

# PRICING MUNI STRUCTURES WITH NON-STANDARD CALL FEATURES

---

Webinar: January 15 & 17, 2019

[View Webinar](#)



KalotayAnalytics

**FIXED INCOME** INNOVATION, PRECISION & PERFORMANCE

# Kalotay Analytics

- Best-in-class fixed income analytics for a wide range of applications, including trading, risk management, wealth advisory and debt management
  - **BondOAS**: *Fixed rate bonds*
  - **MuniOAS**: *'Tax-neutral' valuation of tax-exempt municipal bonds*
  - **CurviLinear**: *Yield curve & volatility estimation*
  - MuniSignal: *Tax-loss harvesting and tax-rate arbitrage*
  - CLEANMBS: *MBS valuation and prepayment modeling*



## Before the 2018 Tax Law Eliminating Advance Refunding

- 5% NC-10 bonds the dominant structure
  - *Selling at high premiums*
  - *For institutional investors, cushion against 'de minimis' discount risk*
  - *For issuers, advance refunding often a lay-up with 5% NC-10 bonds*

See: [The Allure of 5% Bonds ...](#) *Bond Buyer*, January 27, 2012



# 5% NC-10 Example: Georgia Series 2017C

**\$348,630,000**  
**State of Georgia**  
**General Obligation Refunding Bonds 2017C**

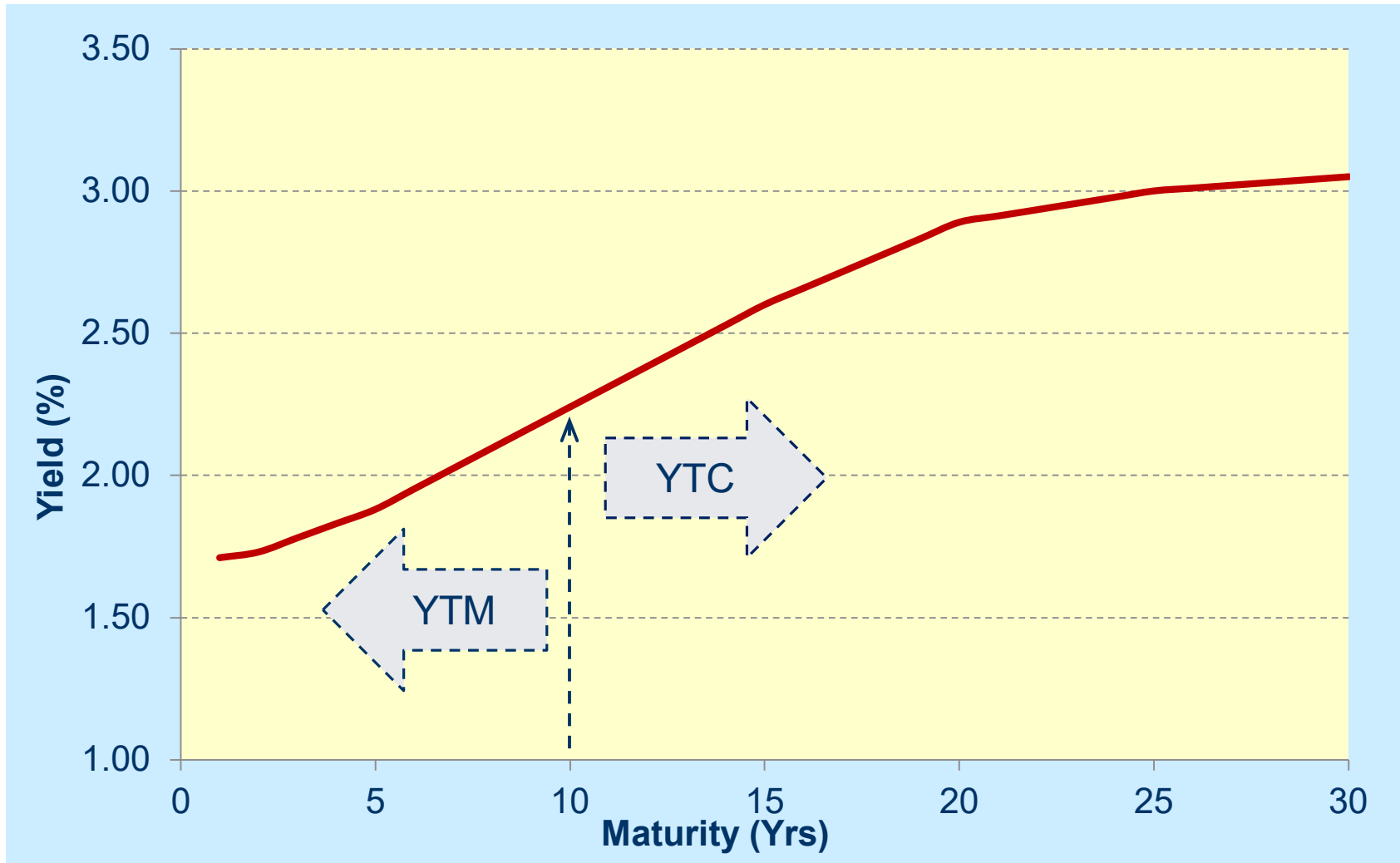
**Maturity Schedule**

<u>Maturing July 1,</u>	<u>Principal Amount</u>	<u>Interest Rate</u>	<u>Price or Yield</u>	<u>CUSIP (a)</u>
2018	\$25,975,000	5.000%	0.840%	373385AW3
2019	45,710,000	5.000	0.950	373385AX1
2020	35,400,000	5.000	1.030	373385AY9
2021	48,210,000	5.000	1.120	373385AZ6
2022	16,700,000	5.000	1.230	373385BA0
2023	18,060,000	5.000	1.350	373385BB8
2024	19,495,000	5.000	1.450	373385BC6
2025	20,790,000	5.000	1.590	373385BD4
2026	22,220,000	5.000	1.750	373385BE2
2027	10,585,000	5.000	1.850	373385BF9
2028	27,035,000	5.000	1.960*	373385BG7
2029	28,495,000	5.000	2.060*	373385BH5
2030	29,955,000	5.000	2.140*	373385BJ1

\*Priced to July 1, 2027 optional redemption date.



# Recent Benchmark 5% NC-10 Yield Curve



## Process for Pricing 5% NC-10 Bonds

- Underwriter quotes spreads to benchmark (e.g. MMD)
  - *Sum of benchmark yields and spreads make up the issuer curve*
- Issuer 5% NC-10 yield curve converts to prices for various maturities



Maturity (yrs)	5% NC-10 Benchmark Yields (%)	Issuer Spreads (bps)	Issuer 5% NC-10 Yields (%)	Price (% par)
1	1.72	15	1.87	103.087
2	1.74	18	1.92	106.015
3	1.79	20	1.99	108.724
4	1.83	20	2.03	111.355
5	1.86	20	2.06	113.900
⋮	⋮	⋮	⋮	⋮
25	3.00	40	3.40	113.468
26	3.01	40	3.41	113.377
27	3.02	40	3.42	113.287
28	3.03	40	3.43	113.196
29	3.04	40	3.44	113.106
30	3.05	40	3.45	113.015



[What Makes the Muni Yield Curve Rise? – Journal of Fixed Income, Winter 2008](#)

[Creating a Live Yield Curve in the Illiquid Muni Market – Journal of Fixed Income, Summer 2017](#)

# Life Without Advance Refunding

- 2018 saw a 24% decline in issuance volume\*
  - *Effect of elimination of advance refunding*
  
- Impetus for structures with calls shorter than 10 years
  - *Issuers desire flexibility to capture interest rate savings sooner than 10 years*
  - *Primary market infrastructure wants action to compensate for loss in volume*
  
- With shorter calls, 5% coupon renders bond a short bullet
  - *Bond virtually certain to be called*
  - *So lower coupons make sense*
  
- Challenge: How to price, say, 4% NC-6
  - *5% NC-10 yields can't be used directly*
  - *Secondary market trades of similar bonds are unlikely to be useful*

\* *Bond Buyer*





**\$1,517,675,000**  
**STATE OF CALIFORNIA**  
**VARIOUS PURPOSE GENERAL OBLIGATION BONDS**  
**Base CUSIP<sup>†</sup>:13063D**

**From OS dated  
March 6, 2018**

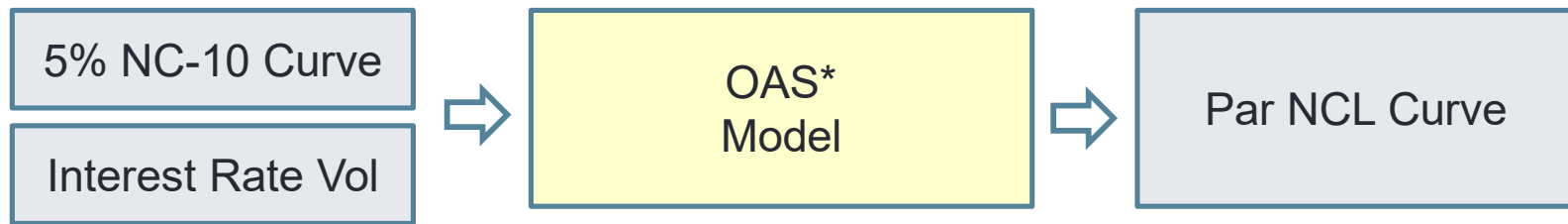
Maturity Date (October 1)	Principal Amount	Interest Rate	Price or Yield	CUSIP <sup>†</sup> Suffix
2018	\$ 50,000,000	3.000%	1.300%	EW4
2018	50,000,000	5.000	1.300	EX2
2019	50,000,000	2.000	1.430	EY0
2019	50,000,000	5.000	1.430	EZ7
2020	13,320,000	3.000	1.560	FB9
2020	86,680,000	5.000	1.560	FA1
2021	5,980,000	4.000	1.740	FC7
2021	94,020,000	5.000	1.740	FD5
2022	14,625,000	3.000	1.950	FE3
2022	85,375,000	5.000	1.950	FF0
2023	17,335,000	2.000	2.110	FG8
2023	82,665,000	5.000	2.110	FH6
2026	75,000,000	5.000	2.490 <sup>C</sup>	FJ2
2027	75,000,000	5.000	2.600 <sup>C</sup>	FK9
2032	50,000,000	3.000	97.750	FL7
2035	117,675,000	5.000	3.040 <sup>C</sup>	FM5
2039	50,000,000	4.000	3.500 <sup>C</sup>	FP8
2039	125,000,000	5.000	3.140 <sup>C</sup>	FN3
2039	125,000,000	5.250	3.060 <sup>C</sup>	FQ6
2047	100,255,000	3.625	3.720	FR4
2047	199,745,000	5.000	3.240 <sup>C</sup>	FS2

**Callable  
April 1, 2026**



# How to Calculate Fair Prices with Option-Based Analytics?

- ① Extract par optionless curve (NCL) from issuer 5% NC-10 yield curve  
*Iteratively solve for optionless rates that explain the prices of 5% NC-10 bonds*  
***Need appropriate interest rate volatility***



*\*Option-adjusted spread*



# Extracting the Issuer Par Non-Call Curve (15% Vol)

Maturity (yrs)	5% NC-10 Benchmark Yields (%)	Issuer Spreads (bps)	Issuer 5% NC-10 Yields (%)	Implied Issuer Par Non-Call Yields (%)
1	1.72	15	1.87	1.870
2	1.74	18	1.92	1.921
3	1.79	20	1.99	1.993
4	1.83	20	2.03	2.034
5	1.86	20	2.06	2.064
6	1.94	20	2.14	2.149
7	2.01	20	2.21	2.223
8	2.10	20	2.30	2.318
9	2.18	20	2.38	2.403
10	2.25	20	2.45	2.477
11	2.31	25	2.56	2.733
12	2.37	25	2.62	2.870



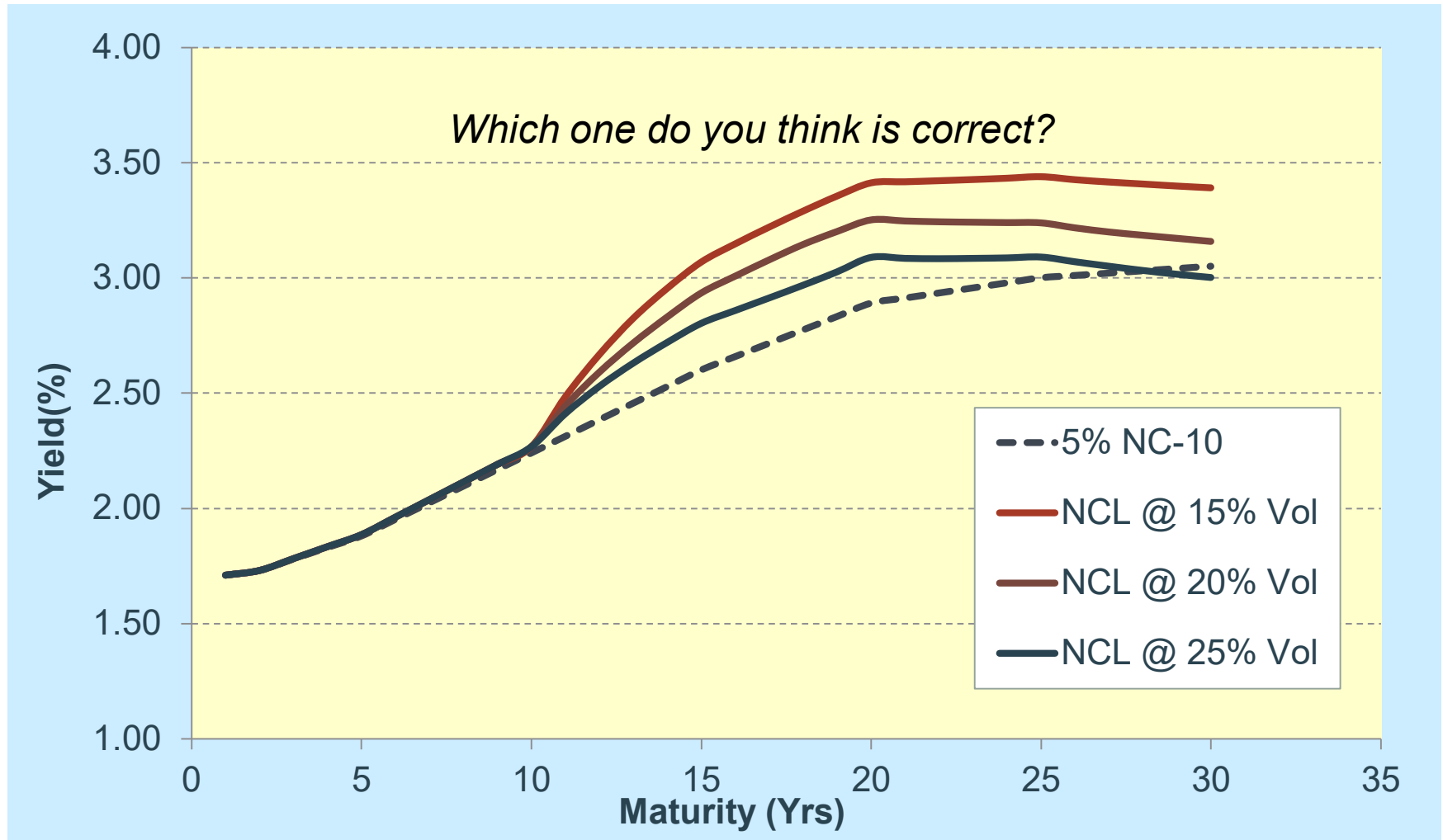
## But What's a Good Volatility?

- For agency bonds, swaption vols are the starting point
  - *Years to call and remaining maturity are factors*
- In the muni market, swaption vols are overkill
- Kalotay's research suggests that currently a single vol in the range of 15% - 16% would suffice
  - Analysis using *CurviLinear*\* software explains a large number of dealer bids

*\*Optimizer that simultaneously solves for par optionless curve and interest volatility that explain dealer prices with the least average price error*

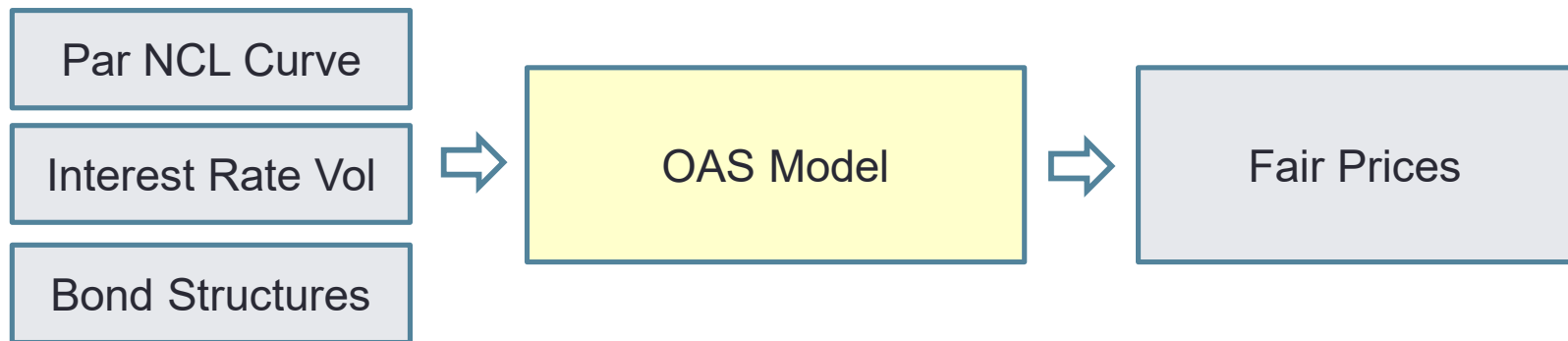


## Effect of Vol on Implied NCL Curve



## How to Calculate Fair Prices with Option-Based Analytics?

- 1 Extract par optionless curve (NCL) from issuer 5% NC-10 yield curve  
*Iteratively solve for optionless rates that explain the prices of 5% NC-10 bonds*
- 2 Option-based (OAS) model takes Par NCL curve and volatility as input and can price structures with any coupon and call feature



# Fair Prices of 4% NC-6 Bonds (15% Vol)

Maturity (yrs)	Implied Issuer Par Non-Call Yields (%)	Coupon (%)	Price (% par)	YTW (%)
1	1.870	4.000	102.100	1.870
2	1.921	4.000	104.062	1.920
3	1.993	4.000	105.823	1.991
4	2.034	4.000	107.527	2.031
5	2.064	4.000	109.165	2.061
6	2.149	4.000	110.404	2.143
7	2.223	4.000	110.329	2.156
8	2.318	4.000	110.175	2.182
9	2.403	4.000	110.007	2.210
10	2.477	4.000	109.834	2.239
11	2.733	4.000	108.929	2.393
12	2.870	4.000	108.305	2.501

Yields are to 6-Year Call



# Live Demo

- MuniCycle
  - <https://analytics.kalotay.com/municycle>





# How Does Vol Affect Price?

## Starting with 5% NC-10 Curve

***Price of Callable Bond = Value of Underlying Bullet – Value of Call Option***

- ① *Higher vol => Lower par NCL rates (slide 14) => Larger PV of underlying bullet*
- ② *Higher vol => Larger option value*

Effects go in opposite directions!



## How Does Vol Affect Price? (cont'd)

Structure	Interest Rate Vol (%)			
	10	15	20	25
5.00% 30NC-8	112.03	111.42	111.09	110.80
4.25% 30NC-8	101.75	102.44	102.56	102.35
3.00% 30NC-8	81.83	84.42	86.15	86.96

- 5s decrease with vol (option value increase dominates)
- 4.25s insensitive (effects offset)
- 3s increase with vol (bullet value increase dominates)
- Lower coupon bonds are more sensitive to vol – make sure you're comfortable with your implied 'optionless' rates



# Questions

## Live Demos

- MuniCycle <https://analytics.kalotay.com/municycle>
- BondOAS: <http://analytics.kalotay.com/realtimeagency/>
- MuniOAS: <http://analytics.kalotay.com/munianalyzer/>
- MuniSignal: <http://analytics.kalotay.com/munisignal/>

**Blog:** [www.kalotay.com/blog](http://www.kalotay.com/blog)

**Brochures:** [Fixed Income Coverage](#)  
[Municipal Markets Coverage](#)

- Leslie Abreo [leslie.abreo@kalotay.com](mailto:leslie.abreo@kalotay.com)
- Radek Wyrwas [radek@kalotay.com](mailto:radek@kalotay.com)
- Mike Palmieri [mpalmieri@kalotay.com](mailto:mpalmieri@kalotay.com)
- Tel +1 (212) 482-0900

Follow us on



[www.kalotay.com](http://www.kalotay.com)

