Project Portfolio – Yash

Note: This document includes continuation from Project 5 onward.

# Project 6: Cognitive Learning Curve Modeling Across Reinforcement Conditions

A psychometric data analysis project exploring individual learning rates and adaptive behavior under varying reward probabilities using trial-wise performance data.

## Overview

Project Name: Reward-Driven Learning Analysis – Cognitive Modeling Assignment

Role: Cognitive Data Analyst & Statistical Modeler

Tech Stack: Python, Pandas, NumPy, SciPy, Matplotlib, Excel

Dataset: Trial-level behavior of participants under structured reward-feedback tasks

Outcome / Impact: Identified and visualized learning patterns using reward curves and modeled trial-by-trial learning rates across varying uncertainty environments.

## Problem Statement

How do human learners adapt to probabilistic rewards over time? This project modeled behavioral reinforcement learning by analyzing how participants adjusted their choices based on reward feedback during a simulated decision task.

## Methodology Highlights

🧠 Experimental Task: Participants completed learning trials under different block structures, with fixed and variable reward probabilities tied to their responses.

📊 Learning Rate Estimation: Calculated trial-level learning rate using reward prediction error (RPE) based logic from behavioral economics and cognitive modeling.

🔁 Data Processing: Cleaned, sorted, and reorganized multi-participant Excel datasets using automated scripts for condition-based grouping.

📈 Curve Analysis: Generated smoothed learning curves to show how probability of correct responses evolved across time.

🧮 Aggregate vs Individual Learning: Compared average learning rates between blocks and visualized inter-individual variability using violin and line plots.

🧪 Statistical Evaluation: Applied correlation and trend-based analysis to explore consistency across reward regimes and assess hypothesis-driven predictions.

## Results Summary

Participants demonstrated higher learning rates in deterministic reward conditions vs probabilistic ones, supporting reward sensitivity theory.

Increased noise in learning was observed under low-reward or 50-50 feedback conditions, aligning with stochastic decision-making behavior.

Individual plots indicated trait-like variance — some learners adapted sharply, others showed slow, noisy updates — relevant for cognitive diagnostics.

## Resume-Ready Entry

Reward-Based Learning Model – Behavioral Psychology Assignment (PSY306)

📍 Developed a psychometric learning rate estimation tool using trial-wise feedback logs from participant decision data.

- Engineered a trial-by-trial reward prediction engine to analyze how human learning adapts under stable vs uncertain reinforcement.

- Parsed and cleaned multi-sheet Excel datasets; implemented condition-wise learning rate computations and visual behavior tracking.

- Visualized cognitive learning curves and individualized response patterns across blocks using Python and statistical libraries.

- Generated insights into decision volatility, cognitive adaptability, and latent reward sensitivity across participants.