



# Evolution of Technology in the Bond Markets

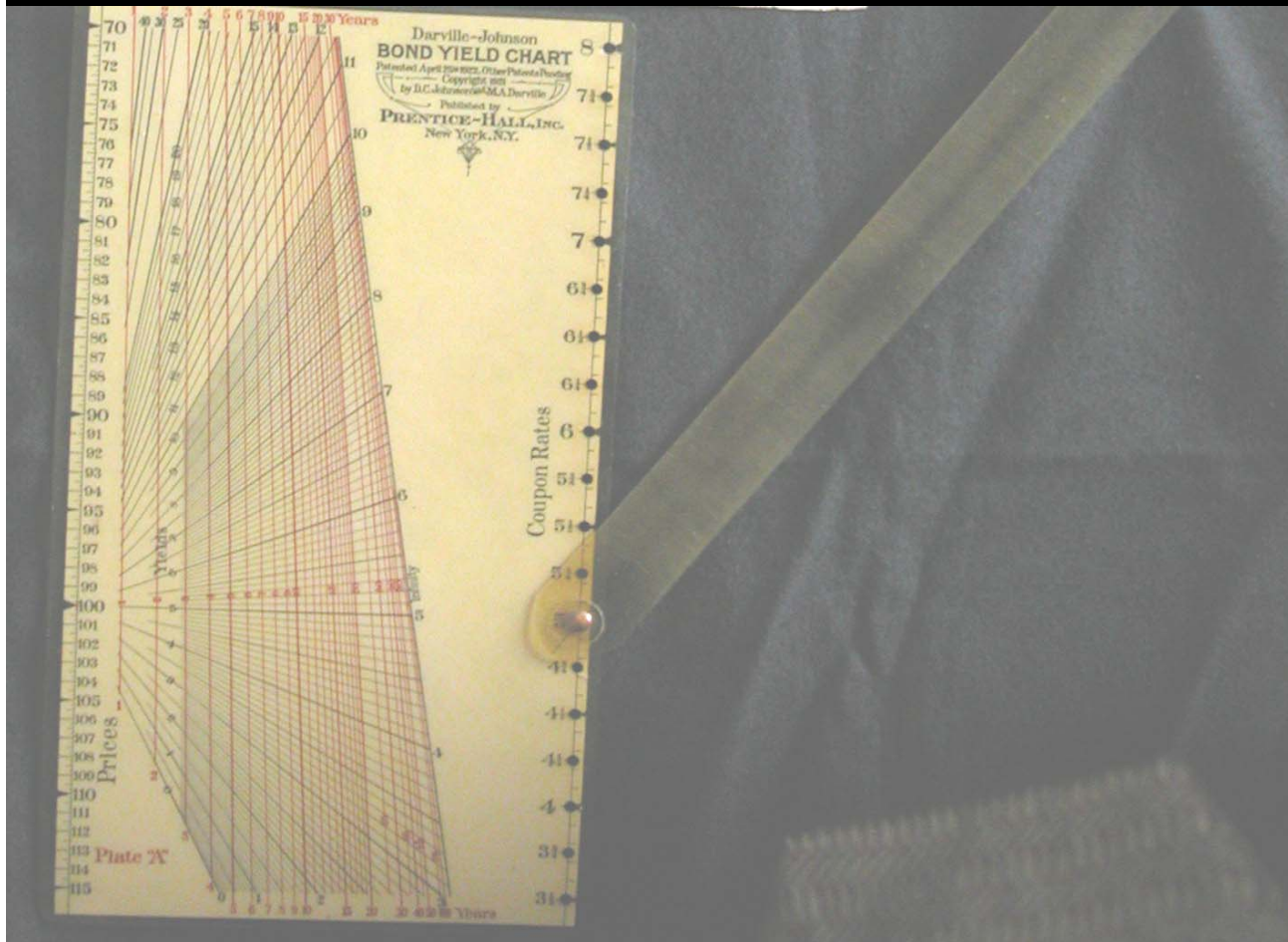
BMA Annual Meeting  
April 10, 2003

# Bond Math Requires Technology

- Conventional price/yield conversion
  - Needed since the advent of bonds
- Contemporary option-adjusted valuation
  - In use since the mid-80's
  - For transactions, portfolio analysis and risk management
- What lies ahead?

# Darville-Johnson Bond Yield Chart: "Slide Rule" of the Bond Markets

Copyright 1921 Patent 1922



# Darville-Johnson Bond Yield Chart User Manual

## *What the BOND YIELD CHART Enables You To Do*

THE DARVILLE-JOHNSON BOND YIELD CHART is a unique invention which has proved in practice to be especially rapid and accurate in the computation of bond yields. Among its many advantages are the following :

The Chart is *accurate* in that yields to the nearest 1/100 of 1% for usual problems are immediately read, without pro-rating or other computation as at present required.

The Chart is *comprehensive* in that an unusually wide range in prices, coupon rates, yields and maturities is given, including all yields from 0 to over 40%, all maturities to infinity, and all the usual coupon rates, as well as odd rates such as 3.65%, 4.375% and the like.

The yields for *split maturities* (such as 4 years and 1 month) are immediately ascertained without computation.

*Stock yields* (or the current rate of return of bonds) to the nearest 1/100 of 1% are read simultaneously with bond yields.

The yields of so-called *premium bonds* (those having a repayment value at maturity greater than their face amount) to the nearest 1/100 of 1% are quickly found. This problem is much more complicated when solved by other practical methods which give less accurate results.

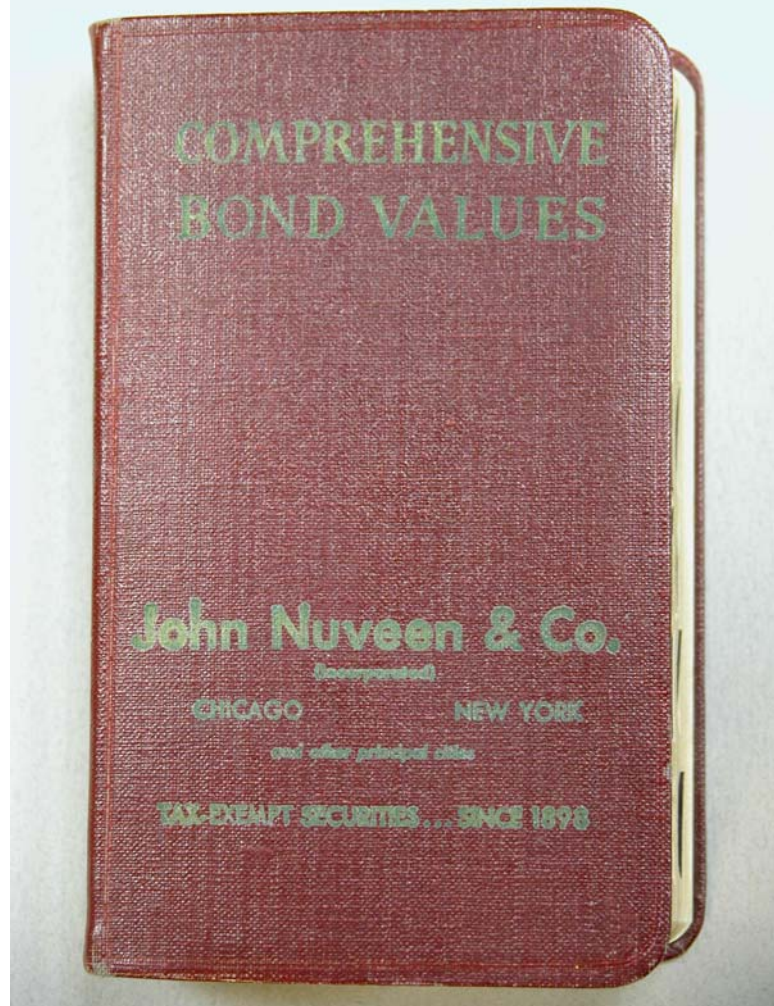
The *speed* with which yields are obtained as shown by actual tests is considerably greater than by other methods, due in large part to the fact that all problems are answered on the one chart without the necessity of referring to different books, turning many pages and pro-rating between prices and maturities.

*The established theory of valuing bonds has not been changed but the equations employed have been put in simple graphic form.*

That the Chart is *practical and convenient* is evidenced by the many important uses to which it has been put since 1920.

# Pocket Yield Book: Every Bond Trader's Companion

First Published 1936



# Early Yield Book Table

Capped at 6%

							6%
1Y <sup>3</sup> <sub>RS</sub> <sup>MOS</sup>	1Y <sup>4</sup> <sub>RS</sub> <sup>MOS</sup>	1Y <sup>5</sup> <sub>RS</sub> <sup>MOS</sup>	1Y <sup>6</sup> <sub>RS</sub> <sup>MOS</sup>	1Y <sup>7</sup> <sub>RS</sub> <sup>MOS</sup>	1Y <sup>8</sup> <sub>RS</sub> <sup>MOS</sup>	1Y <sup>9</sup> <sub>RS</sub> <sup>MOS</sup>	
103.65	103.89	104.13	104.37	104.60	104.84	105.07	
103.59	103.82	104.06	104.29	104.52	104.75	104.98	
103.52	103.75	103.99	104.22	104.44	104.67	104.90	
103.46	103.69	103.92	104.14	104.37	104.59	104.81	
103.40	103.62	103.84	104.07	104.29	104.50	104.72	
103.34	103.55	103.77	103.99	104.21	104.42	104.64	
103.27	103.49	103.70	103.92	104.13	104.34	104.55	
103.21	103.42	103.63	103.85	104.05	104.26	104.46	
103.15	103.36	103.56	103.77	103.97	104.17	104.37	
103.09	103.29	103.49	103.70	103.89	104.09	104.29	
103.03	103.22	103.42	103.62	103.81	104.01	104.20	
102.96	103.16	103.35	103.55	103.74	103.93	104.12	
102.90	103.09	103.28	103.47	103.66	103.84	104.03	
102.84	103.03	103.21	103.40	103.58	103.76	103.94	
102.78	102.96	103.14	103.33	103.50	103.68	103.86	
102.72	102.89	103.07	103.25	103.42	103.60	103.77	
102.65	102.83	103.00	103.18	103.35	103.51	103.68	
102.59	102.76	102.93	103.10	103.27	103.43	103.60	
102.53	102.70	102.86	103.03	103.19	103.35	103.51	
102.47	102.63	102.79	102.96	103.11	103.27	103.43	
102.41	102.57	102.72	102.88	103.03	103.19	103.34	
102.35	102.50	102.65	102.81	102.96	103.11	103.26	
102.28	102.43	102.59	102.74	102.88	103.02	103.17	
102.22	102.37	102.52	102.66	102.80	102.94	103.08	
102.16	102.30	102.45	102.59	102.73	102.86	103.00	
102.10	102.24	102.38	102.52	102.65	102.78	102.91	
102.04	102.17	102.31	102.44	102.57	102.70	102.83	
1.98	102.11	102.24	102.37	102.49	102.62	102.74	
1.92	102.04	102.17	102.30	102.42	102.54	102.66	
1.86	101.98	102.10	102.23	102.34	102.46	102.57	
1.80	101.91	102.03	102.15	102.26	102.38	102.49	
1.73	101.85	101.96	102.08	102.19	102.29	102.40	
1.67	101.78	101.89	102.01	102.11	102.21	102.32	
1.61	101.72	101.83	101.93	102.03	102.13	102.24	
1.55	101.65	101.76	101.86	101.96	102.05	102.15	
1.49	101.59	101.69	101.79	101.88	101.97	102.07	



# Monroe 1272

## First Electronic Bond Yield Calculator

**1971      \$1,995      15 secs/bond**





# Monroe Trader Still in use

1976 Design

Released 1979

\$1,200



# HP 80: The First Handheld Financial Calculator

Introduced 1973

Discontinued 1978

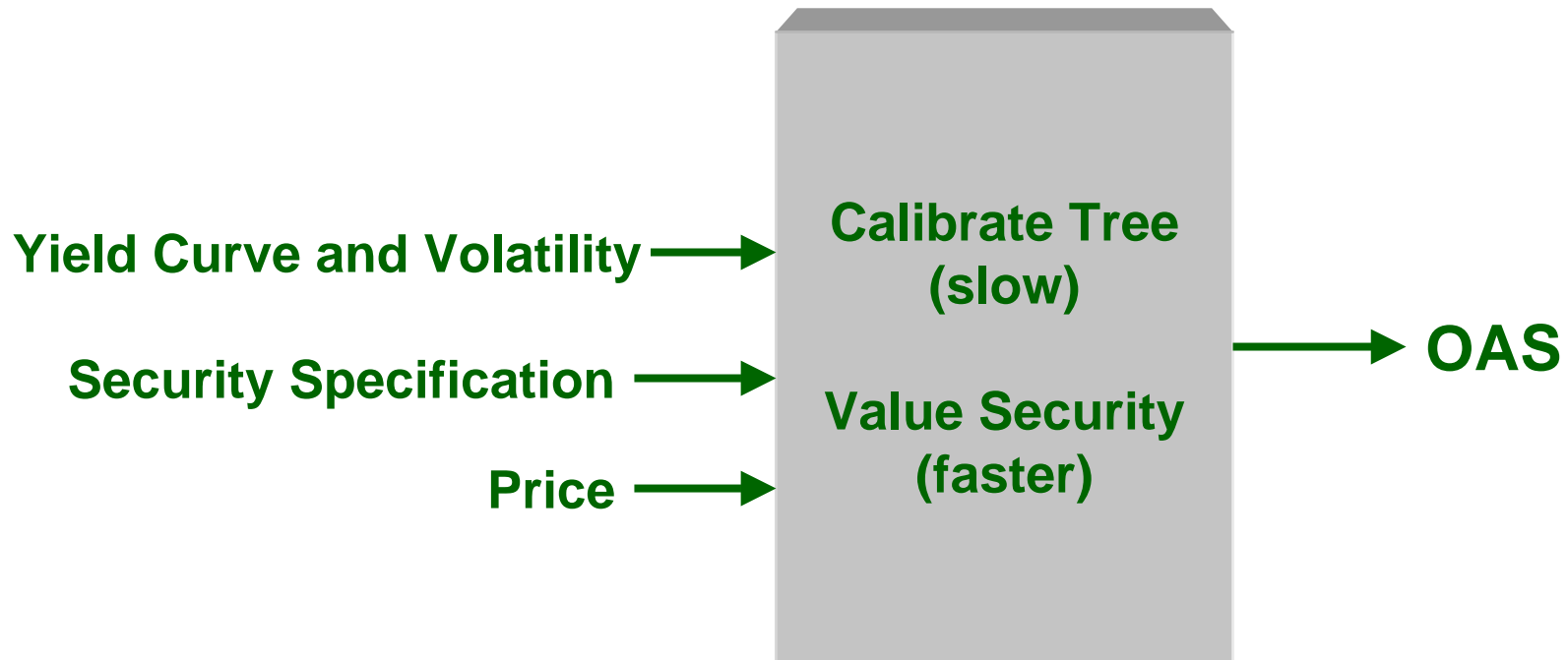
\$395



# Price-Yield Conversion Today: Speed Exceeds Need

- An \$800 PC can compute 60,000 yields per second using TIPS software

# OAS-based Valuation Introduced in 1986



# Bond Valuation Can Deliver Instant Gratification ...

	1990	2003
Processor	386	2.0 GHz Pentium
Calibration of lattice	Up to 4 hours	Under 1/100 <sup>th</sup> of a second
Calculation of fair value	Several seconds	Instantaneous

... but poor implementation  
and bad interface design are common

# Fast Analytics and Internet Data Streaming Make Real-Time Pricing A Reality

## Valuation of 10,478 Agency Bonds in 28 seconds

Real Time Analysis of U.S. Agency Bonds: Home

As of: 04/02/2003 15:33 EST

Analytics provided by Andrew Kalotay Associates, Inc.

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User: leslie

Treasury Benchmarks 04/02/2003 15:33 EST  
2Y 1.625 03/05 1.566 5Y 3.000 02/08 2.830 10Y 3.875 02/13 3.919 30Y 5.375 02/31 4.914

Agency Summary							
Agency	No. of Issues	Amt O/S (\$bn)	Avg. Coupon	Avg. Maturity	Avg. Price	Effective Duration	Option Value (\$MM)
Fannie Mae	1,797	500.4	4.947	4.88	105.334	3.16	6,807
Freddie Mac	1,626	399.0	4.762	4.88	103.963	3.24	5,951
Federal Home Loan Banks	6,014	432.3	4.221	3.16	103.096	1.80	7,760
Federal Farm Credit Banks	810	50.2	4.179	3.23	103.605	2.16	582
Sallie Mae	108	16.1	3.572	1.26	102.623	1.14	7
Farmer Mac	51	1.1	5.715	4.92	109.695	3.94	9
Tennessee Valley Authority	66	19.3	6.124	17.65	111.799	7.33	383
<i>All Agencies Now</i>	10,472	1,418.4	4.647	4.43	104.266	2.78	21,499
<i>3 Minutes Ago</i>	10,472	1,418.4	4.647	4.43	104.263	2.78	21,484
<i>Previous Close</i>	10,478	1,418.6	4.647	4.43	104.543	2.74	22,939

For detail and "what-if" analysis, click on CUSIP or [SEARCH](#) U.S. Agency Bond database

Active Issues										
CUSIP	Issuer	Coupon (%)	Maturity	Amt O/S (\$MM)	Price	Effective Dur. (yrs)	OAS@14% vol to Trsy(bp)	YTM (%)	Spread bps	Spread Bmrk
31359MMU4	FNMA	3.625	04/15/04	5,000	102-10	1.00	-5.6	1.365	-20.6	2Y
31359MNG4	FNMA	3.000	06/15/04	6,000	101-26+	1.17	1.0	1.456	-11.5	2Y
31359MQJ5	FNMA	1.875	12/15/04	4,000	100-08	1.66	20.5	1.727	15.6	2Y
31359MNV5*	FNMA	3.125	08/15/05	3,500	100-23	0.37	6.6	1.186	YTC -38.5	2Y
31359MPT4	FNMA	2.875	10/15/05	5,000	101-19+	2.42	43.1	2.220	64.9	2Y
31359MPV9*	FNMA	2.750	11/14/05	2,000	100-19	1.09	51.2	1.777	YTC 20.6	2Y
31359MQF3*	FNMA	2.750	12/16/05	2,000	100-18+	1.37	54.1	1.926	YTC 35.5	2Y
31359MQZ9	FNMA	2.125	04/15/06	4,000	98-25+	2.93	53.6	2.540	-28.4	5Y

# On-the-Fly Analysis and Execution

- BMA formula for callable agency bonds (2003) on the Bloomberg
  - Black '76 formula and volatility skew adjustment applied to real-time issuer-specific yield curve and swaption volatility
- Reverse inquiries for callable agency bonds
  - Structuring a cancelable swap based on live market inputs to achieve desired sub-LIBOR funding

# Computer Technology is Both a Blessing and a Curse

- **Instant gratification**
  - Real-time market data and analysis
- **Intellectual laziness**
  - Overuse of intrinsically imprecise Monte Carlo simulation
- **Complexity for its own sake**
  - Technology accommodates complicated derivatives of questionable usefulness



# Emergence of Richer Models Will Drive Future Technology

- **Tax-exempt bonds**
  - Pre-refunding option benefits both issuer and investor
- **Corporate bonds**
  - Repurchase of premium bonds creates value for taxable issuers
- **Mortgage-backed securities**
  - Refinancing can benefit both mortgagor and MBS investor

*Non-zero-sum feature not captured by today's models*