DA Case Study using Pandas and Matplotlib

Dataset: class_marks.csv

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```
import pandas as pd
import matplotlib.pyplot as plt

data = pd.read_csv('class_marks.csv')

print("Dataset Preview:")
print(data.head())

print("\nDataset Info:")
print(data.info())
```

```
Dataset Preview:
   Total  Q1aM4  Q1bM6  Q2aM6  Q2bM4  Q3aM5  Q3bM5  Q4aM3  Q4bM7
Q5M10  \
0     37    4.0    5.0    6.0    4.0    2.0    1.0    NaN    5.0
8.0
1     32    4.0    3.0    4.0    3.0    NaN    NaN    3.0    6.0
9.0
2     33    4.0    5.0    5.0    1.0    5.0    5.0    NaN    NaN
8.0
3     24    4.0    6.0    6.0    3.0    2.0    2.0    NaN    NaN
NaN
4     36    3.0    6.0    4.0    4.0    5.0    4.0    NaN    NaN
10.0

   Q6aM4  Q6bM6
0    4.0    6.0
1    NaN    NaN
2    NaN    NaN
3    2.0    NaN
4    NaN    NaN

Dataset Info:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 86 entries, 0 to 85
Data columns (total 12 columns):
```

```
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   Total   86 non-null     int64
 1   Q1aM4   85 non-null     float64
 2   Q1bM6   73 non-null     float64
 3   Q2aM6   72 non-null     float64
 4   Q2bM4   75 non-null     float64
 5   Q3aM5   52 non-null     float64
 6   Q3bM5   51 non-null     float64
 7   Q4aM3   32 non-null     float64
 8   Q4bM7   26 non-null     float64
 9   Q5M10   56 non-null     float64
 10  Q6aM4   33 non-null     float64
 11  Q6bM6   28 non-null     float64
dtypes: float64(11), int64(1)
memory usage: 8.2 KB
None
```

This kernel imports necessary libraries, loads the dataset from a CSV file, and then displays a preview and summary information of the dataset.

```
print("Basic Statistical Overview:")
print(data.describe())
```

```
Basic Statistical Overview:
           Total      Q1aM4      Q1bM6      Q2aM6     Q2bM4      Q3aM5
\
count  86.000000  85.000000  73.000000  72.000000  75.00000  52.000000

mean   29.360465   3.141176   4.972603   5.291667   3.20000   4.173077

std     7.839437   1.013633   1.246914   1.155970   1.03975   1.294349

min     3.000000   0.000000   2.000000   1.000000   1.00000   1.000000

25%    25.000000   2.000000   4.000000   5.000000   2.00000   3.750000

50%    31.000000   4.000000   5.000000   6.000000   4.00000   5.000000

75%    36.000000   4.000000   6.000000   6.000000   4.00000   5.000000

max    40.000000   4.000000   6.000000   6.000000   4.00000   5.000000
```

```
            Q3bM5       Q4aM3       Q4bM7       Q5M10       Q6aM4
Q6bM6
count  51.000000  32.000000  26.000000  56.000000  33.000000
28.000000
mean    4.098039   2.468750   4.884615   8.000000   3.484848
4.964286
std     1.345435   0.761339   2.196851   1.705606   0.972150
1.502643
min     1.000000   1.000000   1.000000   4.000000   1.000000
1.000000
25%     3.000000   2.000000   3.000000   7.000000   3.000000
4.000000
50%     5.000000   3.000000   5.500000   8.000000   4.000000
6.000000
75%     5.000000   3.000000   7.000000  10.000000   4.000000
6.000000
max     5.000000   3.000000   7.000000  10.000000   4.000000
6.000000
```

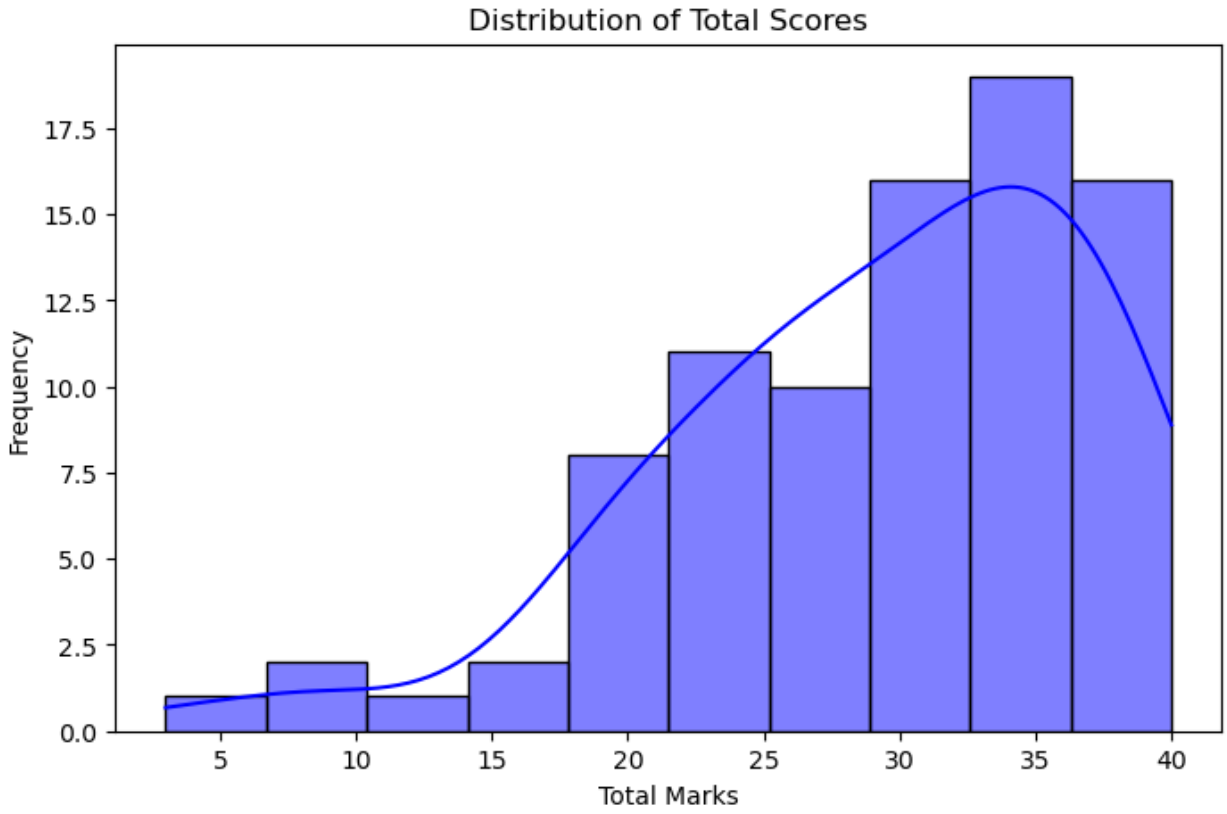
This kernel computes and displays basic statistical summary (e.g., mean, median, standard deviation) for the dataset's numerical columns.

```
average_score = data['Total'].mean()
max_score = data['Total'].max()
min_score = data['Total'].min()

print(f"Average Total Score: {average_score}")
print(f"Maximum Total Score: {max_score}")
print(f"Minimum Total Score: {min_score}")
```

```
Average Total Score: 29.36046511627907
Maximum Total Score: 40
Minimum Total Score: 3
```

This kernel calculates and prints the average, maximum, and minimum values of the "Total" score column in the dataset.

```
plt.figure(figsize=(8, 5))
sns.histplot(data['Total'], kde=True, bins=10, color='blue')
plt.title('Distribution of Total Scores')
plt.xlabel('Total Marks')
plt.ylabel('Frequency')
plt.show()
```



This kernel visualizes the distribution of total scores using a histogram with KDE (Kernel Density Estimation).

```
threshold = 35
top_performers = data[data['Total'] > threshold]
```

```
print(f"Number of Top Performers (Total > {threshold}):
{len(top_performers)}")
print(top_performers)
```

```
Number of Top Performers (Total > 35): 23
    Total  Q1aM4  Q1bM6  Q2aM6  Q2bM4  Q3aM5  Q3bM5  Q4aM3  Q4bM7
Q5M10  \
0      37    4.0    5.0    6.0    4.0    2.0    1.0    NaN    5.0
8.0
4      36    3.0    6.0    4.0    4.0    5.0    4.0    NaN    NaN
10.0
10     37    3.0    5.0    6.0    4.0    NaN    NaN    3.0    6.0
NaN
17     36    3.0    4.0    6.0    4.0    NaN    NaN    NaN    NaN
9.0
26     39    4.0    6.0    6.0    3.0    4.0    NaN    NaN    NaN
NaN
28     38    2.0    6.0    6.0    4.0    5.0    5.0    NaN    NaN
10.0
33     40    NaN    NaN    6.0    4.0    5.0    5.0    3.0    7.0
NaN
36     37    2.0    NaN    6.0    4.0    5.0    5.0    NaN    NaN
10.0
42     38    4.0    6.0    6.0    4.0    5.0    5.0    3.0    5.0
NaN
44     36    3.0    6.0    6.0    2.0    NaN    NaN    2.0    7.0
10.0
46     36    4.0    5.0    6.0    4.0    5.0    5.0    NaN    NaN
7.0
47     38    2.0    6.0    6.0    4.0    5.0    5.0    3.0    7.0
10.0
49     39    3.0    6.0    6.0    4.0    5.0    5.0    NaN    NaN
10.0
51     40    0.0    NaN    6.0    4.0    NaN    NaN    3.0    7.0
10.0
53     40    4.0    6.0    6.0    4.0    5.0    5.0    NaN    NaN
10.0
55     38    3.0    5.0    6.0    4.0    NaN    NaN    NaN    NaN
10.0
59     38    2.0    6.0    6.0    4.0    5.0    5.0    NaN    NaN
10.0
62     36    3.0    4.0    6.0    4.0    5.0    5.0    NaN    NaN
7.0
64     36    1.0    6.0    6.0    4.0    5.0    5.0    NaN    NaN
9.0
65     40    4.0    6.0    6.0    4.0    5.0    5.0    NaN    NaN
10.0
71     36    4.0    5.0    6.0    4.0    5.0    5.0    NaN    NaN
7.0
73     40    4.0    6.0    NaN    NaN    5.0    5.0    3.0    NaN
```

```
10.0
83     37    4.0    6.0    6.0    2.0    NaN    NaN    NaN    NaN
9.0
```

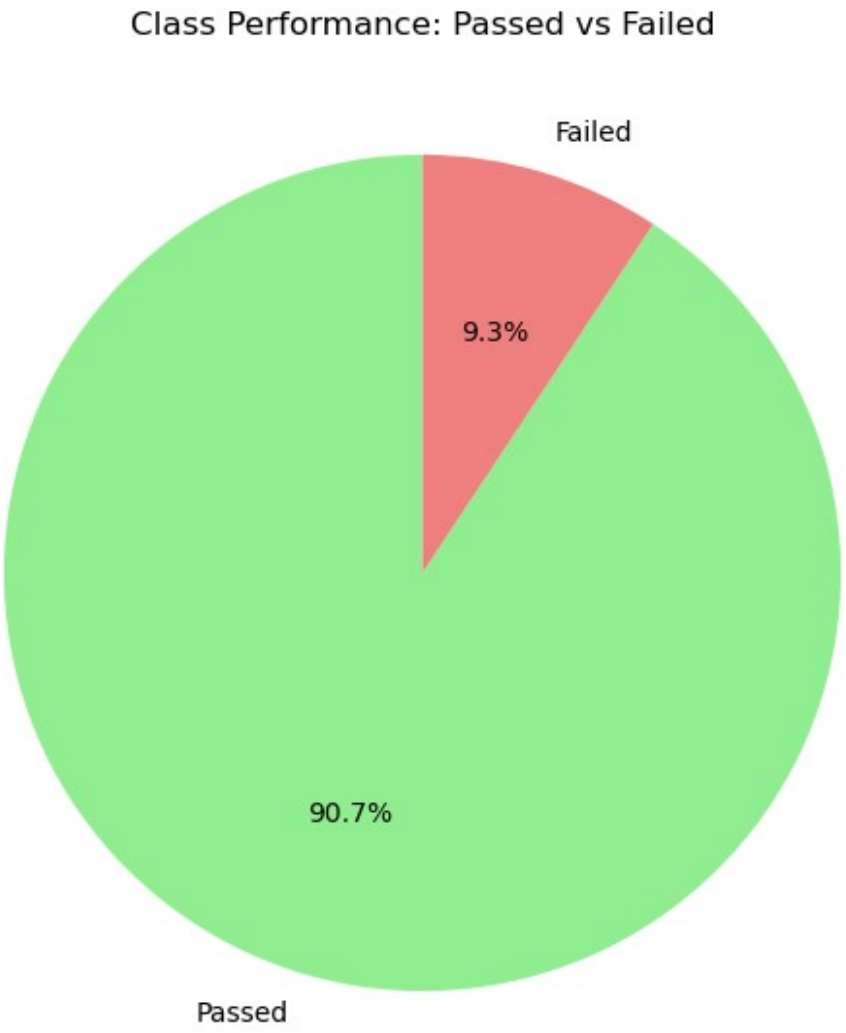
	Q6aM4	Q6bM6
0	4.0	6.0
4	NaN	NaN
10	4.0	6.0
17	4.0	6.0
26	4.0	6.0
28	NaN	NaN
33	4.0	6.0
36	4.0	5.0
42	NaN	NaN
44	NaN	NaN
46	NaN	NaN
47	NaN	NaN
49	NaN	NaN
51	NaN	NaN
53	NaN	NaN
55	4.0	6.0
59	4.0	6.0
62	NaN	NaN
64	NaN	NaN
65	NaN	NaN
71	NaN	NaN
73	4.0	6.0
83	4.0	6.0

This kernel identifies and displays the students whose total scores are above a specified threshold (35), and prints the number of top performers.

```
pass_threshold = 20
passed_students = data[data['Total'] >= pass_threshold]
pass_percentage = (len(passed_students) / len(data)) * 100

print(f"Pass Percentage: {pass_percentage:.2f}%")

data['Passed'] = data['Total'] >= 20

pass_fail_counts = data['Passed'].value_counts()
labels = ['Passed', 'Failed']
colors = ['lightgreen', 'lightcoral']
```

```
plt.figure(figsize=(7, 7))
plt.pie(pass_fail_counts, labels=labels, autopct='%1.1f%%',
colors=colors, startangle=90)
plt.title('Class Performance: Passed vs Failed')
plt.show()
```

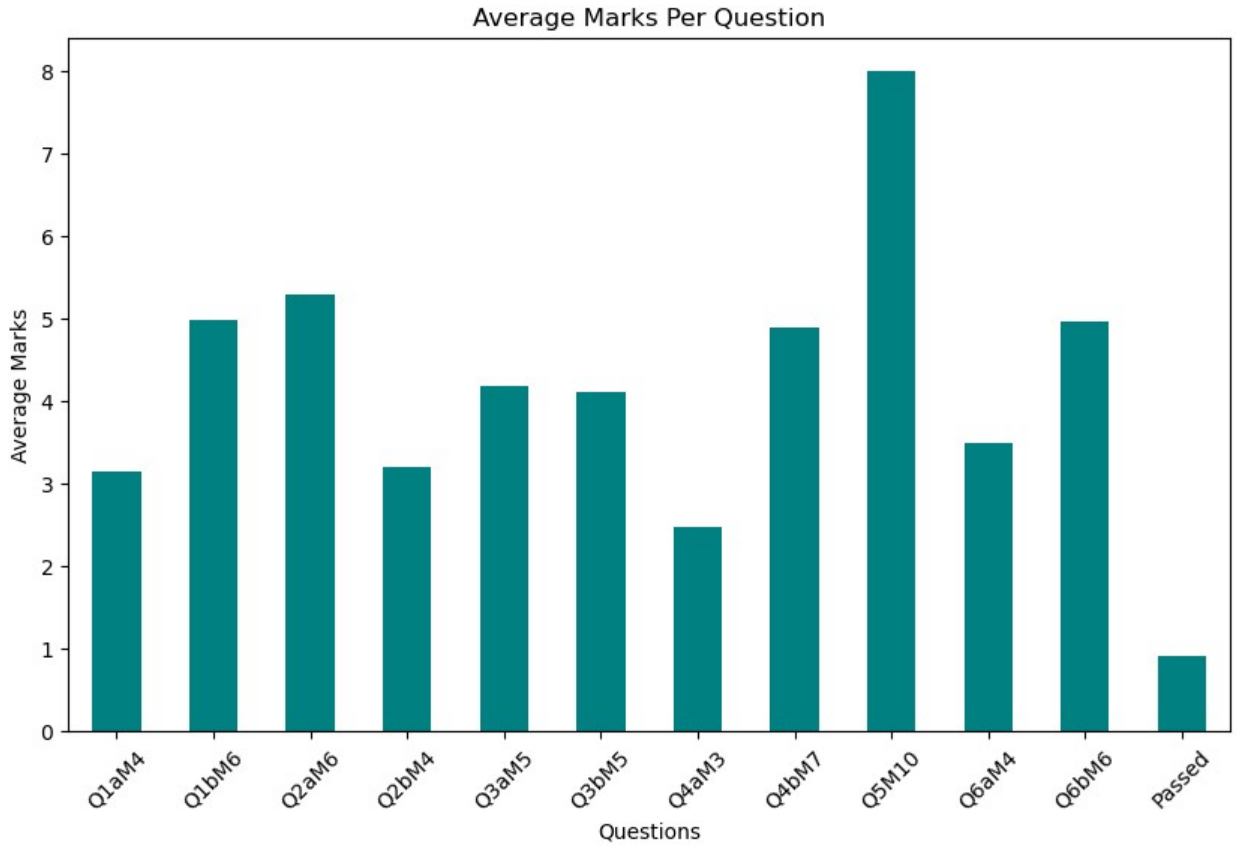
```
Pass Percentage: 90.70%
```



This kernel calculates the pass percentage based on a threshold and creates a new "Passed" column, followed by visualizing the pass/fail distribution using a pie chart.

```
question_columns = [col for col in data.columns if col != 'Total']
average_marks_per_question = data[question_columns].mean()

print("Average Marks Per Question:")
print(average_marks_per_question)

plt.figure(figsize=(10, 6))
average_marks_per_question.plot(kind='bar', color='teal')
plt.title('Average Marks Per Question')
plt.xlabel('Questions')
plt.ylabel('Average Marks')
plt.xticks(rotation=45)
plt.show()
```

```
Average Marks Per Question:
Q1aM4     3.141176
Q1bM6     4.972603
Q2aM6     5.291667
Q2bM4     3.200000
Q3aM5     4.173077
Q3bM5     4.098039
Q4aM3     2.468750
Q4bM7     4.884615
Q5M10     8.000000
Q6aM4     3.484848
Q6bM6     4.964286
Passed    0.906977
dtype: float64
```



This kernel calculates and displays the average marks for each question, then visualizes the averages using a bar chart.

```
challenging_questions =
average_marks_per_question[average_marks_per_question <
average_marks_per_question.mean()]
print("Challenging Questions (Below Average):")
print(challenging_questions)
```

```
Challenging Questions (Below Average):
Q1aM4     3.141176
Q2bM4     3.200000
Q3bM5     4.098039
Q4aM3     2.468750
Q6aM4     3.484848
Passed    0.906977
dtype: float64
```

This kernel identifies and displays the questions with average scores below the overall average, indicating the most challenging questions.

```
top_5_students = data.nlargest(5, 'Total')
print("Top 5 Students:")
print(top_5_students)

bottom_5_students = data.nsmallest(5, 'Total')
print("\nBottom 5 Students:")
print(bottom_5_students)
```

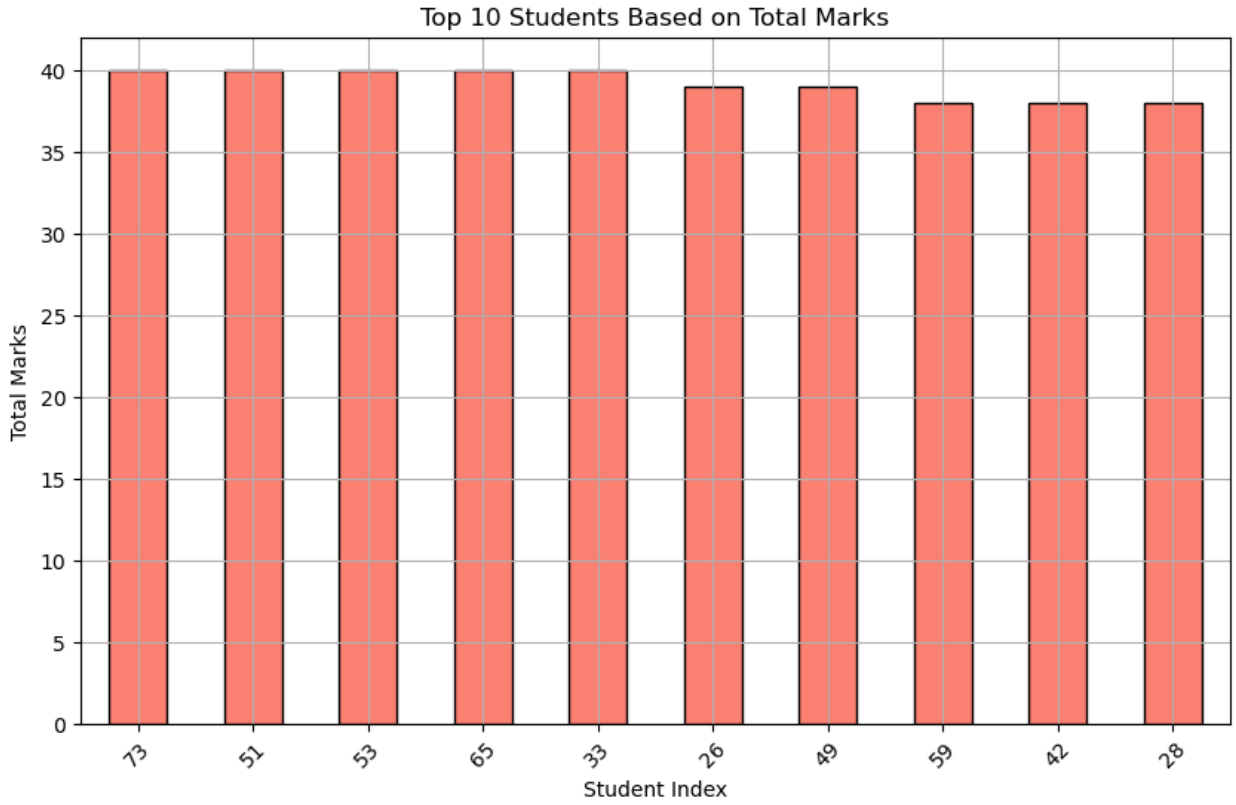
```
Top 5 Students:
    Total  Q1aM4  Q1bM6  Q2aM6  Q2bM4  Q3aM5  Q3bM5  Q4aM3  Q4bM7
Q5M10  \
33     40    NaN    NaN    6.0    4.0    5.0    5.0    3.0    7.0
NaN
51     40    0.0    NaN    6.0    4.0    NaN    NaN    3.0    7.0
10.0
53     40    4.0    6.0    6.0    4.0    5.0    5.0    NaN    NaN
10.0
65     40    4.0    6.0    6.0    4.0    5.0    5.0    NaN    NaN
10.0
73     40    4.0    6.0    NaN    NaN    5.0    5.0    3.0    NaN
10.0

    Q6aM4  Q6bM6  Passed
33    4.0    6.0    True
51    NaN    NaN    True
53    NaN    NaN    True
65    NaN    NaN    True
73    4.0    6.0    True

Bottom 5 Students:
    Total  Q1aM4  Q1bM6  Q2aM6  Q2bM4  Q3aM5  Q3bM5  Q4aM3  Q4bM7
Q5M10  \
69      3    1.0    NaN    1.0    NaN    NaN    NaN    1.0    NaN
NaN
11      8    2.0    2.0    NaN    3.0    1.0    NaN    NaN    NaN
NaN
23      9    4.0    3.0    NaN    NaN    NaN    NaN    NaN    NaN
NaN
22     14    4.0    4.0    5.0    2.0    NaN    NaN    NaN    NaN
NaN
57     17    3.0    NaN    NaN    4.0    NaN    NaN    3.0    7.0
NaN

    Q6aM4  Q6bM6  Passed
```

```
69    NaN    NaN   False
11    NaN    NaN   False
23    1.0    1.0   False
22    NaN    NaN   False
57    4.0    NaN   False
```

This kernel displays the top 5 and bottom 5 students based on their total marks in the dataset.

```
top_students = data['Total'].sort_values(ascending=False).head(10)

print(top_students)
plt.figure(figsize=(10, 6))
top_students.plot(kind='bar', color='salmon', edgecolor='black')
plt.title('Top 10 Students Based on Total Marks')
plt.xlabel('Student Index')
plt.ylabel('Total Marks')
plt.xticks(rotation=45)
plt.grid(True)
plt.show()
```

```
73    40
51    40
53    40
65    40
33    40
26    39
49    39
59    38
42    38
28    38
Name: Total, dtype: int64
```

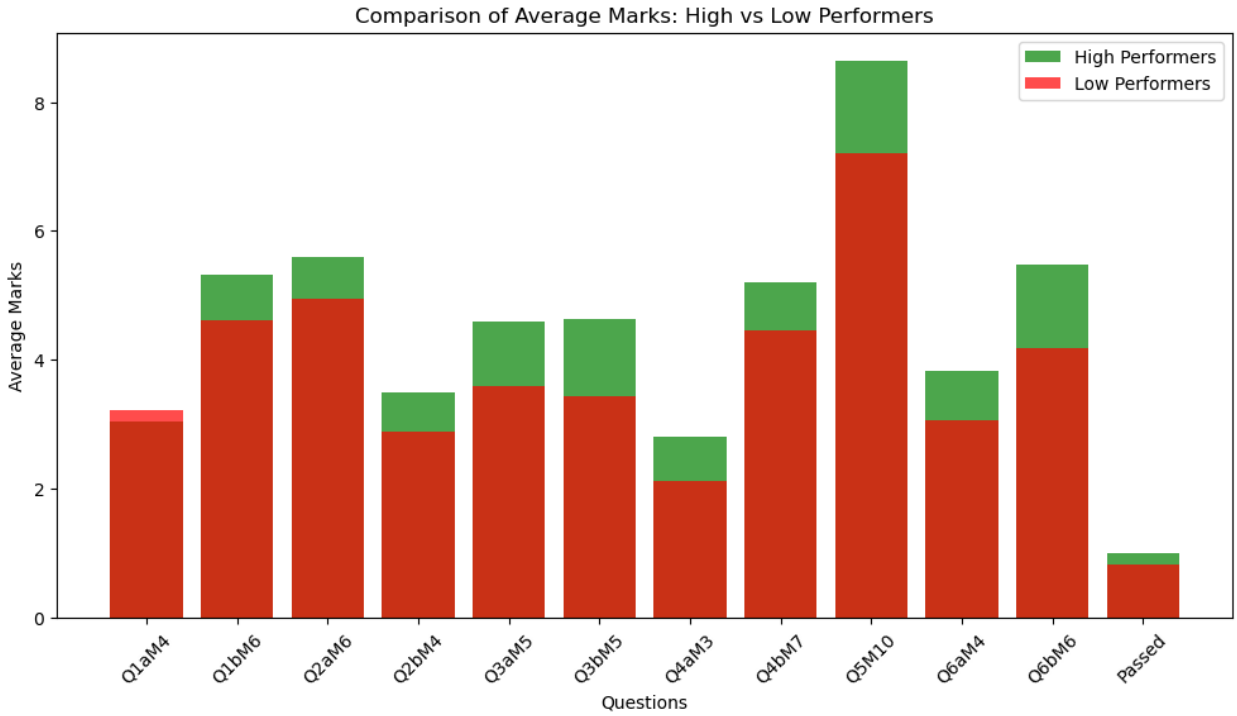


This kernel displays the top 10 students based on their total marks and visualizes the results using a bar chart.

```
median_score = data['Total'].median()
high_performers = data[data['Total'] > median_score]
low_performers = data[data['Total'] <= median_score]

high_avg = high_performers[question_columns].mean()
low_avg = low_performers[question_columns].mean()

print("Average Marks of High Performers:")
print(high_avg)
print("\nAverage Marks of Low Performers:")
print(low_avg)

plt.figure(figsize=(12, 6))
plt.bar(high_avg.index, high_avg.values, alpha=0.7, label='High
Performers', color='green')
plt.bar(low_avg.index, low_avg.values, alpha=0.7, label='Low
Performers', color='red')
```

```
plt.title('Comparison of Average Marks: High vs Low Performers')
plt.xlabel('Questions')
plt.ylabel('Average Marks')
plt.legend()
plt.xticks(rotation=45)
plt.show()
```

```
Average Marks of High Performers:
Q1aM4     3.050000
Q1bM6     5.324324
Q2aM6     5.605263
Q2bM4     3.500000
Q3aM5     4.600000
Q3bM5     4.642857
Q4aM3     2.812500
Q4bM7     5.200000
Q5M10     8.645161
Q6aM4     3.833333
Q6bM6     5.470588
Passed    1.000000
dtype: float64

Average Marks of Low Performers:
Q1aM4     3.222222
Q1bM6     4.611111
Q2aM6     4.941176
Q2bM4     2.891892
Q3aM5     3.590909
Q3bM5     3.434783
Q4aM3     2.125000
Q4bM7     4.454545
Q5M10     7.200000
Q6aM4     3.066667
Q6bM6     4.181818
Passed    0.822222
dtype: float64
```



This kernel divides students into high and low performers based on the median total marks, calculates the average marks for each group, and visualizes the comparison using a bar chart.

```
max_marks_per_question = {
    'Q1aM4': 4,
    'Q1bM6': 6,
    'Q2aM6': 6,
    'Q2bM4': 4,
    'Q3aM5': 5,
    'Q3bM5': 5,
    'Q4aM3': 3,
    'Q4bM7': 7,
    'Q5M10': 10,
    'Q6aM4': 4,
    'Q6bM6': 6
}

difficulty_threshold = 0.7
difficult_questions = []

for question, max_marks in max_marks_per_question.items():
```

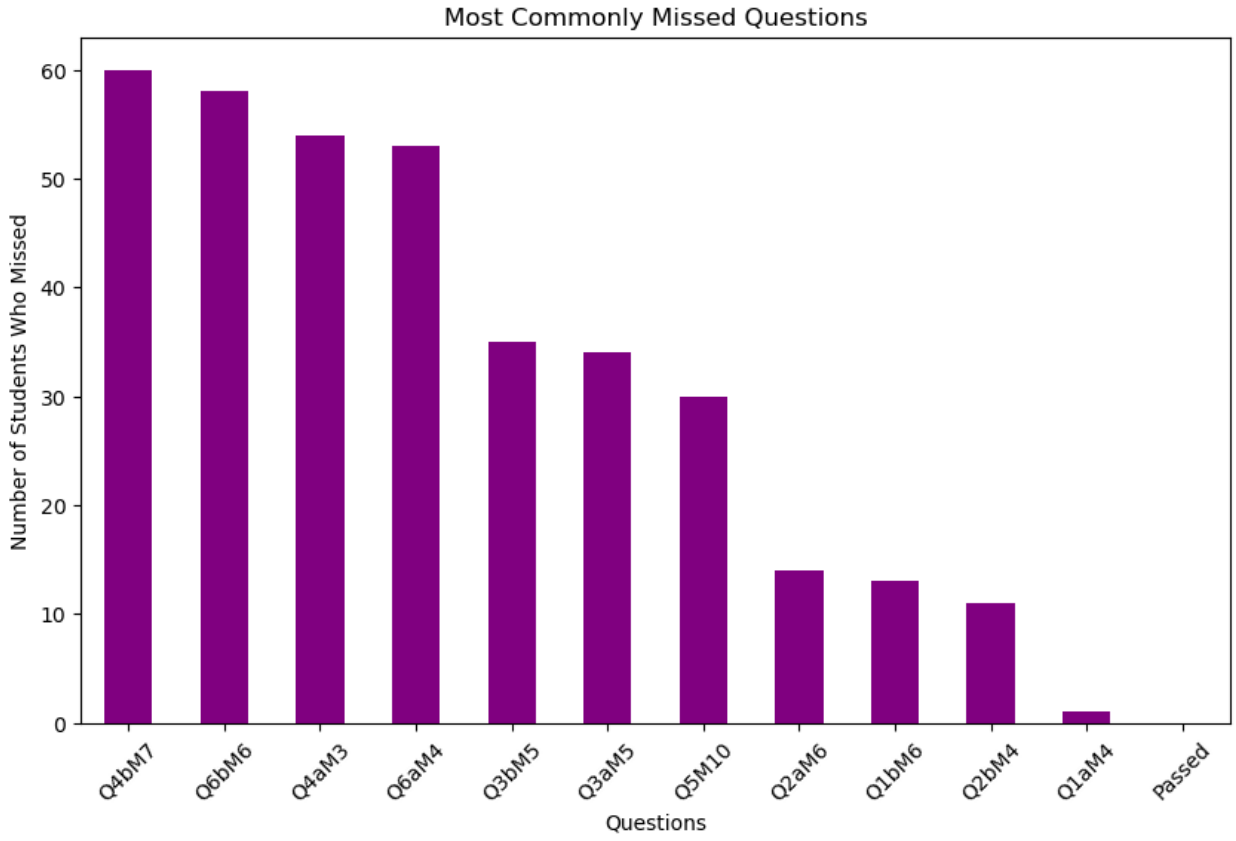
```
    avg_marks = data[question].mean()
    if avg_marks / max_marks < difficulty_threshold:
        difficult_questions.append((question, avg_marks, max_marks))

print("Difficult Questions (Average Marks < 70% of Max):")
for q in difficult_questions:
    print(f"Question: {q[0]}, Average Marks: {q[1]:.2f}, Max Marks:
{q[2]}")
```

```
Difficult Questions (Average Marks < 70% of Max):
Question: Q4bM7, Average Marks: 4.88, Max Marks: 7
```

This kernel identifies and prints the questions where the average marks are less than 70% of the maximum possible marks, labeling them as "difficult" questions.

```
missed_counts = data[question_columns].isnull().sum()

most_missed = missed_counts.sort_values(ascending=False)
print("Most Commonly Missed Questions:")
print(most_missed)

plt.figure(figsize=(10, 6))
most_missed.plot(kind='bar', color='purple')
plt.title('Most Commonly Missed Questions')
plt.xlabel('Questions')
plt.ylabel('Number of Students Who Missed')
plt.xticks(rotation=45)
plt.show()
```

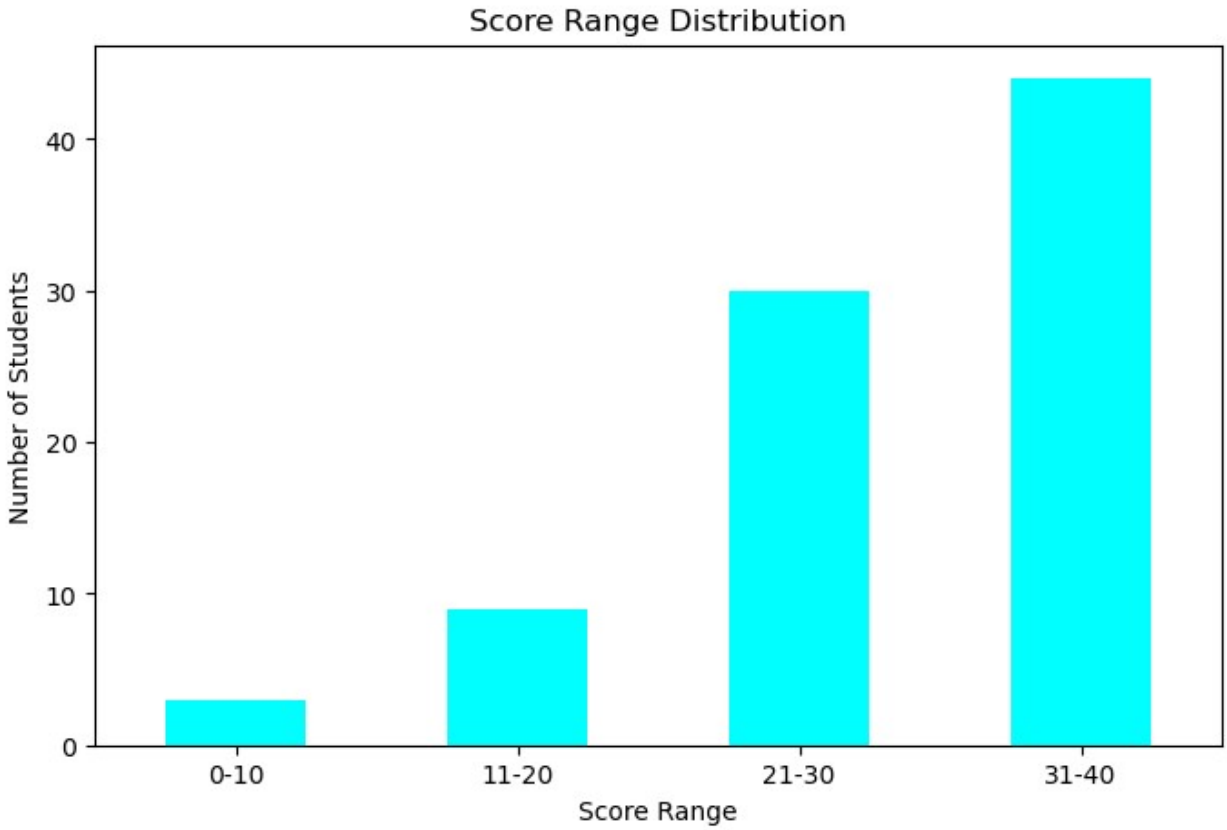
```
Most Commonly Missed Questions:
Q4bM7     60
Q6bM6     58
Q4aM3     54
Q6aM4     53
Q3bM5     35
Q3aM5     34
Q5M10     30
Q2aM6     14
Q1bM6     13
Q2bM4     11
Q1aM4      1
Passed     0
dtype: int64
```



This kernel counts and displays the number of students who missed each question, then visualizes the most commonly missed questions using a bar chart.

```
bins = [0, 10, 20, 30, 40]
labels = ['0-10', '11-20', '21-30', '31-40']

data['Score_Range'] = pd.cut(data['Total'], bins=bins, labels=labels,
include_lowest=True)

score_range_counts = data['Score_Range'].value_counts()

print("Number of Students in Each Score Range:")
print(score_range_counts)

plt.figure(figsize=(8, 5))
score_range_counts.sort_index().plot(kind='bar', color='cyan')
plt.title('Score Range Distribution')
plt.xlabel('Score Range')
```

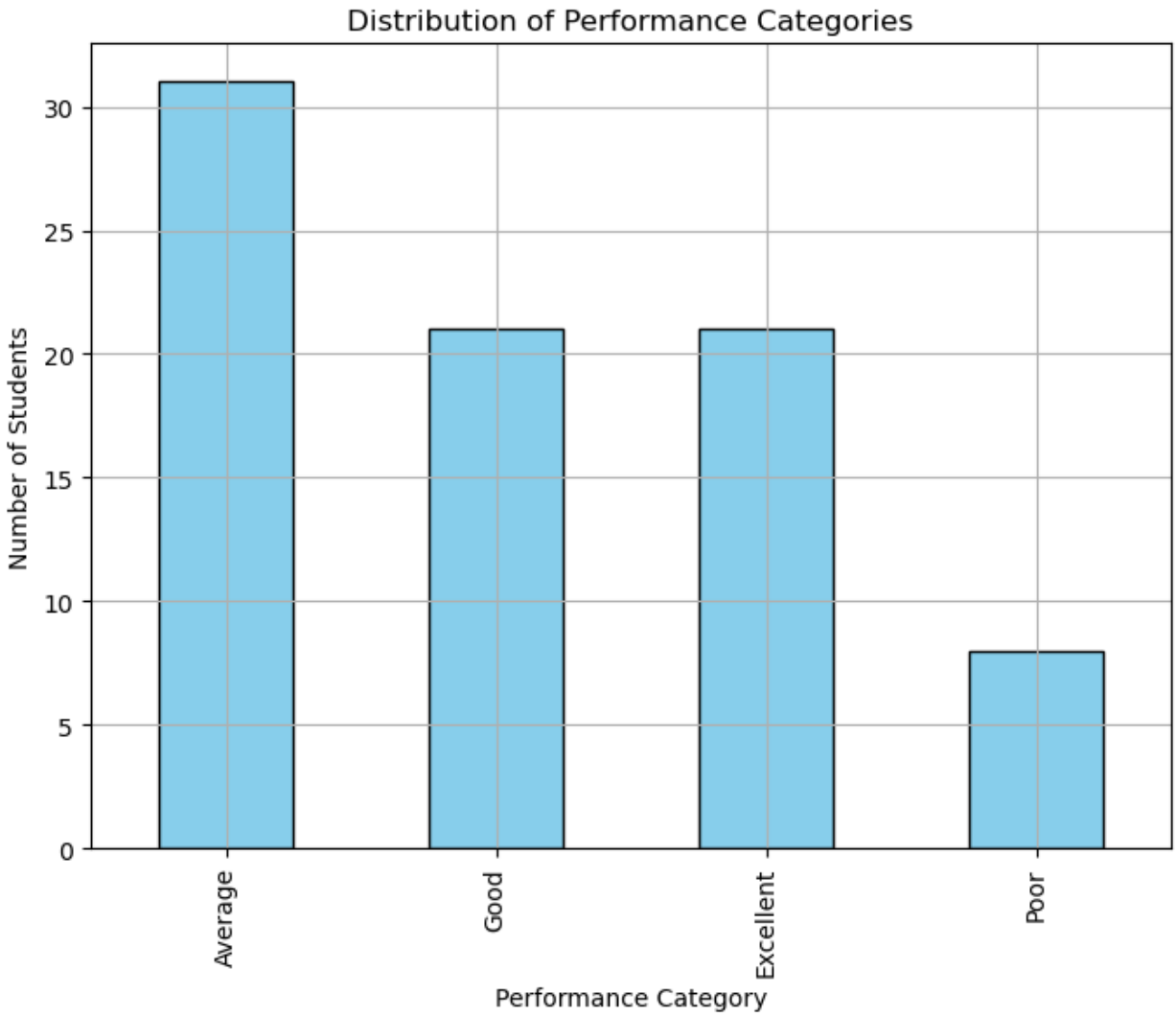
```
plt.ylabel('Number of Students')
plt.xticks(rotation=0)
plt.show()

Number of Students in Each Score Range:
31-40    44
21-30    30
11-20     9
0-10      3
Name: Score_Range, dtype: int64
```



This kernel defines score ranges for total marks, assigns students to these ranges, and visualizes the distribution of students across the defined score ranges using a bar chart.

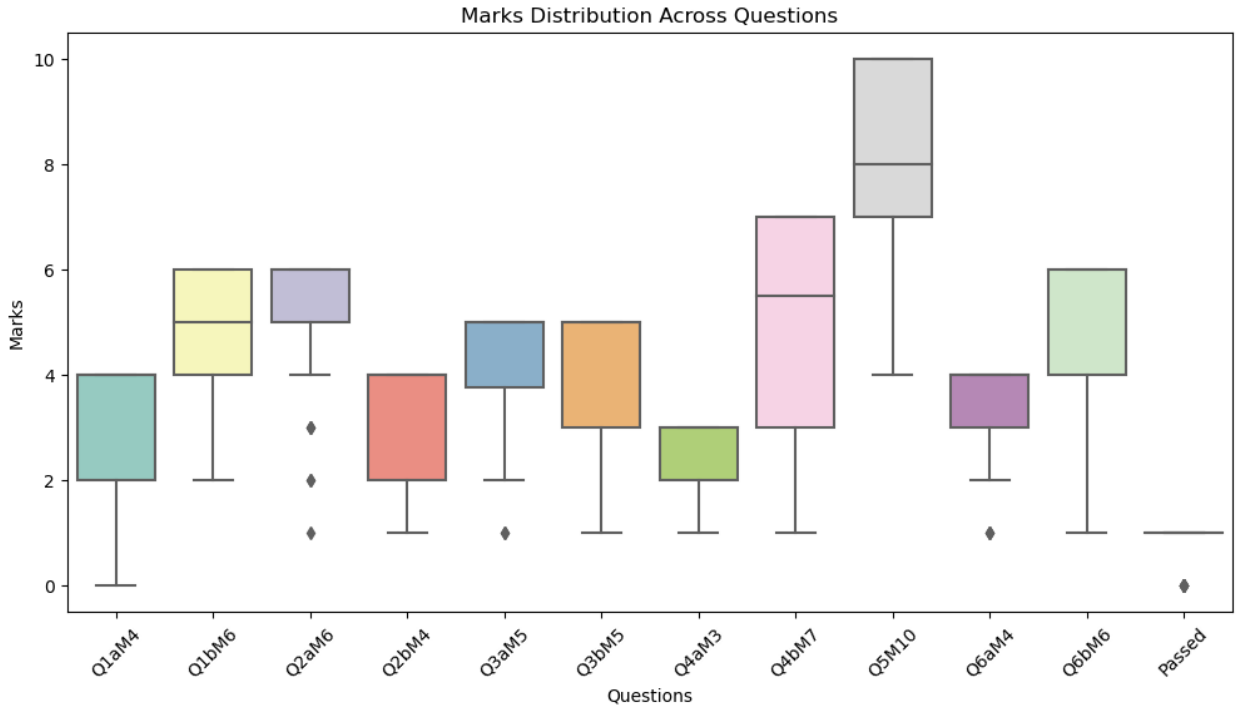
```
bins = [0, 20, 30, 35, 40]
labels = ['Poor', 'Average', 'Good', 'Excellent']
data['Performance_Category'] = pd.cut(data['Total'], bins=bins,
```

```
labels=labels, right=False)

data[['Total', 'Performance_Category']].head()

plt.figure(figsize=(8, 6))
data['Performance_Category'].value_counts().plot(kind='bar',
color='skyblue', edgecolor='black')
plt.title('Distribution of Performance Categories')
plt.xlabel('Performance Category')
plt.ylabel('Number of Students')
plt.grid(True)
plt.show()
```



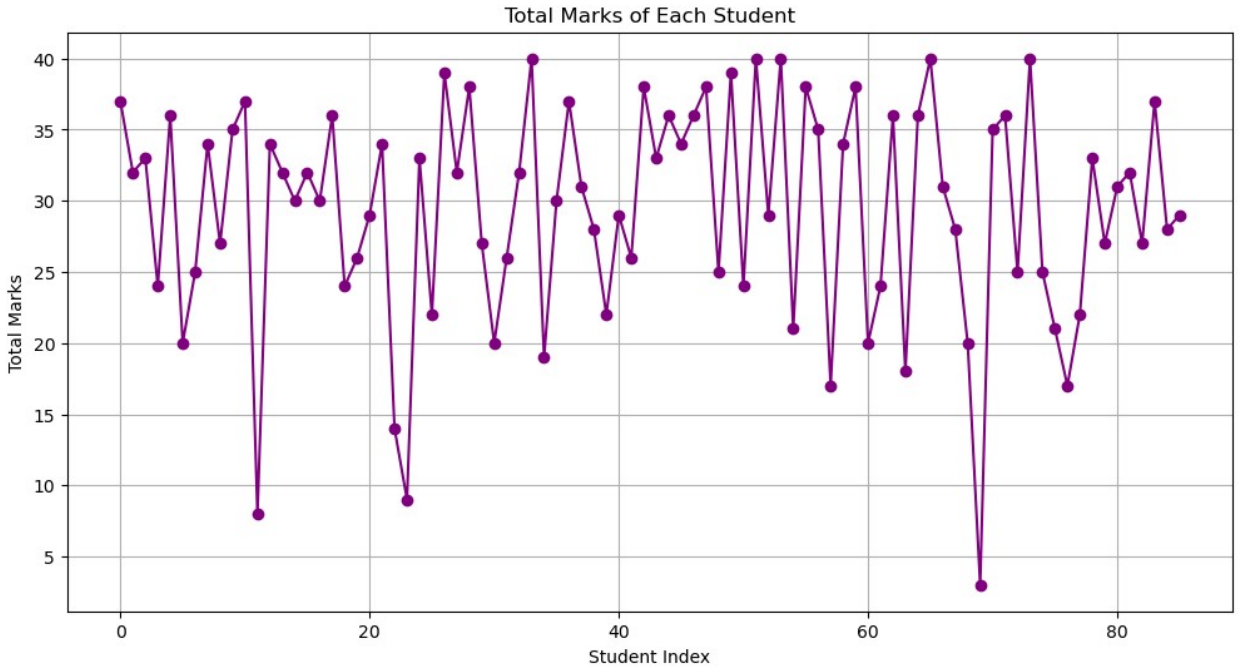
This kernel categorizes students into performance categories based on their total marks, displays the first few rows with these categories, and visualizes the distribution of students across the categories using a bar chart.

```
plt.figure(figsize=(12, 6))
sns.boxplot(data=data[question_columns], palette='Set3')
plt.title('Marks Distribution Across Questions')
plt.xlabel('Questions')
plt.ylabel('Marks')
plt.xticks(rotation=45)
plt.show()
```



This kernel creates a boxplot to compare the marks distribution across all questions, highlighting the spread, median, and outliers for each question.

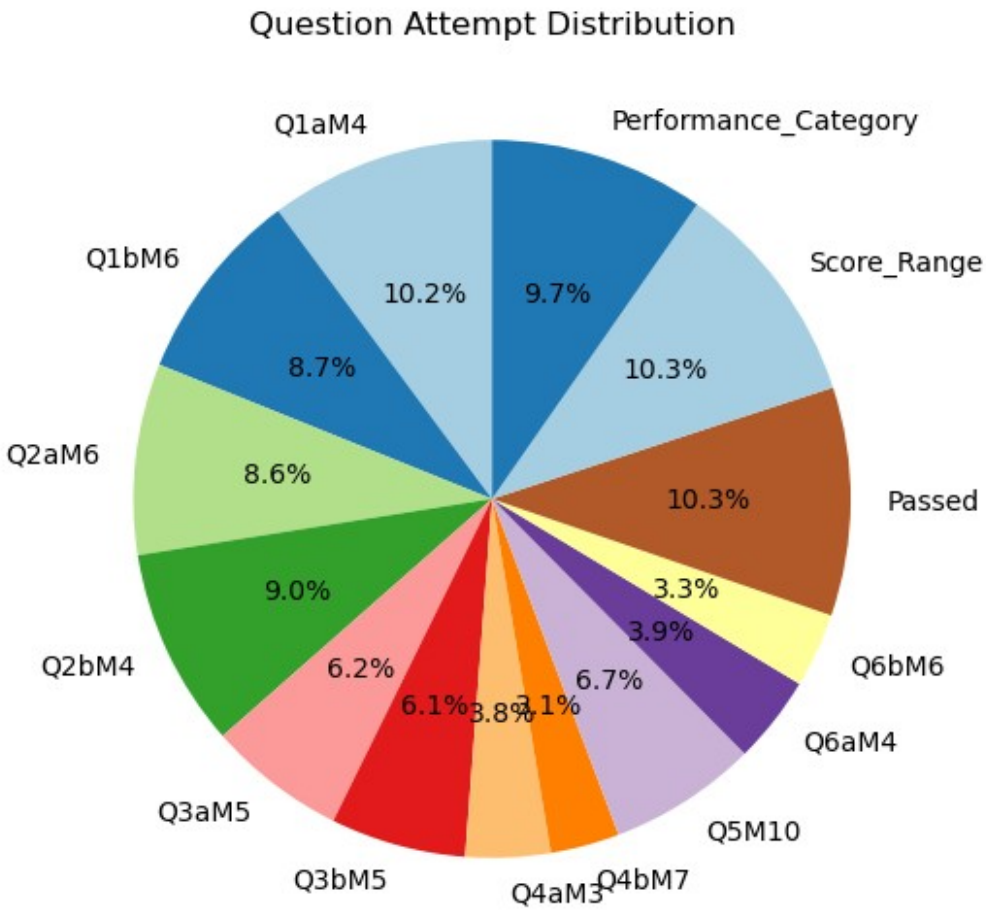
```
plt.figure(figsize=(12, 6))
plt.plot(data['Total'], marker='o', color='purple')
plt.title('Total Marks of Each Student')
plt.xlabel('Student Index')
plt.ylabel('Total Marks')
plt.grid(True)
plt.show()
```



This kernel visualizes the total marks of each student as a line plot, showing how individual student scores vary across the dataset.

```
question_attempts = data.drop(columns='Total').notna().sum()

plt.figure(figsize=(6, 6))
plt.pie(question_attempts, labels=question_attempts.index,
```

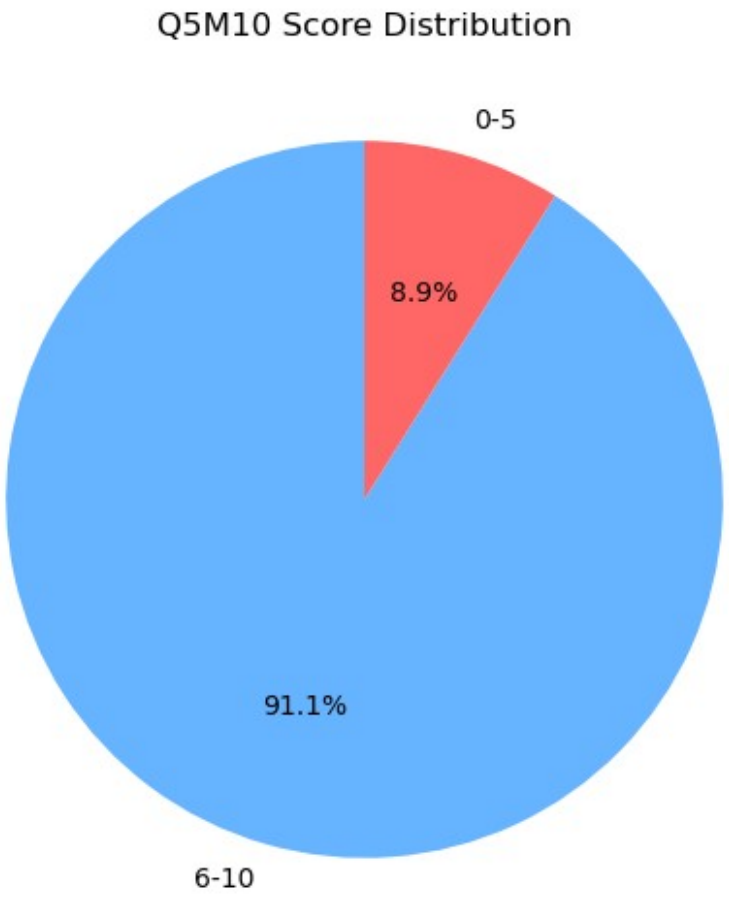
```
autopct='%1.1f%%', startangle=90, colors=plt.cm.Paired.colors)
plt.title('Question Attempt Distribution')
plt.show()
```



This kernel counts the number of non-null (attempted) entries for each question and visualizes the distribution of attempts across the questions using a pie chart.

```
q5_marks = data['Q5M10'].dropna()

bins = [0, 5, 10]
labels = ['0-5', '6-10']
q5_bins = pd.cut(q5_marks, bins=bins, labels=labels)
```

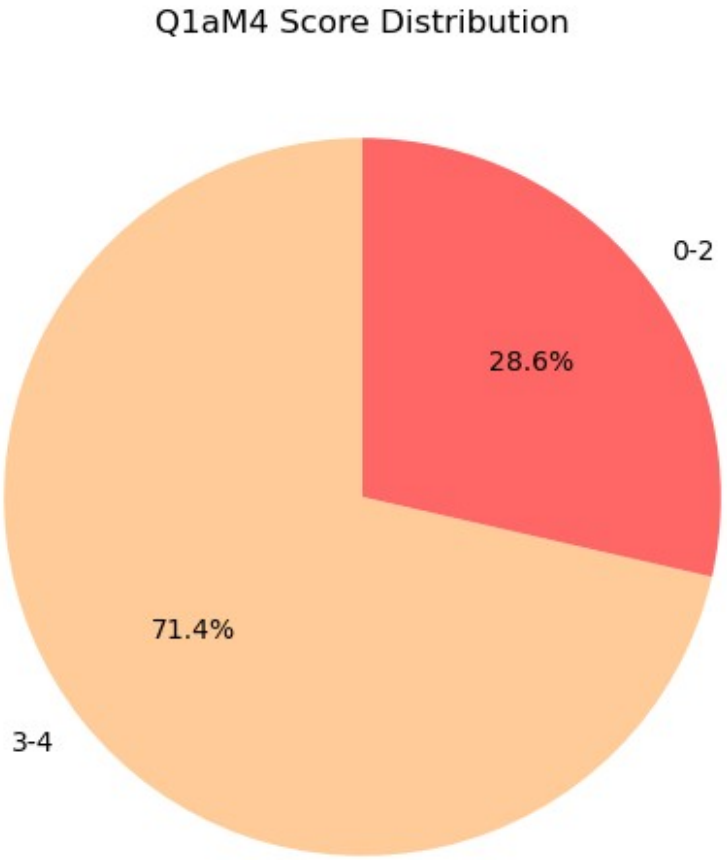
```
q5_distribution = q5_bins.value_counts()

plt.figure(figsize=(6, 6))
plt.pie(q5_distribution, labels=q5_distribution.index, autopct='%1.1f%
%', startangle=90, colors=['#66b3ff','#ff6666'])
plt.title('Q5M10 Score Distribution')
plt.show()
```



This kernel analyzes the distribution of marks for the question "Q5M10" by grouping scores into two ranges (0-5, 6-10) and visualizes the distribution using a pie chart.

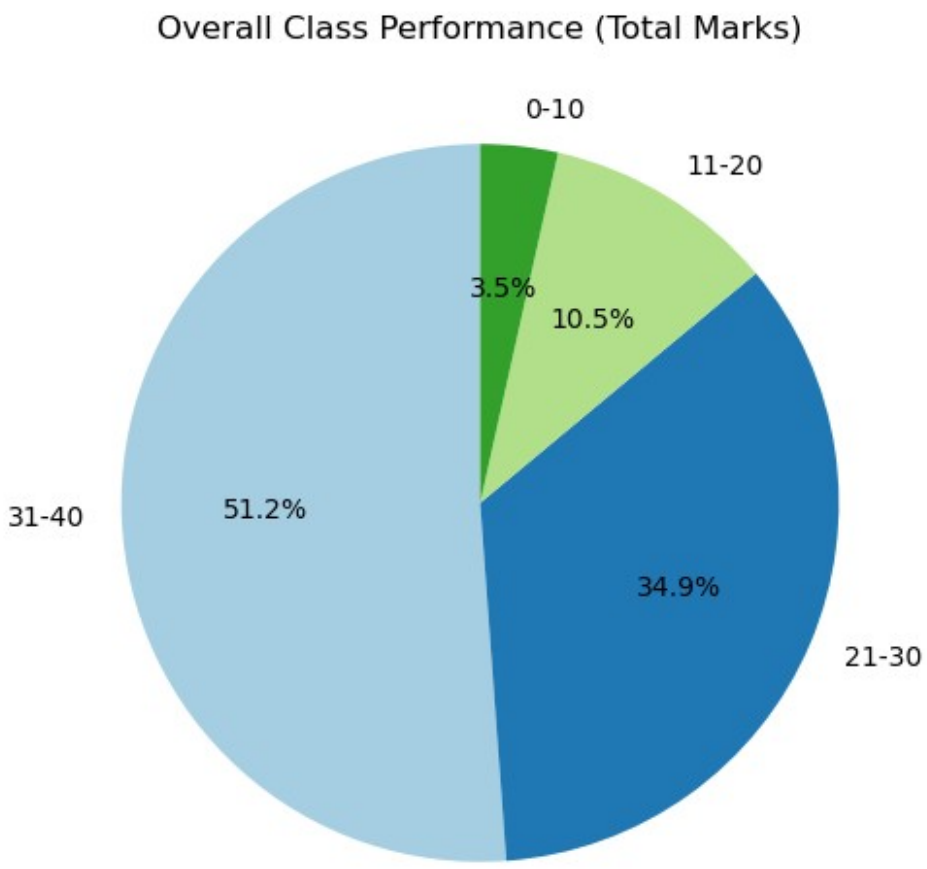
```
q1a_marks = data['Q1aM4'].dropna()
```

```
bins = [0, 2, 4]
labels = ['0-2', '3-4']
q1a_bins = pd.cut(q1a_marks, bins=bins, labels=labels)

q1a_distribution = q1a_bins.value_counts()

plt.figure(figsize=(6, 6))
plt.pie(q1a_distribution, labels=q1a_distribution.index,
autopct='%1.1f%%', startangle=90, colors=['#ffcc99','#ff6666'])
plt.title('Q1aM4 Score Distribution')
plt.show()
```



This kernel analyzes the distribution of marks for the question "Q1aM4" by grouping scores into two ranges (0-2, 3-4) and visualizes the distribution using a pie chart.

```
bins = [0, 10, 20, 30, 40]
labels = ['0-10', '11-20', '21-30', '31-40']
total_bins = pd.cut(data['Total'], bins=bins, labels=labels)

total_distribution = total_bins.value_counts()

plt.figure(figsize=(6, 6))
plt.pie(total_distribution, labels=total_distribution.index,
autopct='%1.1f%%', startangle=90, colors=plt.cm.Paired.colors)
plt.title('Overall Class Performance (Total Marks)')
plt.show()
```



This kernel categorizes students based on their total marks into predefined score ranges (0-10, 11-20, 21-30, 31-40) and visualizes the overall class performance using a pie chart.