Data Science Analysis - Quiz 3

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EE20BTECH11042

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Importing Libraries

[1]:
```
import numpy as np
from scipy.stats import chi2
import matplotlib.pyplot as plt
```

Question 1

[2]:
```
def calculate_score(H0_exp1, H0_exp2, H0_exp1_err, H0_exp2_err):
    # Significance from p-value is also known as Z-score
    z_score = np.abs(H0_exp1 - H0_exp2) / np.sqrt(H0_exp1_err ** 2 + H0_exp2_err␣
 ↪** 2)
    return z_score
```

[3]:
```
H0_exp1, H0_exp2 = 67, 71
H0_exp1_err, H0_exp2_err = 2.3, 1.3

z_score = calculate_score(H0_exp1, H0_exp2, H0_exp1_err, H0_exp2_err)

print(f"The Z-score between measurements: {z_score:.5f} sigmas.")
```

```
The Z-score between measurements: 1.51402 sigmas.
```

Question 2

[4]:
```
free_params = 2
confidence_interval = 0.85

# This formula is from the slides of Second and Third week on page 17
del_chi2 = chi2(free_params).ppf(confidence_interval)

print(f"The value for constant del Chi2 for an {int(confidence_interval * 100)}%␣
 ↪confidence interval: {del_chi2:.5f}")
```

```
The value for constant del Chi2 for an 85% confidence interval: 3.79424
```

Question 3

[5]:
```
def calculate_del_BIC(num_data, chi2_vals, free_params):
    A_chi2, B_chi2 = chi2_vals
    A_free, B_free = free_params

    # Note that in this question, the reduced Chi2 value is given
    # To find out Chi2 value, we need to multiply it with number of free␣
 ↪parameters (given in slides)
    BIC_A = (A_free * np.log(num_data)) - (2 * np.log(A_free * A_chi2))
    BIC_B = (B_free * np.log(num_data)) - (2 * np.log(B_free * B_chi2))
    return BIC_A, BIC_B, (BIC_A - BIC_B)
```

[6]:
```
num_data_points = 10
A_red_chi2, A_free = 1.3, 6
B_red_chi2, B_free = 0.7, 8

BIC_A, BIC_B, del_BIC = calculate_del_BIC(num_data_points, [A_red_chi2,␣
 ↪B_red_chi2], [A_free, B_free])

print(f"BIC of Model A: {BIC_A:.5f}")
print(f"BIC of Model B: {BIC_B:.5f}\n")
print(f"The difference in BIC of two models are: {del_BIC:.5f}")
```

```
BIC of Model A: 9.70726
BIC of Model B: 14.97515

The difference in BIC of two models are: -5.26788
```

Question 4

[7]:
```
mean = 10
number = 1000
random_variables = np.random.poisson(mean, number)
print(random_variables)

fig = plt.figure(figsize = (12, 6))
plt.hist(random_variables, bins = 20, label = "Poisson Random Numbers")
plt.title("Histogram plot for Poisson distributed random variables", size = 15)
plt.xlabel("Value", size = 15)
plt.ylabel("Count", size = 15)
plt.legend()
plt.show()
```

```
[ 6  6 11 10  8 11  9  5  9 10  9 12  9 14 16 11  5  8  5  8 11  6  6 12
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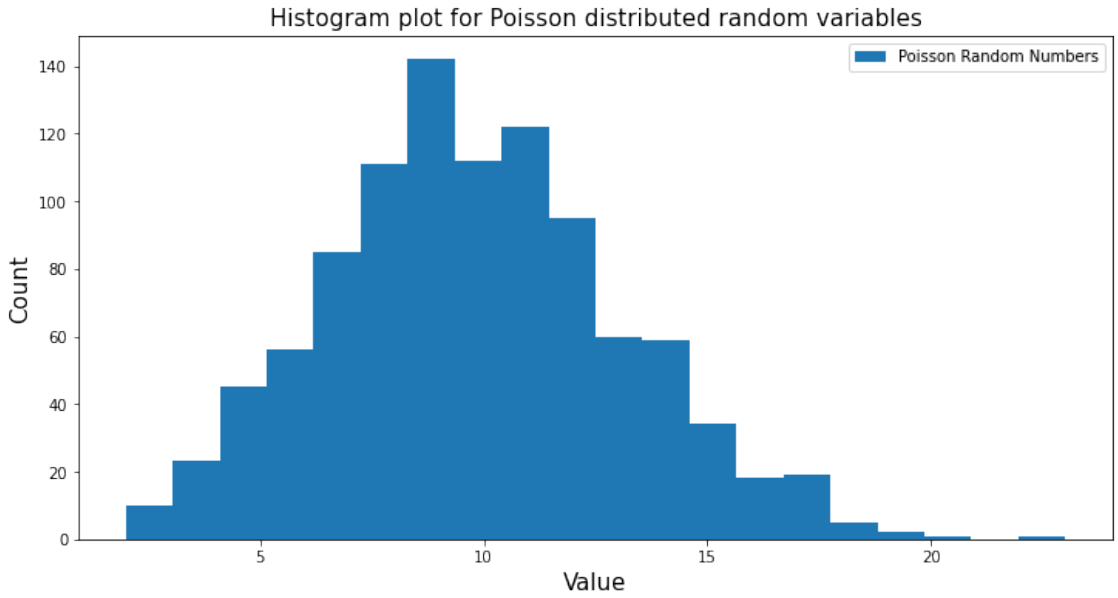
Histogram plot for Poisson distributed random variables
Poisson Random Numbers
Count
Value
0
20
40
60
80
100
120
140
5
10
15
20