

## DATA

## SPEAKERS

# Advanced Transaction Cost Analytics (TCA) with AI-enhanced Peer Grouping & Slippage Models

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## Why do transactional cost analytics matter to trading participants?

- *Transactional analytics provide valuable insights into your trading activities.*
- *By gathering data on your trades, you gain a better understanding of your trading patterns, risk factors, and performance. This in turn will help you to optimize your strategies and improve returns.*
- *Additionally, transactional analytics can provide traders with an edge by enabling them to identify opportunities, identify weaknesses in their strategies, and develop better risk management policies.*

## CME Group Transaction Cost Analytics development program

CME Group is shortly launching a new analytics service via Google GCP starting with a comprehensive suite of client TCA **covering all US Treasury trades, Brokertec CLOB** and across our **major UST futures markets**, followed soon by FX Futures, Equity, Major commodity markets and EBS cash FX.

The service will include

- **Full Order and Trade level mark to market calculations** and **market impact by time and order book update** count
- **Parent level aggregation**: Parent order summations by same trader ID, same Firm, Session ID in same direction within continuous time frame of 5 mins
- **Peer group benchmarking** including MTM of Futures/Cash equivalents on each transaction (including Basis Spreads cash-futures)
  - Peer grouping by Order Fill Ratios, and Market Maker classifications,
  - Peer group rankings using explainable machine learning attribution models powered by Google Vertex Ai.
- **Best Execution Total Cost analysis** using aggregate methods with VWAP, TWAP, Optimal Execution calculations.

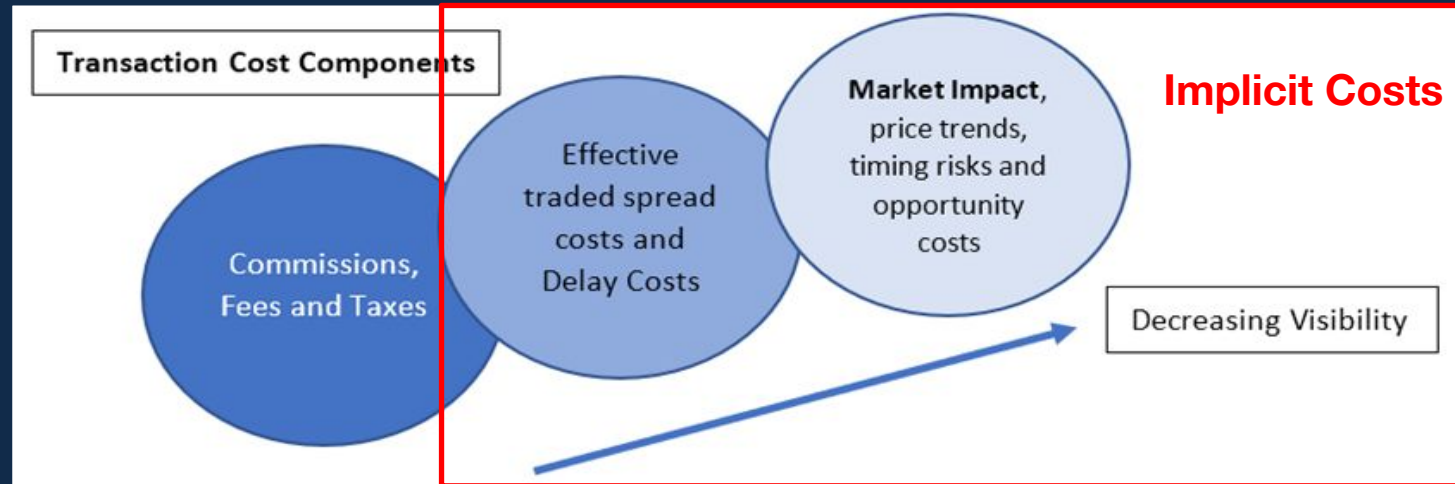
**External client access will start later this year.**

The google analytics platform will **expand in time to other products**, and more complex analysis.

# What is TCA and Market Impact and why is it important

# What is TCA? (Transaction cost analysis)

*TCA stands for Transaction Cost Analysis, which is a method used to measure and evaluate costs associated with executing financial transactions*



# What do we plan to deliver to market?

A simple scenario to explain ...

A corporation is looking to secure a significant volume of crude oil futures to hedge against the risk of rising prices

.....

They send the order to  
“Barry the Broker” who will  
execute this order on behalf  
of the client ...



# Trading “blind”

Without the tools to minimise market impact

## Before the order

**T-0**

Barry places a large order to buy a number of oil futures contracts

Crude oil futures are trading at \$50 per contract

## Seconds after ...

**T+5s**

Other market participants notice the buy order, interpret it as a bullish sentiment for crude oil prices. This causes a temporary large pop in the price against the client

**T+10s**

The impact of the first trade parcel reduces with time

**T+60s**

The price of the crude oil futures contract has settled at \$50.50 - a higher price than before the order

**T+ns**

This will affect the remaining balance of the client orders that Barry needs to execute to complete the overall parent order

# What just happened?

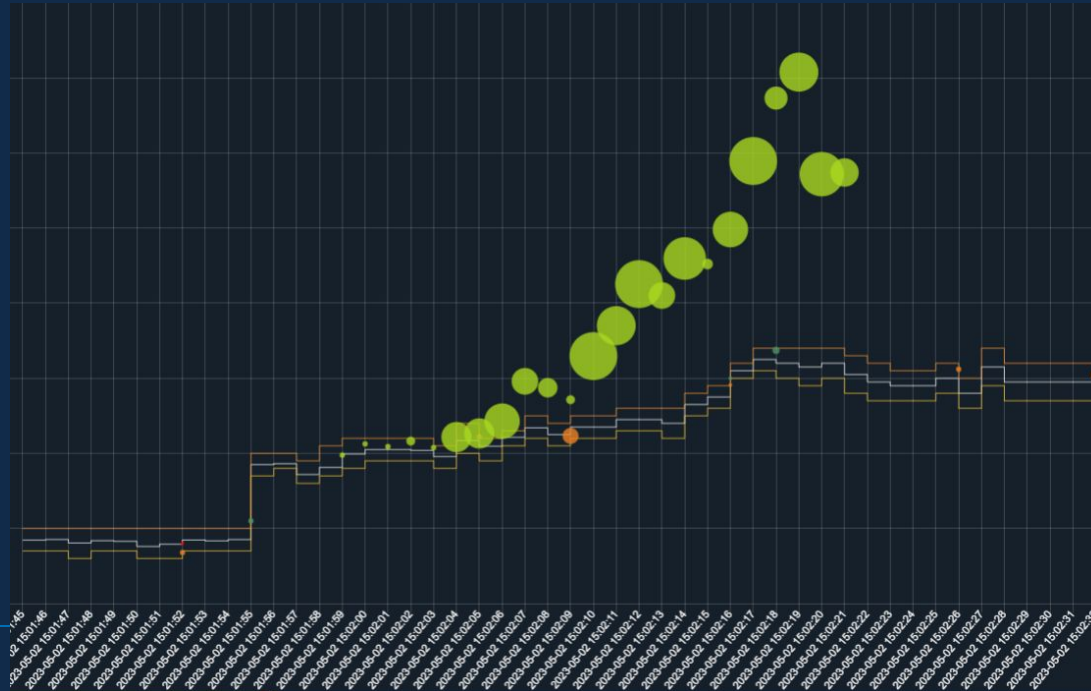
The answer can be explained by **Market Impact**

- The act of placing a large buy order has pushed the price from \$50 to \$50.50
  - The change in price (50 cents per contract) represents the market impact at 60 seconds
  - The overall price that “Barry the broker” ended up executing the entire order at was higher than what it would have been if there was no market impact at all
- Market impact is the **difference** between the **price trajectory** of the market **with the order** and what the price trajectory **without the order** ... if only it was that easy to calculate! We are not able to simultaneously observe both price trajectories and measure market impact with any exactness, often referred to as the “Heisenberg uncertainty principle of trading.”
  - A simple measure used by many e-trading professionals is to look at the market impact of a client’s trade in time slices (pre and post trade). Using this process clients can attempt to ascertain on average how much price impact they are causing.



# What is Market Impact and why does it matter so much

- Market impact refers to **the effect that a trade has on the price of a financial instrument**
- When a **large trade is executed**, or a **series of fast small trades**, it can move the market by creating demand or supply pressure. This can result in a temporary (or permanent) change in the price of the market which can affect the execution price of subsequent trades, or the clients targeted trade quantity.



# Trading smart

Now powered with CME TCA insights

## Before the order

**T-0**

Barry adjusts his trade execution, speed, order size and order execution methodology based on post trade analysis prior to the order

Crude oil futures are trading at \$50 per contract

## Seconds after ...

**T+1s**

We provide Barry with TCA insights -

- Mark to Markets
- A corresponding CME benchmark
- The matching engine timestamp
- The type of counterparty matched with

**T+60s**

Barry uses these tools to reduce the traded Market Impact and therefore delivers a better execution quality service for his client



*I write the algos that make my client's sing!*

# Trading smart - How can these TCA insights be used?

## Using Low Latency Analytics API

Clients will be able to **adjust their strategy in near real time** and optimise their overall market impact based on the results of their prior execution analysis.

Have an insight into the **type of counterparty they are matching with**. Based on this they might adjust their trade execution differently

## Using post trade analytics

Clients can look at the market impact by transaction size and trade execution style (i.e. aggressive or passive) and use this information to:

- Adjust the speed of execution of the order
- Adjust the size of the child orders (assuming the parent order needs to be broken down into smaller pieces to execute)
- Adjust the execution methodology with the intention to optimise the market impact on their trades.

# What we plan on delivering \*

Exact release dates TBC

## MDTCA-49

Create Customer Friendly TCA data views

We will be launching the service across cash and futures US Treasury markets followed soon by FX Futures, Equity, Major commodity markets and EBS cash FX

Q4, 2024

**Low Latency TCA**  
(WebSocket API)

Q1 2025

**Post Trade TCA**  
(REST API)

Q3, 2024

**Post trade TCA data sets via Analytics Hub**

## MDTCA-18

Mark To Market at T-0

## MDTCA-20

CME Benchmark

## MDTCA-19

Time lookbacks for peer benchmarks

Q4, 2024 / Q1 2025

**Dashboards to showcase analytics offering**

*\* We have dependencies on other PODS such as data enablements and API PODs*

# What will the TCA look like ?

# Trade Event View: Walk through each child and parent trade

**Clients will be able to query via a Looker Dashboard** (or via API, Big Query access, or through a CME Analytics HUB), individual trades and analytics for specific date ranges, whether trades are outright or spreads, by client ID, trader or session, multi product or single, order type (TBA), MTM type, or even a single match event

Over 130 fields available today, more will be available in the future

- **Basic Trade fields** : nanosecond time stamps, product codes, firm information (Firm ID, Operator ID, Session ID)
- **Order Information:** Trade Qty, Trade Direction, Trade Price, passive/aggressive indicator, Order ID, CME match events, CME Sequence numbers, Market Spread match type, Order type (TBA), Iceberg Amt shown/hidden (TBA)
- **Parent Order information:** Trades aggregated from same trader, trading in same direction continuously without a 5 minute break : Total Parent Trade Size, Parent Group ID, Parent VWAP, Parent Duration
- **Best Execution Benchmarks:** Market TWAP, Sweep VWAP at time zero, Optimal Execution Rate, slippage for each
- **Market Stats:** Hourly and Daily Volatility, Cash to Futures Basis Spread, Futures Equivalent Mid Price, Futures BBO and Qty, Previous BBO for Cash

**Mark to Market Stats:** MTM stats in USD or USD per million, First Trade of Day, Last trade of Day, MTM stats in time from -60 sec, -30, -5, -1, 0, 10ms, 50ms... out to 20 mins (31 slices currently), and MTM stats by count of number of market orderbook updates from -400..-10, -1, 1, ...5,...50...200..400..4000.. (gives a dynamic MTM based on trade activity in the market instead of just time)

# Trade Event View: 5 year Brokertec UST example

CME Group

Trade Analytics MVP

Trade Event View

9m ago

Time Breakdown

Market Spread Type

Cycle Date

Transaction Time

Execution Firm ID

Operator ID

Session ID

Exchange ID

Product Code

Product Type

PTG Order ID

Aggressor Indicator (Yes / No)

Market Impact Display Type

Market Impacts by Time

By Cycle Date

Market Impact Type

By Time

Transaction Time (Nanoseconds)

Side

Market Spread Type

Trade Qty

Total PTG Qty

Trade Price Volume Weighted Avg Price

Parent Trade Volume Weighted Avg Price

Trade Parent Duration (seconds)

Market TWAP

19 2022-06-02 05:18:05.293693

20 2022-06-02 05:52:25.997023

21 2022-06-02 11:22:26.608860

22 2022-06-02 11:22:26.609014

23 2022-06-02 11:22:26.609052

24 2022-06-02 11:22:26.609111

25 2022-06-02 11:22:26.609377

26 2022-06-02 11:22:32.234440

27 2022-06-02 11:22:32.234458

28 2022-06-02 11:22:32.234459

29 2022-06-02 11:22:32.714375

30 2022-06-02 11:22:32.714590

31 2022-06-02 11:23:55.838461

32 2022-06-02 11:23:55.838475

33 2022-06-02 11:23:55.838475

34 2022-06-02 11:24:37.366864

35 2022-06-02 11:25:13.057948

36 2022-06-02 11:25:13.057948

37 2022-06-02 11:25:13.057960

38 2022-06-02 11:25:13.057968

39 2022-06-02 11:25:13.057969

40 2022-06-02 11:25:39.506409

41 2022-06-02 11:25:39.506426

42 2022-06-02 11:25:39.506429

43 2022-06-02 11:33:20.902653

44 2022-06-02 11:33:20.902653

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46 2022-06-02 11:33:20.902653

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63 2022-06-02 11:33:20.902653

64 2022-06-02 11:33:20.902653

65 2022-06-02 11:33:20.902653

Parent Trade Volume Weighted Avg Price

Trade Parent Duration (seconds)

Market TWAP

98.6171875

0

98.6171875

98.5703125

0

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# Trade Event View: Optimal Execution Rates, Volatility, Futures BBO

CME Group

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Trade Analytics MVP

## Trade Event View

9m ago 🔄 ⌵ ⌵

Time Breakdown

Market Spread Type

Cycle Date

Transaction Time

Execution Firm ID

Operator ID

Session ID

Exchange ID

Product Code

Product Type

PTG Order ID

Aggressor Indicator (Yes / No)

Market Impact Display Type

Market Impacts by Time

By Cycle Date

is Outright in Direct Market or Outright in Ind...

2022/06/02 - 2022/06/02

is any time

Firm ID

Operator

SSN ID

is BTEC

is UB05

is BOND

is any value

any value

Dollars per Million

is mid\_px\_minus30sec or mid\_px\_0ms or ml...

Market Impact Type

Match Event ID

Trading Platform

By Time

is any value

BTD

GLBX

Trade Event View

	Trade Parent Sweep VWAP	PTG Optimal Execution Rate	PTG Optimal Execution Slippage	PTG Sweep Slippage	PTG TWAP Slippage	Prev OB Mid Price	Vol Val Daily	Vol Val Hourly	Cash to Futures - Basis Spread	Futures - Mid Price	Futures - Best Bid Qty	Futures - Best Bid Price	Futures - Best Ask Qty	Futures - Best Ask Price	Previous Top Bid Price	Prev
19	98.625	98.61718750	0	0.00781250	0.00000000	98.62109375	0.0896	0.3	13.7421875	112.36328125	119	112.359375	155	112.3671875	98.6171875	2
20	98.5625	98.57031250	0	0.00781250	0.00000000	98.56640625	0.0896	0.3	13.75	112.31640625	276	112.3125	206	112.3203125	98.5625	2
21	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.60546875	0.0896	0.3	13.7421875	112.34765625	542	112.34375	74	112.3515625	98.6015625	1
22	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.60546875	0.0896	0.3	13.7421875	112.34765625	542	112.34375	74	112.3515625	98.6015625	5
23	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.60546875	0.0896	0.3	13.7421875	112.34765625	542	112.34375	74	112.3515625	98.6015625	7
24	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.60546875	0.0896	0.3	13.7421875	112.34765625	542	112.34375	74	112.3515625	98.6015625	6
25	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.60546875	0.0896	0.3	13.7421875	112.34765625	542	112.34375	74	112.3515625	98.6015625	5
26	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.60546875	0.0896	0.3	13.7421875	112.34765625	311	112.34375	158	112.3515625	98.6015625	5
27	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.60546875	0.0896	0.3	13.7421875	112.34765625	307	112.34375	158	112.3515625	98.6015625	5
28	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.60546875	0.0896	0.3	13.7421875	112.34765625	311	112.34375	158	112.3515625	98.6015625	4
29	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.60546875	0.0896	0.3	13.7421875	112.34765625	307	112.34375	161	112.3515625	98.6015625	5
30	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.60546875	0.0896	0.3	13.7421875	112.34765625	307	112.34375	161	112.3515625	98.6015625	1
31	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.60546875	0.0896	0.3	13.7421875	112.34765625	432	112.34375	183	112.3515625	98.6015625	5
32	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.60546875	0.0896	0.3	13.7421875	112.34765625	432	112.34375	183	112.3515625	98.6015625	5
33	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.60546875	0.0896	0.3	13.7421875	112.34765625	432	112.34375	183	112.3515625	98.6015625	5
34	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.60546875	0.0896	0.3	13.7421875	112.34765625	432	112.34375	183	112.3515625	98.6015625	4
35	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.59765625	0.0896	0.3	13.7421875	112.33984375	120	112.3359375	331	112.34375	98.59375	5
36	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.59765625	0.0896	0.3	13.7421875	112.33984375	266	112.3359375	273	112.34375	98.59375	5
37	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.59765625	0.0896	0.3	13.7421875	112.33984375	266	112.3359375	273	112.34375	98.59375	5
38	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.59765625	0.0896	0.3	13.7421875	112.33984375	266	112.3359375	273	112.34375	98.59375	5
39	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.59765625	0.0896	0.3	13.7421875	112.33984375	266	112.3359375	273	112.34375	98.59375	5
40	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.59765625	0.0896	0.3	13.7421875	112.33984375	183	112.3359375	317	112.34375	98.59375	5
41	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.59765625	0.0896	0.3	13.7421875	112.33984375	183	112.3359375	317	112.34375	98.59375	4
42	98.61588541680952	98.59579613	-0.00241815	0.01767113	0.00142560	98.59765625	0.0896	0.3	13.7421875	112.33984375	183	112.3359375	317	112.34375	98.59375	1
43	98.609375	98.60156250	0	0.00781250	0.00000000	98.60546875	0.0896	0.3	13.7421875	112.34765625	550	112.34375	169	112.3515625	98.6015625	5

Trade Parent Sweep VWAP



# Trade Event View: Basis, Futures BBO, Traded Market BBO, SOD/EOD MTM

CME Group



Trade Analytics MVP

## Trade Event View

10m ago

Time Breakdown

By Cycle Date

Market Spread Type

Is Outright in Direct Market or Outright in Indi...

Cycle Date

2022/06/02 - 2022/06/02

Transaction Time

Is any time

Execution Firm ID

Firm ID

Operator ID

Operator

Session ID

SSN ID

Exchange ID

Is BTC

Product Code

Is UB05

Product Type

Is BOND

PTG Order ID

Is any value

Aggressor Indicator (Yes / No)

any value

Market Impact Display Type

Dollars per Million

Market Impacts by Time

Is mid\_px\_minus30sec or mid\_px\_0ms or mL...

Market Impact Type

By Time

Match Event ID

Is any value

Trading Platform

BTD

GLBX

### Trade Event View

Cash to Futures - Basis Spread	Futures - Mid Price	Futures - Best Bid Qty	Futures - Best Bid Price	Futures - Best Ask Qty	Futures - Best Ask Price	Previous Top Bid Price	Previous Top Bid Qty	Previous Top Ask Price	Previous Top Ask Qty	Avg PTG Max Shown Qty	Total SOD Mark to Market	Total EOD Mark to Market	Mid Price -60sec	Mid Price -30sec
13.7421875	112.36328125	119	112.359375	155	112.3671875	98.6171875	2	98.625	8	2	\$156.25	\$703.13	-\$39.06	\$0.00
13.75	112.31640625	276	112.3125	206	112.3203125	98.5625	25	98.5703125	5	5	-\$625.00	-\$1,171.88	\$0.00	\$0.00
13.7421875	112.3475625	542	112.34375	74	112.3515625	98.6015625	11	98.609375	15	5	\$312.50	\$859.38	\$39.06	\$39.06
13.7421875	112.3475625	542	112.34375	74	112.3515625	98.6015625	9	98.609375	15	5	\$312.50	\$859.38	\$39.06	\$39.06
13.7421875	112.3475625	542	112.34375	74	112.3515625	98.6015625	7	98.609375	16	5	\$312.50	\$859.38	\$39.06	\$39.06
13.7421875	112.3475625	542	112.34375	74	112.3515625	98.6015625	6	98.609375	16	5	\$312.50	\$859.38	\$39.06	\$39.06
13.7421875	112.3475625	542	112.34375	74	112.3515625	98.6015625	5	98.609375	16	5	\$312.50	\$859.38	\$39.06	\$39.06
13.7421875	112.3475625	311	112.34375	158	112.3515625	98.6015625	5	98.609375	14	5	\$312.50	\$859.38	\$39.06	\$39.06
13.7421875	112.3475625	311	112.34375	158	112.3515625	98.6015625	5	98.609375	14	5	\$312.50	\$859.38	\$39.06	\$39.06
13.7421875	112.3475625	311	112.34375	158	112.3515625	98.6015625	4	98.609375	14	5	\$312.50	\$859.38	\$39.06	\$39.06
13.7421875	112.3475625	307	112.34375	161	112.3515625	98.6015625	5	98.609375	15	5	\$312.50	\$859.38	\$39.06	\$39.06
13.7421875	112.3475625	307	112.34375	161	112.3515625	98.6015625	1	98.609375	15	5	\$312.50	\$859.38	\$39.06	\$39.06
13.7421875	112.3475625	432	112.34375	183	112.3515625	98.6015625	8	98.609375	17	5	\$312.50	\$859.38	\$39.06	\$39.06
13.7421875	112.3475625	432	112.34375	183	112.3515625	98.6015625	5	98.609375	17	5	\$312.50	\$859.38	\$39.06	\$39.06
13.7421875	112.3475625	432	112.34375	183	112.3515625	98.6015625	4	98.609375	17	5	\$312.50	\$859.38	\$39.06	\$39.06
13.7421875	112.33984375	120	112.3359375	331	112.34375	98.59375	5	98.6015625	14	5	\$390.63	\$937.50	\$117.19	\$0.00
13.7421875	112.33984375	266	112.3359375	273	112.34375	98.59375	6	98.6015625	13	5	\$390.63	\$937.50	-\$39.06	\$39.06
13.7421875	112.33984375	266	112.3359375	273	112.34375	98.59375	5	98.6015625	13	5	\$390.63	\$937.50	-\$39.06	\$39.06
13.7421875	112.33984375	266	112.3359375	273	112.34375	98.59375	3	98.6015625	13	5	\$390.63	\$937.50	-\$39.06	\$39.06
13.7421875	112.33984375	266	112.3359375	273	112.34375	98.59375	2	98.6015625	13	5	\$390.63	\$937.50	-\$39.06	\$39.06
13.7421875	112.33984375	183	112.3359375	317	112.34375	98.59375	5	98.6015625	15	5	\$390.63	\$937.50	\$39.06	\$39.06
13.7421875	112.33984375	183	112.3359375	317	112.34375	98.59375	4	98.6015625	15	5	\$390.63	\$937.50	\$39.06	\$39.06
13.7421875	112.33984375	183	112.3359375	317	112.34375	98.59375	1	98.6015625	15	5	\$390.63	\$937.50	\$39.06	\$39.06
13.7421875	112.3475625	550	112.34375	169	112.3515625	98.6015625	6	98.609375	16	4	\$312.50	\$859.38	\$39.06	\$0.00

Comparative 5 ZF Year Futures Market

What was the 5 Year Cash UST market BBO at time of trade

# Trade Event View: MTM by time slice, -60 sec to 15 sec

CME Group

🔍 📄 🗨

Trade Analytics MVP

## Trade Event View

11m ago ⌂

Time Breakdown

By Cycle Date

Market Spread Type

is Outright in Direct Market or Outright in Indi...

Cycle Date

2022/06/02 - 2022/06/02

Transaction Time

is any time

Execution Firm ID

Firm ID

Operator ID

Operator

Session ID

SSN ID

Exchange ID

is BTEC

Product Code

is UB05

Product Type

is BOND

PTG Order ID

is any value

Aggressor Indicator (Yes / No)

any value

Market Impact Display Type

Dollars per Million

Market Impacts by Time

is mid\_px\_minus30sec or mid\_px\_0ms or m...

Market Impact Type

By Time

Match Event ID

is any value

Trading Platform

BTD GLBX

Trade Event View

	Mid Price -60sec	Mid Price -30sec	Mid Price -5sec	Mid Price -1sec	Mid Price -100ms	Mid Price -10ms	Mid Price 0ms	Mid Price 10ms	Mid Price 50ms	Mid Price 100ms	Mid Price 200ms	Mid Price 500ms	Mid Price 1sec	Mid Price 2sec	Mid Price 3sec	Mid Price 4sec	Mid Price 5sec	Mid Price 10sec	Mid Price 15sec	Mid Price 20sec
19	-\$39.06	\$0.00	\$39.06	\$39.06	\$39.06	\$39.06	\$0.00	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	\$0.00	\$39.06	\$39.06
20	\$0.00	\$0.00	\$0.00	\$0.00	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06
21	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06
22	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06
23	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06
24	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06
25	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$0.00	-\$39.06	-\$39.06	-\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06
26	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	\$39.06	\$0.00	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06
27	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	\$39.06	\$0.00	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06
28	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$0.00	-\$39.06	-\$39.06	-\$39.06	-\$39.06	\$39.06	\$0.00	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06
29	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$0.00	-\$39.06	-\$39.06	-\$39.06	-\$39.06	\$39.06	\$0.00	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06
30	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06
31	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
32	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$117.19	-\$117.19	-\$117.19	-\$78.13	-\$78.13
33	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$117.19	-\$117.19	-\$117.19	-\$78.13	-\$78.13
34	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$117.19	-\$117.19	-\$117.19	-\$78.13	-\$78.13
35	\$117.19	\$0.00	\$0.00	\$0.00	-\$39.06	\$39.06	\$0.00	\$0.00	\$0.00	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06
36	-\$39.06	-\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	-\$39.06	\$0.00	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06
37	-\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	-\$39.06	\$0.00	\$0.00	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06
38	-\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$0.00	\$0.00	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06
39	-\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$0.00	-\$39.06	\$0.00	\$0.00	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06
40	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$78.13
41	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$78.13
42	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$0.00	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	-\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$39.06	\$78.13
43	\$39.06	\$0.00	\$39.06	\$39.06	\$39.06	\$39.06	\$0.00	\$0.00	\$0.00	\$0.00	-\$39.06	-\$39.06	-\$39.06	-\$39.06	\$0.00	\$0.00	-\$39.06	-\$39.06	\$0.00	\$0.00

Mark to Market in USD Per Million traded

# Participant Trade Summary

Benchmark comparison shows comparison to CME peer category defined by order fill ratios

Trade Analytics MVP

## Participant Summary (Performance) ♡ 🔍

1m ago 🔄 ☰

Time Breakdown

Market Spread Type

Cycle Date

Execution Firm ID

Operator ID

Session ID

Exchange ID

Product Type

Product Code

Aggressor Indicator (Yes / No)

Split by Trade Indicator (Yes / No)

Peer Category Type

Market Impact Type

By All

is Outright in Direct Market or Outright in Ind...

is any time

Firm ID

is any value

is any value

is BTC

is BOND

is UB10

any value

Yes

No

Order Fill Ratio

By Time

Market Impact Price Display

Dollars per Million

### Peer Group Market Aggregates

Peer Category	Trade Count Total (%)	Trade Qty Total (%)	Aggressive Trade Total (%)	Passive Trade Total (%)	Avg PTG Count	Avg PTG Qty	Avg PTG Aggressive Qty	Avg PTG Passive Qty	Avg PTG Duration (s)	Avg PTG Max Shown Qty	Optimal Execution Slippage	Avg Sweep Slippage	Avg TWAP Slippage	Cash to Futures - Basis VWAP	Mid Price -30sec	Mid Price 0ms	Mid Price 5sec	Mid Price 15sec	Mid Price 30sec	Mid Price 60sec	Mid Price 120sec	Mid Price 600sec
1 High Frequency	24%	21%	16%	26%	3	4	1	2	57.8	0	-0.00997799	92.18062382	0.00044119	40.04	\$12.44	\$2.48	-\$1.63	-\$1.49	-\$1.30	-\$0.40	\$0.76	\$3.61
2 Active Participant	30%	26%	27%	25%	2	3	2	2	47.3	1	-0.00823838	90.79590218	0.00005373	39.86	\$1.75	-\$7.37	\$2.18	\$1.93	\$1.90	\$2.04	\$2.30	\$2.00
3 Primary Participant	17%	17%	18%	16%	3	5	3	2	46.4	0	-0.00816419	92.28318854	0.00019900	40.02	-\$0.01	\$0.44	\$4.25	\$3.43	\$2.95	\$2.40	\$2.31	\$3.44
4 Secondary Participant	19%	24%	26%	21%	3	7	4	3	60.1	1	-0.00966700	91.14510223	-0.00002327	39.19	-\$3.89	\$3.18	\$0.15	\$0.29	\$0.49	\$0.31	-\$0.24	-\$1.51
5 Agency Model	9%	12%	13%	12%	3	6	3	3	55.2	1	-0.01215929	90.59915558	0.00002380	39.61	-\$8.59	\$3.19	-\$9.81	-\$9.01	-\$8.80	-\$8.89	-\$9.32	-\$11.35

### Participant Metrics & Market Impacts

Timeframe	Product Code	Exchange ID	Execution Firm ID	Operator ID	Session ID	Peer Category	Trade Indicator	Avg PTG Max Shown Qty	Optimal Execution Slippage	Avg Sweep Slippage	Avg TWAP Slippage	Cash to Futures - Basis VWAP	Mid Price -30sec	Mid Price 0ms	Mid Price 5sec	Mid Price 15sec	Mid Price 30sec	Mid Price 60sec	Mid Price 120sec
1	UB10	BTEC	Firm ID			Agency Model	-	3	-0.01323956	93.16692917	-0.00008536	42.25	-\$8.41	\$12.92	-\$6.75	-\$2.38	\$1.23	\$2.85	\$1.50
2	UB10	BTEC				Agency Model	-	3	-0.01284264	93.07704079	-0.00016962	42.23	-\$13.47	\$13.72	-\$4.76	-\$2.01	\$0.33	-\$0.27	-\$3.32
3	UB10	BTEC				High Frequency	-	2	-0.01260955	91.09402242	0.00110620	39.52	\$61.00	\$31.60	\$7.17	\$5.28	\$5.66	\$5.09	\$2.63
4	UB10	BTEC				High Frequency	-	2	-0.01246391	91.21113071	0.00100037	39.47	\$59.80	\$31.64	\$6.97	\$3.16	\$4.34	\$5.68	\$3.43
5	UB10	BTEC				Agency Model	-	4	-0.01297041	93.78648895	-0.00009767	36.60	-\$11.95	\$0.90	-\$8.06	-\$4.75	-\$3.73	-\$0.65	-\$4.31
6	UB10	BTEC				Agency Model	-	4	-0.01453585	94.67323432	-0.00016535	36.46	-\$13.28	\$1.81	-\$6.10	\$0.35	\$1.03	\$2.01	\$5.41
7	UB10	BTEC				Active Participant	-	1	-0.01246251	94.82626739	0.00062605	43.17	\$50.50	\$31.51	-\$8.53	-\$10.28	-\$10.52	-\$7.08	-\$9.07
8	UB10	BTEC				Active Participant	-	1	-0.01196258	94.95037477	0.00057539	43.22	\$49.67	\$33.53	-\$5.14	-\$7.10	-\$7.94	-\$2.77	-\$3.57
9	UB10	BTEC				Secondary Participant	-	7	-0.00135987	84.31297982	0.00018105	37.87	-\$19.89	\$37.67	\$1.58	-\$4.29	-\$3.09	\$13.35	\$0.94
10	UB10	BTEC				Active Participant	-	7	-0.00368184	76.55094717	-0.00012769	28.19	-\$82.83	\$14.42	\$13.68	-\$23.28	\$2.48	\$69.27	\$86.11
11	UB10	BTEC				Active Participant	-	10	-0.00246659	84.12726281	-0.00141812	32.86	\$42.12	-\$37.92	\$12.72	\$42.36	\$16.68	-\$23.40	\$1.56
12	UB10	BTEC				Agency Model	-	4	-0.00062296	88.59516995	0.00000468	37.73	-\$46.68	\$8.44	-\$21.35	-\$34.26	-\$40.39	\$5.30	\$18.37
13	UB10	BTEC				High Frequency	-	2	-0.01622768	93.56391887	-0.00034077	39.14	\$73.11	\$17.38	\$2.69	\$5.55	-\$29.21	-\$45.33	-\$75.26
14	UB10	BTEC				Agency Model	-	1	-0.00228987	82.93468806	0.00039911	26.47	-\$98.44	-\$33.40	\$129.10	\$110.94	\$148.44	\$188.28	\$195.12
15	UB10	BTEC				Agency Model	-	2	-0.00034091	97.10330294	0.00194098	39.14	-\$111.27	\$17.16	\$8.09	\$29.00	\$112.06	\$201.82	\$169.86
16	UB10	BTEC				Secondary Participant	-	3	-0.00194752	86.74682668	0.00077837	7.55	-\$40.40	-\$11.44	\$4.62	\$2.92	\$7.06	-\$6.08	\$27.50
17	UB10	BTEC				Secondary Participant	-	10	0.00000000	84.29200491	0.00072570	24.29	-\$9.11	\$15.63	\$11.07	-\$18.88	-\$29.30	-\$14.65	\$9.44
18	UB10	BTEC				Agency Model	-	6	0.00000000	83.7377528	0.00000000	33.25	\$38.36	\$5.58	-\$14.30	-\$6.28	\$3.14	\$90.68	\$36.27

# Participant Trade Summary

Trade Analytics MVP

## Participant Summary (Performance) ♥ 📄

just now ↺ ⌵

Time Breakdown

Market Spread Type

Cycle Date

Execution Firm ID

Operator ID

Session ID

Exchange ID

Product Type

Product Code

Aggressor Indicator (Yes / No)

Split by Trade Indicator (Yes / No)

Peer Category Type

Market Impact Type

By All

Is Outright in Direct Market or Outright in Indi...

Is any time

Firm ID

Is any value

Is any value

Is BTEC

Is BOND

Is UB10

any value

Yes

No

Market Maker

By Time

Market Impact Price Display

Dollars per Million

### Peer Group Market Aggregates

Peer Category	Trade Count Total (%)	Trade Qty Total (%)	Aggressive Trade Total (%)	Passive Trade Total (%)	Avg PTG Count	Avg PTG Qty	Avg PTG Aggressive Qty	Avg PTG Passive Qty	Avg PTG Duration (s)	Avg PTG Max Shown Qty	Optimal Execution Slippage	Avg Sweep Slippage	Avg TWAP Slippage	Cash to Futures - Basis VWAP	Mid Price -30sec	Mid Price 0ms	Mid Price 5sec	Mid Price 15sec	Mid Price 30sec	Mid Price 60sec	Mid Price 120sec	Mid Price 600sec
1 Market Maker	54%	48%	55%	40%	2	3	2	1	43.2	0	-0.00794896	92.07330421	0.00011345	39.86	-\$0.82	-\$12.11	\$1.76	\$1.94	\$2.04	\$2.54	\$3.14	\$4.30
2 Non Market Maker	46%	52%	45%	60%	3	7	3	4	69.2	1	-0.01152182	90.26304559	0.00024367	39.62	\$2.77	\$10.66	-\$2.03	-\$2.28	-\$2.33	-\$2.64	-\$2.96	-\$3.71

### Participant Metrics & Market Impacts

Timeframe	Product Code	Exchange ID	Execution Firm ID	Operator ID	Session ID	Peer Category	Trade Indicator	Order Fill %	Trade Count Total	Trade Qty Tot	Spread Trade Total	Direct Trade Total	Indirect Trade Total	Aggressive Trade Total	Passive Trade Total	% Aggressor	Avg PTG Count	Avg PTG Qty	Avg PTG Aggressive Qty	Avg PTG Passive Qty	Avg PTG Duration (s)	Avg Sho
1	UB10	BTEC	Firm ID			Non Market Maker	-	82.0%	44,254	100,633	0	100,628	5	50,320	50,313	50%	4	9	4	4	111.0	-
2	UB10	BTEC				Non Market Maker	-	81.7%	44,135	99,896	0	99,860	36	50,317	49,579	50%	4	9	4	4	107.8	-
3	UB10	BTEC				Non Market Maker	-	6.9%	67,490	87,651	0	87,786	65	32	87,819	0%	4	5	0	5	100.7	-
4	UB10	BTEC				Non Market Maker	-	6.9%	67,067	87,323	0	87,217	106	43	87,280	0%	4	5	0	5	97.6	-
5	UB10	BTEC				Non Market Maker	-	88.3%	8,674	22,022	0	22,022	0	14,987	7,035	68%	3	8	6	3	85.9	-
6	UB10	BTEC				Non Market Maker	-	88.4%	8,472	21,570	0	21,564	6	15,020	6,550	70%	3	8	6	2	90.1	-
7	UB10	BTEC				Non Market Maker	-	17.5%	2,918	3,662	0	3,661	1	88	3,574	2%	4	5	0	5	135.1	-
8	UB10	BTEC				Non Market Maker	-	17.6%	2,941	3,632	0	3,632	6	86	3,546	2%	4	5	0	5	129.7	-
9	UB10	BTEC				Non Market Maker	-	57.4%	1,085	2,329	0	2,329	0	686	1,643	29%	5	11	4	7	29.5	-
10	UB10	BTEC				Non Market Maker	-	14.8%	266	1,262	0	1,262	0	915	347	73%	3	15	9	6	48.1	-
11	UB10	BTEC				Non Market Maker	-	17.7%	200	651	0	651	0	478	173	73%	6	19	14	5	26.8	-
12	UB10	BTEC				Non Market Maker	-	96.9%	145	472	0	472	0	264	208	56%	2	6	3	3	1.3	-
13	UB10	BTEC				Non Market Maker	-	2.5%	266	436	0	436	0	102	334	23%	3	5	1	4	79.3	-
14	UB10	BTEC				Non Market Maker	-	96.7%	30	400	0	400	0	400	0	100%	3	26	25	1	10.3	-
15	UB10	BTEC				Non Market Maker	-	86.8%	43	396	0	396	0	368	28	93%	9	43	32	11	2.7	-
16	UB10	BTEC				Non Market Maker	-	59.0%	141	321	0	321	0	257	64	80%	3	7	5	2	64.3	-
17	UB10	BTEC				Non Market Maker	-	65.9%	75	240	0	240	0	126	114	53%	5	16	9	8	14.0	-
18	UB10	BTEC				Non Market Maker	-	80.2%	104	224	0	224	0	122	102	54%	5	13	8	5	2.5	-
19	UB10	BTEC				Non Market Maker	-	84.3%	42	210	0	210	0	130	80	62%	5	23	14	9	1.2	-
20	UB10	BTEC				Non Market Maker	-	95.2%	20	190	10	190	0	176	14	93%	2	13	11	2	2.8	-
21	UB10	BTEC				Non Market Maker	-	82.8%	172	172	0	172	0	167	5	97%	1	1	1	0	52.1	-
22	UB10	BTEC				Non Market Maker	-	77.9%	165	165	0	165	0	161	4	98%	1	1	1	0	38.7	-

# Summary

## Clients will be able to query via

- CME Google Analytics Hub / Google Big Query (Sep 24)
- Low latency Direct API with updated trade deltas in near real time (Q4 24)
- Looker dashboards in 2025

**Clients can pick and choose which bit of information they wish to focus on, and which benchmarks are meaningful to them and grab just the information that they want and download to their own systems for analysis.**

## Eg, a client may want to see only

- Basic Trade Information
- Parent Order stats, including best ex comparison to VWAP at time of trade with lookup including hidden orders
- MTM at Zero seconds, 10 and 30 seconds, and Benchmark Market Maker MTM for that time period

## We expect to be adding new features over coming months before its live

For example,

1. What type of client did you match with on each trade, market maker or non market maker ?
2. If you traded the whole sweep at the start what would have being your fill including hidden liquidity ?
3. How can you reduce trade execution slippage using a machine learning model ?



# AI-enabled TCA: ML-based Peer Grouping & Explainable AI can Lower Costs

# AI - Treasury TCA on Google Cloud Platform

- Utilizing leading edge Google Cloud **AI technology** to help customers **better comprehend** and **refine trade execution activities**.
- **Net new insight:** Peer group benchmarking based on trading behavior. Explainable AI to provide actionable suggestions to reduce slippage rate, helping customers unlock new value.

\*slippage rate = the difference between the expected price of an order and the price when the order actually executes

# TCA Evolution

Improved Actions Over Time

Traditional  
TCA

What are  
my costs?

AI  
Enhanced TCA

Net new AI-based insight:

- Trading Behavior-Based Peer Group Rankings
- AI-Based Suggestions to Improve TCA

*the*  
**future**

## Peer Group Ranking

- Puts TCA in context relative to those who trade similar to you
- Provides new, more valuable benchmarking



## Actions to Lower TCA

- Explicitly Identifies Features to Act On
- Improve TCA Outcomes





# AI-Enabled TCA

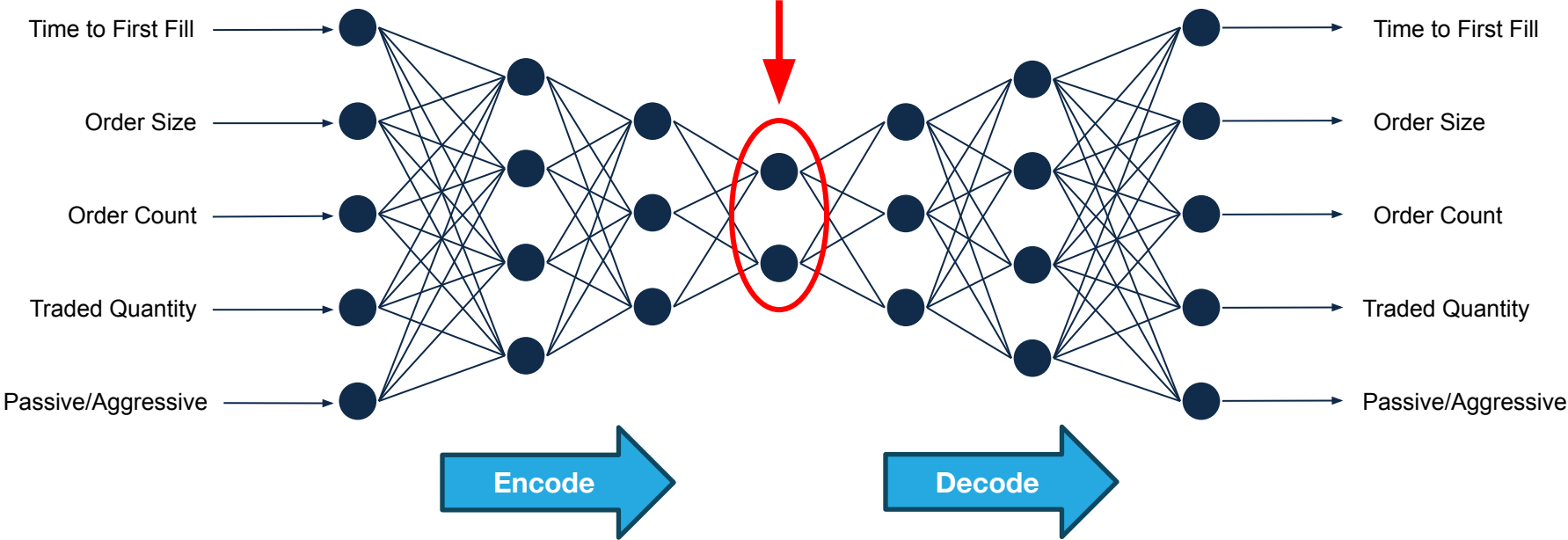


# Autoencoder Neural Network

Trading Data

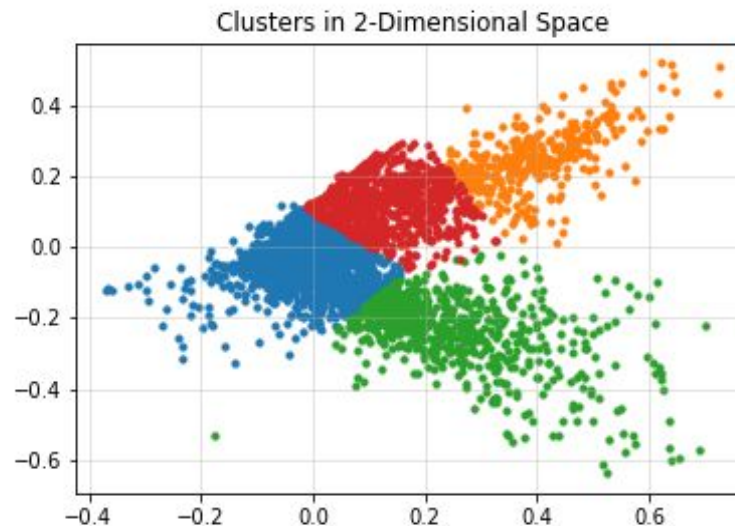
Reconstructed Trading Data

Embeddings



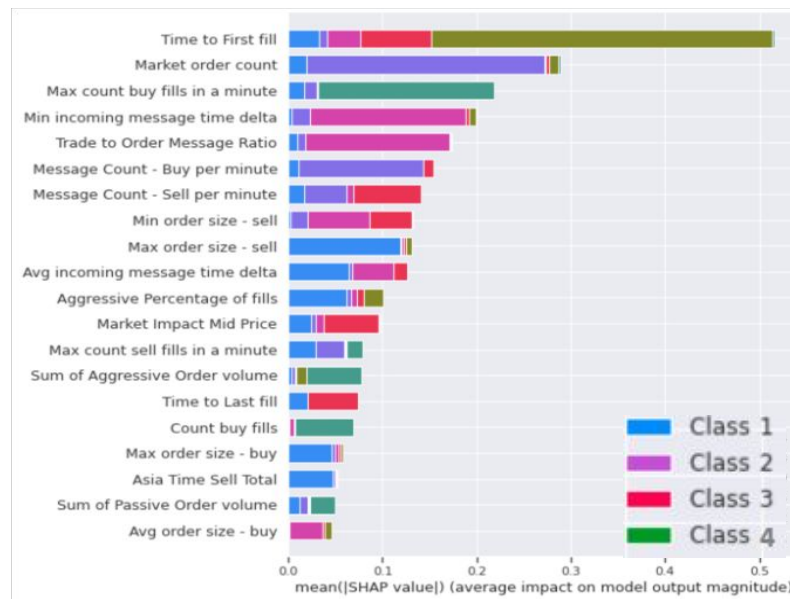
# Using K-Means Clustering Algorithm to Group Participants

- Transform participant trading data into embeddings using Autoencoder.
- Run K-Means clustering using the embeddings.
- Evaluate cluster "goodness of fit" using silhouette score.



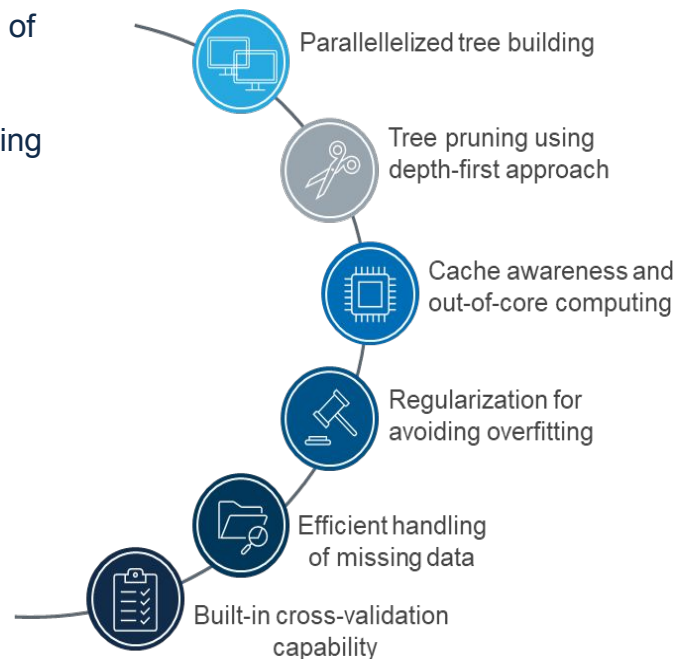
# Using Explainable AI to Define the Peer Groups

- XGBoost Classifier Model trained using original participant trading data.
- Determine the most important features attributed to each peer group using Shapley Additive Explanations (SHAP).
- Explain why a particular individual was placed into a particular peer group using Local Interpretable Model-agnostic Explanations (LIME).

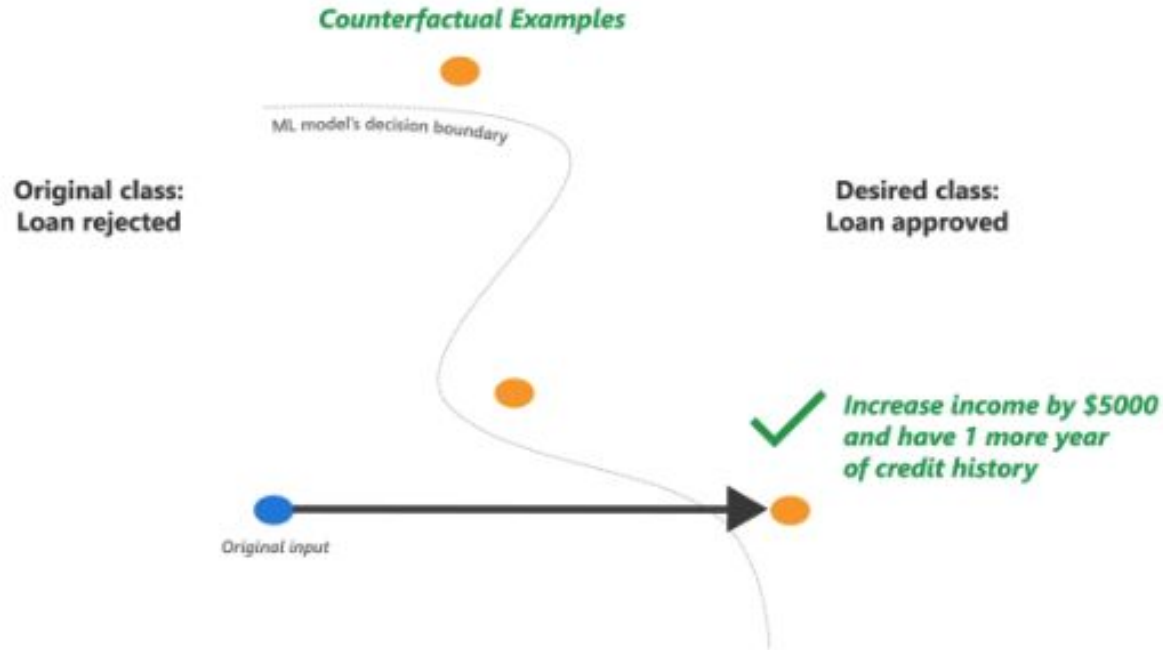


# Slippage Rate Reduction

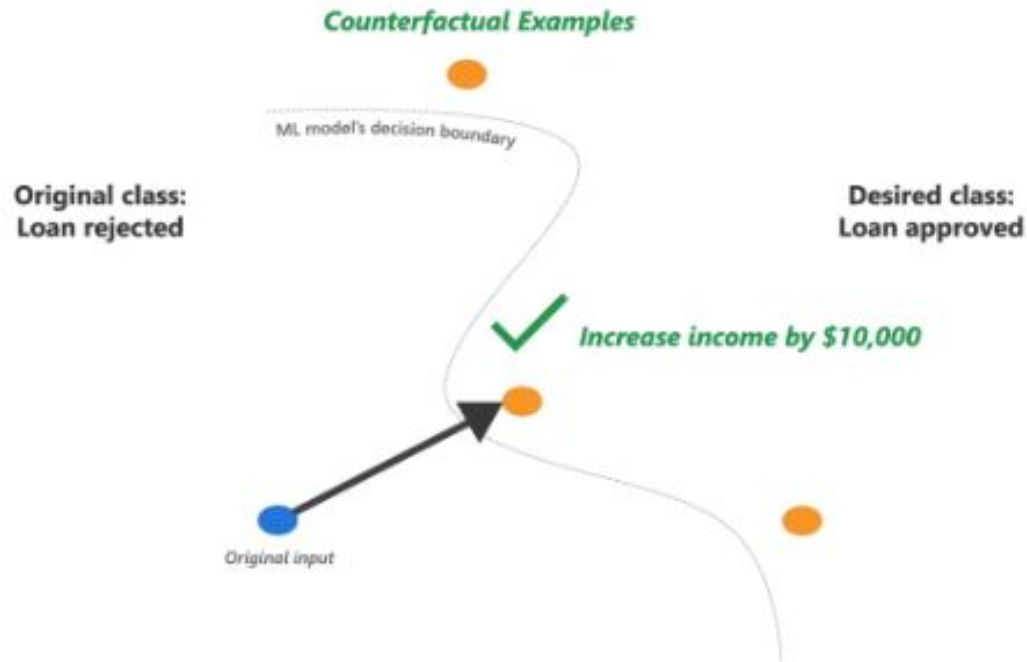
- XGBoost Regression Model trained to predict slippage rate of trade parent.
- Helps the client understand how they can change their trading behavior in order to reduce their slippage cost.
- Prescribe alternative trading behavior using Diverse Counterfactual Explanations (DiCE).



# Explainable AI Using Diverse Counterfactual Explanations (DiCE)



# Explainable AI Using Diverse Counterfactual Explanations (DiCE)



# CME Group and Gen AI

	Public	Internal	Individual Customer
Purpose	Broad, general purpose	Broad, general purpose	Individual & firm specific
Accessibility	Open to the public	Restricted access, employee only, ambassadors	Access is limited to entitled users and firms
Performance	Scalable, supports a large number of users simultaneously, optimal	Customized, optimized for specific operational tasks, personalization engine	Personalized, high volume, mission critical
Data Handling & Privacy	Low data privacy, companies can use data in accordance with the law	High data security, company handles its own data	high-level security & privacy, users agree to company terms of service



# Thank you