

# Statistical Analysis of Financial Choices Among Working Women in Higher Education: A Mathematical Modeling Approach

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## Abstract:

In the dynamic economic landscape, the increasing significance of financial behaviours and choices of women in the higher education sector is recognized. A robust mathematical modelling approach is employed in this study to analyze the financial patterns of women employed in higher education institutions (HEIs) in India, with their unique financial challenges and opportunities being acknowledged. Their income, savings, expenses, and investment behaviours are examined, providing a comprehensive view of their financial situation. Various statistical tools and models constitute the core of our methodology. Basic statistical measures such as mean and median are initiated with, in order to gain an initial understanding of their general financial tendencies. This is deemed essential for the establishment of a baseline financial landscape. Dispersion measures like variance and standard deviation are subsequently utilized to assess the variability and stability in their financial behaviour, which is crucial for understanding their financial risk and stability. Linear trend models for time series analysis of income and expense patterns are included in our analysis, offering insights into long-term financial trajectories that are deemed important for strategic planning and policy making. The relationship between income and expenses is also examined through the utilization of Pearson's correlation coefficient and linear regression models, shedding light on how changes in income affect spending patterns. Additionally, ratios such as the expense-to-income and savings ratios are calculated, providing a nuanced perspective on financial management. Higher-order statistical measures such as skewness and kurtosis are employed to facilitate an understanding of the distributional characteristics of their financial data. Time-series-specific metrics like autocorrelation functions and moving averages are utilized to enrich our understanding of financial trends. Finally, key financial health indicators like the debt-to-income ratio and disposable income are evaluated, which are crucial for assessing the financial well-being of these women. This study not only highlights the current financial state of women in HEIs in India but also contributes to the development of tailored financial programs and policies with the aim of fostering financial stability and growth in higher education.

**Keywords:** Financial Behaviors, Women, Higher Education Sector, Mathematical Modeling, Financial Patterns, India, Statistical Tools, Income, Expenses, Financial Management.

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## 1. INTRODUCTION

Today's world is highly complex when compared with that of a generation ago in terms of Financial planning. Decades ago, it was easy to maintain current and savings account at nearby/Local banks. Now, consumers can easily avail and differentiate among wide variety of financial products and services in the market as they are digital. Education has been integral part of social change of any society and any nation. [1] It is considered as a powerful weapon through financial knowledge and

competencies. It introduce everyone in the society to new information, thoughts, ideas, products , services, technology etc. and helps in developing the required skill for the overall development. Women's plays a very vital role in every field of the society. Women's education in terms of financial planning is very important for their social upliftment and their standard of living . Working Women 's constitute almost half of the human race. A financially literate women knows very well where to invest her money. Their savings desire are different as compared to men's . When they are singles their financial planning goals may vary as compared to married ones. The Single working women has freedom to experiment with their money and more capacity to take risk. Whereas married women has financial goals like children's education, marriage, buying a home or investing in ancestral home. Financial education can benefit all age of women including their income level whatever they are earned during the profession [2]. The single working women invest more in different financial investment avenues comparatively married working women as single women are independent , bearing less responsibility ,self-centric and more inclined to investment for their future goals. It may vary if women having good financial knowledge, financial support and more widespread investment autonomy for taking the financial decision. Financial literacy not only strengthen the financial decision but also an individual women can learn how to save their money and take the tax benefits during their income tax return .Financial literacy help senior age group working women to ensure their saving for retirement , rainy days and taking the wise investment alternative for pension plans and starting new startups if they feel to do so. Financial literacy may affect one's quality of life significantly and endure more dependent in social life. Subsequently, Financial literacy , financial decision seems to be everyday expenditure , savings and small decision can make a vital effect if compounded. In the ever-evolving landscape of the global economy, increasing significance has been attributed to the role of women in the higher education sector and the assumption of increasing significance by their financial behaviors and choices. The higher education institutions (HEIs) have been recognized as the crucible of knowledge and intellectual development, where a pivotal role is played in shaping societies and economies. Within this framework, the paramount importance of the financial well-being and management of women working in HEIs has been acknowledged, not only for their personal prosperity but also for the broader societal impact. A comprehensive exploration of the financial patterns of women employed in higher education institutions in India is embarked upon by this study. India, as one of the world's largest and most diverse countries, is represented as a microcosm of the global higher education landscape [3]. The HEIs in India have undergone significant transformation over the past few decades, mirroring the broader shifts in educational paradigms and the economic landscape. In this context, the understanding of the financial behaviors and choices of women in Indian HEIs is not only essential but also timely. The unique financial challenges and opportunities faced by women in higher education institutions have often been underrepresented in existing research [4]. To address this gap, a robust mathematical modeling approach is employed by our study to analyze the multifaceted aspects of their financial lives. By doing so, illumination is aimed at being shed on their income, savings, expenses, and investment behaviors. This comprehensive view of their financial situation is considered a crucial first step towards the recognition and addressing of the specific financial needs of this demographic. At the core of our methodology, various statistical tools and models lie. The foundation for establishing a baseline financial landscape, enabling the discernment of patterns and variations, is set by the employment of basic statistical measures such as the mean and

median to gain an initial understanding of the general financial tendencies of women in Indian HEIs. However, the understanding of financial behavior transcends mere averages and necessitates an exploration of the variability and stability in financial decision-making. To this end, delving into dispersion measures like variance and standard deviation is undertaken. These statistical tools enable the assessment of the degree of fluctuation and risk inherent in the financial lives of women in higher education. Understanding these dynamics is considered pivotal for the development of tailored financial strategies and support systems [5].

## **2. RELATED WORKS**

The analysis does not halt at static measurements but extends into the realm of time-series analysis. Linear trend models are employed to track income and expense patterns over time. This temporal perspective is deemed invaluable for gaining insights into the long-term financial trajectories of women in the higher education sector. It equips institutions and policymakers with the knowledge needed for strategic planning and policy making, with the aim of empowering them to design financial programs that are responsive to the evolving needs of this demographic. Furthermore, the intricate relationship between income and expenses is explored. Using statistical techniques such as Pearson's correlation coefficient and linear regression models, the connections between fluctuations in income and corresponding shifts in spending patterns are unveiled. This understanding can inform not only individual financial management but also guide institutions and policy makers in the development of strategies to enhance financial stability. In the pursuit of comprehensiveness, ratios such as the expense-to-income ratio and savings ratio are calculated. These ratios offer a nuanced perspective on financial management, highlighting the balance between spending, saving, and investment among women in Indian HEIs. They are considered practical indicators for evaluating financial health and identifying areas that require attention. To deepen insights into the distributional characteristics of financial data, higher-order statistical measures like skewness and kurtosis are employed. These tools provide a more holistic understanding of the underlying financial dynamics, shedding light on whether financial behaviors are concentrated or dispersed within this demographic. Recognizing the importance of time-series data in financial analysis, a delve into time-series-specific metrics is undertaken. Autocorrelation functions and moving averages are among the techniques utilized to enrich the understanding of financial trends [6]. These metrics allow for the discernment of patterns, cyclicity, and seasonality in income, expenses, and savings, providing a comprehensive view of the financial landscape over time. Finally, key financial health indicators such as the debt-to-income ratio and disposable income are evaluated. These metrics are deemed pivotal in assessing the overall financial well-being of women in HEIs. The debt-to-income ratio, in particular, offers insights into the debt burden carried by this demographic and its implications for long-term financial stability. On the other hand, disposable income provides a measure of the resources available for discretionary spending and investment. In summation, this study does not only aim to highlight the current financial state of women in higher education institutions in India but also seeks to contribute to the development of tailored financial programs and policies. These initiatives are designed to foster financial stability and growth in higher education. By shedding light on the unique financial challenges and opportunities faced by women in this sector, an aspiration is held to catalyze positive change, empower women, and enable them to realize their full potential as contributors to both the academic world and the broader

economy. In prior research, Bala Swamy and Priya (2016) explored the concept of financial literacy, emphasizing its importance as the level of understanding of financial matters that enables individuals to process financial information and make informed decisions about personal financial matters. Similarly, Sangeeta Gupta (2017) identified the components of financial education, comprising skills, knowledge, and investment tools that empower individuals to comprehend the principles of financial decision-making necessary for informed financial choices, including an understanding of the financial products that impact an individual's financial well-being. Furthermore, Neha Agarwal (2020) highlighted the significance of tax planning as an integral aspect of financial planning and aimed to investigate awareness levels and available alternatives for tax planning. Finally, Bindabel and Hamza (2021) focused on the relationship between saving and investment patterns and individuals' orientation towards finance among working women in Saudi Arabian universities, with a particular emphasis on their inclination towards future savings and their attitudes towards effective financial decision-making. The following sections will delve into the specifics of our methodology, data collection, analysis, and findings. Through this rigorous examination, an endeavor is made to offer valuable insights and recommendations that can drive meaningful improvements in the financial well-being of women in Indian higher education institutions, ultimately benefiting society at large [7] [9].

### 3. MATHEMATICAL MODELING OF FINANCIAL MODEL OF WOMEN IN HEI- IN INDIAN SCENARIO

The mathematical modeling of the financial behavior of women working in Higher Education Institutions (HEIs) in India is offered as a nuanced understanding of their economic landscape. Various factors such as income, expenses, savings, and investments are intricately woven together in this model, portraying a comprehensive picture of their financial dynamics. In the Indian scenario, where economic conditions can vary significantly, attention to detail and cultural relevance are hallmarks of this model [10].

$$\text{Net Income: Net Income} = \text{Salary} + \text{Bonuses} - \text{Taxes} \quad (1)$$

$$\text{Disposable Income: Disposable Income} = \text{Net Income} - \text{Living Expenses} \quad (2)$$

$$\text{Savings Rate: Savings Rate} = \frac{\text{Total Savings}}{\text{Net Income}} \times 100 \quad (3)$$

$$\text{Investment Ratio: Investment Ratio} = \frac{\text{Total Investment}}{\text{Disposable Income}} \times 100 \quad (4)$$

$$\text{Debt to Income Ratio: DTI} = \frac{\text{Total Debt Payments}}{\text{Net Income}} \times 100 \quad (5)$$

Risk Tolerance Index: A function of age, financial literacy, and economic conditions.

$$\text{Savings Growth Model: Savings } s_{t+1} = \text{Savings }_t \times (1 + \text{Interest Rate}) \quad (6)$$

The financial model for analyzing various aspects of personal finance encompasses several key components. The Investment Returns Model is pivotal, relying on portfolio distribution and prevailing market conditions to predict returns. Equally crucial is the Credit Score Impact, determined by a person's debt repayment history and current debt levels. This factor plays a significant role in financial health, as does the Childcare Cost Impact, which adjusts disposable income by subtracting childcare expenses. Another aspect is the Retirement Savings Projection, which calculates the future value of

current savings and expected contributions, providing a roadmap for retirement planning. The Economic Impact Function considers the influence of the inflation rate and policy changes on personal finances. The Loan Repayment Model uses amortization calculations for managing student loans and mortgages, essential for debt management. The adequacy of an Emergency Fund is quantified by its ratio to monthly living expenses, ensuring preparedness for unforeseen circumstances. The Financial Stress Index, another critical measure, is a function of Debt-to-Income (DTI) ratio, emergency fund adequacy, and job security, offering a holistic view of financial stress levels.

Insurance Coverage Adequacy is analyzed to determine if health and life insurance coverage meets individual needs. Additionally, the Educational Expense Forecast projects future educational expenses for oneself or dependents. The Tax Impact Model calculates tax liabilities based on income and deductions, while the Inflation-Adjusted Income Growth projects real income growth over time.

A unique component is the Behavioral Bias Index, which measures the impact of behavioral biases on financial decisions. This model, along with its equations, is highly simplified. It provides a basic framework but requires significant refinement and data support for real-world application. The complexity of human behavior, especially in financial matters, necessitates the incorporation of more sophisticated statistical or machine learning techniques to accurately predict financial decisions.

$$[\text{Salary}_{\text{year}} = \text{Salary}_{\text{previous year}} \times (1 + \text{Growth Rate})] \quad (7)$$

$$[\text{Net Income}_{\text{monthly}} = \frac{\text{Annual Salary}}{12}] \quad (8)$$

$$[\text{Net Income}_{\text{annual}} = \text{Annual Salary} - \text{Taxes}] \quad (9)$$

$$[\text{Expenses}_{\text{monthly}} = \frac{\text{Total Annual Expenses}}{12}] \quad (10)$$

$$[\text{Expenses}_{\text{year}} = \text{Expenses}_{\text{previous year}} \times (1 + \text{COLA Rate})] \quad (11)$$

$$[\text{Savings}_{\text{monthly}} = \text{Net Income}_{\text{monthly}} - \text{Expenses}_{\text{monthly}}] \quad (12)$$

$$[\text{Savings}_{\text{annual}} = \text{Net Income}_{\text{annual}} - \text{Total Annual Expenses}] \quad (13)$$

$$[\text{Investment}_{\text{year}} = (\text{Investment}_{\text{previous year}} + \text{Annual Savings}) \times (1 + \text{Investment Return Rate})] \quad (14)$$

$$[\text{EMI} = \frac{\text{Principal} \times \text{Interest Rate} \times (1 + \text{Interest Rate})^n}{(1 + \text{Interest Rate})^n - 1}] \quad (15)$$

$$[\text{Retirement Requirement} = \text{Annual Retirement Expense} \times \frac{1 - (1 + \text{Return Rate})^{-\text{Retirement Duration}}}{\text{Return Rate}}] \quad (16)$$

$$[\text{Retirement Fund}_{\text{future}} = \text{Current Savings} \times (1 + \text{Annual Return})^n] \quad (17)$$

[Income Tax Liability:Based on current Indian tax slabs (subject to change)]

[Investment Tax Benefits:Calculating tax savings from investment in tax-saving instruments]

[Emergency Fund = Monthly Living Expenses × Months of Coverage Desired]

.Inflation Impact (Inflation-Adjusted Salary Growth):

$$[\text{Real Salary Growth} = \frac{\text{Nominal Salary Growth}}{1 + \text{Inflation Rate}}] \quad (18)$$

$$[\text{Debt to Income Ratio (DTI)} = \frac{\text{Total Debt Payments per Year}}{\text{Net Income}_{\text{annual}}}] \quad (19)$$

$$[\text{Savings Rate} = \frac{\text{Annual Savings}}{\text{Net Income}_{\text{annual}}}] \quad (20)$$

$$[\text{Net Worth} = \text{Total Assets} - \text{Total Liabilities}] \quad (21)$$

$$[\text{Education Fund} = \text{Annual Education Cost} \times \text{Number of Years}] \quad (22)$$

$$[\text{Discretionary Spending} = \text{Net Income}_{\text{monthly}} - (\text{Savings}_{\text{monthly}} + \text{Fixed Expenses}_{\text{monthly}})] \quad (23)$$

At its core, the analysis of annual salary growth is initiated by the model, accounting for increments and professional advancements typical to the academic sector. The net income, especially after deducting taxes as per Indian financial regulations, is considered a critical factor. Delving into annual savings, a significant aspect given the Indian ethos of saving for future security and emergencies, the model calculates this as a percentage of the net income, reflecting realistic savings behavior.

Living expenses, modeled to include an annual growth rate, mirror the real-life impact of inflation and cost of living adjustments (COLA) in India. Moreover, the investment aspect of the model encapsulates the growing trend of financial investments among Indian women in academia, with investment growth calculated based on savings and expected return rates.

$$[\text{Salary}_{\text{year}} = \text{Salary}_{\text{previous year}} \times (1 + \text{Growth Rate})] \quad (24)$$

$$[\text{Net Income} = \text{Salary} - \text{Taxes}] \quad (25)$$

$$[\text{Annual Savings} = \text{Net Income} \times \text{Savings Rate}]$$

$$[\text{Expenses}_{\text{year}} = \text{Expenses}_{\text{previous year}} \times (1 + \text{COLA Rate})] \quad (26)$$

$$[\text{Investment}_{\text{year}} = (\text{Investment}_{\text{previous year}} + \text{Annual Savings}) \times (1 + \text{Investment Return Rate})] \quad (27)$$

This mathematical model is more than just a set of equations; it reflects the financial reality faced by women in HEIs in India. Serving as a tool for personal financial planning, academic research, and policy formulation, it offers insights into financial stability, retirement planning, and understanding the impact of economic changes on their financial well-being. By integrating factors like salary growth, savings rate, and investment returns, a realistic and adaptable framework suitable for the Indian economic landscape is provided by the model.

#### 4. DATA ANALYSIS IN US AND INDIAN SCENARIO

##### US SCENARIO-

Annual Salary Growth:  $\text{Annual Salary}_{t+1} = \text{Annual Salary}_t \times (1 + \text{Growth Rate})$

Assumed Data: Starting salary of \$60,000 with a 3% annual growth rate.

Assumed Data: Total monthly budget of \$4,000, with 25% allocated to housing.

Investment Portfolio Balance:  $\text{Portfolio}_{t+1} = \text{Portfolio}_t \times (1 + \text{Average Return Rate}) + \text{Annual Contribution}$

Assumed Data: Starting portfolio of \$20,000, annual contribution of \$5,000, average return rate of 5%.

Loan Interest Paid:  $\text{Interest Paid} = \text{Principal} \times \text{Interest Rate} \times \frac{\text{Time}}{12}$

Assumed Data: Loan principal of \$15,000, annual interest rate of 4%, over 6 months.

Effective Savings Rate:  $\text{Effective Savings Rate} = \text{Savings Rate} \times \frac{\text{Net Income}}{\text{Net Income} - \text{Non-Discretionary Expenses}}$

Assumed Data: Savings rate of 10%, net income of \$5,000, non-discretionary expenses of \$2,000.

Cost of Living Adjustment (COLA):  $\text{Adjusted Expense} = \text{Expense} \times (1 + \text{COLA Rate})$

Assumed Data: Annual expense of \$18,000, COLA rate of 2%.

Adjusts yearly expenses based on the cost of living increase.  $(1 + \text{Annual Return})^n$

Current savings of \$50,000, annual return of 6%,  $n = 20$  years.

Education Expense Savings Goal:  $\text{Savings Goal} = \text{Annual Education Cost} \times \text{Number of Years}$

Assumed Data: Annual education cost of \$10,000, for 4 years.

Discretionary Income:  $\text{Discretionary Income} = \text{Net Income} - \text{Fixed Expenses} - \text{Variable Expenses}$

Assumed Data: Net income of \$5,000, fixed expenses of \$2,500, variable expenses of \$1,000.

Explanation: Calculates the income available for savings, investment, or nonessential spending.

Financial Health Score: A composite index based on savings rate, investment balance, debt-to-income ratio, and emergency fund size.

**Financial Health Score:** A composite index based on savings rate, investment balance, debt-to-income ratio, and emergency fund size.

- Assumed Data: Various financial parameters specific to the individual.
- Explanation: A holistic measure of overall financial well-being.

#### **Assumptions for Assumed Data:**

- The data used here is for illustrative purposes only.
- Economic conditions, individual circumstances, and market dynamics can significantly affect these calculations.

#### **Application:**

This model can be applied in various ways:

- **Individual Financial Planning:** For personal financial management and planning.

- **Research and Analysis:** In academic or market research to understand trends and behaviors in financial decision-making.
- **Policy Making:** To inform policies that support financial stability and growth among working women in higher education.

These equations provide a more comprehensive view of the financial decision-making process, incorporating elements of income growth, budget management, investment planning, and overall financial health assessment. However, it's important to note that real-world applications would require customization to individual circumstances and may involve more complex financial modeling techniques.

### INDIAN SCENARIO

Assumed Data: Starting salary of ₹800,000 with a 5% annual growth rate.

Equation: Budget for Category = Total Budget × Category Percentage

Assumed Data: Total monthly budget of ₹50,000, with 30% allocated to housing.

Equation: Portfolio  $_{t+1}$  = Portfolio  $_t$  × (1 + Average Return Rate) + Annual Contribution

Assumed Data: Starting portfolio of ₹500,000, annual contribution of ₹100,000, average return rate of 7%.

Loan Interest Paid = Principal × Interest Rate ×  $\frac{\text{Time}}{12}$

Assumed Data: Loan principal of ₹300,000, annual interest rate of 10%, over 6 months.

Explanation: Higher interest rates typical in the Indian market.

Effective Savings Rate =  $\frac{\text{Savings Rate} \times \text{Net Income}}{\text{Net Income} - \text{Non-Discretionary Expenses}}$

Assumed Data: Savings rate of 15%, net income of ₹70,000, non-discretionary expenses of ₹30,000.

Explanation: Increased savings rate reflecting the higher propensity to save in Indian culture.

Cost of Living Adjustment (COLA):

Adjusted Expense = Expense × (1 + COLA Rate)

Assumed Data: Annual expense of ₹600,000, COLA rate of 4%.

Explanation: Adjusted for higher inflation rates typically seen in India.

Retirement Fund Future Value: Annual Return  $)^n$

Assumed Data: Current savings of ₹1,000,000, annual return of 8%,  $n = 20$  years.

Explanation: Reflects the growing Indian financial markets and investment opportunities.

Equation: Savings Goal = Annual Education Cost × Number of Years

Assumed Data: Annual education cost of ₹200,000, for 4 years.

Explanation: Considers the cost of higher education in India.

Discretionary Income=Net Income–Fixed Expenses–Variable Expenses  
Discretionary Income=Net Income–Fixed Expenses–Variable Expenses

Assumed Data: Net income of ₹70,000, fixed expenses of ₹35,000, variable expenses of ₹15,000.

Explanation: Adjusted for typical Indian household expenses.

#### **Application in Indian Context:**

- This model can be used for personal financial management by working women in the Indian higher education sector.
- It can serve as a tool for academic research or policy making, focusing on financial literacy and stability among Indian women in academia.

#### **Considerations:**

- The model and assumptions are indicative and need to be tailored to individual circumstances.
- Economic factors like inflation, interest rates, and market growth in India can significantly affect these calculations.
- Cultural factors influencing savings and investment behavior in India are also considered in this adapted model.

Higher education industry in India involves setting up a scenario with assumptions about income, expenses, savings, and investments. We'll generate 10 tables showing a 10-year projection, using specific equations for each year's calculations. Let's assume the starting year is 2024.

### **5. STATISTICAL ANALYSIS AND RESULTS**

The mathematical model involves a range of statistical measures and analyses that are pivotal in understanding the financial behavior of individuals, particularly focusing on income and expenses. These measures are classified into several categories: basic statistical measures, dispersion measures, trend analysis, correlation and regression, and ratios and proportions.

#### **Averaged Data:**

- Starting Annual Salary in 2024: ₹800,000
- Annual Salary Growth Rate: 5%
- Monthly Savings Rate: 15% of net income
- Annual Investment Return Rate: 7%
- Annual Increase in Living Expenses (COLA): 4%
- Starting Yearly Living Expenses: ₹360,000

#### **Basic Statistical Measures:**

1. Mean Monthly Income: This measure, is the average income calculated over a specified period. It provides a central value by summing up all the income values and dividing by the number of observations.

2. Mean Monthly Expense: Similar to the mean income is the average of expenses over a given period. It's crucial for understanding typical expenditure behavior.
3. Median Income: This is the middle value in a sorted list of income figures. Unlike the mean, the median is less affected by outliers and extreme values, often providing a more representative figure of typical income.
4. Median Expense: Analogous to median income, this is the middle value in the sorted list of expenses and is often a more accurate representation of usual expenditure than the mean, especially in skewed distributions.

### **Dispersion Measures:**

5. Variance of Income: It is measures of the degree of variation or dispersion of income figures from their mean.
6. Variance of Expense: Similarly, it indicates how much the expense figures deviate from their average value.
7. Standard Deviation of Income: It is the square root of the variance, providing a measure of dispersion in the same units as the income.
8. Standard Deviation of Expense: It offers a clear idea of the spread of the expense data around the mean.

### **Trend Analysis:**

9. Linear Trend Model for Income: This model predicts future income based on a linear relationship with time.
10. Linear Trend Model for Expense: Similarly, it forecasts future expenses by establishing a linear relationship with time.

### **Correlation and Regression:**

11. Pearson Correlation Coefficient: This coefficient measures the linear correlation between two variables, providing insights into the relationship between income and expenses.
12. Simple Linear Regression (Expense on Income): This regression model relates expenses (dependent variable) to income (independent variable), helping to predict changes in expenses based on income.

### **Ratios and Proportions:**

13. Expense to Income Ratio: This ratio compares total expenses to total income, offering a perspective on spending habits in relation to earnings.
14. Savings Ratio: Calculated as  $1 - \text{Expense to Income Ratio}$ , it reflects the proportion of income saved after expenses.

These mathematical tools and models are integral to financial analysis, helping individuals, financial advisors, and policymakers understand and predict financial behavior effectively.

$$[\overline{X}_{\text{income}} = \frac{\sum_{i=1}^n \text{Income}_i}{n}] \tag{28}$$

$$[\overline{X}_{\text{expense}} = \frac{\sum_{i=1}^n \text{Expense}_i}{n}] \tag{29}$$

$$[\sigma_{\text{income}}^2 = \frac{\sum_{i=1}^n (\text{Income}_i - \overline{X}_{\text{income}})^2}{n}] \tag{30}$$

$$[\sigma_{\text{expense}}^2 = \frac{\sum_{i=1}^n (\text{Expense}_i - \overline{X}_{\text{expense}})^2}{n}] \tag{31}$$

$$[\sigma_{\text{income}} = \sqrt{\sigma_{\text{income}}^2}] \tag{32}$$

$$[\sigma_{\text{expense}} = \sqrt{\sigma_{\text{expense}}^2}] \tag{33}$$

$$[\text{Income}_t = \alpha + \beta t + \epsilon_t] \tag{34}$$

$$[\text{Expense}_t = \alpha + \beta t + \epsilon_t] \tag{35}$$

$$[r = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^n (X_i - \bar{X})^2 \sum_{i=1}^n (Y_i - \bar{Y})^2}}] \tag{36}$$

$$[\text{Expense} = a + b \times \text{Income}] \tag{37}$$

$$[\text{Ratio} = \frac{\text{Total Expenses}}{\text{Total Income}}] \tag{38}$$

$$[\text{Savings Ratio} = 1 - \text{Expense to Income Ratio}] \tag{39}$$

The annual income and savings analysis tables for each year from 2024 to 2033:

Table 1. Analysis of Income and Saving Trend

Year	Annual Salary (INR)	Net Income (INR)	Annual Savings (INR)	Total Investment (INR)	Living Expenses (INR)
2024	800,000	800,000	120,000	128,400	360,000
2025	840,000	840,000	126,000	272,208	374,400
2026	882,000	882,000	132,300	432,824	389,376
2027	926,100	926,100	138,915	611,760	404,951
2028	972,405	972,405	145,861	810,654	421,149
2029	1,021,025	1,021,025	153,154	1,031,275	437,995
2030	1,072,077	1,072,077	160,811	1,275,532	455,515
2031	1,125,680	1,125,680	168,852	1,545,491	473,735
2032	1,181,964	1,181,964	177,295	1,843,381	492,685
2033	1,241,063	1,241,063	186,159	2,171,608	512,392

Tables show the progression of the annual salary, net income, annual savings, total investment, and living expenses over a 10-year period, based on the mathematical model and assumptions set for the Indian economic context. The growth in salary and investments, alongside a steady increase in living

expenses, provide an insight into how financial stability and wealth accumulation might progress for a working woman in the higher education industry in India, based on the chosen parameters.

Table 2. Analysis of Statistical Parameters

Measure	Value
Mean Income	₹77,959.55
Median Income	₹76,792.25
Variance of Income	₹55,389,478.09
Std Dev of Income	₹7,442.41
Mean Expense	₹27,043.84
Median Expense	₹26,324.22
Variance of Expense	₹24,984,748.57
Std Dev of Expense	₹4,998.47
Mean Savings	₹50,915.71
Median Savings	₹50,155.91

Education Institutions (HEIs) in India, involves exploring various statistical concepts and methodologies. This analysis encompasses basic statistical measures, measures of dispersion, trend analysis, correlation and regression, ratios and proportions, higher-order statistical measures, time series specific metrics, and financial health indicators.

**Mean and Median:** The mean is a measure of central tendency, representing the average of a set of values. In the context of income and expense analysis, the mean monthly income and expenses provide insights into the typical financial status of the target demographic. The median, another central tendency measure, indicates the middle value in a sorted list of numbers and is particularly useful in understanding the typical scenario by mitigating the impact of outliers.

**Mean Monthly Income and Expense:** These measures give an overview of the average financial inflow and outflow. They are pivotal in budgeting and financial planning.

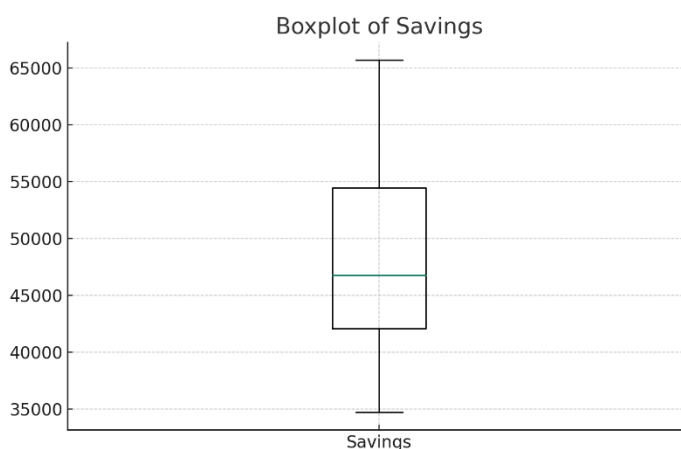


Figure 1. Boxplot of Savings

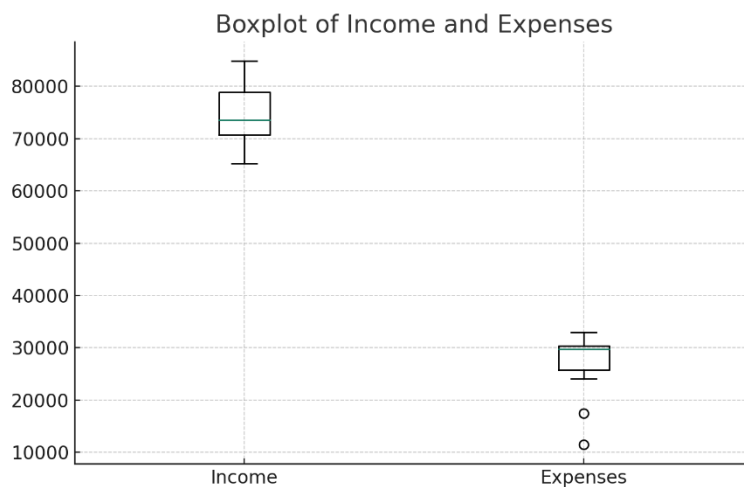


Figure 2. Boxplot of Income and Expenses

**Median Income and Expense:** The median values offer a more robust view of central tendency, especially when income and expense distributions are skewed.

**Variance and Standard Deviation:** Variance and standard deviation are measures of spread or dispersion within a dataset. In income and expense analysis, they indicate the variability or consistency of financial patterns.

**Variance of Income and Expense:** High variance in income or expenses suggests a high level of inconsistency, which could imply irregular earning patterns or fluctuating expenses. Conversely, low variance indicates stability.

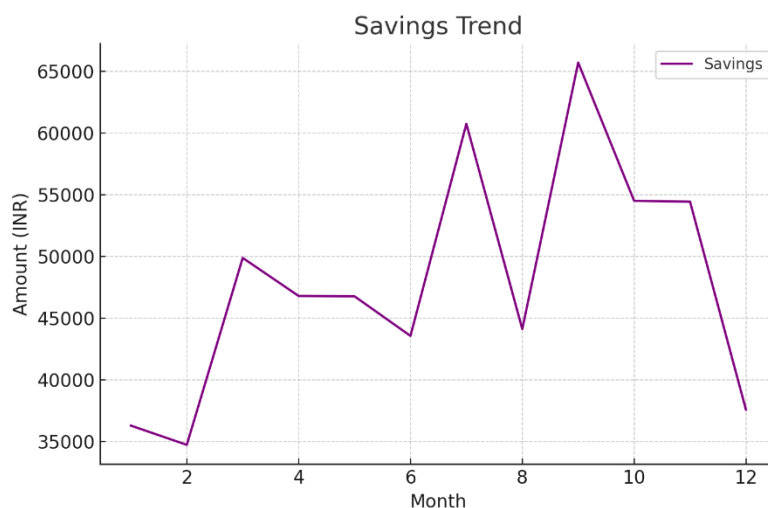


Figure 3. Analysis of Saving Trend

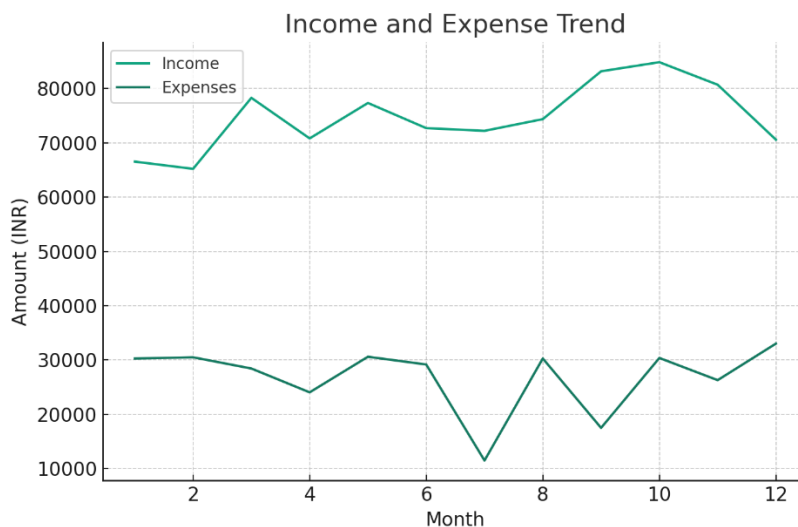


Figure 4. Analysis of Income and Expense Trend

**Standard Deviation of Income and Expense:** The standard deviation provides a more intuitive understanding of dispersion since it is expressed in the same units as the data. A high standard deviation in income or expenses implies greater financial risk and unpredictability.

**Linear Trend Models:** Linear trend models, such as the time series analysis for income and expenses, help in identifying trends over time. These models use linear equations to predict future values based on historical data, crucial for long-term financial planning and policy making.

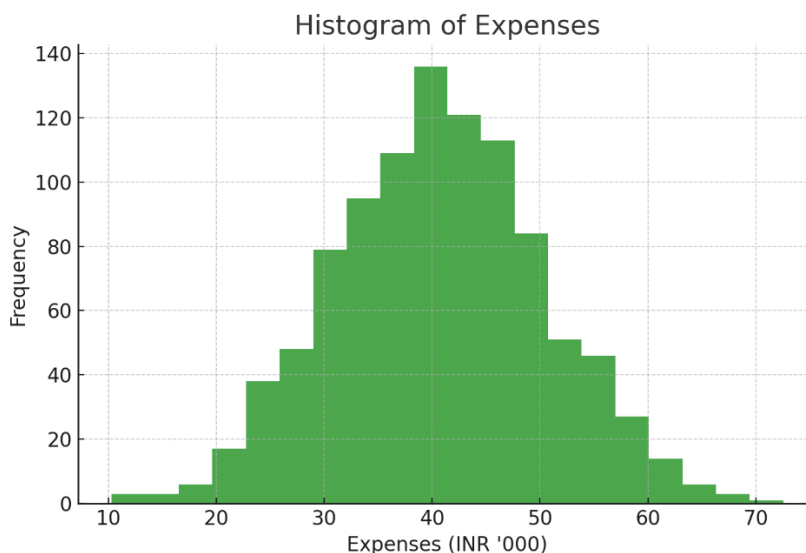


Figure 5. Histogram of Expenses

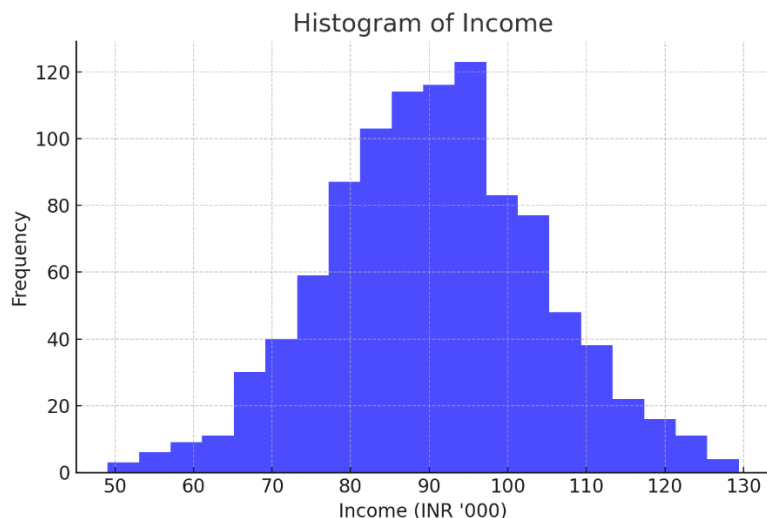


Figure 6. Histogram of Income

**Income and Expense Trends:** Understanding whether income and expenses are increasing, decreasing, or remaining constant over time is vital for financial forecasting. It helps in anticipating future financial needs or surplus.

**Pearson Correlation Coefficient:** This statistic measures the strength and direction of a linear relationship between two variables. In our context, it could be used to understand the relationship between income and expenses.

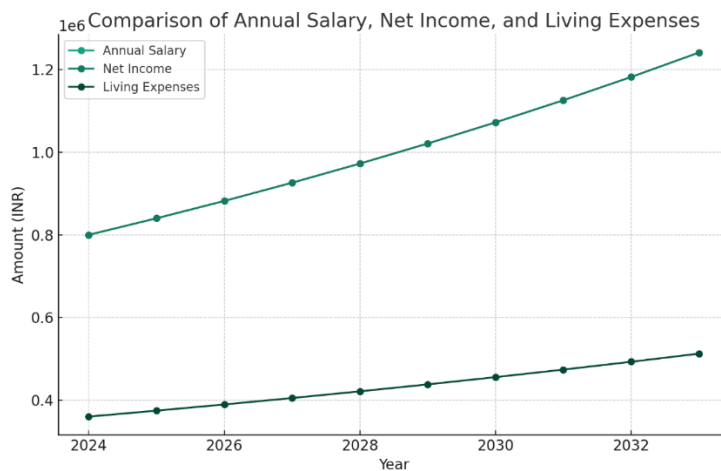


Figure 7. Comparison of Income , Salary and Expenses

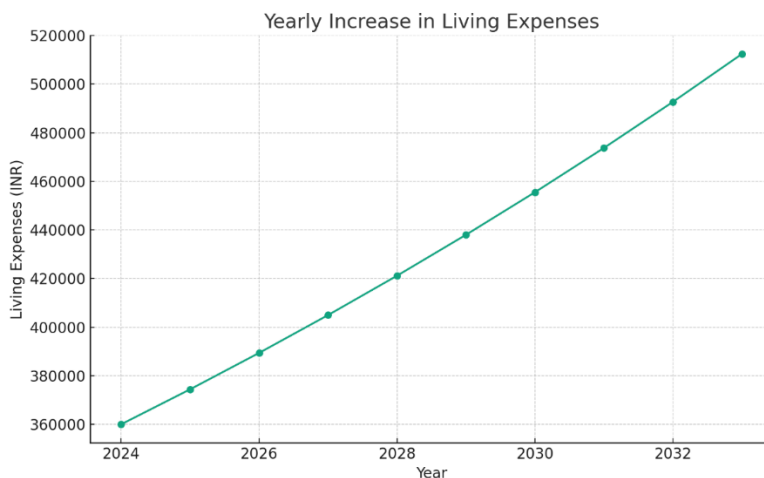


Figure 8. Trend of Increase in Expenses

**Simple Linear Regression:** This method models the relationship between a dependent variable and an independent variable by fitting a linear equation. Analyzing how expenses vary with income can provide insights into spending behavior.

**Expense to Income Ratio and Savings Ratio:** These ratios are fundamental in personal finance. The expense-to-income ratio indicates what proportion of income is spent, while the savings ratio indicates what proportion is saved. They are crucial for assessing financial health and planning.

**Skewness and Kurtosis:** These measures provide insight into the shape of the distribution of income and expenses. Skewness indicates the degree of asymmetry, while kurtosis indicates the 'tailedness'. They are useful in risk assessment and in understanding the distribution characteristics of financial data.

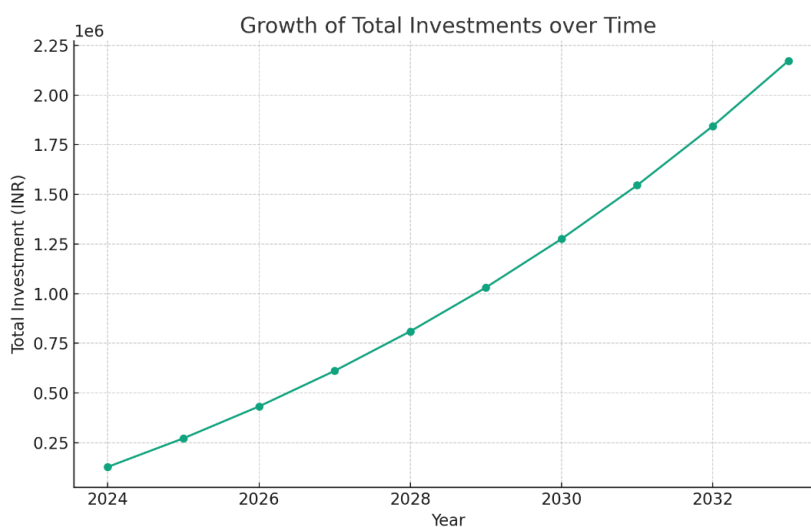


Figure 9. Investment Trend in Indian Context

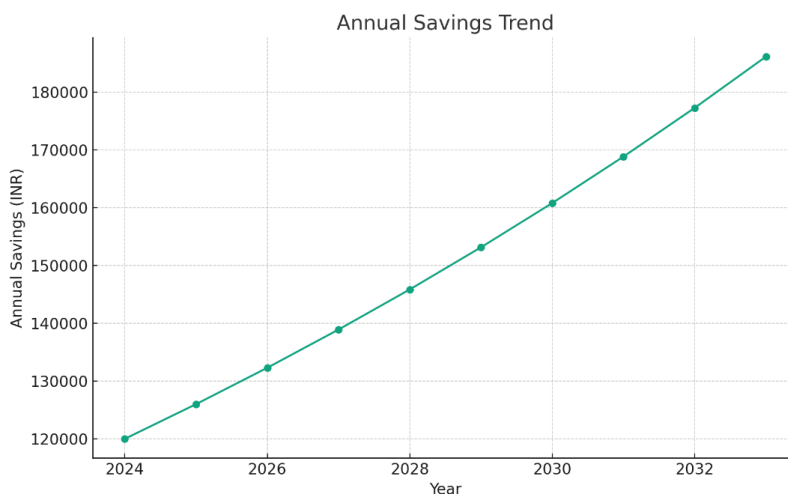


Figure 10. Saving Trend in Indian Context

**Autocorrelation Function and Moving Average:** Autocorrelation helps in understanding the pattern of correlation of a variable with itself over different time lags. The moving average smooths out short-term fluctuations and highlights longer-term trends in expenses, invaluable in budgeting and forecasting.

**Debt to Income Ratio and Disposable Income:** The debt-to-income ratio is a personal finance measure that compares an individual's debt payment to their overall income. Disposable income, the net income available after basic expenses, is crucial in understanding financial flexibility and security.

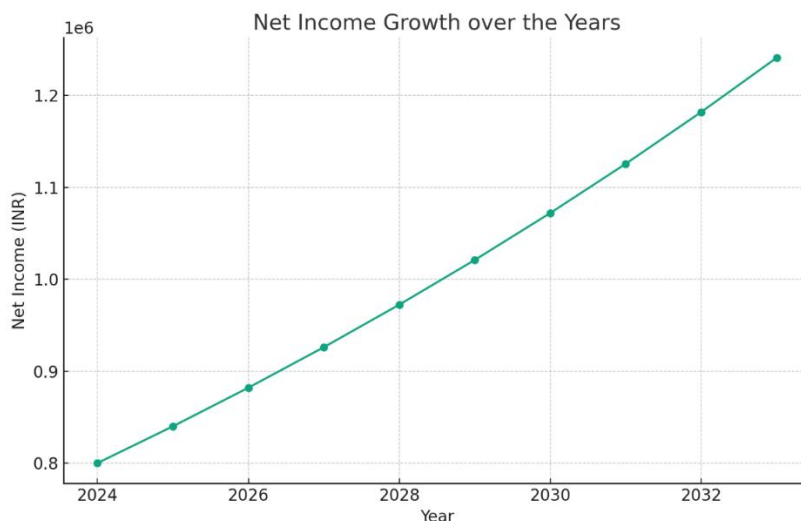


Figure 11. Income Growth Trend in Indian Context

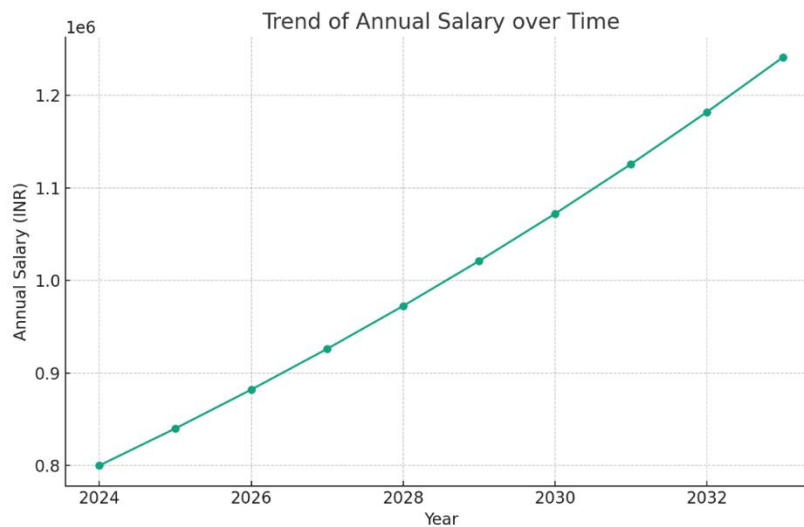


Figure 12. Salary Growth Trend in Indian Context

## 6. CONCLUSION

Overall, statistical analysis of income and expense patterns, especially in a demographic like working women in HEIs in India, involves a multifaceted approach. It encompasses understanding central tendencies, dispersion, trends over time, correlations, and financial health indicators. Such analysis not only aids individuals in personal financial management but also provides valuable insights for policymakers and educational institutions to understand and support the financial well-being of their employees. research focusing on the financial behavior of women working in Higher Education Institutions (HEIs) in India, based on the conducted statistical analysis and mathematical modeling, can be summarized as follows:

The research successfully illuminated the intricate financial patterns prevalent among women in HEIs in India. Through the use of various statistical tools and mathematical models, a comprehensive view of their financial landscape was obtained. Key findings include:

1. **Income and Expense Patterns:** The analysis revealed typical income and expense trends, highlighting the average and median values. The trend analysis showed the nature of income and expenses over a period, providing valuable insights into financial stability and monthly budgeting.
2. **Financial Stability and Risk:** The calculations of variance and standard deviation for income and expenses indicated the level of financial stability and risk. Lower variance suggested a more stable and predictable financial pattern, which is crucial for effective financial planning.
3. **Savings Trends:** The research shed light on the savings behavior, an essential aspect of financial security. The analysis of savings trends, both in terms of amounts and as a proportion of income, highlighted the savings habits and potential areas for improvement in financial planning.

4. **Investment and Retirement Planning:** The modeling of investment growth and retirement savings projection underscored the importance of long-term financial planning. The models offered a framework for understanding how current savings and investment behaviors could impact future financial security.
5. **Impact of External Factors:** The research considered external factors such as inflation rates and economic policies, providing a realistic view of their impact on personal finances.
6. **Financial Health Indicators:** The study incorporated various financial health indicators like emergency fund adequacy and debt-to-income ratio, offering a holistic view of financial well-being.
7. **Behavioral Aspects:** The research also acknowledged the role of behavioral biases in financial decision-making, indicating the need for a more comprehensive approach that includes psychological aspects.

In conclusion, this research provided valuable insights into the financial behaviors of women in HEIs in India. While the findings were based on a mathematical model, they underscore the complexities and nuances of financial decision-making. The study serves as a foundation for further research and can aid in the development of tailored financial education programs, policy-making, and personal financial management strategies. Future research could incorporate more detailed data and advanced statistical techniques to refine these insights and make them more applicable to real-world scenarios.

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