SVKM's NMIMS
Mukesh Patel School of Technology Management & Engineering
Computer Engineering Department
Program: B. Tech/MBA Tech EXTC

Course: B. Tech/MBA. Tech (EXTC)
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AIM: -To implement descriptive models of stimulus cognition using statistical tests and supervise machine learning algorithms

Instructions and Objective:

1. Download FTheta and OTheta from file section team
2. Curate the data if required
3. Perform various statistical analysis to create region descriptive and asymmetry descriptive model (for both dataset)
4. Perform t-test and one-way ANOVA (analysis of variance)

Google Colab Links:

F-Theta

https://colab.research.google.com/drive/11YXwuMgolldhz1iyVFACmRBOz66j-jhU?usp=sharing

O-Theta

https://colab.research.google.com/drive/1Sks57wKaDoE7G80dyd5WHUTOttuQTQfG?usp=sharing

Outcomes:

Otheta

Description of features of right and left brain

```
print('Right brain reading descriptive data:')
f_right_data.describe()
```

Right brain reading descriptive data:

	Sr.	Age	Before	During	After
count	40.000000	40.00000	40.000000	40.000000	40.000000
mean	20.500000	30.45000	2.183443	2.217831	2.033269
std	11.690452	11.11467	0.799946	0.852757	0.680573
min	1.000000	17.00000	0.512824	0.582216	0.620576
25%	10.750000	20.00000	1.687719	1.822024	1.580514
50%	20.500000	27.50000	2.059239	2.187084	2.010220
75%	30.250000	37.75000	2.572517	2.327945	2.361270
max	40.000000	63.00000	4.569232	4.998833	4.280547

```
[5] f_left_data
```

8	9	F	18	4.054390	2.847232	3.268775	A
9	10	M	17	2.503892	2.365560	2.337952	A
10	11	M	37	2.036012	1.348073	1.311032	A
11	12	F	40	2.261763	2.028148	1.853168	A
12	13	M	63	1.311032	1.558145	1.350667	A
13	14	M	32	0.916291	1.022451	1.220830	A

```
print('Left brain reading descriptive data:')
f_left_data.describe()
```

Left brain reading descriptive data:

	Sr.	Age	Before	During	After
count	40.000000	40.00000	40.000000	40.000000	40.000000
mean	20.500000	30.45000	2.151937	2.165033	2.026786
std	11.690452	11.11467	0.882513	0.749115	0.920392
min	1.000000	17.00000	0.916291	1.022451	0.770108
25%	10.750000	20.00000	1.609383	1.593797	1.360320
50%	20.500000	27.50000	1.969031	2.065531	1.734101
75%	30.250000	37.75000	2.390499	2.613530	2.381552
max	40.000000	63.00000	5.542596	4.126650	5.306633

Parametric T-test

Appreciator Right: [Alpha-0.05]

```
Before stimulus & During stimulus Right side data:
Statistics=-0.140, p=0.889
Same distribution (fail to reject H0)
```

```
Before stimulus & After stimulus Right side data:
Statistics=1.848, p=0.075
Same distribution (fail to reject H0)
```

```
During stimulus & After stimulus Right side data:
Statistics=-1.891, p=0.069
Same distribution (fail to reject H0)
```

Appreciator Left: [Alpha-0.05]

```
Before stimulus & During stimulus Left side data:
Statistics=0.121, p=0.905
Same distribution (fail to reject H0)
```

```
Before stimulus & After stimulus Left side data:
Statistics=1.749, p=0.091
Same distribution (fail to reject H0)
```

```
During stimulus & After stimulus Left side data:
Statistics=1.186, p=0.245
Same distribution (fail to reject H0)
```

Non-Appreciator Right: [Alpha-0.05]

```
Before stimulus & During stimulus Right side data:
Statistics=-0.607, p=0.557
Same distribution (fail to reject H0)
```

```
Before stimulus & After stimulus Right side data:
Statistics=-0.071, p=0.945
Same distribution (fail to reject H0)
```

```
During stimulus & After stimulus Right side data:
Statistics=-0.491, p=0.634
Same distribution (fail to reject H0)
```

Non-Appreciator Left: [Alpha-0.05]

```
Before stimulus & During stimulus Left side data:
Statistics=-1.048, p=0.319
Same distribution (fail to reject H0)
```

```
Before stimulus & After stimulus Left side data:
Statistics=-0.054, p=0.958
Same distribution (fail to reject H0)
```

```
During stimulus & After stimulus Left side data:
Statistics=0.790, p=0.448
Same distribution (fail to reject H0)
```

Annova

Right Appreciator

```
Statistics=0.792, p=0.456
```

Left Appreciator

```
Statistics=0.360, p=0.699
```

Right Non – Appreciator

```
Statistics=0.024, p=0.977
```

Left Non – Appreciator

```
Statistics=0.038, p=0.963
```

Non – Parametric **[Wilcoxon Test]**

Appreciator right

```
Before stimulus & During stimulus Right side data:
Statistics=210.000, p=0.871
Same distribution (fail to reject H0)

Before stimulus & After stimulus Right side data:
Statistics=136.000, p=0.078
Same distribution (fail to reject H0)

After stimulus & During stimulus Right side data:
Statistics=131.000, p=0.061
Same distribution (fail to reject H0)
```

Appreciator left

```
Before stimulus & During stimulus Left side data:
Statistics=194.000, p=0.611
Same distribution (fail to reject H0)

Before stimulus & After stimulus Left side data:
Statistics=134.000, p=0.071
Same distribution (fail to reject H0)

After stimulus & During stimulus Left side data:
Statistics=156.000, p=0.184
Same distribution (fail to reject H0)
```

Non - Appreciator right

```
Before stimulus & During stimulus Right side data:
Statistics=26.000, p=0.534
Same distribution (fail to reject H0)

Before stimulus & After stimulus Right side data:
Statistics=26.000, p=0.534
Same distribution (fail to reject H0)

After stimulus & During stimulus Right side data:
Statistics=33.000, p=1.000
Same distribution (fail to reject H0)
```

Non - Appreciator left

```
Before stimulus & During stimulus Left side data:
Statistics=21.000, p=0.286
Same distribution (fail to reject H0)

Before stimulus & After stimulus Left side data:
Statistics=33.000, p=1.000
Same distribution (fail to reject H0)

After stimulus & During stimulus Left side data:
Statistics=31.000, p=0.859
Same distribution (fail to reject H0)
```

Man-Whitney Test

Appreciator Right

```
Before stimulus & During stimulus Right side data:
Statistics=419.500, p=0.497
Same distribution (fail to reject H0)

Before stimulus & After stimulus Right side data:
Statistics=357.000, p=0.164
Same distribution (fail to reject H0)

After stimulus & During stimulus Right side data:
Statistics=365.000, p=0.196
Same distribution (fail to reject H0)
```

Appreciator Left

```
Before stimulus & During stimulus Left side data:
Statistics=398.000, p=0.366
Same distribution (fail to reject H0)

Before stimulus & After stimulus Left side data:
Statistics=339.000, p=0.104
Same distribution (fail to reject H0)

After stimulus & During stimulus Left side data:
Statistics=326.000, p=0.072
Same distribution (fail to reject H0)
```

Non-Appreciator Right

```
Before stimulus & During stimulus Right side data:
Statistics=58.000, p=0.448
Same distribution (fail to reject H0)

Before stimulus & After stimulus Right side data:
Statistics=59.000, p=0.474
Same distribution (fail to reject H0)

After stimulus & During stimulus Right side data:
Statistics=59.000, p=0.474
Same distribution (fail to reject H0)
```

Non-Appreciator Left

```
Before stimulus & During stimulus Left side data:
Statistics=58.000, p=0.448
Same distribution (fail to reject H0)

Before stimulus & After stimulus Left side data:
Statistics=58.000, p=0.448
Same distribution (fail to reject H0)

After stimulus & During stimulus Left side data:
Statistics=59.000, p=0.474
Same distribution (fail to reject H0)
```

Asymmetric

T-test Appreciator

```
Before stimulus & During stimulus:
Statistics=-0.024, p=0.981
Same distribution (fail to reject H0)
```

```
After stimulus & Before stimulus:
Statistics=2.222, p=0.035
Different distribution (reject H0)
```

```
After stimulus & During stimulus:
Statistics=1.835, p=0.077
Same distribution (fail to reject H0)
```

T-test Non-Appreciator

```
Before stimulus & During stimulus:
Statistics=-0.970, p=0.355
Same distribution (fail to reject H0)
```

```
After stimulus & Before stimulus:
Statistics=-0.074, p=0.942
Same distribution (fail to reject H0)
```

```
After stimulus & During stimulus:
Statistics=0.671, p=0.518
Same distribution (fail to reject H0)
```

Annova for 'A' and 'N'

```
[39] l = total_data.loc[total_data['Rating']=='A']['Before']
     m = total_data.loc[total_data['Rating']=='A']['During']
     n = total_data.loc[total_data['Rating']=='A']['After']

     F, p = scst.f_oneway(l,m,n)
     print('Statistics=%.3f, p=%.3f' % (F, p))

     Statistics=0.748, p=0.477

     l = total_data.loc[total_data['Rating']=='N']['Before']
     m = total_data.loc[total_data['Rating']=='N']['During']
     n = total_data.loc[total_data['Rating']=='N']['After']

     F, p = scst.f_oneway(l,m,n)
     print('Statistics=%.3f, p=%.3f' % (F, p))

     Statistics=0.033, p=0.967
```

Non Parametric Wilcoxon

Appreciator

```
Before stimulus & During stimulus Right side data:
Statistics=210.000, p=0.871
Same distribution (fail to reject H0)

Before stimulus & After stimulus Right side data:
Statistics=118.000, p=0.031
Different distribution (reject H0)

After stimulus & During stimulus Right side data:
Statistics=148.000, p=0.133
Same distribution (fail to reject H0)
```

Non-Appreciator

```
Before stimulus & During stimulus Right side data:
Statistics=20.000, p=0.248
Same distribution (fail to reject H0)

Before stimulus & After stimulus Right side data:
Statistics=31.000, p=0.859
Same distribution (fail to reject H0)

After stimulus & During stimulus Right side data:
Statistics=33.000, p=1.000
Same distribution (fail to reject H0)
```

F-Theta

Right and Left Brain F-theta

```
[ ] print('Right brain reading descriptive data:')
    f_right_data.describe()
```

Right brain reading descriptive data:

	Subject No	age	BS - sum	DS - sum	AS - sum
count	41.000000	41.000000	41.000000	41.000000	41.000000
mean	21.000000	30.756098	2.988494	2.931721	3.004317
std	11.979149	11.148499	0.644221	0.600782	0.625231
min	1.000000	17.000000	1.774952	1.798404	1.860975
25%	11.000000	20.000000	2.517696	2.587764	2.512846
50%	21.000000	28.000000	2.982140	2.924773	3.032064
75%	31.000000	40.000000	3.404857	3.245323	3.459781
max	41.000000	63.000000	4.646888	4.747711	4.645256

```
print('Left brain reading descriptive data:')
f_left_data.describe()
```

Left brain reading descriptive data:

	Subject No	age	BS - sum	DS - sum	AS - sum
count	41.000000	41.000000	41.000000	41.000000	41.000000
mean	21.000000	30.756098	3.088908	3.189903	3.082170
std	11.979149	11.148499	0.678456	0.715495	0.624376
min	1.000000	17.000000	1.607436	1.947338	2.144761
25%	11.000000	20.000000	2.621766	2.583998	2.698673
50%	21.000000	28.000000	3.163363	3.203965	3.017983
75%	31.000000	40.000000	3.624074	3.609295	3.438172

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Hypothesis

Hypotheses for paired t-test

H00 --> μb = μd

H01 --> μb = μa

H02 --> μd = μa

H10 --> μb =/= μd

H11 --> μb =/= μa

H12 --> μd =/= μa

Assume the threshold value for p to be 0.05:

Parametric T- test Appreciator right

```
Before stimulus & During stimulus Right side data:
Statistics=1.998, p=0.056
Same distribution (fail to reject H0)
```

```
Before stimulus & After stimulus Right side data:
Statistics=0.667, p=0.510
Same distribution (fail to reject H0)
```

```
During stimulus & After stimulus Right side data:
Statistics=0.902, p=0.375
Same distribution (fail to reject H0)
```

Parametric T- test Appreciator left

```
Before stimulus & During stimulus Left side data:
Statistics=-1.415, p=0.168
Same distribution (fail to reject H0)
```

```
Before stimulus & After stimulus Left side data:
Statistics=0.594, p=0.557
Same distribution (fail to reject H0)
```

```
During stimulus & After stimulus Left side data:
Statistics=1.803, p=0.082
Same distribution (fail to reject H0)
```

Non-Appreciator Right

```
Before stimulus & During stimulus Right side data:
Statistics=-0.476, p=0.644
Same distribution (fail to reject H0)
```

```
Before stimulus & After stimulus Right side data:
Statistics=-0.955, p=0.360
Same distribution (fail to reject H0)
```

```
During stimulus & After stimulus Right side data:
Statistics=0.830, p=0.424
Same distribution (fail to reject H0)
```

Non-Appreciator Left

```
Before stimulus & During stimulus Left side data:
Statistics=-0.346, p=0.736
Same distribution (fail to reject H0)
```

```
Before stimulus & After stimulus Left side data:
Statistics=-1.018, p=0.331
Same distribution (fail to reject H0)
```

```
During stimulus & After stimulus Left side data:
Statistics=-1.512, p=0.159
Same distribution (fail to reject H0)
```

Annova

Right Appreciator

```
[ ] l = f_right_data.loc[f_right_data['Rating']=='A']['BS - sum']
    m = f_right_data.loc[f_right_data['Rating']=='A']['DS - sum']
    n = f_right_data.loc[f_right_data['Rating']=='A']['AS - sum']

    F, p = scst.f_oneway(l,m,n)
    print('Statistics=%.3f, p=%.3f' % (F, p))

    Statistics=0.218, p=0.805
```

Left Appreciator

```
    l = f_left_data.loc[f_left_data['Rating']=='A']['BS - sum']
    m = f_left_data.loc[f_left_data['Rating']=='A']['DS - sum']
    n = f_left_data.loc[f_left_data['Rating']=='A']['AS - sum']

    F, p = scst.f_oneway(l,m,n)
    print('Statistics=%.3f, p=%.3f' % (F, p))

    Statistics=0.640, p=0.530
```

Right Non - Appreciator

```
l = f_right_data.loc[f_right_data['Rating']=='N']['BS - sum']
m = f_right_data.loc[f_right_data['Rating']=='N']['DS - sum']
n = f_right_data.loc[f_right_data['Rating']=='N']['AS - sum']

F, p = scst.f_oneway(l,m,n)
print('Statistics=%.3f, p=%.3f' % (F, p))
```

```
Statistics=0.327, p=0.724
```

Left Non - Appreciator

```
l = f_left_data.loc[f_left_data['Rating']=='N']['BS - sum']
m = f_left_data.loc[f_left_data['Rating']=='N']['D
n = f_left_data.loc[f_left_data['Rating']=='N']['AS - sum']

F, p = scst.f_oneway(l,m,n)
print('Statistics=%.3f, p=%.3f' % (F, p))
```

Loading...

```
Statistics=0.079, p=0.924
```

Non – Parametric Wilcoxon Test

Appreciator right

```
Before stimulus & During stimulus Right side data:
Statistics=158.000, p=0.198
Same distribution (fail to reject H0)

Before stimulus & After stimulus Right side data:
Statistics=183.000, p=0.456
Same distribution (fail to reject H0)

After stimulus & During stimulus Right side data:
Statistics=195.000, p=0.627
Same distribution (fail to reject H0)
```

```
Before stimulus & During stimulus Left side data:
Statistics=145.000, p=0.117
Same distribution (fail to reject H0)

Before stimulus & After stimulus Left side data:
Statistics=158.000, p=0.198
Same distribution (fail to reject H0)

After stimulus & During stimulus Left side data:
Statistics=135.000, p=0.074
Same distribution (fail to reject H0)
```

Non - Appreciator right

```
Before stimulus & During stimulus Right side data:
Statistics=35.000, p=0.754
Same distribution (fail to reject H0)

Before stimulus & After stimulus Right side data:
Statistics=29.000, p=0.433
Same distribution (fail to reject H0)

After stimulus & During stimulus Right side data:
Statistics=27.000, p=0.347
Same distribution (fail to reject H0)
```

Non - Appreciator left

```
Before stimulus & During stimulus Left side data:
Statistics=37.000, p=0.875
Same distribution (fail to reject H0)

Before stimulus & After stimulus Left side data:
Statistics=33.000, p=0.638
Same distribution (fail to reject H0)

After stimulus & During stimulus Left side data:
Statistics=23.000, p=0.209
Same distribution (fail to reject H0)
```

Man-Whitney Test

Appreciator Right

```
Before stimulus & During stimulus Right side data:
Statistics=393.000, p=0.337
Same distribution (fail to reject H0)

Before stimulus & After stimulus Right side data:
Statistics=402.000, p=0.390
Same distribution (fail to reject H0)

After stimulus & During stimulus Right side data:
Statistics=399.000, p=0.372
Same distribution (fail to reject H0)
```

Appreciator Left

```
Before stimulus & During stimulus Left side data:
Statistics=372.000, p=0.228
Same distribution (fail to reject H0)

Before stimulus & After stimulus Left side data:
Statistics=381.500, p=0.275
Same distribution (fail to reject H0)

After stimulus & During stimulus Left side data:
Statistics=331.000, p=0.083
Same distribution (fail to reject H0)
```

Non - Appreciator Right

```
Before stimulus & During stimulus Right side data:
Statistics=66.500, p=0.386
Same distribution (fail to reject H0)

Before stimulus & After stimulus Right side data:
Statistics=57.000, p=0.201
Same distribution (fail to reject H0)

After stimulus & During stimulus Right side data:
Statistics=58.000, p=0.218
Same distribution (fail to reject H0)
```

Non - Appreciator Left

```
Before stimulus & During stimulus Left side data:
Statistics=71.000, p=0.488
Same distribution (fail to reject H0)

Before stimulus & After stimulus Left side data:
Statistics=71.000, p=0.488
Same distribution (fail to reject H0)

After stimulus & During stimulus Left side data:
Statistics=67.000, p=0.398
Same distribution (fail to reject H0)
```

Asymmetric

T-test Appreciator

```
Before stimulus & During stimulus:
Statistics=-0.147, p=0.884
Same distribution (fail to reject H0)
```

```
After stimulus & Before stimulus:
Statistics=0.737, p=0.467
Same distribution (fail to reject H0)
```

```
After stimulus & During stimulus:
Statistics=0.862, p=0.396
Same distribution (fail to reject H0)
```

Non – Appreciator

```
Before stimulus & During stimulus:
Statistics=-0.491, p=0.633
Same distribution (fail to reject H0)
```

```
After stimulus & Before stimulus:
Statistics=-1.127, p=0.284
Same distribution (fail to reject H0)
```

```
After stimulus & During stimulus:
Statistics=-1.124, p=0.285
Same distribution (fail to reject H0)
```

Annova

```
[ ] l = total_data.loc[total_data['Rating']=='A']['BS - sum']
    m = total_data.loc[total_data['Rating']=='A']['DS - sum']
    n = total_data.loc[total_data['Rating']=='A']['AS - sum']

    F, p = scst.f_oneway(l,m,n)
    print('Statistics=%.3f, p=%.3f' % (F, p))

    Statistics=0.086, p=0.917

    l = total_data.loc[total_data['Rating']=='N']['BS - sum']
    m = total_data.loc[total_data['Rating']=='N']['DS - sum']
    n = total_data.loc[total_data['Rating']=='N']['AS - sum']

    F, p = scst.f_oneway(l,m,n)
    print('Statistics=%.3f, p=%.3f' % (F, p))

    Statistics=0.198, p=0.822
```

Non Parametric Wilcoxon

Appreciator

```
Before stimulus & During stimulus Right side data:
Statistics=195.000, p=0.627
Same distribution (fail to reject H0)

Before stimulus & After stimulus Right side data:
Statistics=177.000, p=0.381
Same distribution (fail to reject H0)

After stimulus & During stimulus Right side data:
Statistics=161.000, p=0.222
Same distribution (fail to reject H0)
```

Non Appreciator

```
Before stimulus & During stimulus Right side data:
Statistics=38.000, p=0.937
Same distribution (fail to reject H0)

Before stimulus & After stimulus Right side data:
Statistics=32.000, p=0.583
Same distribution (fail to reject H0)

After stimulus & During stimulus Right side data:
Statistics=28.000, p=0.388
Same distribution (fail to reject H0)
```

Conclusion:

The F-theta and O-theta data consists of appreciater (Someone who responded significantly to the stimuli) and non appreciater. So their p value would be less than threshold value and this something we found by the results we worked on. Parametric(T-Test) and Non Parametric (Wilcoxon and Mann Whitney) test was undertaken and results of the hypothesis is mentioned below each cell