```
# import necessary libraries
import numpy as np
import pandas as pd
from scipy import stats
import matplotlib.pyplot as plt
import seaborn as sns
import random

import numpy as np
import pandas as pd

# New random seed for different random values
np.random.seed(7)

# Sample size
n = 100

# Generate dataset with changed values
data = pd.DataFrame({
    'Gender': np.random.choice(['Male', 'Female'], size=n, p=[0.48,
0.52]),
    'Age': np.random.randint(22, 66, size=n),  # slightly broader age
range
    'Tenure': np.random.choice(['Tenured', 'Non-Tenured'], size=n,
p=[0.45, 0.55]),
    'Beauty_Score': np.round(np.random.normal(5.5, 1.2, size=n), 2),
# slightly higher mean, less spread
    'Teaching_Evaluation': np.round(np.random.normal(4.3, 0.6,
size=n), 2)  # higher mean, more variance
})

data.head()
```

	Gender	Age	Tenure	Beauty_Score	Teaching_Evaluation
0	Male	63	Tenured	4.91	4.27
1	Female	33	Tenured	4.50	3.47
2	Male	28	Tenured	4.94	5.48
3	Female	55	Tenured	5.93	4.73
4	Female	43	Non-Tenured	5.54	4.48

Q1. T-Test: Using the teachers' rating data set, does gender affect teaching evaluation rates?

```
import numpy as np
import pandas as pd
from scipy import stats

np.random.seed(7)
n = 100

data = pd.DataFrame({
```

```python
    'Gender': np.random.choice(['Male', 'Female'], size=n, p=[0.48, 
0.52]),
    'Age': np.random.randint(22, 66, size=n),
    'Tenure': np.random.choice(['Tenured', 'Non-Tenured'], size=n, 
p=[0.45, 0.55]),
    'Beauty_Score': np.round(np.random.normal(5.5, 1.2, size=n), 2),
    'Teaching_Evaluation': np.round(np.random.normal(4.3, 0.6, 
size=n), 2)
})

alpha = 0.05  # significance level

print("Question 1: Independent T-Test (Gender and Evaluation Score) \
n")
print("Null Hypothesis (H0): No difference in evaluation scores 
between genders.")
print("Alternative Hypothesis (H1): There is a difference. \n")

female_scores = data[data['Gender'] == 'Female']
['Teaching_Evaluation']
male_scores = data[data['Gender'] == 'Male']['Teaching_Evaluation']

t_stat, p_value_ttest = stats.ttest_ind(female_scores, male_scores, 
nan_policy='omit')

print(f"T-statistic: {t_stat:.4f}")
print(f"P-value: {p_value_ttest:.4f} \n")

if p_value_ttest < alpha:
    print("Conclusion: Reject the null hypothesis.")
    print("There is a statistically significant difference in teaching 
evaluation scores between genders.\n")
else:
    print("Conclusion: Fail to reject the null hypothesis.")
    print("There is no statistically significant difference in 
teaching evaluation scores between genders.\n")
```

```
Question 1: Independent T-Test (Gender and Evaluation Score)

Null Hypothesis (H0): No difference in evaluation scores between 
genders.
Alternative Hypothesis (H1): There is a difference.

T-statistic: -0.5822
P-value: 0.5618

Conclusion: Fail to reject the null hypothesis.
There is no statistically significant difference in teaching 
evaluation scores between genders.
```

Q2. ANOVA: Using the teachers' rating data set, does beauty score for instructors differ by age?

```
import pandas as pd
from scipy import stats

print("Question 2: ANOVA (Age and Beauty Score)\n")

print("Null Hypothesis (H0): No significant difference in beauty
scores across age groups")
print("Alternative Hypothesis (H1): At least one age group has a
significantly different mean beauty score\n")

# Define age groups
bins = [0, 40, 55, 100]
labels = ['Young', 'Middle-Aged', 'Senior']
data['Age_Group'] = pd.cut(data['Age'], bins=bins, labels=labels,
right=True)

# Extract beauty scores for each group
group_young = data[data['Age_Group'] == 'Young']
['Beauty_Score'].dropna()
group_middle = data[data['Age_Group'] == 'Middle-Aged']
['Beauty_Score'].dropna()
group_senior = data[data['Age_Group'] == 'Senior']
['Beauty_Score'].dropna()

# Ensure groups are not empty
groups = [g for g in [group_young, group_middle, group_senior] if
len(g) > 0]

if len(groups) < 2:
    print("Error: Not enough valid groups for ANOVA.\n")
else:
    f_stat, p_value_anova = stats.f_oneway(*groups)
    alpha = 0.05

    print(f"F-statistic: {f_stat:.4f}")
    print(f"P-value: {p_value_anova:.4f}\n")

    if p_value_anova < alpha:
        print("Conclusion: Reject the null hypothesis.")
        print("There is a statistically significant difference in mean
beauty scores among the age groups.\n")
    else:
        print("Conclusion: Fail to reject the null hypothesis.")
        print("There is no statistically significant difference in
mean beauty scores among the age groups.\n")
```

```
Question 2: ANOVA (Age and Beauty Score)

Null Hypothesis (H0): No significant difference in beauty scores
```

```
across age groups
Alternative Hypothesis (H1): At least one age group has a
significantly different mean beauty score

F-statistic: 0.4726
P-value: 0.6248

Conclusion: Fail to reject the null hypothesis.
There is no statistically significant difference in mean beauty scores
among the age groups.
```

Q3. Chi-square: Using the teachers' rating data set, is there an association between tenure and gender?

```
import pandas as pd
from scipy import stats

print("Question 3: Chi-square Test (Tenure and Gender)\n")

print("Null Hypothesis (H0): No association between tenure and
gender")
print("Alternative Hypothesis (H1): There is an association between
tenure and gender\n")

# Define significance level
alpha = 0.05

# Clean data: remove missing values
data_clean = data[['Tenure', 'Gender']].dropna()

# Build contingency table
contingency_table = pd.crosstab(data_clean['Tenure'],
data_clean['Gender'])
print("Contingency Table:")
print(contingency_table)

# Ensure the table has at least 2 rows and 2 columns
if contingency_table.shape[0] < 2 or contingency_table.shape[1] < 2:
    print("\nError: Not enough categories for Chi-square test. Need at
least 2 levels for each variable.\n")
else:
    # Perform Chi-square test
    chi2_stat, p_value_chi2, dof, expected =
stats.chi2_contingency(contingency_table)

    print(f"\nChi-square statistic: {chi2_stat:.4f}")
    print(f"P-value: {p_value_chi2:.4f}")
    print(f"Degrees of freedom: {dof}")
    print("\nExpected frequencies:")
```

```
    print(pd.DataFrame(expected,
                       index=contingency_table.index,
                       columns=contingency_table.columns))

    # Decision
    if p_value_chi2 < alpha:
        print("\nConclusion: Reject the null hypothesis.")
        print("There is a statistically significant association
between tenure and gender.\n")
    else:
        print("\nConclusion: Fail to reject the null hypothesis.")
        print("There is no statistically significant association
between tenure and gender.\n")
```

```
Question 3: Chi-square Test (Tenure and Gender)

Null Hypothesis (H0): No association between tenure and gender
Alternative Hypothesis (H1): There is an association between tenure
and gender

Contingency Table:
Gender       Female  Male
Tenure
Non-Tenured      30    24
Tenured          21    25

Chi-square statistic: 0.6189
P-value: 0.4315
Degrees of freedom: 1

Expected frequencies:
Gender       Female   Male
Tenure
Non-Tenured   27.54  26.46
Tenured       23.46  22.54

Conclusion: Fail to reject the null hypothesis.
There is no statistically significant association between tenure and
gender.
```

Q4. Correlation: Using the teachers rating dataset, Is teaching evaluation score correlated with beauty score?

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from scipy import stats

print("Question 4: Pearson Correlation (Evaluation Score and Beauty
```

```
Score)\n")

print("Null Hypothesis (H0): No linear correlation between teaching
evaluation and beauty scores.")
print("Alternative Hypothesis (H1): There is a linear correlation.\n")

# Significance level
alpha = 0.05

# Extract relevant data and drop missing values for both columns
together
subset = data[['Teaching_Evaluation', 'Beauty_Score']].dropna()

# Separate variables
eval_score = subset['Teaching_Evaluation']
beauty_score = subset['Beauty_Score']

# Check that both have enough data points
if len(eval_score) < 2:
    print("Error: Not enough valid data points to calculate
correlation.\n")
else:
    # Calculate Pearson correlation
    corr_coeff, p_value_corr = stats.pearsonr(eval_score,
beauty_score)

    print(f"Pearson Correlation Coefficient (r): {corr_coeff:.4f}")
    print(f"P-value: {p_value_corr:.4f}\n")

    # Hypothesis test conclusion
    if p_value_corr < alpha:
        print("Conclusion: Reject the null hypothesis.")
        print("There is a statistically significant linear correlation
between teaching evaluation score and beauty score.\n")
    else:
        print("Conclusion: Fail to reject the null hypothesis.")
        print("There is no statistically significant linear
correlation between these variables.\n")

    # Scatter plot with regression line
    plt.figure(figsize=(10, 6))
    sns.regplot(x='Beauty_Score', y='Teaching_Evaluation',
data=subset,
                line_kws={"color": "red", "lw": 2},
scatter_kws={'alpha': 0.6})
    plt.title('Teaching Evaluation Score vs. Beauty Score',
fontsize=16)
    plt.xlabel('Beauty Score', fontsize=12)
    plt.ylabel('Teaching Evaluation Score', fontsize=12)
```

```
    plt.grid(True)
    plt.show()
```

```
Question 4: Pearson Correlation (Evaluation Score and Beauty Score)

Null Hypothesis (H0): No linear correlation between teaching
evaluation and beauty scores.
Alternative Hypothesis (H1): There is a linear correlation.

Pearson Correlation Coefficient (r): 0.1293
P-value: 0.2000

Conclusion: Fail to reject the null hypothesis.
There is no statistically significant linear correlation between these
variables.
```