Transforming Bank Telemarketing Through Predictive Analytics

From 11% Success to Strategic Precision: Predictive Analytics for Term Deposit Subscription

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The Challenge: Low Conversion, High Cost

11.3%
Overall Success Rate

88.7%
Wasted Telemarketing Effort

- 1 in 9 calls result in a subscription
- No systematic way to identify high-potential customers
- Campaign costs escalating without proportional returns

The Bank's Dilemma

The Data Story: 41,188 Customer Interactions

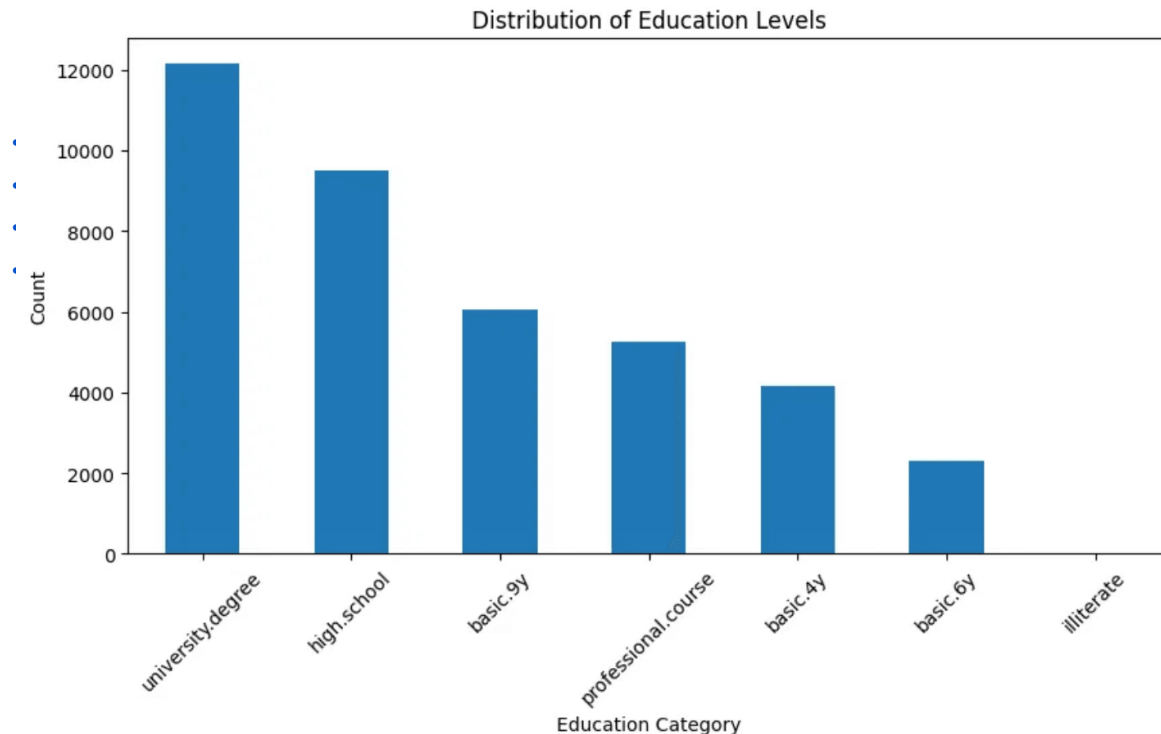May 2008 - November 2010

Client Demographics

- Age, Job, Marital Status
- Education Level
- Credit Default Status
- Housing & Personal Loans

Campaign History

- Contact Communication Type
- Last Contact Duration
- Number of Contacts
- Days Since Previous Campaign

Economic Context

- Employment Variation Rate
- Consumer Price Index
- Consumer Confidence Index
- Euribor 3-Month Rate

Distribution of Education Levels

Visualizing the Customer Base: Education Distribution

Our Approach: From Data to Deployment

A Systematic Data Science Workflow

01 Data Collection

Ingested 41,188 records with 21 features spanning demographics, campaign history, and economics.

02 Exploratory Analysis

Identified 4 critical insights including the non-linear impact of consumer confidence.

03 Feature Engineering

Created interaction features like 'previous success' to capture relationship depth.

04 Model Development

Benchmarked Logistic Regression, Random Forest, and XGBoost. XGBoost emerged as superior.

05 Threshold Optimization

Adjusted classification threshold from 0.5 to 0.30 to prioritize recall over precision.

06 Deployment

Built production-ready scoring API for real-time integration with CRM systems.

Key Innovation

Lowering the decision threshold from 0.5 to 0.30 doubled the model's recall, capturing high-value prospects that default settings missed.

Key Insight #1: Call Duration Matters

Longer Conversations Signal Higher Engagement

- Successful calls (Yes) average significantly longer durations
- Unsuccessful calls(No are heavily concentrated in short durations (< 200s).

Duration serves as a critical proxy for genuine customer interest.

"The violin plot reveals a distinct separation: short calls rarely convert, while extended engagement correlates strongly with subscription."
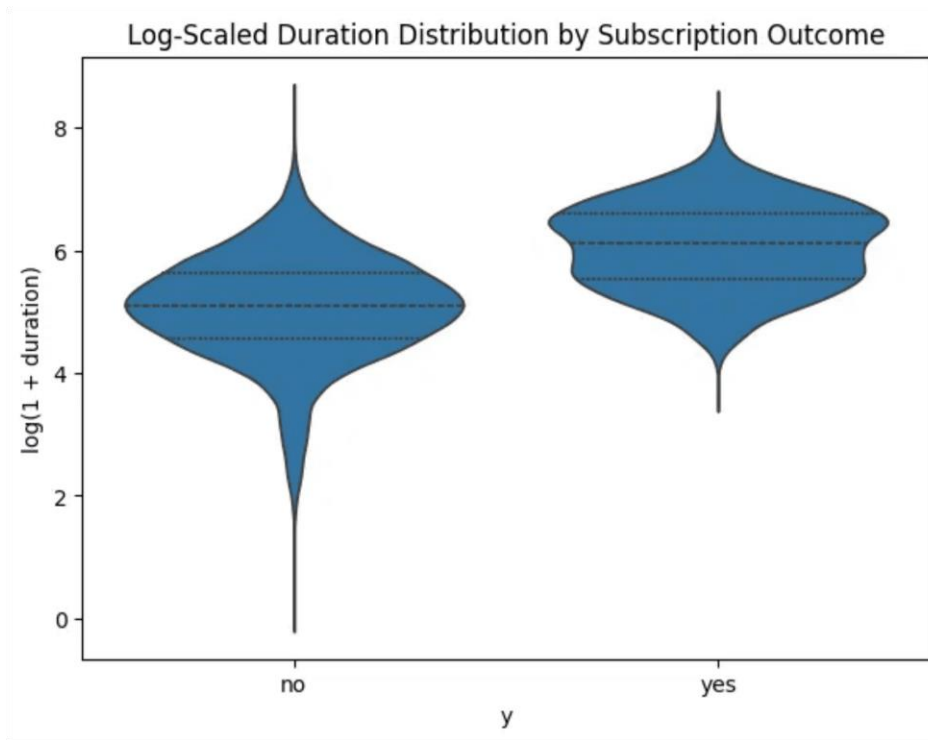
Figure: Log-Scaled Duration Distribution by Subscription Outcome

Key Insight #2: Past Success Predicts Future Success

Previous Campaign Outcomes Are Powerful Predictors

65%
Success Rate
For customers with previous contact history

10%
Success Rate
For first-time contacts

Relationship history drives trust. A 6.5× difference in conversion probability makes "previous outcome" the single strongest predictor.
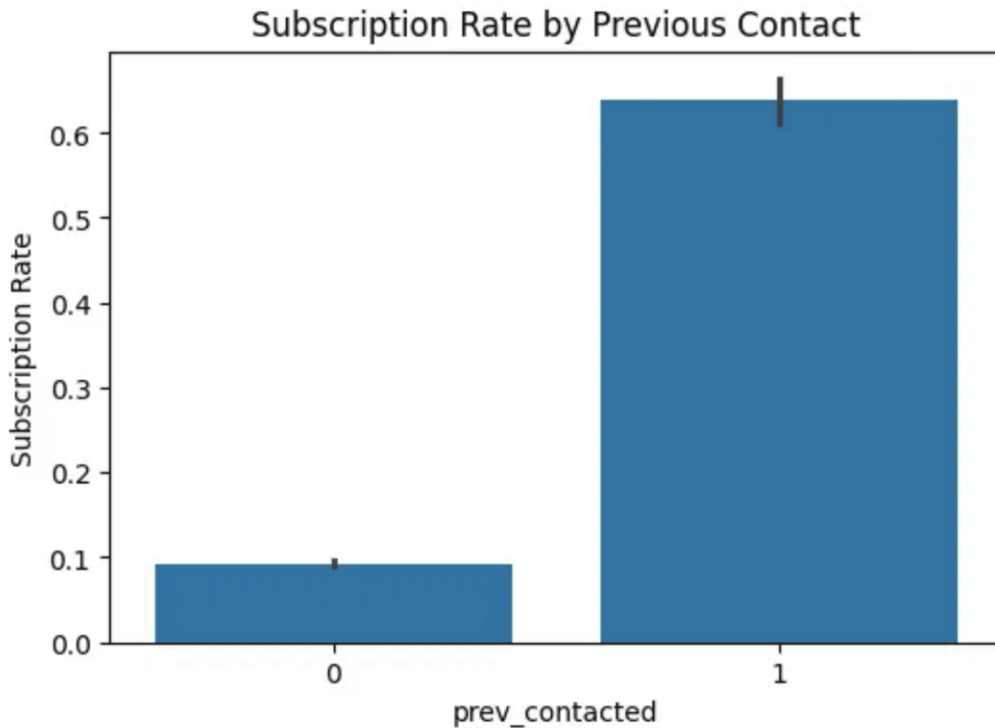

Figure: Subscription rates for previously contacted (1) vs. new (0) clients

Key Insight #3: Economic Timing Is Critical

Consumer Confidence Dramatically Affects Willingness to Subscribe.

- Subscription rates vary from 5% to 75% based on economic sentiment
- Relationship is non-linear: moderate confidence often yields the best results.
- External economic context is as powerful as internal customer data.

Strategic Lever

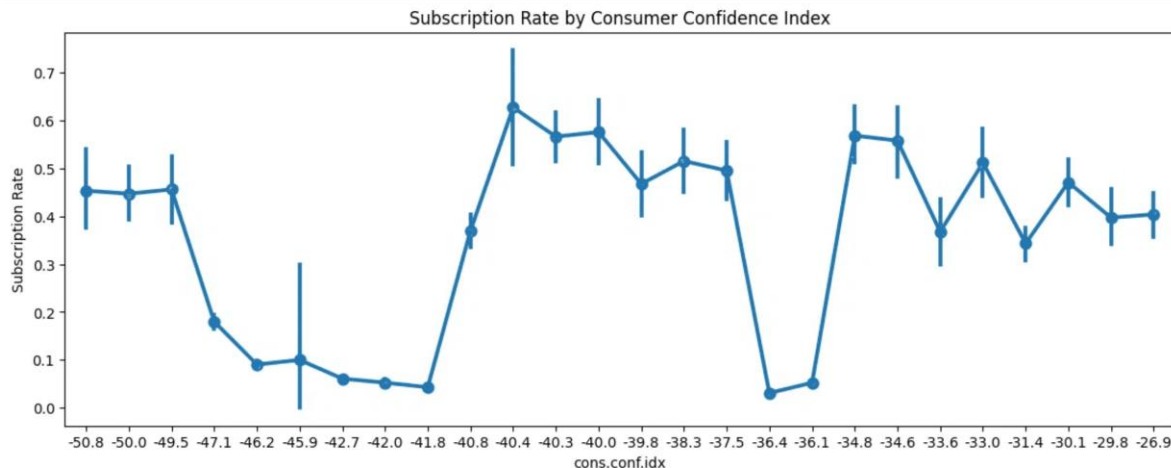*Campaign timing relative to economic conditions is a critical success factor.*

Figure: Subscription Rate variation across Consumer Confidence Index levels

Key Insight #4: Employment Trends Drive Behavior

Economic Uncertainty Drives "Safe Haven" Behavior

Negative Employment Variation

40-60%

Subscription Rate (Job Losses)

Positive Employment Variation

< 10%

Subscription Rate (Job Growth)

Counter-intuitive Finding: Customers are significantly more likely to secure funds in term deposits when the job market is contracting, seeking financial safety.
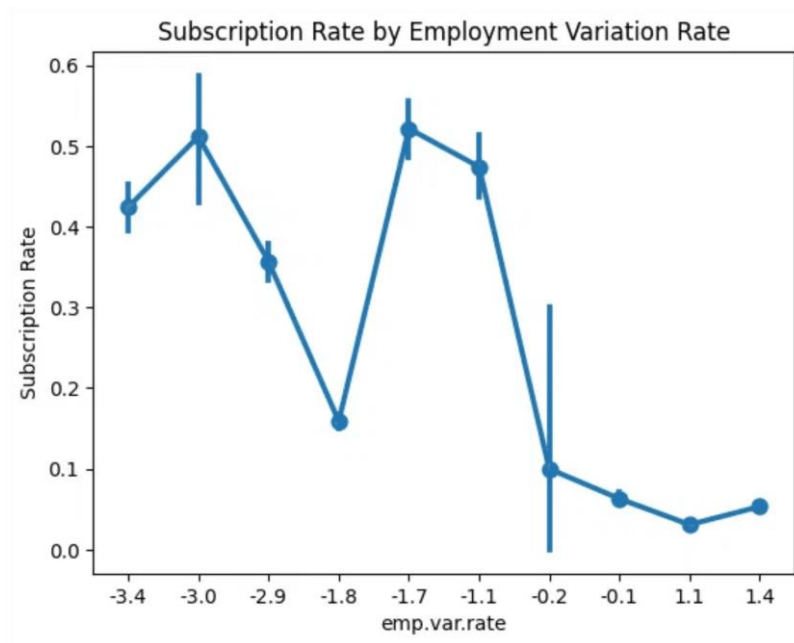

Subscription Rate by Employment Variation Rate

Figure: Subscription rates peak when employment variation is negative

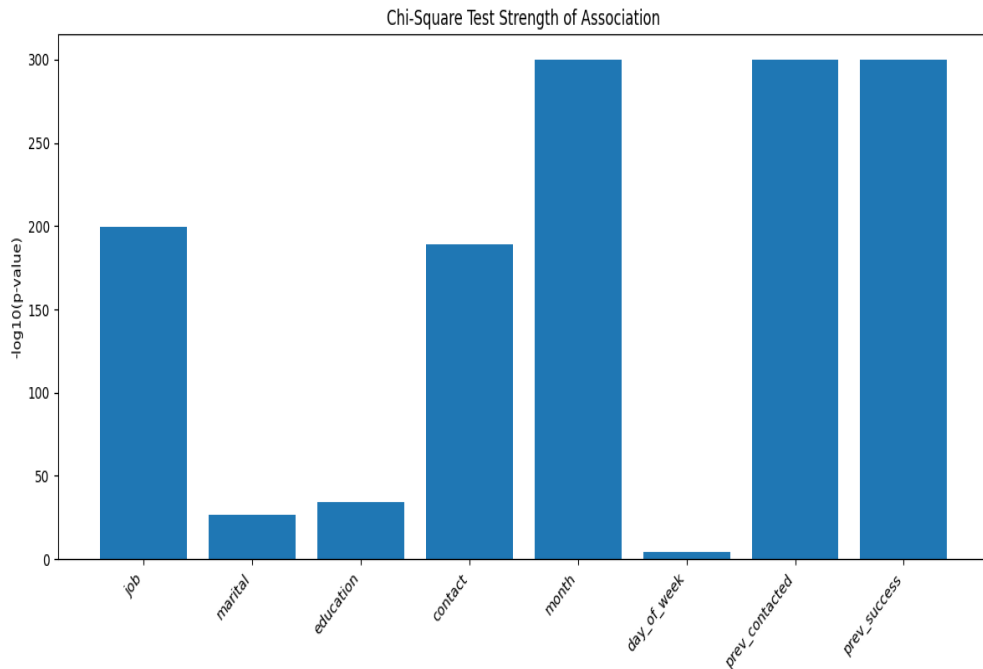# The Predictive Features That Matter Most
Statistical Testing Reveals the True Drivers

Top 3 Predictors:

01 **Previous Outcome**
Strongest signal: Did they subscribe before?

02 **Month of Contact**
Seasonal patterns and economic timing matter.

03 **Contact History**
Relationship depth (previous contacts) drives trust.

Critical Finding

Behavioral history and context outweigh static demographics. Job, marital status, and education have minimal predictive power.

Chi-Square Test Strength of Association

The Winning Model: XGBoost at 0.30 Threshold

Precision Targeting Delivers 4.7× Lift

4.7×

Performance Lift

- Top 10% Prospects: 53% subscription rate
- (vs 11% avg)
- Top 20% Prospects: Captures ~617 respondents
- Top 30% Prospects: Diminishing returns begin after this point

Strategic Implication

Concentrating effort on the top 20-30% of ranked prospects maximizes ROI. Targeting beyond this segment yields minimal additional value.
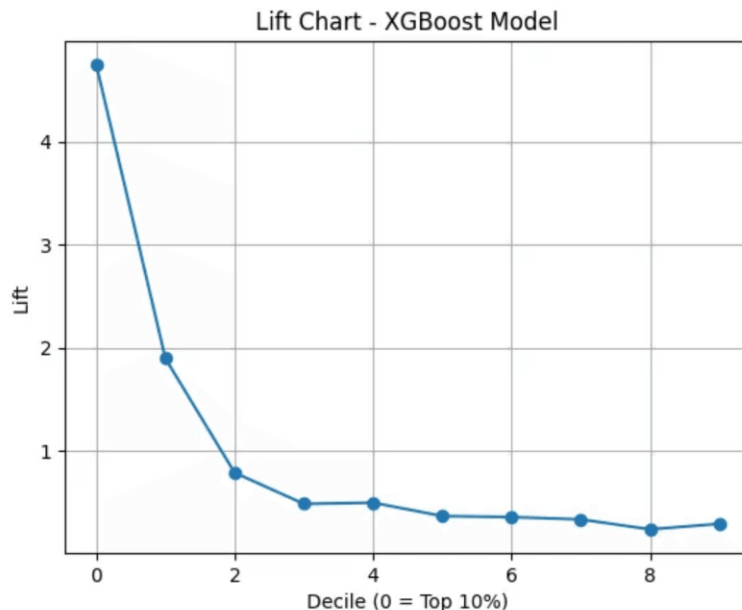

Figure: Lift Chart showing model performance across deciles

Strategic Recommendations

Five Actions to Transform Campaign Effectiveness

01 Deploy XGBoost Model (0.30 Threshold)
Deploy as primary scoring engine. 0.30 threshold balances precision and recall for optimal lead identification.

02 Prioritize Top 20-30% of Customers
Focus resources here to capture ~650 responders. Avoid bottom 50% (Lift < 1.0

03 Implement Tiered Contact Strategy

High-Touch (Top 10%): Call + SMS + Email
Medium-Touch (10-30%): Standard Phone
Low/No-Touch (30%+): Automated only

04 Dynamic Threshold Tuning
Adjust threshold daily based on call center capacity. Lower threshold when capacity is low to increase precision.

05 Economic Timing Optimization
Intensify campaigns when Consumer Confidence Index > -40. Scale back during low confidence periods.

Expected Impact

Implementing these strategies is projected to improve marketing ROI by 200-300% by concentrating resources on high-probability prospects.

Scenario #1: Economic Downturn

What If Consumer Confidence Drops Below -45?

Scenario Context

Recession fears, job losses, and market volatility drive the Consumer Confidence Index to historical lows (-47).

Impact: Subscription rates plummet to **5-10%** as customers avoid risk.

Strategic Response: "Defensive Precision"

01 Scale Back Volume
Reduce campaign volume by 60-70% to avoid wasted effort on unresponsive segments.

02 Focus on Top 10%
Target exclusively the highest-conviction prospects (Decile 0).

03 Shift Messaging
Emphasize "Safe Haven" products and capital preservation rather than growth.

04 Increase Threshold to 0.40
Prioritize precision over recall to minimize cost per acquisition.

05 Nurture Relationships
Redirect resources to existing clients with previous success history.

Expected Outcome

Maintain 30-40% of normal responder volume while reducing operational costs by 50%, preserving ROI during adverse conditions.

Scenario #2: Economic Recovery

What If Consumer Confidence Rises Above -35 ?

Scenario Context

- Strong job growth & rising wages
- Market optimism returns
- Confidence Index rises -30

50-65%

Projected Subscription Rate

Bank's Response Strategy

Expand Campaign Volume
Increase volume by 100-150% to capitalize on favorable market conditions.

Broaden Targeting
Target top 40% of model scores (vs. usual 20-30%) as conversion probability widens.

Lower Threshold to 0.25
Maximize recall to capture every potential prospect; cost of false positives is offset by high conversion.

Create Urgency
Launch time-limited promotional offers to accelerate decision-making.

Expected Outcome: Double responder volume with only 1.5× cost increase, resulting in a **33% improvement in cost-efficiency**.

Expected Business Impact:
Quantifying the Transformation

⟲ Current State

Success Rate
11.3%
Low conversion due to random targeting ("Spray and Pray").

Cost Efficiency: Low
89% of calls are wasted on uninterested prospects.

Prioritization: None
No systematic way to rank leads.

→

◎ Future State

Cost Reduction
40-50%
Achieved by focusing exclusively on top deciles.

Conversion Rate
2-3×
In targeted segments (Top 20-30%).

ROI Improvement
~300%
Driven by higher yield and lower operational costs.

Implementation Roadmap

From Model to Production

Deployment Architecture

Model Artifact
Serialized XGBoost model (joblib) with version control.

Scoring Pipeline
Automated preprocessing & feature engineering script.

API Endpoint
RESTful API for real-time or batch scoring requests.

Monitoring Dashboard
Real-time tracking of precision, recall, and lift.

Daily Operational Workflow

1 **Data Extraction**
Extract daily prospect list from CRM system.

2 **Automated Scoring**
Score prospects via API. Flag "High Priority" if probability > 0.30.

3 **List Distribution**
Call center receives prioritized list sorted by model score.

4 **Execution & Feedback**
Agents execute calls; outcomes are fed back to the monitoring system.

Conclusion: A New Era of Precision Marketing

From Spray-and-Pray to Strategic Targeting

Key Achievements

- ✓ Developed production-ready model with **53% response rate** in the top decile.

- ✓ Identified **4 critical insights** (Duration, History, Confidence, Employment) driving customer behavior.

- ✓ Created a **tiered contact strategy** to optimize operational resource allocation.

- ✓ Established **scenario-based playbooks** for economic volatility resilience.

The Bottom Line

This project establishes a scalable, data-driven framework that transforms telemarketing from a cost center into a precision acquisition engine, positioning the bank for sustained competitive advantage.

THANK YOU