A Comparative Analysis Of Secure Investment Schemes In India Using Streamlit Visualization

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Abstract:
In a rapidly evolving financial environment, making informed investment decisions is crucial for individuals seeking both safety and returns. India offers a wide array of secure investment instruments such as Fixed Deposits (FDs), Public Provident Fund (PPF), Sukanya Samriddhi Yojana (SSY), and Sovereign Gold Bonds (SGB), each differing in terms of risk, taxation, liquidity, and returns. However, for a typical investor—especially first-timers—the diversity and complexity of these options can be overwhelming.

This project presents a user-friendly, interactive Streamlit application that enables investors to compare multiple government-backed and low-risk financial schemes. By taking user input (investment amount and duration), the application dynamically visualizes maturity value, risk, and liquidity ratings for each scheme. The tool also displays detailed tax implications and official references, helping users make educated, data-backed financial choices.

This solution bridges the gap between financial literacy and practical investment planning by combining finance, data science, and intuitive web development.

Keywords: Investment Planning, Secure Investment Schemes, Compound Interest, Financial Visualization, Risk Assessment, Tax Efficiency, Liquidity Analysis, Government-Backed Instruments, Decision Support Systems, Strategic Investment Tools, Streamlit Dashboard.

Introduction

India's financial ecosystem offers a comprehensive suite of government-backed investment instruments designed to cater to diverse investor needs, risk appetites, and financial goals. These instruments range from traditional fixed-income products like Fixed Deposits and National Savings Certificates to specialized schemes such as the Public Provident Fund and Sukanya Samriddhi Yojana. Each scheme presents unique characteristics in terms of interest rates, lock-in periods, tax treatments, and liquidity provisions, creating a complex decision-making environment for retail investors.

The diversity of available options, while beneficial in meeting varied investment objectives, presents significant challenges for individual investors. The complexity arising from variable

interest rates, differing tax treatments under various sections of the Income Tax Act, diverse maturity periods, and varying liquidity constraints often leads to suboptimal investment decisions. Traditional methods of investment comparison rely heavily on manual calculations, which are time-consuming, error-prone, and fail to provide comprehensive insights into the long-term implications of investment choices.

Furthermore, the critical importance of tax efficiency in investment planning is often overlooked by retail investors. Different schemes fall under distinct tax categories - some following the Exempt-Exempt-Exempt (EEE) structure, others being taxable on interest, and some subject to capital gains taxation. This complexity makes post-tax return calculations essential for meaningful investment comparisons, particularly for investors in higher tax brackets.

The advent of financial technology has created unprecedented opportunities to democratize financial planning through user-friendly, interactive tools. This study addresses the pressing need for a comprehensive, tax-aware investment comparison platform by developing an interactive Streamlit application that consolidates critical investment information, performs complex financial calculations, and presents results through intuitive visualizations.

1.1 Problem Statement

Retail investors in India face a range of challenges when selecting among government-backed investment schemes, many of which stem from systemic complexity and limited access to consolidated information. Investment details such as interest rates, eligibility criteria, and tax implications are often fragmented across multiple official sources, making comprehensive comparisons difficult. Additionally, understanding post-tax returns requires navigating intricate tax provisions, which can be overwhelming without specialized knowledge. Traditional methods of comparing schemes rely heavily on manual calculations that are both time-consuming and prone to error. The lack of visual and interactive tools further compounds the issue, as static information fails to provide meaningful insights into how investments perform over time. Coupled with generally low levels of financial literacy, these barriers make it challenging for non-expert investors to make informed, strategic decisions. These limitations highlight the urgent need for user-friendly, digital decision-support tools that can simplify complexity, improve accessibility, and foster better investment outcomes.

1.2 Research Objectives

This study aims to develop and evaluate an interactive investment comparison tool designed to assist retail investors in making informed decisions regarding Indian government-backed investment schemes. The tool provides a unified platform for comparing multiple schemes, addressing the issue of information fragmentation. It incorporates tax-aware calculations, enabling users to view realistic post-tax returns based on current fiscal regulations. To enhance user comprehension, the application includes dynamic visualizations that illustrate investment performance over time. Additionally, it serves an educational purpose by offering detailed explanations of each scheme's features, including risk, liquidity, and tax treatment. The tool also supports customized analysis, allowing users to input their specific investment amounts, durations, and tax brackets to receive tailored insights that reflect their unique financial profiles.

1.3 Scope and Limitations
The study focuses on eight major government-backed investment schemes available in India as of FY 2024-25. While the tool provides comprehensive analysis within its defined parameters, certain limitations include the assumption of fixed interest rates over investment tenure, exclusion of intermediate reinvestment scenarios, and focus on nominal rather than inflation-adjusted returns.

Literature Review
2.1 Investment Decision-Making Frameworks
Contemporary investment decision-making is increasingly guided by insights from Modern Portfolio Theory (MPT) and behavioral finance. These frameworks advocate for a multi-faceted evaluation approach, recognizing that return alone is insufficient for optimal asset selection. Traditional return-centric models have evolved into multi-dimensional frameworks that incorporate risk tolerance, liquidity preferences, tax implications, and individual investor goals. The proliferation of decision support systems (DSS) in finance stems from the widespread acknowledgment that retail investors often lack access to the analytical tools and domain expertise required for strategic portfolio allocation.

2.2 Government Securities and Retail Investment Patterns
Research into Indian retail investment behavior, particularly concerning government-backed savings schemes, reveals a strong inclination toward capital safety and assured returns. Despite the availability of a wide array of financial instruments, retail investors frequently rely on limited information sources, including informal advice and social influence, rather than conducting structured comparative analysis. This behavior often leads to suboptimal choices that overlook key factors such as tax efficiency, which plays a pivotal role in long-term wealth accumulation. The literature emphasizes the need for tools that bridge the information gap and promote evidence-based investment planning.

2.3 Financial Technology and Investment Tools
The rise of financial technology (FinTech) has transformed personal finance management, enabling more accessible and transparent investment planning. Studies highlight that interactive digital tools—particularly those incorporating visualizations, real-time feedback, and personalized inputs—significantly enhance users' understanding of complex financial concepts. Furthermore, the integration of educational content within these tools has been shown to boost financial literacy and foster informed decision-making. The intersection of technology, data analytics, and user-centric design continues to play a critical role in democratizing access to investment knowledge.

Methodology
3.1 System Architecture
The investment comparison tool is built using Python's Streamlit framework, selected for its capability to rapidly develop interactive, browser-based applications with minimal development overhead. The system architecture is modular and consists of the following three core components:

1.   **Data Layer**: Stores scheme-specific parameters such as interest rates, tenure limits, tax treatments, and qualitative attributes like risk and liquidity scores. This layer ensures that all computations are grounded in accurate and up-to-date input data.

2.   **Computational Engine**: Serves as the core logic layer, executing financial algorithms to compute investment returns, tax liabilities, post-tax gains, and other performance metrics. It ensures accuracy, consistency, and efficiency in processing user-defined scenarios.

3.   **Presentation Layer**: Manages the user interface, facilitating seamless interaction through input widgets and rendering real-time visualizations. It bridges user inputs with computed outputs, enabling intuitive interpretation of results.

3.2 Financial Algorithms

1.   Compound Interest Model (CIM): This equation forms the backbone of investment growth projections. It calculates the maturity value for each scheme based on the user's principal, tenure, and scheme-specific annual return rate.

$$A = P \times \left(1 + \frac{r}{100}\right)^t$$

2.   Liquidity Score Index (LSI): Liquidity is modeled using a subjective scale, where schemes are assigned values between 1 (very illiquid) and 5 (highly liquid) based on withdrawal rules and lock-in conditions.

$$LSI = \sum_{i=1}^{n} \left(L(i) \times W(i)\right)$$

3.   Risk Rating Model (RRM): Risk scoring quantifies safety based on credit risk, reinvestment risk, market volatility, and institutional backing.

$$RS = \sum_{j=1}^{m} \left(R(j) \times W(j)\right)$$

4.   Tax Efficiency Index (TEI): This algorithm differentiates between schemes based on their tax regime classification: EEE, TEE, or fully taxable. A normalized score is computed to represent overall tax friendliness.

$$TEI = T_{contrib} + T_{interest} + T_{maturity}$$

3.3 Data Collection and Validation

The investment scheme parameters utilized in the application are sourced from authoritative and official entities, including the Reserve Bank of India (RBI), the Ministry of Finance, and other relevant government departments. These sources ensure the credibility and reliability of financial data. Key variables such as interest rates, tax treatments, tenure restrictions, and eligibility criteria are cross-referenced and validated against the regulatory guidelines applicable for the Financial Year 2024–25. This rigorous validation process ensures that all computations and comparisons presented by the tool are grounded in accurate, current, and policy-compliant data.

3.4 Visualisation Framework

The application integrates a diverse set of visualization techniques to enhance data interpretation and user engagement. These visual tools transform complex financial computations into intuitive graphical formats, enabling users to make well-informed investment decisions. Key components of the visualization framework include:

● **Bar Charts**: Used for side-by-side comparisons of maturity values, tax liabilities, and composite risk-liquidity scores across different investment schemes.

● **Line Plots**: Illustrate the growth trajectory of investments over time, helping users visualize the effect of compounding and time horizon.

● **Summary Tables**: Provide a comprehensive tabular view of computed results, including gross returns, post-tax values, effective yield, and other key metrics.

● **Interactive Elements**: Enable users to adjust input parameters dynamically (e.g., investment amount, duration, tax bracket), with all visualizations updating in real time to reflect changes.

This multi-modal approach ensures both clarity and customizability, catering to users with varying levels of financial literacy.

System Implementation and User Experience
4.1 Application Features
The Streamlit application is designed with a user-centric approach, integrating several key features to enhance both functionality and learning:

● **Interactive Input Panel**: Empowers users to customize scenarios by entering variables such as investment amount, duration, and applicable tax bracket, thereby personalizing the analysis.

● **Real-Time Calculations**: Performs instantaneous computations of key financial metrics, ensuring users receive immediate feedback as they adjust inputs.

● **Comprehensive Visualizations**: Utilizes a variety of chart types—such as bar graphs, line charts, and comparative visuals—to present data from multiple analytical angles.

● **Educational Content**: Offers clear, contextual explanations of tax treatments, scheme types, and financial terminology, enriching user understanding.

● **Responsive Design**: Built with adaptability in mind, ensuring a seamless and intuitive experience across desktops, tablets, and mobile devices.

4.2 User Interface Design
The application adheres to user-centric design principles, ensuring a seamless and engaging user experience through the following elements:

● **Intuitive Navigation**: Features a clean and logically structured layout that guides users effortlessly through the input, analysis, and results sections.

● **Visual Hierarchy**: Emphasizes critical data points and insights through thoughtful use of typography, spacing, and color, allowing users to quickly grasp key information.

Interactive Elements: Incorporates user-friendly controls such as sliders and dropdown menus, enabling smooth and precise adjustment of parameters without overwhelming the user.

● **Accessibility Features**: Employs clear labeling, consistent color-coding, and high-contrast visuals to enhance readability and ensure inclusivity for users with varying levels of

visual   or   cognitive   ability.

4.3 Performance Validation

Testing across a range of investment scenarios demonstrates the application's reliability and performance through the following attributes:

● **Accuracy**: All financial outputs have been cross-verified with manual calculations, ensuring precise and trustworthy results.
● **Responsiveness**: The interface delivers immediate updates to visualizations and metrics as user inputs change, enhancing interactivity and user engagement.
● **Robustness**: The application is resilient against edge cases and invalid inputs, with built-in error handling to maintain stability and usability.
● **Scalability**: Maintains consistent performance across a wide spectrum of investment amounts, durations, and user profiles, confirming its adaptability to real-world use.

Results and Discussion

This analysis investigates the performance of various government-backed investment schemes in India for the financial year 2024–25 (assessment year 2025–26). An investment amount of ₹50,00,000 over a 7-year period was used as the baseline, and the applicable income tax slab was selected at 25%. The primary focus was to compare the schemes in terms of pre-tax and post-tax returns, tax liabilities, liquidity, and risk, providing investors with a comprehensive view of each scheme's suitability.

5.1

Pre-Tax Maturity Comparison: Senior Citizens Savings Scheme (SCSS) delivered the highest returns at ₹8,680,822, followed by RBI Bonds (₹8,431,230) and PPF (₹8,081,580). FDs offered ₹7,769,933, while SGBs significantly underperformed with ₹5,943,429. Schemes like NSC, SSY, and Postal Bonds were ineligible for a 7-year duration and hence not considered.
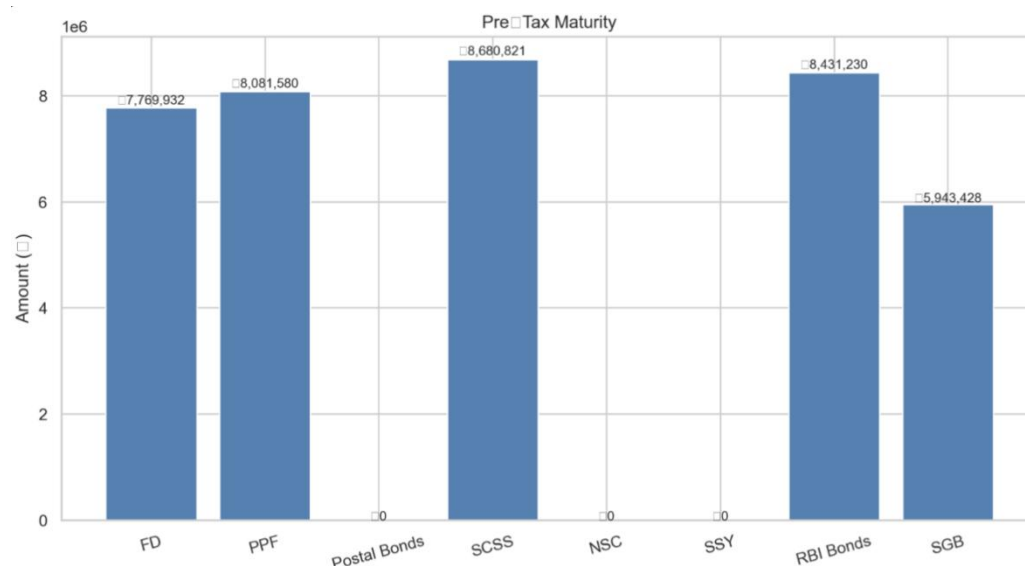

Figure 1: Bar Graph showing Pre-Tax Maturity over Amount

Post Tax Maturity Comparison: PPF remained the most attractive option post-tax with ₹8,081,580 as it is fully tax-exempt (EEE). SCSS and RBI Bonds were substantially impacted by taxation, reducing their returns to ₹7,760,616 and ₹7,573,423 respectively. FDs post-tax value dropped to ₹7,077,449. SGBs, despite having a lower interest rate, retained ₹5,707,572 due to LTCG tax exemption beyond 8 years, though this analysis considers only 7 years.
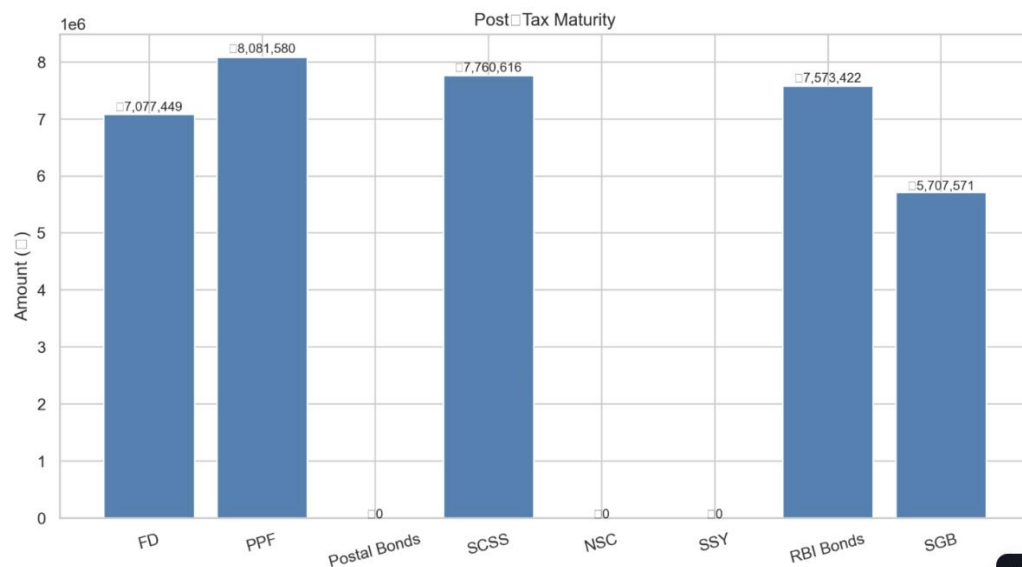

Figure 2: Bar Graph showing Post-Tax Maturity over Amount

Tax Liability: Tax burden played a crucial role in the net profitability of each scheme. SCSS incurred the highest tax liability of ₹920,205. RBI Bonds followed at ₹857,808, and FDs at ₹692,483. PPF and SSY remained completely tax-free. SGBs had a modest tax liability of ₹235,857, owing to capital gains on early redemption (before 8 years).
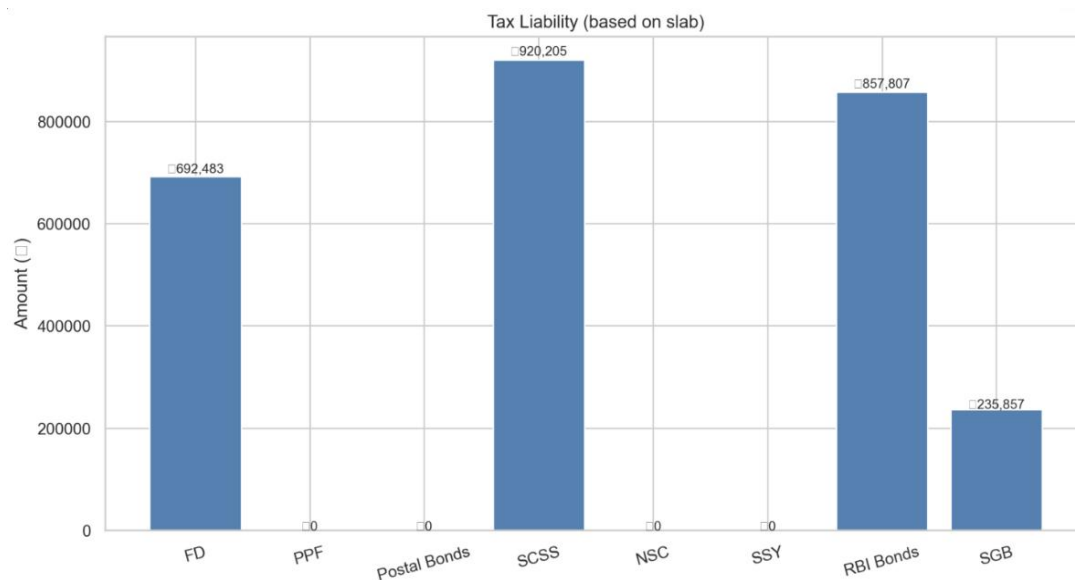

Figure 3: Bar Graph showing Tax Liability over Amount

Liquidity Assessment: SGBs scored the highest (4), offering relatively better exit options compared to traditional instruments. FDs and SCSS scored moderately (3), reflecting limited but accessible withdrawal provisions. NSC, SSY, Postal Bonds scored the lowest (1), indicating poor liquidity.
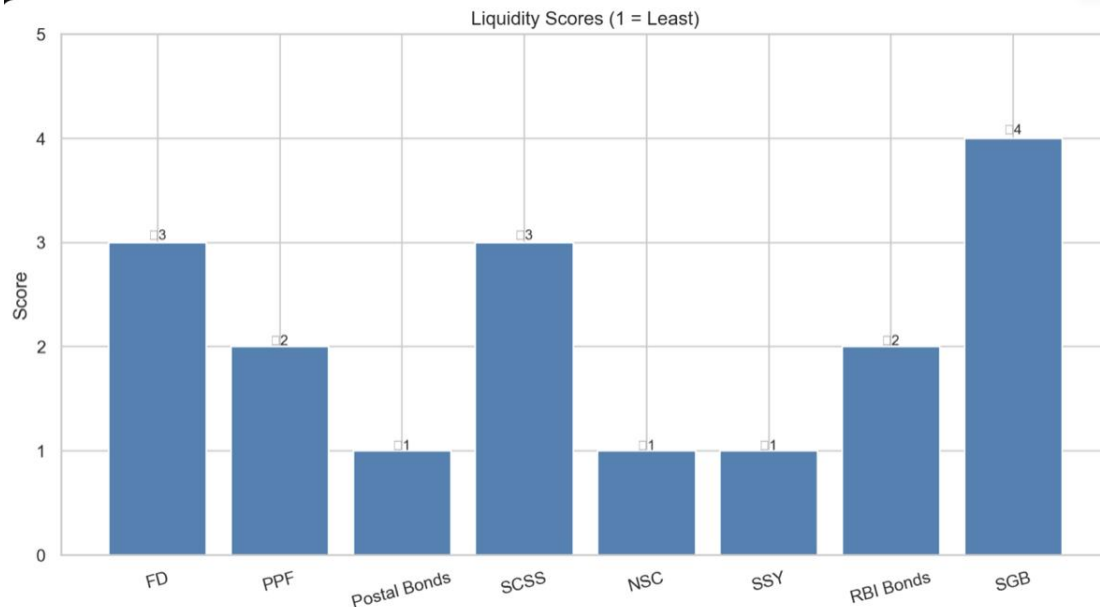

Figure 4: Bar Graph showing Liquidity Scores

Risk Assessment: Most traditional government-backed schemes (PPF, SCSS, NSC, SSY) scored 1, indicating very low risk. SGBs had a risk score of 3, reflecting market-linked gold price volatility. FDs and Postal Bonds had a slightly higher risk score of 2, mainly due to bank-related risks and lack of sovereign guarantee (in some bank FDs).
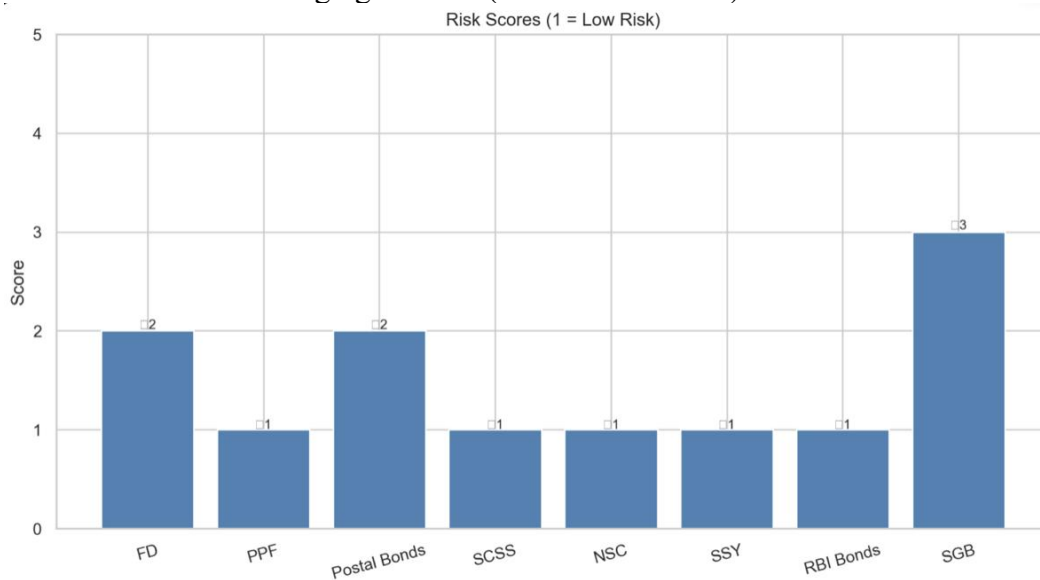

Figure 5: Bar Graph showing Risk Scores

Year Wise Investment Growth: The Year-wise Investment Growth graph illustrates the compounded growth trajectories of eight secure Indian investment schemes over a 7-year period, based on an initial investment (e.g., ₹50,00,000). The chart is generated using the compound interest formula, which projects the annual maturity value using scheme-specific interest rates. The year-wise growth chart revealed a steady compounding pattern:

● SCSS, RBI Bonds, and PPF showed strong compounding effects, surpassing ₹8M by year 7.

● SGBs had a linear and flatter growth curve due to a modest interest rate (2.5%), emphasizing their suitability more for gold-price appreciation than income generation.

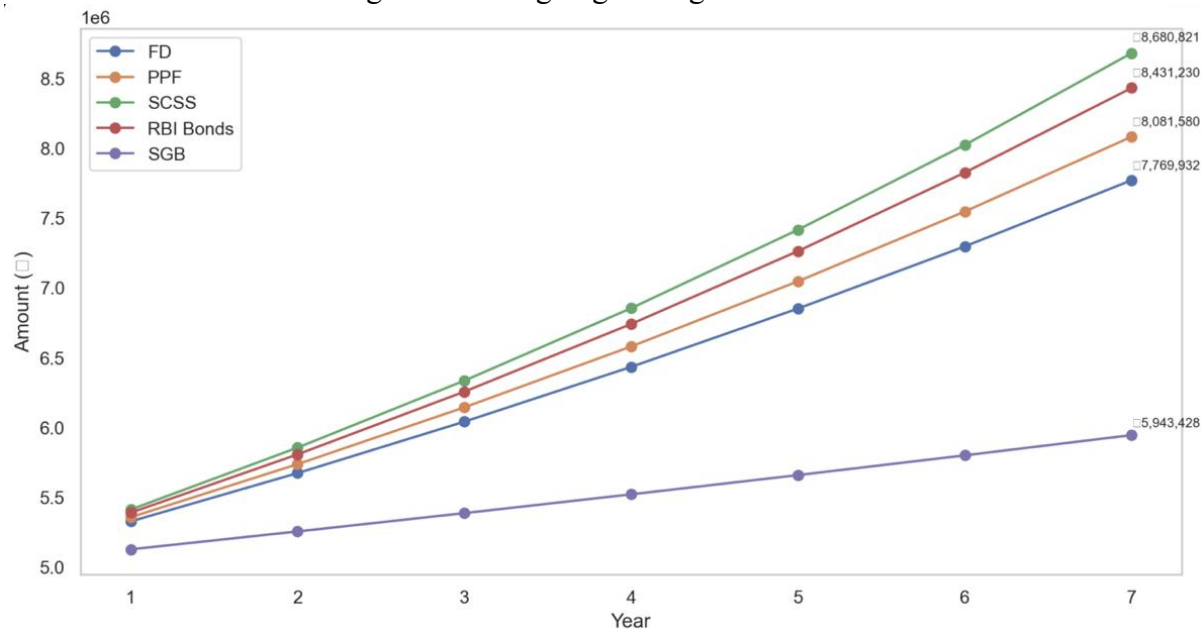● FDs had the slowest growth among eligible high-return schemes.

Figure 6: Line Graph showing Investment Growth Over Time

5.2 Investment Recommendations

Based on the comparative analysis:

● **Best Post-Tax Return with Low Risk:** PPF is the most attractive option due to tax-free maturity, consistent growth, and low risk.

● **Best Pre-Tax Return:** SCSS leads in returns, but taxes substantially reduce its advantage.

● **Highest Liquidity:** SGBs, though low in return, offer better liquidity.

● **Overall Balanced Choice:** RBI Bonds provide a good blend of return and low risk but come with higher tax liabilities.

For conservative investors aiming for long-term tax-free growth, PPF is ideal. For higher returns with some tax exposure, SCSS and RBI Bonds can be considered. SGBs should be chosen only if held for over 8 years to benefit from LTCG exemption.

5.3 Implications for Financial Planning

The tool underscores the significance of a comprehensive investment evaluation framework that goes beyond surface-level metrics. Specifically, it highlights the following key principles:

● **Holistic Analysis**: Evaluating investment options through a multidimensional lens—factoring in risk, liquidity, inflation, and opportunity costs—rather than relying solely on headline returns.

● **Tax Planning**: Demonstrating how incorporating tax implications into investment decisions can substantially affect real returns, and emphasizing the strategic role of tax-efficient instruments.

● **Long-Term Perspective**: Showcasing the transformative impact of compounding over time, reinforcing the value of patience and consistency in wealth accumulation.

● **Personalization**: Advocating for investment strategies tailored to an individual's unique goals, risk tolerance, income profile, and time horizon, rather than one-size-fits-all solutions.

5.4 Educational Value

The application functions as an educational platform, empowering users with practical financial knowledge through the following means:

● **Simplifying Complex Concepts**: It translates intricate financial calculations and investment principles into an intuitive, user-friendly format, making them accessible even to those without a background in finance.

● **Promoting Awareness**: By shedding light on often-overlooked aspects—such as tax implications, inflation, and time value of money—it broadens users' understanding of real-world investment dynamics.

● **Encouraging Informed Decisions**: The tool offers data-driven comparisons and visualizations, enabling users to make more rational, evidence-based investment choices.

● **Building Financial Literacy**: Through interactive scenarios and real-time simulations, it educates users on core investment strategies, fostering long-term financial competence and confidence.

Limitations and Future Enhancements

6.1 Current Limitations

While the tool offers a comprehensive analysis within its defined scope, it is subject to certain limitations that should be acknowledged. Firstly, it operates on static rate assumptions, treating interest rates as constant over the entire investment tenure, which may not reflect future rate fluctuations or policy changes. Secondly, the model employs simplified tax calculations, omitting complex scenarios such as exemptions under specific sections, indexation benefits, or deductions beyond basic slabs. Additionally, the tool presents nominal returns without adjusting for inflation, which may lead to an overestimation of real purchasing power over time. Lastly, the scope is limited to a selection of major government-backed investment schemes, and does not include private sector options or market-linked instruments, potentially narrowing the range of comparative insights for users.

6.2 Future Enhancement Opportunities

To enhance the tool's functionality and real-world applicability, several potential improvements have been identified. Integrating real-time data feeds for interest rates and scheme updates would ensure greater accuracy and relevance of the analysis. Incorporating inflation-adjusted return calculations would provide users with a clearer picture of real purchasing power over time.

Enhancing the tax computation module to support advanced scenarios—such as deductions under various sections, capital gains treatments, and indexation—would increase the tool's utility for diverse user profiles. Additionally, introducing a portfolio optimization feature could help users identify optimal allocation strategies across multiple schemes based on their risk tolerance and financial goals. Finally, mobile interface optimization would improve accessibility, enabling a seamless experience across devices and expanding the tool's reach among digitally active investors.

6.3 Scalability Considerations

The system architecture has been designed with scalability and flexibility in mind, supporting future growth and adaptability. Its structure allows for seamless expansion, enabling the easy addition of new government or private investment instruments as needed. The modular design facilitates ongoing feature enhancements, allowing individual components—such as visualization tools, tax logic, or UI elements—to be updated or extended independently. The framework also supports a high degree of user customization, accommodating a wide range of personalized investment scenarios based on variables like amount, duration, and tax bracket. Additionally, the architecture is equipped to support external data integration, laying the groundwork for real-time updates and connectivity with third-party financial data sources.

Conclusion

This study successfully demonstrates the development and implementation of a comprehensive investment comparison tool that addresses critical gaps in retail investment planning. The interactive Streamlit application provides unprecedented accessibility to complex financial analysis, enabling informed investment decisions through intuitive visualizations and educational content.

The research reveals that tax considerations fundamentally alter investment attractiveness, with tax-efficient instruments like PPF providing superior long-term value despite lower nominal returns. The tool's ability to present complex financial data in accessible formats promotes financial literacy and empowers individual investors to make data-driven decisions.

The system's comprehensive approach, incorporating multiple evaluation criteria including returns, tax implications, risk, and liquidity, provides a holistic framework for investment analysis. The educational components enhance user understanding of financial concepts, contributing to improved financial literacy and better investment outcomes.

Future enhancements focusing on real-time data integration, inflation adjustment, and advanced tax scenarios will further strengthen the tool's utility and relevance. The scalable architecture ensures continued value as the financial landscape evolves and new investment instruments emerge.

This research contributes to the broader goal of democratizing financial planning tools, making sophisticated investment analysis accessible to retail investors regardless of their financial expertise. The tool serves as a model for similar applications in other financial domains, demonstrating the potential of technology to bridge the gap between complex financial concepts and practical decision-making.

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