	0.13	0.17	0.21	0.25	0.29	0.33	0.36	0.40	0.43	0.47	0.50	0.54	0.57	0.61	0.64	0.68	0.71	0.74
25%	0.05	0.09	0.13	0.17	0.21						0.42	0.45	0.48	0.51	0.55	0.58	0.61	0.64	0.67	0.70
30%	0.05	0.09	0.13	0.17	0.21						0.40	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.63	0.66
35%	0.05	0.09	0.13	0.17	0.20						0.39	0.42	0.44	0.47	0.50	0.52	0.55	0.58	0.60	0.63
40%	0.05	0.09	0.13	0.17	0.20	0.23	0.26	0.29	0.32	0.35	0.38	0.40	0.43	0.45	0.48	0.50	0.53	0.55	0.57	0.59
45%	0.05	0.10	0.13	0.17	0.20	0.23	0.26	0.29	0.32	0.34	0.37	0.39	0.41	0.44	0.46	0.48	0.50	0.52	0.54	0.56
50%	0.06	0.10	0.13	0.17	0.20	0.23	0.26	0.28	0.31	0.33	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.53
55%	0.06	0.10	0.14	0.17	0.20	0.23	0.26	0.28	0.30	0.33	0.35	0.37	0.39	0.41	0.43	0.44	0.46	0.48	0.49	0.51
60%	0.06	0.10	0.14	0.17	0.20	0.23	0.25	0.28	0.30	0.32	0.34	0.36	0.38	0.40	0.41	0.43	0.44	0.46	0.47	0.48
65%	0.06	0.10	0.14	0.17	0.20	0.23	0.25	0.28	0.30	0.32	0.33	0.35	0.37	0.38	0.40	0.41	0.42	0.44	0.45	0.46
70%	0.06	0.11	0.14	0.17	0.20	0.23	0.25	0.27	0.29	0.31	0.33	0.34	0.36	0.37	0.39	0.40	0.41	0.42	0.43	0.44
75%	0.06	0.11	0.14	0.18	0.20	0.23	0.25	0.27	0.29	0.31	0.32	0.34	0.35	0.36	0.38	0.39	0.39	0.40	0.41	0.42
80%	0.07	0.11	0.15	0.18	0.21	0.23	0.25	0.27	0.29	0.31	0.32	0.33	0.34	0.36	0.36	0.37	0.38	0.39	0.39	0.40
85%	0.07	0.11	0.15	0.18	0.21	0.23	0.25	0.27	0.29	0.30	0.32	0.33	0.34	0.35	0.36	0.36	0.37	0.37	0.38	0.38
90%	0.07	0.12	0.15	0.18	0.21	0.23	0.25	0.27	0.29	0.30	0.31	0.32	0.33	0.34	0.35	0.35	0.36	0.36	0.36	0.36
95%	0.07	0.12	0.16	0.19	0.21	0.24	0.26	0.27	0.29	0.30	0.31	0.32	0.33	0.33	0.34	0.34	0.35	0.35	0.35	0.35
100%	0.07	0.12	0.16	0.19	0.22	0.24	0.26	0.27	0.29	0.30	0.31	0.32	0.32	0.33	0.33	0.34	0.34	0.34	0.34	0.33

Call% = Push% * 2

Good Bad

Optimal (Most in Favor of BB)

Massachusetts Institute of Technology

EV when M = 1

Good calling range

Villain's Push Range

Hero's Call Range

	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5%	0.05	0.10	0.14	0.19	0.24	0.28	0.33	0.38	0.42	0.47	0.52	0.56	0.61	0.66	0.70	0.75	0.80	0.84	0.89	0.93
10%	0.05	0.09	0.14	0.18	0.23	0.27	0.32	0.36	0.41	0.45	0.49	0.54	0.58	0.62	0.67	0.71	0.75	0.80	0.84	0.88
15%	0.05	0.09	0.14	0.18	0.22	0.26	0.31	0.35	0.39	0.43	0.47	0.51	0.55	0.59	0.64	0.68	0.72	0.76	0.80	0.84
20%	0.05	0.09	0.13	0.17	0.21	0.25	0.29	0.33	0.37	0.41	0.45	0.49	0.53	0.57	0.61	0.64	0.68	0.72	0.76	0.80
25%	0.05	0.09	0.13	0.17	0.21						.43	0.47	0.51	0.54	0.58	0.62	0.65	0.69	0.72	0.76
30%	0.05	0.09	0.13	0.17	0.20						.42	0.45	0.49	0.52	0.55	0.59	0.62	0.66	0.69	0.72
35%	0.05	0.09	0.12	0.16	0.20						.40	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.66	0.69
40%	0.05	0.09	0.12	0.16	0.19	0.23	0.26	0.29	0.33	0.36	0.39	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.62	0.65
45%	0.05	0.08	0.12	0.16	0.19	0.22	0.25	0.28	0.32	0.34	0.37	0.40	0.43	0.46	0.49	0.51	0.54	0.57	0.60	0.62
50%	0.05	0.08	0.12	0.15	0.19	0.22	0.25	0.28	0.31	0.33	0.36	0.39	0.41	0.44	0.47	0.49	0.52	0.54	0.57	0.59
55%	0.05	0.08	0.12	0.15	0.18	0.21	0.24	0.27	0.30	0.32	0.35	0.37	0.40	0.42	0.45	0.47	0.49	0.52	0.54	0.56
60%	0.05	0.08	0.12	0.15	0.18	0.21	0.23	0.26	0.29	0.31	0.34	0.36	0.38	0.41	0.43	0.45	0.47	0.49	0.51	0.53
65%	0.05	0.08	0.12	0.15	0.18	0.20	0.23	0.25	0.28	0.30	0.32	0.35	0.37	0.39	0.41	0.43	0.45	0.47	0.49	0.51
70%	0.05	0.08	0.12	0.15	0.17	0.20	0.22	0.25	0.27	0.29	0.31	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.46	0.48
75%	0.05	0.08	0.11	0.14	0.17	0.20	0.22	0.24	0.26	0.28	0.30	0.32	0.34	0.36	0.38	0.39	0.41	0.42	0.44	0.45
80%	0.05	0.08	0.11	0.14	0.17	0.19	0.21	0.24	0.26	0.27	0.29	0.31	0.33	0.34	0.36	0.37	0.39	0.40	0.41	0.43
85%	0.05	0.08	0.11	0.14	0.17	0.19	0.21	0.23	0.25	0.27	0.28	0.30	0.31	0.33	0.34	0.36	0.37	0.38	0.39	0.40
90%	0.05	0.08	0.11	0.14	0.16	0.18	0.21	0.22	0.24	0.26	0.27	0.29	0.30	0.31	0.33	0.34	0.35	0.36	0.37	0.38
95%	0.05	0.08	0.11	0.14	0.16	0.18	0.20	0.22	0.23	0.25	0.26	0.28	0.29	0.30	0.31	0.32	0.33	0.34	0.35	0.36
100%	0.05	0.08	0.11	0.14	0.16	0.18	0.20	0.21	0.23	0.24	0.26	0.27	0.28	0.29	0.30	0.31	0.31	0.32	0.33	0.33

Call% = Push% * 10

Good Bad

Optimal (Most in Favor of BB)

Massachusetts Institute of Technology

When Hero is BB (second to act)

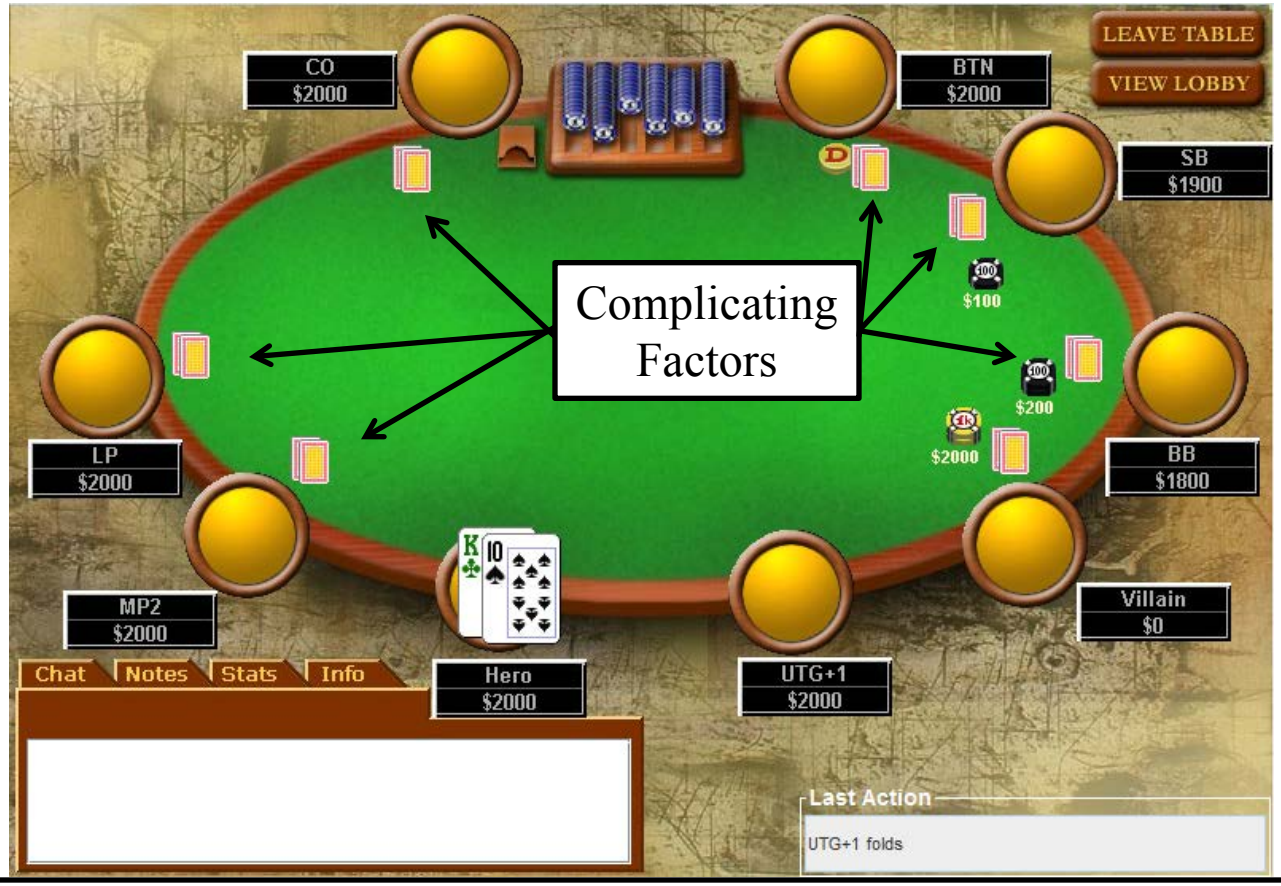
The dominating calling range is a proportion of the SB's pushing range

Stack (M)	Call Multiple
1	10x
2	2x
4	1x
6	2/3x
9	1/2x

Optimal BB Call% = SB Push% * CM

Other Positions (Calling)

Other Positions (Calling)



Pre-flop Analysis

- Motivator
- Range Definition
- Basic Assumptions
- Heads Up
- Other Positions

Other Positions (Calling)

We need to make generous assumptions to help develop rules for other positions

The biggest unknown is the actions of players left to act

Assumptions are on the conservative side, so that the errors are folding small positive edges, rather than calling small negative edges

Conservative Assumptions

- SDWinAmt = Stack (no discount for being SB or BB)
- Second caller range is TT+, AQ+ or top 5%
- Win% if called twice = 0%

Minimum Win% = 50% + 5% for each remaining player

- Since a second caller reduces our equity to 0%

Other Positions (Calling)

Minimum Win% = 50% + 5% for each remaining player

$$HeroWin\% = 50\% + .085 * \ln(VillainRange) - .085 * \ln(HeroRange) + \varepsilon$$

Players Remaining	Minimum Hero Win%	Hero Range Multiple
5	75%	5%
4	70%	10%
3	65%	20%
2	60%	30%
1	55%	55%
0	50%	100%

HeroRange = VillainRange * HRM

Example: Villain pushes top 50% from CO, Hero is BTN (2 remaining)

Hero needs 60% equity to call
Hero should call 50% * 30% = Top 15%

Win% = 50%+.085ln(50%)-.085ln(15%)
Win% = 60.2%

Other Positions (Calling) – Rules of Thumb

Position	Hero Calling Range
MP	5%*V-Range
LP	10%*V-Range
CO	30%*V-Range
SB	50%*V-Range

Reminder: These are conservative estimates, so a threshold call is likely to be very +EV

Significant reliance on reading opponent push ranges

Thought process of the Cutoff facing a push:

Is his pushing range 3x wider than my cards?

I have AQ, would he push A5?
Top 5% vs Top 15%

I have AT, would he push KJ?
Top 10% vs Top 30%

I have KQ, would he push 85?
Top 20% vs Top 60%

Other Positions (Pushing)

Analytical solution is complex
Our goal is to develop a decision table based on conservative assumptions

Conservative Assumptions

- SDWinAmt = Stack
- First caller range is 55+, AT+ or top 10%
- Second caller range is TT+, AQ+ or top 5%
- Win% if called twice = 20%
- Third caller range is 0% [never called three times]

Questions:

- When can we profitably push Broadway (Top 30%)?
- When can we profitably push any two cards (Top 100%)?

Pushing Top 30% (Broadway)

Hero's EV (in terms of M)

Remaining Players

Stack Size

	1 left	2 left	3 left	4 left	5 left	6 left	7 left	8 left	9 left
1M	0.21	0.14	0.09	0.06	0.04	0.02	0.00	-0.01	-0.01
2M	0.20	0.14	0.08	0.05	0.02	0.00	-0.02	-0.03	-0.04
3M	0.20	0.13	0.08	0.04	0.01	-0.02	-0.04	-0.05	-0.07
4M	0.20	0.12	0.07	0.02	-0.01	-0.04	-0.06	-0.08	-0.10
5M	0.20	0.12	0.06	0.01	-0.02	-0.05	-0.08	-0.10	-0.12
6M	0.19	0.11	0.05	0.00	-0.04	-0.07	-0.10	-0.13	-0.15
7M	0.19	0.11	0.04	-0.01	-0.05	-0.09	-0.12	-0.15	-0.18
8M	0.19	0.10	0.03	-0.02	-0.07	-0.11	-0.14	-0.17	-0.20
9M	0.18	0.09	0.02	-0.04	-0.08	-0.13	-0.16	-0.20	-0.23
10M	0.18	0.09	0.01	-0.05	-0.10	-0.14	-0.19	-0.22	-0.26

Good Bad

Pushing Top 100% (ATC)

Hero's EV (in terms of M)

Remaining Players

Stack Size

	1 left	2 left	3 left	4 left	5 left	6 left	7 left	8 left	9 left
1M	0.63	0.37	0.18	0.05	-0.05	-0.12	-0.17	-0.21	-0.24
2M	0.56	0.25	0.02	-0.14	-0.26	-0.35	-0.42	-0.47	-0.52
3M	0.49	0.13	-0.14	-0.33	-0.48	-0.59	-0.67	-0.74	-0.80
4M	0.42	0.01	-0.30	-0.52	-0.69	-0.82	-0.92	-1.01	-1.08
5M	0.35	-0.11	-0.46	-0.71	-0.90	-1.05	-1.17	-1.27	-1.36
6M	0.28	-0.23	-0.62	-0.90	-1.12	-1.29	-1.43	-1.54	-1.64
7M	0.21	-0.36	-0.78	-1.09	-1.33	-1.52	-1.68	-1.81	-1.92
8M	0.15	-0.48	-0.94	-1.28	-1.55	-1.76	-1.93	-2.07	-2.20
9M	0.08	-0.60	-1.10	-1.47	-1.76	-1.99	-2.18	-2.34	-2.48
10M	0.01	-0.72	-1.26	-1.66	-1.98	-2.23	-2.43	-2.61	-2.76

Good Bad

Pushing Top 10% (AT+, 55+)

Hero's EV (in terms of M)

Remaining Players

Stack Size

	1 left	2 left	3 left	4 left	5 left	6 left	7 left	8 left	9 left
1M	0.07	0.06	0.04	0.03	0.03	0.02	0.02	0.01	0.01
2M	0.08	0.06	0.05	0.04	0.04	0.03	0.03	0.02	0.02
3M	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.03	0.03
4M	0.09	0.08	0.07	0.06	0.06	0.05	0.05	0.04	0.04
5M	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.05	0.05
6M	0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.05
7M	0.10	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.06
8M	0.11	0.11	0.11	0.10	0.10	0.09	0.08	0.08	0.07
9M	0.11	0.11	0.11	0.11	0.11	0.10	0.09	0.09	0.08
10M	0.11	0.12	0.12	0.12	0.12	0.11	0.10	0.10	0.09

Good Bad

Pushing Rules of Thumb

AT+ 55+

	1 left	2 left	3 left	4 left	5 left	6 left	7 left	8 left	9 left
1M	0.07	0.06	0.04	0.03	0.03	0.02	0.02	0.01	0.01
2M	0.08	0.06	0.05	0.04	0.04	0.03	0.03	0.02	0.02
3M	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.03	0.03
4M	0.09	0.08	0.07	0.06	0.06	0.05	0.05	0.04	0.04
5M	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.05	0.05
6M	0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.05
7M	0.10	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.06
8M	0.11	0.11	0.11	0.10	0.10	0.09	0.08	0.08	0.07
9M	0.11	0.11	0.11	0.11	0.11	0.10	0.09	0.09	0.08
10M	0.11	0.12	0.12	0.12	0.12	0.11	0.10	0.10	0.09

Pushing top 10% is profitable from any position with stack size up to 10M

Broadway

	1 left	2 left	3 left	4 left	5 left	6 left	7 left	8 left	9 left
1M	0.21	0.14	0.09	0.06	0.04	0.02	0.00	-0.01	-0.01
2M	0.20	0.14	0.08	0.05	0.02	0.00	-0.02	-0.03	-0.04
3M	0.20	0.13	0.08	0.04	0.01	-0.02	-0.04	-0.05	-0.07
4M	0.20	0.12	0.07	0.02	-0.01	-0.04	-0.06	-0.08	-0.10
5M	0.20	0.12	0.06	0.01	-0.02	-0.05	-0.08	-0.10	-0.12
6M	0.19	0.11	0.05	0.00	-0.04	-0.07	-0.10	-0.13	-0.15
7M	0.19	0.11	0.04	-0.01	-0.05	-0.09	-0.12	-0.15	-0.18
8M	0.19	0.10	0.03	-0.02	-0.07	-0.11	-0.14	-0.17	-0.20
9M	0.18	0.09	0.02	-0.04	-0.08	-0.13	-0.16	-0.20	-0.23
10M	0.18	0.09	0.01	-0.05	-0.10	-0.14	-0.19	-0.22	-0.26

Pushing top 30% is profitable
- From any position with 1M
- From late position with 6M
- From cutoff with 10M

Any Two Cards

	1 left	2 left	3 left	4 left	5 left	6 left	7 left	8 left	9 left
1M	0.63	0.37	0.18	0.05	-0.05	-0.12	-0.17	-0.21	-0.24
2M	0.56	0.25	0.02	-0.14	-0.26	-0.35	-0.42	-0.47	-0.52
3M	0.49	0.13	-0.14	-0.33	-0.48	-0.59	-0.67	-0.74	-0.80
4M	0.42	0.01	-0.30	-0.52	-0.69	-0.82	-0.92	-1.01	-1.08
5M	0.35	-0.11	-0.46	-0.71	-0.90	-1.05	-1.17	-1.27	-1.36
6M	0.28	-0.23	-0.62	-0.90	-1.12	-1.29	-1.43	-1.54	-1.64
7M	0.21	-0.36	-0.78	-1.09	-1.33	-1.52	-1.68	-1.81	-1.92
8M	0.15	-0.48	-0.94	-1.28	-1.55	-1.76	-1.93	-2.07	-2.20
9M	0.08	-0.60	-1.10	-1.47	-1.76	-1.99	-2.18	-2.34	-2.48
10M	0.01	-0.72	-1.26	-1.66	-1.98	-2.23	-2.43	-2.61	-2.76

Pushing top 100% is profitable
- From late position with 1M
- From button with 4M
- From SB with 10M

Other Positions (Pushing) – Rules of Thumb

Conservative +EV Pushing Ranges
Simplified (Not Optimal)

Stack Size	Push ATC From	Push Broadway From	Push AT+, 55+ From
1M	Late	Always	Always
5M	Button	Late	Always
10M	Small Blind	Cutoff	Always

Always push top 10% for M < 10
Push very wide from any position for M < 1
Push in late position with Broadway for M < 5

Other Positions (Calling) – Rules of Thumb

Position	Hero Calling Range
MP	5%*V-Range
LP	10%*V-Range
CO	30%*V-Range
SB	50%*V-Range

Reminder: These are conservative estimates, so a threshold call is likely to be very +EV

Significant reliance on reading opponent push ranges

Thought process of the Cutoff facing a push:

Is his pushing range 3x wider than my cards?

I have AQ, would he push A5?
Top 5% vs Top 15%

I have AT, would he push KJ?
Top 10% vs Top 30%

I have KQ, would he push 85?
Top 20% vs Top 60%

Heads Up (Pushing) – Rules of Thumb

If you think Villain is tight, top 100% is always optimal

Otherwise…

Stack Size	Push
1M	Top 100%
5M	Top 75%
10M	Top 50%

Heads Up (Calling) – Rules of Thumb

The dominating calling range is a proportion of the SB's pushing range

Stack (M)	Call Multiple
1	10x
2	2x
4	1x
6	2/3x
9	1/2x

Optimal BB Call% = SB Push% * CM

Range of Hands

- Simplified ranges you can memorize

- TT+, AQ+ = 5%
- 55+, **AT+** = 10%
- 22+, **A2+,** KQ = 20%
- 22+, A2+, **Broadway** = 30%
- Pairs and cards adding to **16** = 50%
- Any two cards = 100%

15.S50 Poker Theory and Analytics

January IAP 2015