Binary Cash-or-Nothing Option

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1 Inputs to Function

Description	*Symbol*	*min*	*max*	*Reasonable range*
Underlying	S	0^+	$+\infty$	
Strike	X	0^+	$+\infty$	
Cash amount payoff	K	0^+	$+\infty$	
Continuous risk-free interest rate till T	r	0^+	$+\infty$	
Continuous secondary rate till T	q	0^+	$+\infty$	
Volatility till T	σ	0^+	$+\infty$	
Time to maturity	T	0^+	T_s	
Continuous risk-free interest rate till T_s	r_s	0^+	$+\infty$	
Time to settlement	T_s	T	$+\infty$	
Put or Call	*indicator*	–	–	"P", "C"

Table 1: Inputs for Binary Cash-or-Nothing Option pricing function

2 Formula

Haug (1998)[1] states that *binary cash-or-nothing* options can be valued using Reiner and Rubinstein (1991)'s formula.

Our Risk Engine uses the following pricing formula, which includes the settlement period,

$$f = Ke^{-r_s T_s} N\left(\phi d_2\right),$$

where

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

ϕ	Option Type
-1	Put
1	Call

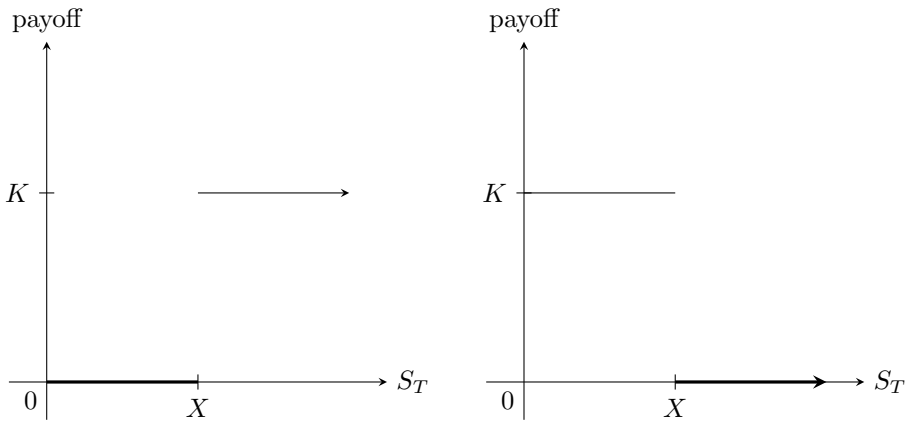
3 Properties of Instrument

A binary cash-or-nothing option pays out a cash amount K at settlement if the option expires *in* the money, as illustrated in Table 2 and Figure 1, with S_T representing the value of the underlying at expiry. A call option expires in the money if $S_T > X$ and a put option expires in the money if $S_T < X$.

[1] Haug (1998) p.88, 2.11.2 *Cash-or-Nothing Options*

Option Type	Condition	Payoff
Call	$S_T > X$	K
	$S_T \leq X$	0
Put	$S_T \geq X$	0
	$S_T < X$	K

Table 2: Payoff at settlement for binary cash-or-nothing option



(a) Call (b) Put

Figure 1: Payoff at settlement for binary cash-or-nothing option

Bibliography

Espen Gaarder Haug. *The Complete Guide To Option Pricing Formulas*. McGraw Hill, New York, 1st edition, 1998.

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

Glossary

Risk Engine The Vector Risk market risk and credit risk system.