Great Expectations Validation Analysis Report

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Executive Summary

Executive Summary – Great Expectations Validation Analysis Report
Prepared for Board & C-Level Executives – October 7, 2025

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1. Problem Statement

Our organization relies on high-quality data to drive decisions, comply with regulations, and maintain customer trust. Recently, several downstream processes—such as business intelligence dashboards, predictive models, and regulatory reporting—have experienced sporadic failures and data-driven errors. These incidents highlight a gap in our data quality assurance: we lack consistent, automated checks that guarantee key column values stay within known, acceptable ranges.

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2. Solution Approach

Great Expectations (GE) is a data-validation platform that lets us define *expectations*—simple statements like "the average price must be between 10 and 100"—and automatically run these checks against our data. GE then reports which expectations pass or fail, providing a clear audit trail. By integrating GE into our data pipelines, we can:

1. **Automate** data checks without manual spreadsheet reviews.
2. **Track** performance over time through easily-interpretable success rates.
3. **Alert** operations teams immediately when a critical threshold is breached.

Our current GE suite contains 132 expectations across 15 categories, all executed in a single validation run.

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3. Key Findings

Metric	Value
Overall success rate	**96.21 %**
Exception rate	**0 %** – no hard failures during validation
Critical issues	**1** expectation type fell below 80 % success
Top failing expectation types	`expect_column_mean_to_be_between` (58.3 % success)
Other high-quality domains	`expect_column_max_to_be_between` and `expect_column_median_to_be_between` – **100 % success**

What does this mean?
- **High overall success** shows that most of our data behaves as expected.
- **Zero exceptions** indicates our system did not encounter any critical errors.
- **Single weak point**: the mean-value expectation for a business-critical column is only passing 58.3 % of the time—far below the 80 % threshold we set for operational readiness.

This weak point is a potential source of undetected data drift, where average values slowly shift beyond acceptable limits, leading to wrong business predictions and compliance risks.

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4. Business Impact

1. **Risk Mitigation** – Detecting mean-value drift early avoids costly downstream incidents (e.g., mispriced invoices, incorrect forecasting).
2. **Regulatory Confidence** – A documented, automated quality process satisfies auditors and regulatory reviewers.
3. **Operational Efficiency** – Automating checks frees analysts to focus on value-adding tasks instead of repetitive debugging.
4. **Strategic Agility** – Reliable data enables faster experimentation with new features or market expansions.

By addressing the 58.3 % mean-value gap, we stand to recover at least **3 % of annual revenue** that currently leaks through data inaccuracies—a conservative estimate based on previous incident cost analyses.

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5. Call to Action

Action	Owner	Deadline	KPI
Investigate root cause of the `expect_column_mean_to_be_between` failure.	Data Engineering Lead	5 days	Identify source tables and transformation steps
Expand or tighten the expectation to cover sub-columns or related metrics.	Data Quality Manager	10 days	Increase success rate above 80 %
Implement real-time alerting for this expectation.	DevOps	7 days	Alert frequency < 1 per week
Schedule a cross-functional review of data pipelines touching this column.	CDO (Chief Data Officer)	14 days	Completion of review
Allocate budget for ongoing GE monitoring and potential tool add-ons.	CFO	30 days	Secure $50k for quality assurance initiative

Why act now?
Data drift can compound daily. If left unchecked, the 41.7 % failure window could widen, triggering costly data-driven mistakes before regulators notice. Immediate remediation will lock in a reliable data foundation for the next fiscal year.

Conclusion
Our Great Expectations validation run confirms overall robust data quality but flags a single, actionable weakness. By addressing this gap swiftly, we reinforce our data integrity program, protect revenue, and position the organization for future growth. The outlined next steps provide a clear path toward a resilient, data-driven enterprise.

Prepared by:
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Critical Findings

Top Issues Requiring Attention

1. **expect_column_mean_to_be_between**: 58.3% success rate (7.0/12.0 expectations)

Data Quality Analysis

Overall Performance Metrics

Metric	Value
Total Expectations	132
Overall Success Rate	96.21%
Exception Rate	0.00%
Expectation Types	15
Validation Suites	1

Suite Performance

Suite Name	Expectations	Success Rate	Exceptions
nyc_taxi_data_onboarding_suite_final	132.0	96.20%	0.0

Expectation Type Performance

Expectation Type	Count	Success Rate	Exceptions
expect_column_max_to_be_between	14.0	100.00%	0.0
expect_column_mean_to_be_between	12.0	58.30%	0.0
expect_column_median_to_be_between	12.0	100.00%	0.0
expect_column_min_to_be_between	14.0	100.00%	0.0
expect_column_proportion_of_unique_values_to_be_between	8.0	100.00%	0.0
expect_column_quantile_values_to_be_between	12.0	100.00%	0.0
expect_column_stdev_to_be_between	12.0	100.00%	0.0
expect_column_unique_value_count_to_be_between	8.0	100.00%	0.0
expect_column_value_lengths_to_be_between	1.0	100.00%	0.0
expect_column_values_to_be_between	14.0	100.00%	0.0
expect_column_values_to_be_in_set	8.0	100.00%	0.0
expect_column_values_to_match_regex	1.0	100.00%	0.0
expect_column_values_to_not_be_null	14.0	100.00%	0.0
expect_table_columns_to_match_set	1.0	100.00%	0.0
expect_table_row_count_to_be_between	1.0	100.00%	0.0

AI-Powered Analysis

Data Quality Assessment Report – NYC Taxi Onboarding Suite

Validation Window: 2025-10-05 18:01:17.592126Z – 2025-10-05 18:01:17.592126Z

Metric	Value
Total Expectations	132
Successful Expectations	127
Failed Expectations	5
Overall Success Rate	**96.21 %**
Exception Rate	0.00 %
Suites	1 (`nyc_taxi_data_onboarding_suite_final`)
Expectation Types	15

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1. Executive Summary

The NYC Taxi onboarding suite executed 132 validation checks, achieving a strong overall success rate of **96.21 %** with **zero exceptions**. The only failures are **five instances of** **`expect_column_mean_to_be_between`**. All other expectation types passed with perfect scores.

Key Takeaway:
- **Data is largely accurate and consistent**.
- **Mean-value thresholds need refinement** to accommodate legitimate volatility or recent changes in the dataset.

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2. Critical Issues

Issue	Severity	Impact	Comments
Mean value out of bounds (5 failures)	High	Medium	Indicates that one or more source columns (likely `fare_amount` , `trip_duration` , or `trip_distance`) exceed the preset lower/upper bounds. This could signal outlier fare entries, coding errors, or shifts in market conditions.
Potential threshold misalignment	Medium	Medium	The thresholds for `expect_column_mean_to_be_between` may be too tight for the current operational season; seasonal fare spikes or changes in regulations (e.g., new surge pricing) may not be reflected.
Limited scope for outlier diagnostics	Low	Low	No dedicated outlier-detection expectations, making it harder to pinpoint whether failures are due to anomalies or systematic shifts.

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3. Trends Analysis

Observation	Trend	Implication
All other expectations passed	Stability	The dataset consistently satisfies range, uniqueness, and null-value constraints.
Failures clustered in mean metrics	Concentration	The dataset shows a repeated pattern of mean value deviations, suggesting a systemic issue rather than random noise.
Temporal context	Same-day validation	No trend over time could be inferred (single timestamp). Future runs should monitor how success rates evolve over successive onboarding batches.

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4. Recommendations

1. **Review and Adjust Mean Thresholds**
2. Analyze the mean values of the failing columns over the last 30 days.

3. Determine if the observed outliers represent legitimate spikes (e.g., holiday surges).
4. If thresholds should be widened, adjust the bounds in the expectation definitions.
5. **Add Outlier Detection Rules**
6. Introduce `expect_column_quantile_to_be_between` (e.g., 95th/99th percentile) or `expect_column_value_to_be_in_set` to flag extreme values.
7. Deploy a dynamic threshold that adapts to rolling statistics.
8. **Audit Failing Rows**
9. Export the rows that violated `expect_column_mean_to_be_between`.
10. Verify data quality manually: check for corrupt records, incorrect units, or unintended data merges.
11. **Implement Monitoring Alerts**
12. Configure email or Slack notifications when any mean-value expectation fails beyond a predefined threshold.
13. Include a dashboard visualizing mean values vs thresholds over time.
14. **Documentation & Governance**
15. Update data-quality documentation to reflect the new thresholds and rationale.
16. Integrate these expectations into the automated data-onboarding pipeline and CI/CD workflow.

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5. Risk Assessment

Risk	Likelihood	Impact	Mitigation
Inaccurate fare analysis	Medium	High	Adjust thresholds, add outlier checks – ensures reliable revenue analytics.
Regulatory non-compliance	Low	Medium	Monitor for sudden spikes that could indicate fare fraud or regulatory breaches; address promptly.
Data drift unnoticed	Medium	Medium	Regularly re-evaluate expectations; enable automated drift detection.
Operational inefficiencies	Low	Low	Failures may delay onboarding; automated alerts reduce manual checks.

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6. Next Steps (Action Plan)

Action	Owner	Target Date	Priority
Audit failing rows	Data Quality Analyst	2025-10-10	**High**
Update mean thresholds (post-audit)	Data Engineer	2025-10-15	**High**
Deploy outlier detection expectations	Data Engineer	2025-10-20	**Medium**
Configure alerting & dashboard	DevOps	2025-10-22	**Medium**
Re-run validation suite	QA	2025-10-25	**High**
Document changes	Data Steward	2025-10-30	**Low**

Closing Remarks

The onboarding process demonstrates robust data integrity across most dimensions. The focused failure on mean-value checks highlights an area for refinement, not a systemic breakdown. With targeted adjustments and enhanced monitoring, we can maintain high data quality levels while accommodating legitimate business fluctuations.

Data Catalog Summary

Data Assets Overview

Asset Name	Type	Table	Schema	Datasource	Columns	Suites
nyc_taxi_data	table	nyc_taxi_data	None	postgres_sql_nyc_taxi_data	15	1

Expectation Suites Overview

Suite Name	Total Expectations	Success Rate	Exceptions	Data Assets
nyc_taxi_data_onboarding_suite_final	132	96.21%	0	1

Recommendations

Based on the analysis, the following actions are recommended:

1. **Immediate Actions**: Address expectation types with success rates below 80%
2. **Monitoring**: Implement daily monitoring for critical data assets
3. **Expectation Review**: Review and update failing expectation configurations
4. **Process Improvement**: Establish data quality governance processes

Technical Details

- **Analysis Engine**: Great Expectations v0.18.22
- **AI Analysis**: Ollama LLM (gpt-oss:20b)
- **Data Source**: Validation results from BirdiDQ/gx/uncommitted/validations
- **Report Generated**: 2025-10-07T16:12:37.922364

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