Double Touch Barrier Option

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1 Input to Function

Description	*Symbol*	*min*	*max*	*Reasonable range*
Underlying price	S	0^+	$+\infty$	
Strike price	X	0^+	$+\infty$	
Lower barrier level	L	0^+	$< U$	
Upper barrier level	U	$> L$	$+\infty$	
Continuous risk-free interest rate	r	0^+	$+\infty$	
Continuous secondary rate	q	0^+	$+\infty$	
Volatility	σ	0^+	$+\infty$	
Time to option maturity	T	0^+	$+\infty$	
Put or Call	*indicator*	–	–	"P", "C"
In or Out		–	–	"I", "O"

Table 1: Inputs for Double Touch Barrier Option pricing function

2 Properties of Instrument

A double touch barrier option is an option with two barriers, coming into existence (knocking-in) or terminating (knocking-out) if *both* barriers are touched during the life of the option. Double touch barrier options can be valued as combinations of regular single[1] and double[2] barrier options, as detailed in Table 2 and Table 3, with valuation dependent on the position of the underlying relative to the two barriers. We assume zero rebate.

2.1 Knock-in

Condition	Valuation method
$S \geq U$	the upper barrier has already been touched, with the value of the option given by a down-and-in type Single Barrier option, with barrier L (to send the option 'in' after L), and rebate 0.0.
$S \leq L$	the lower barrier has already been touched, with the value of the option given by an up-and-in type Single Barrier option, with barrier U (to send the option 'in' after U), and rebate 0.0.
$L < S < U$	both barriers have not been touched, the value of the option is given by the difference between the above Single Barrier options, and a similar regular Double Barrier option.

Table 2: Valuation method for knock-in type double touch barrier options

[1] See pricing specification *Single Barrier Option* for details.
[2] See pricing specification *Double Barrier Option* for details.

2.2 Knock-out

Condition	Valuation method
$S \geq U$	the upper barrier has already been touched, with the value of the option given by a down-and-out type Single Barrier option, with barrier L (to send the option 'out' after L), and rebate 0.0.
$S \leq L$	the lower barrier has already been touched, with the value of the option given by an up-and-out type Single Barrier option, with barrier U (to send the option 'out' after U), and rebate 0.0.
$L < S < U$	both barriers have not been touched, the value of the option is given by the difference between the above Single Barrier options, and a similar regular Double Barrier option.

Table 3: Valuation method for knock-out type double touch barrier options