Using Interactive Data Visualization for DeFi Market Analysis

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Abstract

The Decentralized Finance (DeFi) ecosystem is characterized by data-richness, high volatility, and multi-dimensional complexity. Traditional static reports often fail to effectively convey short-term market dynamics and cross-sectional structure simultaneously. This paper presents a comprehensive Business Intelligence (BI) solution designed to overcome these challenges. We introduce an interactive Tableau dashboard built upon a systematic ETL pipeline that aggregates and processes data from key public APIs, including CoinGecko and DeFiLlama. The dashboard integrates a high-level KPI header (Total Market Cap, BTC Dominance, DeFi Market Cap, DeFi 24h Volume), a time-series view of Total Value Locked (TVL), a cross-sectional analysis of market categories (bar and pie charts), and a "Top Movers" panel (24h/7d). Through synchronized, interactive filters (e.g., Time Window, Category Metric, Top N), the dashboard enables rapid data slicing and drill-down analysis. This work demonstrates how a well-designed BI workflow significantly reduces the time-to-insight for DeFi market analysis, transforming static CSV snapshots into reproducible and powerful interactive views. We conclude by discussing the limitations, data quality considerations, and potential extensions of this approach, highlighting its value for both academic research and practical investment decision-making.

Keywords

DeFi, Business Intelligence, Tableau, TVL, KPI dashboards, Interactive Visualization, Financial Analytics

1 Introduction

Decentralized Finance (DeFi) compresses high-frequency market activities—such as liquidity flows, protocol deployments, and shifting incentive programs—into complex datasets that evolve on an hourly or daily basis. To navigate this environment, market participants must simultaneously answer three critical questions:

(1) **What is the current state of the market?** (Level KPIs)
(2) **What are the prevailing trends?** (Time-series analysis)
(3) **What are the underlying structural drivers?** (Cross-sectional analysis of categories and top movers)

Traditional analytical methods involving static tables and charts are ill-suited for this dynamic context. They often present information in fragmented views, increasing the cognitive load on the analyst and obscuring salient patterns [3, 10]. Interactive visualization, by contrast, offers a powerful solution. As outlined by pioneers like Tufte and Few, effective visualization leverages human perceptual capabilities to make complex data intuitive and accessible [3, 10].

This paper's primary contribution is the demonstration of a compact, reproducible BI workflow for DeFi analysis. Using publicly available data, a lightweight ETL pipeline, and the data visualization software Tableau, we construct a dashboard designed to provide a holistic and actionable view of the market. Our goal is to illustrate how this approach can empower analysts, researchers, and investors to make more informed, data-driven decisions.

2 Related Work & Theoretical Framework

Our work is situated at the intersection of DeFi analytics, business intelligence, and the principles of information design.

DeFi Analytics: The academic and industry analysis of DeFi systems highlights metrics like Total Value Locked (TVL), market capitalization, and trading volume as primary signals for monitoring protocol health and adoption [12]. Platforms such as Nansen and Dune Analytics have emerged to provide advanced on-chain analytics, often requiring specialized skills like SQL to build custom queries [1]. Our approach complements these platforms by providing a curated, high-level dashboard that requires no coding knowledge to use, democratizing access to key market insights. Public APIs from data aggregators like CoinGecko and DeFiLlama serve as the foundational data sources for both our system and many industry-standard dashboards, ensuring data consistency and reliability.

Business Intelligence and Dashboards: The principles of data warehousing and BI formalize the process of transforming raw data into structured information for decision support [6]. Modern BI platforms like Tableau are recognized by industry analysts such as Gartner as leading tools for exploratory data analysis due to their interactive capabilities [4]. The design of our dashboard is explicitly guided by established visualization principles, most notably **Ben Shneiderman's "Visual Information Seeking Mantra": Overview first, zoom and filter, then details-on-demand** [8]. This mantra provides a robust framework for creating user-centric interfaces that facilitate data exploration rather than merely presenting static data.

Perception and Information Design: The choice of visualizations in our dashboard is grounded in the science of graphical perception. Research by Cleveland & McGill, later popularized by others, demonstrates that the human eye can judge and compare lengths (as in bar charts) more accurately than angles or areas (as in pie charts) [2, 5]. Consequently, we use bar charts for direct comparisons of market categories and reserve the pie chart for illustrating proportional, part-to-whole relationships. Furthermore, our use of semantic coloring (green for gains, red for losses) in the "Top Movers" panel leverages preattentive processing, allowing users to spot significant movements instantly [11].

3 Methodology: Data and System Design

Our methodology consists of a two-stage process: first, an automated ETL pipeline to prepare the data, and second, the design and implementation of the interactive dashboard in Tableau.

3.1 Data and ETL Pipeline

The analysis is based on **four** clean, processed CSV snapshots generated by our open-source 'deFi-bI-etl' pipeline:

- **`kpi_snapshot.csv`**: A single-row snapshot containing headline market metrics: Total Market Cap, BTC Dominance, DeFi Market Cap, and DeFi 24h Volume.
- **`tvl_protocols_30d.csv`**: A time-series dataset with daily TVL for major DeFi protocols over the last 30 days.
- **`categories_snapshot.csv`**: Category-level aggregations (e.g., *Smart Contract Platforms*, *Layer 1*) with their corresponding Market Cap and 24h Volume.
- **`markets_top.csv`**: Performance data for the top 100 cryptocurrencies by market cap, including price, volume, and percentage change over 24-hour and 7-day periods.

The ETL pipeline is scripted in Python and performs the following tasks: it extracts data from CoinGecko and DeFiLlama APIs, transforms the raw JSON responses into tidy DataFrames using the Pandas library, cleans the data (ensuring consistent naming, UTC timestamps, and correct numeric types), and loads the final output into the CSV files. Tableau connects directly to this folder, and a data refresh in Tableau can trigger the pipeline to regenerate the snapshots.

3.2 Dashboard Design and Layout in Tableau

The dashboard layout is intentionally structured to follow Shneiderman's mantra:

(1) **Overview First:** The top row contains large, clear KPI cards, giving an immediate, high-level summary of the market's state.
(2) **Zoom and Filter:** A persistent sidebar on the right hosts interactive filters:
   - **Parameter *Time Window***: A toggle between '24h' and '7d' that dynamically updates the "Top Movers" view.
   - **Parameter *Category Metric***: Switches the measure used in the category bar and pie charts between 'Market Cap' and 'Volume 24h'.
   - **Parameter *Top N***: An integer input that limits the number of items shown in the "Top Movers" and "Categories" lists.
(3) **Details-on-Demand:** The main canvas is divided into detailed views: a TVL time-series chart, the "Top Movers" bar chart (derived from `markets_top.csv`), and the market category bar and pie charts. Hovering over any data point reveals a detailed tooltip with precise values and contextual information.

This design enables a fluid analytical workflow, where a user can move from a macro overview to a granular investigation without leaving the main dashboard view.

4 Results and Analytical Interpretation

The integrated dashboard (Figure 1) provides a multi-faceted view of the DeFi market. The following sections analyze each component.

4.1 TVL Dynamics: Tracking Capital Flows

The TVL time-series chart (Figure 2) is essential for understanding the flow of capital within the DeFi ecosystem. **Analytical Interpretation:** This view reveals both macro trends and protocol-specific performance. A sustained upward slope across multiple major protocols, for instance, suggests broad risk-on sentiment in the market. Conversely, the sharp, isolated spike in a single protocol's TVL near the end of August points to a specific event, such as a successful product launch or a new liquidity mining program. This visualization transforms a simple metric into a powerful tool for competitive analysis and narrative identification.

4.2 Top Movers: Identifying Short-Term Outliers

The "Top Movers" panel (Figure 3), sourced from `markets_top.csv`, acts as a market scanner, immediately drawing attention to assets with significant short-term price movements. **Analytical Interpretation:** This component is critical for risk management and opportunity spotting. A cluster of assets from the same category (e.g., liquid staking tokens) appearing as top movers can signal the emergence of a new market narrative. Large negative movers can serve as an early warning for protocol-specific issues, such as security exploits or negative regulatory news. The ability to toggle between 24-hour and 7-day views helps distinguish short-term noise from developing momentum.

4.3 Market Structure: Categories and Concentration

The category bar and pie charts (Figures 4 & 5) provide a structural map of the market, showing where value is concentrated. **Analytical Interpretation:** The bar chart (Figure 4) clearly shows that "Layer 1," "Smart Contract Platform," and "Stablecoins" are the dominant sectors by market capitalization. The interactive parameter allows the user to switch this view to "Volume 24h," which can reveal "pockets of activity" in smaller sectors that may be leading indicators of future capital rotation. The pie chart (Figure 5) complements this by providing an immediate visual understanding of market concentration. When the top two or three slices comprise over 50% of the pie, it indicates a highly concentrated market, which has important implications for portfolio diversification and risk management.

5 Discussion

5.1 Synthesis for Decision-Making

The true power of the dashboard lies in the synthesis of these views:

- **Macro Analysis:** High BTC dominance combined with rising DeFi volume can suggest a market where beta is rising, but investors are still selective.
- **Capital Flow Analysis:** Rising overall TVL coupled with high sector-specific volume indicates genuine new capital inflows, whereas rising TVL with flat volume might suggest liquidity is merely being reshuffled or "parked."
- **Narrative Rotation:** When the "Top Movers" list is dominated by assets from a single category, and the "Category" view shows a corresponding rise in volume for that sector, it provides strong evidence of a "narrative rotation" that traders can act upon.

5.2 Threats to Validity and Data Quality

The analysis is subject to several limitations inherent in DeFi data:

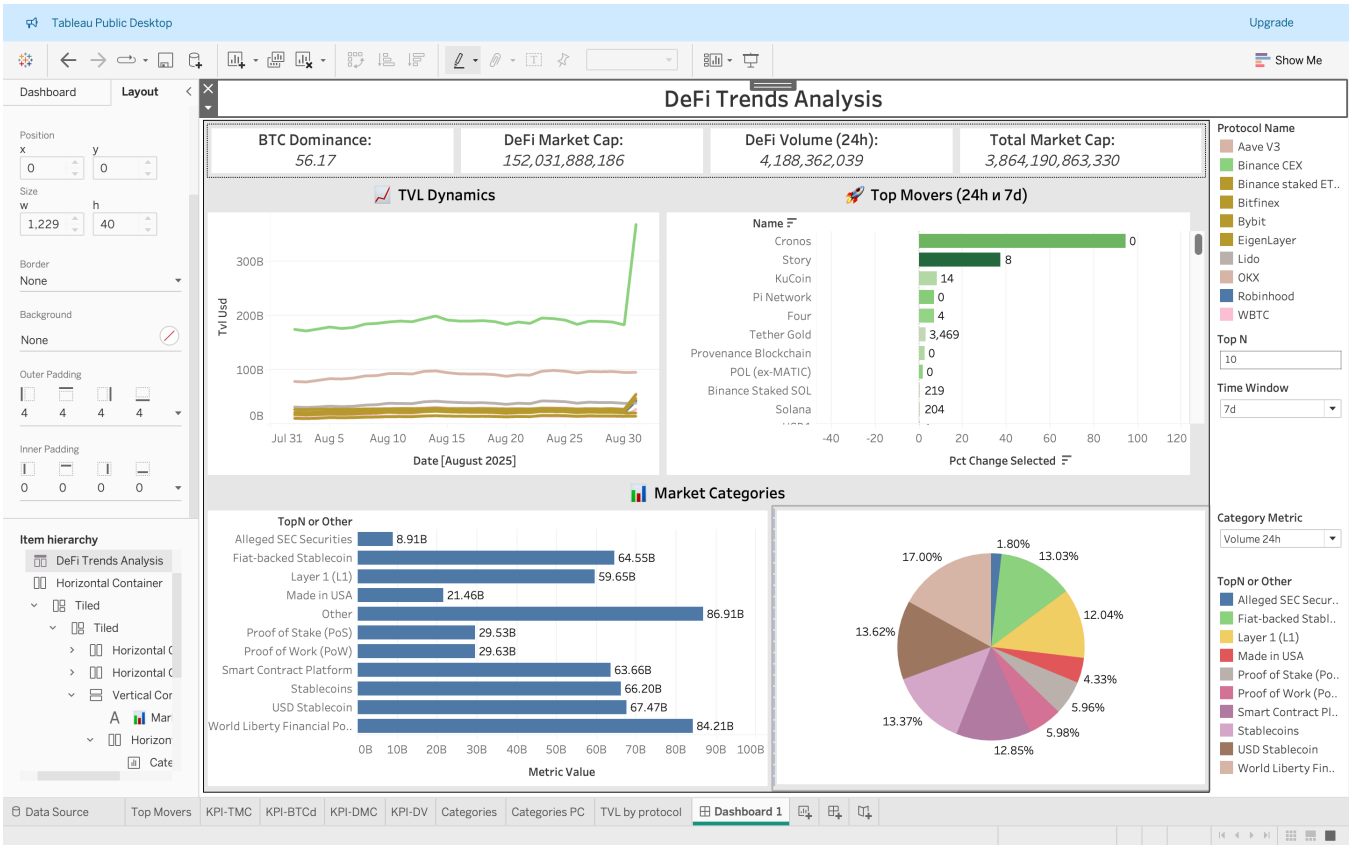

Figure 1: The integrated DeFi Analysis Dashboard. It consolidates all key visualizations into a single, interactive system. The right-hand filters for "Protocol Name," "Time Window," and "Category Metric" allow for dynamic cross-filtering of all charts on the canvas, enabling a deeply integrated analysis.

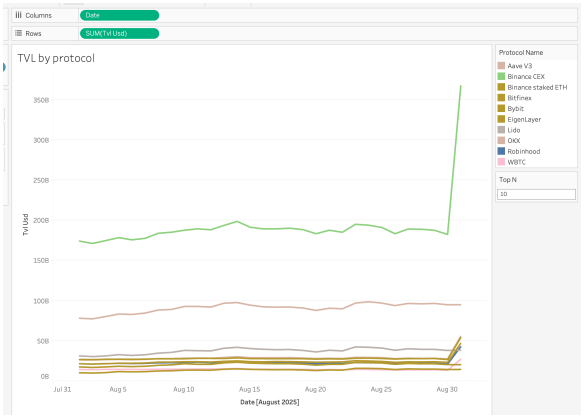

Figure 2: TVL Time-Series (30 days) for Top Protocols.

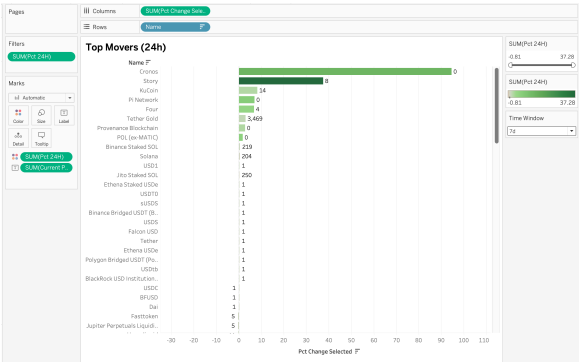

Figure 3: Top Movers Panel (7-day performance view shown).

- **TVL Ambiguity:** Methodologies for calculating TVL can differ. The rehypothecation of assets and derivative tokens can lead to the double-counting of collateral.
- **Universe Bias:** Public APIs may exclude very new or small protocols, and inconsistencies in token naming can lead to data duplication or fragmentation.
- **Latency:** While sufficient for strategic analysis, the CSV snapshots are not tick-by-tick and may miss intraday events.

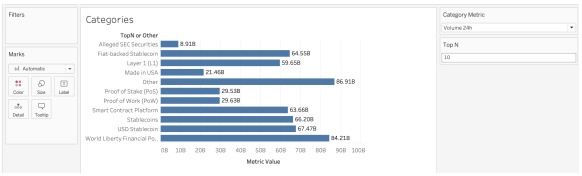

Figure 4: Market Categories by Market Cap.

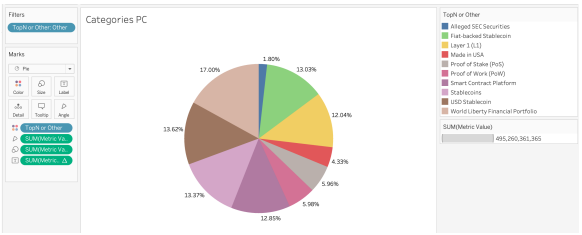

Figure 5: Proportional Breakdown of Market Categories.

To mitigate these, our ETL pipeline includes de-duplication logic, and future iterations could incorporate more robust statistical methods (like Median Absolute Deviation) for anomaly detection.

5.3 Business Value and Use Cases

This dashboard provides tangible value to multiple stakeholders:

- **Investors & Traders:** As a tool for identifying narrative rotations, screening for momentum, and assessing market concentration for risk management.
- **Protocol Teams:** For benchmarking performance against competitors, attributing spikes in TVL to marketing campaigns, and monitoring user retention.
- **Risk & Operations Teams:** For incident triage (via large negative movers) and receiving early warnings of structural shifts in the market.

6 Conclusion and Future Work

This paper has demonstrated a robust, reproducible, and analytically powerful BI workflow for the DeFi market. By integrating a systematic ETL process with an interactive Tableau dashboard guided by established design principles, we have created a tool that significantly shortens the time-to-insight for market participants. The system effectively fuses a high-level overview with deep-dive capabilities, empowering users to move beyond static data consumption to active data exploration.

This work serves as a strong foundation for future enhancements. Immediate next steps include:

(1) **Automation and Real-Time Data:** Fully automating the ETL pipeline with a scheduler (e.g., via GitHub Actions) to provide near real-time dashboard updates.
(2) **Advanced Analytics:** Integrating predictive models (e.g., ETS or GBM forecasting) for TVL and volume, and implementing statistical anomaly detection to automatically flag unusual market activity.
(3) **Data Enrichment:** Expanding the data sources to include on-chain fundamentals such as protocol revenue, daily active users, governance proposal activity, and developer commit metrics to create a richer, more holistic analytical context.

By pursuing these extensions, this BI solution can evolve into an even more indispensable tool for navigating the complexities of the Decentralized Finance ecosystem.

7 Reproducibility

The entire project, including the ETL source code and dashboard structure, is open-sourced to encourage transparency and further development.

Data Sources: The dashboard is powered by four core CSV files generated by the ETL pipeline:

- `kpi_snapshot.csv`
- `tvl_protocols_30d.csv`
- `categories_snapshot.csv`
- `markets_top.csv`

Tooling: The dashboard was created using Tableau Public Desktop.

Source Code: The complete Python ETL pipeline is available at: https://github.com/dariapavlova02/defi_bi_seminar

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