San Francisco Crime Trend Analysis and Forecasting (2018 - 2025)

From Data to Decision Support

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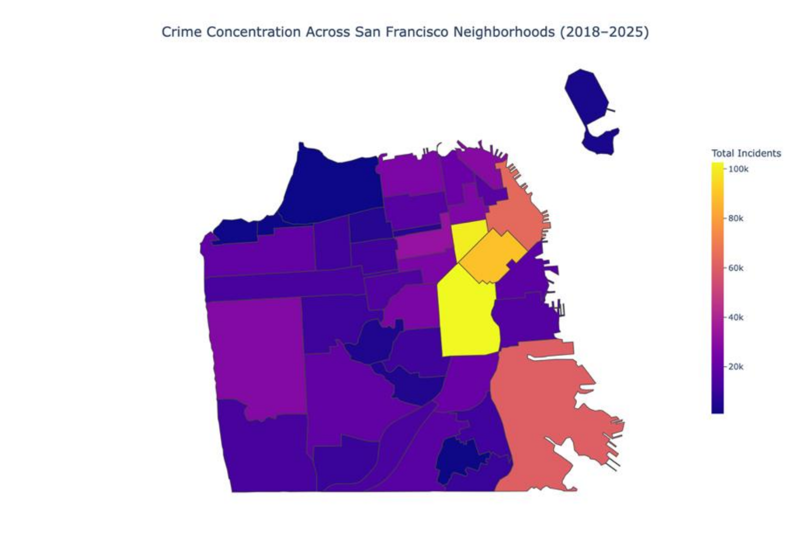
The Problem: Data Exists, Decisions Lag

- San Francisco publishes extensive crime data, but it is not decision-ready.
- Incident records are noisy, seasonal, and difficult to interpret.
- Short-term spikes are often mistaken for long-term change.
- Result: decisions become reactive rather than strategic.

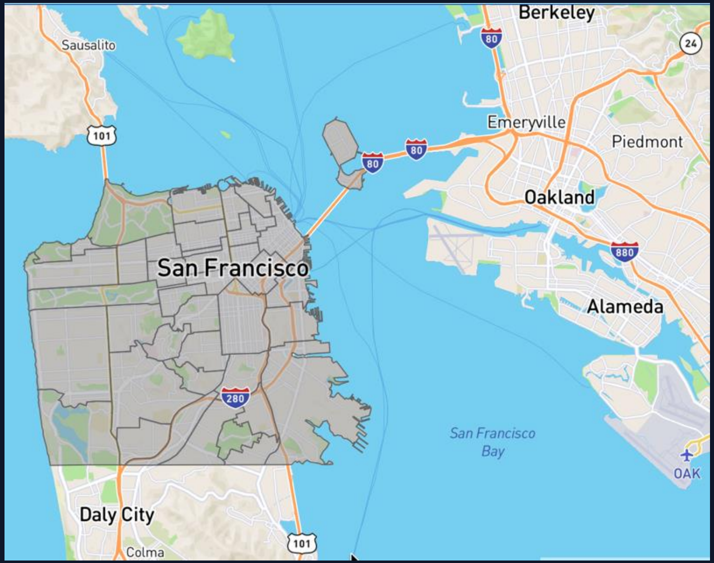

Crime Concentration Across San Francisco Neighborhoods (2018–2025)
Total Incidents
100k
80k
60k
40k
20k

Project Goal

- Transform raw crime data into a decision-support framework.
- Explain where crime concentrates across neighborhoods.
- Clarify when incidents occur by time and season.
- Provide a validated outlook for near-term planning.

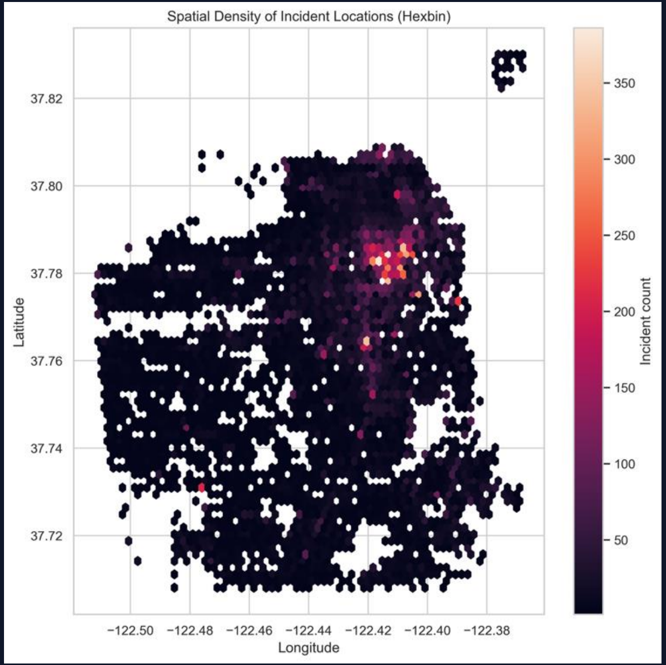
Key Questions This Project Answers

- Where are incidents most concentrated across neighborhoods?
- How does crime vary by hour, weekday, and season?
- How has crime changed from 2018 through 2025?
- Did crime rebound after COVID or structurally decline?
- What does the 2026 outlook suggest?



Dataset Scope & Integrity

- **994,600 SFPD incident records.**
- **Full coverage** from Jan 1, 2018 to Dec 31, 2025.
- **41 official** Analysis Neighborhoods.
- **Zero invalid timestamps** after validation.

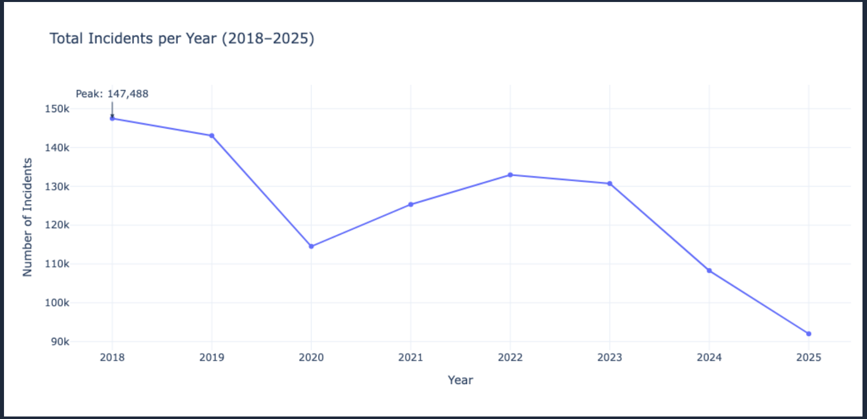


Long-Term Change: Crime Volume (2018–2025)

Total Reported Incidents by Year (2018 - 2025)

↓ 37.6%

$$\frac{(92001 - 147488)}{(147488)} \times 100\%$$



Key Insight: The decline reflects a structural shift rather than short-term volatility.

Executive Summary: What the Data Says

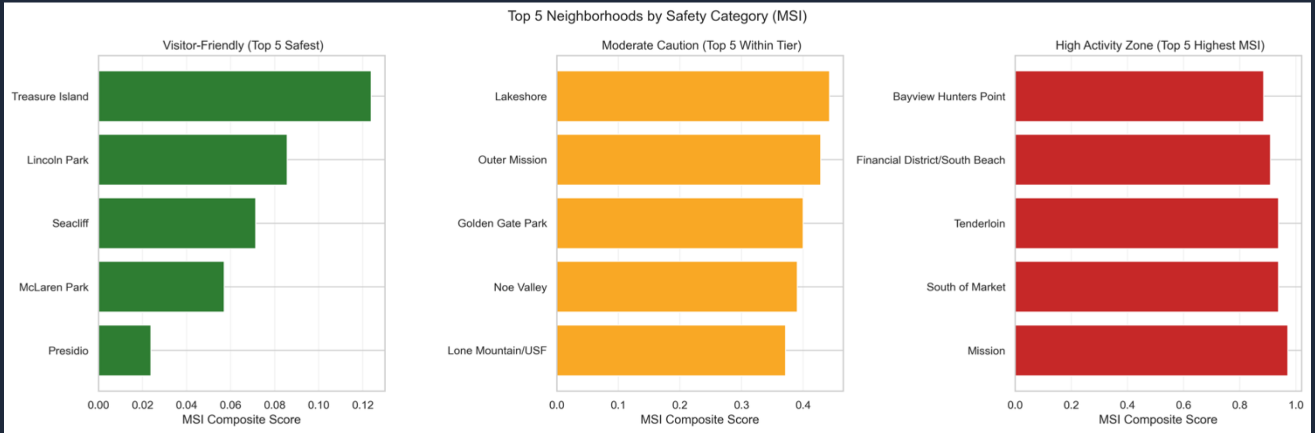
- **Citywide crime declined 37.6%** from 2018 to 2025.
- **Crime is highly concentrated** in a small number of neighborhoods.
- **Time of day explains more variation** than day of week.
- **Post-COVID crime levels stabilized** rather than rebounded.
- **2026 outlook** shows continuity, not escalation.

How I Approach Data Problems

- **Establish data integrity first.**
- **Identify structural patterns** before modeling.
- **Use relative metrics** for fair comparison.
- **Validate results** before forecasting.
- **Translate findings** into decision-relevant insight.

Mobility Safety Index (MSI)

Top 5 neighborhoods ranked by MSI score



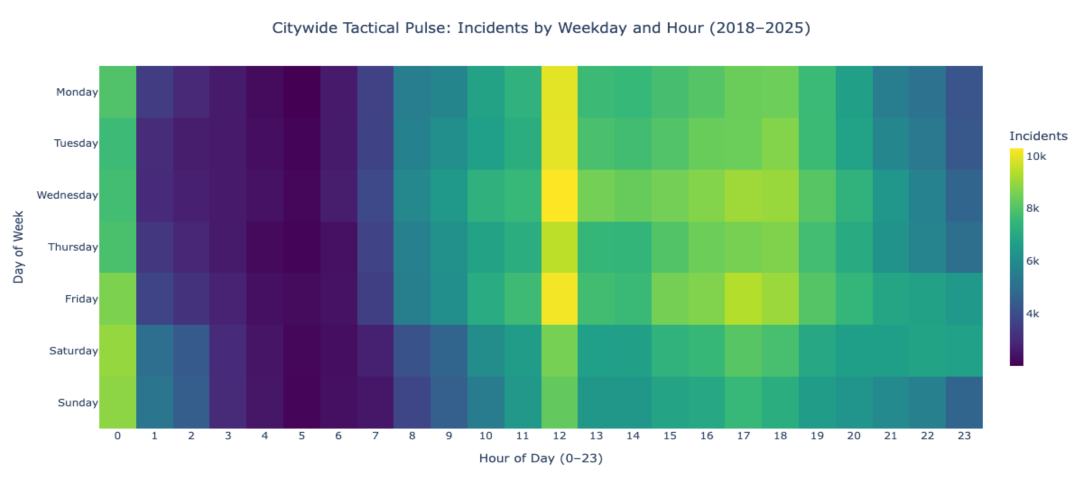
MSI combines incident volume, visitor-impact exposure, and recent momentum into a single score.

On the 0 – 1 scale, values closer to 0 indicate lower exposure, while values closer to 1 indicate higher and more persistent activity.

Purpose: comparison, not labeling.

When Crime Happens

Hour (rows) × Day of Week (columns)



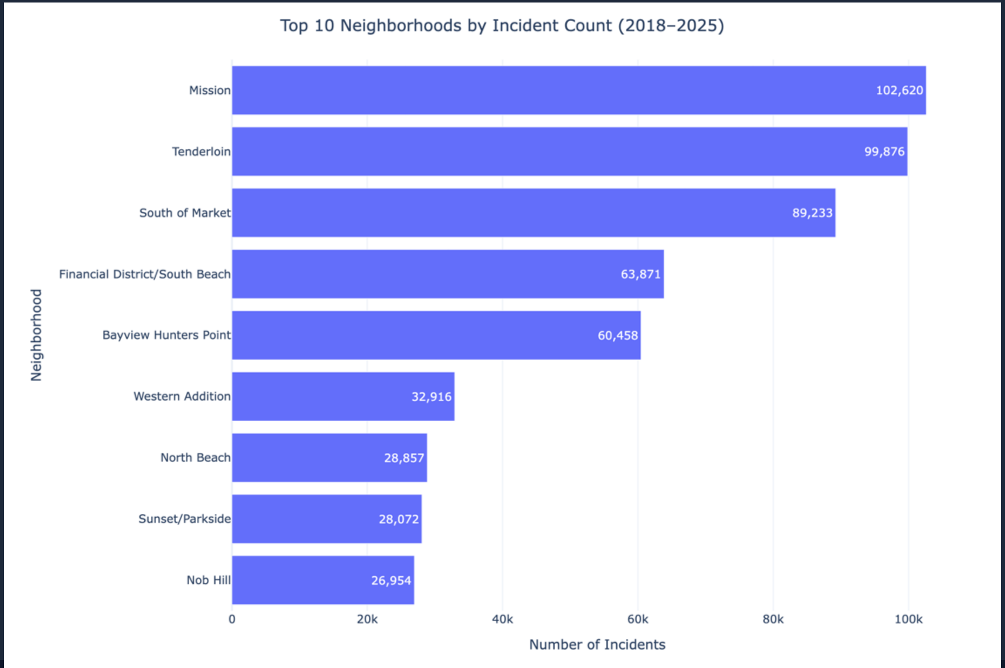
- Incidents peak around midday on weekdays, when city activity is highest.
- Weekday incident activity reaches its highest levels around midday, reflecting peak urban movement.

Key Insight: Time of day matters more than day of week

Where Crime Concentrates

Incidents by neighborhood

- Total incidents citywide (2018–2025): 939,401
- Top 3 neighborhoods: 291,729 incidents
  - 31.1% of all incidents
- Top 5 neighborhoods: 416,058 incidents
  - 44.3% of all incidents



Key Insight: A small number of neighborhoods account for a disproportionate share of total incidents.

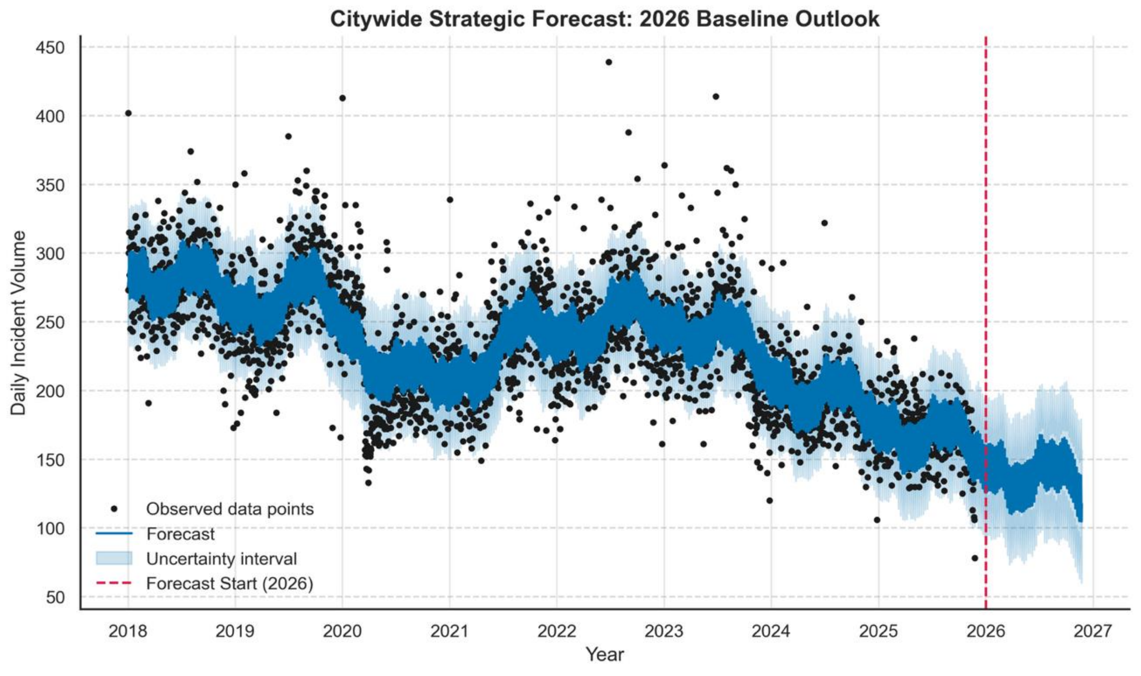
Model Selection as a Business Decision

- **Multiple models evaluated** to avoid bias.
- **Criteria:** stability, interpretability, seasonal reliability.
- **Prophet selected** for balance of accuracy and usability.
- **Chosen** to support stakeholder decision-making.

Citywide Baseline Forecast

Actual vs Predicted (2025)

- The model captures long-term decline and recurring seasonal patterns observed since 2018.
- The 2026 forecast extends this downward trend, assuming no major structural shocks.
- Uncertainty increases into 2026, reflecting greater variability as projections move forward.



Key Insight: The forecast extends an existing downward trend, with uncertainty widening into 2026.

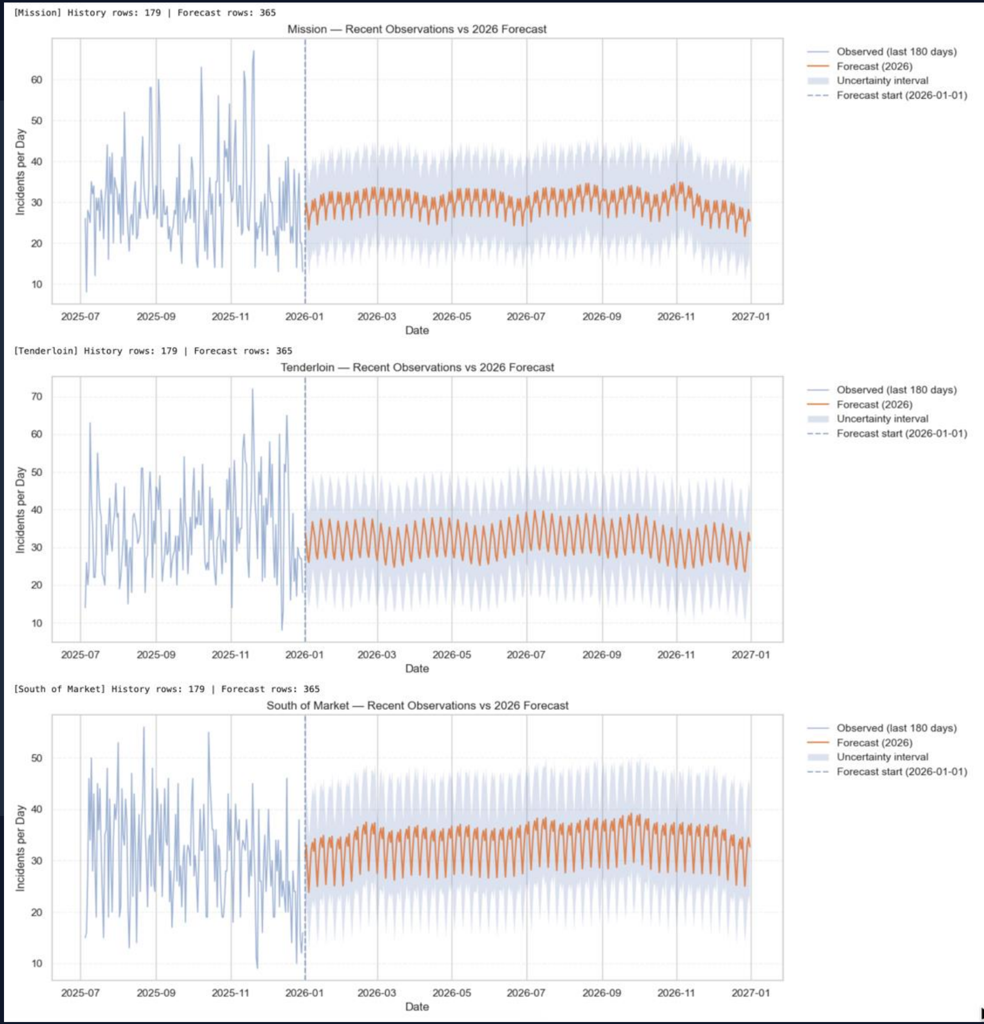
Forecast Performance & Validation (2025 Holdout)

- Citywide Prophet: MAE ~127 incidents/month, RMSE ~156 (explains 84% variance)
- Cross-validation: 5-fold CV on 2018-2024 training window; consistent performance
- 2025 validation: Model tested on blind holdout year before 2026 projection
- Structural assumptions: No reversion to 2018 peaks; stabilization at 2023-2024 baseline (~8.5-9.5K/month citywide)

Top 3 Hotspot Forecasts: 2026

Forecast Line with confidence intervals

- All three hotspots remain elevated into 2026, even as citywide levels decline.
- Forecasts smooth daily noise to reveal stable underlying patterns.
- Uncertainty widens over time, reflecting sensitivity to external conditions.



```
[Mission] History rows: 179 | Forecast rows: 365
```

```
[Tenderloin] History rows: 179 | Forecast rows: 365
```

```
[South of Market] History rows: 179 | Forecast rows: 365
```

Interpretation: Citywide improvement does not eliminate persistent hotspot risk.

What I Would Recommend as an Analyst

- **Align staffing** to time-of-day patterns.
- **Focus resources** on top 3-4 neighborhoods.
- **Use MSI** as a monitoring signal, not a label.
- **Review trends quarterly** to detect drift.

Limitations & Responsible Use

- Reported incidents only.
- No socioeconomic causal modeling.
- Not a surveillance escalation tool.
- Insights should guide prevention and investment.

From Data to Decisions

- Start with data integrity.
- Identify structure and trends.
- Validate before forecasting.
- Communicate insights for decisions.

Live Dashboard & Reproducible Artifacts

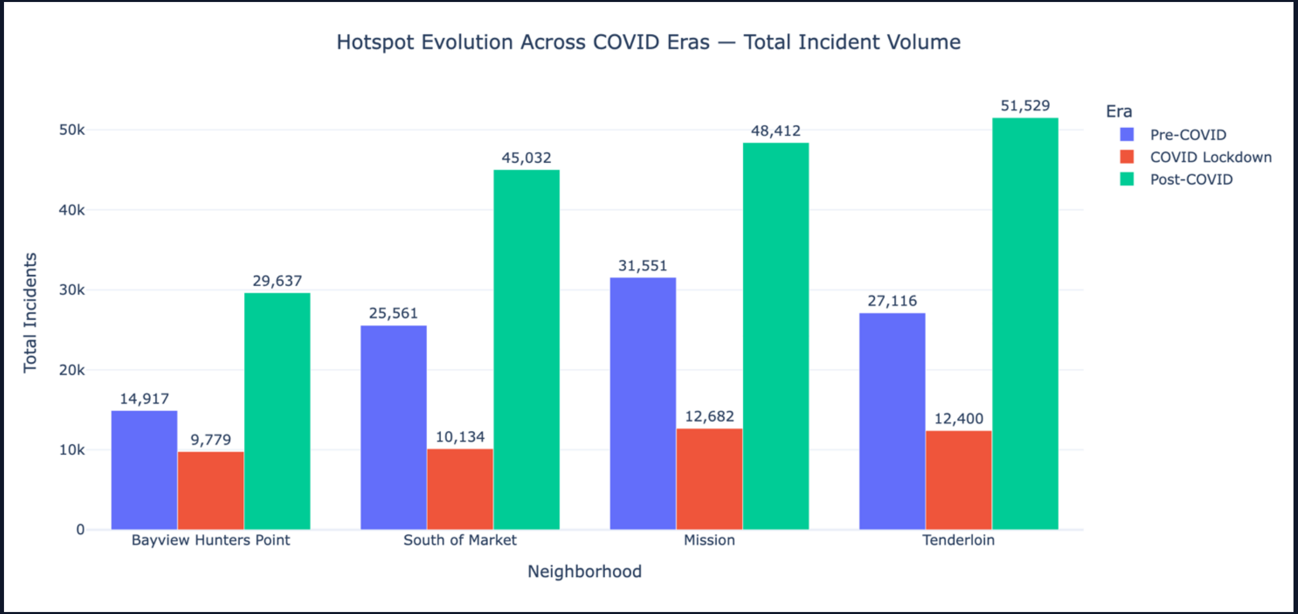
🔗 **LIVE Dashboard (Streamlit)** https://project2sfcrimeportfolio-g6jhgqizljzqexcb3ss7wd.streamlit.app/

- ✓ Interactive filters by year range, neighborhood, and incident category
- ✓ Monthly incident trends from precomputed parquet aggregates
- ✓ Top neighborhoods and categories based on filtered views
- ✓ Exploratory 2026 outlook aligned with offline forecasting results

- Jupyter: Full reproducible pipeline (cleaning → EDA → MSI construction → forecasting → validation)
- GitHub repository: Clean, modular codebase with requirements.txt and documented methodology
- Data Artifacts: Parquet aggregates (~ 995K records), CSV exports, neighborhood tables

Strategic Insights for Decision Makers

- Concentrated risk: Nearly half of incidents (44%) are concentrated in the top five neighborhoods, supporting focused interventions.
- Structural stabilization: Post-2020 incident levels remain ~15–25% below the 2018–2019 baseline, with no automatic rebound evident.
- Category matters: Larceny (29%) dominates; assault (6.5%) concentrated in nightlife; drug offenses structural in Tenderloin
- Mobility integration: High-activity areas align with transit hubs, tourist corridors, and nightlife density.



Strategic Applications & Stakeholder Impact

Law Enforcement

Predictive patrol optimization. Resource allocation to top 3 neighborhoods (40% of incidents). Shift staffing aligned to hourly patterns.

City Planning

Environmental design interventions in high-larceny zones. Lighting & transit improvements in assault hotspots. Community safety programs (seasonal).

Community/Tourism

Risk-aware travel guidance. Neighborhood safety scorecards. Visitor information systems. Predictive event security planning.

Limitations & Recommended Extensions

- Data scope: Reported crimes only (excludes unreported, victimization bias); no socioeconomic covariates
- Forecast horizon: 2026 only; longer horizons require external features (economic, policy, events)
- Next steps: Integrate foot traffic data, economic indicators, weather, major events; build micro-location grids (500m²)
- Prescriptive layer: Evolve from predictive → optimization (optimal patrol allocation, intervention timing)

Conclusion: From Data to Decision Support

- Unified framework: MSI + Hierarchical forecasting = data-driven resource planning
- Rigorous validation: 2025 holdout year, cross-validation, model benchmarking ensure confidence in 2026 outlook
- Actionable insight: Specific recommendations for police, city planning, community stakeholders
- Reproducibility: Full pipeline archived in GitHub; dashboard scales to new data (monthly updates)