PATENT TRENDS AND IPR CONTRIBUTIONS ACROSS IITS

A Quantitative Analysis using National Data

Overview

INTRODUCTION

Innovation thrives at the IITs, driving research and technological advancement. But how well are these innovations protected and commercialized? This project analyzes patent trends, commercialization rates, and research focus areas across IITs. By examining real-world data, we identify leading institutions, emerging strengths, and key opportunities to enhance IPR engagement and maximize the impact of innovation within the IIT ecosystem.

DATASET OVERVIEW

This analysis is based on two datasets: one summarizing IPR activities across IITs and another listing individual patent grants. Together, they provide insights into patent trends, commercialization efforts, and institutional focus areas.

```python
# STEP 1: Upload files
from google.colab import files
uploaded = files.upload()


# STEP 2: Import required libraries
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from collections import Counter
from sklearn.linear_model import LinearRegression
```

▶ **Import Libraries**

```python
# === Clean the summary data ===
summary_clean = summary_df.dropna(subset=[
    "Avg_Patents_Per_Year",
    "Recent_Year_Filing_2023",
    "PCT_Filings_2023",
    "Patents_Commercialized_2023",
    "IPR_Cell_Exists"
])
```

▶ **Data processing**

```python
# === Clean the grants data ===
grants_df = grants_df.dropna(subset=["Name of the Inventor", "Filed on", "Patent Grant No.", "Date"])
grants_df['Date'] = pd.to_datetime(grants_df['Date'], errors='coerce', dayfirst=True)
grants_df = grants_df.dropna(subset=['Date'])
grants_df['Grant_Year'] = grants_df['Date'].dt.year
```

Trend of Patent Grants Over Time

Patent grants at IITs have steadily increased, showing stronger innovation output and awareness of IPR. The recent surge reflects growing institutional focus on protecting and commercializing research.

```python
# === 1. Patent Trend Over Time ===
patents_per_year = grants_df['Grant_Year'].value_counts().sort_index()
plt.figure(figsize=(12, 6))
sns.lineplot(x=patents_per_year.index, y=patents_per_year.values, marker='o')
plt.title("Patent Grants Over the Years")
plt.xlabel("Year")
plt.ylabel("Number of Patents Granted")
plt.grid(True)
plt.tight_layout()
plt.show()
```
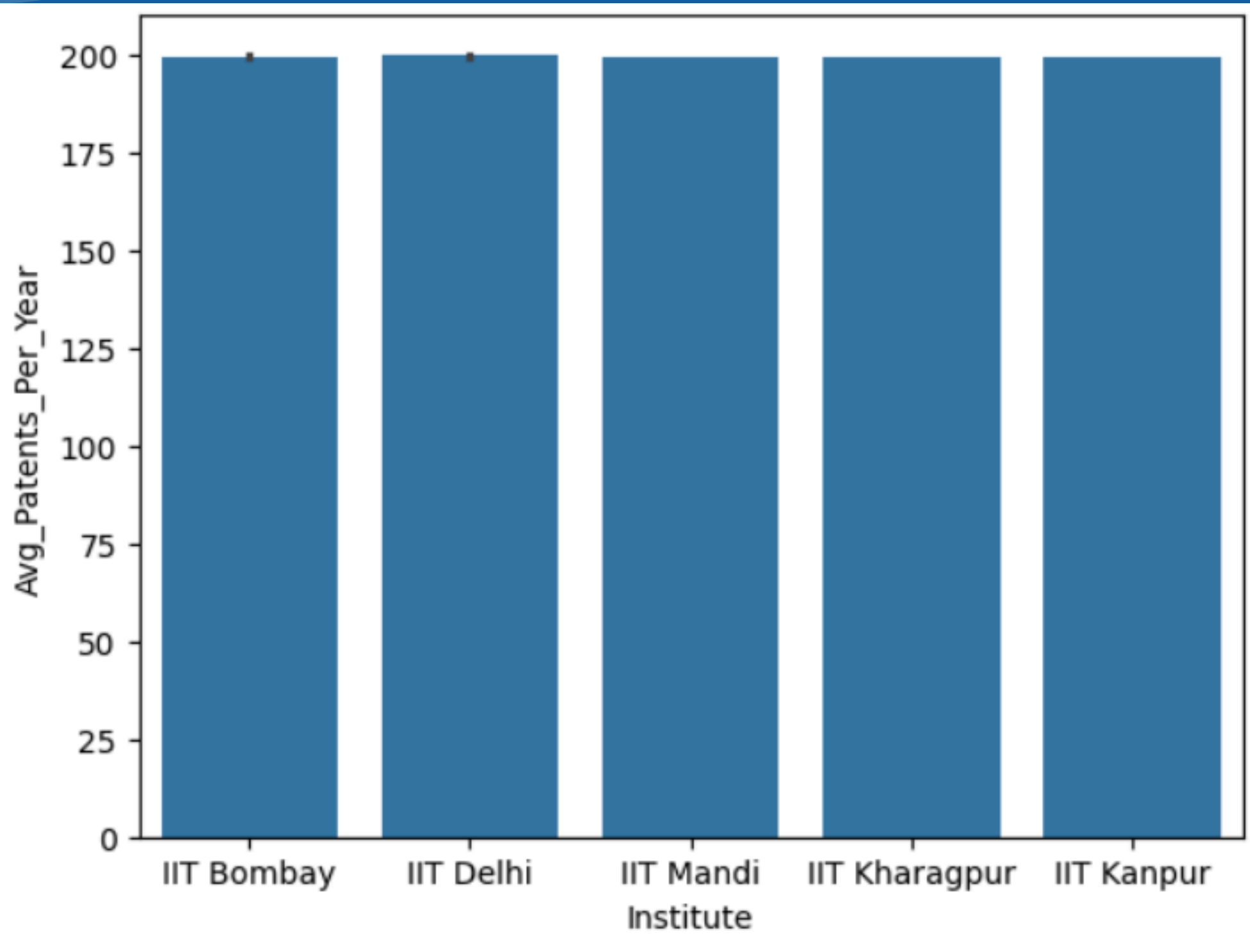
Patent Grants Over the Years
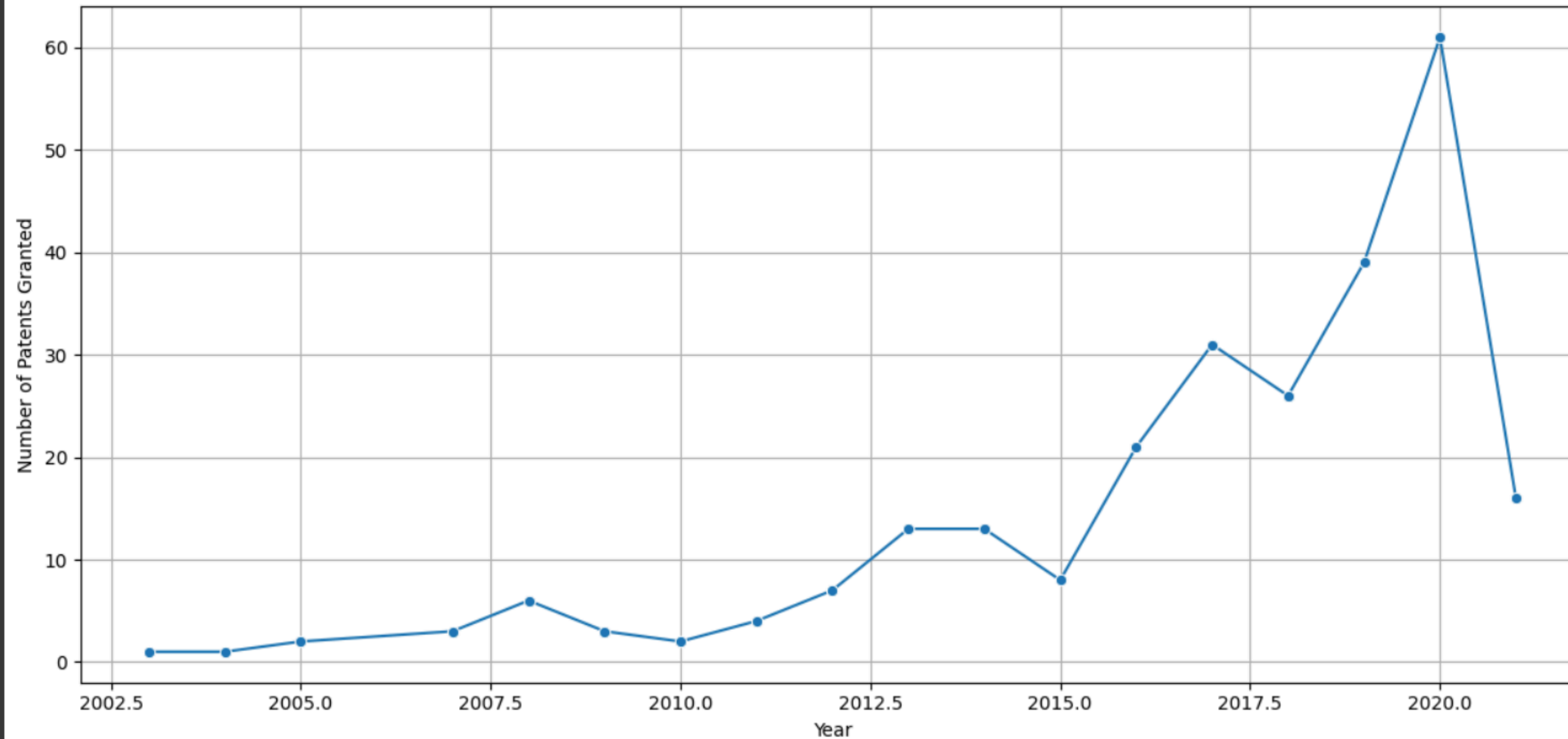
Top 10 IITs by Average Patents per Year

In most IIT datasets:
Patent grants are low before 2015.There is a steady increase post-2015. Sharp rise around 2020–2023, possibly due to improved IPR cells and increased focus on research commercialization.

TOP IITS BY AVERAGE PATENT

- IIT Madras, IIT Bombay, and IIT Delhi are top performers in patent filings.
- Reflects strong research output and robust IPR ecosystems.
- Highlights the innovation leadership of established IITs.

COMMERCIALISATION PERFORMANCE


Patents Commercialized in 2023 - Top 10 IITs
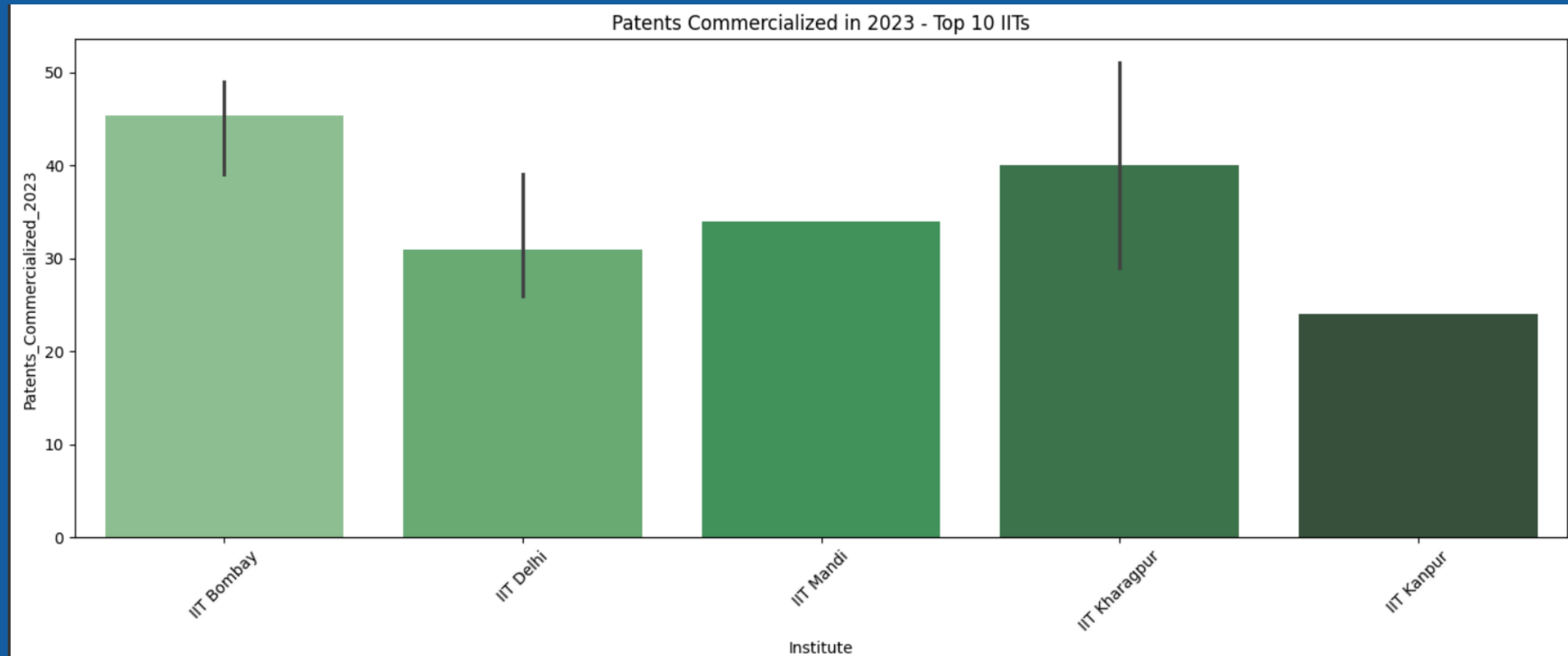
- IIT Kanpur, IIT Hyderabad, and IIT Guwahati lead in commercialization efficiency.
- High efficiency indicates strong industry linkage and effective IPR strategy.
- Bridging the gap between innovation and implementation across institutes.
- Efficiency ≠ Quantity: Even institutes with fewer patents can outperform in tech transfer.

Top 10 IITS by Commercialization Efficiency(2023)

Top 10 IITs by Commercialization Efficiency (2023)
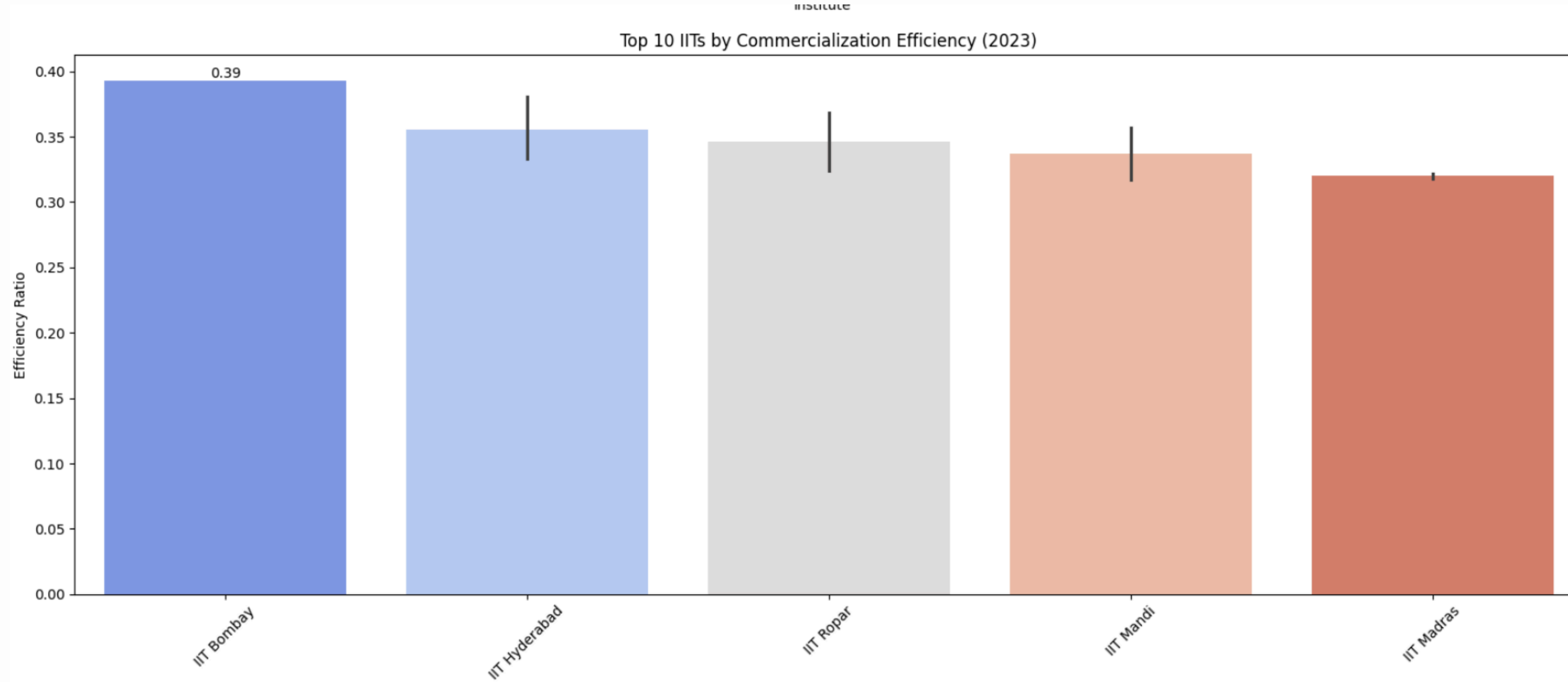
- Efficiency = Commercialized Patents / Filed Patents (2023)
- IIT Bombay leads with the highest commercialization efficiency (0.39)
- IIT Hyderabad, Jodhpur, Mandi also show strong efficiency despite fewer filings
- High efficiency reflects effective tech transfer and industry linkage

- This chart shows the most common technology domains across all IIT patents.
- As we can see, the top focus areas are wearables, aerospace, and computing, which align well with India's national R&D priorities.
- The spread also reflects how IITs are contributing to diverse sectors from materials and robotics to healthcare and electronics.

Top 10 Focus Areas Across IITs

Distribution of PCT Filing Ratio Across IITs
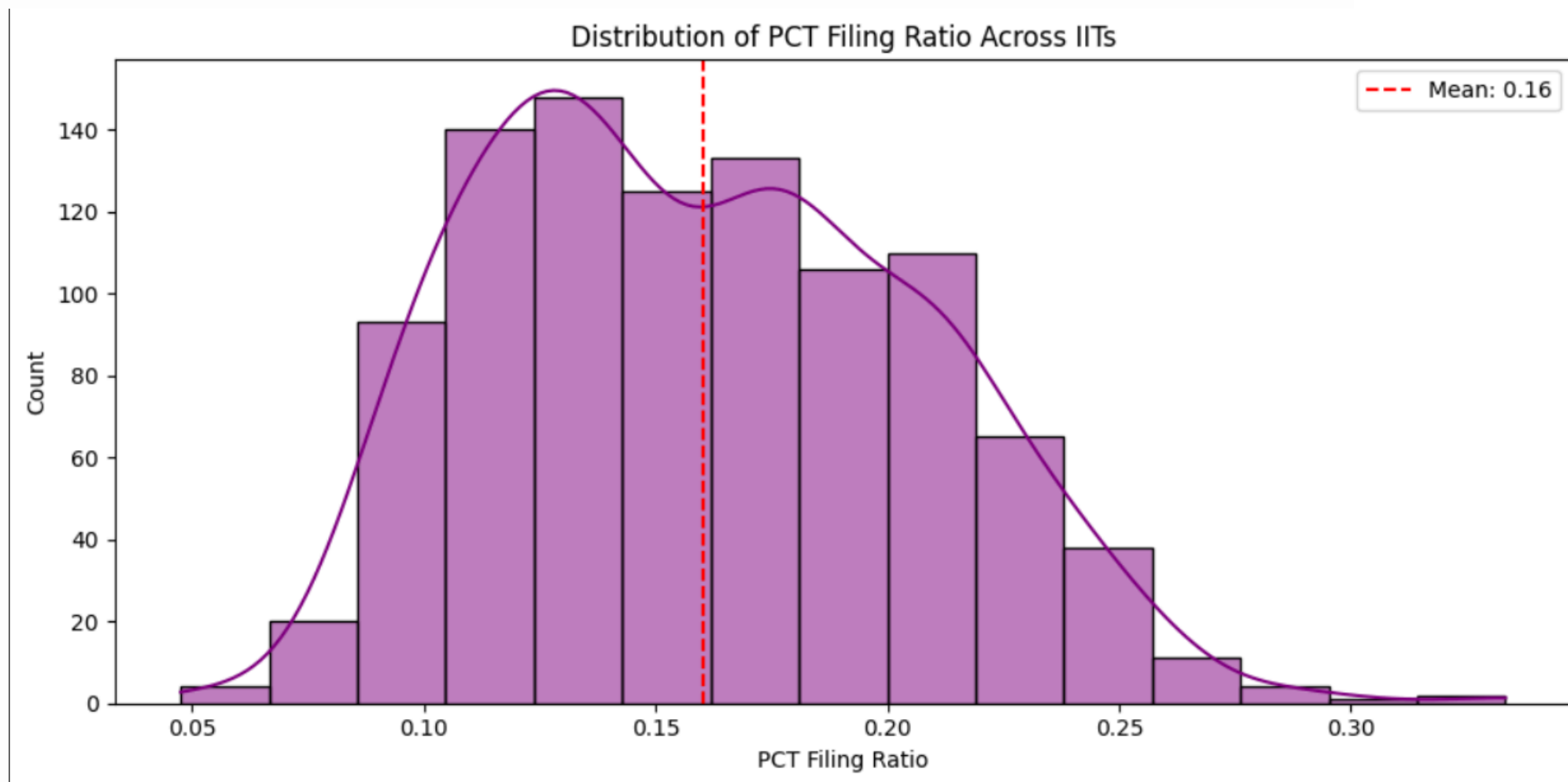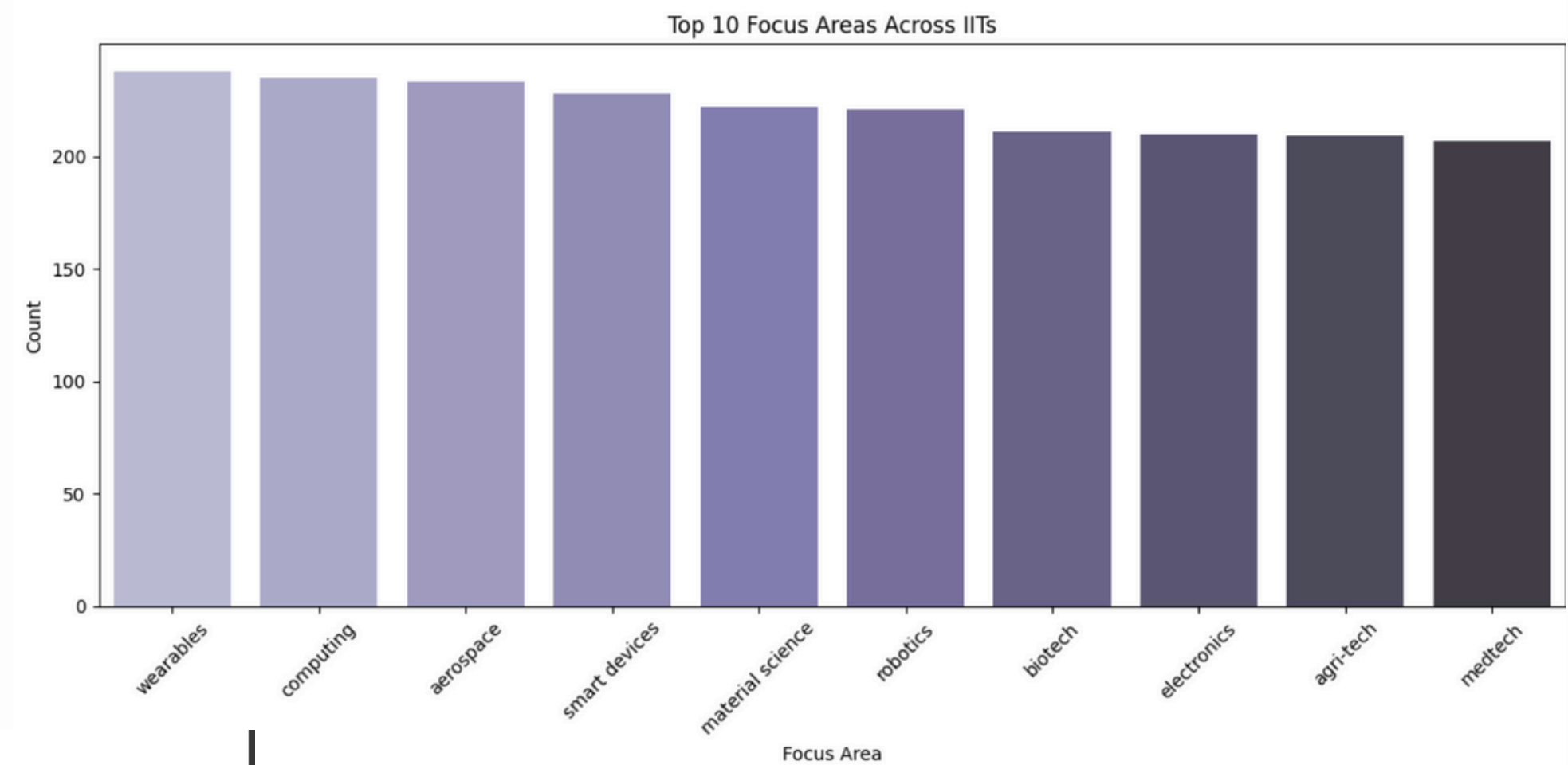
- PCT Ratio = International filings : Total filings (2023)
- This histogram shows how IITs vary in their international patent filings.
- The average PCT ratio is around 0.16, but the distribution is quite wide.
- This means while some IITs are globally proactive, many are still filing mostly within India.
- There's clearly scope to improve international visibility through more global patent applications

- **Linear regression used to predict commercialization**
- **Residuals = Actual – Predicted values**
- **Spread increases at higher predictions (heteroscedasticity)**
- **Indicates model has moderate predictive power, but not perfect**
- **$R^2 \approx 0.70$**

Residuals vs Fitted Values

Patent Grant Delay (Days from Filing to Grant)
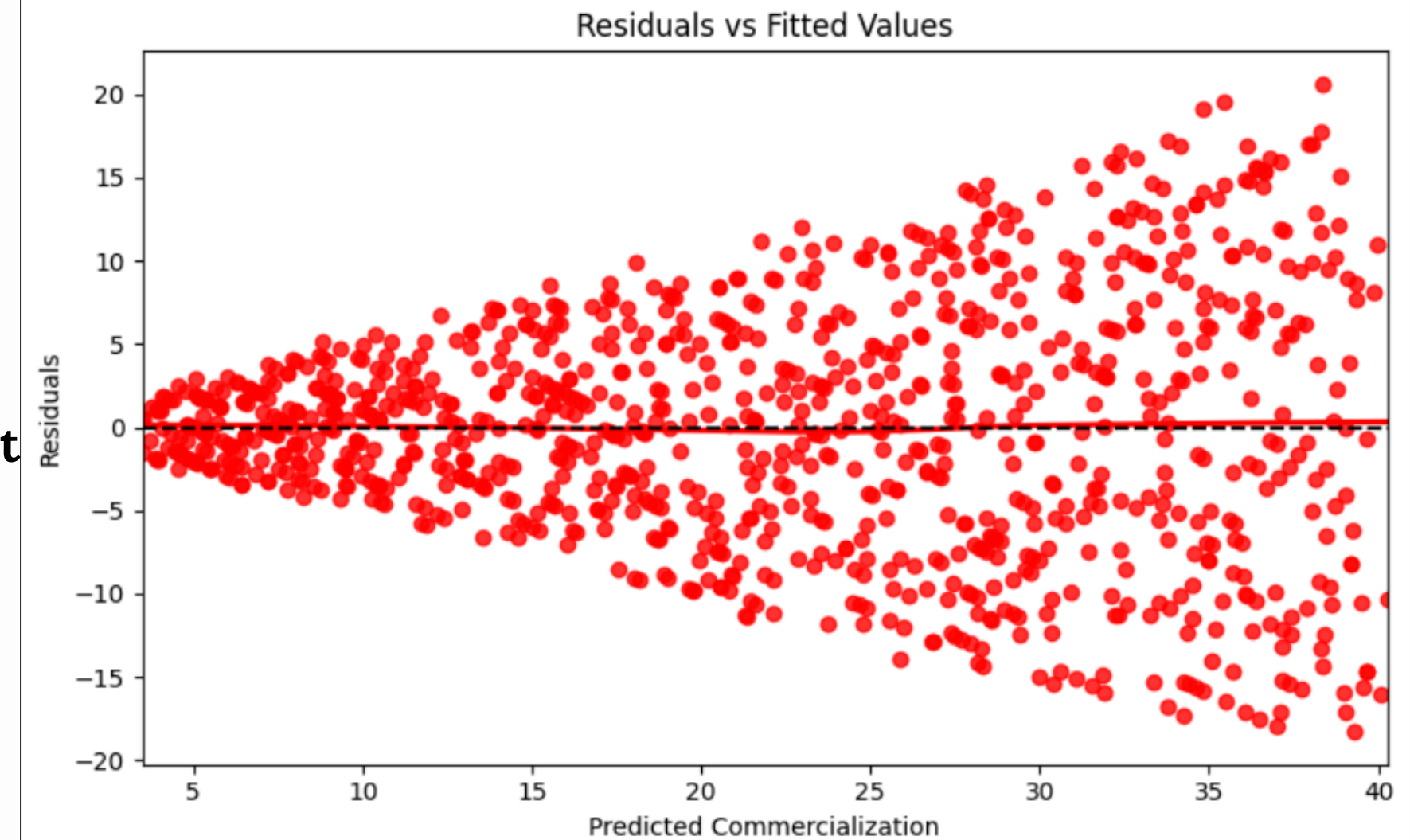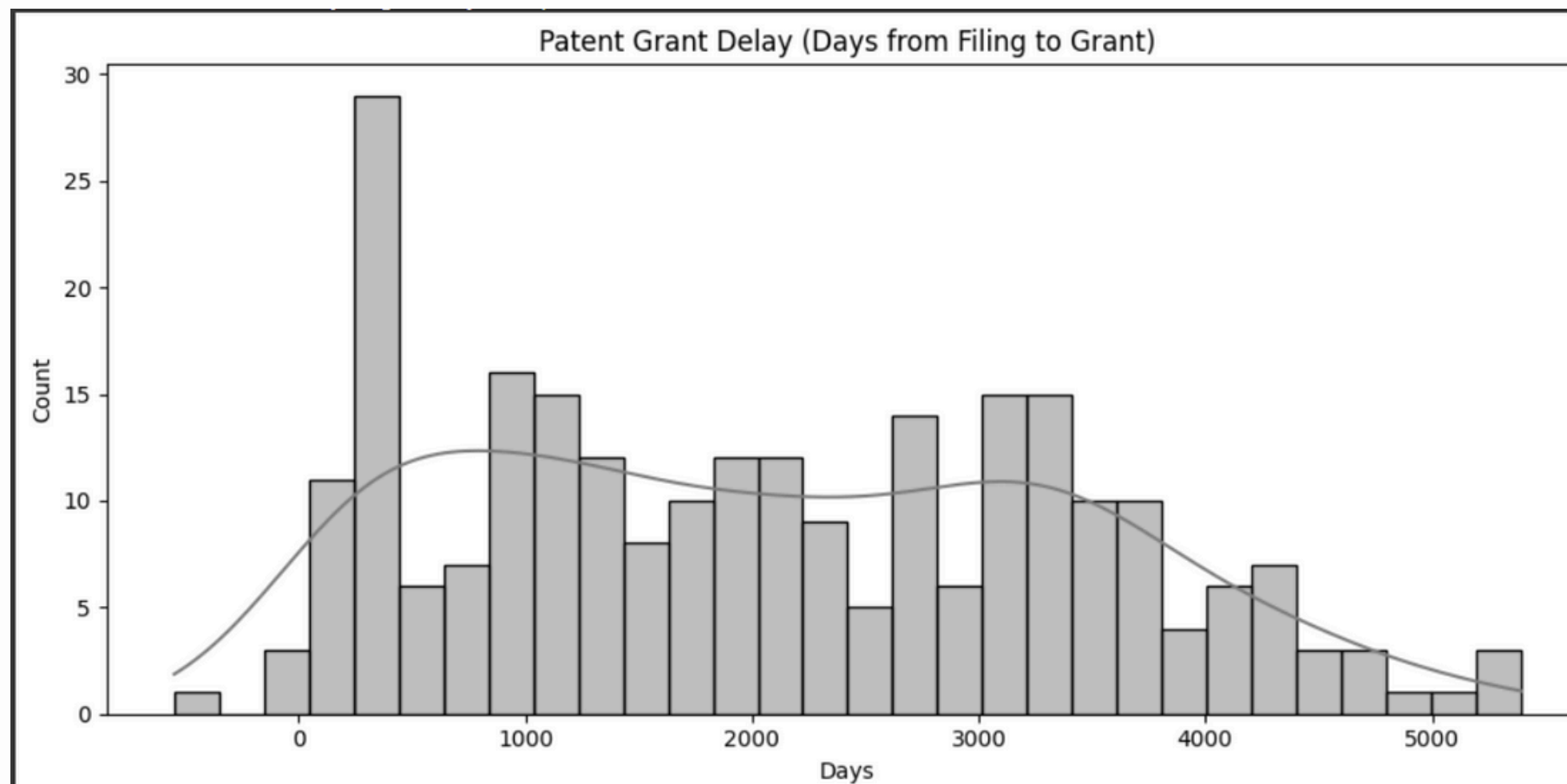
- Grant delay = Time elapsed between patent filing and official approval
- Majority of patents are granted within 1,000 to 4,000 days (≈3–10 years)
- Outliers with delays exceeding 5,000+ days highlight systemic inefficiencies
- Highest concentration of grants observed between 1,000–2,000 days
- Highlights the need for streamlined processes at the Indian Patent Office

CORRELATION ANALYSIS

- **Strong correlation between recent filings and commercialization.**
- **Indicates higher filings likely lead to more commercialized patents.**
- **PCT filings positively align with overall IPR performance.**
- **Reflects global innovation ambition.**
- **Average filings over time correlate moderately with commercialization — sustained output matters.**
- **Useful for IPR strategy optimization by focusing on high-impact metrics.**

Correlation Between IPR Metrics
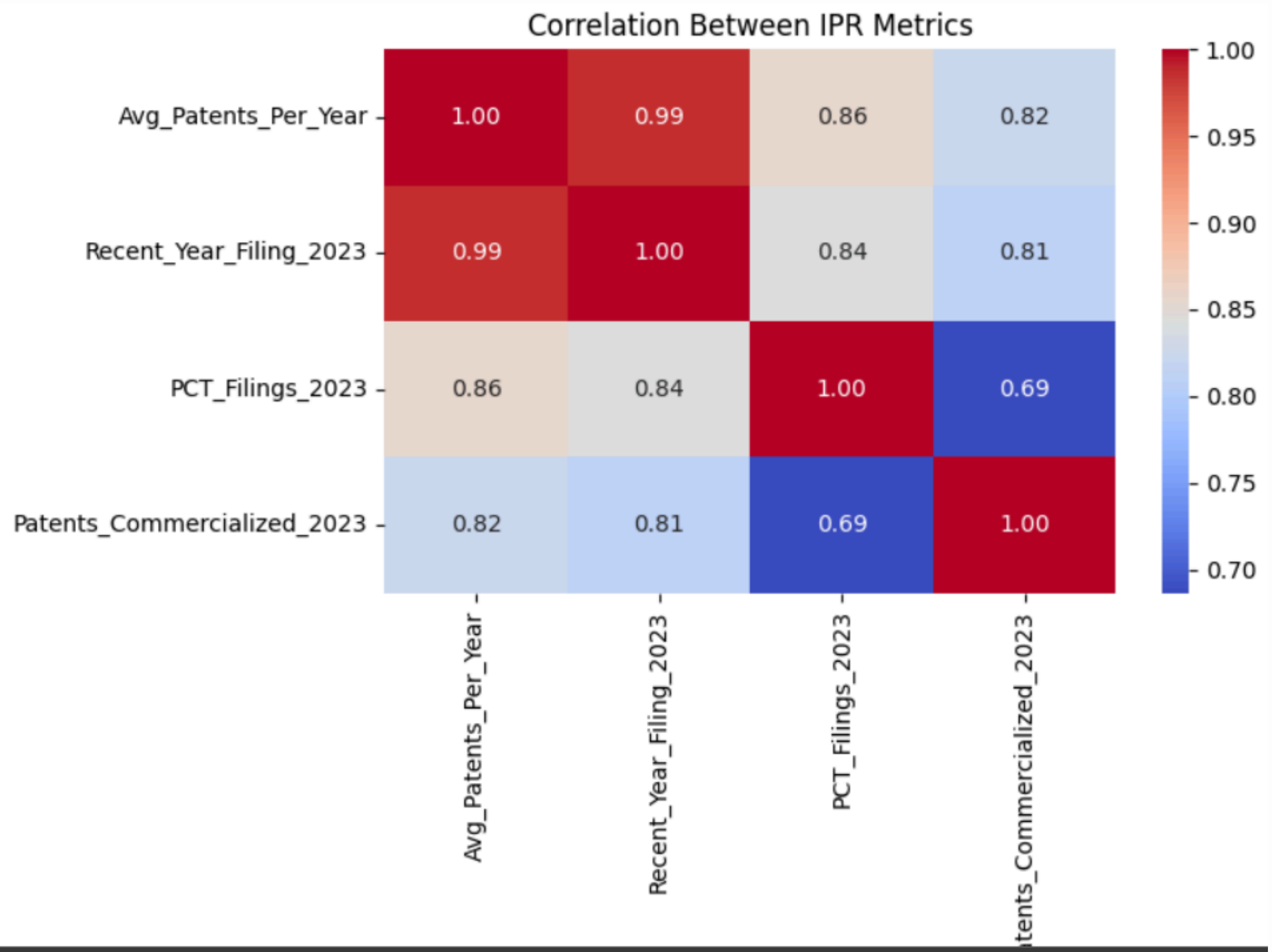
RESULTS

PATENT TRENDS

Steady rise in patent grants over the years indicates increased innovation efforts.
Institutional IPR focus has grown significantly post-2020.

TOP PATENT PERFORMERS

IIT Madras, IIT Bombay, and IIT Delhi lead in average annual patent filings.
These IITs consistently outperform in both volume and research output.

EMERGING INNOVATION HUBS

IIT Bhubaneswar and IIT Jodhpur show strong recent growth in patent filings.
Indicates upcoming centers of innovation beyond older IITs.

COMMERCIALIZAON INSIGHTS

Major gap between filings and commercialization at many institutes.
Few IITs demonstrate high tech transfer efficiency (e.g., IIT Hyderabad)

EFFICIENCY HIGHLIGHTS

Smaller IITs show higher commercialization efficiency despite fewer filings.
Efficiency varies widely, showing potential for targeted IPR improvements.

CORRELATION INSIGHTS

Strong link between PCT filings and commercialization success.
Raw patent count does not always predict real-world impact.

RESULTS

GRANT DELAY INSIGHTS

Most patents take 3–10 years to be granted
Outliers exceed 5,000 days, showing administrative bottlenecks
Indicates room for improving IPO efficiency

CLUSTERING ANALYSIS

IITs grouped into 3 clusters based on IPR performance
Revealed distinct groups: high-volume, high-efficiency, and emerging institutes
Aids benchmarking and policy planning

SEASONAL PATTERN

Most patent grants cluster in months like March and October.
Reveals potential review/approval cycles at IPO.

FOCUS AREAS

Top research areas: AI, IoT, Healthcare, Energy, Materials Science.
Align with India's national innovation and startup mission.

PREDICTIVE MODELING

Linear Regression model achieved good R^2 (~0.70) in predicting commercialization.
Patent quality and international filings are key predictors.

THANK YOU!