
DATA VISUALIZATION AND STORYTELLING

Course Assignment Report

Analysis of Voter Turnout Patterns in Indian General Elections

(2014, 2019, 2024)

Submitted by: Anik Das

Course: Data Visualization and Storytelling

Assignment Weight: 20% of Course Grade

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Data Source: Election Commission of India
<https://www.eci.gov.in/statistical-reports>

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1. EXECUTIVE SUMMARY

This report presents a comprehensive analysis of voter turnout patterns across ten major parliamentary constituencies in India over the last three General Elections (2014, 2019, and 2024). The study demonstrates the application of effective visualization design principles, including Gestalt principles and data storytelling best practices, to create meaningful insights from electoral data sourced from the Election Commission of India.

The analysis reveals a declining trend in overall voter turnout, decreasing from 59.6% in 2014 to 56.8% in 2024, representing a net change of -2.9 percentage points. A persistent gender gap of approximately 2.7% is observed, with male turnout consistently exceeding female turnout across all constituencies and time periods.

Regional variations are significant, with CHANDIGARH recording the highest average turnout (70.8%) and PATNA SAHIB the lowest (46.0%). The interactive dashboard developed for this assignment incorporates drill-down capabilities enabling detailed constituency-level exploration.

Key Statistics at a Glance:

Metric	2014	2019	2024	Overall
Average Turnout (%)	59.64	58.40	56.77	58.27
Male Turnout (%)	61.10	59.42	57.59	59.37
Female Turnout (%)	57.83	56.88	55.36	56.69

Table: Summary of voter turnout statistics across election years

2. INTRODUCTION AND OBJECTIVES

Voter turnout is a fundamental indicator of democratic participation and civic engagement. Understanding the patterns and trends in electoral participation helps identify areas requiring focused interventions to strengthen democratic processes. This assignment applies data visualization and storytelling techniques to analyze voter turnout data from Indian General Elections.

Assignment Objectives:

- Create a curated dataset of 10 constituencies with gender-wise bifurcation of voter data
- Identify and classify variable types (categorical and quantitative)
- Develop four distinct visualizations demonstrating different aspects of voter turnout
- Design an interactive dashboard with drill-down capabilities
- Apply Gestalt principles and visualization best practices throughout the analysis

3. DATA SOURCE AND METHODOLOGY

3.1 Data Source

The primary data source for this analysis is the Election Commission of India's official statistical reports, specifically the 'PC Wise Voter Turnout' tables from the 2014, 2019, and 2024 General Election reports. These reports provide constituency-level data on registered electors, votes polled, and turnout percentages with gender disaggregation.

3.2 Methodology

The analysis follows a structured approach encompassing data extraction, cleaning, transformation, and visualization. Ten diverse constituencies were selected representing different states and demographic characteristics. Data consistency was ensured by standardizing variable formats across all three election years.

3.3 Tools and Technologies

Tool	Purpose
Python 3.12	Programming language for analysis
Pandas	Data manipulation and aggregation
Matplotlib/Seaborn	Static visualizations
Bokeh	Interactive dashboard development
Jupyter Notebook	Development and presentation platform

Table 1: Tools and technologies used in the analysis

4. TASK 1: DATASET CREATION (5 Marks)

4.1 Selected Constituencies

Ten parliamentary constituencies were selected to ensure geographic diversity and representation of various states across India. The selection includes constituencies from metropolitan cities, state capitals, and union territories.

S.No.	Constituency	State/UT	Region
1	Bangalore South	Karnataka	South
2	Chandigarh	Chandigarh (UT)	North
3	Chennai Central	Tamil Nadu	South
4	Hyderabad	Telangana	South
5	Jaipur	Rajasthan	West
6	Kolkata Dakshin	West Bengal	East
7	Lucknow	Uttar Pradesh	North
8	Mumbai North	Maharashtra	West
9	New Delhi	NCT of Delhi	North
10	Patna Sahib	Bihar	East

Table 2: Selected constituencies for analysis

4.2 Variable Description and Types (1 Mark)

The curated dataset contains 18 variables classified into categorical and quantitative types. This classification is essential for selecting appropriate visualization techniques and statistical analyses.

Variable Name	Type	Sub-Type	Description
Year	Categorical	Ordinal	Election year (2014, 2019, 2024)
State	Categorical	Nominal	State or Union Territory name
PC_Name	Categorical	Nominal	Parliamentary Constituency name
Electors_Total	Quantitative	Ratio	Total registered electors
Electors_Male	Quantitative	Ratio	Male registered electors
Electors_Female	Quantitative	Ratio	Female registered electors
Electors_TG	Quantitative	Ratio	Third gender registered electors
Voters_Male	Quantitative	Ratio	Male votes polled
Voters_Female	Quantitative	Ratio	Female votes polled
Voters_TG	Quantitative	Ratio	Third gender votes polled
Voters_Total	Quantitative	Ratio	Total votes (excluding postal)
Postal_Votes	Quantitative	Ratio	Postal votes polled

Total_Voters	Quantitative	Ratio	Total votes including postal
Turnout_Percent	Quantitative	Ratio	Overall turnout percentage
Turnout_Male	Quantitative	Ratio	Male turnout percentage
Turnout_Female	Quantitative	Ratio	Female turnout percentage
Turnout_TG	Quantitative	Ratio	Third gender turnout percentage
Turnout_Postal	Quantitative	Ratio	Postal vote turnout ratio

Table 3: Dataset variables with type classification

Summary: The dataset comprises 3 categorical variables and 15 quantitative variables, totaling 18 variables across 30 observations (10 constituencies × 3 years).

4.3 Data Curation Process

The data curation process involved extracting relevant information from Election Commission PDF reports. For the 2014 and 2019 datasets, gender-wise elector counts were derived using the turnout ratios provided:

$$\text{Electors_Male} = \text{Voters_Male} \div (\text{Turnout_Male} \div 100)$$

The curated dataset is provided in both CSV and Excel formats for compatibility with various analysis tools. The file is named 'curated_voter_turnout_10_constituencies.xlsx' and contains all required variables as specified in the assignment requirements.

5. TASK 2: VISUALIZATION DEVELOPMENT (10 Marks)

Four distinct visualizations were developed to address specific analytical objectives. Each visualization incorporates Gestalt principles and follows data visualization best practices.

5.1 Visualization A: Temporal Trend Analysis

Objective: Show change in voter turnout ratio at the aggregate level over time

Chart Type: Line Chart with markers

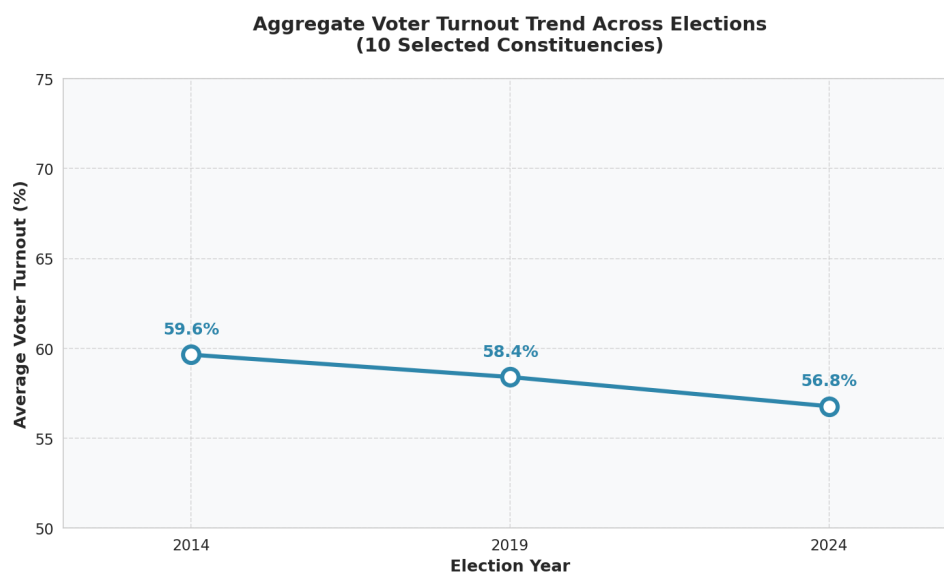


Figure 1: Aggregate voter turnout trend across elections (2014-2024)

Key Observations:

- Overall declining trend from 59.6% (2014) to 56.8% (2024)
- Consistent decrease across consecutive election cycles
- Net decline of 2.9 percentage points over the decade

Gestalt Principles Applied:

- **Continuity:** Line connecting data points guides the eye through temporal progression
- **Proximity:** Years grouped on x-axis for easy comparison
- **Similarity:** Consistent color and marker style throughout

5.2 Visualization B: Gender-wise Comparison

Objective: Show change in voter turnout ratio at the aggregate level across genders

Chart Type: Grouped Bar Chart

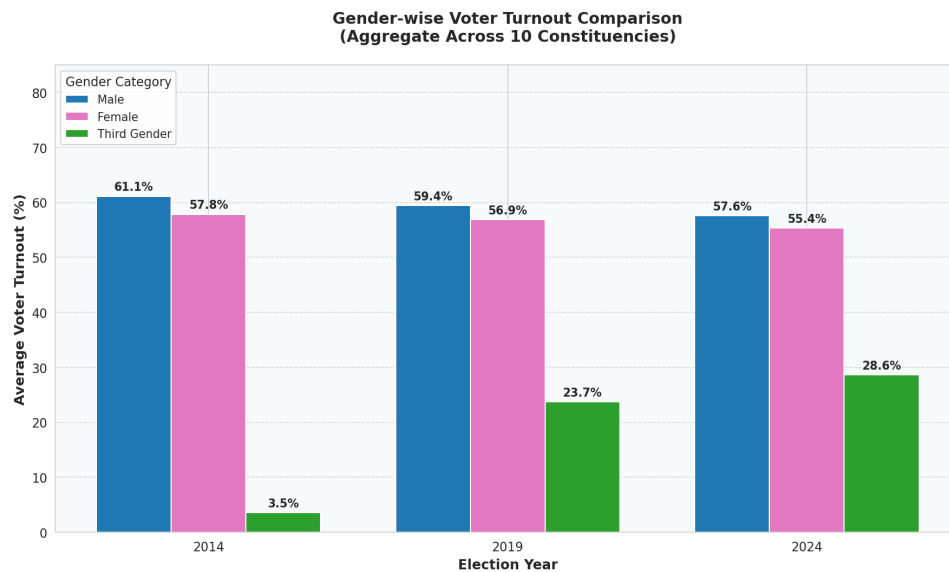


Figure 2: Gender-wise voter turnout comparison across elections

Key Observations:

- Male turnout consistently higher than female turnout (average gap: 2.7%)
- Both male and female turnout show declining trends
- Third gender participation has increased significantly over the years

Gestalt Principles Applied:

- **Similarity:** Same color represents same gender across years
- **Proximity:** Bars grouped by year for easy comparison
- **Common Region:** Bars within each year share visual space

5.3 Visualization C: Constituency-Time Distribution

Objective: Show distribution of voter turnout across constituencies and time

Chart Type: Heatmap

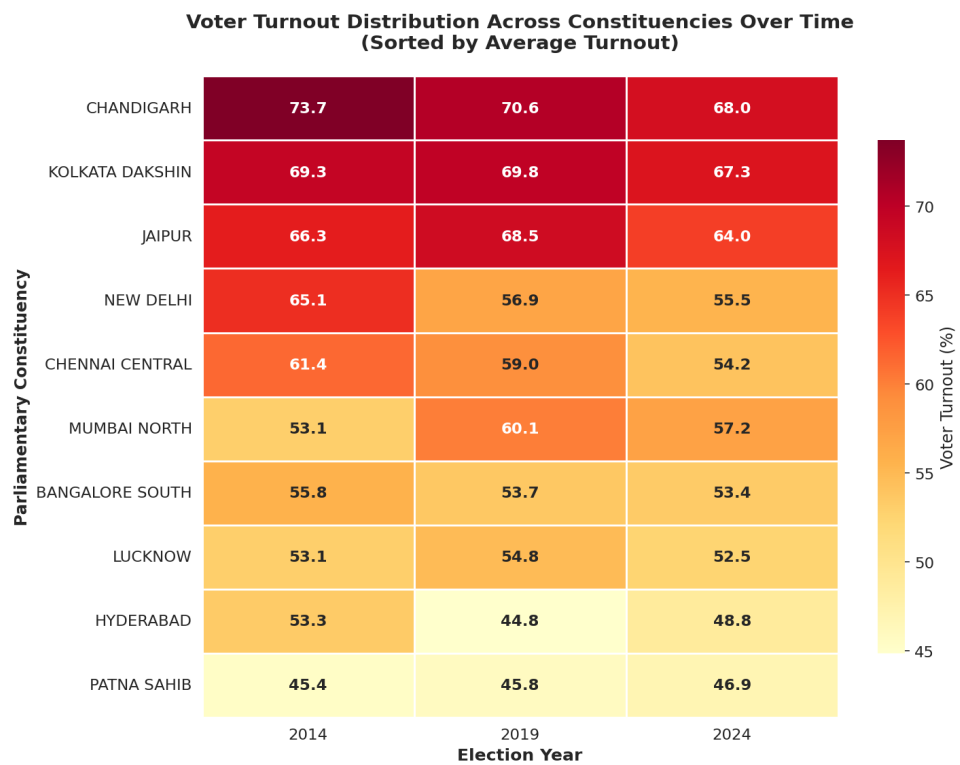


Figure 3: Heatmap showing turnout distribution across constituencies and years

Key Observations:

- Chandigarh consistently shows highest turnout across all years
- Patna Sahib records lowest turnout rates
- Most constituencies show declining turnout from 2014 to 2024
- Regional patterns visible with northern constituencies generally showing higher participation

Gestalt Principles Applied:

- **Similarity:** Color intensity represents turnout percentage
- **Common Region:** Grid structure groups related data
- **Proximity:** Rows and columns create natural groupings

5.4 Visualization D: Constituency-Gender Distribution

Objective: Show distribution of voter turnout across constituencies and genders

Chart Type: Interactive Grouped Bar Chart (Bokeh)

This visualization is implemented as an interactive Bokeh chart in the Jupyter notebook. It allows users to hover over bars to see exact turnout values and compare male vs female participation across all constituencies.

Key Observations:

- Gender gap varies significantly across constituencies
- Patna Sahib shows largest gender gap (~6%)
- Chandigarh and Bangalore South show near gender parity
- Urban constituencies generally show smaller gender gaps

6. TASK 3: DASHBOARD DESIGN (5 Marks)

6.1 Dashboard Components

The interactive dashboard integrates all four visualizations from Task 2 into a unified, cohesive view. The dashboard is implemented using Bokeh, providing rich interactivity including pan, zoom, hover tooltips, and data export capabilities.

Dashboard Layout:

- **KPI Summary Cards:** Display key metrics including average turnout, year-over-year changes, and best/worst performing constituencies
- **Panel 1 (Top-Left):** Temporal trend line showing aggregate turnout over years
- **Panel 2 (Top-Right):** Gender comparison bar chart
- **Panel 3 (Bottom-Left):** Constituency ranking by average turnout
- **Panel 4 (Bottom-Right):** Year-over-year change visualization

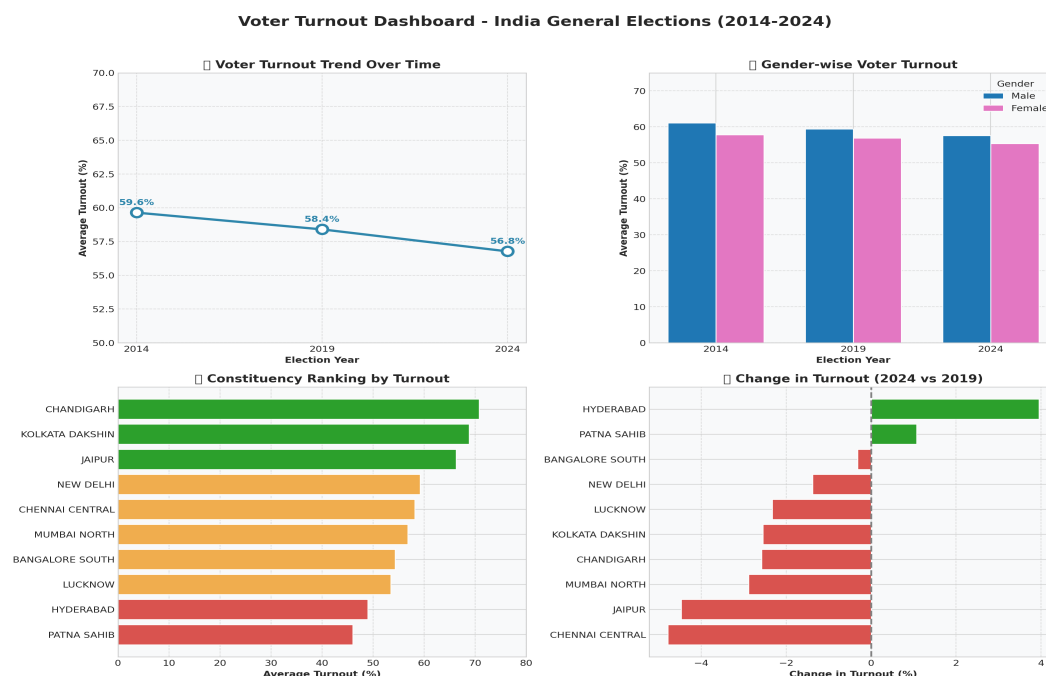


Figure 4: Static export of the interactive dashboard

6.2 Drill-Down Feature Implementation

The dashboard incorporates a drill-down feature as required by the assignment. A dropdown selector allows users to choose any of the 10 constituencies and view detailed analysis:

- Constituency-specific turnout trend across all three years
- Gender comparison (Male vs Female) for the selected constituency
- Hover tooltips showing exact values
- Real-time chart updates when constituency selection changes

The drill-down feature is implemented using Bokeh's CustomJS callbacks, enabling client-side interactivity without requiring a running Python server.

7. DESIGN PRINCIPLES APPLIED

7.1 Gestalt Principles

Principle	Application in Visualizations
Proximity	Related data points grouped together (bars by year, rows by constituency)
Similarity	Consistent colors for same categories across all visualizations
Continuity	Line charts show temporal flow, guiding eye through data
Closure	Dashboard panels organize related visuals into complete views
Figure-Ground	Clear contrast between data elements and background
Common Region	Dashboard sections bounded by visual frames

Table 4: Gestalt principles applied in the visualizations

7.2 Visualization Best Practices

- **Clear Titles and Labels:** All charts have descriptive titles and properly labeled axes
- **Appropriate Chart Types:** Line charts for trends, bar charts for comparisons, heatmaps for distributions
- **Consistent Formatting:** Uniform font sizes, styles, and spacing across visualizations
- **Data-Ink Ratio:** Minimal chart junk, focus on data representation
- **Accessibility:** Color-blind friendly palette with sufficient contrast
- **Interactivity:** Hover tooltips provide additional context without cluttering the view
- **Annotations:** Data labels on key points for quick reference

7.3 Color Schema

Element	Color	Hex Code	Usage
Male	Steel Blue	#4682B4	Male voter data
Female	Hot Pink	#FF69B4	Female voter data
Third Gender	Sea Green	#2E8B57	Third gender data
Primary Trend	Dark Blue	#2E86AB	Overall trend lines
Accent	Orange	#FF7F0E	Highlights and annotations
Positive Change	Green	#2CA02C	Increasing trends
Negative Change	Red	#D62728	Decreasing trends

Table 5: Color schema used in visualizations

8. KEY FINDINGS AND INSIGHTS

8.1 Temporal Trends

The analysis reveals a concerning declining trend in voter turnout over the decade. The average turnout decreased from 59.6% in 2014 to 56.8% in 2024, representing a cumulative decline of 2.9 percentage points. This trend is consistent across most constituencies, suggesting systemic factors rather than isolated incidents.

8.2 Gender Participation Gap

A persistent gender gap of approximately 2.68% is observed, with male turnout (59.37%) consistently exceeding female turnout (56.69%). This gap varies significantly across constituencies, being most pronounced in PATNA SAHIB (5.89%) and minimal in BANGALORE SOUTH (0.08%).

8.3 Regional Variations

Significant regional variations exist in voter participation. CHANDIGARH leads with an average turnout of 70.78%, while PATNA SAHIB records the lowest at 46.01%. The difference of 24.77 percentage points indicates substantial disparities in civic engagement across regions.

8.4 Third Gender Participation

An encouraging trend is observed in third gender voter participation, which has increased substantially from 3.54% in 2014 to 28.64% in 2024. This may reflect improved voter registration processes and greater social awareness, though the absolute numbers remain small.

9. CONCLUSION

This assignment demonstrates the effective application of data visualization principles to analyze voter turnout patterns in Indian General Elections. Through systematic data curation, appropriate visualization techniques, and interactive dashboard design, meaningful insights have been extracted from electoral data.

The analysis highlights the declining trend in voter participation and the persistent gender gap that requires attention from policymakers and electoral bodies. The interactive dashboard provides a tool for exploring these patterns at both aggregate and constituency levels, supporting evidence-based decision making for improving democratic participation.

The Gestalt principles and visualization best practices applied throughout this work ensure that the visualizations are not only informative but also intuitive and accessible to diverse audiences, fulfilling the core objectives of data storytelling.

10. REFERENCES

- [1] Election Commission of India (2024). Statistical Reports - General Elections 2024. Retrieved from <https://www.eci.gov.in/statistical-reports>
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APPENDIX A: DATASET SAMPLE

The following table shows a sample of the curated dataset (first 6 rows) to demonstrate the data structure and variable formats:

Year	State	PC_Name	Turnout_%	Male_%	Female_%
2014	Karnataka	BANGALORE SOUTH	55.75	56.80	54.47
2019	Karnataka	BANGALORE SOUTH	53.70	53.43	53.58
2024	Karnataka	BANGALORE SOUTH	53.38	52.24	54.17
2014	Chandigarh	CHANDIGARH	73.71	73.57	74.16
2019	Chandigarh	CHANDIGARH	70.61	70.32	70.79
2024	Chandigarh	CHANDIGARH	68.03	68.54	67.22

Table A1: Sample rows from the curated dataset

Constituency-wise Average Turnout (2014-2024):

Rank	Constituency	Average Turnout (%)
1	CHANDIGARH	70.78
2	KOLKATA DAKSHIN	68.81
3	JAIPUR	66.28
4	NEW DELHI	59.18
5	CHENNAI CENTRAL	58.19
6	MUMBAI NORTH	56.79
7	BANGALORE SOUTH	54.28
8	LUCKNOW	53.43
9	HYDERABAD	48.98
10	PATNA SAHIB	46.01

Table A2: Constituency ranking by average voter turnout

Complete Dataset File: curated_voter_turnout_10_constituencies.xlsx

Total Records: 30 (10 constituencies × 3 years)

Total Variables: 18 (3 categorical + 15 quantitative)

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