



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

QUANTITATIVE INVESTMENT MANAGEMENT

LECTURE 15

Z Spread & Option Adjusted Spread (OAS)

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Z-SPREAD & OAS



Z-SPREAD & OAS

- There are three sources that create uncertainty in the cash flows from investment in a bond.
- Possibility of default by the issuer in payment of interest & principal for straight risky bonds (credit risk).
- In the case of option embedded bonds, there is the additional possibility of exercise of option (option risk).
- Changes in interest rates and hence bond prices (interest rate risk).
- The first source of risk is captured by the Z-spread and the second source by the OAS.

ZERO-VOLATILITY SPREADS

- **G- spread essentially involves comparing the YTM of the given bond with the YTM of a G-bond with corresponding maturity.**
- **YTM is a single number that captures the entire term structure of interest rates.**
- **Thus, G-spread assumes that the spot yield curve is flat so that yields are approximately the same across maturities.**
- **Normally, however, the spot yield curve is upward-sloping (i.e., longer-term yields are higher than shorter-term yields).**



- In the Z spread or zero volatility spread, we add an equal amount to each benchmark spot rate and value the bond with those rates.
- When we find an amount which, when added to the benchmark spot rates, produces a value **equal to the market price of the bond**, we have the appropriate yield curve spread.
- $$P_0 = \sum_{t=1}^T \frac{C_t}{(1 + S_{B,0t} + \delta)^t}$$
- Thus, Z-spread **accounts for the shape of the yield curve.**

OPTION ADJUSTED SPREAD



OPTION ADJUSTED SPREADS

- An option-adjusted spread (OAS) is used for bonds with embedded options.
- The option-adjusted spread takes the option yield component out of the Z-spread measure.
- The OAS is the spread to the government spot rate curve that the bond would have if the risk on account of option exercise is removed.
- This is done by taking account of the option payoffs at each node of the tree.



- The OAS is added to the tree after the adjustment for the embedded option (i.e., the node values are adjusted according to the call/put rule).
- Hence the OAS is calculated after the option risk has been removed.
- Thus, the OAS accounts only for the credit/liquidity risk of the bond.

- The Z spread relates the current market price of the bond to the bond cash flows for straight bonds.
- The OAS is based on the current market price.
- It assumes that the option has been exercised wherever it happens to be in the money.

- The term *zero volatility* in the Z-spread refers to the assumption of zero interest rate volatility.
- Z-spread is not appropriate to use to value bonds with embedded options.
- Without any interest rate volatility options are meaningless.

- **If we ignore the embedded option payoffs for a bond having option features and estimate the Z-spread, the estimated Z-spread will include the cost of the embedded option (i.e., it will reflect compensation for option risk as well as compensation for credit and liquidity risk).**

OAS (CALLABLE BONDS)

- For a callable bond, because the investor is short in the call, the callable bond price is less than the equivalent straight bond price.
- Thus, the yield on the callable bond exceeds the yield on the corresponding straight bond.
- The excess yield compensates the investor for the call option exercise risk.
- If we calculate an OAS for the callable bond i.e. after the option is exercised where it is in the money so that the option risk is eliminated, it will be **less** than the bond's Z-spread that includes option risk.

- The Z-spread essentially ignores the call option payoffs, so the cash flows at the nodes where the call is in the money will be **HIGHER** than the cash flows considered for OAS which will be after the call exercise at these nodes.
- If both spreads relate to the same market price, it means that the Z-spread for callable bonds will be higher than the OAS for such bonds.

- The difference is the extra yield required to compensate bondholders for the call option.
- That extra yield is the option value.
- Thus, we can write:
- $\text{Option value} = \text{Z-spread} - \text{OAS}$
- $\text{OAS} = \text{Z-spread} - \text{Option value}$
- For example, if a callable bond has a Z-spread of 180 bp and the value of the call option is 60 bp, the bond's OAS is $180 - 60 = 120$ bp.

Z SPREAD & OAS: INTERPRETATION

- The Z Spread is the constant spread above the treasury curve that compensates the bond holder for credit, liquidity and option risk.
- The Option Adjusted Spread is simply the spread excluding the spread to compensate for the option risk.
- Thus, the OAS is the spread above the treasury curve that compensates for credit and liquidity risk only.



CALCULATION OF OPTION- ADJUSTED SPREAD



CALCULATION OF OPTION-ADJUSTED SPREAD WITH THE BINOMIAL MODEL

- So far our backward induction process has relied on the risk-free binomial interest rate tree; our valuation assumed that the underlying bond was riskfree.**
- If risk-free rates are used to discount cash flows of a credit risky corporate bond, the calculated value will be too high.**



- To correct for this, a constant spread must be added to all one-period rates in the tree such that the calculated value equals the market price of the risky bond. Let this be (δ) .
- This constant spread (δ) is called the Z-spread.
- PLEASE NOTE THAT NO OPTION PAYOFFS ARE TAKEN INTO ACCOUNT WHEN WE WORK OUT THE Z-SPREAD FOR OPTION EMBEDDED BONDS.
- In fact, Z Spread is not the appropriate measure for option embedded bonds.

- To calculate the OAS in the case of option embedded bonds, option payoffs are considered at each node where the option is in the money and the spread from the riskfree rate is calculated also considering the option payoffs. Let this be (θ) .
- Then, (θ) is the option adjusted spread.

EXAMPLE

A \$100-par, three-year, 6% annual-pay ABC Inc. callable bond trades at \$99.95.

The underlying call option is a Bermudan-style option that can be exercised in one or two years at par.

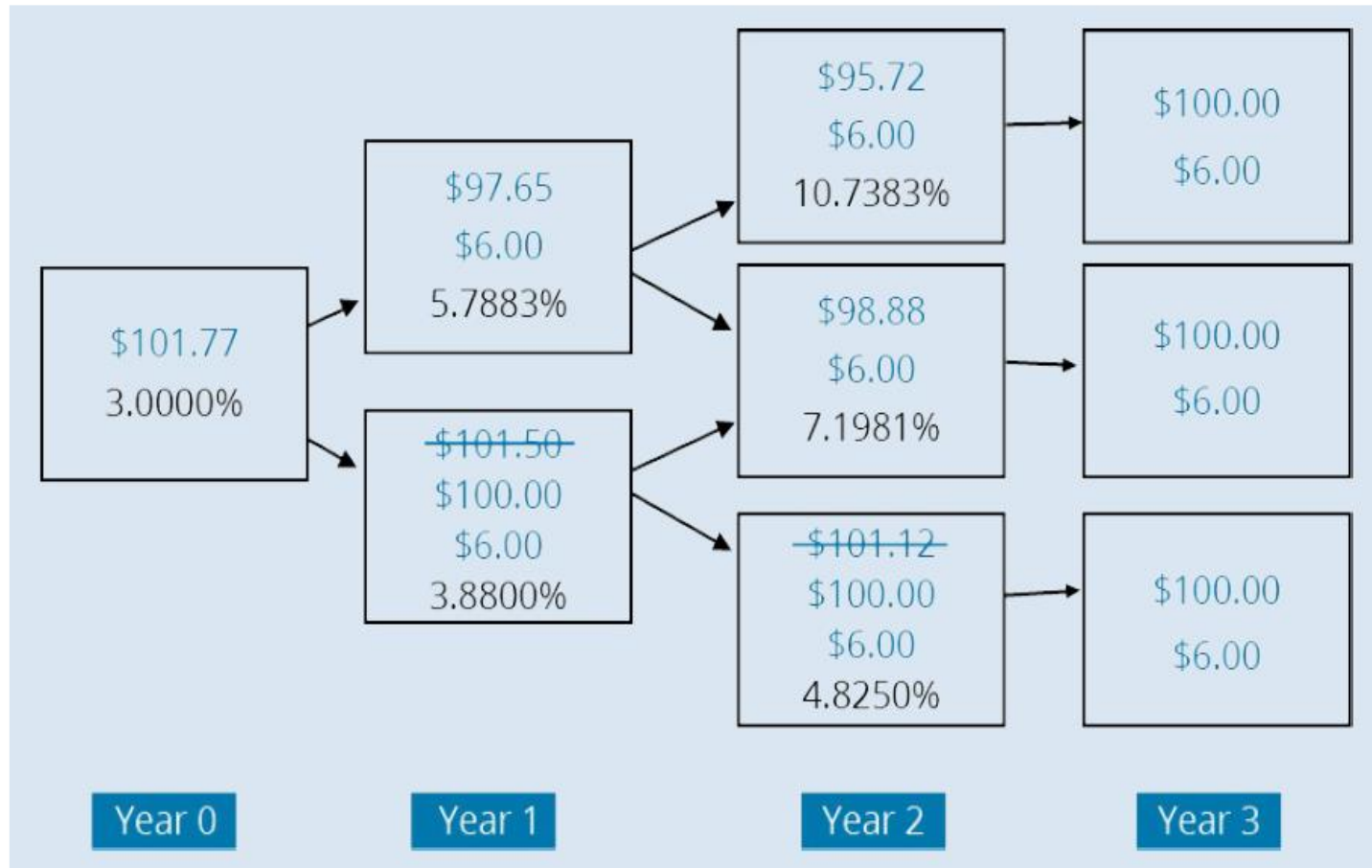
The benchmark interest rate tree assuming volatility of 20% is provided. Calculate OAS.

ONE-PERIOD FORWARD RATES

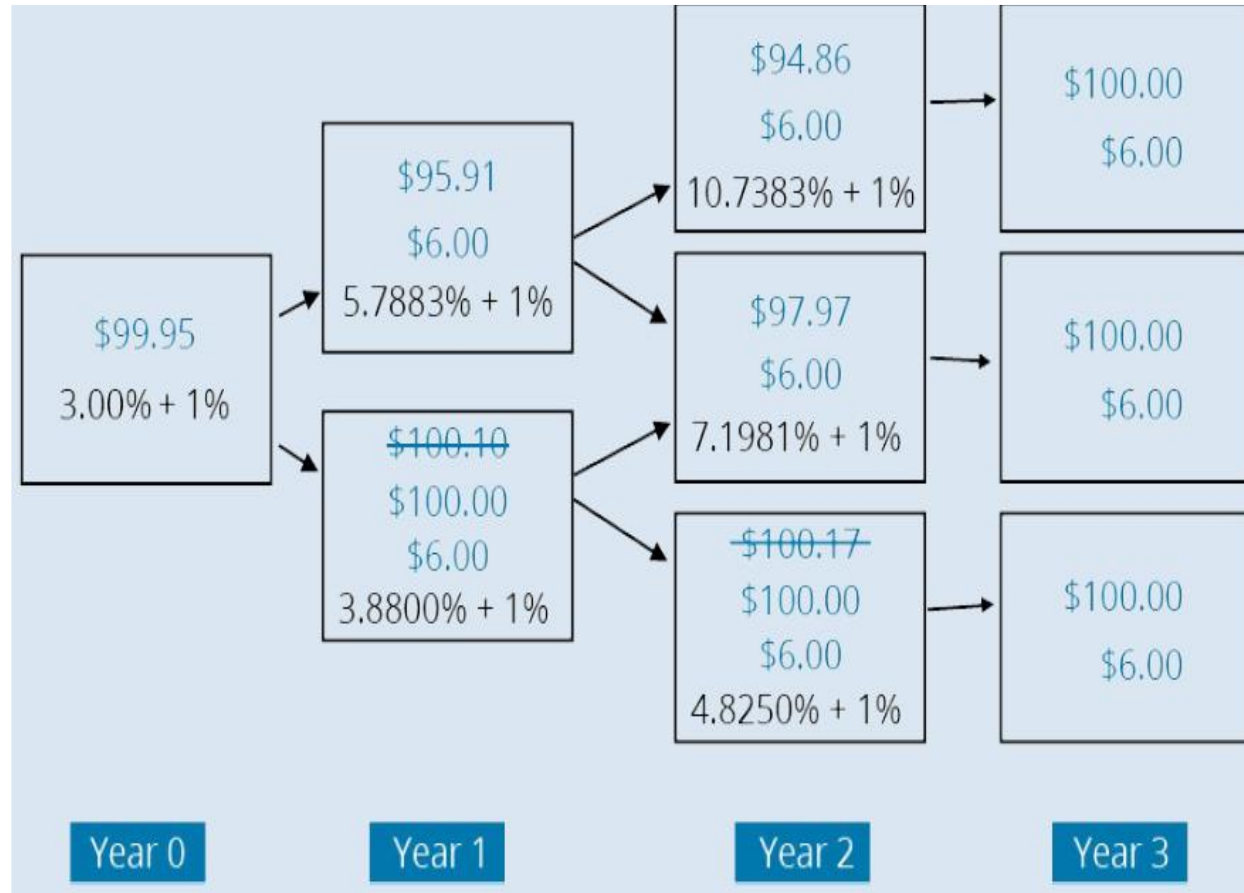
Yr 0 (%)	Yr 1(%)	Yr 2(%)
3.000%	5.7883	10.7383
	3.8800	7.1981
		4.8250

SOLUTION

The value of the bond using the benchmark interest rate tree and considering call payoffs is \$101.77, as shown.



To force the computed value to be equal to the current market price of \$99.95, a constant spread (OAS) of 100 bps is added to each interest rate in the tree as shown. Hence, OAS=100bp



APPLICATIONS OF OAS

- Consider the difference between:
- the calculated value of a bond that we obtain from a tree using riskfree rates & option payoffs and
- the bond's actual market price.
- The greater this difference is, the greater the OAS we would need to add to the rates in the tree to force the calculated bond value down to the market price.
- The greater would be the riskiness of the bond.

- **OAS is used by analysts in relative valuation; bonds with similar credit risk should have the same OAS.**
- **If the OAS for a bond is higher than the OAS of its peers, it is considered to be undervalued and hence an attractive investment (i.e., it offers a higher compensation for a given level of risk).**
- **Conversely, bonds with low OAS (relative to peers) are considered to be overvalued.**