Municipal bonds (munis) are debt securities issued by state and local governments, as well as public entities, to fund public projects and initiatives. They can be classified based on their structure, use case, and revenue source

**1. General Obligation (GO) Bonds**

* **Use Case:** These are backed by the full faith and credit of the issuing municipality and repaid through general taxation.
* **Subtypes:**
  + **Limited-Tax GO Bonds** – Subject to a legal limit on tax rates.
  + **Unlimited-Tax GO Bonds** – Allow the issuer to levy taxes without limits to cover debt service.
* **General Use Cases:**
  + Schools
  + Infrastructure (roads, bridges, government buildings)
  + Public safety (fire, police, emergency services)
* **Special Use Cases:**
  + Disaster relief and emergency funding

**2. Revenue Bonds**

* **Use Case:** Repaid using revenue from specific projects rather than taxation.
* **Subtypes & Use Cases:**
  + **Transportation Bonds** – Fund toll roads, bridges, airports, and transit systems.
  + **Utility Bonds** – Finance water, sewer, and electric utility projects.
  + **Health Care Bonds** – Fund hospitals and health-related facilities.
  + **Higher Education Bonds** – Finance colleges and universities.
  + **Housing Bonds** – Fund affordable housing projects.

**8. Variable-Rate and Floating-Rate Bonds**

* **Use Case:** Have interest rates that adjust periodically.
* **Subtypes & Use Cases:**
  + **Variable-Rate Demand Obligations (VRDOs)** – Interest resets frequently, allowing investors to put the bond back to the issuer.
  + **Floating-Rate Notes (FRNs)** – Adjust interest based on a benchmark like LIBOR/SOFR.
* **Special Use Cases:**
  + Protecting against interest rate fluctuations.

**10. Refunding Bonds**

* **Use Case:** Used to refinance older bonds at lower rates.
* **Subtypes & Use Cases:**
  + **Current Refunding Bonds** – Replace an old bond with a new one immediately.
  + **Advance Refunding Bonds** – Issued to prepay an existing bond before maturity.
* **Special Use Cases:**
  + Reducing debt service costs.

Below is a detailed breakdown of the different types of **municipal bonds (munis)** based on their **interest rate structures, call/put features, and tax treatment**.

**1. Interest Rate Structures**

Municipal bonds come in different rate structures that affect their risk and return profile.

**a) Fixed-Rate Bonds**

* **Definition:** The most common type of muni bond where the interest rate (coupon) remains constant throughout the bond's life.
* **Advantages:**
  + Predictable income for investors.
  + Less exposure to interest rate fluctuations.
* **Disadvantages:**
  + If interest rates rise, fixed-rate bonds lose market value.
* **Use Cases:**
  + General Obligation (GO) bonds.
  + Revenue bonds for long-term infrastructure projects.

**b) Floating-Rate Bonds (FRNs)**

* **Definition:** The interest rate periodically resets based on a benchmark (e.g., SOFR, LIBOR, or an index like CPI).
* **Advantages:**
  + Protects investors from rising interest rates.
  + Provides flexibility in uncertain interest rate environments.
* **Disadvantages:**
  + Lower initial yields compared to fixed-rate bonds.
  + Potential volatility in interest payments.
* **Use Cases:**
  + Short-term financing.
  + Municipal revenue bonds linked to inflation-sensitive projects.

**c) Variable-Rate Demand Obligations (VRDOs)**

* **Definition:** A type of floating-rate bond where interest resets frequently (weekly, monthly) and bondholders can "put" the bond back to the issuer at specific intervals.
* **Advantages:**
  + Provides liquidity to investors.
  + Issuers may benefit from lower short-term interest rates.
* **Disadvantages:**
  + Risk of interest rate spikes.
  + Dependence on credit enhancement (like letters of credit).
* **Use Cases:**
  + Short-term municipal financing.
  + Bonds with demand features for investors who need liquidity.

**2. Callable vs. Puttable vs. Called Bonds**

These features determine how a bond can be redeemed before maturity.

**a) Callable Bonds**

* **Definition:** Bonds that allow the issuer to redeem them before their maturity date, typically after a specific "call date."
* **Why Issuers Use Them:**
  + If interest rates drop, issuers can refinance at lower rates.
* **Impact on Investors:**
  + Investors may lose out on expected interest payments.
  + Callable bonds often offer higher yields to compensate for early redemption risk.
* **Use Cases:**
  + Refinancing high-interest muni debt.
  + Infrastructure financing that allows early paydown.

**b) Puttable Bonds**

* **Definition:** Bonds that allow the **investor** to sell them back (put) to the issuer before maturity at predetermined dates.
* **Why Investors Use Them:**
  + Provides liquidity if interest rates rise.
* **Impact on Issuers:**
  + Must be prepared to buy back bonds if investors exercise the put option.
* **Use Cases:**
  + Suitable for risk-averse investors who want flexibility.
  + VRDOs often have put features.

**c) Called Bonds**

* **Definition:** A callable bond that the issuer has actually redeemed before maturity.
* **Investor Impact:**
  + Bondholders receive their principal back early but must reinvest at prevailing rates, which may be lower.
* **Use Cases:**
  + Common when interest rates decline.

**3. Taxable vs. Tax-Exempt Munis**

The tax treatment of a muni bond determines its attractiveness to different investors.

**a) Tax-Exempt Municipal Bonds**

* **Definition:** The most common type of muni, where **interest payments are exempt from federal taxes** and sometimes **state and local taxes** (if the investor lives in the issuing state).
* **Advantages:**
  + Higher after-tax returns for investors in high tax brackets.
* **Disadvantages:**
  + Generally offer lower yields than taxable bonds.
* **Use Cases:**
  + Public infrastructure projects (roads, bridges, schools, hospitals).
  + Essential government services.

**b) Taxable Municipal Bonds**

* **Definition:** Bonds issued by municipalities that **do not qualify for tax-exempt status** due to the nature of the project being funded.
* **Advantages:**
  + Attracts a broader investor base (including foreign investors who don’t benefit from U.S. tax exemptions).
* **Disadvantages:**
  + Interest income is subject to federal income tax.
* **Use Cases:**
  + **Build America Bonds (BABs):** Introduced in 2009 to stimulate the economy by offering federal subsidies to taxable municipal bonds.
  + **Pension Obligation Bonds (POBs):** Used to fund municipal pension liabilities.
  + **Sports stadium financing.**

**Key Takeaways for VVVV**

1. **Interest Rate Sensitivity:**
   * Fixed-rate munis are best for long-term investors seeking stability.
   * Floating and variable-rate munis provide flexibility in changing interest rate environments.
2. **Liquidity Considerations:**
   * Puttable bonds and VRDOs offer liquidity to investors.
   * Callable bonds favor issuers but may disadvantage investors.
3. **Taxation Strategy:**
   * High-net-worth individuals prefer tax-exempt munis for tax efficiency.
   * Taxable munis attract institutional investors and foreign buyers.

Impact of Municipal Bond Structures on Pricing & Risk Analytics in VVVV

**1. Fixed-Rate Munis: Pricing & Risk Considerations**

* **Pricing Model:** Discounted cash flow (DCF) approach using a fixed yield.
* **Key Risks:**
  + **Interest Rate Risk:** Prices decline when rates rise.
  + **Duration & Convexity:** Longer-duration bonds are more sensitive to rate changes.
  + **Credit Risk:** Assessed via credit ratings and spread analysis.
* **VVVV Analytics Considerations:**
  + Yield curve fitting using municipal yield curves (e.g., Bloomberg BVAL).
  + Tracking benchmark spreads vs. U.S. Treasuries or AAA Muni Index.

**How VVVV Handles It:**

* Computes present value of future cash flows discounted at appropriate yield.
* Monitors changes in credit spreads and municipal yield curve slopes.
* Provides risk metrics such as **DV01, Modified Duration, and Convexity**.

**2. Floating-Rate & Variable-Rate Munis: Pricing & Risk Considerations**

* **Pricing Model:** Valued based on **benchmark rate + spread** (SOFR, LIBOR, SIFMA).
* **Key Risks:**
  + **Interest Rate Volatility:** Cash flows change with market rates.
  + **Liquidity Risk:** VRDOs depend on remarketing agents or liquidity facilities.
* **VVVV Analytics Considerations:**
  + Model coupon resets using **stochastic interest rate models** (e.g., Hull-White).
  + Adjust pricing for **market liquidity risk premiums**.
  + Perform **Monte Carlo simulations** for rate path dependency.

**How VVVV Handles It:**

* Prices FRNs using an interest rate term structure model.
* Incorporates market swap rates and **volatility surface analysis**.
* Evaluates impact of rate movements on expected returns and reinvestment risk.

**3. Callable Munis: Pricing & Risk Considerations**

* **Pricing Model:** Uses **binomial or trinomial trees** for early exercise scenarios.
* **Key Risks:**
  + **Reinvestment Risk:** If called, investors must reinvest at lower rates.
  + **Yield-to-Worst (YTW):** Must calculate yield assuming the earliest call date.
  + **Implied Volatility Sensitivity:** Higher volatility increases call probability.
* **VVVV Analytics Considerations:**
  + **OAS (Option-Adjusted Spread) modeling** to account for call risk.
  + **Scenario analysis for early redemption probabilities**.
  + **Yield curve interpolation for call date pricing**.

**How VVVV Handles It:**

* Uses a **callable bond pricing model** (e.g., Black-Derman-Toy) to adjust for embedded optionality.
* Evaluates call risk based on current and historical **municipal market volatilities**.
* Computes **effective duration vs. modified duration** to measure sensitivity with call adjustments.

**4. Puttable Munis: Pricing & Risk Considerations**

* **Pricing Model:** Uses an **American-style put option pricing model**.
* **Key Risks:**
  + **Liquidity Risk for Issuers:** Investors may redeem bonds in unfavorable market conditions.
  + **Yield Floor Considerations:** Investors are protected from rising yields.
* **VVVV Analytics Considerations:**
  + **Scenario-based stress testing** for puttable bonds.
  + **Put option valuation using risk-neutral probabilities**.
  + **Estimating expected holding period return (HPR) under different put scenarios**.

**How VVVV Handles It:**

* Incorporates **put convexity adjustments** in pricing models.
* Uses **Cox-Ingersoll-Ross (CIR) or Black-Karasinski models** for rate-dependent put valuation.
* Provides **implied put spread analysis** for market mispricing detection.

**5. Taxable vs. Tax-Exempt Munis: Pricing & Risk Considerations**

* **Pricing Model:** Tax-exempt bonds require **tax-equivalent yield (TEY)** adjustments.
* **Key Risks:**
  + **Yield Differentials:** Taxable munis must offer higher yields than tax-exempt munis.
  + **Liquidity & Demand Differences:** Institutional vs. retail investor base.
  + **Tax Policy Risks:** Changes in tax laws can affect relative attractiveness.
* **VVVV Analytics Considerations:**
  + **TEY calculation:** Adjusting yields based on investor tax brackets.
  + **Yield curve construction:** Separating taxable and tax-exempt curves.
  + **Relative value analysis vs. corporate bonds and U.S. Treasuries**.

**How VVVV Handles It:**

* Computes **Tax-Equivalent Yield (TEY)** using: TEY=Tax-Exempt Yield1−Tax RateTEY = \frac{\text{Tax-Exempt Yield}}{1 - \text{Tax Rate}}TEY=1−Tax RateTax-Exempt Yield​
* Provides **spread analytics** comparing tax-exempt munis vs. Treasuries and investment-grade corporates.
* Monitors **historical spread trends** to detect arbitrage opportunities.

**Key Takeaways for VVVV**

* **Fixed-rate munis:** Priced using DCF models and risk-adjusted spreads.
* **Floating-rate munis:** Require stochastic rate models to assess coupon resets.
* **Callable munis:** Need OAS modeling to price optionality risk correctly.
* **Puttable munis:** Require scenario-based risk analysis for investor behavior.
* **Taxable vs. Tax-exempt:** TEY calculations ensure correct yield spread analysis.

**Low Floater Bonds: Definition, Pricing, and Risk Analysis in VVVV**

Low floater bonds, also called **low-coupon floating-rate municipal bonds**, are a subset of **floating-rate municipal bonds** that reset their interest rates at extremely low levels relative to market rates. These bonds are typically **structured for tax efficiency and liquidity purposes**. Below is a detailed breakdown of how low floater bonds function, their pricing mechanics, associated risks, and how VVVV can analyze them.

**1. What Are Low Floater Bonds?**

* **Definition:** Low floater municipal bonds are **floating-rate securities with interest rates that are reset frequently at very low levels, often below prevailing market rates**.
* **Interest Rate Mechanism:** The rate resets **daily, weekly, or monthly** based on short-term benchmarks (e.g., **SIFMA Index**, SOFR, or LIBOR in older contracts).
* **Key Characteristic:** Often backed by a **liquidity facility** (like a bank letter of credit) to ensure investors can redeem them at par.

**Use Cases of Low Floater Bonds:**

* **Municipal financing with short-term rate exposure.**
* **Issued by local governments and agencies seeking lower borrowing costs.**
* **Frequently structured as Variable Rate Demand Obligations (VRDOs).**

**2. Pricing & Valuation of Low Floater Bonds**

Since low floaters are a subset of **floating-rate bonds**, their valuation depends on:

1. **Reset Rate Formula:**
   * The bond's coupon rate is reset based on a floating index.
   * Formula Example: Coupon Rate=Benchmark Rate+Spread\text{Coupon Rate} = \text{Benchmark Rate} + \text{Spread}Coupon Rate=Benchmark Rate+Spread
   * However, low floaters have a **minimum rate cap** (often near 0%) and a low spread.
2. **Discounted Cash Flow (DCF) Model:**
   * The bond is valued by discounting expected future cash flows using **current market discount rates**.
   * Present Value (PV) of bond: PV=∑Ct(1+rt)t+F(1+rn)nPV = \sum \frac{C\_t}{(1 + r\_t)^t} + \frac{F}{(1 + r\_n)^n}PV=∑(1+rt​)tCt​​+(1+rn​)nF​
     + CtC\_tCt​ = Coupon payments (low floating rate)
     + rtr\_trt​ = Discount rate (typically based on tax-exempt yield curve)
     + FFF = Face value of the bond
3. **Option-Adjusted Spread (OAS) Analysis:**
   * Since many low floaters are **callable or puttable**, pricing must incorporate the optionality.
   * The OAS model **adjusts for credit risk, prepayment risk, and liquidity risk**.

**How VVVV Models Pricing for Low Floaters:**

* Uses a **stochastic rate model** (e.g., Hull-White or CIR) to model reset rates.
* Integrates **Monte Carlo simulations** for optionality risk in callable low floaters.
* Calculates **tax-adjusted spreads** to compare tax-exempt yield vs. taxable yield.

**d) Tax-Exempt vs. Taxable Risk**

* Low floaters are typically **tax-exempt**, meaning **after-tax yield comparisons** are crucial.
* VVVV computes **Tax-Equivalent Yield (TEY)**: TEY=Tax-Exempt Yield1−Tax RateTEY = \frac{\text{Tax-Exempt Yield}}{1 - \text{Tax Rate}}TEY=1−Tax RateTax-Exempt Yield​
* **Impact:** Higher tax brackets benefit more from low floater munis.

**4. Low Floater Market Trends & Considerations**

* **Popular among money market funds and institutional investors** seeking tax-exempt short-term yields.
* **VRDO market dependency:** If VRDO demand declines, low floater rates may become volatile.
* **Regulatory Risk:** Changes in **monetary policy** (e.g., Federal Reserve rate hikes) impact floater performance.

**Are Low Floater Bonds Considered Municipal Bonds or Money Market Instruments?**

Low floater bonds **straddle the line** between **municipal bonds** and **money market instruments (like commercial paper)** due to their unique structure. However, **they are classified as municipal bonds** rather than pure money market instruments. Below is an analysis of why this is the case.

**1. Why Low Floaters Are Considered Municipal Bonds**

* **Issuer Type:** Low floater bonds are issued by **state and local governments** or public authorities, which makes them municipal securities.
* **Purpose of Issuance:** Used to finance **public projects (e.g., infrastructure, schools, utilities)**, aligning with traditional muni bond use cases.
* **Long-Term Maturity:** Unlike money market instruments, **low floaters typically have long maturities (10-30 years)**, even though their interest rates reset frequently.

**How They Resemble Traditional Munis**

✅ **Tax-Exempt Status:** Most low floaters are **tax-exempt** under U.S. federal tax laws, a key feature of municipal bonds.  
✅ **Municipal Bond Credit Risk:** Their creditworthiness is tied to the **issuing city, state, or authority** rather than corporate credit like commercial paper.  
✅ **Callable & Puttable Features:** Like other **VRDOs (Variable Rate Demand Obligations)**, many low floaters allow **investors to "put" the bond back to the issuer**, requiring a **liquidity provider** (e.g., a bank).

**2. How Low Floaters Resemble Money Market Instruments**

* **Frequent Interest Rate Resets:** Their **coupons reset daily, weekly, or monthly**, similar to commercial paper or money market funds.
* **Liquidity Features:** Many low floaters are **VRDOs**, which means investors can redeem them **at par value on short notice**, making them behave like cash-equivalents.
* **Short-Term Trading Market:** Investors (like money market funds) use low floaters for **liquidity management**, similar to Treasury bills or corporate commercial paper.

**Why They Can Be Treated Like Money Market Instruments**

✅ **Liquidity:** The "demand" feature allows investors to exit, similar to commercial paper rollovers.  
✅ **Market Participants:** Many institutional investors, such as **money market funds**, buy low floaters due to their short-duration characteristics.  
✅ **Low Yields:** Their yields tend to track **short-term benchmarks like SIFMA or SOFR**, much like money market instruments.

**3. Key Difference Between Low Floaters & Commercial Paper**

| **Feature** | **Low Floater Bonds** | **Commercial Paper** |
| --- | --- | --- |
| **Issuer** | State/local governments (municipal issuers) | Corporations & financial institutions |
| **Maturity** | **Long-term (10-30 years)**, but rates reset often | **Short-term (30-270 days)** |
| **Liquidity Support** | Often backed by **bank liquidity facilities** | No formal liquidity backing |
| **Tax Status** | Mostly **tax-exempt** | **Taxable** |
| **Rate Reset** | **Floating rate (SIFMA, SOFR, LIBOR-linked)** | Fixed short-term rates |
| **Investor Base** | **Money market funds, high-net-worth individuals, municipalities** | **Corporations, institutional investors** |

**Verdict: Low Floaters = Municipal Bonds with Money Market Characteristics**

* **Low floaters are legally municipal bonds**, but their structure makes them behave like **money market securities**.
* Money market funds **often hold VRDOs and low floaters** because they offer liquidity and stability similar to commercial paper.

Understanding Rate Resets in Low Floater Bonds (with Simple Examples)

**1. What Does "Rate Reset" Mean?**

Unlike fixed-rate bonds where the interest rate stays the same for the entire bond term, **low floater bonds adjust their coupon rate periodically** based on a benchmark (e.g., SOFR, SIFMA, or another short-term index).

**Key Concept:**

* **Reset Frequency:** The rate on a low floater resets on a specific schedule (daily, weekly, or monthly).
* **Formula for Coupon Rate Reset:** New Coupon Rate=Benchmark Rate+Spread\text{New Coupon Rate} = \text{Benchmark Rate} + \text{Spread}New Coupon Rate=Benchmark Rate+Spread
* **Example Benchmarks:**
  + **SIFMA Index (for tax-exempt munis)**
  + **SOFR (Secured Overnight Financing Rate)**
  + **LIBOR (used historically, now being phased out)**

**2. How Rate Resets Work (Simple Examples)**

**📌 Daily Rate Reset Example**

* Suppose a **low floater bond resets daily** and uses **SOFR + 0.50%** (50 basis points) as its formula.
* If **SOFR is 2.00% today**, the bond’s coupon rate will be: 2.00%+0.50%=2.50%2.00\% + 0.50\% = 2.50\%2.00%+0.50%=2.50%
* **Tomorrow**, SOFR changes to **2.10%**, so the coupon is now: 2.10%+0.50%=2.60%2.10\% + 0.50\% = 2.60\%2.10%+0.50%=2.60%
* Every day, the coupon **adjusts based on the new SOFR rate**.

**📌 Weekly Rate Reset Example**

* A low floater resets **every Wednesday** based on the **SIFMA index + 0.30%**.
* On **Monday, March 4th,** SIFMA is **1.80%**.
* The new rate (valid from **March 6th – March 12th**) is: 1.80%+0.30%=2.10%1.80\% + 0.30\% = 2.10\%1.80%+0.30%=2.10%
* The next Wednesday (**March 13th**), if SIFMA rises to **2.00%**, the new coupon becomes: 2.00%+0.30%=2.30%2.00\% + 0.30\% = 2.30\%2.00%+0.30%=2.30%
* The bond now pays this new rate until the next reset.

**📌 Monthly Rate Reset Example**

* A low floater resets **on the first trading day of each month** using **SOFR + 0.40%**.
* On **April 1st**, SOFR = **2.50%**, so the bond’s rate for April is: 2.50%+0.40%=2.90%2.50\% + 0.40\% = 2.90\%2.50%+0.40%=2.90%
* On **May 1st**, SOFR changes to **2.80%**, so the new rate is: 2.80%+0.40%=3.20%2.80\% + 0.40\% = 3.20\%2.80%+0.40%=3.20%
* The bond pays **3.20% until June 1st**, when it resets again.

**3. Why Do Low Floaters Reset to Lower Market Rates?**

Low floater bonds are tied to **short-term interest rates**. When the market sees:

* **Falling rates** → The benchmark (SIFMA, SOFR) drops → The bond’s coupon also drops.
* **Rising rates** → The bond’s coupon increases accordingly.

**Example of Falling Rates:**

1. **Today**: SIFMA is **2.50%**, so the bond pays: 2.50%+0.30%=2.80%2.50\% + 0.30\% = 2.80\%2.50%+0.30%=2.80%
2. **Next week**, SIFMA falls to **2.00%** → New coupon: 2.00%+0.30%=2.30%2.00\% + 0.30\% = 2.30\%2.00%+0.30%=2.30%
3. **Two weeks later**, SIFMA drops to **1.50%** → New coupon: 1.50%+0.30%=1.80%1.50\% + 0.30\% = 1.80\%1.50%+0.30%=1.80%

This automatic reset **protects issuers** because they always pay interest in line with market rates.

**4. What Does "7 Days After Settlement Date as the Maturity" Mean?**

Some low floater structures are designed to **mature 7 days after settlement** for liquidity reasons.

**Simple Example:**

* **March 1st:** An investor buys a **weekly-reset low floater**.
* **March 8th (7 days later):** The bond is **redeemed at par ($1,000 per bond)**.
* The issuer may **reissue** the bond to a new investor for another 7 days.

**Why This Matters:**

* This makes the bond behave **like a short-term instrument**, similar to a **7-day rolling deposit**.
* Money market funds prefer these bonds because they can **always sell them back** on short notice.

**5. Key Takeaways**

| **Feature** | **Low Floater Bonds** |
| --- | --- |
| **Rate Type** | Floating-rate (resets frequently) |
| **Reset Frequency** | **Daily, Weekly, Monthly** |
| **Formula** | Benchmark (SOFR/SIFMA) + Spread |
| **Why It Resets?** | Keeps rates in line with short-term market conditions |
| **Maturity Handling** | Often structured as **7-day rolling securities** for liquidity |
| **Investor Benefit** | Offers flexibility and short-term rate exposure |
| **Issuer Benefit** | Keeps borrowing costs aligned with market rates |

Understanding Call Schedule, Put Schedule, and Sink Schedule

**1. Call Schedule vs. Put Schedule vs. Sink Schedule**

**a) Call Schedule (Callable Bonds)**

* **Definition:** A **call schedule** specifies the dates and prices at which an issuer can **redeem (call) bonds before maturity**.
* **How It Works:**
  + The issuer has the right (not obligation) to **buy back** the bond from investors at predetermined prices.
  + Typically follows a **declining premium structure** (e.g., 105% of par in Year 5, 103% in Year 6, etc.).
  + Investors price in this risk using **Option-Adjusted Spread (OAS) models**.
* **Example of a Call Schedule:**

| **Call Date** | **Call Price (% of Par)** |
| --- | --- |
| Year 5 | 105% (1.05 × Par) |
| Year 6 | 103% (1.03 × Par) |
| Year 7+ | 100% (Par) |

* **Impact on Pricing:**  
  The **call price is rescaled** by the ratio between **outstanding principal balance and par amount** during pricing. If part of the bond has already been paid off via a **sinking fund**, the callable amount is adjusted proportionally.

**b) Put Schedule (Puttable Bonds)**

* **Definition:** A **put schedule** specifies the dates and prices at which an investor can **sell (put) the bond back to the issuer**.
* **How It Works:**
  + Gives **bondholders** the right to force the issuer to **repurchase the bond** at specified prices.
  + This **benefits investors** when interest rates rise (they can put the bond and reinvest at higher rates).
* **Example of a Put Schedule:**

| **Put Date** | **Put Price (% of Par)** |
| --- | --- |
| Year 3 | 100% (Par) |
| Year 5 | 101% (1.01 × Par) |

* **Impact on Pricing:**
  + The embedded **put option is always valued**, even in pre-refunded bonds.
  + If market interest rates rise, the **value of the put option increases**, making the bond more attractive.

**c) Sink Schedule (Sinking Fund Bonds)**

* **Definition:** A **sinking fund schedule** dictates how much of the bond’s **principal must be repaid periodically** before maturity.
* **How It Works:**
  + Bonds are **partially retired each year** instead of a lump sum at maturity.
  + The **outstanding principal decreases** over time according to the sinking fund payments.
* **Example of a Sinking Fund Schedule:**

| **Year** | **Principal Repayment (%)** |
| --- | --- |
| 2026 | 10% of total issuance |
| 2027 | 15% of total issuance |
| 2028 | 20% of total issuance |

* **Impact on Pricing:**
  + Since principal is repaid over time, pricing is based on the **decreasing balance**.
  + The **call price is adjusted based on the remaining balance**.

**2. What is a Pre-Refunding Bond?**

* **Definition:** A **pre-refunded bond** is a bond that has been **advanced refunded**, meaning the issuer has set aside funds to repay it before its original maturity date.
* **How It Works:**
  + The bond is **no longer callable**, and investors **ignore call optionality** when pricing.
  + A **refund date is set** where the bond will be redeemed.
  + The **redemption value** is a fraction of the **refunded price over par**.
* **Key Adjustments for Pre-Refunded Bonds:**
  + **Call optionality is ignored** (since the bond will be redeemed early).
  + **Sink schedule is shortened** (since all principal is paid on the refunded date).
  + **Coupon rate schedule is shortened** (if it was a multi-step bond).
  + **Capitalization schedule is shortened** (for pay-in-kind bonds).
* **Impact on Puttable Bonds:**
  + If the bond has a **put option**, the put option is still **valued separately**.
  + Investors can **still exercise the put if the terms allow**.

**Example of Pre-Refunding Bond Adjustment**

* **Original Maturity:** 2035
* **Refunded Date:** 2027 (new final payment date)
* **Call Optionality:** Ignored (since it's being repaid early)
* **Sink Schedule Adjustment:** All payments are due by 2027

**3. What is a Multi-Step Bond?**

* **Definition:** A **multi-step bond** has a coupon rate that **changes at predefined intervals**.
* **How It Works:**
  + Instead of a fixed coupon, the interest rate **steps up or down** based on a pre-set schedule.
* **Example of a Multi-Step Bond:**

| **Period** | **Coupon Rate (%)** |
| --- | --- |
| Year 1-3 | 3.00% |
| Year 4-6 | 4.50% |
| Year 7+ | 5.50% |

* **Impact on Pricing:**
  + Investors must price in **expected future cash flows** based on the step-up rates.
  + A bond’s yield-to-maturity reflects the **weighted average of step-up coupons**.

**4. What is an Amortized Bond?**

* **Definition:** An **amortized bond** is a bond where the principal is **gradually repaid over time** instead of a lump sum at maturity.
* **How It Works:**
  + Each periodic payment includes **both interest and principal repayment**.
  + Similar to a **mortgage loan** where part of the loan is paid off every month.
* **Example of an Amortized Bond Schedule:**

| **Year** | **Interest Paid** | **Principal Paid** | **Remaining Principal** |
| --- | --- | --- | --- |
| 2025 | $5,000 | $10,000 | $90,000 |
| 2026 | $4,500 | $10,000 | $80,000 |
| 2027 | $4,000 | $10,000 | $70,000 |

* **Impact on Pricing:**
  + Unlike **bullet bonds** (where all principal is paid at the end), investors need to price the bond using an **amortization schedule**.

**5. Key Takeaways**

| **Feature** | **Explanation** |
| --- | --- |
| **Call Schedule** | Specifies when and at what price an issuer can redeem bonds early. |
| **Put Schedule** | Specifies when an investor can sell the bond back to the issuer. |
| **Sink Schedule** | Specifies periodic principal repayments over time. |
| **Pre-Refunded Bond** | A bond that is set to be paid off early, ignoring call optionality. |
| **Multi-Step Bond** | A bond where the coupon rate changes at predefined intervals. |
| **Amortized Bond** | A bond where the principal is gradually repaid over time. |