Refract's Boost Model

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Abstract

Refract is introducing a modular boost model integrated within its existing Junior tranche system. This model allows Junior depositors to customize their risk-reward profiles through granular boost selection without disrupting the fundamental Junior-Senior tranche dynamic. While the Senior tranche remains protected by the Junior tranche's "first-loss" capital, the boost model redistributes yields and potential losses specifically among Junior participants based on their chosen exposure. Essentially, the boost redistributes yield and losses in the junior tranche across capital based on relative boost.

1 Integration Into Refract's Tranche System

The boost model is integrated into the Junior tranche and allows Junior depositors to select their "leverage" (relative to other depositors), which determines their yield and risk exposure.

The Junior-Senior tranche dynamic, with the Junior tranche providing coverage for the Senior tranche, remains untouched. The Junior tranche acts as first-loss capital in exchange for receiving higher yield. The underlying Base APY of an asset is distributed between Junior and Senior tranche based on the mechanics described in the Refract Litepaper (also see Appendix). A target coverage for the Senior tranche is determined, with the market deciding the risk premium the Junior tranche has to be paid to achieve the target coverage.

The boost model applies to the Junior tranche. The yield for the Junior tranche, determined by the market as described above, is redistributed between Junior depositors based on their selected boost. Accordingly, potential losses will be redistributed between Junior depositors.

The boost model is optional and can be enabled or disabled for tranche markets by the curator.

Objectives of the Boost Model:

- **Granularity:** Allow depositors to select their risk-reward exposure on a highly granular level.
- **Stability:** The boost model redistributes losses in the Junior tranche, meaning every Junior tranche depositor has to take on a pro-rata share of the loss based on their "boosted TVL". This is done intentionally to create stability, compared to a

system with, for example, 10 tranches where losses are accounted for per tranche, and later tranches only take on losses if previous tranches have been fully depleted.

- **Modularity:** The boost model can be added to Refract's tranche markets if desired, without affecting the basic tranching logic of Senior and Junior tranche. For instance, the boost model is designed in a way that it doesn't have a negative impact on the coverage for the Senior tranche (e.g. highly-levered Junior depositors crowding out other depositors, reducing total coverage)
- **Simplicity:** Utilizing familiar mechanics for users (boost/leverage) to give a sense of control. While the boost model itself introduces increased variability for Junior depositors, Refract aims to abstract its complexities, for instance via managed Junior Buckets that optimize for a target risk-reward exposure (low, medium, high).

2 Boost Model

2.1 Yield Distribution

The boost model introduces a **Floor Junior APY** that all Junior depositors receive at a minimum, no matter their boost.

$$FloorJuniorAPY = SeniorAPY + \beta \tag{1}$$

with $\beta : buffer$

This prevents the APY for any given junior depositor to dip low enough to have them leave for the Senior tranche for a better individual risk-reward ratio, which would negatively impact Senior coverage.

The excess APY (Total Junior APY - Floor Junior APY) then gets distributed prorata among junior deposits based on their boosted TVL (Deposit * Boost).

The overall **APY per Junior deposit** is therefore calculated as:

$$\text{APY}_i = \text{Floor Junior APY} + \left(\frac{\text{user boost}}{\text{TVL weighted boost in the Junior tranche}} \right) \times \text{Excess Junior APY} \tag{2}$$

with

$$\text{TVL-weighted boost} = \frac{\sum (Deposit_i \times boost_i)}{\sum Deposit_i}$$

Ultimately, a Junior depositor's APY depends on:

- Junior APY
- Senior APY
- β
- Selected boost
- TVL-weighted boost in the Junior tranche

Characteristics
Junior Yield $\uparrow$ (ceteris paribus) $\rightarrow$ Excess Junior Yield $\uparrow \rightarrow$ Yield difference between boost tiers $\uparrow$ & Yield gap lowest junior APY vs senior APY $\uparrow$

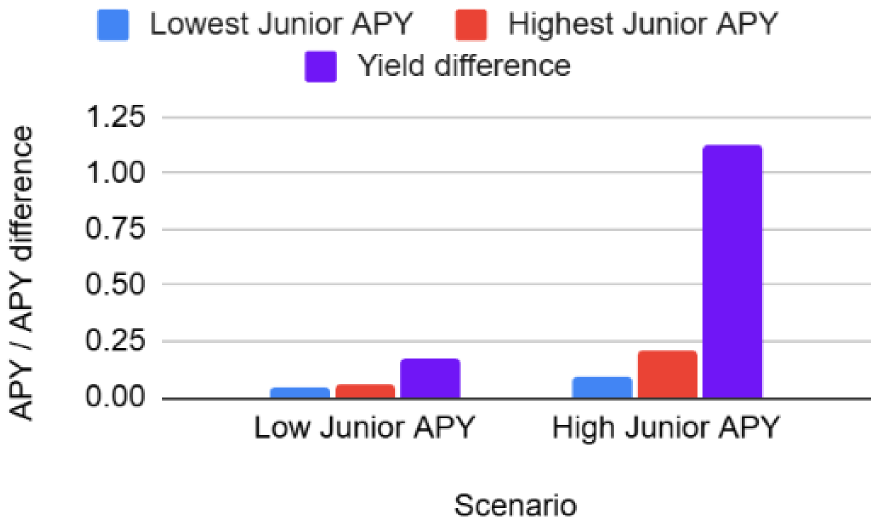

Figure 1: Example Scenarios for two different Junior APY regimes and their effect on APYs of Junior Deposits with different boost

Senior Yield $\uparrow$ (ceteris paribus) $\rightarrow$ Excess Junior Yield $\downarrow \rightarrow$ Yield difference between boost tiers $\downarrow$ & Yield gap lowest junior APY vs senior APY $\downarrow$

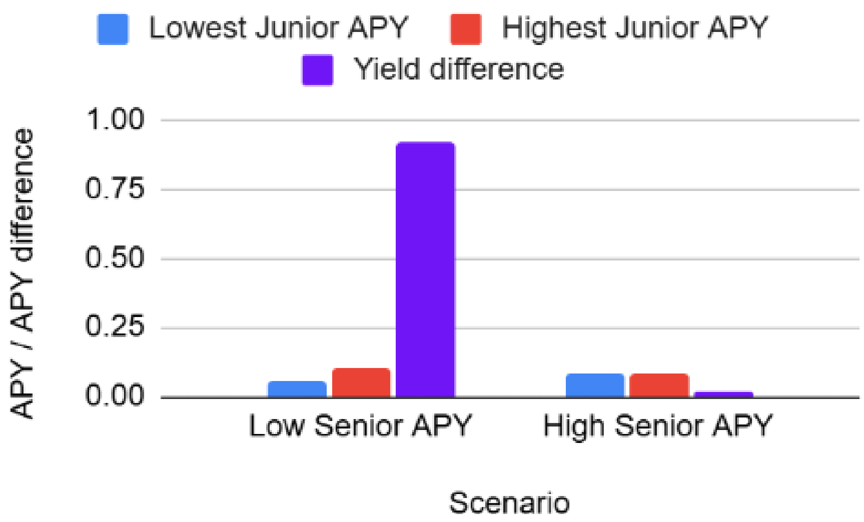

Figure 2: Example Scenarios for two different Senior APY regimes and their effect on APYs of Junior Deposits with different boost

2.2 Loss Accounting

In the event of a loss, loss allocation to Junior deposits is done via a multi-round, boost-weighted pro-rata model.

- **Boost weighted pro-rata:** Losses are distributed across deposits pro-rata based on effective boost with
$$\lambda_i = \frac{APY_i}{\min_{j \in U}(APY_j)}$$
The more yield a deposit receives, the higher its loss allocation.

- **Multi-round:** Within each round, the loss is distributed proportionally based on the current relative "Effective Boost" of the deposits. If a deposit is completely wiped, any potential remaining loss is distributed among the remaining deposits based on their relative Effective Boost. This continues until all losses are accounted for or all Junior deposits are depleted, whatever comes first. In the latter case, the Senior tranche takes on the loss remainder.

Variables

$$L^{(0)} = TotalInitialLoss$$
$$T_i^{(0)} = InitialTVLofuseri$$
$$\lambda_i = \frac{APY_i}{\min_{j \in U}(APY_j)}$$

The Iterative Step In each round k, the loss allocated to user i is calculated based on their weighted share of the remaining debt, capped by their remaining TVL:

$$\Delta L_i^{(k)} = min(T_i^{(k)}, L^{(k)} \times \frac{T_i^{(k)} \times \lambda_i}{\sum_{j \in A^{(k)}} T_j^{(k)} \times \lambda_j}) \tag{3}$$

with
$$A^{(k)} = \{i \mid T_i^{(k)} > 0\}$$

State Updates After each round, we update the remaining TVL and the remaining loss for the next iteration (k+1).

<u>TVL</u>

$$T_i^{(k+1)} = T_i^{(k)} - \Delta L_i^{(k)} \tag{4}$$

<u>Remaining Loss</u>

$$L^{(k+1)} = L^{(k)} - \sum_{i \in A^{(k)}} \Delta L_i^{(k)} \tag{5}$$

Final Result

$$TotalLoss_i = \sum_{k=0}^{\infty} \Delta L_i^{(k)} \tag{6}$$

Ultimately, a Junior depositor's loss depends on:

- Total loss size
- Selected boost
- Boost of all other deposits

Characteristics

The higher the boost, the more loss a deposit takes on and the earlier it gets fully depleted.

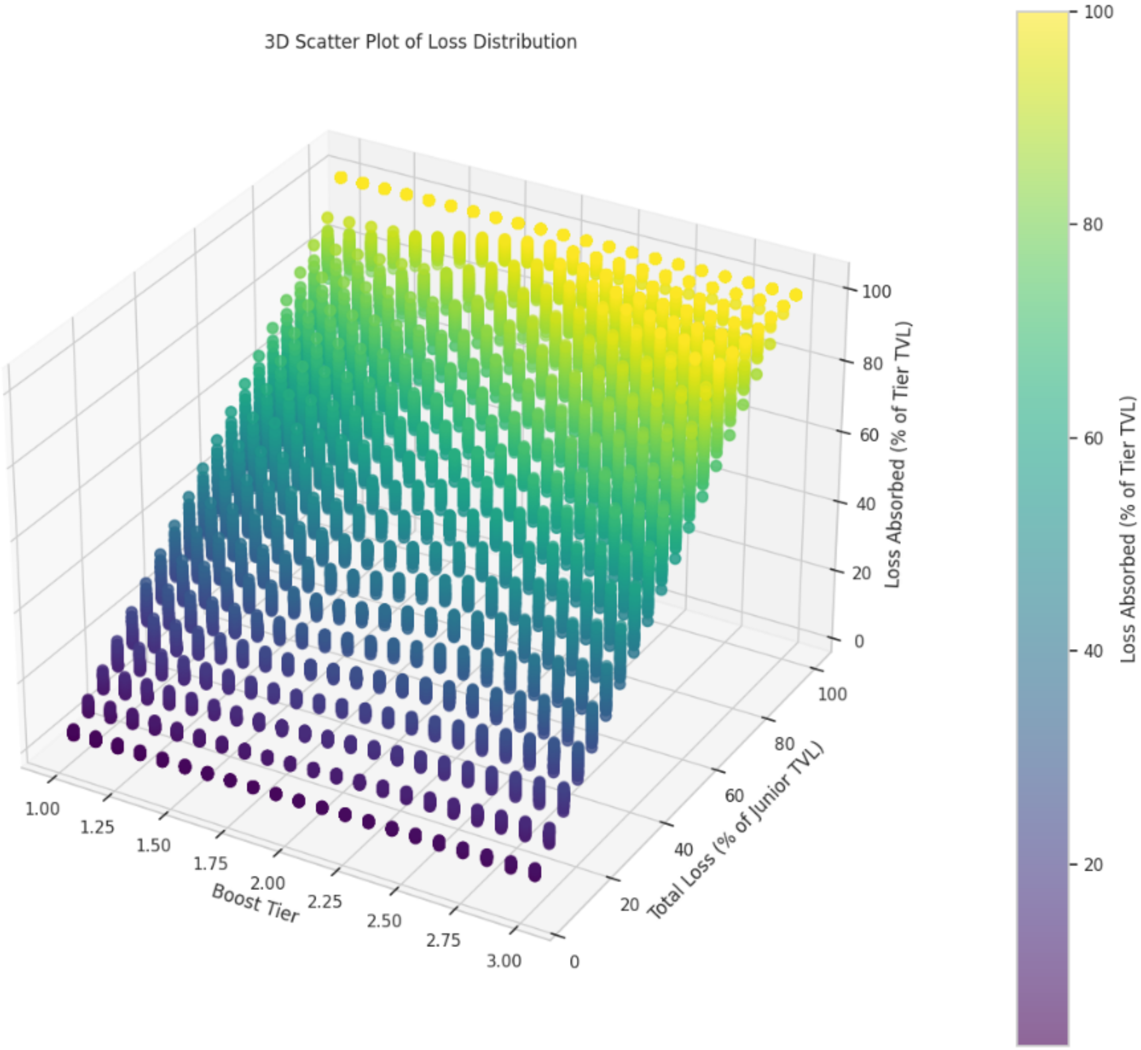

Figure 3: Impact of boost on Junior deposit depletion across 1000 TVL and boost scenarios

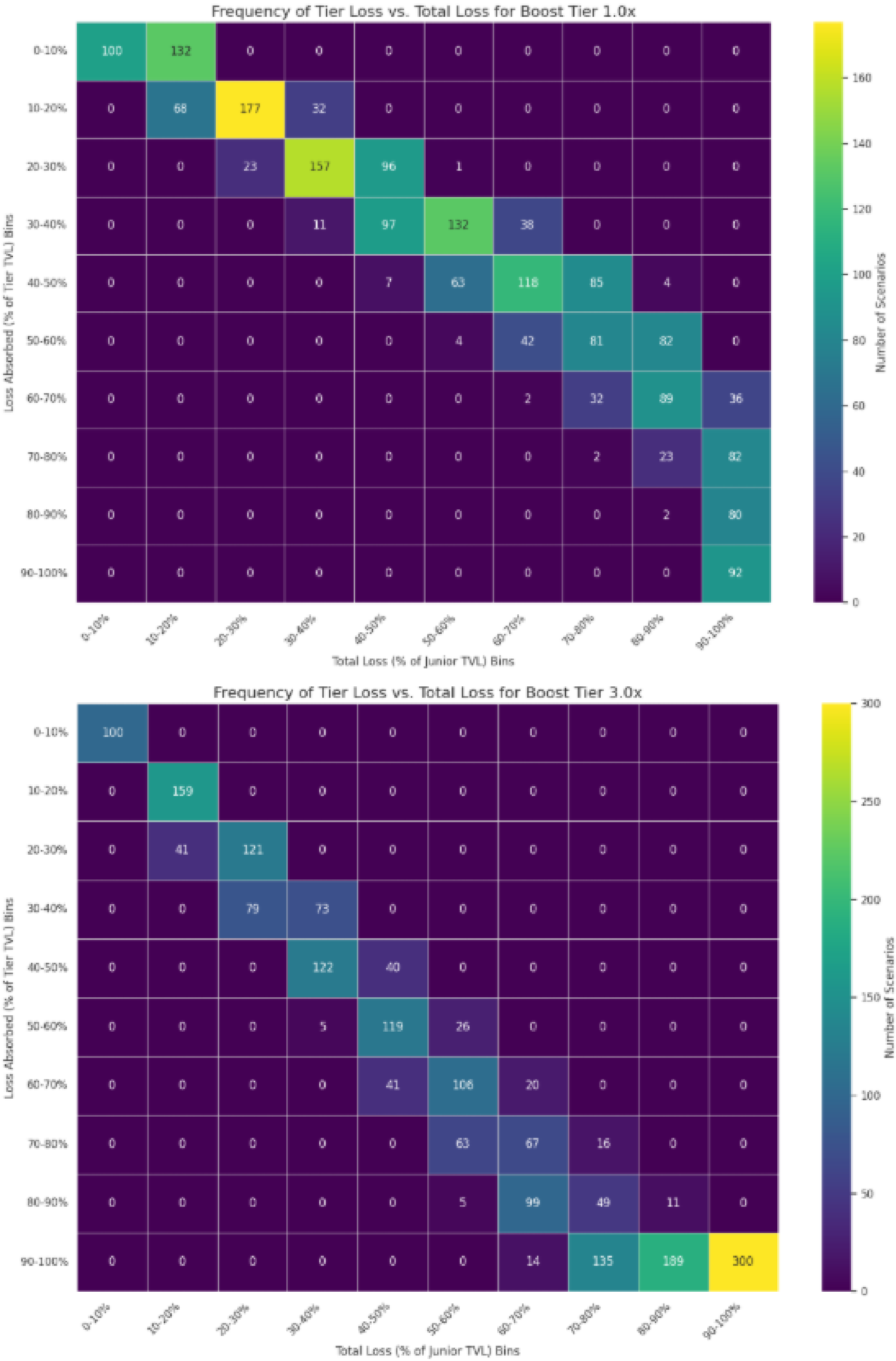

Figure 4: Two heatmaps comparing the loss of 1x boost vs 3x boost for 1000 TVL and boost scenarios

3 Appendix: Refract's 2-Tranche System

Refract uses a proprietary yield splitting model to distribute the base yield (yield of the underlying asset) across Senior and Junior Tranche.

Characteristics

- Each tranche market optimizes for a target coverage that protects the Senior Tranche. The coverage is provided by the Junior Tranche acting as a first-loss buffer. The target coverage is set at market creation.
- The protocol shifts yield between Senior and Junior Tranche dependent on the actual coverage and the gap to the target coverage. The market determines the risk premium (APY) required for Juniors to provide the target coverage.
  - Below-target coverage means higher Junior APY to incentivize deposits, increasing coverage. As the base yield that can be distributed stays constant, Senior APY automatically decreases (inverse correlation between Senior and Junior APY).
  - Above-target coverage has Junior APY decrease until it converges with the Senior APY. This reduces coverage as Juniors take on more risk for a smaller (or even no) risk premium compared to Seniors. The system is designed so that the Junior APY is equal to or smaller than the Senior APY.
- Refract lets yield for both Junior and Senior Tranches float freely based on real-time market dynamics (actual coverage vs target coverage). By moving away from fixed rates and external benchmarks, our system eliminates yield speculation. Both Senior and Junior tranches float freely, allowing the market to price risk with total clarity. This ensures the system self-optimizes for target coverage based on actual demand, rather than fluctuating interest rate spreads.

Senior and Junior Tranche receive yield based on Base APY, coverage, and target coverage. As they share the underlying Base APR, the yield Seniors and Juniors receive is inversely correlated.

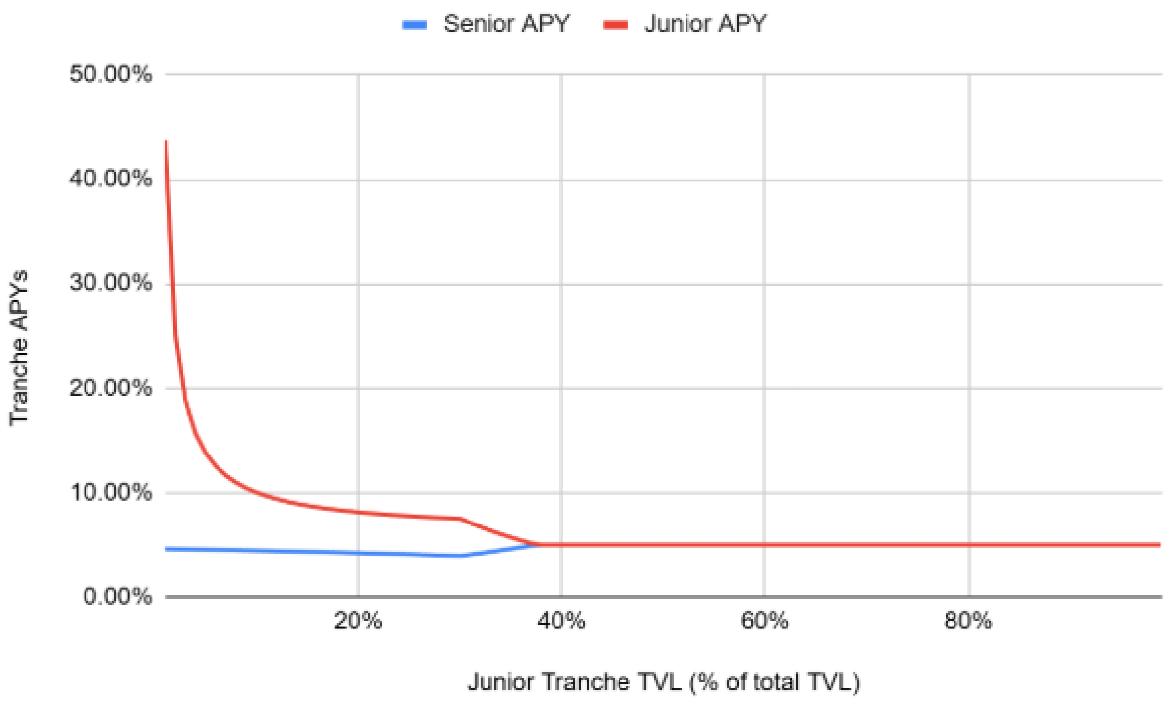

Figure 5: Exemplary APYs for Junior and Senior Tranche for different coverage levels (percentage of total TVL in Junior Tranche) with a Base APY of 5.00 percent

3.1 Yield Splitting

Refract uses a proprietary yield splitting model that dynamically distributes underlying yield to Senior and Junior Tranche based on the coverage (% of total TVL in the junior tranche).

The Junior Tranche receives at minimum the same yield as the senior tranche and more yield the further coverage is from the target coverage.

3.1.1 Parameters

At market creation, curators can set the following parameters.

Target Coverage ($tgtTVLratio_{jr}$)
The targeted TVL of the junior tranche, as a percentage of the total TVL in the Senior and Junior Tranche

$$Coverage = \frac{TVL_{jr}}{TVL_{jr} + TVL_{sr}} \tag{7}$$

Target Boost ($tgtBoost_{jr}$)
The percentage APY boost the Junior Tranche receives on the Base APY at $tgtTVLratio_{jr}$

Boost Curve Slopes ($s1$, $s2$)
The steepness of the Junior APY Boost curve below ($s1$) and above ($s2$) the target coverage $tgtTVLratio_{jr}$

From these parameters, the initial Junior APY Boost Curve is generated. The target coverage and target boost provide the anchor point for the curve. The slope s1 defines the steepness of the curve below target coverage; s2 determines the steepness above target coverage and influences how quickly the Junior APY converges with the Senior APY.

The **Junior APY Boost** is built as follows:

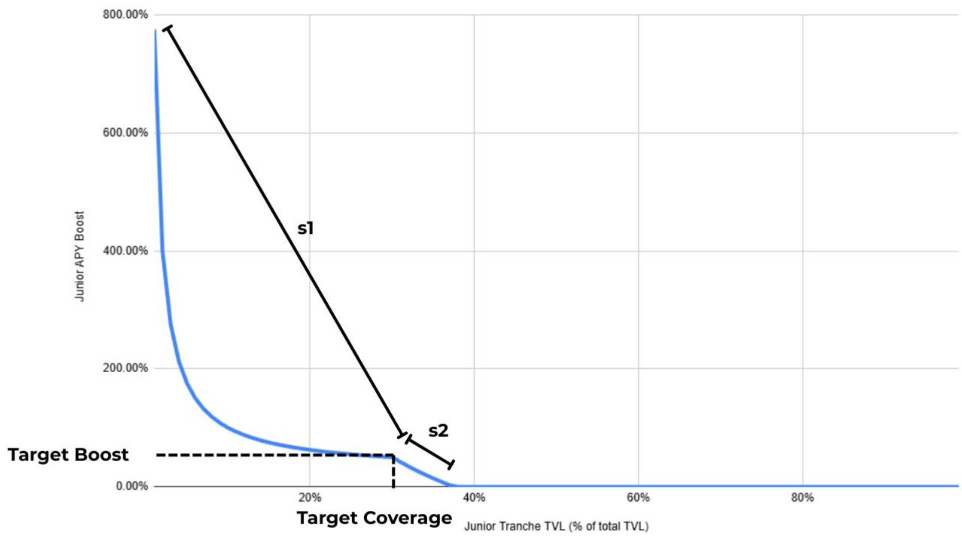

Figure 6: Exemplary Junior APY Boost Curve

From the APY Boost Curve and the Base APY, we can generate the **Junior APY Curve**. The realized Junior APY is determined along the curve based on the actual coverage.

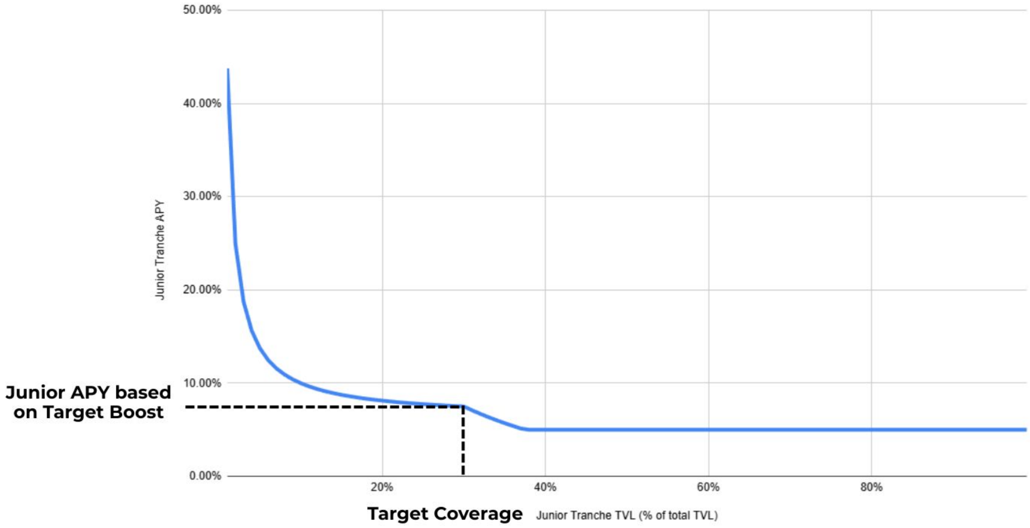

Figure 7: Exemplary Junior APY Curve

3.1.2 APR Calculation

Junior APR

First, the APY Boost for the Junior Tranche is calculated based on the boost curve parameters and the actual coverage (% of total TVL in the Junior Tranche). The APY boost is applied to the Base APY.

The further the coverage is below target, the higher the Junior APY Boost as determined by s1. Above target coverage, the APY Boost decreases to zero as defined by s2. When the boost is 0, the Junior APY is equal to the Senior APY.

$$\text{Boost}_{jr} = \min\left(\frac{\text{TVLratio}_{sr}}{\text{TVLratio}_{jr}}, \begin{cases} \text{tgtBoost}_{jr} \times \left(1 + s_1 \times \left(\frac{\text{tgtTVLratio}_{jr}}{\text{TVLratio}_{jr}} - 1\right)\right) & \text{if } \text{TVLratio}_{jr} < \text{tgtTVLratio}_{jr} \\ \max\left(0, \text{tgtBoost}_{jr} \times \left(1 + s_2 \times \left(\frac{\text{tgtTVLratio}_{jr}}{\text{TVLratio}_{jr}} - 1\right)\right)\right) & \text{if } \text{TVLratio}_{jr} \geq \text{tgtTVLratio}_{jr} \end{cases}\right) \tag{8}$$

The APY Boost is then used to calculate the Junior APY based on the underlying Base APY.

$$APY_{jr} = \frac{\frac{TVL_{jr}}{TVL_{total}} \times (1 + Boost_{jr}) \times TVL_{total} \times APY_{underlying}}{TVL_{jr}} = APY_{underlying} \times (1 + Boost_{jr}) \tag{9}$$

Senior APR
The yield the Senior Tranche receives is inversely correlated to the yield of the Junior Tranche. The higher the APY Boost for Juniors, the more of the underlying yield is allocated to them, leaving a smaller remaining yield for Seniors.

$$APY_{sr} = APY_{underlying} \times \left(1 - Boost_{jr} \times \frac{TVLratio_{jr}}{TVLratio_{sr}}\right) \tag{10}$$

3.1.3 Adaptive APY Boost Curve

The curve of the Junior APY Boost is dynamic. It moves up/down to autonomously find the market-clearing risk premium at target coverage (Target Boost) that brings the coverage to target. This adaptive APY Boost is how Refract uses economic levers to optimize yield distribution with the goal of reaching the selected target coverage in a tranche market.

The adaptive mechanic moves the Target Boost (anchor point of the curve) up/down when the coverage is below/above target. The "speed" (size) of the move is dependent upon A) size of the gap to target coverage B) duration the gap has persisted for.

As the Target Boost moves while keeping the slopes of the boost curve ($s1$, $s2$) and target coverage constant, the whole APY Boost Curve moves up or down with it. This impacts how yield is distributed across Seniors and Juniors. If the Target Boost moves up, Juniors receive more of the yield at the same coverage, and vice versa.

1. Calculate the error (gap to target rate, normalized)

2. Calculate the speed factor (how much the boost curve moves up/down)

3. Update the new target boost $tgtBoost_{jr}$

$$tgtBoost_{jr}(t) = MAX(0, tgtBoost_{jr}(t_{last}) \times speed(t)) \tag{11}$$