MONTE CARLO SIMULATION FOR STARTUP CASH FLOW FORECASTING UNDER UNCERTAINTY

1. Project Background

A fast-scaling B2B SaaS startup, recently funded through a pre-Series A round, approached me to build a **risk-aware financial projection model**. They had ambitious revenue targets but limited visibility on their **operational cash flow runway** due to fluctuating customer acquisition costs (CAC), delayed payments, and uncertain churn behavior.

The founders had a deterministic Excel model but **wanted a more realistic, probabilistic forecast** that accounted for variability in revenues and expenses—especially to prepare for future investor meetings.

2. Objectives

The goals of the project were to:

- Simulate **thousands of possible cash flow paths** for the next 24 months
- Quantify the **likelihood of cash shortfalls** under multiple revenue and churn scenarios
- Identify critical **burn rate breakpoints** and suggest buffer policies
- Provide **evidence-backed funding timelines** for investor conversations
- Deliver a model that could be used by the finance team monthly for replanning

3. Tools & Technologies Used

- **Language:** R
- **Libraries:** tidyverse, data.table, ggplot2, dplyr, truncnorm, reshape2
- **Model Engine:** Monte Carlo with log-normal and truncated normal distributions for key variables
- **Outputs:** Plots (forecast ribbons, cash depletion probability curves), scenario-specific CSV reports
- **Delivery:** R Markdown + interactive HTML dashboard (offline-ready)

4. Key Variables Modeled

Variable	Distribution Used	Assumptions
Monthly New Customers	Truncated Normal	Mean = 120, SD = 30, Min = 60, Max = 180
Average Revenue per Customer (ARPU)	Log-normal	Skewed distribution based on early pricing tiers
CAC (Customer Acquisition Cost)	Truncated Normal	Simulated to fluctuate ±25%
Monthly Fixed Costs	Deterministic + 10% random noise	
Churn Rate	Uniform	Between 3% and 8% monthly
Payment Lag	Triangular Distribution	Most likely: 30 days, Min: 15, Max: 45

5. Simulation Approach

- Ran **10,000 simulations** over a rolling 24-month period
- Incorporated **monthly granularity** with cumulative cash flow computation
- Included **random payment delays** and customer churn dynamics
- Forecasted **cash inflow/outflow each month**, tracking net balance
- Flagged simulations where **cash balance dropped below zero**
- Created conditional scenarios for revenue seasonality and marketing campaign spikes

6. Deliverables

Component	Description
R Simulation Script	Modular and reusable, with parameter control via a config file
Interactive Dashboard	Standalone HTML with tabs for simulation outcomes, input sliders, cash burn charts

- Cash flow forecast ribbons (5%, 25%, 50%, 75%, 95%)
- Probability of cash depletion by month

- Monthly survival curve for 24-month horizon | | Risk Analysis Memo | Highlighted high-risk months and key drivers of cash volatility | | Scenario Kit | Pre-built templates for 3 business cases: Base Case, Aggressive Growth, Conservative Burn |

7. Insights Derived

- **14% of simulations showed cash depletion within 18 months**, despite initial 24-month runway
- Introducing a **30% churn reduction strategy** extended cash runway by **4.7 months on median**
- CAC variance had a **higher marginal impact** on runway than ARPU volatility
- Revenue lag caused by late payments **shifted depletion curve by 2–3 months** in multiple runs
- Recommended **buffer capital raise** at month 16 to reduce probability of cash-out below 10%

8. Business Impact

- Allowed finance and strategy teams to **move beyond single-point forecasts**
- Enabled board members to **visually see risk zones** and plan funding checkpoints
- Helped founders **justify early bridge funding**, improving investor trust
- The model is now updated every 60 days as part of internal planning reviews

9. Client Testimonial

“The simulation Siddharth built helped us make our forecasts bulletproof in front of investors. It’s now a core part of our boardroom discussions.”