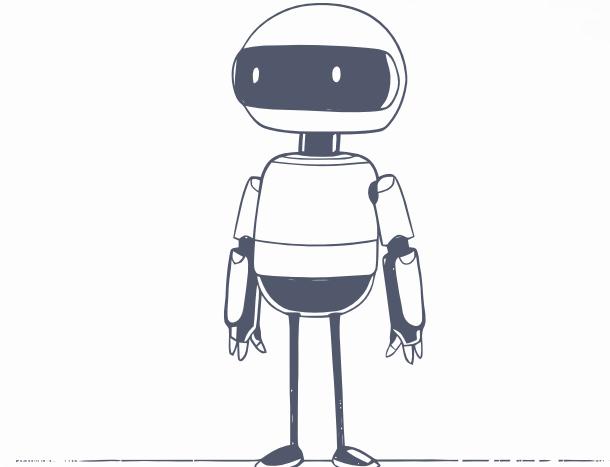
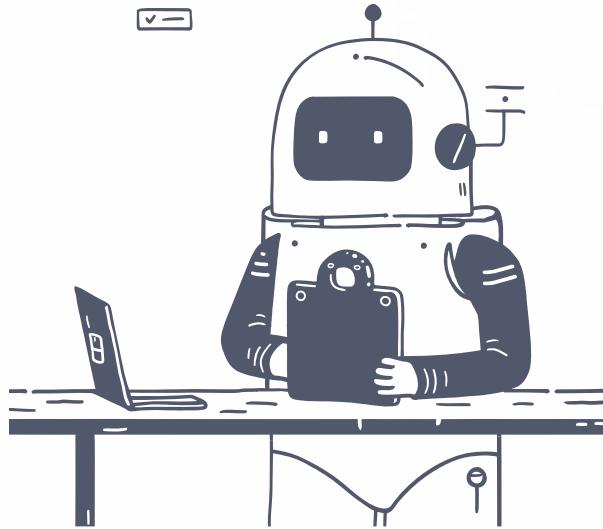


# Market Anomaly Demo



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# Multi-Source Market Anomaly Detection Engine

An agentic system (powered by IBM Agentics) that detects market anomalies by seamlessly integrating structured market data, analyst expectations, and advanced LLM-powered reasoning to provide actionable insights.



## WRDS Data Ingestion

- CRSP delivers daily market metrics including returns and volume.
- Compustat provides fundamental data on revenues and margins.
- IBES supplies analyst forecasts and consensus estimates.



## Text2SQL

Natural-language financial querying powered by schema-aware SQL generation, enabling intuitive data exploration without manual query construction.



## Anomaly Detection

Independent signal channels aggregate into unified anomaly scores with component-level explanations and clear z-score interpretability.

# Data Architecture: WRDS Integration Pipeline

## CRSP Market Data

Daily returns, volatility metrics, trading volume, and shares outstanding power statistical anomaly detection through return shocks and volatility analysis.

## Compustat Fundamentals

Quarterly revenue reports, profit margins, leverage ratios, and cash flow statements identify fundamental drifts and accounting irregularities.

## IBES Analyst Data

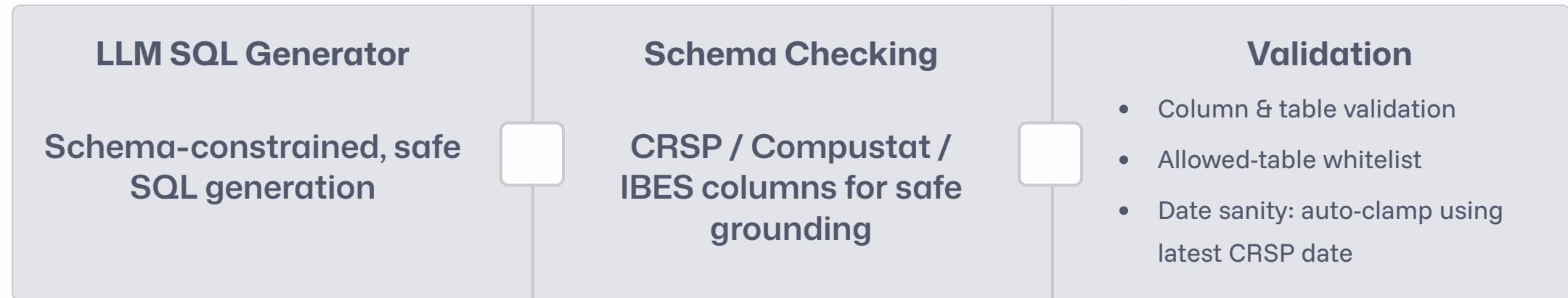
EPS forecasts, revision tracking, and surprise metrics capture sentiment deviations and expectation misalignments across the market.

## Processing Pipeline

Data flows from WRDS through quality control data ingestors into local SQLite and Parquet storage, feeding automated feature generation.

# Text2SQL: Natural-Language Querying

Allows analysts to ask intuitive questions like "*Which companies beat earning estimates last quarter?*" to query the rich market database without having to specify any SQL code.



# Anomaly Detection & Scoring Framework



## CRSP Statistical

Return shocks, volatility jumps, liquidity drops analyzed through z-score interpretation

## Compustat Fundamentals

Margin changes, leverage shifts, accrual anomalies versus historical baselines

## IBES Sentiment

Forecast revisions, surprise dispersion, consensus divergence tracking

## Z-Score Interpretation

- $|z| \leq 0.5$ : Normal range
- $|z| \approx 1.5$ : Moderate anomaly (~33%)
- $|z| \approx 2.0$ : Elevated concern (~50%)
- $|z| \geq 3.0$ : Strong anomaly (~100%)

## Aggregation Model

Weighted combination of independent channels produces final anomaly score with full transparency and component-level breakdown.

$$A_{final} = w_1 A_{CRSP} + w_2 A_{Fund} + w_3 A_{Sent}$$

# Compustat & IBES Anomaly Probabilities

## Compustat

- Build rolling baseline for each metric (revenue, margins, leverage):  
 $\mu$  = historical mean/median,  $\sigma$  = volatility/MAD
- Compute standardized deviation:  $z = \frac{X_{\text{current}} - \mu}{\sigma}$
- Convert to anomaly probability:  $P_{\text{Fund}} = 1 - \Phi(|z|)$
- Aggregate across metrics using max or weighted average

## IBES

- Compute EPS surprise:  $z_{\text{surprise}} = \frac{EPS_{\text{actual}} - EPS_{\text{consensus}}}{\sigma_{\text{surprise}}}$
- Compute forecast revision anomaly:  $z_{\text{rev}} = \frac{\Delta_{\text{rev}}}{\sigma_{\text{rev}}}$
- Convert each into anomaly probabilities:  
 $P_{\text{surprise}} = 1 - \Phi(|z_{\text{surprise}}|), \quad P_{\text{rev}} = 1 - \Phi(|z_{\text{rev}}|)$
- Combine:  $P_{\text{IBES}} = \max(P_{\text{surprise}}, P_{\text{rev}})$

# How Are the Weights Computed?

The weights in our final anomaly score formula are dynamically determined to reflect the informativeness of each signal channel, ensuring a data-driven approach.

## Signal Variance Normalization (Default)

Each component's weight is proportional to how informative (i.e., how variable) its anomaly signal is across the universe of securities.

$$w_i = \frac{Var(A_i)}{\sum_j Var(A_j)}$$

## Adaptive Intuition

- If CRSP anomalies vary significantly, CRSP gets more weight.
- If fundamentals are stable but IBES surprises spike, IBES gets more weight.
- Weights adapt automatically over time to market conditions.

# Future Directions



## Integrate External News & Sentiment

- Add news-based anomaly signals (e.g. Yahoo Finance, Google News, RSS feeds)
- Incorporate Google Trends/search-volume spikes as early indicators
- Use NLP models for tone, uncertainty, and narrative shifts
- Align news timestamps with CRSP/IBES events for causal consistency



## Bayesian Market Priors

- Build an adaptive Bayesian anomaly model
- System learns prior distribution over typical market behavior
- High volatility → weaker prior (more flexible)
- Stable markets → stronger prior (shrinkage toward historical norms)
- Adaptive anomaly probabilities calibrated to market regimes



## Improved Feature Engineering

- Add cross-sectional features: peer deviation, sector-normalized anomalies
- Integrate macroeconomic indicators (VIX, rates, PMI) for market context
- Explore temporal models (RNNs, Transformers) for sequence-aware anomaly scoring