
Contents

Acknowledgements	ii
Contents	iv
Introduction	xii
I Foundation	1
1 Probability	2
1.1 Randomness	2
1.1.1 Randomness and Pattern Recognition	3
1.2 Probability of a Single Event	5
1.2.1 Sum of Probabilities	6
1.3 Multiple Independent Events	7
1.4 Important Probabilities in Backgammon	8
1.5 Multiple Moves	12
1.6 Arbitrary Positions	14
2 Equity	18
2.1 DMP	18
2.2 Gammons and Backgammons	20
2.2.1 Gammon-Adjusted Wins	23
2.3 Zero-Sum Games and the Long Run	24
2.4 A Practical Application	25
3 The Basics of Take/Pass Decisions	28
3.1 Take/Pass Decisions in Last Roll Positions	28

3.2	Take/Pass Decisions When the Cube Is Live	30
3.3	Take Point and Live Cube Take Point	33
3.3.1	A Lower Limit for the Take	36
3.4	Take/Pass Decisions in Gammonish Positions	37
3.5	Cubeless and Cubeful Equities	39
3.5.1	Normalization and Fair Settlements	40
3.5.2	General Observations Regarding Equities	40
4	The Basics of Double Decisions	42
4.1	Double Point	42
4.2	The Next Sequence	44
4.3	Market Losers	48
4.3.1	Doubling in Strong Positions	48
4.3.2	Doubling in Positions with Lower Equity	49
4.4	Volatility	52
4.5	The Redouble	54
4.5.1	Initial Double Versus Redouble in Middle Game Positions	56
4.6	Too Good to Double	58
4.6.1	Market Gainers	58
4.7	The Jacoby Rule	60
4.7.1	The Kauder Paradox	62
5	Equity in Match Play	64
5.1	Match Equity	64
5.2	Match Winning Chances	66
5.2.1	The Relation Between MWC and DMP Probabilities . . .	66
5.2.2	The Problem with MWC as a Measure for Mistakes . . .	67
5.3	Equivalent to Money Game Equity	69
5.3.1	The Derivation of EMG Equity	69
5.3.2	EMG Equity and Gammons	72
5.3.3	Cubeful EMG Equity	74
5.3.4	EMG Equity and Cube Level	76
5.3.5	Equity Loss Converted into Loss of MWC	77
6	Take/Pass Decisions in Match Play	82
6.1	The Take Point in Match Play	83
6.1.1	Match Winning Chances After Double/Take	83
6.1.2	Risk versus Gain	84
6.1.3	Live Cube Take Point	86
6.1.4	Higher Cubes	89
6.1.5	Neil's Numbers	91

6.2	Gammon Value in Match Play	92
6.3	Gammon-Adjusted Wins in Match Play	94
6.3.1	Defining the Take Point with GAW	95
6.3.2	Too Good to Double/Take	98
7	Double Decisions in Match Play	100
7.1	Double Point in Match Play	100
7.1.1	When Doubling Below the Double Point Is Correct	104
7.1.2	Quasi Last Roll Positions	105
7.2	The Doubling Window	107
7.2.1	Comparing Doubling for Money to Doubling in Matches	109
7.2.2	Cube Strategy in Gammonish Positions	111
8	Special Match Scores	114
8.1	Post-Crawford	114
8.1.1	Match Equities and Take Points at Post-Crawford Scores	115
8.1.2	Cube Strategy at Post-Crawford	116
8.2	The Crawford Game	120
8.2.1	Gammon Values at Crawford	120
8.2.2	Gammon-Save and Gammon-Go	122
8.2.3	Backgammons at Crawford	124
8.3	2-Away/2-Away	125
8.3.1	Game Theory Optimal Strategy	125
8.3.2	Delaying the Double at 2-Away/2-Away	126
II	Advanced Concepts and Applications	129
9	Computer Programs	130
9.1	The Competitors of eXtreme Gammon	130
9.2	Basic Analysis	131
9.2.1	Search	132
9.3	Luck	134
9.3.1	Definition of Luck	134
9.3.2	The Influence of Luck on the Result	135
9.4	Rollouts	139
9.4.1	Confidence	141
9.4.2	Wrong Moves and Confidence	143
9.4.3	Variance Reduction	145
9.4.4	Truncated Rollouts	145
9.5	Performance Rating	146

9.5.1	Some Historical Context	147
9.5.2	A Sample Match	147
9.6	Dice Distribution	150
10	A Theoretical Framework for Analyzing Cube Decisions	154
10.1	Cube Impact	154
10.1.1	Cube Efficiency	155
10.2	Value of Cube Ownership	161
10.3	Recube Vig	162
10.4	Gammon Deficit	163
10.5	Relating GAW and Recube Vig to Take/Pass Decisions	164
10.5.1	Studying Cube Decisions with XG	165
11	Take/Pass Decisions for Money	170
11.1	A Formula for Take/Pass Decisions	172
11.1.1	Wins and Gammon Deficit at the Take/Pass Borderline	172
11.1.2	The Schiemann Borderline Function	174
11.1.3	Standard Recube Vig	175
11.2	Applying the Model	177
11.2.1	Holding-Type Positions	177
11.2.2	Positions with a Moderate to High Number of Gammons	179
11.2.3	Positions with a Very High Gammon Deficit	185
11.2.4	Negative Gammon Deficit	189
11.3	Estimating Cubeful Equity After Double/Take	190
11.3.1	Estimating E_{DT} in Some Reference Positions	191
11.4	The Accuracy of Our Model	195
12	Double Decisions for Money	196
12.1	A Closer Look at Volatility	196
12.1.1	High-End Volatility and Low-End Volatility	198
12.2	The Opponent's Recube Vig	199
12.3	Finding Market Losing Sequences	201
12.3.1	The Second Roll of the Sequence	201
12.4	Initial Double versus Redouble	203
12.4.1	When the Value of Exclusive Access to the Cube Is Very High	204
12.5	Playing on for the Gammon	207
12.5.1	Playing on and the Position of the Cube	207
12.5.2	Playing on in Positions with Relatively Low Equity	209
12.6	Double Decisions in Practice	212
12.6.1	When in Doubt, Double	214

13 The Impact of the Cube on Checker Play	216
13.1 Checker Play as the Favorite	216
13.1.1 Being Close to Winning	217
13.1.2 Amount of Risk	219
13.1.3 When the Most Common Variation Leads to a Very Efficient Double	222
13.2 Checker Play as the Underdog	223
13.2.1 Analyzing Checker Plays Over the Board	224
13.2.2 Inducing a Double Now to Avoid Facing More Efficient Cubes Later	229
13.2.3 When the Most Common Variation Leads to a Very Efficient Double for the Opponent	232
14 Match Play Cubes in Non-Gammonish Positions	236
14.1 Recube Vig in Match Play	236
14.1.1 The Dependence of Recube Vig upon the Attacker's Take Point for the 4 Cube	237
14.1.2 Doubling when the Opponent's Recube Vig Is High	242
14.1.3 A Blunder by XG in a Simple Holding Game	243
14.2 The Automatic Take	244
14.3 Comparing Live Cube Take Points	246
14.3.1 Cube Impact in an Even Race	247
15 Match Play Cubes in Gammonish Positions	248
15.1 Cube Impact in Positions with Gammons	248
15.2 Cube Strategy in Gammonish Positions	250
15.2.1 The Change of Gammon Values at Different Cube Levels	250
15.2.2 The Inefficiency of Blitz Doubles for the Leader	253
15.2.3 The Efficiency of the Opponent's Initial Cubes/Recubes	255
15.2.4 Strategic Adjustments when the Trailer Is on Roll	258
15.2.5 The Impact of Gammons on Recubes	261
15.3 Playing On for the Gammon in Matches	263
15.3.1 The Number of Regret Scenarios	263
15.3.2 High Gammon Value at the 1 Level	264
15.3.3 Some Generalizations for Playing On	265
16 Adjusting Checker Play to the Match Score	266
16.1 Relating Checker Play to Gammon Rates	266
16.1.1 Strategy Changes in the Early Game	266
16.1.2 When Gammon Values at the Current Cube Level Matter	269
16.2 Planning for a Possible Cube Action	270

16.2.1	At Certain Scores Sometimes Only Wins Matter	271
16.2.2	When the Presence of the Cube Lowers the Risk of a Bold Move	272
16.2.3	Bad Situations Sometimes Require Bold Actions	273
16.2.4	Potential 4 Cubes Can Have a Big Impact on Strategy . .	275
16.2.5	When the Opponent Is 4-Away	277
17	A Practice-Oriented Guide for Match Play	280
17.1	The Relative Value of Points in a Match	280
17.1.1	Consequences for Raw Take Points	281
17.2	The Five Point Match	283
17.2.1	Non-Gammonish Positions	283
17.2.2	Gammonish Positions	285
17.2.3	Using Our Reference Positions	288
17.3	Longer Matches	293
17.3.1	Our Reference Positions in a 13 Point Match	293
17.3.2	The 4-Away Score in a Longer Match	294
17.3.3	Early Changes to Cube Strategy	295
III	The Human Element	299
18	Non-Optimal Play	300
18.1	Non-Optimal Play and Its Consequences for Rollouts	300
18.2	Two Equally Strong Human Players	303
18.2.1	When the Position Is More Difficult to Play for You	304
18.2.2	When the Position Is More Difficult to Play for Your Opponent	305
18.2.3	Adjusting Cube Strategy in Early Game and Middle Game Positions	306
18.3	Stronger Player Against Weaker Player	308
18.3.1	Strategic Adjustments for the Stronger Player	309
18.3.2	Strategic Adjustments for the Weaker Player	310
19	Changes in Cube Strategy	312
19.1	Changes to Strategy in an Endgame Situation	312
19.2	Strategy Changes in General	315
19.2.1	When the Weaker Player Should Double More Aggressively	316
19.2.2	When the Stronger Player Should Double More Aggressively	317

19.3 An Example from a Live Tournament	319
20 Exploitative Play	322
20.1 An Introduction to Exploitation in Backgammon	322
20.1.1 Punishing Exploitative Plays	323
20.2 Exploitative Play in Practice	323
20.2.1 The Bluff Double	324
20.2.2 Putting Your Opponent on the Bar	326
20.2.3 A Big Blunder and an Even Bigger Reward	328
20.2.4 The Dynamics of a Money Game Session	330
IV Appendix	333
A Tournament Backgammon	334
A.1 Single Elimination Tournaments	334
A.1.1 Player Strength	335
A.1.2 Tournament Simulation	337
A.1.3 Consolation and Double Elimination	343
A.2 Three Lives Tournaments	344
B Solutions to Exercises	348
C Important Tables	352
Index	356