

Build Your Own Tennis Calculator

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Refer to book 'The Mathematics of Tennis'

Preface

1.1 Introduction p1

1.2 Counting Paths p1

1.3 Binomial Theorem p6

1.4 Backward Recursion p13

Refer to studenttenniscalc.xlsx

Probabilities of player A winning a game on serve

Go to Sheet2

In cell D19 enter $=D\$2*D20+D\$3*E19$ (this is the recursion formula for a game with player A serving)

Copy (Ctrl c) and paste (Ctrl v) into the other cells coloured yellow

In cell G22 enter $=D2^2/(D2^2+D3^2)$ (this is the probability of player A winning from deuce)

In cell D23 enter **1**

Copy and paste into cells E23 and F23 (these are the boundary conditions for player A winning the game)

In cell H19 enter **0**

Copy and paste into cells H20 and H21 (these are the boundary conditions for player A losing the game)

Probabilities of player A winning a game with player B serving

In cell N19 enter $=D\$5*N20+D\$4*O19$ (this is the recursion formula for a game with player B serving)

Copy and paste into the other cells coloured yellow

In cell Q22 enter $=D5^2/(D5^2+D4^2)$ (this is the probability of player A winning from deuce)

In cell N23 enter **1**

Copy and paste into cells O23 and P23 (these are the boundary conditions for player A winning the game)

In cell R19 enter **0**

Copy and paste into cells R20 and R21 (these are the boundary conditions for player A losing the game)

Refer to book 'The Mathematics of Tennis'

2.1 Introduction p22

2.2 Winning a tiebreak game p24

2.3 Winning a tiebreak set p27

2.5 Winning an all tiebreak set match p32

Probabilities of player A winning a tiebreak game with player A currently serving

In cell D29 enter $=\$D\$2*O30+\$D\$3*P29$ (this is a recursion formula for a tiebreak game with player A currently serving)

Copy and paste into the other cells coloured yellow

In cell D30 enter $=\$D\$2*D31+\$D\$3*E30$ (this is a recursion formula for a tiebreak game with player A currently serving)

Copy and paste into the other purple cells

In cell J35 enter $=(D2*D5)/(D2*D5+D3*D4)$ (this is the probability of player A winning the tiebreak game from 6 points all)

In cell D36 enter **1** (these are the boundary values of player A winning the tiebreak game)

Copy and paste into the other green cells

In cell K29 enter **0** (these are the boundary values of player A losing the tiebreak game)

Copy and paste into the other grey cells

Probabilities of player A winning a tiebreak game with player B currently serving

In cell O29 enter $=\$D\$5*D30+\$D\$4*E29$ (this is a recursion formula for a tiebreak game with player B currently serving)

Copy and paste into the other cells coloured yellow

In cell O30 enter $=\$D\$5*O31+\$D\$4*P30$ (this is a recursion formula for a tiebreak game with player B currently serving)

Copy and paste into the other purple cells

In cell U35 enter $=(D2*D5)/(D2*D5+D3*D4)$ (this is the probability of player A winning the tiebreak game from 6 points all)

In cell O36 enter **1** (these are the boundary values of player A winning the tiebreak game)

Copy and paste into the other green cells

In cell V29 enter **0** (these are the boundary values of player A losing the tiebreak game)

Copy and paste into the other grey cells

Probabilities of player A winning a tiebreak set with player A currently serving

In cell D45 enter $=\$G\$2*O46+\$G\$3*P45$ (this is a recursion formula for a tiebreak set with player A currently serving)

Copy and paste into the other cells coloured yellow

In cell J51 enter **G6** (this is the probability of player A winning a tiebreak game)

In cell D51 enter **1** (these are the boundary values of player A winning the tiebreak set)

Copy and paste into the other green cells

In cell J45 enter **0** (these are the boundary values of player A losing the tiebreak set)

Copy and paste into the other grey cells

Probabilities of player A winning a tiebreak set with player B currently serving

In cell O45 enter $=\$G\$5*D46+\$G\$4*E45$ (this is a recursion formula for a tiebreak set with player B currently serving)

Copy and paste into the other cells coloured yellow

In cell U51 enter **G6** (this is the probability of player A winning a tiebreak game)

In cell O51 enter **1** (these are the boundary values of player A winning the tiebreak set)

Copy and paste into the other green cells

In cell U45 enter **0** (these are the boundary values of player A losing the tiebreak set)

Copy and paste into the other grey cells

Probabilities of player A winning a best-of-5 all tiebreak set match

In cell D62 enter $=\$J\$2*D63+\$J\$3*E62$ (this is a recursion formula for a best-of-5 all tiebreak set match)

Copy and paste into the other cells coloured yellow

In cell D65 enter 1 (these are the boundary values of player A winning the match)

Copy and paste into the other green cells

In cell G62 enter 0 (these are the boundary values of player A losing the match)

Copy and paste into the other grey cells

Go to Sheet1 and check that your calculator is correct by altering the serving parameters and score line against tennisdeuce.xlsx

Refer to book 'The Mathematics of Tennis'

4.1 Introduction p51

4.2 Binomial theorem p52

4.5 Backward recursion p61

Challenge: Obtain the mean and variance of the number of points remaining in the game from various score lines and obtain tables in Excel the same as Table 4.2 (p62) and Table 4.3 (p64)

Documentation for TennisCalc

Refer to tennisdeuce.xlsx

TennisCalc is a dynamic calculator for obtaining the chances of winning and match duration of a game, set and match dependent of the score line. It allows for updating the serving probabilities of each player during the match in progress to account for player form on the day. It has an Interactive and Predictive feature.

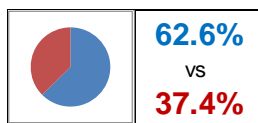
The Interactive feature

Type
Interactive

allows the user to adjust the serving probabilities and score line to output the chances of winning and match duration. For example, with player A winning 62% of points on serve and player B winning 60% of points on serve;

Player	Initial Serve
Player A	< > 62.0%
Player B	< > 60.0%

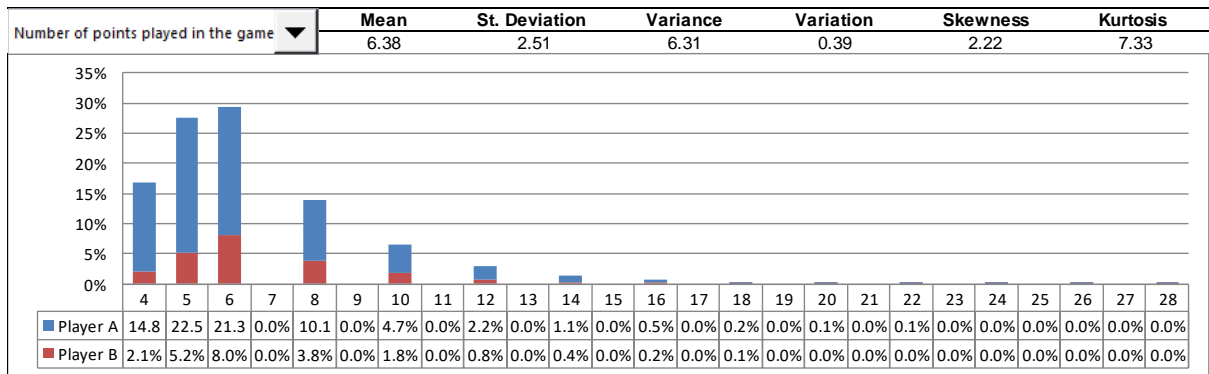
player A has a 62.6% chance of winning the match from the outset in a best-of-5 all tiebreak sets match.



Player A also has a 77.6% chance of winning the game on serve and a 56.8% chance of winning the set

Player	Point	Game	Set	Match
Player A	62.0%	77.6%	56.8%	62.6%
Player B	38.0%	22.4%	43.2%	37.4%

Player A has a 14.8%, 22.5% and 21.3% chance of winning the game to 0, 15, 30 respectively. Player B has a 2.1%, 5.2% and 8.0% chance of winning the game to 0, 15, 30 respectively. The chances of playing 4, 5 and 6 points are given by the sums of $14.8\%+2.1\%=16.9\%$, $22.5\%+5.2\%=27.7\%$ and $21.3\%+8.0\%=29.3\%$ respectively. The mean number of points played in such a game is 6.38 with a standard deviation of 2.51. Other measures of risk include the coefficient of variation as 0.39, coefficient of skewness as 2.22 and coefficient of excess kurtosis as 7.33.



Suppose player A wins the first point on serve to a score line of 15-0 (1-0);

Player	Server	Points	Games	Sets
Player A	●	< █ > 1	< █ > 0	< █ > 0
Player B	○	< █ > 0	< █ > 0	< █ > 0

the chances of winning the game, set and match are now 87%, 59.5% and 63.5% respectively.

Player	Point	Game	Set	Match
Player A	62.0%	87.0%	59.5%	63.5%
Player B	38.0%	13.0%	40.5%	36.5%

Suppose from this score line of 1-0 we wish to calculate the chances of reaching deuce. This can be obtained as 21.1%.

Points	Games	Sets
< █ > 3	< █ > 0	< █ > 0
< █ > 3	< █ > 0	< █ > 0
Game	Set	Match
21.1%	0.0%	0.0%

The Predictive feature

Type
Predictive

allows the user to enter two players and the type of court surface to output the chances of winning and match duration. For example, Roger Federer vs Rafael Nadal on grass has Federer winning 73.9% of matches;

