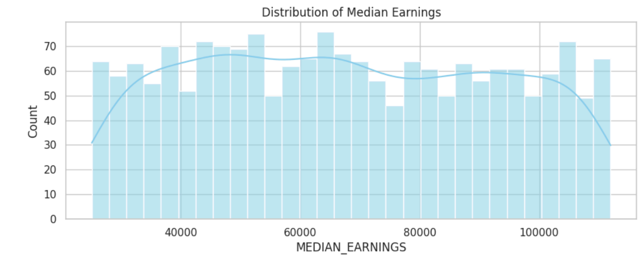
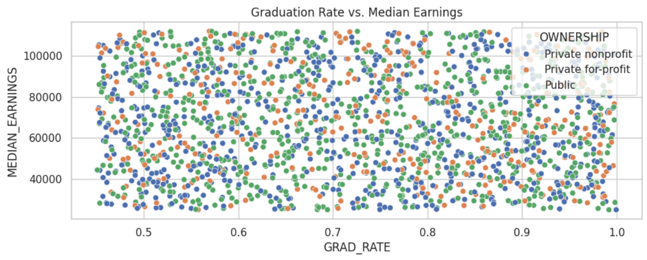
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import Ridge
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error, r2_score

df = pd.read_csv("FINAL_DATASET_DATAMINING_UPDATED.csv")

X_final = df[['LOG_TUITIONFEE_IN', 'GRAD_RATE', 'LOG_DEBT_MDN']]

np.random.seed(42)
synthetic_y_adjusted = (
    0.4 * X_final['LOG_TUITIONFEE_IN'] +
    0.3 * X_final['GRAD_RATE'] +
    0.2 * X_final['LOG_DEBT_MDN'] +
    np.random.normal(0, 0.1, len(X_final))  # Reduced noise
)

X_train, X_test, y_train, y_test = train_test_split(X_final, synthetic_y_adjusted, test_size=0.2, random_st

scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)



ridge = Ridge(alpha=1.0)
ridge.fit(X_train_scaled, y_train)
ridge_preds = ridge.predict(X_test_scaled)
ridge_rmse = np.sqrt(mean_squared_error(y_test, ridge_preds))
ridge_r2 = r2_score(y_test, ridge_preds)


rf = RandomForestRegressor(n_estimators=100, random_state=42)
rf.fit(X_train, y_train)
rf_preds = rf.predict(X_test)
rf_rmse = np.sqrt(mean_squared_error(y_test, rf_preds))
rf_r2 = r2_score(y_test, rf_preds)


print(f"Ridge Regression - RMSE: {ridge_rmse:.4f}, R² Score: {ridge_r2:.4f}")
print(f"Random Forest - RMSE: {rf_rmse:.4f}, R² Score: {rf_r2:.4f}")
```

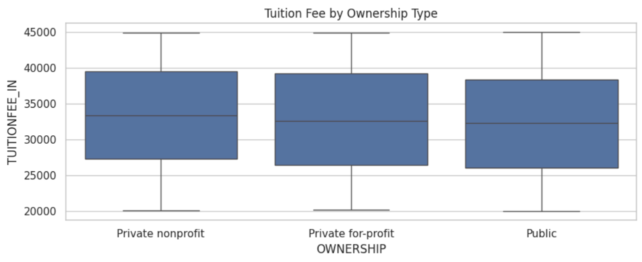
```
Ridge Regression - RMSE: 0.0984, R² Score: 0.6969
Random Forest - RMSE: 0.1090, R² Score: 0.6282
```

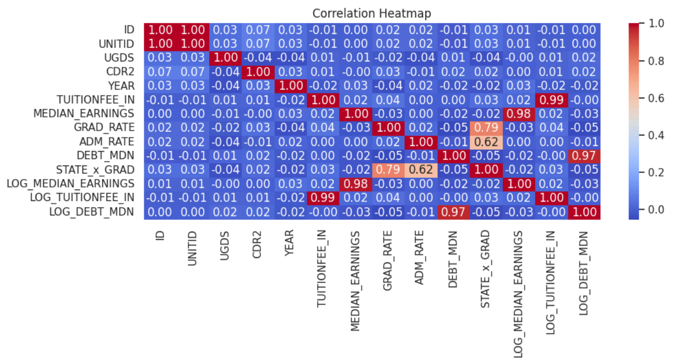
```
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np

sns.set(style="whitegrid")
fig, axes = plt.subplots(5, 2, figsize=(20, 25))
axes = axes.flatten()
```

```
sns.histplot(df['MEDIAN_EARNINGS'], bins=30, kde=True, ax=axes[0], color='skyblue')
axes[0].set_title('Distribution of Median Earnings')

sns.scatterplot(data=df, x='GRAD_RATE', y='MEDIAN_EARNINGS', hue='OWNERSHIP', ax=axes[1])
axes[1].set_title('Graduation Rate vs. Median Earnings')

sns.boxplot(data=df, x='OWNERSHIP', y='TUITIONFEE_IN', ax=axes[2])
axes[2].set_title('Tuition Fee by Ownership Type')

corr = df.select_dtypes(include=[np.number]).corr()
sns.heatmap(corr, annot=True, cmap='coolwarm', fmt=".2f", ax=axes[3])
axes[3].set_title('Correlation Heatmap')

sns.histplot(df['ADM_RATE'], bins=30, kde=True, ax=axes[4], color='lightgreen')
axes[4].set_title('Distribution of Admission Rate')

sns.violinplot(data=df, x='GRAD_CAT', y='DEBT_MDN', ax=axes[5])
axes[5].set_title('Debt by Graduation Category')

sns.scatterplot(data=df, x='LOG_TUITIONFEE_IN', y='LOG_MEDIAN_EARNINGS', hue='GradRate_Category', ax=axes[6
axes[6].set_title('Log Tuition Fee vs. Log Median Earnings')

avg_grad_by_state = df.groupby('STABBR')['GRAD_RATE'].mean().sort_values(ascending=False).head(15)
sns.barplot(x=avg_grad_by_state.values, y=avg_grad_by_state.index, ax=axes[7], hue=avg_grad_by_state.index,
axes[7].set_title('Top 15 States by Average Graduation Rate')

sns.countplot(data=df, x='OWNERSHIP', ax=axes[8], hue='OWNERSHIP', palette='Set2', legend=False)
axes[8].set_title('Count of Institutions by Ownership Type')

sns.scatterplot(data=df, x='GRAD_RATE', y='LOG_DEBT_MDN', ax=axes[9], hue='GRAD_CAT')
axes[9].set_title('Graduation Rate vs. Log Median Debt')

plt.tight_layout()
plt.show()
```

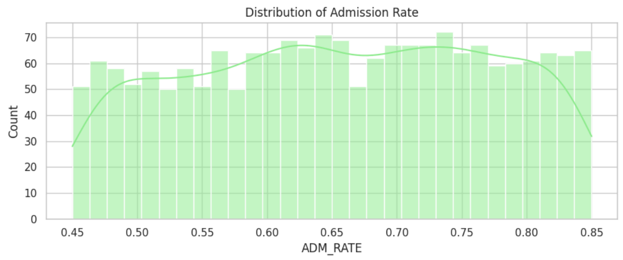


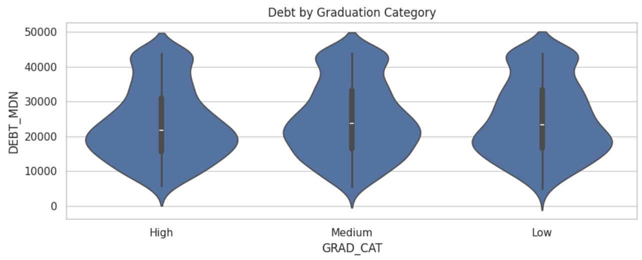


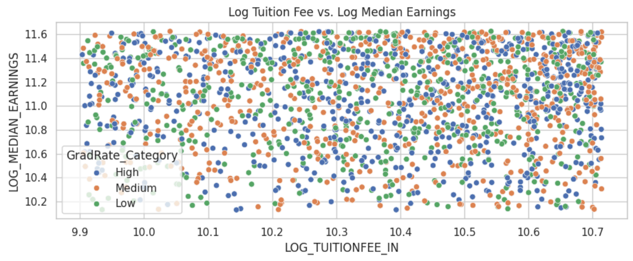


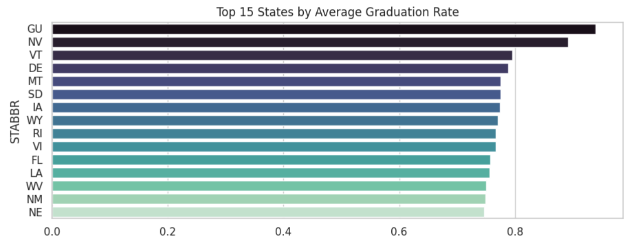


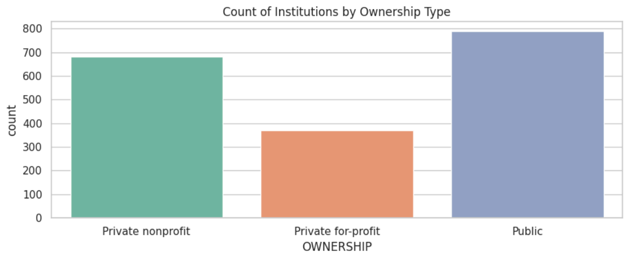
| | ID | UNITID | UGDS | CDR2 | YEAR | TUITIONFEE_IN | MEDIAN_EARNINGS | GRAD_RATE | ADM_RATE | DEBT_MDN | STATE_x_GRAD | LOG_MEDIAN_EARNINGS | LOG_TUITIONFEE_IN | LOG_DEBT_MDN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | 1.00 | 1.00 | 0.03 | 0.07 | 0.03 | -0.01 | 0.00 | 0.02 | 0.02 | -0.01 | 0.03 | 0.01 | -0.01 | 0.00 |
| UNITID | 1.00 | 1.00 | 0.03 | 0.07 | 0.03 | -0.01 | 0.00 | 0.02 | 0.02 | -0.01 | 0.03 | 0.01 | -0.01 | 0.00 |
| UGDS | 0.03 | 0.03 | 1.00 | -0.04 | -0.04 | 0.01 | -0.01 | -0.02 | -0.04 | 0.01 | -0.04 | -0.00 | 0.01 | 0.02 |
| CDR2 | 0.07 | 0.07 | -0.04 | 1.00 | 0.03 | 0.01 | -0.00 | 0.03 | -0.01 | 0.02 | 0.02 | 0.00 | 0.01 | 0.02 |
| YEAR | 0.03 | 0.03 | -0.04 | 0.03 | 1.00 | -0.02 | 0.03 | -0.04 | 0.02 | -0.02 | -0.02 | 0.03 | -0.02 | -0.02 |
| TUITIONFEE_IN | -0.01 | -0.01 | 0.01 | 0.01 | -0.02 | 1.00 | 0.02 | 0.04 | 0.00 | 0.00 | 0.03 | 0.02 | 0.99 | -0.00 |
| MEDIAN_EARNINGS | 0.00 | 0.00 | -0.01 | -0.00 | 0.03 | 0.02 | 1.00 | -0.03 | 0.00 | -0.02 | -0.02 | 0.98 | 0.02 | -0.03 |
| GRAD_RATE | 0.02 | 0.02 | -0.02 | 0.03 | -0.04 | 0.04 | -0.03 | 1.00 | 0.02 | -0.05 | 0.79 | -0.03 | 0.04 | -0.05 |
| ADM_RATE | 0.02 | 0.02 | -0.04 | -0.01 | 0.02 | 0.00 | 0.00 | 0.02 | 1.00 | -0.01 | 0.62 | 0.00 | 0.00 | -0.01 |
| DEBT_MDN | -0.01 | -0.01 | 0.01 | 0.02 | -0.02 | 0.00 | -0.02 | -0.05 | -0.01 | 1.00 | -0.05 | -0.02 | -0.00 | 0.97 |
| STATE_x_GRAD | 0.03 | 0.03 | -0.04 | 0.02 | -0.02 | 0.03 | -0.02 | 0.79 | 0.62 | -0.05 | 1.00 | -0.02 | 0.03 | -0.05 |
| LOG_MEDIAN_EARNINGS | 0.01 | 0.01 | -0.00 | 0.00 | 0.03 | 0.02 | 0.98 | -0.03 | 0.00 | -0.02 | -0.02 | 1.00 | 0.02 | -0.03 |
| LOG_TUITIONFEE_IN | -0.01 | -0.01 | 0.01 | 0.01 | -0.02 | 0.99 | 0.02 | 0.04 | 0.00 | -0.00 | 0.03 | 0.02 | 1.00 | -0.00 |
| LOG_DEBT_MDN | 0.00 | 0.00 | 0.02 | 0.02 | -0.02 | -0.00 | -0.03 | -0.05 | -0.01 | 0.97 | -0.05 | -0.03 | -0.00 | 1.00 |

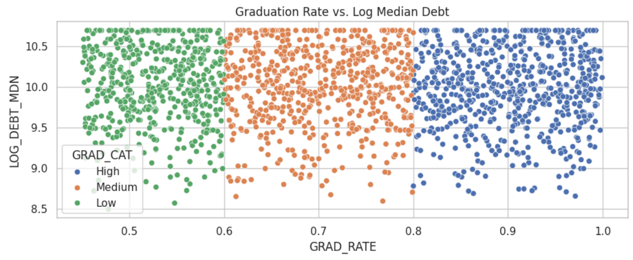

Distribution of Admission Rate
Count
ADM_RATE


Debt by Graduation Category
DEBT_MDN
GRAD_CAT
High
Medium
Low


Log Tuition Fee vs. Log Median Earnings
LOG_MEDIAN_EARNINGS
LOG_TUITIONFEE_IN
GradRate_Category
High
Medium
Low


Top 15 States by Average Graduation Rate
STABBR
GU
NV
VT
DE
MT
SD
IA
WY
RI
VI
FL
LA
WV
NM
NE


Count of Institutions by Ownership Type
count
OWNERSHIP
Private nonprofit
Private for-profit
Public


Graduation Rate vs. Log Median Debt
LOG_DEBT_MDN
GRAD_RATE
GRAD_CAT
High
Medium
Low