Binary Gap Option

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April 06, 2017

Version 8.0.7905

1 Inputs to Function

Description	*Symbol*	*min*	*max*	*Reasonable range*
Underlying	S	0^+	$+\infty$	
Deciding strike price	X_1	0^+	$+\infty$	
Payoff strike price	X_2	0^+	$+\infty$	
Continuous risk-free interest rate	r	0^+	$+\infty$	
Continuous secondary rate	q	0^+	$+\infty$	
Volatility	σ	0^+	$+\infty$	
Time to maturity	T	0^+	$+\infty$	
Put or Call	*indicator*	–	–	"P", "C"

Table 1: Inputs for Binary Gap Option pricing function

2 Formula

Hull (2000)[1] stated that the valuation of *binary gap* options can be made using one of the formulae described by Reiner and Rubinstein (1991),

$$\boxed{\phi S e^{-qT} N(\phi d_1) - \phi X_2 e^{-rT} N(\phi d_2)\,,}$$

where

$$d_1 = \frac{\ln \frac{S}{X_1} + \left(r - q + \frac{\sigma^2}{2}\right) T}{\sigma\sqrt{T}} \qquad d_2 = d_1 - \sigma\sqrt{T}.$$

ϕ	Option Type
-1	Put
1	Call

3 Properties of Instrument

A binary gap option, effectively has two strike values,

1) a 'deciding' strike X_1 and

2) a payoff strike X_2,

giving option payoffs as in Table 2, Figure 1 and Figure 2, where S_T represents the value of the underlying at expiry.

[1] Hull (2000) p.464, *Binary Options*

Option Type	Condition	Payoff
Call	$S_T \leq X_1$	0
	$S_T > X_1$	$S_T - X_2$
Put	$S_T \geq X_1$	0
	$S_T < X_1$	$X_2 - S_T$

Table 2: Payoff at maturity for binary gap option

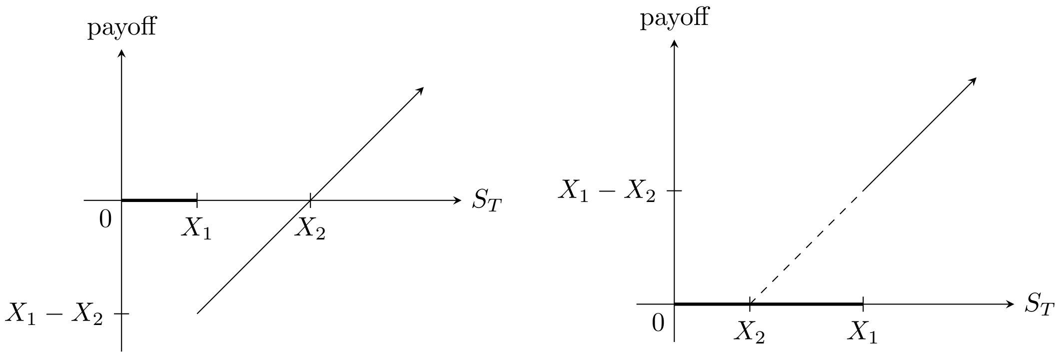

Figure 1: Payoff for binary gap call option

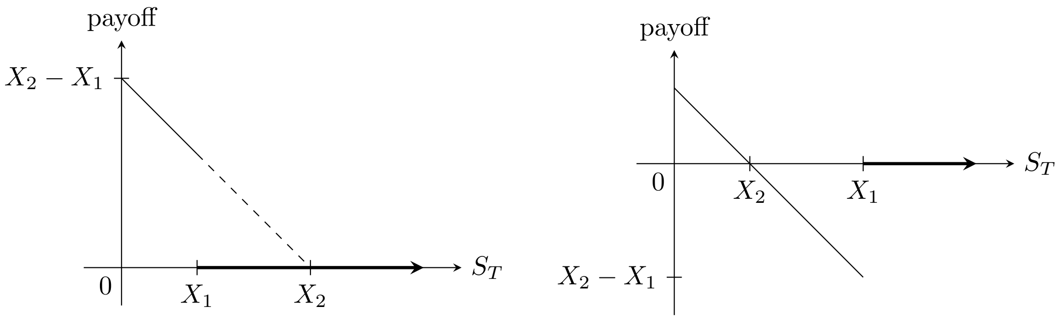

Figure 2: Payoff for binary gap put option

Bibliography

John C. Hull. *Options, Futures and Other Derivatives.* Prentice Hall, Upper Saddle River, New Jersey, 4th edition, 2000.

Eric Reiner and Mark Rubinstein. Unscrambling the binary code. *Risk*, 4(9):75–83, October 1991.