

# USING GEN AI AGENTS WITH GAE AND VAE TO ENHANCE RESILIENCE OF US MARKETS

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## ABSTRACT

*In this study, we explore the application of Generative AI (Gen AI) in enhancing interest rate models utilized in financial risk modeling. We employ advanced Gen AI Large Language Models (LLMs), including OpenAI's ChatGPT-4 and ChatGPT-4 Mini, as well as Google's Gemini versions 2.0 and 1.5, to generate pertinent queries and assess their accuracy. We propose and evaluate a prototype that leverages queries generated by publicly available LLMs to model and fine-tune parameters for Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs), methodologies that can also be applied to other interest rate models. Our findings demonstrate that ChatGPT (OpenAI) can produce relevant questions and queries that enhance data generated by GANs and VAEs. We implemented our model over a decade (2012–2024) using 10-year U.S. Treasury rates, integrating publicly trained LLM models with Gen AI data tools, and proposed a full stack framework that can be extended to building AI agents. We also presented the GANs and VAEs results using different visualization techniques for better understanding. The accuracy of the LLM-generated queries is evaluated by three independent volunteers with expertise in this area. Our proposed architecture incorporates a Gen AI-based agent to validate current scenario generation and Monte Carlo methods traditionally used in modeling. Additionally, we present backtesting results comparing real and generated data, along with querying and optimizing models, paving the way for future agent-based virtual analysts.*

## KEYWORDS

*Gen AI for Risk Modeling, US economic system, US regulatory, Generative adversarial networks (GANs), Variational Autoencoders (VAEs)*

## 1. INTRODUCTION

As of January 2025, the latest iteration of the GPT model, GPT-4o (with the 'o' representing 'omni'), has shown promising results in various real-world applications. This study utilizes GPT-4o for its analysis. Currently, most models used for regulatory purposes in the financial sector are based on traditional Monte Carlo simulations, particularly in interest rate modeling. While financial institutions are advancing the development of Large Language Models (LLMs) for customer-facing chatbots, the application of LLM infrastructure for financial risk modeling remains largely untapped. Furthermore, many institutions' LLM frameworks are not fully integrated with their big data storage systems, limiting the potential for comprehensive financial modeling.

GANs are artificial intelligence (AI) models that use neural networking and Gen AI infrastructure to create new data from existing datasets. These models would require setting and using Vector Databases and infrastructure used in LLMs. While VAEs are made up of an encoder and a decoder, GANs are made up of a generator and a discriminator. GANs consist of two neural networks: a generator and a discriminator. The generator creates synthetic data samples, while the discriminator evaluates their authenticity so they are both working into different directions to