A STUDY ON ENROLMENTS IN SCHOOL EDUCATION SYSTEM OF INDIA OVER THE YEARS 2018 - 2023

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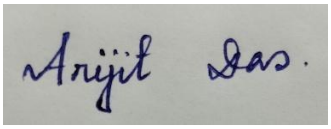
DECLARATION

I affirm that I identify all my sources and that no part of dissertation paper uses unacknowledged materials.



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Without the help of all these people, this dissertation could not have been completed.

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ABSTRACT

Education at school level is a key driver of a country's development, molding the next generation and impacting socio-economic development. This research compares school enrolment patterns in India between 2018-19 and 2023-24 based on data from the Unified District Information System for Education Plus (UDISE+) and Population data from Unique Identification Authority of India. The study investigates enrolments trends by school management type (government, private, government aided, and others), education level and demographic categories. It also delved into state wise analysis, regional disparities, effect of COVID-19, and availability of school infrastructure.

The research uses statistical methods like trend analysis, regression modelling, different statistical tests, and time series analysis to evaluate enrolment changes and forecast future patterns. Comparison of government and private schools, and also a review of pupil-teacher ratios and gender gaps, give a complete picture of the education sector.

The results point out important trends in enrolment, differences and potential policy intervention areas. By identifying factors influencing school participation, this research aims to contribute to evidence-based education planning and policymaking in India.

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CONTENTS

1. **INTRODUCTION**

Education is the pillar of national progress, and school education quality and access have a direct bearing on a nation's socio-economic advancement. In India, the school education system has been through drastic reforms in the last few years, but despite that, problems like high rates of dropouts, uneven pupil-teacher ratios (PTR), and gender disparities remain. For addressing these effectively, it is critical to study school-level information statistically.

This dissertation utilizes the Unified District Information System for Education Plus (UDISE+) data for the years 2018–2023. While UDISE+ has restricted publicly available data, this six-year period provides a significant window into recent trends and developments. The emphasis has been on comprehending the behaviour and trends of important indicators such as dropout rates, enrolment trends, and PTR, and how these change along gender, school levels, and regions.

The objective of this research is to present data-driven findings that can inform evidence-based policymaking in Indian school education. By exploratory data analysis and hypothesis testing, the project tries to identify key areas that require focus, as well as demonstrate how statistical methods can be used in actual educational planning.

2. **DATA VISUALIZATION**

Several datasets have been used for the study.

1. Enrolments dataset consists of 6 columns and 225 rows
2. Dropout Rate dataset consists of 11 columns and 224 rows. Dropout Rate of Ladakh for the Year 2018 is missing in the dataset.
3. Pupil-Teacher Ratio dataset consists of 6 columns and 225 rows
4. 2023 dataset containing enrolments, population, PTR, Dropout rates, Unemployment Rates etc consists of 6 columns and 38 rows

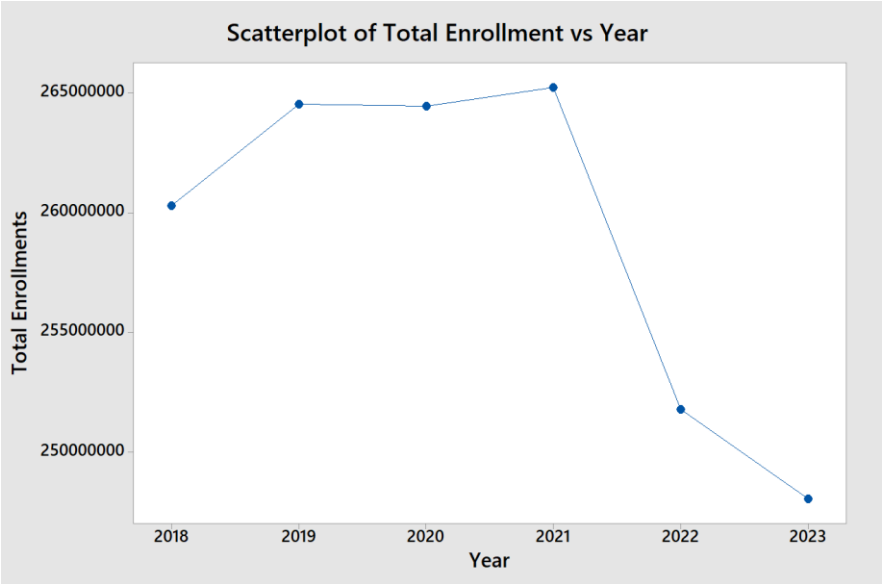
Let us proceed with the trend of School Enrolments in India from 2018-19 to 2023-24.

Let us first discuss about a brief enrolment structure

Table 2.1: Enrolment structure of different types of Schools over the years

Year	Government School enrolment	Private School enrolment	Govt. Aided School enrolment	Others School enrolment	Total Enrolment
2018-19	131113434	92194512	27978999	9007271	260294216
2019-20	130931634	98209302	27498530	7888109	264527575
2020-21	134904560	95157082	26845527	7542818	264449987
2021-22	143240480	88271316	27039457	6684577	265235830
2022-23	136204917	84162385	26233480	5190940	251791722
2023-24	127490199	90036939	25547841	4970849	248045828

<u>Figure 2.a:</u> Time series plot of Total Enrolment over the Years (2018-19 to 2023-24)



Comments on Figure 2.a:

From the 2.a time series plot we can say that:

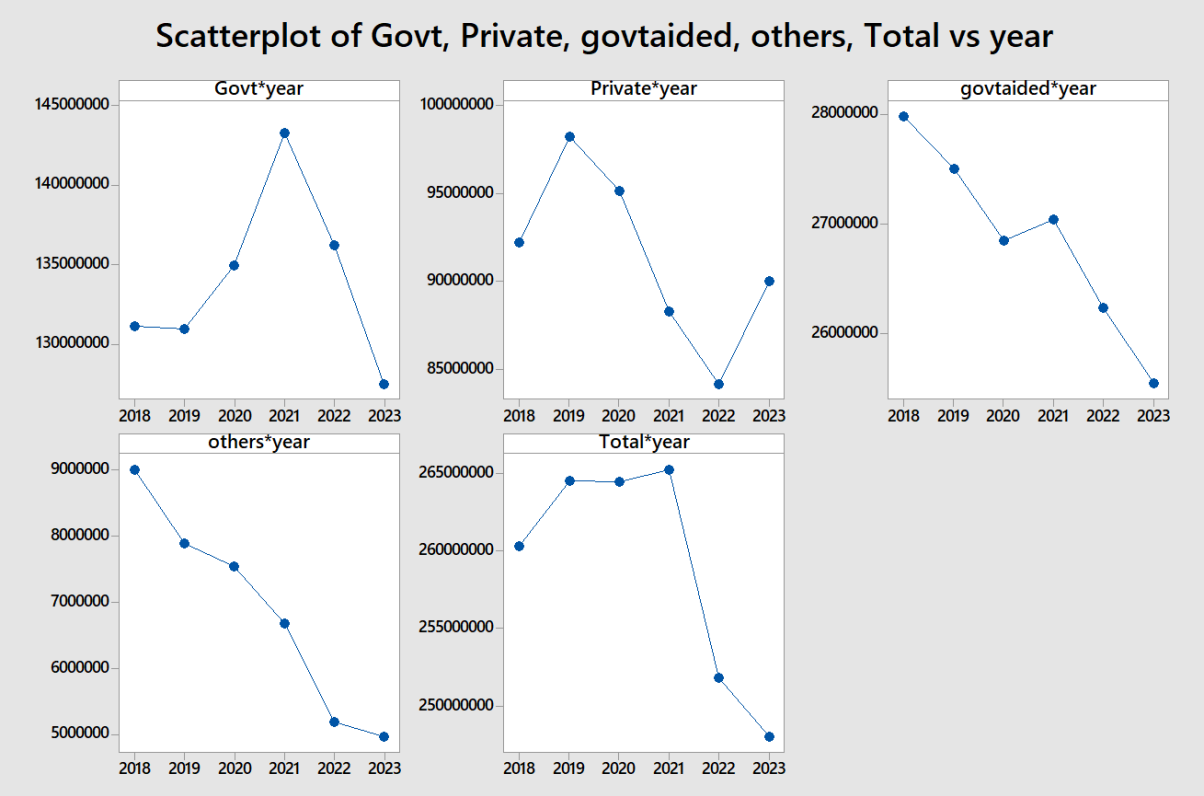
1. The total enrolments **increased from 2018 to 2019**, showing a **positive growth**.
2. The enrolments **remained relatively stable from 2019 to 2021**, indicating a **steady trend** in school enrolments during these years.
3. However, a **sharp decline** in total enrolments is observed **from 2021 to 2023**.

Possible Explanations for the Trend in Figure 2.a:

- **Increase from 2018 to 2019**: This could be due to **government policies promoting education**, increased awareness, or economic factors encouraging more enrolments.
- **Stability from 2019 to 2021**: The period coincides with **COVID-19**, which may have **disrupted new enrolments**, but total enrolments did not drop significantly during this time.
- **Sharp decline from 2021 onward**:
    1. The decline from 2021 to 2023 is **drastic**, which could indicate **mass dropouts, demographic changes, or a shift to alternative education models (online/home-schooling).**

2. **Post-pandemic economic hardships** might have forced some children out of school, especially in rural and economically weaker regions.

<u>Figure 2.b:</u> Time series plot of different types of School's enrolment pattern over the years (2018-19 to 2023-24)



Comments on Figure 2.b:

For Government School Enrolments:

- Government school enrolments remained relatively stable from 2018 to 2019, then increased significantly, peaking in 2021, before sharply declining in 2022 and 2023.

For Private School Enrolments:

- Private school enrolments increased until 2019, followed by a decline in 2020, a sharper drop in 2022, and then a recovery in 2023.

For Government-aided School Enrolments:

- Government-aided school enrolments consistently declined from 2018 to 2023, with small fluctuations in 2020 and 2021.

For Others School Enrolments:

- Enrolment in Other school types (likely including alternative schools, special schools, etc.) showed a continuous decline from 2018 to 2023, with a sharper drop after 2021.

For Total School Enrolment:

- Overall enrolments increased slightly until 2020 but then saw a huge decline from 2021 onward.

Let us now discuss about the annual growth rates

Let,

Annual Growth Rate = R

Current Year Enrolment = c

Previous Year Enrolment = p

Then Annual Growth Rate (R) is given by:

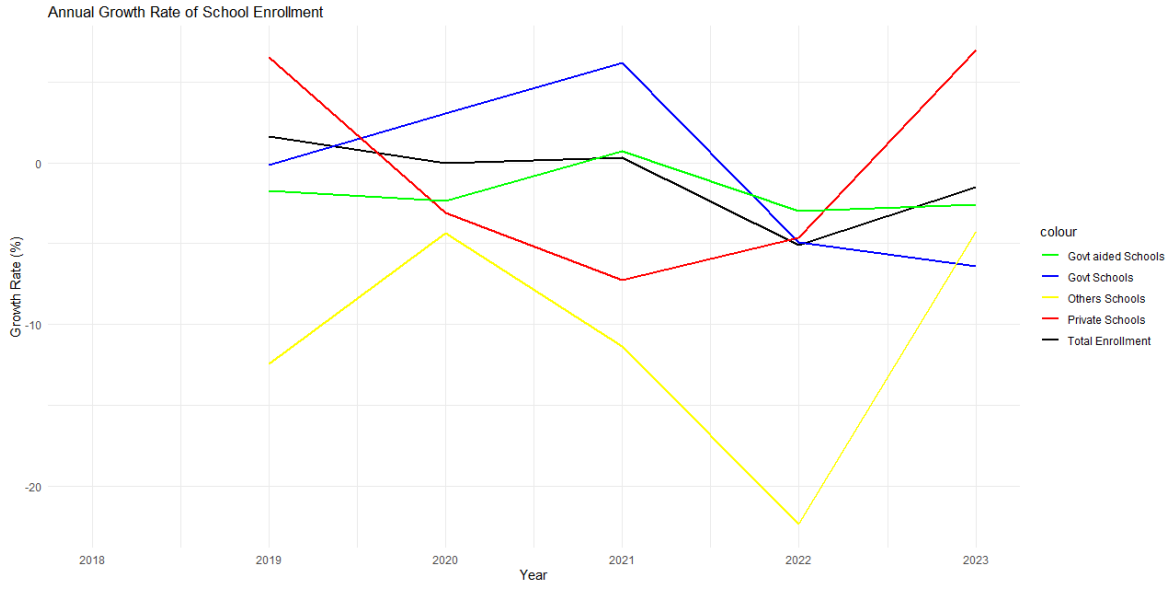
$$R = \left(\frac{c - p}{p}\right) \times 100$$

The following are the annual growth rates:

Table 2.2: Annual Growth Rates of enrolments in different types of Schools in India over the years

Year	Government school Growth rates	Private school growth rates	Govt. aided school growth rates	Others school growth rates	Total Growth rates
2018-19	NA	NA	NA	NA	NA
2019-20	-0.1386586	6.524022	-1.7172487	-12.425095	1.62637459
2020-21	3.0343515	-3.107873	-2.3746833	-4.377361	-0.02933078
2021-22	6.1791240	-7.236210	0.7223922	-11.378254	0.29716129
2022-23	-4.9117142	-4.654888	-2.9807440	-22.344525	-5.06873751
2023-24	-6.3982404	6.980023	-2.6136029	-4.239906	-1.48769545

<u>Figure 2.c:</u> Time Series Plot of Annual Growth Rates in School Enrolments by School Type over the Years (2018–19 to 2023–24)



Comments on Figure 2.c:

- **Government Schools (Blue Line)**

1. Showed a positive growth rate until around 2021, indicating an increase in enrolments during the pandemic period.
2. After 2021, growth declined but remained relatively stable.
3. This suggests that more students moved to government schools during COVID-19, possibly due to financial hardships, but the trend stabilized post-pandemic.

- **Government-Aided Schools (Green Line)**

1. Growth was slightly positive or neutral until 2020, followed by a sharp increase in 2021.
2. After 2021, the growth rate dropped significantly, showing a negative trend.
3. This suggests that government-aided schools initially benefitted during the pandemic but later experienced reduced enrolments.

- **Private Schools (Red Line)**

1. The growth rate was **negative from 2018 to 2021**, indicating a decline in private school enrolments.
2. However, in 2023, private school enrolments rebounded, showing a sharp increase in growth rate.
3. This aligns with the trend of students switching to government schools during the pandemic and then returning to private institutions as the economy recovered.

- **Other Schools (Yellow Line)**

1. Consistently **declining growth rate**, with the steepest drop observed in 2022 and increasing after 2022

- **Total Enrolment (Black Line)**

1. Growth remained stable until 2021 but turned negative in 2022.
2. The total enrolment trend aligns with the overall decline in student retention after the peak COVID-19 period.
3. The slight improvement in 2023 suggests some recovery in school enrolments.

3. Regression Analysis of State-wise School Enrolments for the year 2023

To identify key factors influencing school enrolments across Indian states in 2023, a **multiple linear regression** was performed. The dependent variable was **total school enrolment per state**, and the predictors included:

- **Total population** of the state (as a demographic indicator),
- **Unemployment rate** (as a socio-economic measure),
- **Dropout rate at the secondary level** (educational indicator),
- **Pupil-Teacher Ratio (PTR) at the secondary level** (infrastructure-related factor).

The regression model is specified as follows:

$$Yi = \beta_0 + \beta_1 P_i + \beta_2 U_i + \beta_3 D_i + \beta_4 T_i + \varepsilon_i \quad ; i = 1\ (1)\ n$$

Where,

Y_i : Total enrolments due to the i^{th} State

P_i : Total Population of the i^{th} State

U_i : Unemployment rate of the i^{th} State

D_i : Dropout rate at secondary level of the i^{th} State

T_i : Pupil-Teacher Ratio at the secondary level of the i^{th} State

ε_i : Random error associated with Yi.

$\varepsilon_i \sim N(0, \sigma^2)$, i = 1 (1) n

n = 37

Now, Using R we get the following results:

Table 3.1: Summary of regression model using R

	Estimate	Std. error	t value	Pr (> | t |)
Intercept	3.900e+05	2.682e+05	1.454	0.1556
Population	1.790e-01	4.355e-04	410.969	<2e-16
Unemployment rates	1.213e+03	8.707e+03	1.393	0.1733
Dropout rates	3.109e+03	1.683e+04	0.185	0.8546
Pupil Teacher Ratio	-4.432e+04	1.671e+04	-2.652	0.0123

Residual Standard Error: 572500 on 32 degrees of freedom

Multiple R-squared: 0.9998

Adjusted R-squared: 0.9998

F-Statistic: 4.52e+04 on 4 and 32 DF

p-value: < 2.2e-16

From Table 3.1 and the above mentioned results we conclude that,

1. A unit increase in population increases enrolment by 0.179 students (highly significant).

2. A **1 unit increase** in pupil-teacher ratio (i.e., more students per teacher) results in a **decrease of 44,320** enrolments, which is statistically significant.

3. The estimate of intercept is coming out to be 390000 i.e the baseline value when all predictors are 0.

4. **Multiple R-squared = 0.9998**
   Indicates that **99.98%** of the variability in enrolment is explained by the model — extremely high.

4. TEST OF SIGNIFICANCE, VIF & MULTICOLINIEARITY AMONG THE PREDICTORS

Test of Significance of the Predictors:

We will test the significance of the predictors i.e we want to test the null hypothesis that the coefficient associated with a particular predictor is equal to zero .

So we are to test ,

$$H_{0j}: \beta_j = 0 \qquad vs \qquad H_{1j}: \beta_j \neq 0 \quad \forall j=1(1)4$$

Under H_{0j} the test statistics is given by

$$T_j = \frac{\hat{\beta}_j}{se(\hat{\beta}_j)} \; ; \forall j=1(1)4$$

Critical region :

We reject H_{0j} at α level of significance iff $|T_{j\,obs}| > t_{n-p-1,\,\alpha/2}$

$t_{n-p-1,\,\alpha/2} = 2.036933$; for $\alpha = 0.05$

n= Total number of observation (37)

p= Number of predictors (4)

Here in the Table 3.1 “t value” are the values of $T_{j\,obs.}$

Now decisions made on the basis of the observed value of the test statistics and the critical region are given below:

Table 4.1: Decision based on Critical Region and Test Statistic

PREDICTORS	DECISION
Population	Reject
Unemployment Rates	Accept
Dropout Rates	Accept
Pupil-Teacher Ratio	Reject

From table 4.1, we can conclude that,

1. **Population** has the strongest and most statistically significant positive impact on enrolment.
2. **Pupil-teacher ratio (secondary)** has a **significant negative impact**, indicating that poor teacher availability discourages enrolment.
3. **Unemployment rates** and **dropout rates** in secondary education are **not statistically significant** in this model

Variance Inflation factor (VIF):

VIF measures how much the variance of a regression coefficient is **inflated** due to **multicollinearity** among the independent variables.

In simple terms:

It checks if your predictor variables are **correlated with each other**, which can **distort the results** of your regression.

Formula for VIF is given by:

$$\mathbf{VIF_i} = \frac{1}{1-R_i^2}$$

Where,

$\boldsymbol{R_i^2}$ **:** The R-squared value from regressing i^{th} variable on all the other predictor variables.

Table 4.2: VIF values of the predictors

Predictor	VIF Value
Population	1.074759
Unemployment Rates	1.038708
Dropout Rates	1.206055
Pupil-Teacher Ratio	1.244534

From Table 4.2 we can say that,

All VIFs are **close to 1**, which means:

- There is **no multicollinearity** issue among your predictor variables.
- Each independent variable contributes unique information to the model.
- The **regression coefficients are stable** and interpretable.

5. GRAPHICAL REPRESENTATION OF EXAMINING THE SHIFT IN ENROLMENTS BETWEEN GOVERNMENT AND PRIVATE SCHOOLS IN INDIA

Here we will graphically discuss about the shifts in enrolments between Government and Private Schools of all the States in India.

Here we will take the proportions of Government and Private enrolments which are as follows:

Let,

Proportion of Govt. Enrolment = G

Proportion of Private Enrolment = P

No. of enrolments in Government Schools at primary level = x

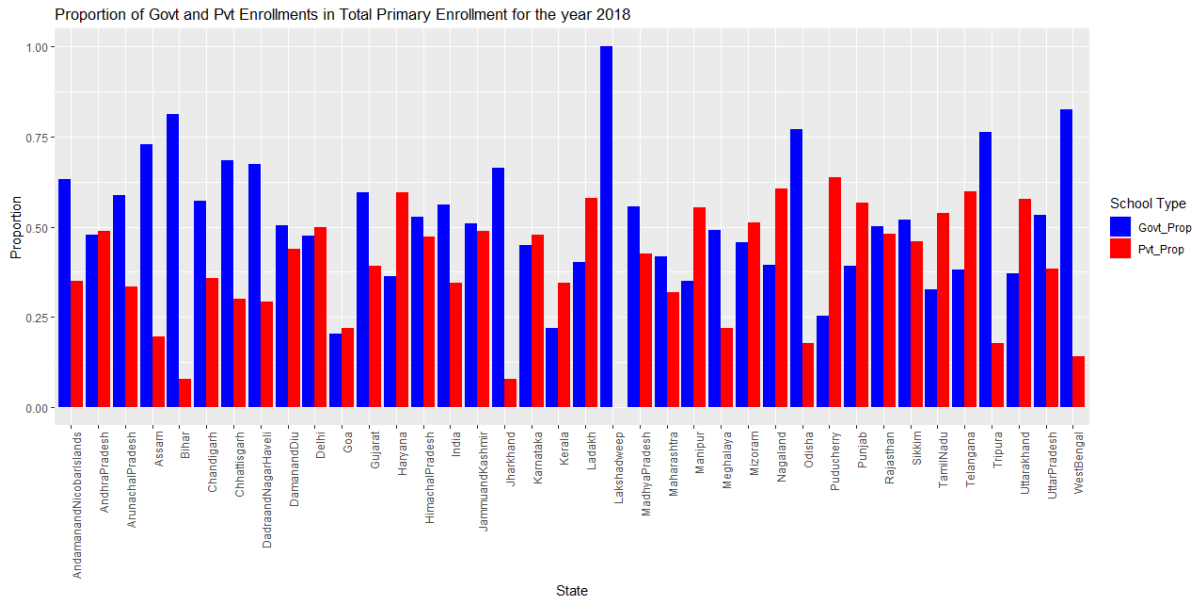
No. of enrolments in Private Schools at primary level = c

Total no. of enrolments in Primary Schools = n

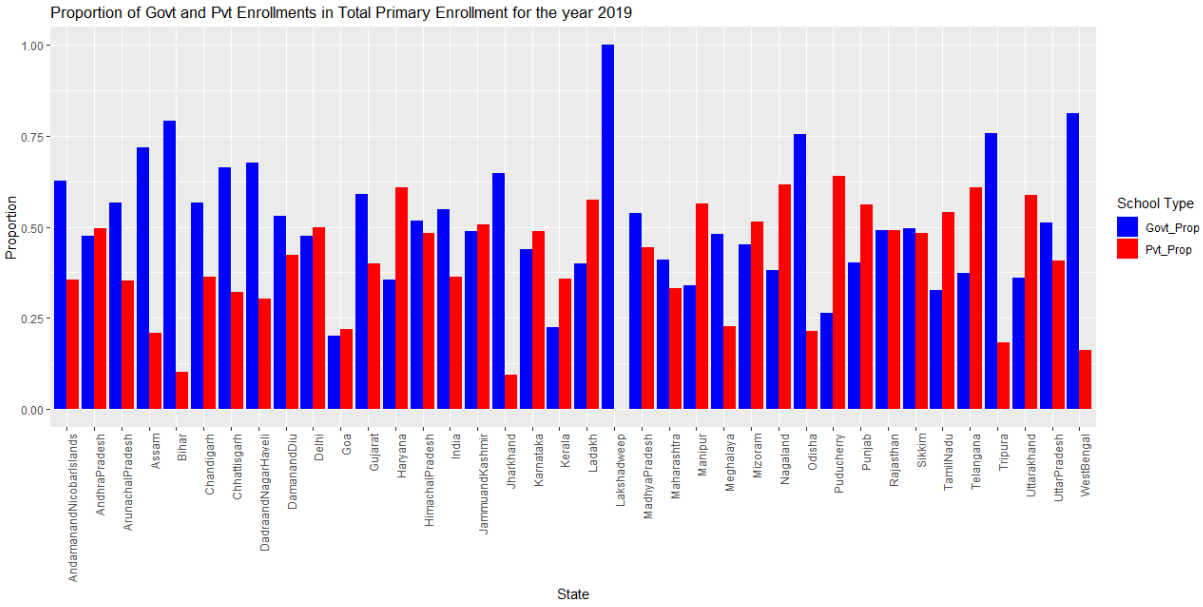
Hence,

$$G = \frac{x}{n} \quad \text{and} \quad P = \frac{c}{n}$$

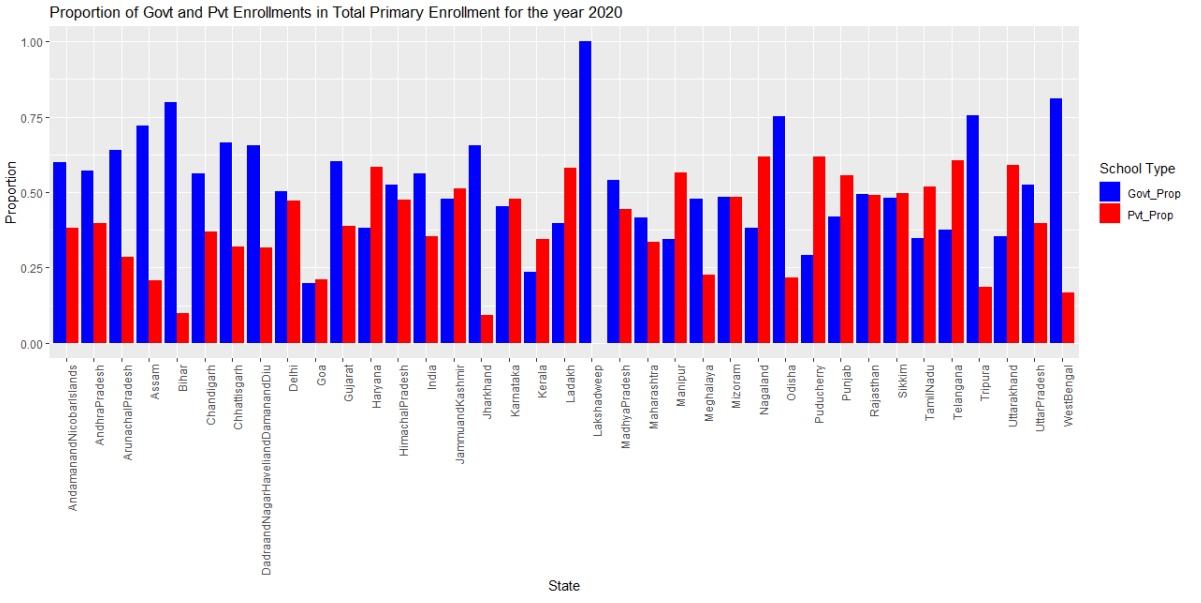
<u>Figure 5.a:</u> Grouped Bar Chart Showing Proportion of Government and Private Enrolments in Total Primary School Enrolment Across Indian States for the year 2018



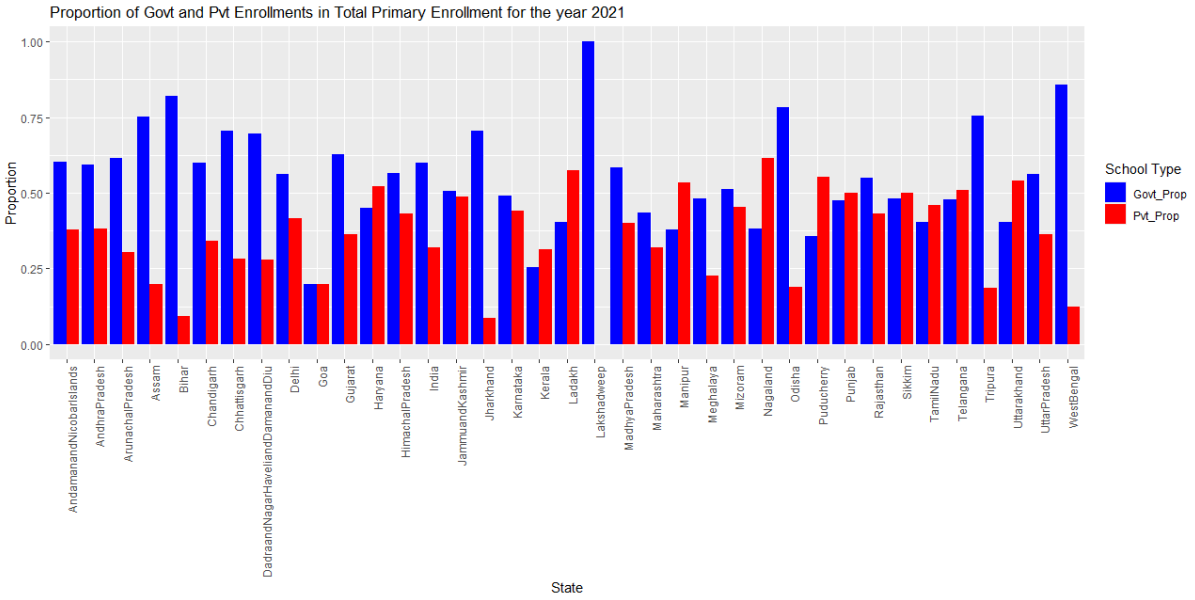
<u>Figure 5.b:</u> Grouped Bar Chart Showing Proportion of Government and Private Enrolments in Total Primary School Enrolment Across Indian States for the year 2019



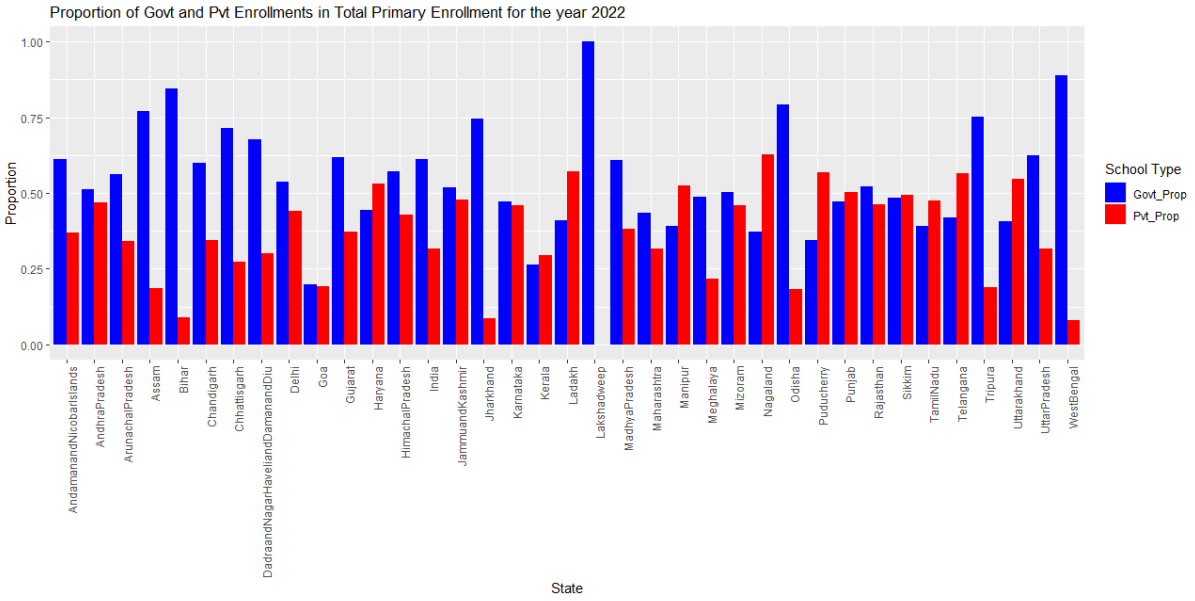
<u>Figure 5.c:</u> Grouped Bar Chart Showing Proportion of Government and Private Enrolments in Total Primary School Enrolment Across Indian States for the year 2020



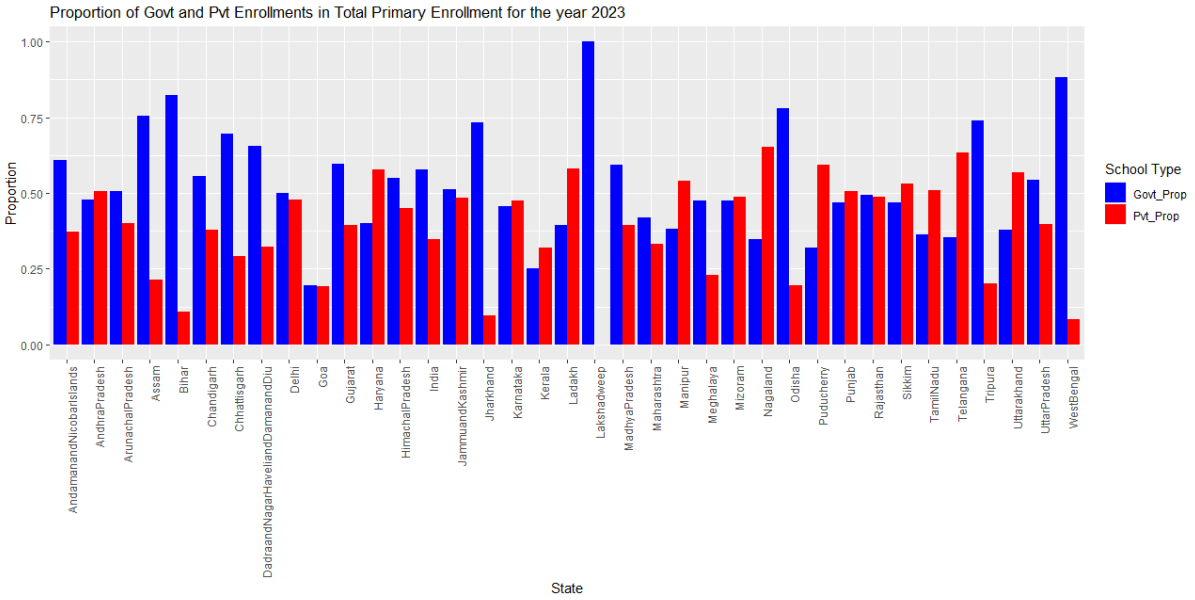
<u>Figure 5.d:</u> Grouped Bar Chart Showing Proportion of Government and Private Enrolments in Total Primary School Enrolment Across Indian States for the year 2021



<u>Figure 5.e:</u> Grouped Bar Chart Showing Proportion of Government and Private Enrolments in Total Primary School Enrolment Across Indian States for the year 2022



<u>Figure 5.f:</u> Grouped Bar Chart Showing Proportion of Government and Private Enrolments in Total Primary School Enrolment Across Indian States for the year 2023

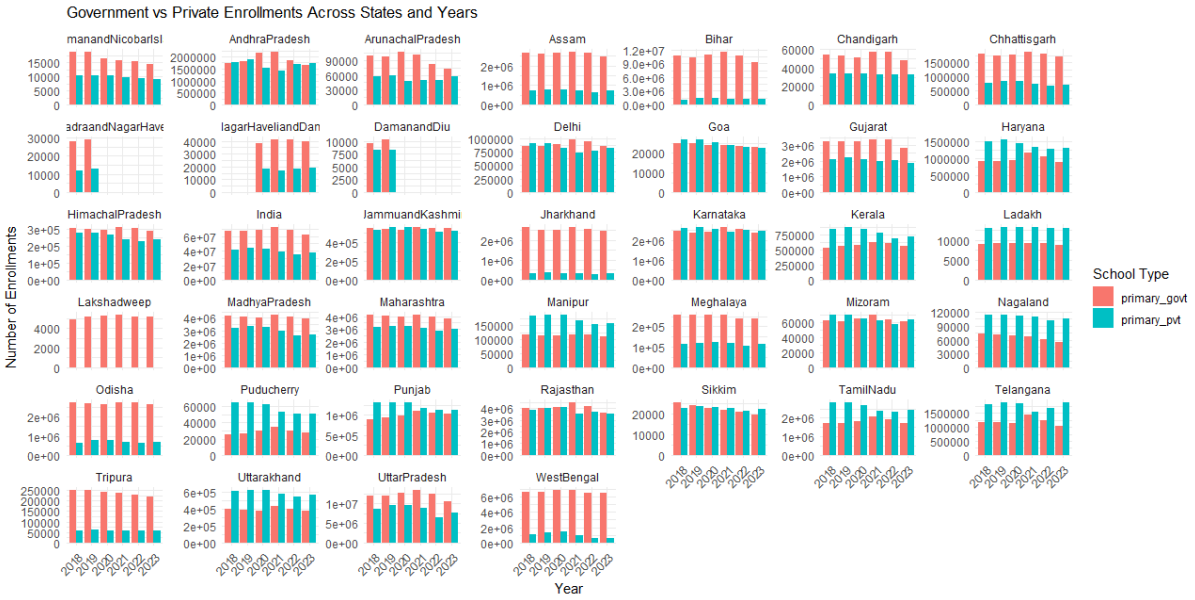


Overall Comments:

- The growth rate varies across states.
- A few states exhibit a **relatively stable ratio** of government and private enrolments, implying no significant shift in school preference over the years like West Bengal, Jharkhand etc.

<u>Figure 5.g:</u> Grouped Bar Chart Showing Government and Private Primary Enrolments Across Indian States from 2018 to 2023

Each panel represents a state/UT, displaying the number of enrolments in government and private primary schools over the years.



Comments on Figure 5.g:

- The **gap between government and private enrolments varies** across years, with certain states seeing a significant **high private enrolments**.
- The overall trend suggests that while **government enrolments remain dominant in most states**, private school enrolments have **grown at a faster rate** in many regions.
- Some **states with high population density** (such as Uttar Pradesh and Bihar) still show a **strong presence of government enrolments**.

<u>Figure 5.h:</u> Stacked Bar Chart Showing Proportion of Government and Private Enrolments in Primary Education Across Indian States (2018–2023)

Each panel represents a state/UT. For each year, the total primary enrolment is broken down into government and private school shares.

Comments on Figure 5.h:

- Certain **states have a very high proportion of government school enrolments** (e.g., Bihar, Jharkhand, Chhattisgarh, and Madhya Pradesh), likely due to **government-led education schemes** and lower affordability of private schools.

- States like **Kerala, Maharashtra, and Karnataka show a high percentage of private enrolments**, indicating **better infrastructure and demand for private education**.

- The distribution highlights a **regional disparity** where northern and eastern states have **higher government enrolments**, while **southern and western states lean more toward private enrolments**.

6. DROPOUT TRENDS OVER TIME AND ACROSS GENDER

School dropout rates are key measures of the efficiency and equity of the education system. They indicate the proportion of students who drop out of school before reaching a specific level of schooling. The purpose of this section is to examine the trends in primary level dropout rates over various years and compare them between boys and girls, using statistical methods to assess the significance of any observed differences.

To statistically test **whether there is a significant difference in dropouts between boys and girls** we will be using a **paired t-test.**

Comparison of Dropouts Between Boys and Girls:

We are to test:

Null Hypothesis (H_0):
There is no significant difference between the dropout counts of boys and girls.
H_0: $\mu_d = 0$, where μ_d = mean difference (boys - girls)

Alternative Hypothesis (H_1):
There is a significant difference between the dropout counts of boys and girls.
H_1: $\mu_d = \neq 0$

Test statistic:

$$T = \frac{\bar{d}}{s\,d(d)/\sqrt{n}}$$

Where;

$\bar{d}$ = Mean of differences (boys' dropout counts – girls' dropout counts)

$s\,d(d)$ = Standard Deviation of the difference

n = Number of paired observations (223 here)

Critical Region:

Reject H_0 iff $|\mathbf{T_{obs}}| > \boldsymbol{t_{n-1,\alpha/2}}$

Where;

$\boldsymbol{\alpha}$ = Level of significance (0.05) , n-1=222

R Output:

T = 3.7227

Degrees of freedom = 222

P-value = 0.0002499

95% Confidence Interval : 7645.506 24845.597

Sample Estimates: mean difference = 16245.55

The p-value (< 0.001) indicates a statistically significant difference in dropout counts between boys and girls. On an average, boys have **16,246 more dropouts** than girls across the observations.

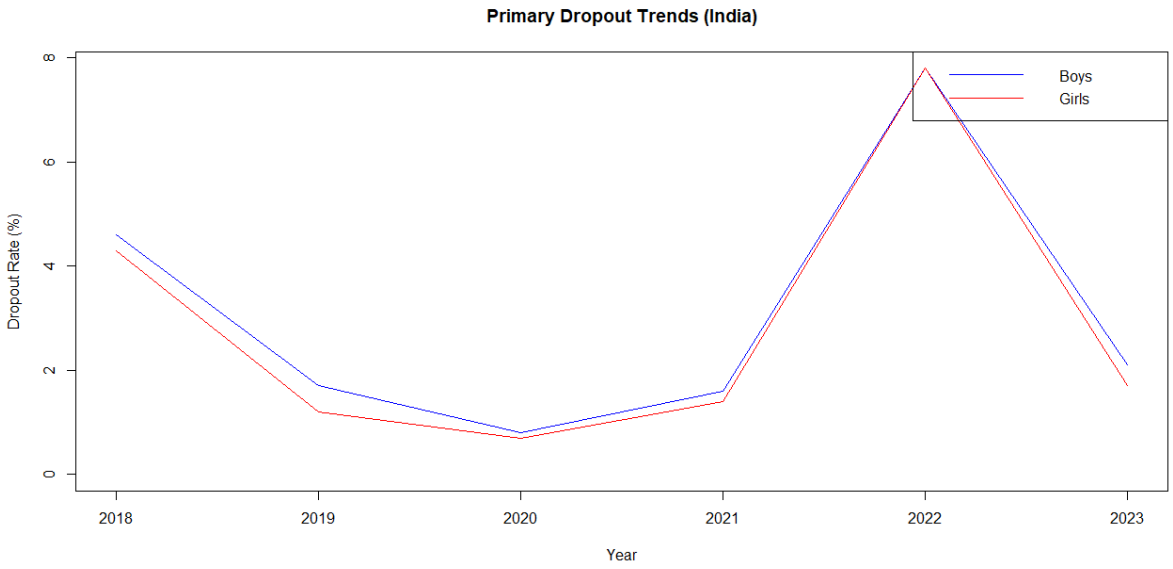
Also, T is coming out to be 3.7227 and T_{crit}=1.970

Hence **reject** the null hypothesis.

There is **strong statistical evidence** that the dropout counts of boys and girls are **not equal** — the difference is statistically significant.

Now, let us look at some plots of dropout rates at different levels of Schools in India over the years:

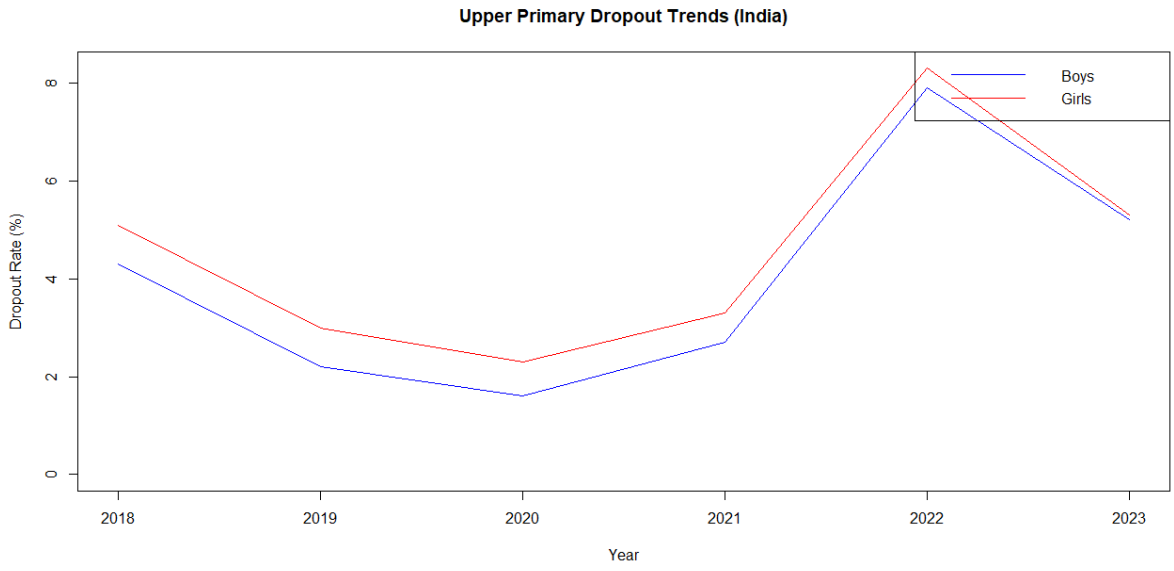
Figure 6.a: Time series plot of Primary Dropouts in India over the years



Comments on Figure 6.a:

- Dropout Rate was **decreasing from 2018 to 2020**.
- After 2020 dropout rates started increasing.
- **After 2021 there is a huge increase in dropout rates** which overcomes at 2023. This may be due to the COVID-19 Pandemic.
- **Boys have higher dropout rates than of girls**

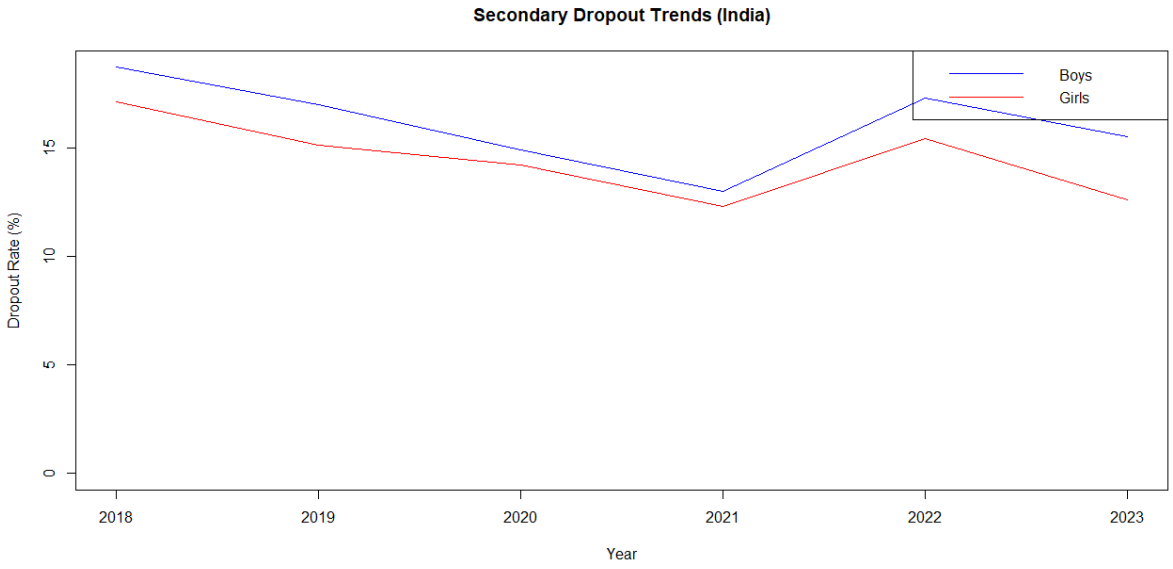
Figure 6.b: Time series plot of Upper Primary dropout rates in India over the years



Comments on Figure 6.b:

- Almost similar Pattern with Primary dropouts.
- **Girls have comparatively more dropouts than boys throughout every year.**

<u>Figure 6.c:</u> Time series plot of Secondary dropout rates in India over the years



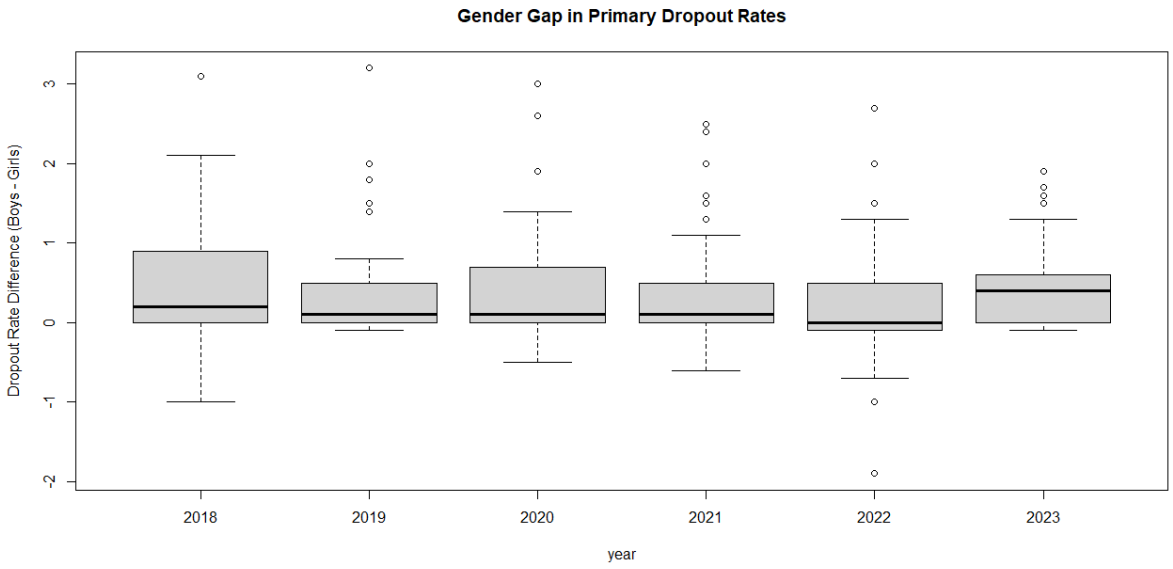
Comments on Figure 6.c:

- Dropout rates are comparatively higher than Primary or Upper Primary level.
- Boys have higher dropout rates than girls throughout the whole time period.
- Dropout rate for both boys and girls was decreasing from 2018 to 2021
- Started increasing after 2021
- Again started stabilizing after 2022.

Now let us have a look on the plot of Gender Gaps at Primary Level:

- **For Primary Level:**

<u>Figure 6.d</u>: Boxplot of Gender gaps(boys-girls) in Primary Dropout rates



Comments on Figure 6.d:

- In every year from **2018 to 2023**, the **median dropout gap is slightly positive**, indicating that **boys consistently had marginally higher dropout rates than girls** at the primary level.
- The **central line (median)** remains quite close to 0 across the years, suggesting that while the gap favours boys dropping out more, the **magnitude of the gap has not changed drastically** over time.
- All years show several **positive outliers**, which point to **states or regions where boys dropped out at much higher rates than girls**.
- A few **negative outliers**, especially in **2022**, indicate **some instances where girls' dropout rates exceeded those of boys**.
- **2018 and 2023** show wider **interquartile ranges (IQRs)**, suggesting **greater variation in gender gaps** across states in those years.
- The spread is **relatively consistent** in the middle years (2019–2021), indicating more uniformity during that period.
- Despite the pandemic, the **gender gap did not significantly widen or narrow**, implying that **both genders were similarly affected** at the primary level in terms of dropout behaviour.

7. IMPACT OF COVID-19 PANDEMIC ON SCHOOL ENROLMENTS AND DROPOUTS

The COVID-19 pandemic, which broke out in early 2020, had a significant impact on India's school education system. Even with available data covering just a brief period (2018–2023), the trends in enrolments and in dropout rates indicate evident disruptions induced by the pandemic, both in terms of magnitude and direction.

Enrolment data analysis reveals a steep drop-off after 2021, especially in private and other category schools, with government school enrolments either picking up or fluctuating for some time, as the economic crunch made families think twice before investing in education. The plots of growth rates exhibit this change effectively, with private schools showing negative growth, and government schools registering a temporary hike in enrolments around 2021.

Dropout patterns, however, indicate an alarming increase during the pandemic years, particularly between 2020–2022. The paired t-tests on calculated dropout numbers supported statistically significant disparity between boys and girls. This strengthens the break in normal schooling and possible reporting flaws during pandemic years.

Further, primary and upper primary dropout rate gender gap boxplots reveal higher variability and extreme outliers in the pandemic period, reflecting state-wise differences in how boys and girls were impacted. As the median difference between boys' and girls' dropout rates was comparatively small, but the spread and outliers indicate some states experienced dramatic gendered effects because of school closures, no digital access, and financial stress.

Although the available data spans just a brief duration, it's clear that enrolment patterns were disrupted and dropout risks increased under the COVID-19 pandemic, especially among the vulnerable and the marginalized groups. The visual pattern and statistical indication combined provide testimony to how the education system came under strain during crisis periods to reveal inequalities of access and retention.

8. PUPIL TEACHER RATIO

The Pupil Teacher Ratio (PTR) is one of the major education indicators measuring the ratio of pupils to teachers at a particular level of schooling. It is an indicator of the availability of teachers.

The formula for PTR is given by:

$$\textbf{PTR}= \frac{\textit{Total Number of Students enrolled}}{\textit{Total Number of Teachers}}$$

From the data the summarized results are given in the following table:

Table 8.1: PTR summarization of different school levels

Summary	Primary	Upper Primary	Secondary	Higher Secondary
Minimum	6.00	3.00	5.00	8.00
1st Quartile	15.85	11.00	10.00	15.00
Median	21.00	16.00	12.00	19.00
Mean	21.25	16.05	15.34	22.86
3rd Quartile	26.00	20.00	18.00	28.00
Maximum	57.00	33.00	55.00	67.00

Important Findings from Table 8.1:

Primary:

- Mean PTR is 21.25, almost the same as the median (21), representing quite a symmetrical distribution.
- Range: Extensive (6 to 57), reflecting inequality in teacher distribution among schools.
- 3rd Quartile (Q3) = 26 implies that 75% of the schools have PTR ≤ 26.

Upper Primary:

- Mean (16.05) and Median (16) are highly similar → symmetrical.
- Minimum PTR is 3, reflecting some schools with very few students per teacher.

- Max = 33 → significantly less than Primary's max, reflecting fewer extreme cases.

Secondary:

- Mean (15.34) greater than Median (12) → Slight right-skew, there are a few schools with very high PTR.
- Range is broad (5 to 55)

Higher Secondary:

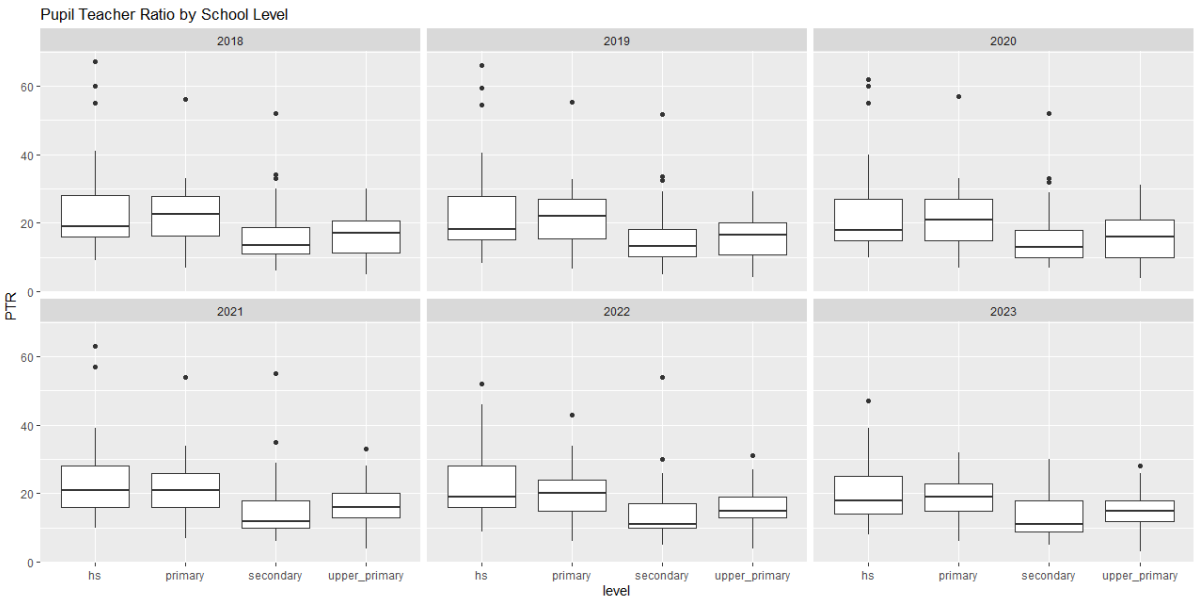
- Maximum Mean PTR (22.86) of all the levels.
- Median = 19, and Max = 67 – reflects there are some schools which are highly understaffed.
- Wide gap between 3rd Quartile (28) and Max (67) indicates outliers with extremely high PTRs.

Observations:

- Higher Secondary is experiencing the most severe teacher shortage problems on average and at extremes.
- Secondary and Upper Primary have comparatively lower PTRs, which reflects improved teacher availability.
- The Primary level, although balanced at the median, has some schools with extremely high PTRs.

<u>Now let us see it graphically (boxplots) for different school levels over the years:</u>

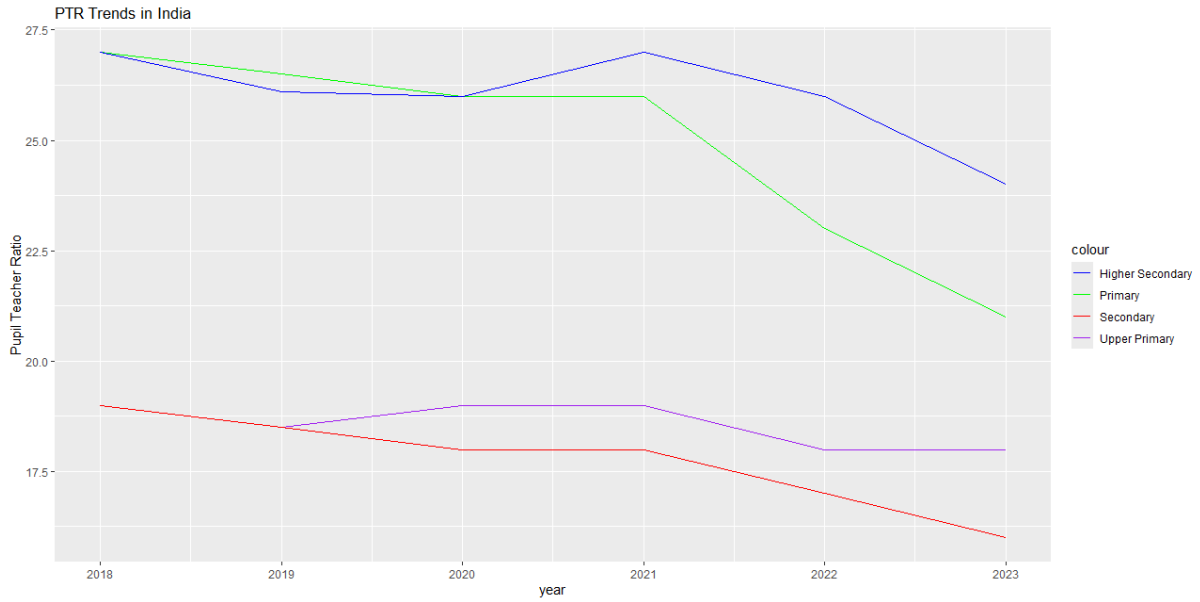
<u>Figure 8.a:</u> Boxplot of PTR for different school levels over the years



The Pupil Teacher Ratio (PTR) of India has exhibited a steady downward trend in all levels of schools from 2018 to 2023, reflecting better teacher availability. Primary and higher secondary level experienced the highest PTR and the largest number of outliers, reflecting staffing difficulties, while upper primary and secondary levels reported lower, more consistent PTRs. Overall, the trend is a positive indication of improvement in teacher distribution balance, although higher secondary still needs specific focus.

Let us now discuss about the Pupil-Teacher ratio trends in India for the year 2018-2023

Figure 8.b: PTR trends in India over the years (2018-2023)



Comments on Figure 8.b:

Primary Level (Green Line):

- In the beginning close to 27 in 2018, a steady fall up to 2021, then a steep decline from 2021 to 2023.This may indicate recent targeted recruitment or reallocation of teachers at primary schools.
- 2023 PTR for primary is approximately 21, a notable improvement.

Higher Secondary (Blue Line):

- Begins near 27 in 2018, remains fairly level up to 2020, peaks in 2021, and then falls in 2022–2023.

- The 2021 peak might be caused by policy changes or short-term teacher deficiencies.
- Decreases by 25 around 2023, which is still high relative to other levels.

Secondary Level (Red Line):

- The most steady and smooth falling trend from ~19 in 2018 to ~16 in 2023.This indicates consistent improvement in the recruitment of teachers or more equitable distribution over time.

Upper Primary (Purple Line):

- Varies somewhat; presents a slight peak around 2020–2021, then falling.
- The trend is weaker but concludes positively, as is the case at the secondary level.

Overall Decline: Across all levels of education, PTR is steadily declining, indicating improvement in teacher availability per student over the years.

Correlation Matrix:

The correlation matrix shows how closely the Pupil Teacher Ratios (PTR) are related across different school levels.

Using R, the correlation matrix is given by the following table:

Table 8.2: Correlation Matrix of PTR at different school levels

	Primary	Upper Primary	Secondary	Higher Secondary
Primary	1	0.7500614	0.8109576	0.6134052
Upper Primary	0.7500614	1	0.6578350	0.4848897
Secondary	0.8109576	0.6578350	1	0.7534017
Higher Secondary	0.6134052	0.4848897	0.7534017	1

Comments on Table 8.2:

- **Primary & Secondary (0.81):** High positive correlation — places with high PTR in primary are likely to have high PTR in secondary.

- **Primary & Upper Primary (0.75):** High positive correlation — PTR tendencies are much the same for the two levels.
- **Primary & Higher Secondary (0.61):** Moderate correlation — there is some correlation, but weaker.
- **Secondary & Higher Secondary (0.75):** High correlation — probably because of similar policy or staffing factors at these upper levels.
- **Upper Primary & Secondary (0.66):** Moderate to high correlation.
- **Upper Primary & Higher Secondary (0.48):** Lowest correlation — indicating different dynamics operating.

Total insight: PTRs across various school levels tend to be positively related to each other, particularly between consecutive levels (e.g., primary and secondary), suggesting systemic factors influencing teacher availability across levels in similar terms.

9. CONCLUSION

This dissertation examined major school education features in India based on UDISE+ data from 2018 to 2024. By applying statistical techniques like paired t-tests and correlation analysis, it investigated trends in dropout rates, enrolment, and pupil-teacher ratio (PTR) by school level, region, and gender.

These findings indicate significant differences — girls have higher dropout rates at higher levels, and PTR differs substantially among regions, particularly at the primary level. High positive correlations between PTRs at different levels indicate system-wide problems with teacher deployment. Enrolment has picked up in recent years, but retention at the secondary level is a problem.

These findings are useful for policy planning, particularly for targeted teacher recruitment, gender-oriented programs, and region-based education improvements. Overall, the project illustrates the potential of statistical tools to enable evidence-based decisions to enhance educational equity and efficiency in India.

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