In [1]:
```
#PREDICTING STUDENT PERFORMANCE USING MULTIPLE REGRESSION  by k.phanindra reddy-1454
```

In [2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import StandardScaler , LabelEncoder
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error, r2_score  , mean_absolute_error
from sklearn.metrics import confusion_matrix

plt.style.use("fivethirtyeight")
```

In [3]:
```
# Data Source---https://www.kaggle.com/datasets/nikhil7280/student-performance-multiplelinear-reg
```

In [4]:
```
df=pd.read_csv(r"C:\Users\Phani\Downloads\Student_Performance.csv")
```

In [5]:
```
df
```

Out[5]:

	Hours Studied	Previous Scores	Extracurricular Activities	Sleep Hours	Sample Question Papers Practiced	Performance Index
0	7	99	Yes	9	1	91.0
1	4	82	No	4	2	65.0
2	8	51	Yes	7	2	45.0
3	5	52	Yes	5	2	36.0
4	7	75	No	8	5	66.0
...	...	...	...	...	...	...
9995	1	49	Yes	4	2	23.0
9996	7	64	Yes	8	5	58.0
9997	6	83	Yes	8	5	74.0
9998	9	97	Yes	7	0	95.0
9999	7	74	No	8	1	64.0

10000 rows × 6 columns

In [6]:
```
df.isna().sum()
```

Out[6]:
```
Hours Studied                     0
Previous Scores                   0
Extracurricular Activities        0
Sleep Hours                       0
Sample Question Papers Practiced  0
Performance Index                 0
dtype: int64
```

In [7]:
```
df.duplicated().sum()
```

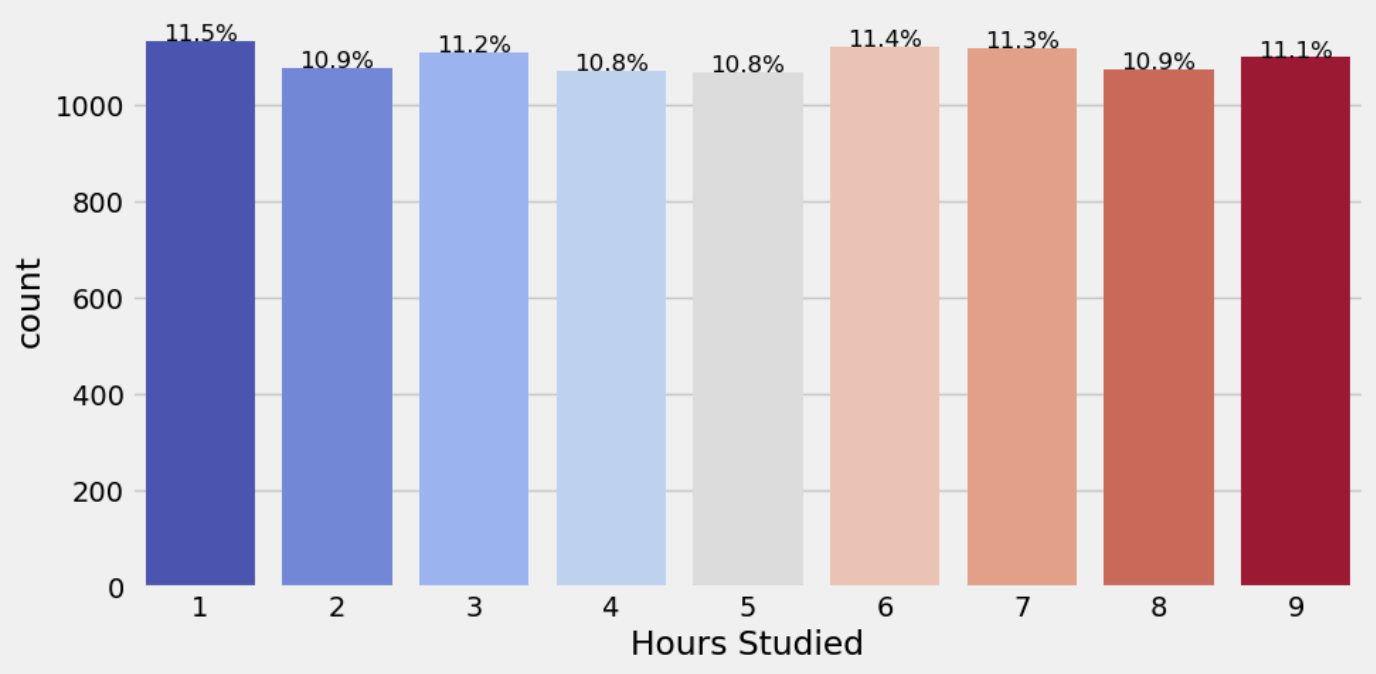
Out[7]:
```
127
```

In [8]:
```
df.drop_duplicates(inplace=True)
```

In [9]:
```
df["Hours Studied"].value_counts()
```

Out[9]:
```
Hours Studied
1    1133
6    1122
7    1118
3    1110
9    1099
2    1077
8    1074
4    1071
5    1069
Name: count, dtype: int64
```

In [10]:
```
plt.figure(figsize=(10,5))


bar_plot = sns.countplot(x="Hours Studied", data=df, hue="Hours Studied", palette="coolwarm", leg

total = len(df["Hours Studied"])

for p in bar_plot.patches:
    bar_plot.text(p.get_x() + p.get_width() / 2, p.get_height() + 0.5,
                  f'{(p.get_height() / total) * 100:.1f}%', ha='center', fontsize=12)

plt.show()
```

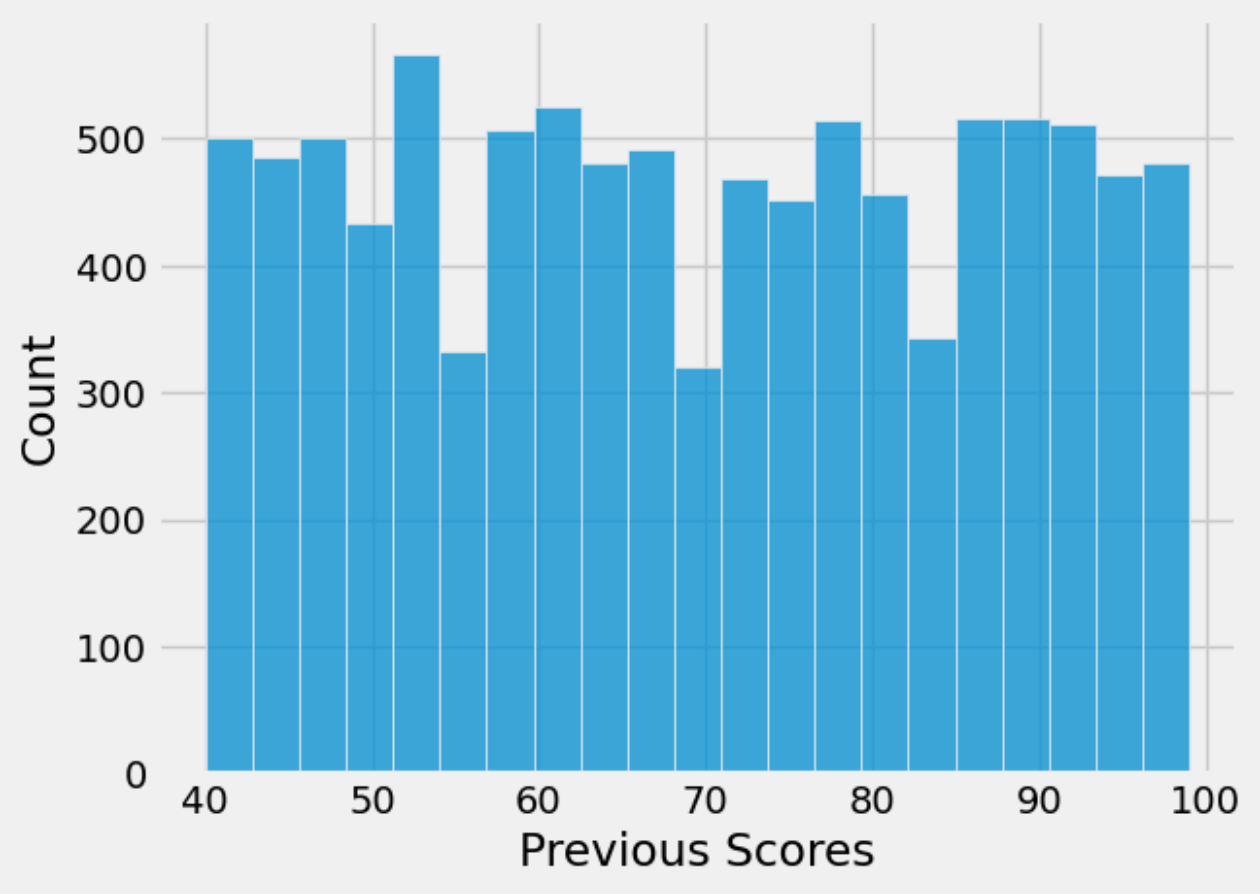


In [11]:
```
df["Previous Scores"].describe()
```

Out[11]:
```
count    9873.000000
mean       69.441102
std        17.325601
min        40.000000
25%        54.000000
50%        69.000000
75%        85.000000
max        99.000000
Name: Previous Scores, dtype: float64
```

In [12]:
```
sns.histplot(x= df["Previous Scores"])
```

Out[12]:
```
<Axes: xlabel='Previous Scores', ylabel='Count'>
```



In [13]:
```
cut_series = pd.cut(df["Previous Scores"], bins=[40, 50, 60, 70, 80, 90, 100], labels=['40-50', '
value_counts = cut_series.value_counts().sort_index()

value_counts.reset_index()
```

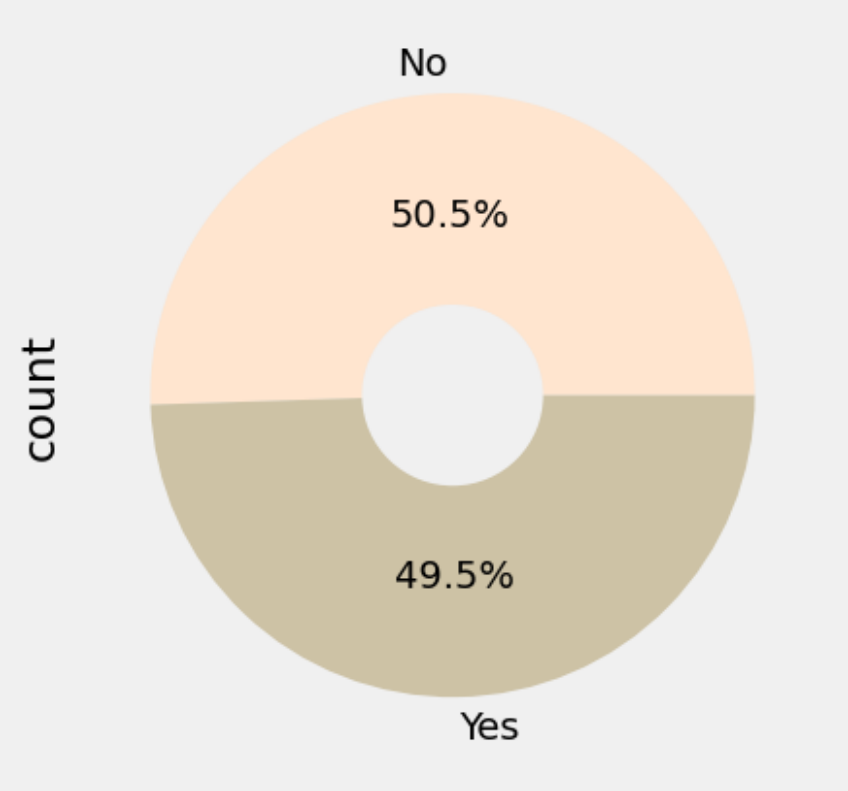
Out[13]:

	Previous Scores	count
0	40-50	1609
1	50-60	1726
2	60-70	1637
3	70-80	1587
4	80-90	1680
5	90-100	1463

In [14]:
```
df["Extracurricular Activities"].value_counts()
```

Out[14]:
```
Extracurricular Activities
No     4986
Yes    4887
Name: count, dtype: int64
```

In [15]:
```
df["Extracurricular Activities"].value_counts().plot(kind ="pie" , autopct='%1.1f%%', colors=["#F
```



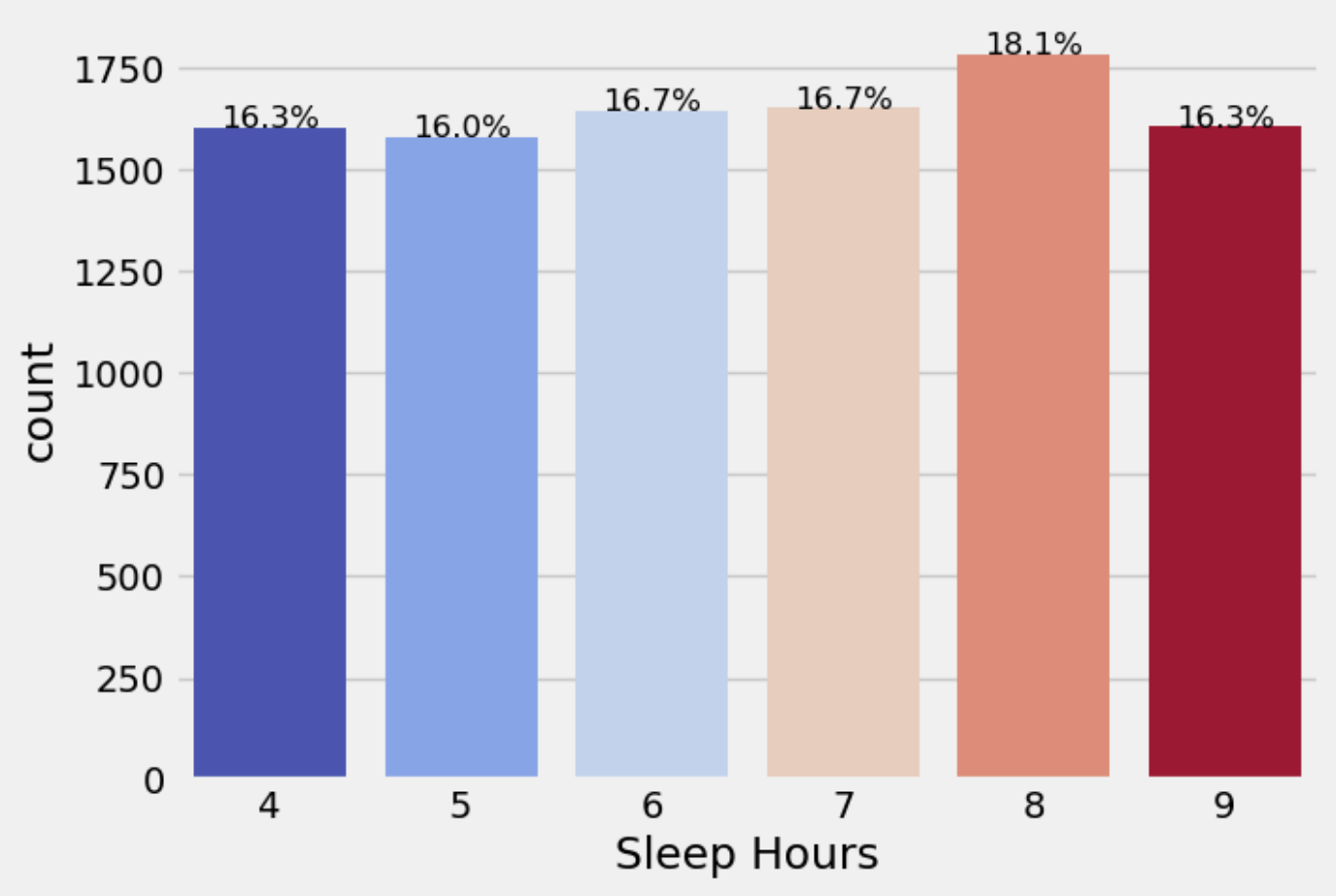
In [16]:
```
df["Sleep Hours"].describe()
```

Out[16]:
```
count    9873.000000
mean        6.531652
std         1.697683
min         4.000000
25%         5.000000
50%         7.000000
75%         8.000000
max         9.000000
Name: Sleep Hours, dtype: float64
```

In [17]:
```
df["Sleep Hours"].value_counts()
```

Out[17]:
```
Sleep Hours
8    1784
7    1653
6    1645
9    1606
4    1605
5    1580
Name: count, dtype: int64
```

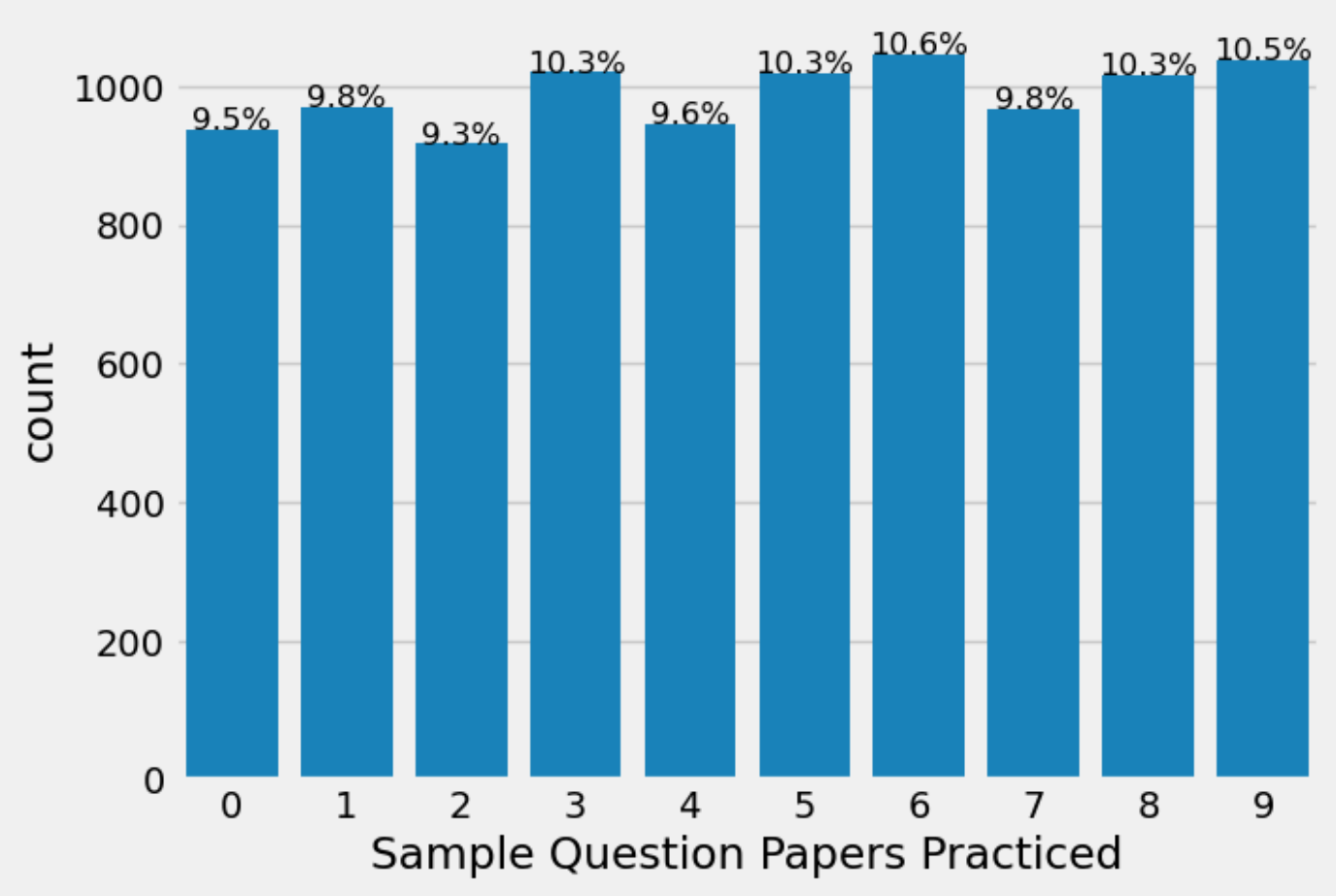
In [18]:
```
plt.figure(figsize=(7,5))


bar_plot = sns.countplot(x="Sleep Hours", data=df, hue="Sleep Hours", palette="coolwarm", legend=

total = len(df["Sleep Hours"])

for p in bar_plot.patches:
    bar_plot.text(p.get_x() + p.get_width() / 2, p.get_height() + 0.5,
                  f'{(p.get_height() / total) * 100:.1f}%', ha='center', fontsize=12)

plt.show()
```



In [19]:
```
df["Sample Question Papers Practiced"].value_counts()
```

Out[19]:
```
Sample Question Papers Practiced
6    1046
9    1038
3    1020
5    1018
8    1016
1     969
7     967
4     945
0     937
2     917
Name: count, dtype: int64
```

In [20]:
```
plt.figure(figsize=(7,5))
bar_plot = sns.countplot(x="Sample Question Papers Practiced", data=df)
total = len(df["Sample Question Papers Practiced"])

for p in bar_plot.patches:
    bar_plot.text(p.get_x() + p.get_width() / 2, p.get_height() + 0.5,
                  f'{(p.get_height() / total) * 100:.1f}%', ha='center', fontsize=12)

plt.show()
```

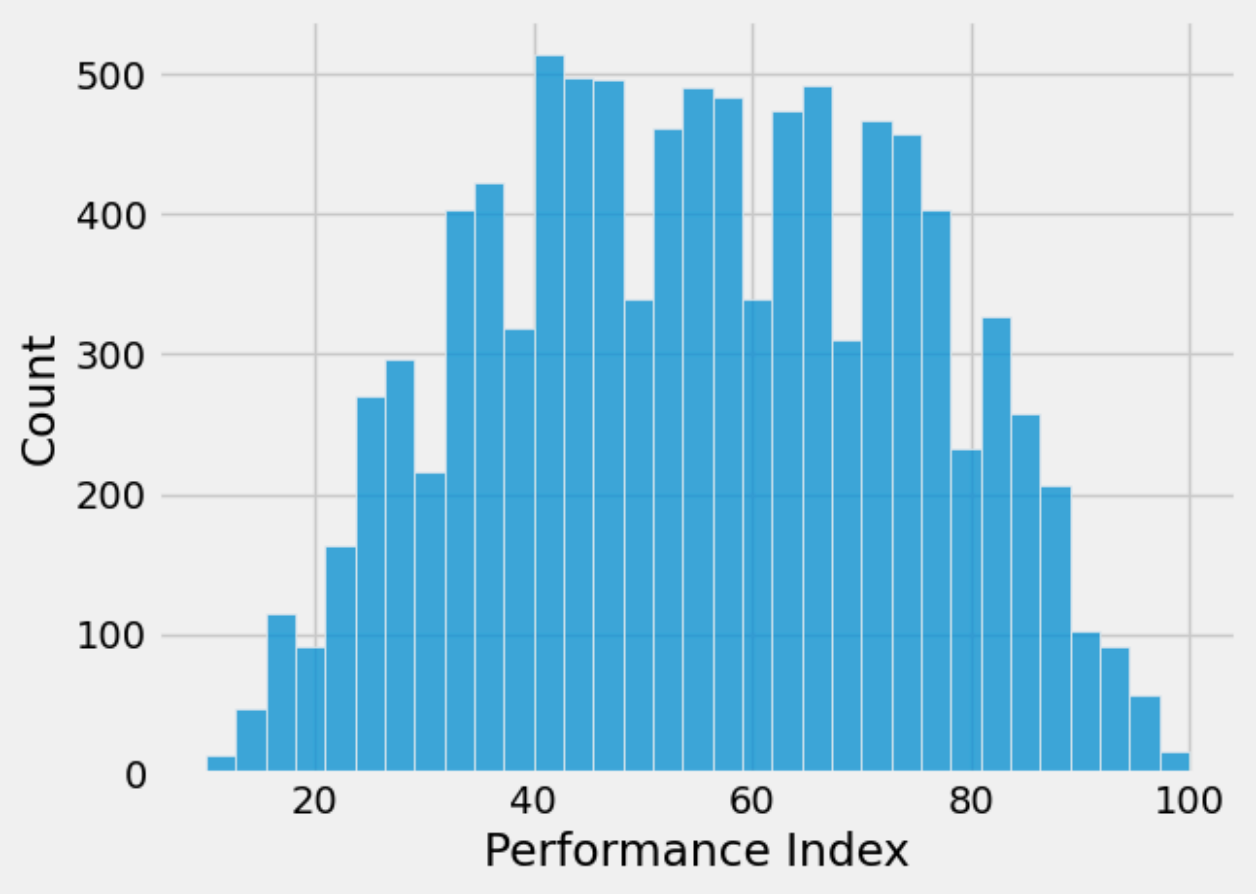


In [21]:
```
df["Performance Index"].describe()
```

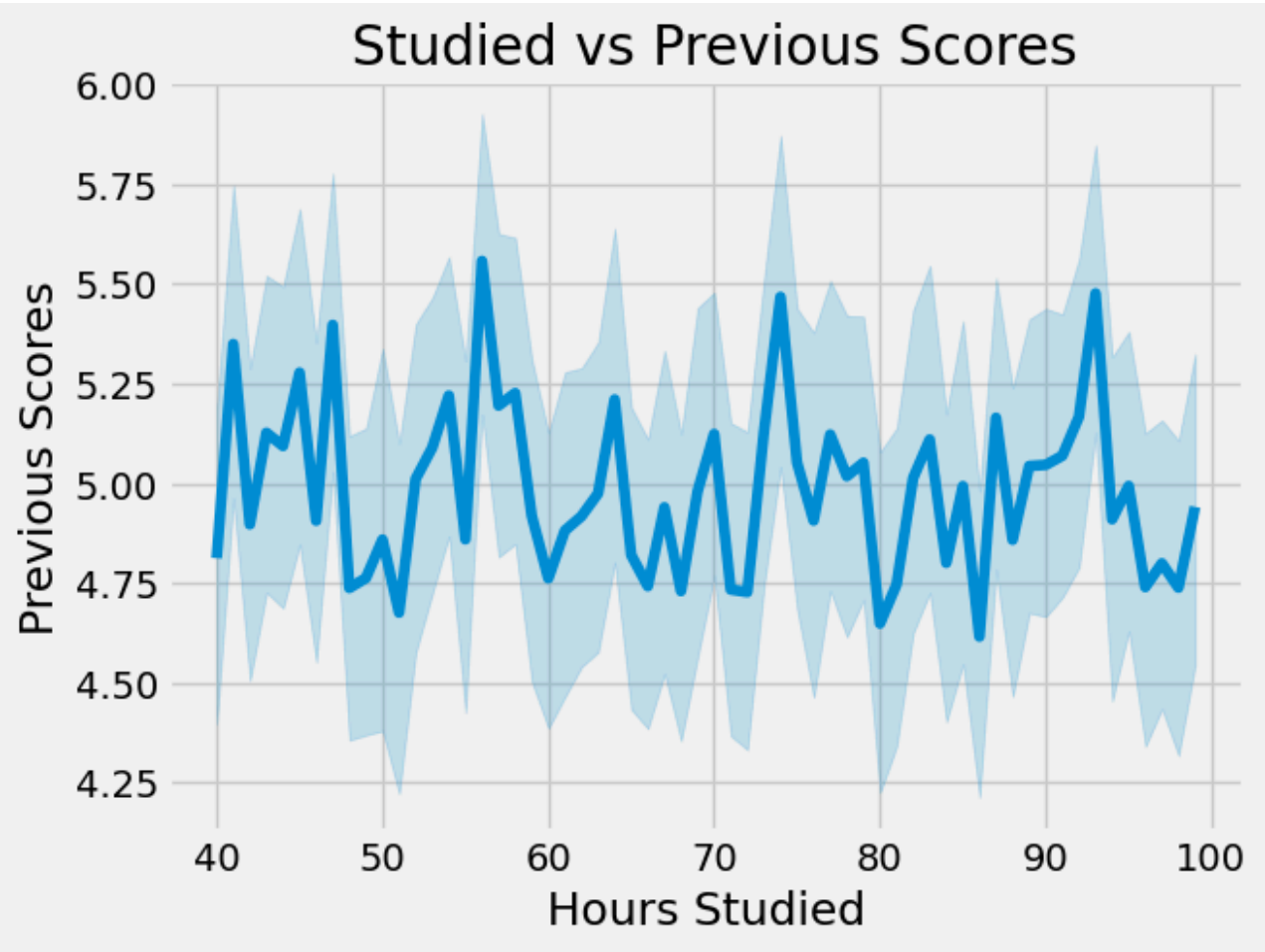
Out[21]:
```
count    9873.000000
mean       55.216651
std        19.208570
min        10.000000
25%        40.000000
50%        55.000000
75%        70.000000
max       100.000000
Name: Performance Index, dtype: float64
```

In [22]:
```
sns.histplot(x= df["Performance Index"])
```

Out[22]:
```
<Axes: xlabel='Performance Index', ylabel='Count'>
```



In [23]:
```
sns.lineplot(y=df['Hours Studied'], x=df['Previous Scores'])
plt.xlabel('Hours Studied')
plt.ylabel('Previous Scores')
plt.title(' Studied vs Previous Scores')
plt.show()
```

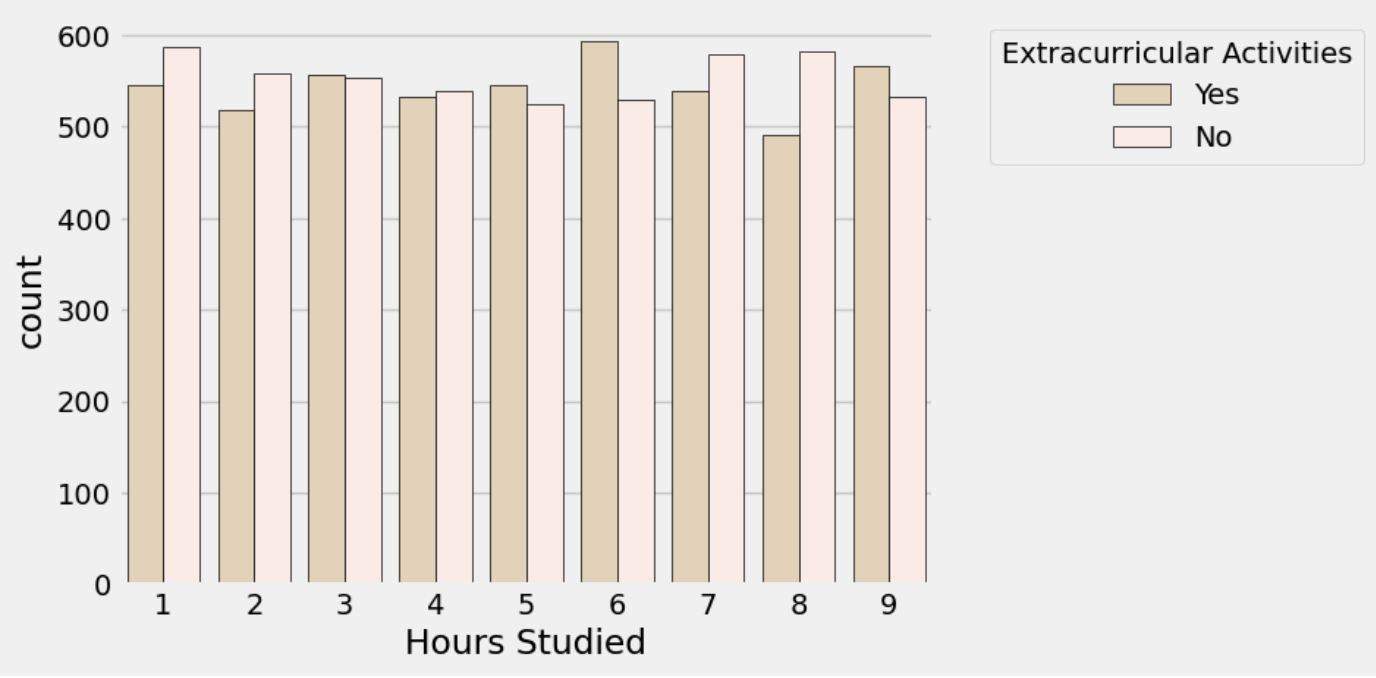


In [24]:
```
df.groupby(["Extracurricular Activities"])["Hours Studied"].value_counts().unstack()
```

Out[24]:

Hours Studied	1	2	3	4	5	6	7	8	9
Extracurricular Activities									
No	587	559	553	539	524	529	579	583	533
Yes	546	518	557	532	545	593	539	491	566

In [25]:
```
sns.countplot(data=df, hue="Extracurricular Activities", x="Hours Studied" ,  palette=["#E7D4B5"
plt.legend(title='Extracurricular Activities', bbox_to_anchor=(1.05, 1), loc='upper left')
plt.show()
```



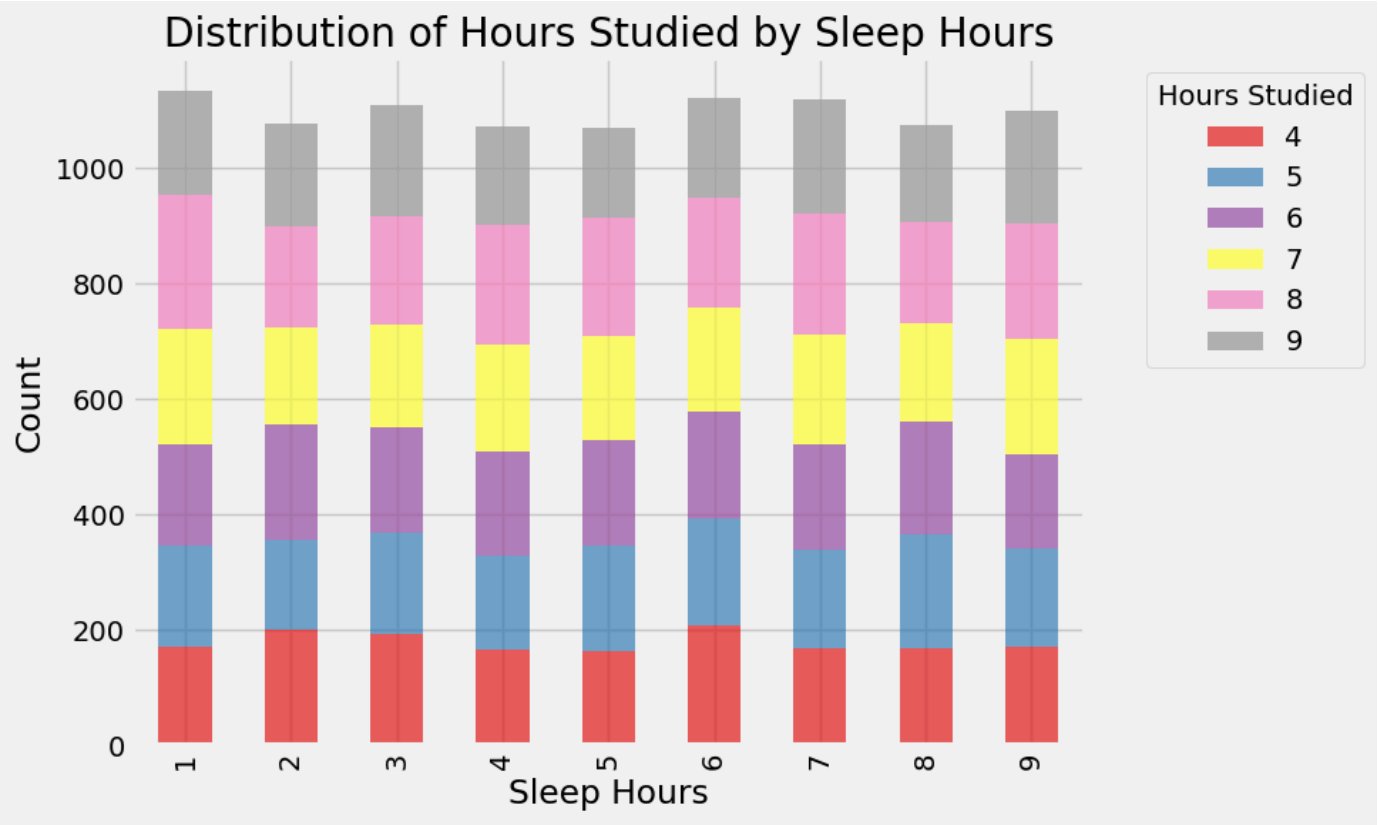
In [26]:
```
grouped_data= df.groupby("Hours Studied")["Sleep Hours"].value_counts().unstack()
grouped_data
```

Out[26]:

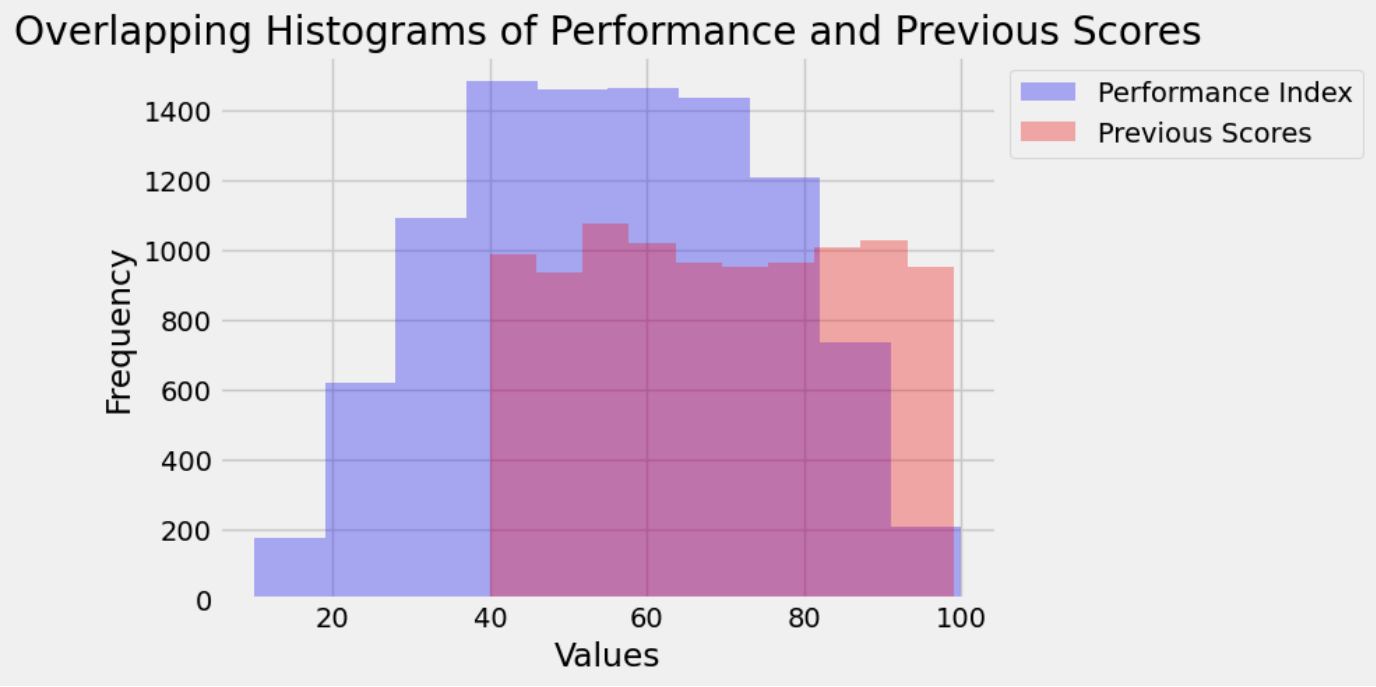
Sleep Hours	4	5	6	7	8	9
Hours Studied						
1	170	177	175	199	233	179
2	200	157	200	166	176	178
3	192	177	182	178	188	193
4	166	163	180	186	207	169
5	163	182	183	181	205	155
6	207	187	183	182	190	173
7	168	170	184	189	211	196
8	168	197	195	172	175	167
9	171	170	163	200	199	196

In [27]:
```
import pandas as pd
import matplotlib.pyplot as plt

grouped_data = df.groupby("Hours Studied")["Sleep Hours"].value_counts().unstack(fill_value=0)


plt.figure(figsize=(10, 6))
```

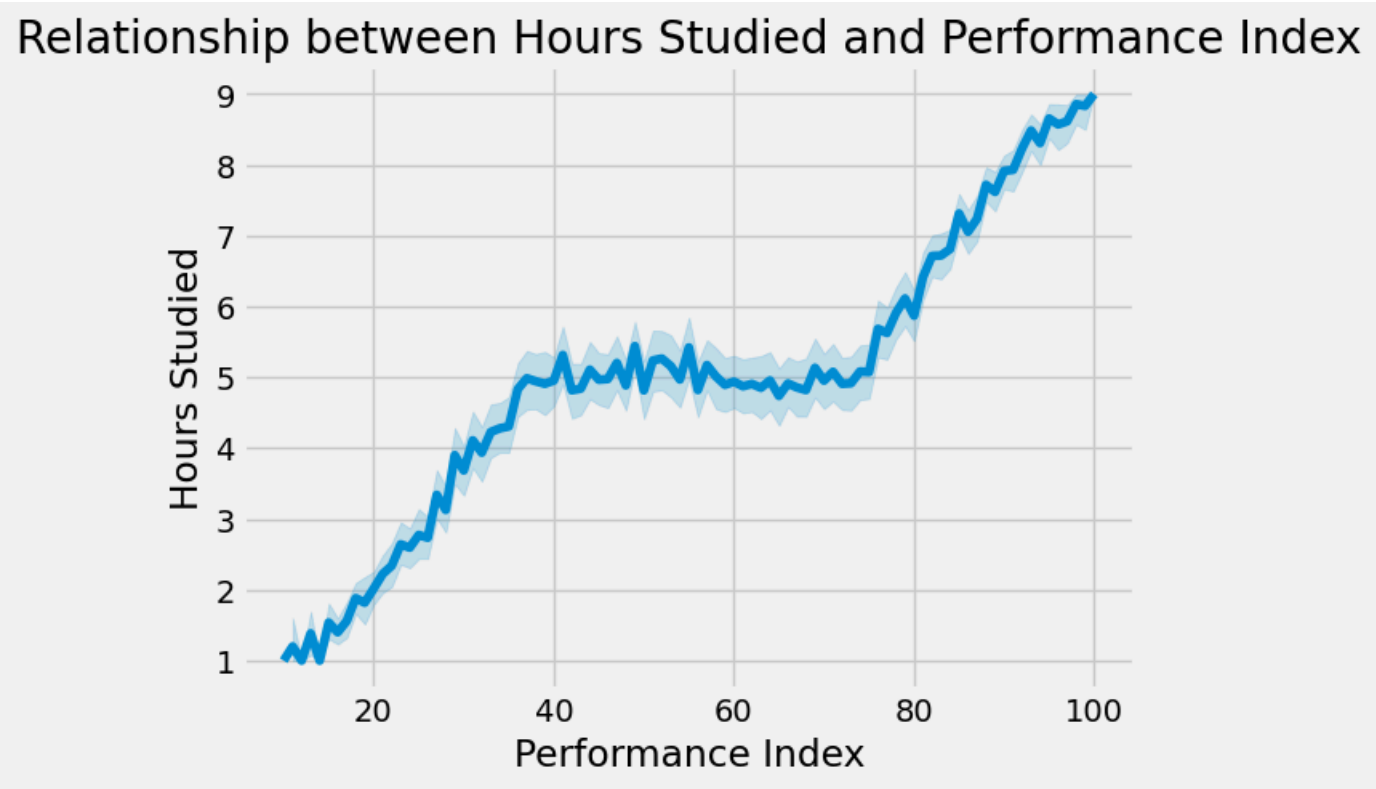
```
grouped_data.plot(kind='bar', stacked=True, ax=plt.gca(), colormap='Set1', alpha=0.7)


plt.title('Distribution of Hours Studied by Sleep Hours')
plt.xlabel('Sleep Hours')
plt.ylabel('Count')
plt.legend(title='Hours Studied', bbox_to_anchor=(1.05, 1), loc='upper left')


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



In [28]:
```
papers_practiced = df['Performance Index']
previous_scores = df['Previous Scores']

plt.hist(papers_practiced, bins=10, alpha=0.3, label='Performance Index', color='blue')
plt.hist(previous_scores, bins=10, alpha=0.3, label='Previous Scores', color='red')

plt.xlabel('Values')
plt.ylabel('Frequency')
plt.title('Overlapping Histograms of Performance and Previous Scores')
plt.legend( bbox_to_anchor=(1, 1), loc='upper left')

plt.show()
```

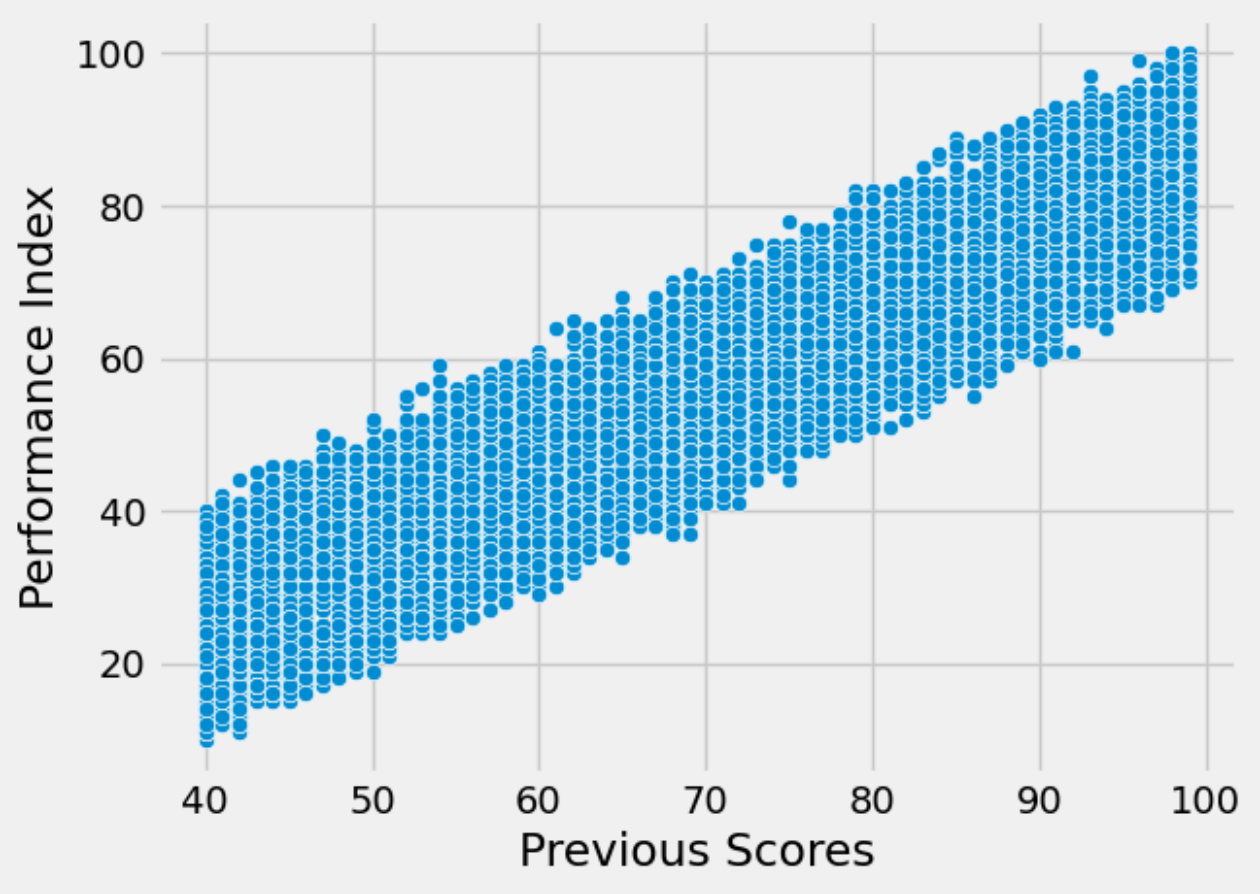


In [29]:
```
sns.lineplot(data=df, y='Hours Studied', x='Performance Index')

plt.title('Relationship between Hours Studied and Performance Index')
plt.ylabel('Hours Studied')
plt.xlabel('Performance Index')
plt.show()
```



In [30]:
```
sns.scatterplot(x='Previous Scores' , y='Performance Index', data=df)
```

Out[30]:
```
<Axes: xlabel='Previous Scores', ylabel='Performance Index'>
```



In [31]:
```
#Machine learning
label_encoder = LabelEncoder()

df['Extracurricular Activities'] = label_encoder.fit_transform(df['Extracurricular Activities'])
```

In [32]:
```
X = df.drop(columns=['Performance Index'])
y = df['Performance Index']
```

In [33]:
```
X
```

Out[33]:

	Hours Studied	Previous Scores	Extracurricular Activities	Sleep Hours	Sample Question Papers Practiced
0	7	99	1	9	1
1	4	82	0	4	2
2	8	51	1	7	2
3	5	52	1	5	2
4	7	75	0	8	5
...	...	...	...	...	...
9995	1	49	1	4	2
9996	7	64	1	8	5
9997	6	83	1	8	5
9998	9	97	1	7	0
9999	7	74	0	8	1

9873 rows × 5 columns

In [34]:
```
y
```

Out[34]:
```
0       91.0
1       65.0
2       45.0
3       36.0
4       66.0
        ...
9995    23.0
9996    58.0
9997    74.0
9998    95.0
9999    64.0
Name: Performance Index, Length: 9873, dtype: float64
```

In [35]:
```
#Model Creation and Training
```

In [36]:
```
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X.drop(["Extracurricular Activities"] ,axis=1))
scaler_y = StandardScaler()
y_scaled = scaler_y.fit_transform(y.values.reshape(-1, 1))
```

In [37]:
```
column= X[["Extracurricular Activities"]]
X_combined = np.hstack((X_scaled, column.values))
```

In [38]:
```
X_train, X_test, y_train, y_test = train_test_split(X_combined, y_scaled, test_size=0.2, random_s
```

In [39]:
```
model = LinearRegression()
model.fit(X_train, y_train)
```

Out[39]:
```
LinearRegression()
```

In [40]:
```
y_train_pred = model.predict(X_train)
y_pred = model.predict(X_test)
```

In [41]:
```
r2 = r2_score(y_test, y_pred)
print(f"R² Score: {r2}")
```

```
R² Score: 0.9884301209927054
```

In [42]:
```
mse = mean_squared_error(y_test, y_pred)
mae = mean_absolute_error(y_test, y_pred)
print(f"Mean Absolute Error (MAE): {mae}")
print(f"Mean Squared Error(MSE): {mse}")
```

```
Mean Absolute Error (MAE): 0.08574577950768571
Mean Squared Error(MSE): 0.011671265615520255
```

In [43]:
```
rmse = np.sqrt(mse)
print(f"Root Mean Squared Error (RMSE): {rmse}")
```

```
Root Mean Squared Error (RMSE): 0.10803363187230287
```

In [45]:
```
input_data = np.array([[7, 99, 0, 9, 1]])

y_pred = model.predict(input_data)

print("Predicted Performance Index:", y_pred[0])
```

```
Predicted Performance Index: [93.89895519]
```