

# VBA Bond Market financial instruments

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## **Curriculum**

FIM 700 Course VBA Excel financial engineering.

## **Publication**

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# 1-Function BlackBondCall(rT, rs, S, t, sigmaf, xf)

Microsoft Excel - Bond\_J.Awad\_FIM700\_Aut2012\_USherbrooke.xls

Fichier Edition Affichage Insertion Format Outils Données Fenêtre ?

10 Arial

120%

Sécurité...

European Call Price on Zero Bond

1												
2												
3	rT	0,03										
4	rs	0,03										
5	s	5										
6	T	1										
7	sigmaf	0,1										
8	xf	0,75										
9												
10	Call Price		←	Request Function BlackBondCall(rT, rs, S, t, sigmaf, xf)								
11												
12												
13												
14												
15												
16	Variable Definitions											
17	rT	Interest rate for period T										
18	rs	Interest rate for period s										
19	s	Stock Price										
20	T	Obligation Maturity in years										
21	sigmaf	Price Volatility										
22	xf	Exercise price										
23												

Clear Black Bond

European Call Price Zero Bond / Coupon Bond Options / Black Call Zero Bond / Black Cap Zero Bond / Newton-Ra

Prêt

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FR 16:23

# 2-Sub BlackCapPrice()

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Tapez une question

Arial 10

121%

Sécurité...

Black European Cap Zero Bond

Black Cap Bond Price

Clear Black Cap Bond Price

	A	B	C	D	E	F	G	H	I	J	K	L
1						Black European Cap Zero Bond						
2												
3	rM1	0,04										
4	rM2	0,04										
5	M1	9										
6	T	0,75										
7	M2	12										
8	M	12										
9	sigma	0,5										
10	Rcap	0,03										
11	Principal	10000000										
12	s	1										
13												
14	Black Cap Price											
15	JM1											
16	JM2											
17	V											
18	f											
19												
20												
21												
22	Variable Definitions											

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# 3-Sub EuropeanCallPriceZeroBond()

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114%

Sécurité...

Variable Definitions:

Period	Period in years
Rmat	Interest rate
Price	Price for specified period
Volatility	Volatility rates
Principal	Notional bond price
delt	Step

European call price zero bond cash-flow tree

European Call Price Zero Bond Cash-Flow Tree

Clear Call Price Zero Bond Cas-Flow Tree

Cash-flow Tree

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# 4-Sub BondCouponOptionPrice()

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Echier Edition Affichage Insertion Format Outils Données Fenêtre ?

Tapez une question

Arial 12

Sécurité...

Option prices for bond with coupons Vectors

Period	Rmat	Price	Volatility
1	0,1	0,904837	0,2
2	0,11	0,802519	0,19
3	0,12	0,697676	0,18

Coupon Bond Option Prices Vectors

Clear Bond Coupon Option Prices Vectors

Variable Definitions:

Period	Period in years
Rmat	Interest rate
Price	Price for specified period
Volatility	Volatility rates
Principal	Notional bond price
delt	Step

Principal 100

delt 1

VW1

SWAP Binomial Tree Zero Bond European Call Price Zero Bond Coupon Bond Options Black Call Zero Bond

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# 5-Sub BondDurationPrice()

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Formulas Ribbon: 100%

Variable definitions:

Coupon	Coupon rate on a year
Maturity	Bond maturity on a year
Price	Bond price in \$
Bond Duration	The sum of weighted

Bond Duration and YTM computation

Bond Duration and YTM computation

Clear Bond Duration and YTM computation


Coupon Bond Options / Black Call Zero Bond / Black Cap Zero Bond / Newton-Raphson / **Bond Duration Price**

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# 6-Sub SWAP()

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Echier Edition Affichage Insertion Format Outils Données Fenêtre ?

Tapez une question

Arial 12

Period

Period	Rmat	Price	Volatility
1	0,1	0,904837	
2	0,11	0,802519	0,19
3	0,12	0,697676	0,18
4	0,125	0,606531	0,17
5	0,13	0,522046	0,16
6	0,14	0,431711	0,15
7	0,145	0,362402	0,13
8	0,15	0,301194	0,12
9	0,155	0,247833	0,11
10	0,16	0,201897	0,1
11	0,165	0,162838	0,09
12	0,17	0,130029	0,08

Principal 1

delt 1

SWAP tree

Rmat(t+1)

SWAP

SWAP

Clear SWAP

cap(t+1)

floor(t+1)

swap(t+1)

k(t+1)

Variable Definitions:

Variable	Definition
Period	Period in years
Rmat	Interest rate
Price	Price for specified period
Volatility	Volatility rates
Principal	Notional bond price
delt	Step
cap(t+1)	sum cap
floor(t+1)	sum floor
swap(t+1)	swap
k(t+1)	SWAP following Newton algorithm
Rmat(t+1)	SWAP tree in Newton algorithm
pji(t+1)	SWAP tree in Newton algorithm
Rmatef(t+1)	SWAP tree in Newton algorithm
SC(t+1)	SWAP tree in Newton algorithm

SWAP Binomial Tree Zero Bond European Call Price Zero Bond Coupon Bond Options Black Call Zero Bond

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# 7-Sub NewtonRaphson()

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Fichier Edition Affichage Insertion Format Outils Données Fenêtre ?

Tapez une question

Arial 10 G I S

110%

Sécurité...

A1

A B C D E F G H I J K L

1

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4 Computing Loop xt fx f(x) f'(x)

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Newton Raphson

Newton Raphson

Clear Newton Raphson

Variable Definitions:

Computing Loop	Iterations
xt	xt variables
fx	fx function
f'(x)	first derivative of fx function
f''(x)	second derivative of fx function

Newton-Raphson Bond Duration Price Price Zero Coupon Bond Vasicek Call Euro Bond Zero Vasicek

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# 8-Function CallOptionBondZeroVasicek(a, b, r, t, S, sigma, L, k, TC)

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Echier Edition Affichage Insertion Format Outils Données Fenêtre ? Tapez une question

Arial 10 G I S

106%

Sécurité...

Vasicek model to calculate European call price for zero coupon bond

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2	a	0,5											
3	b	0,08											
4	r	0,03											
5	t	0											
6	s	10											
7	sigma	0,04											
8	L	1											
9	k	0,6											
10	TC	4											
11													
12	CallOptionBondZeroVasicek	0,035	←	Request function CallOptionBondZeroVasicek									
13													
14				Clear European Call Vasicek									
15													
16	<b>Variable Definitions</b>												
17	a	interest rate speed adjustment											
18	b	long-term interest rate level											
19	r	spot interest rate											
20	t	time value of cash-flows at initial period											
21	s	zero coupon bond maturity											
22	sigma	interest rate standard deviation											
23	L	Notional value of zero coupon bond											
24	k	option exercise price											
25	TC	option timeframe											
26													

Newton-Raphson / Bond Duration Price / Price Zero Coupon Bond Vasicek / Call Euro Bond Zero Vasicek /

Prêt

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# 9-Function PriceBondZeroCouponVasicek(a, b, r, t, S, sigma)

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Echier Edition Affichage Insertion Format Outils Données Fenêtre ? Tapez une question

Arial 10

1 Vasicek model for Zero Coupon Bond Price

2 a 0,5

3 b 0,08

4 r 0,03

5 t 0

6 s 10

7 sigma 0,04

8

9 Price Zero Coupon Bond Vasicek 0,51 ← Request function PriceBondZeroCouponVasicek

10

11

12 Variable Definitions Clear Vasicek Bond Price

13 a interest rate speed adjustment

14 b long-term interest rate level

15 r spot interest rate

16 t time value of cash-flows at initial period

17 s zero coupon bond maturity

18 sigma interest rate standard deviation

19

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# 10-Function BinTreeZeroBondRate(pvol, volv, L, delt)

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Echier Edition Affichage Insertion Format Outils Données Fenêtre ? Tapez une question

Arial 12 G

Period

Period	Rmat	Price	Volatility
1	0,1	0,904837	
2	0,11	0,802519	0,19
3	0,12	0,697676	0,18
4	0,125	0,606531	0,17
5	0,13	0,522046	0,16
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8	0,15	0,301194	0,12
9	0,155	0,247833	0,11
10	0,16	0,201897	0,1
11	0,165	0,162838	0,09
12	0,17	0,130029	0,08

Binomial Tree Zero Bond

Bond Price Binomial Tree

Clear Bond Price Tree

Variable Definitions:

Variable	Definition
Period	Period in years
Rmat	Interest rate
Price	Price for specified period
Volatility	Volatility rates
Principal	Notional bond price
delt	Step

Principal 1

delt 1

BinomialTree

Binomial Tree Zero Bond / European Call Price Zero Bond / Coupon Bond Options / Black Call Zero Bond / Black C

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# Références

- **Clelow L., C. Strickland, “Implementing Derivative Models”, Chichester, Wiley, 1998.**
- **Hull, J, A. White, “Efficient Procedures for valuing European and American path-dependent options”, Journal of Derivatives, Vol. 1, 1990.**
- **Paul Wilmott, “Derivatives: The theory and practice of financial engineering”, J. Wiley, 1998.**
- **Racicot François-Éric, Théoret Raymond, « Le calcul numérique en finance empirique et quantitative : ingénierie financière et Excel (Visual Basic) », Presse de l’université du Québec, 2004.**
- **S.G. Kou, “Jump diffusion models for asset pricing in financial engineering”, J.R. Birge, V. Linetsky, Elsevier, 2008.**
- **Salih N. Neftci, “Principles of financial engineering”, Academic Press, 2008.**