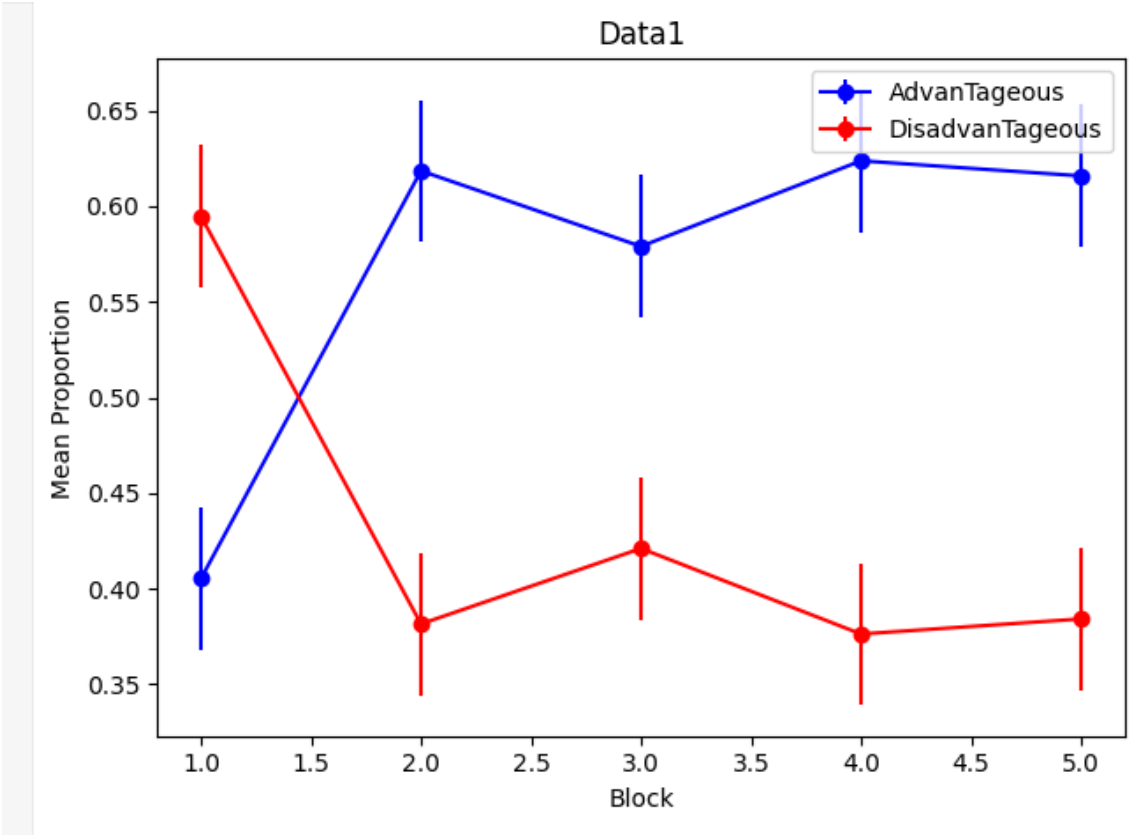
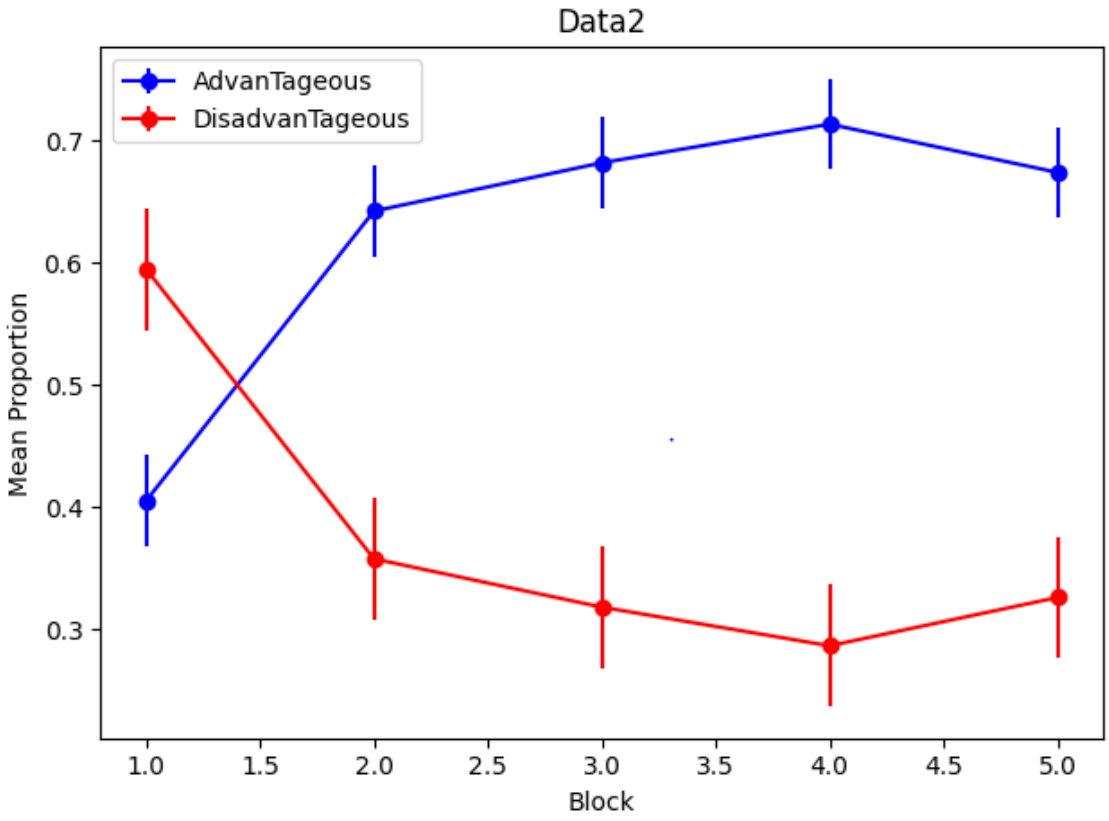
Q2)

Two independent groups of participants (19 each) performed an Iowa Gambling task. Their data are named Data1 and Data2 respectively. Each sheet in the attached excel file (NDM_Assignment3) contains data of one group. Each row represents one participant and each column represents one trial. There are a total of 4 decks and 100 trials. Decks 1 and 2 yield immediate and steady rewards, but they are also characterised by unpredictable occasional losses that can result in negative long-term outcomes. Decks 3 and 4 offer relatively lower and steady immediate rewards, accompanied by even lower and less unpredictable occasional losses, leading to favourable long-term outcomes. Solve the following.

Insert a figure (wherever required) and paste the MATLAB/Python/R code for the same. All figures should be properly labelled and MUST have accompanying captions to provide all information necessary to interpret the figures

A. Divide the trials into five equal sized blocks and then calculate the mean proportion (across participants) of advantageous cards and disadvantageous cards selected by the participants. Create two subplots as part of a single figure. Each subplot should depict the mean proportions across 5 blocks for each independent group using line and marker plots. Mark advantageous cards with blue colour and disadvantageous cards with red colour. Include standard errors of the mean as error bars at each marker location in both subplots. Interpret the figures in the context of affective decision making.


Data1
AdvanTageous
DisadvanTageous
Mean Proportion
0.65
0.60
0.55
0.50
0.45
0.40
0.35
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Block


Data2
AdvanTageous
DisadvanTageous
Mean Proportion
0.7
0.6
0.5
0.4
0.3
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Block

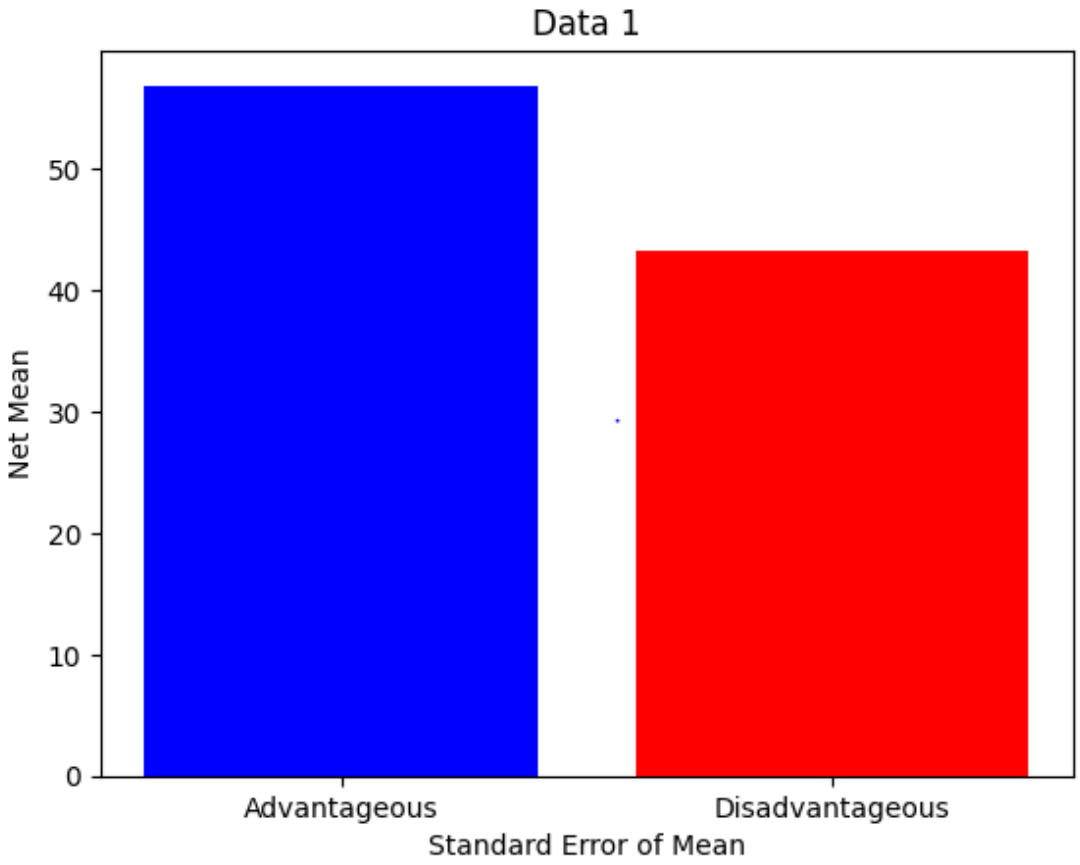
Code is:

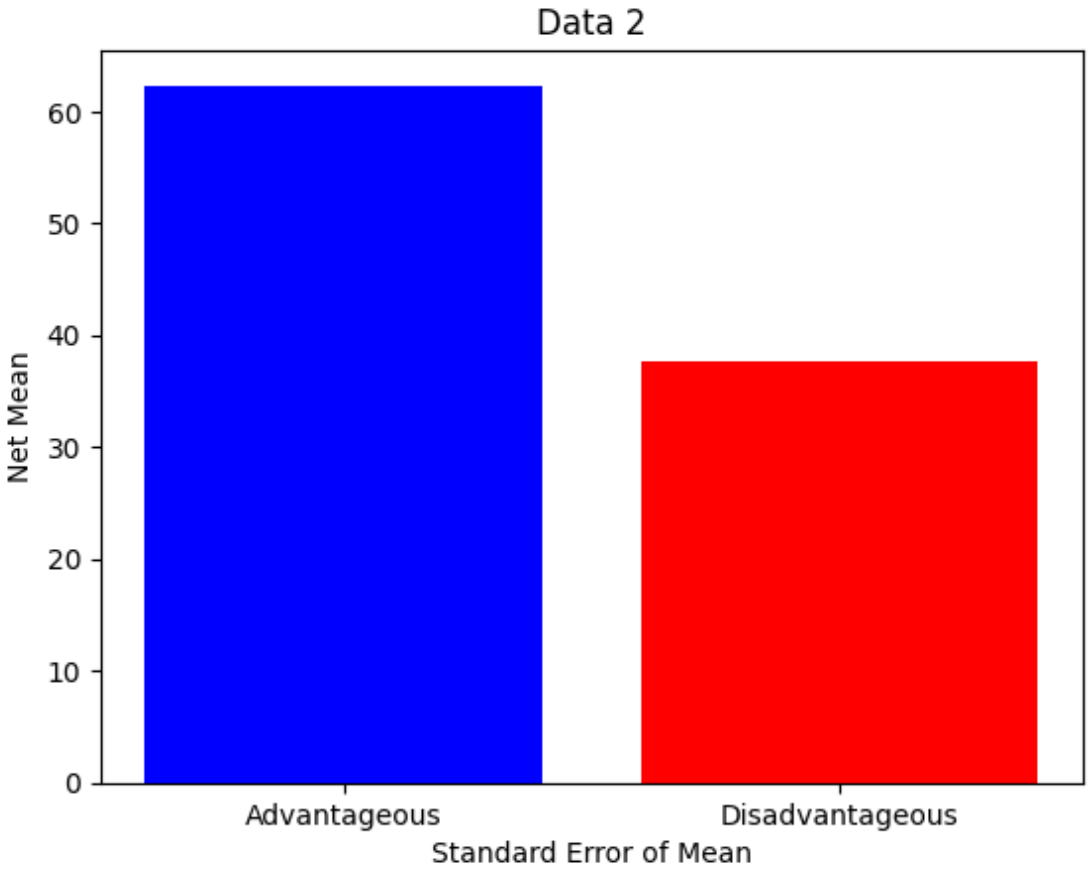
```
#!/usr/bin/env python
# coding: utf-8

# In[4]:


import pandas as pd
import numpy as np
import matplotlib.pyplot as plt


# In[15]:


# For data 1
data1 = pd.read_excel('NDM_Assignment3.xlsx', header=None)
data1 = data1.drop(0,axis =1)
data1


# In[14]:


# For data 2
data2 = pd.read_excel('NDM_Assignment3.xlsx', header=None,sheet_name=1)
data2 = data2.drop(0,axis =1)
data2


# In[23]:


group = data1

AdvanTageous_Data1 = []  # Change variable name from advantageous to
AdvanTageous_Data1
DisadvanTageous_Data1 = []  # Change variable name from disadvantageous to
DisadvanTageous_Data1

# Divide the trials into five equal-sized blocks
for i in range(0, group.columns.size, group.columns.size // 5):
    block = group.iloc[:, i:i + group.columns.size // 5]

    # Calculate the mean proportion of AdvanTageous and DisadvanTageous cards
    AdvanTageous_Data1.append((block.isin([3, 4])).sum().sum() / block.size)
    DisadvanTageous_Data1.append((block.isin([1, 2])).sum().sum() /
block.size)

# Calculate standard errors of the mean
```

```
AdvanTageous_err_Data1 = np.std(AdvanTageous_Data1) /
np.sqrt(len(AdvanTageous_Data1))
DisadvanTageous_err_Data1 = np.std(DisadvanTageous_Data1) /
np.sqrt(len(DisadvanTageous_Data1))

# Plotting
plt.errorbar(range(1, 6), AdvanTageous_Data1, yerr=AdvanTageous_err_Data1,
fmt='-o', color='blue', label='AdvanTageous')
plt.errorbar(range(1, 6), DisadvanTageous_Data1,
yerr=DisadvanTageous_err_Data1, fmt='-o', color='red',
label='DisadvanTageous')
plt.title('Data1')
plt.xlabel('Block')
plt.ylabel('Mean Proportion')
plt.legend()

plt.tight_layout()
plt.show()



group = data2

AdvanTageous_Data2 = []  # Change variable name from AdvanTageous to
AdvanTageous_Data2
DisadvanTageous_Data2 = []  # Change variable name from DisadvanTageous to
DisadvanTageous_Data2

i = 0
while i < group.columns.size:
    block = group.iloc[:, i:i + group.columns.size // 5]

    # Calculate the mean proportion of AdvanTageous and DisadvanTageous cards
    AdvanTageous_Data2.append((block.isin([3, 4])).sum().sum() / block.size)
    DisadvanTageous_Data2.append((block.isin([1, 2])).sum().sum() /
block.size)

    i += group.columns.size // 5

# Calculate standard errors of the mean
AdvanTageous_err_Data2 = np.std(AdvanTageous_Data2) /
np.sqrt(len(AdvanTageous_Data2))
DisadvanTageous_err_Data2 = np.std(DisadvanTageous_Data2) /
np.sqrt(len(DisadvanTageous_Data2))

# Plotting
plt.errorbar(range(1, 6), AdvanTageous_Data2, yerr=AdvanTageous_err_Data1,
fmt='-o', color='blue', label='AdvanTageous')
```

```
plt.errorbar(range(1, 6), DisadvanTageous_Data2,
yerr=DisadvanTageous_err_Data2, fmt='-o', color='red',
label='DisadvanTageous')
plt.title('Data2')
plt.xlabel('Block')
plt.ylabel('Mean Proportion')
plt.legend()

plt.tight_layout()
plt.show()



# In[11]:


print("The the standard error of advantage for data 1 is
{}".format(AdvanTageous_err_Data1))
print("The the standard error of disadvantage for data 1 is
{}".format(DisadvanTageous_err_Data1))


# In[24]:


print("The the standard error of advantage for data 1 is
{}".format(AdvanTageous_err_Data2))
print("The the standard error of disadvantage for data 1 is
{}".format(DisadvanTageous_err_Data2))


# In[ ]:
```

B. Plot bar diagrams with error bars to show the net mean score/count/selections (across participants; across advantageous vs disadvantageous cards respectively) and standard error of the mean of advantageous cards versus disadvantageous cards selected by participants of both groups.


Data 1
Net Mean
50
40
30
20
10
0
Advantageous
Disadvantageous
Standard Error of Mean



Code is:

```
#!/usr/bin/env python
# coding: utf-8

# # q2 B

# In[1]:


import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns


# In[2]:


data1 = pd.read_excel('NDM_Assignment3.xlsx', header=None)
data1 = data1.drop(0,axis =1)
data1
```

```
# In[3]:


data2 = pd.read_excel('NDM_Assignment3.xlsx', header=None,sheet_name=1)
data2 = data2.drop(0,axis =1)
data2


# In[4]:


def calculateNetMean(data, decks):
    selected = data[data.isin(decks)].count(axis=1)
    net_mean = selected.mean()
    return net_mean
def calculate_StandardError(data, decks):
    selected = data[data.isin(decks)].count(axis=1)
    stdErr = selected.sem()
    return stdErr


# In[5]:


# Calculate net mean and standard error for each group

advantageous_decks = [3, 4]
disadvantageous_decks = [1, 2]

netMeanData1Advantagous = calculateNetMean(data1, advantageous_decks)
netMeanData2Advantageous = calculateNetMean(data2, advantageous_decks)
netMeanData1Disadvantageous = calculateNetMean(data1, disadvantageous_decks)
netMeanData2Disadvantageous = calculateNetMean(data2, disadvantageous_decks)


# Calculate standard error of the mean for each group and deck type
semAdvantageousData1 = calculate_StandardError(data1, advantageous_decks)
semDisadvantageousData1 = calculate_StandardError(data1,
disadvantageous_decks)
semAdvantageousData2 = calculate_StandardError(data2, advantageous_decks)
semDisadvantageousData2 = calculate_StandardError(data2,
disadvantageous_decks)



# In[6]:


import matplotlib.pyplot as plt
```

```
# Assuming the following variables have been calculated
# sem_advantageous_data1, sem_disadvantageous_data1,
net_mean_data1_Advantagous, net_mean_data1_Disadvantageous

labels = ['Advantageous', 'Disadvantageous']
x = [semAdvantageousData1, semDisadvantageousData1]
y = [netMeanData1Advantagous, netMeanData1Disadvantageous]

fig, axis = plt.subplots()


axis.bar(labels, y,color=['blue', 'red'])


axis.set_ylabel('Net Mean')


axis.set_xlabel('Standard Error of Mean')

# Set the title
axis.set_title('Data 1')

# Display the plot
plt.show()


# In[7]:


import matplotlib.pyplot as plt

# Assuming the following variables have been calculated
# sem_advantageous_data1, sem_disadvantageous_data1,
net_mean_data1_Advantagous, net_mean_data1_Disadvantageous

labels = ['Advantageous', 'Disadvantageous']
x = [semAdvantageousData2, semDisadvantageousData2]
y = [netMeanData2Advantageous, netMeanData2Disadvantageous]

fig, axis = plt.subplots()


axis.bar(labels, y,color=['blue', 'red'])


axis.set_ylabel('Net Mean')


axis.set_xlabel('Standard Error of Mean')
```

```
# Set the title
axis.set_title('Data 2')

# Display the plot
plt.show()


# In[ ]:
```

C. Carry out a statistical test to find if the means of the two different groups (calculated in partB) from data1 and data2 differ from one another. Calculate the confidence interval and effect size and report the results along with p-values, test statistics, and degrees of freedom.

For Advantageous Decks:
T-value: -4.957181970878901
P-value: 1.7123035593755243e-05
Confidence Interval: (50.96035037956482, 62.72386014675097)
Effect Size (Cohen's d): -1.6083222082395392
The degree of freedom :36

For Disadvantageous Decks:
T-value: 4.957181970878901
P-value: 1.7123035593755243e-05
Confidence Interval: (37.27613985324903, 49.03964962043518)
Effect Size (Cohen's d): 1.6083222082395392
The degree of freedom :36

Interpret the results of the statistical test with regards to the decision making ability of the participants in the two groups citing the key brain region(s) that might be linked to the performance of both groups in the task.

The t-test results for both the advantages and disadvantages show a significant difference between the two groups of participants.

For the Advantageous Decks:

- The negative t-value of this, which is -4.95 it tells that the mean score of the first group is less than the second group.
- Now, a small p-value of 1.71e-05 is less than the typical significance level (0.05), showing strong evidence against the null hypothesis.
- The confidence interval ranges from 50.96 to 62.72, which means that the 95% confident that the actual mean difference falls within this range.

- (Cohen's d) is -1.61 , indicating significant practical significance of the difference between the data1 and data2/

For the Disadvantageous Decks:

- t-value is 4.96 and is positive tells that the mean score of the data1 is greater than the second group.
- Now, a small p-value of 1.71e-05 is less than the typical significance level (0.05), showing strong evidence against the null hypothesis.
- The confidence interval ranges from 37.27 to 49.0, which means that the 95% confidence that the actual mean difference falls within this range.
- (Cohen's d) is -1.61 , indicating significant practical significance of the difference between the data1 and data2/

Here the key brain regions linked to decision-making ability are the prefrontal cortex and the amygdala, which are known to play crucial roles in decision-making processes.

Code is:

```
# # Q2c

# In[8]:


import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import scipy.stats as stats


# In[9]:


data1 = pd.read_excel('NDM_Assignment3.xlsx', header=None)
data1 = data1.drop(0,axis =1)
data1


# In[10]:


data2 = pd.read_excel('NDM_Assignment3.xlsx', header=None,sheet_name=1)
```

```
data2 = data2.drop(0,axis =1)
data2


# In[15]:


n1 = len(data1)
n2 = len(data2)


# In[16]:


from scipy import stats
import numpy as np

t_stat_advanage, p_val_advadvantage =
stats.ttest_ind_from_stats(netMeanData1Advantagous, semAdvantageousData1, n1,
                                                    netMeanData2Advantageous,
semAdvantageousData2, n2)

# Perform a t-test between the disadvantageous groups in data1 and data2
t_stat_disadvanatge, p_val_disadvantage =
stats.ttest_ind_from_stats(netMeanData1Disadvantageous,
semDisadvantageousData1, n1,
                                                          netMeanData2Disadvant
ageous, semDisadvantageousData2, n2)

# Calculating the confidence interval for advantageous group
conf_int_advantage = stats.t.interval(0.95, df=n1-1,
loc=netMeanData1Advantagous, scale=semAdvantageousData1)

# Calculating the confidence interval for disadvantageous group
conf_int_disadvantage = stats.t.interval(0.95, df=n1-1,
loc=netMeanData1Disadvantageous, scale=semDisadvantageousData1)

# Calculating the   Cohen's d for advantageous groups
d_advantage = (netMeanData1Advantagous - netMeanData2Advantageous) /
np.sqrt((semAdvantageousData1**2 + semAdvantageousData2**2) / 2)

# Calculatinf the effect  Cohen's d for disadvantageous groups
d_disadvantage = (netMeanData1Disadvantageous - netMeanData2Disadvantageous) /
np.sqrt((semDisadvantageousData1**2 + semDisadvantageousData2**2) / 2)

# Calculating degree of freedom for advantage and disadvantage
degreeofFreedom_advantage = n1 + n2 - 2
degreeofFreedom_disadvantage = n1 + n2 - 2
```

```
# Print the results
print(" For Advantageous Decks:")
print("T-value: ", t_stat_advanage)
print("P-value: ", p_val_advadvantage)
print("Confidence Interval: ", conf_int_advantage)
print("Effect Size (Cohen's d): ", d_advantage)
print("The degree of freedom :{}".format(degreeofFreedom_advantage))

print("\n For  Disadvantageous Decks:")
print("T-value: ", t_stat_disadvanatge)
print("P-value: ", p_val_disadvantage)
print("Confidence Interval: ", conf_int_disadvantage)
print("Effect Size (Cohen's d): ", d_disadvantage)
print("The degree of freedom :{}".format(degreeofFreedom_disadvantage))


# In[ ]:
```