CASE STUDY #01

# Customer Churn Analysis

IBM Telco Customer Churn Dataset

**From 7,043 customer records to a prioritized retention and revenue-protection roadmap.**

| CUSTOMERS | CHURN RATE | MRR EXPOSURE |
|---|---|---|
| 7,043 | 26.54% | $139,130.85 |

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Business Operations & Data Analytics Portfolio

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Customer Churn Analysis / Business Analytics Portfolio

EXECUTIVE SNAPSHOT / CASE STUDY #01

# Executive Dashboard

TOTAL CUSTOMERS
**7,043**

CHURN RATE
**26.54%**

GROSS MRR
**$456,116.60**

CHURNED-ACCOUNT MRR
**$139,130.85**

ANNUALIZED EXPOSURE
**$1,669,570.20**

HIGHEST-RISK SEGMENT
**62.92%**

Month-to-month / Electronic check / Fiber optic / No Tech Support

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# Executive Summary

A decision-ready view of customer attrition, recurring revenue exposure and the highest-priority operational levers.

| | | |
|---|---|---|
| TOTAL CUSTOMERS<br>**7,043**<br>complete customer-level records | CHURNED CUSTOMERS<br>**1,869**<br>26.54% of the base | OBSERVED GROSS MRR<br>**$456,116.60**<br>sum of MonthlyCharges |
| CHURNED-ACCOUNT MRR<br>**$139,130.85**<br>historical monthly exposure | ANNUALIZED EXPOSURE<br>**$1,669,570.20**<br>MRR exposure x 12; not a forecast | MEDIAN TENURE<br>**10 mo**<br>churned vs 38 mo active |

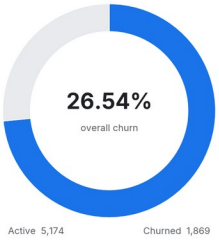
## Executive readout

**Contract structure** Month-to-month customers account for 1,655 churns - 88.55% of all churned customers - with a 42.71% churn rate.

**Early-life risk** Customers in months 0-6 churn at 52.94%; month-to-month Fiber customers in their first 12 months reach 70.20%.

**Service friction signal** Fiber optic customers without Tech Support churn at 49.37%, versus 22.63% when Tech Support is present.

**Concentrated target segment** A 1,138-customer profile represents 16.16% of the base but 38.31% of all churn.




**Decision statement**

Prioritize targeted retention interventions at the intersection of early tenure, month-to-month contracts, Fiber optic service and billing configuration. Treat the analysis as segmentation evidence, not causal proof.

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# Business Context, Stakeholders & Questions

The analytical scope is designed for Business Operations: identify exposure, define operational signals and connect findings to measurable action.

## Business context

Telecommunications is a recurring-revenue business. Customer attrition reduces the installed base, weakens revenue predictability and forces acquisition activity to replace customers who have already been won. This case study evaluates where churn is concentrated and which operational touchpoints are plausible candidates for controlled retention tests.

## Stakeholder map

| STAKEHOLDER | DECISION NEED | PRIMARY KPI |
|---|---|---|
| Executive leadership | Size recurring-revenue exposure and approve priorities. | Churn rate; annualized MRR exposure; retained MRR. |
| Customer lifecycle / CRM | Design triggered retention journeys. | Segment reach; offer conversion; incremental retention. |
| Product & service operations | Investigate Fiber setup and support friction. | 90-day churn; support uptake; repeat contact rate. |
| Billing operations | Assess payment-method and paperless-billing signals. | AutoPay adoption; failed payment rate; billing contacts. |
| Analytics / BI | Operationalize monitoring and experiment readouts. | Data quality; test lift; confidence intervals. |

## Business questions

**Q1** Which commercial terms are most strongly associated with churn?

**Q2** Where does churn concentrate across billing, internet service and support configurations?

**Q3** How does churn vary across the customer lifecycle and monthly charge bands?

**Q4** What monthly recurring revenue is associated with churned accounts?

**Q5** Which interventions should be prioritized by evidence, impact and implementation complexity?

> **Scope boundary**
> The dataset supports descriptive segmentation and opportunity sizing. It does not contain intervention history, customer sentiment, margin, acquisition cost, outage events or a time-stamped churn journey.

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# Dataset Overview & Data Dictionary

A customer-level snapshot containing demographic, service, commercial and churn outcome fields.

| ROWS | SOURCE FIELDS | DUPLICATE IDS | BLANK TOTALCHARGES |
|---|---|---|---|
| **7,043** | **21** | **0** | **11** |
| one row per customer | before engineered fields | customerID is unique | all have tenure = 0 |

## Data dictionary

| FIELD | TYPE | DEFINITION | ROLE |
|---|---|---|---|
| customerID | Text | Unique customer identifier | Key |
| gender | Category | Customer gender | Profile |
| SeniorCitizen | Integer | 1 = senior citizen; 0 = otherwise | Profile |
| Partner | Yes/No | Partner status | Profile |
| Dependents | Yes/No | Dependent status | Profile |
| tenure | Integer | Months with the provider | Lifecycle |
| PhoneService | Yes/No | Phone service subscription | Service |
| MultipleLines | Category | Multiple-line status | Service |
| InternetService | Category | DSL, Fiber optic or no internet | Service |
| OnlineSecurity | Category | Online security subscription | Service |
| OnlineBackup | Category | Online backup subscription | Service |
| DeviceProtection | Category | Device protection subscription | Service |
| TechSupport | Category | Technical support subscription | Service |
| StreamingTV | Category | Streaming TV subscription | Service |
| StreamingMovies | Category | Streaming movies subscription | Service |
| Contract | Category | Month-to-month, one year or two year | Commercial |
| PaperlessBilling | Yes/No | Paperless billing status | Billing |
| PaymentMethod | Category | Customer payment method | Billing |
| MonthlyCharges | Numeric | Current monthly charge | Revenue |
| TotalCharges | Text → numeric | Cumulative charges; 11 blank values | Revenue |
| Churn | Yes/No | Observed churn outcome | Target |

*Engineered fields: TotalCharges_clean, is_churned, tenure_band, charge_band and rule-based risk segment flags.*

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# Data Cleaning Methodology

A compact control framework was used to preserve record integrity and make revenue and churn metrics reproducible.

## Analysis workflow

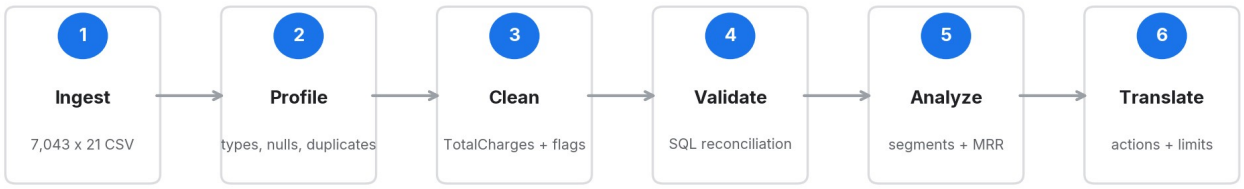


*Figure 1. End-to-end analysis workflow.*

## Cleaning decisions and controls

| CONTROL | APPLIED LOGIC | WHY IT MATTERS |
|---|---|---|
| Schema validation | Confirmed 7,043 rows and 21 source columns. | Prevents silent input drift. |
| Primary-key check | Confirmed 0 duplicate customerID values. | Protects customer and churn counts. |
| TotalCharges conversion | Trimmed blanks, converted to numeric and set 11 zero-tenure blanks to 0. | Enables aggregation without inventing historical spend. |
| Outcome standardization | Mapped Churn = Yes to is_churned = 1; otherwise 0. | Supports consistent rates and SQL aggregation. |
| Lifecycle bands | Grouped tenure into seven bands from 0-6 to 61-72 months. | Reveals early-life concentration without a predictive model. |
| Charge bands | Grouped MonthlyCharges into five business-readable ranges. | Tests whether price level is associated with churn. |
| Reconciliation | Matched SQL and dataframe totals for accounts, churn and lost MRR. | Provides an independent calculation check. |

## Data-quality outcome

| ROWS RETAINED | IDS UNIQUE | NUMERIC CHARGE COVERAGE |
|---|---|---|
| **7,043** | **7,043** | **100.00%** |
| 100.00% of source records | 0 duplicates | after documented zero-tenure treatment |

**Important treatment note**

The 11 blank TotalCharges values are not imputed from averages or neighboring records. Because each corresponding customer has tenure = 0, they are set to 0.00 and explicitly documented.

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# SQL Methodology

SQL was used as a validation layer for cleaning logic, KPI definitions and grouped churn views.

## SQL validation architecture

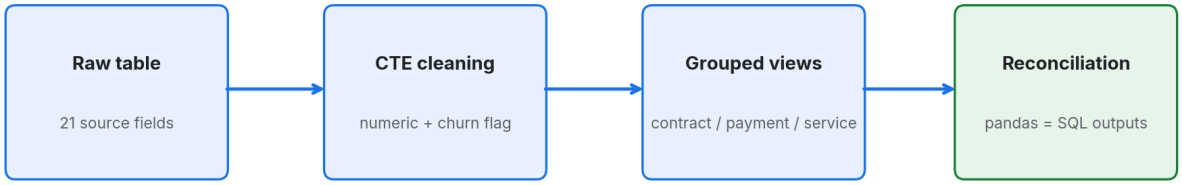


*Figure 2. SQL validation architecture.*

## Representative SQL - contract-level churn and MRR exposure

```
WITH cleaned_customer_base AS (
  SELECT
    customerID,
    Contract,
    PaymentMethod,
    InternetService,
    TechSupport,
    tenure,
    CAST(MonthlyCharges AS REAL) AS monthly_charges,
    CASE
      WHEN TRIM(TotalCharges) = '' OR TotalCharges IS NULL THEN 0.0
      ELSE CAST(TotalCharges AS REAL)
    END AS total_charges_clean,
    CASE WHEN Churn = 'Yes' THEN 1 ELSE 0 END AS is_churned
  FROM telco_customer_churn
)
SELECT
  Contract,
  COUNT(*) AS accounts,
  SUM(is_churned) AS churned_accounts,
  ROUND(100.0 * SUM(is_churned) / COUNT(*), 2) AS churn_rate_pct,
  ROUND(SUM(CASE WHEN is_churned = 1 THEN monthly_charges ELSE 0 END), 2) AS lost_mrr
FROM cleaned_customer_base
GROUP BY Contract
ORDER BY churn_rate_pct DESC;
```

## Validation output

| CONTRACT | ACCOUNTS | CHURNED | CHURN RATE | LOST MRR |
|---|---|---|---|---|
| Month-to-month | 3,875 | 1,655 | 42.71% | $120,847.10 |
| One year | 1,473 | 166 | 11.27% | $14,118.45 |
| Two year | 1,695 | 48 | 2.83% | $4,165.30 |

*Reconciliation passed: 7,043 accounts, 1,869 churned customers and $139,130.85 in churned-account monthly charges matched the independent analysis output.*

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# Exploratory Analysis I - Commercial Terms

Contract commitment and payment method show the strongest business-readable segmentation patterns.

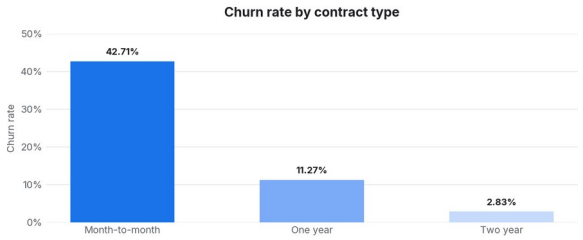


*Figure 3. Contract type.*

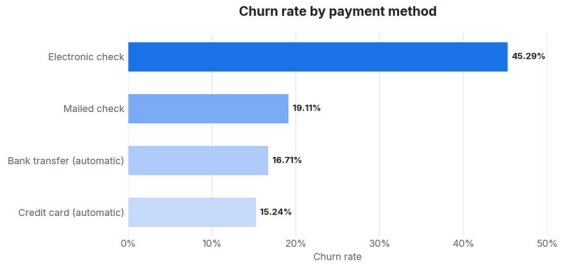


*Figure 4. Payment method.*

Source: IBM Telco Customer Churn dataset; calculations reproduced from the supplied CSV.

## Observed patterns

| CONTRACT | ACCOUNTS | CHURNED | RATE | LOST MRR | CHURN CONCENTRATION |
|---|---|---|---|---|---|
| Month-to-month | 3,875 | 1,655 | 42.71% | $120,847.10 | 88.55% of all churn |
| One year | 1,473 | 166 | 11.27% | $14,118.45 | 8.88% of all churn |
| Two year | 1,695 | 48 | 2.83% | $4,165.30 | 2.57% of all churn |

**Interpretation**

Contract type is a strong risk signal, but the analysis cannot determine whether longer contracts reduce churn or whether lower-risk customers self-select into longer commitments. A migration program should therefore be tested against a control group.

Electronic check customers churn at 45.29%, compared with 15.24% for automatic credit card and 16.71% for automatic bank transfer. This is a diagnostic signal for billing journey review - not proof that the payment method itself causes churn.

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# Exploratory Analysis II - Service & Support

Fiber optic service carries the largest revenue exposure and the highest churn rate, especially when support services are absent.

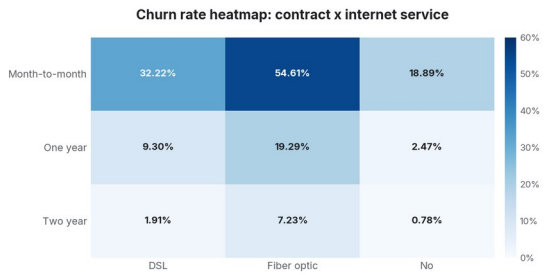


*Figure 5. Contract x internet service heatmap.*

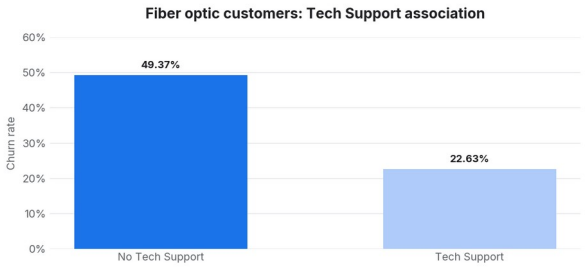


*Figure 6. Fiber optic and Tech Support.*

Source: IBM Telco Customer Churn dataset; calculations reproduced from the supplied CSV.

## Service-level readout

| INTERNET SERVICE | ACCOUNTS | CHURNED | CHURN RATE | LOST MRR |
|---|---|---|---|---|
| Fiber optic | 3,096 | 1,297 | 41.89% | $114,300.05 |
| DSL | 2,421 | 459 | 18.96% | $22,529.20 |
| No internet | 1,526 | 113 | 7.40% | $2,301.60 |

## Support association within Fiber optic

Fiber optic customers without Tech Support show a 49.37% churn rate (1,101 churns), compared with 22.63% when Tech Support is present (196 churns). The 26.74 percentage-point gap supports a targeted onboarding and support experiment.

**Operational hypothesis to test**

New Fiber customers may experience setup, value-realization or service-recovery friction that is partially mitigated by support coverage. The dataset does not contain ticket history, outage data or support quality, so the mechanism remains unproven.

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# Exploratory Analysis III - Lifecycle & Pricing

The customer lifecycle is more discriminating than price alone: churn is highest in the first six months and falls steadily with tenure.

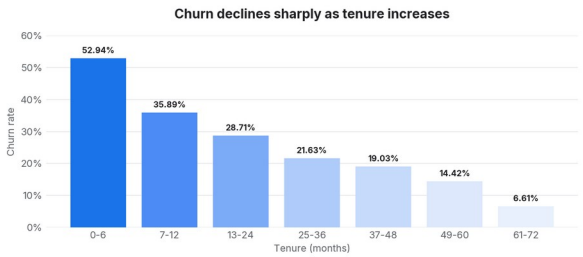


*Figure 7. Churn by tenure band.*

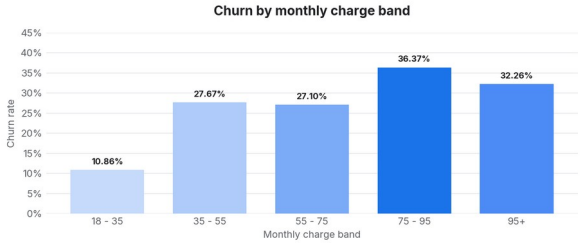


*Figure 8. Churn by monthly charge band.*

Source: IBM Telco Customer Churn dataset; calculations reproduced from the supplied CSV.

## Lifecycle concentration

| TENURE BAND | ACCOUNTS | CHURNED | CHURN RATE | LOST MRR |
|---|---|---|---|---|
| 0-6 | 1,481 | 784 | 52.94% | $49,896.10 |
| 7-12 | 705 | 253 | 35.89% | $19,058.15 |
| 13-24 | 1,024 | 294 | 28.71% | $23,081.65 |
| 25-36 | 832 | 180 | 21.63% | $15,167.95 |
| 37-48 | 762 | 145 | 19.03% | $12,294.55 |
| 49-60 | 832 | 120 | 14.42% | $10,581.90 |
| 61-72 | 1,407 | 93 | 6.61% | $9,050.55 |

**Key lifecycle signal**

The 0-6 month cohort churns at 52.94%. Churned customers have a median tenure of 10 months versus 38 months for active customers. Early-life retention should therefore precede broad portfolio-wide discounting.

Average monthly charges are higher among churned customers ($74.44) than active customers ($61.27), but the relationship is non-linear: the highest observed charge-band churn is 36.37% in the $75-$95 range, not in the $95+ range.

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# Key Findings & Risk Segmentation

A small number of transparent rules capture a disproportionate share of churn and can be operationalized without claiming predictive accuracy.

**62.92%**
CHURN RATE

**Priority rule-based segment**

**Month-to-month + Electronic check + Fiber optic + No Tech Support**

1,138 customers | 716 churns | $61,358.05 observed lost MRR

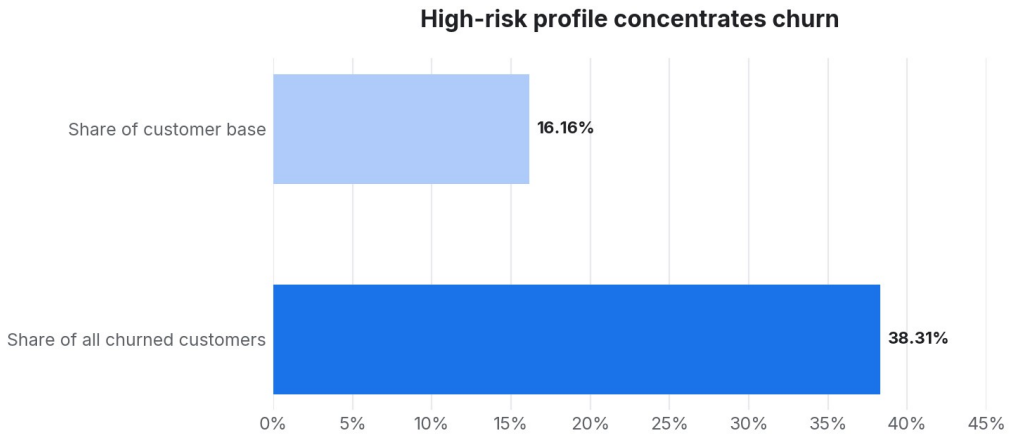


*Figure 9. The priority segment is 16.16% of the base and 38.31% of churn.*
Source: IBM Telco Customer Churn dataset; calculations reproduced from the supplied CSV.

## Five findings that should shape action

| # | FINDING | EVIDENCE |
|---|---|---|
| 1 | Contract risk | Month-to-month customers produce 88.55% of churn and $120,847.10 of churned-account MRR. |
| 2 | Early-life risk | 0-6 month customers churn at 52.94%; first-12-month month-to-month Fiber customers reach 70.20%. |
| 3 | Fiber support gap | Fiber without Tech Support churns at 49.37% versus 22.63% with Tech Support. |
| 4 | Billing signal | Electronic check churn is 45.29%, materially above all other payment methods. |
| 5 | Targetability | The priority segment contains 1,138 customers and 38.31% of all churn. |

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# Financial Impact & Opportunity Sizing

Revenue figures translate attrition into decision scale while preserving a clear boundary between observed exposure and forecast impact.

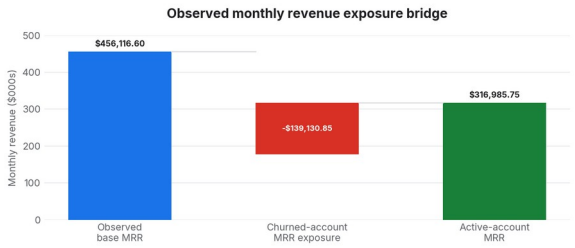


*Figure 10. Observed MRR composition.*

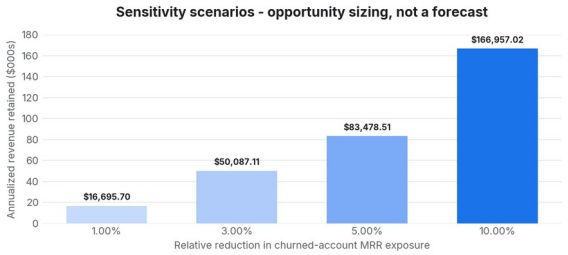


*Figure 11. Sensitivity scenarios.*

Source: IBM Telco Customer Churn dataset; calculations reproduced from the supplied CSV.

## Observed revenue exposure

| METRIC | VALUE | DEFINITION |
|---|---|---|
| Gross monthly charges in dataset | $456,116.60 | All 7,043 customer records. |
| Active-account monthly charges | $316,985.75 | Customers with Churn = No. |
| Churned-account monthly charges | $139,130.85 | Historical MRR exposure associated with Churn = Yes. |
| Annualized churned-account exposure | $1,669,570.20 | Monthly exposure x 12; not incremental profit or a forecast. |

## Sensitivity scenarios

| SCENARIO | MONTHLY MRR RETAINED | ANNUALIZED REVENUE RETAINED |
|---|---|---|
| 1.00% reduction | $1,391.31 | $16,695.70 |
| 3.00% reduction | $4,173.93 | $50,087.11 |
| 5.00% reduction | $6,956.54 | $83,478.51 |
| 10.00% reduction | $13,913.08 | $166,957.02 |

**Financial interpretation**

These values are sensitivity estimates. They assume that a relative share of the observed churned-account MRR could be retained. They do not account for discount cost, contribution margin, intervention expense, seasonality or substitution effects.

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# Recommendation Matrix

Each recommendation is tied to a measurable signal, an operational owner and an experiment-ready success metric.

| ID | RECOMMENDATION | EVIDENCE | OWNER | OPERATIONAL DESIGN | SUCCESS KPI | PRIORITY |
|---|---|---|---|---|---|---|
| R1 | Early-life retention trigger | 0-6 month churn = 52.94%. | CRM / Lifecycle | Trigger at days 14, 45 and 90 for high-risk new customers. | 90-day churn; incremental lift | High |
| R2 | Contract migration journey | Month-to-month churn = 42.71%. | Commercial Ops | Test annual-plan migration at 3, 6 and 12 months. | Migration rate; retained MRR | High |
| R3 | Fiber onboarding + support | 49.37% churn without Tech Support. | Service Ops | Offer guided setup and 90-day support coverage to selected Fiber cohorts. | 90-day churn; support uptake | High |
| R4 | AutoPay migration + billing review | Electronic check churn = 45.29%. | Billing Ops | Test low-friction AutoPay enrollment and audit billing failures / contacts. | AutoPay adoption; churn lift | Medium |
| R5 | Rule-based intervention queue | Priority segment = 62.92% churn. | Analytics + CRM | Route eligible active customers to controlled outreach; compare with holdout. | Precision; lift vs control; MRR | High |

## Measurement guardrails

| GUARDRAIL | REQUIRED CONTROL |
|---|---|
| Holdout design | Keep an untreated comparison group to estimate incremental retention. |
| Cost accounting | Subtract discounts, service cost and contact cost from retained-MRR estimates. |
| Eligibility rules | Exclude customers already in unresolved complaints, collections or active save journeys. |
| Segment fairness | Review performance by age proxy, gender and household variables; do not use sensitive attributes as targeting criteria. |
| Stop criteria | Pause treatments that increase complaints, cancellations or negative unit economics. |

**Recommended starting point**

Launch R1, R2 and R3 as controlled pilots. Use R5 as the orchestration layer, not as a claim of predictive modeling. R4 should begin with billing diagnostics before incentives are introduced.

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# Impact vs Complexity & 90-Day Roadmap

Prioritization balances the size of the observed risk signal with operational dependencies and measurement quality.

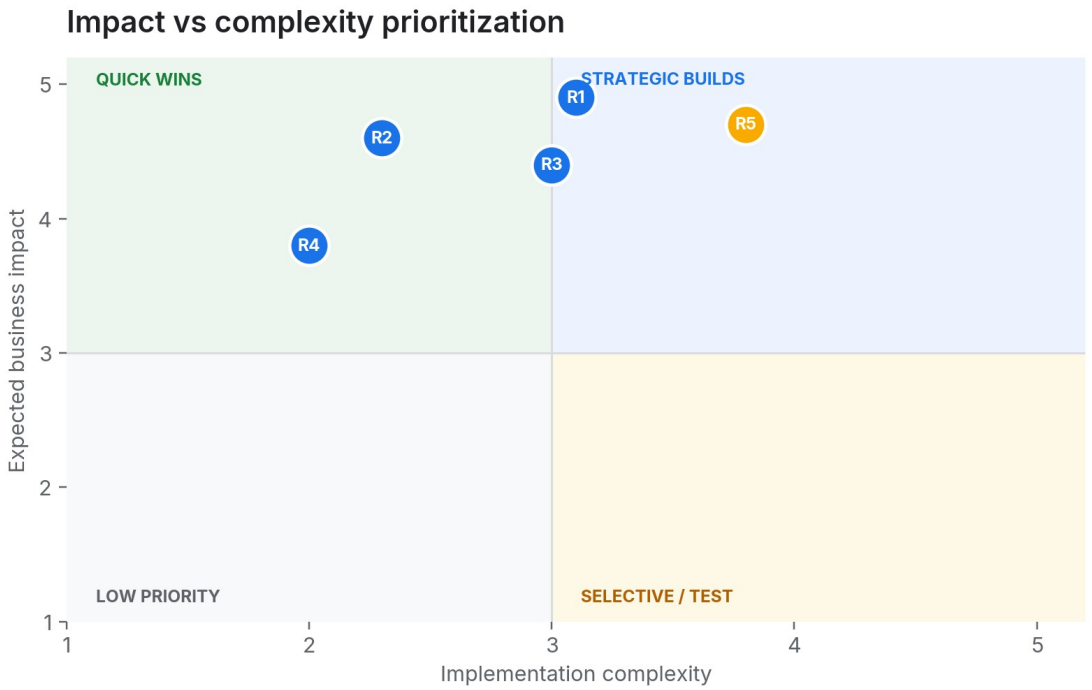


*Figure 12. Relative prioritization based on evidence strength, addressable volume and implementation effort.*

## Recommendation legend

| ID | INITIATIVE |
|---|---|
| R1 | Early-life retention trigger |
| R2 | Contract migration journey |
| R3 | Fiber onboarding + support |
| R4 | AutoPay migration + billing review |
| R5 | Rule-based intervention queue |

## 90-day execution sequence

| TIMING | PHASE | DELIVERABLE |
|---|---|---|
| Days 0-30 | Instrument | Publish metric definitions; validate eligible active cohorts; create holdout logic; baseline churn and MRR. |
| Days 31-60 | Pilot | Launch R1 and R3 to limited cohorts; run billing root-cause review; prepare R2 migration treatment. |
| Days 61-90 | Evaluate & scale | Measure incremental retention, cost per save and complaint impact; scale only statistically and economically positive treatments. |

**Decision cadence**

Use a weekly operational review for execution health and a monthly business review for churn, retained MRR, experiment lift and customer-experience guardrails.

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# Risks, Limitations & Learning

The analysis is useful for prioritization, but its constraints determine which claims are safe and which require new evidence.

## Risks and limitations

| LIMITATION | IMPLICATION | REQUIRED NEXT STEP |
|---|---|---|
| Observational snapshot | Associations do not establish causality. | Use randomized or quasi-experimental evaluation. |
| No time-stamped journey | Sequence of events before churn is unavailable. | Add billing, outage, support and product-usage event data. |
| No intervention history | Prior offers or save actions are unknown. | Capture treatment eligibility, exposure and outcome. |
| Revenue is not profit | MonthlyCharges excludes margin and treatment cost. | Build contribution-margin and cost-per-save models. |
| Limited customer voice | No CSAT, NPS, complaint or transcript data. | Combine structured data with customer feedback and contact reasons. |
| Unknown market context | No geography, competitor pricing or acquisition channel. | Add external and acquisition attributes before scaling. |
| Public benchmark dataset | Collection design and recency are not fully specified in the file. | Treat conclusions as portfolio analysis, not a live company forecast. |

## Lessons learned

| LESSON | APPLICATION |
|---|---|
| Business framing first | A smaller number of decision-linked metrics is more useful than an exhaustive correlation inventory. |
| Transparent rules are valuable | A simple segment can concentrate risk and support operations without overstating model sophistication. |
| Revenue needs qualification | Observed MRR exposure is useful for sizing, but profitability requires margin and intervention-cost data. |
| Validation improves trust | Independent SQL reconciliation prevents formatting or notebook logic from becoming the single source of truth. |

## Future improvements

| NEXT STEP | DELIVERABLE |
|---|---|
| 1. Longitudinal model | Create monthly customer snapshots and time-to-churn labels. |
| 2. Predictive benchmark | Compare logistic regression and tree-based models with calibration and explainability. |
| 3. Experiment layer | Add treatment, control, cost and incremental-retention measurement. |
| 4. Operational dashboard | Monitor eligible active customers, segment drift, outcomes and retained MRR. |

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# Technical Appendix

KPI definitions, reproducibility controls and the analytical boundary used in this case study.

## KPI definitions

| KPI | FORMULA | VERIFIED RESULT |
|---|---|---|
| Customer count | COUNT(customerID) | 7,043 |
| Churned customers | SUM(is_churned) | 1,869 |
| Churn rate | SUM(is_churned) / COUNT(customerID) | 26.54% |
| Gross MRR | SUM(MonthlyCharges) | $456,116.60 |
| Churned-account MRR | SUM(MonthlyCharges) WHERE is_churned = 1 | $139,130.85 |
| Annualized exposure | Churned-account MRR x 12 | $1,669,570.20 |
| Segment churn rate | Segment churned customers / segment customers | 62.92% priority segment |
| Churn concentration | Segment churned customers / all churned customers | 38.31% priority segment |

## Reproducibility checklist

| CONTROL | RESULT |
|---|---|
| Input file | WA_Fn-UseC_-Telco-Customer-Churn.csv |
| Source shape | 7,043 rows x 21 columns |
| Key integrity | 0 duplicate customerID values |
| Documented missing values | 11 blank TotalCharges; all have tenure = 0 |
| Calculation validation | Pandas aggregations reconciled with SQLite SQL output |
| Visual outputs | Charts generated directly from the cleaned dataset |
| Interpretation standard | Observational findings are labelled as associations or hypotheses |

## Priority segment SQL pattern

```
SELECT
  COUNT(*) AS customers,
  SUM(CASE WHEN Churn = 'Yes' THEN 1 ELSE 0 END) AS churned,
  ROUND(100.0 * SUM(CASE WHEN Churn = 'Yes' THEN 1 ELSE 0 END) / COUNT(*), 2) AS churn_rate_pct
FROM telco_customer_churn
WHERE Contract = 'Month-to-month'
  AND PaymentMethod = 'Electronic check'
  AND InternetService = 'Fiber optic'
  AND TechSupport = 'No';
```

**Portfolio positioning**

This project demonstrates a complete business analytics workflow: data-quality control, SQL validation, descriptive segmentation, revenue sizing, executive communication and experiment-ready operational recommendations.

Prepared by Rayan Braccio | Business Operations & Data Analytics Portfolio | Case Study #01

15 / BUSINESS ANALYTICS CASE STUDY

# Executive Takeaways

| | |
|---|---|
| 01 | Customer churn is primarily concentrated within a small number of operational customer segments rather than being evenly distributed across the subscriber base. |
| 02 | The analysis identifies measurable operational opportunities capable of reducing revenue leakage through targeted retention initiatives. |
| 03 | This case study demonstrates an end-to-end Business Analytics workflow, from data preparation and SQL validation to executive communication and business recommendation design. |

## Thank you for reading.

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Business Operations & Data Analytics Portfolio