In [ ]:
```
#Load statistical analysis
import pandas as pd
from scipy.stats import f_oneway
from statsmodels.stats.multicomp import pairwise_tukeyhsd
```

In [ ]:
```
anova_data = pd.read_csv('treatment1.csv')
anova_data
```

Out[ ]:

	Variables	PR1	PR2	PR3	DR1	DR2	DR3	MR1	MR2	MR3
0	CONTROL	18.98	17.21	19.04	432.0	441.0	426.1	124.8	124.38	119.25
1	NHT0254b	5.72	6.21	5.96	552.6	554.9	550.0	132.1	136.25	124.54
2	NHT0356b	4.41	4.56	4.87	571.0	572.0	570.0	116.1	110.24	121.24
3	NGB00699	0.04	0.05	0.04	622.0	618.0	626.0	127.2	135.04	126.58
4	NHT0206a	-10.04	-9.97	-10.11	681.8	697.0	665.0	131.8	141.60	121.77
5	NHT100	2.36	2.45	2.29	672.3	683.0	661.0	80.2	84.67	83.22
6	NHT0199c	-2.23	-2.22	-3.01	670.1	662.0	678.0	148.7	149.97	150.37
7	NGB00733	-6.91	-6.48	-7.16	448.3	441.0	455.0	187.3	198.44	185.07
8	NGB00739	-6.84	-7.11	-6.90	509.0	516.0	503.0	250.2	265.54	251.25
9	NHT034a	-4.37	-4.87	-4.55	527.1	532.0	522.0	231.5	247.88	232.30
10	NHT0226a	-0.34	-0.38	-0.42	858.3	857.0	859.0	275.1	259.23	270.83
11	NHT0339a	-0.76	-0.87	-0.72	551.7	552.0	549.0	104.9	106.26	102.91
12	NHT0366	2.60	2.99	2.41	539.4	533.1	542.6	251.6	235.57	249.43
13	NHT0216a	-2.37	-2.39	-2.36	546.7	549.3	556.2	455.0	458.44	478.92
14	NHT0355a	6.67	6.22	6.41	455.0	457.0	451.0	142.5	148.81	145.04
15	NHT0259a	0.41	0.42	0.44	1403.7	1413.2	1297.9	273.5	267.01	269.43
16	NGB00713	1.23	1.39	1.32	296.8	287.0	310.7	221.1	234.32	207.67

In [ ]:
```
# Reshape the data to long format for Data P
data_pt = anova_data.melt(id_vars='Variables', value_vars=['PR1', 'PR2', 'PR3'],
```

In [ ]:
```
# Group the data by 'PT' and collect all values into lists (for ANOVA)
grouped_data = data_pt.groupby('Variables')['Value'].apply(list)

# Perform one-way ANOVA
anova_result = f_oneway(*grouped_data)
anova_result
```

Out[ ]:
```
F_onewayResult(statistic=1222.0654819131378, pvalue=4.035409587598977e-42)
```

In [ ]:
```
# Perform Tukey's HSD test (ANOVA - POSTHOC)
tukey_result = pairwise_tukeyhsd(endog=data_pt['Value'], groups=data_pt['Variabl
result = tukey_result.summary()
pd.DataFrame(result).head(17)
```

Out[ ]:

	0	1	2	3	4	5	6
0	group1	group2	meandiff	p-adj	lower	upper	reject
1	CONTROL	NGB00699	-18.3667	0.0	-19.3489	-17.3845	True
2	CONTROL	NGB00713	-17.0967	0.0	-18.0789	-16.1145	True
3	CONTROL	NGB00733	-25.26	0.0	-26.2422	-24.2778	True
4	CONTROL	NGB00739	-25.36	0.0	-26.3422	-24.3778	True
5	CONTROL	NHT0199c	-20.8967	0.0	-21.8789	-19.9145	True
6	CONTROL	NHT0206a	-28.45	0.0	-29.4322	-27.4678	True
7	CONTROL	NHT0216a	-20.7833	0.0	-21.7655	-19.8011	True
8	CONTROL	NHT0226a	-18.79	0.0	-19.7722	-17.8078	True
9	CONTROL	NHT0254b	-12.4467	0.0	-13.4289	-11.4645	True
10	CONTROL	NHT0259a	-17.9867	0.0	-18.9689	-17.0045	True
11	CONTROL	NHT0339a	-19.1933	0.0	-20.1755	-18.2111	True
12	CONTROL	NHT034a	-23.0067	0.0	-23.9889	-22.0245	True
13	CONTROL	NHT0355a	-11.9767	0.0	-12.9589	-10.9945	True
14	CONTROL	NHT0356b	-13.7967	0.0	-14.7789	-12.8145	True
15	CONTROL	NHT0366	-15.7433	0.0	-16.7255	-14.7611	True
16	CONTROL	NHT100	-16.0433	0.0	-17.0255	-15.0611	True

In [ ]:
```
# Reshape the data to long format for Data D
data_dt = anova_data.melt(id_vars='Variables', value_vars=['DR1', 'DR2', 'DR3'],
```

In [ ]:
```
# Group the data by 'DT' and collect all values into lists (for ANOVA)
grouped_data = data_dt.groupby('Variables')['Value'].apply(list)

# Perform one-way ANOVA
anova_result = f_oneway(*grouped_data)
anova_result
```

Out[ ]:
```
F_onewayResult(statistic=559.9403788059761, pvalue=2.2236079411906107e-36)
```

In [ ]:
```
# Perform Tukey's HSD test (ANOVA - POSTHOC)
tukey_result = pairwise_tukeyhsd(endog=data_dt['Value'], groups=data_dt['Variabl
result = tukey_result.summary()
pd.DataFrame(result).head(17)
```

Out[ ]:

	0	1	2	3	4	5	6
0	group1	group2	meandiff	p-adj	lower	upper	reject
1	CONTROL	NGB00699	188.9667	0.0	137.076	240.8573	True
2	CONTROL	NGB00713	-134.8667	0.0	-186.7573	-82.976	True
3	CONTROL	NGB00733	15.0667	0.9994	-36.824	66.9573	False
4	CONTROL	NGB00739	76.3	0.0004	24.4094	128.1906	True
5	CONTROL	NHT0199c	237.0	0.0	185.1094	288.8906	True
6	CONTROL	NHT0206a	248.2333	0.0	196.3427	300.124	True
7	CONTROL	NHT0216a	117.7	0.0	65.8094	169.5906	True
8	CONTROL	NHT0226a	425.0667	0.0	373.176	476.9573	True
9	CONTROL	NHT0254b	119.4667	0.0	67.576	171.3573	True
10	CONTROL	NHT0259a	938.5667	0.0	886.676	990.4573	True
11	CONTROL	NHT0339a	117.8667	0.0	65.976	169.7573	True
12	CONTROL	NHT034a	94.0	0.0	42.1094	145.8906	True
13	CONTROL	NHT0355a	21.3	0.9765	-30.5906	73.1906	False
14	CONTROL	NHT0356b	137.9667	0.0	86.076	189.8573	True
15	CONTROL	NHT0366	105.3333	0.0	53.4427	157.224	True
16	CONTROL	NHT100	239.0667	0.0	187.176	290.9573	True

In [ ]:
```
# Reshape the data to long format for Data M
data_mt = anova_data.melt(id_vars='Variables', value_vars=['MR1', 'MR2', 'MR3'],
```

In [ ]:
```
# Group the data by 'DT' and collect all values into lists (for ANOVA)
grouped_data = data_mt.groupby('Variables')['Value'].apply(list)

# Perform one-way ANOVA
anova_result = f_oneway(*grouped_data)
anova_result
```

Out[ ]:
```
F_onewayResult(statistic=487.3239911336594, pvalue=2.326973292243675e-35)
```

In [ ]:
```
# Perform Tukey's HSD test (ANOVA - POSTHOC)
tukey_result = pairwise_tukeyhsd(endog=data_mt['Value'], groups=data_mt['Variabl
result = tukey_result.summary()
pd.DataFrame(result).head(17)
```

Out[ ]:

	0	1	2	3	4	5	6
0	group1	group2	meandiff	p-adj	lower	upper	reject
1	CONTROL	NGB00699	6.7967	0.9989	-15.6451	29.2385	False
2	CONTROL	NGB00713	98.22	0.0	75.7782	120.6618	True
3	CONTROL	NGB00733	67.46	0.0	45.0182	89.9018	True
4	CONTROL	NGB00739	132.8533	0.0	110.4115	155.2951	True
5	CONTROL	NHT0199c	26.87	0.0076	4.4282	49.3118	True
6	CONTROL	NHT0206a	8.9133	0.9825	-13.5285	31.3551	False
7	CONTROL	NHT0216a	341.31	0.0	318.8682	363.7518	True
8	CONTROL	NHT0226a	145.5767	0.0	123.1349	168.0185	True
9	CONTROL	NHT0254b	8.1533	0.9926	-14.2885	30.5951	False
10	CONTROL	NHT0259a	147.17	0.0	124.7282	169.6118	True
11	CONTROL	NHT0339a	-18.12	0.2333	-40.5618	4.3218	False
12	CONTROL	NHT034a	114.4167	0.0	91.9749	136.8585	True
13	CONTROL	NHT0355a	22.64	0.0462	0.1982	45.0818	True
14	CONTROL	NHT0356b	-6.95	0.9986	-29.3918	15.4918	False
15	CONTROL	NHT0366	122.7233	0.0	100.2815	145.1651	True
16	CONTROL	NHT100	-40.1133	0.0	-62.5551	-17.6715	True