How the world advances

**Invoice Spread Calculator**

*Quick Start Guide*

The **Invoice Spread Calculator** provides levels of invoice swap spreads (forward starting swaps vs. CBOT U.S. Treasury futures). This page also contains hedge ratios versus swaps, cheapest-to-deliver (CTD) and DV01 information for Treasury futures.

The page includes analysis relative to the front delivery month for each Treasury Futures contract and displays results based on delayed quotes that are updated every 15 minutes.

<table>
<thead>
<tr>
<th>Treasury Futures Price Analysis</th>
<th>Cheapest-to-Deliver Analysis</th>
<th>Invoice Spreads</th>
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<td></td>
<td>Mid Price</td>
<td>DV01</td>
<td>Contract</td>
</tr>
<tr>
<td>ZTM4 2Y</td>
<td>109.961</td>
<td>37.76</td>
<td>2 1/4</td>
</tr>
<tr>
<td>ZFM4 5Y</td>
<td>119.609</td>
<td>48.07</td>
<td>1 1/2</td>
</tr>
<tr>
<td>ZNM4 10Y</td>
<td>124.594</td>
<td>73.77</td>
<td>3 5/8</td>
</tr>
<tr>
<td>ZBM4 T-Bond</td>
<td>134.500</td>
<td>143.92</td>
<td>6 1/8</td>
</tr>
<tr>
<td>UBM4 Ultra</td>
<td>146.531</td>
<td>232.56</td>
<td>4 1/2</td>
</tr>
</tbody>
</table>

For each Treasury Futures contract, the following fields are displayed:

The **Treasury Futures Price Analysis** section displays fields related to the Treasury Futures contract:

- **Price**: The latest trade quote available.
- **DV01**: The DV01 of the CTD (as described on side 2) divided by the contract conversion factor (CF). Quoted for a notional of one contract.

The **Cheapest-to-Deliver (CTD) Analysis** section displays fields related to the Treasury Futures contract CTD:

- **Contract**: The coupon rate and maturity date of the CTD.
- **Implied Forward Yield**: The yield of the CTD as determined from the Treasury Futures price adjusted by the CTD conversion factor.
- **DV01**: The DV01 of the CTD (as described on side 2).

The **Invoice Spreads** section displays fields comparing the Treasury Futures contract with an OTC forward starting swap with terms matching the CTD and starting at the Treasury Futures contract delivery date:

- **Fwd Swap Rate**: The par rate for the forward starting swap.
- **Spread to Futures**: The **Fwd Swap Rate** minus the **Implied Forward Yield** in bps.
- **Hedge Ratio**: The ratio between the DV01 of the forward starting swap and the DV01 of the CTD.

The **Timestamp** block displays timestamps for the market data.

Continued on next page
All OTC IR swap calculations are based on dual-curve bootstrapping using OIS and 3-month LIBOR quotes sourced from CME (delayed and updated every 15 minutes). Both OIS and LIBOR curve bootstrapping are based on the standard piecewise-constant methodology. Inputs to the bootstrapping algorithm are:

- **OIS**: Cash deposits and Federal Fund swaps.
- **LIBOR**: Cash deposits, Eurodollar futures (convexity adjusted) and 3m LIBOR swaps.

Given bootstrapped OIS and LIBOR curves, both the **OTC Fwd Swap Rate** and the **OTC Spot Swap Rate** are computed to price the swaps to par off the bootstrapped curves.

**DV01s** for both the OTC forward swaps are computed as follows:

- Compute the OTC swap PV (with contract coupon) off the bootstrapped OIS and LIBOR curves.
- Construct bumped bootstrapped OIS and LIBOR curves by bumping all OIS and LIBOR quotes by 1bp and re-bootstrap.
- Compute the OTC swap bumped PV (with contract coupon) off the bumped bootstrapped OIS and LIBOR curves.
- Take the difference between the OTC swap PV and bumped PV.

CTDs for Treasury Futures contracts are computed based on EOD Treasury note and bond prices. The CTD for each Treasury Futures contract is computed daily as follows:

- For each deliverable in the Treasury Futures contract, compute the Implied Repo rate from the Treasury Futures contract price and the price of the deliverable.
- The CTD is the deliverable with the highest Implied Repo rate.

The **Implied Forward Yield** is computed as follows:

- Compute the forward price of the CTD from the Treasury Futures contract price using the conversion factor (with no adjustment for optionality).
- The **Implied Forward Yield** is then the flat rate which prices the CTD cashflows to CTD forward price.

The **DV01** of the CTD is computed as follows:

- Compute the forward price of the CTD from the Treasury Futures contract price using the conversion factor (with no adjustment for optionality).
- Compute the modified duration of the CTD.
- The **DV01** of the CTD is then the CTD modified duration times the CTD forward price divided by 100.

The **DV01** of the Treasury Futures contract is the **DV01** of the CTD divided by the conversion factor.

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