

Ttest_Anova

November 11, 2020

```
[2]: import pandas as pd
import numpy as np
import scipy.stats as stats
import matplotlib.pyplot as plt
```

```
[3]: filepath = "Vertical_Merge.csv"
df = pd.read_csv(filepath)
df.head()
```

```
[3]:      Country  Happiness Rank  Happiness Score  Economy (GDP per Capita) \
0  Switzerland                1           7.587      1.39651
1    Iceland                2           7.561      1.30232
2   Denmark                3           7.527      1.32548
3    Norway                4           7.522      1.45900
4    Canada                5           7.427      1.32629
```

```
      Social Support  Health Life Expectancy  Freedom \
0          1.34951           0.94143  0.66557
1          1.40223           0.94784  0.62877
2          1.36058           0.87464  0.64938
3          1.33095           0.88521  0.66973
4          1.32261           0.90563  0.63297
```

```
      Trust (Government Corruption)  Generosity  Year
0              0.41978           0.29678  2015
1              0.14145           0.43630  2015
2              0.48357           0.34139  2015
3              0.36503           0.34699  2015
4              0.32957           0.45811  2015
```

```
[4]: mask = (df["Happiness Rank"]<= 10) & (df["Year"]==2015)
df_2015 = df.loc[mask].reset_index(drop = True)

df_2015
```

```
[4]:      Country  Happiness Rank  Happiness Score  Economy (GDP per Capita) \
0  Switzerland                1           7.587      1.39651
```

1	Iceland	2	7.561	1.30232
2	Denmark	3	7.527	1.32548
3	Norway	4	7.522	1.45900
4	Canada	5	7.427	1.32629
5	Finland	6	7.406	1.29025
6	Netherlands	7	7.378	1.32944
7	Sweden	8	7.364	1.33171
8	New Zealand	9	7.286	1.25018
9	Australia	10	7.284	1.33358

	Social Support	Health Life Expectancy	Freedom \
0	1.34951	0.94143	0.66557
1	1.40223	0.94784	0.62877
2	1.36058	0.87464	0.64938
3	1.33095	0.88521	0.66973
4	1.32261	0.90563	0.63297
5	1.31826	0.88911	0.64169
6	1.28017	0.89284	0.61576
7	1.28907	0.91087	0.65980
8	1.31967	0.90837	0.63938
9	1.30923	0.93156	0.65124

	Trust (Government Corruption)	Generosity	Year
0	0.41978	0.29678	2015
1	0.14145	0.43630	2015
2	0.48357	0.34139	2015
3	0.36503	0.34699	2015
4	0.32957	0.45811	2015
5	0.41372	0.23351	2015
6	0.31814	0.47610	2015
7	0.43844	0.36262	2015
8	0.42922	0.47501	2015
9	0.35637	0.43562	2015

```
[5]: mask = (df["Happiness Rank"] <= 10) & (df["Year"] == 2020)

df_2020 = df.loc[mask].reset_index(drop = True)

df_2020
```

```
[5]:
```

	Country	Happiness Rank	Happiness Score	Economy (GDP per Capita) \
0	Finland	1	7.8087	1.063927
1	Denmark	2	7.6456	1.077400
2	Switzerland	3	7.5599	1.097993
3	Iceland	4	7.5045	1.077256
4	Norway	5	7.4880	1.108780
5	Netherlands	6	7.4489	1.081271

6	Sweden	7	7.3535	1.075879
7	New Zealand	8	7.2996	1.050094
8	Austria	9	7.2942	1.074282
9	Luxembourg	10	7.2375	1.145068

	Social Support	Health Life Expectancy	Freedom \
0	0.954330	0.719008	0.949172
1	0.955991	0.724025	0.951444
2	0.942847	0.741024	0.921337
3	0.974670	0.730000	0.948892
4	0.952487	0.732008	0.955750
5	0.939139	0.723009	0.908548
6	0.926311	0.726008	0.939144
7	0.949119	0.732026	0.936217
8	0.928046	0.730025	0.899989
9	0.906912	0.726000	0.905636

	Trust (Government Corruption)	Generosity	Year
0	0.195445	-0.059482	2020
1	0.168489	0.066202	2020
2	0.303728	0.105911	2020
3	0.711710	0.246944	2020
4	0.263218	0.134533	2020
5	0.364717	0.207612	2020
6	0.250880	0.111615	2020
7	0.221139	0.191598	2020
8	0.499955	0.085429	2020
9	0.367084	-0.004621	2020

```
[6]: hap_mean_2020 = df_2020["Happiness Score"].mean()
hap_mean_2020
```

```
[6]: 7.4640399933
```

```
[7]: hap_mean_2015 = df_2015["Happiness Score"].mean()
hap_mean_2015
```

```
[7]: 7.4342
```

```
[8]: stats.ttest_ind(df_2015["Happiness Score"], df_2020["Happiness Score"],
↳equal_var = False)
```

```
[8]: Ttest_indResult(statistic=-0.45213664193404385, pvalue=0.657619517154341)
```

```
[9]: mask = (df["Happiness Rank"] >= 148) & (df["Year"] == 2015)
dflow_2015 = df.loc[mask].reset_index(drop = True)
```

```
dflow_2015
```

```
[9]:
```

	Country	Happiness Rank	Happiness Score	\
0	Central African Republic	148	3.678	
1	Chad	149	3.667	
2	Guinea	150	3.656	
3	Ivory Coast	151	3.655	
4	Burkina Faso	152	3.587	
5	Afghanistan	153	3.575	
6	Rwanda	154	3.465	
7	Benin	155	3.340	
8	Syria	156	3.006	
9	Burundi	157	2.905	
10	Togo	158	2.839	

	Economy (GDP per Capita)	Social Support	Health Life Expectancy	Freedom	\
0	0.07850	0.00000	0.06699	0.48879	
1	0.34193	0.76062	0.15010	0.23501	
2	0.17417	0.46475	0.24009	0.37725	
3	0.46534	0.77115	0.15185	0.46866	
4	0.25812	0.85188	0.27125	0.39493	
5	0.31982	0.30285	0.30335	0.23414	
6	0.22208	0.77370	0.42864	0.59201	
7	0.28665	0.35386	0.31910	0.48450	
8	0.66320	0.47489	0.72193	0.15684	
9	0.01530	0.41587	0.22396	0.11850	
10	0.20868	0.13995	0.28443	0.36453	

	Trust (Government Corruption)	Generosity	Year
0	0.08289	0.23835	2015
1	0.05269	0.18386	2015
2	0.12139	0.28657	2015
3	0.17922	0.20165	2015
4	0.12832	0.21747	2015
5	0.09719	0.36510	2015
6	0.55191	0.22628	2015
7	0.08010	0.18260	2015
8	0.18906	0.47179	2015
9	0.10062	0.19727	2015
10	0.10731	0.16681	2015

```
[10]: mask = (df["Happiness Rank"] >= 143) & (df["Year"] == 2020)

dflow_2020 = df.loc[mask].reset_index(drop = True)

dflow_2020
```

```
[10]:
```

	Country	Happiness Rank	Happiness Score \
0	Lesotho	143	3.6528
1	India	144	3.5733
2	Malawi	145	3.5380
3	Yemen	146	3.5274
4	Botswana	147	3.4789
5	Tanzania	148	3.4762
6	Central African Republic	149	3.4759
7	Rwanda	150	3.3123
8	Zimbabwe	151	3.2992
9	South Sudan	152	2.8166
10	Afghanistan	153	2.5669

	Economy (GDP per Capita)	Social Support	Health Life Expectancy \
0	0.796049	0.780496	0.480036
1	0.884982	0.592201	0.602152
2	0.706223	0.544007	0.575929
3	0.775968	0.817981	0.567273
4	0.971120	0.779122	0.589245
5	0.796767	0.688933	0.574961
6	0.662516	0.319460	0.452000
7	0.760010	0.540835	0.610988
8	0.786571	0.763093	0.556173
9	0.742536	0.553707	0.510000
10	0.746286	0.470367	0.525900

	Freedom Trust (Government Corruption)	Generosity	Year
0	0.738126	0.857392	-0.145732 2020
1	0.881445	0.772043	0.057552 2020
2	0.803223	0.731701	0.021433 2020
3	0.599920	0.800288	-0.157735 2020
4	0.821328	0.777931	-0.250394 2020
5	0.821540	0.619799	0.109669 2020
6	0.640881	0.891807	0.082410 2020
7	0.900589	0.183541	0.055484 2020
8	0.711458	0.810237	-0.072064 2020
9	0.451314	0.763417	0.016519 2020
10	0.396573	0.933687	-0.096429 2020

```
[11]: stats.ttest_ind(df_2020["Happiness Score"], dflow_2020["Happiness Score"],
↳equal_var = False)
```

```
[11]: Ttest_indResult(statistic=35.30332537640148, pvalue=4.0812612388392846e-16)
```

```
[12]: stats.ttest_ind(df_2015["Happiness Score"], dflow_2015["Happiness Score"],
↳equal_var = False)
```

```
[12]: Ttest_indResult(statistic=38.63289992322861, pvalue=2.4671262909346708e-14)
```

```
[13]: stats.ttest_ind(df_2015["Economy (GDP per Capita)"], dflow_2015["Economy (GDP_
      ↳per Capita)"], equal_var = False)
```

```
[13]: Ttest_indResult(statistic=18.676000717095384, pvalue=2.3049209127751346e-10)
```

```
[14]: group1 = df[df["Year"] == 2015] ["Economy (GDP per Capita)"]
      group2 = df[df["Year"] == 2016] ["Economy (GDP per Capita)"]
      group3 = df[df["Year"] == 2017] ["Economy (GDP per Capita)"]
      group4 = df[df["Year"] == 2018] ["Economy (GDP per Capita)"]
      group5 = df[df["Year"] == 2019] ["Economy (GDP per Capita)"]
      group6 = df[df["Year"] == 2020] ["Economy (GDP per Capita)"]
```

```
[15]: stats.f_oneway(group1, group2, group3, group4, group5, group6)
```

```
[15]: F_onewayResult(statistic=2.7965841239901525, pvalue=0.016250577893722376)
```

```
[16]: group_1 = df[df["Year"] == 2015] ["Happiness Score"]
      group_2 = df[df["Year"] == 2016] ["Happiness Score"]
      group_3 = df[df["Year"] == 2017] ["Happiness Score"]
      group_4 = df[df["Year"] == 2018] ["Happiness Score"]
      group_5 = df[df["Year"] == 2019] ["Happiness Score"]
      group_6 = df[df["Year"] == 2020] ["Happiness Score"]
```

```
[17]: stats.f_oneway(group_1, group_2, group_3, group_4, group_5, group_6)
```

```
[17]: F_onewayResult(statistic=0.2240305396190551, pvalue=0.9522023583869341)
```

```
[19]: mask = (df["Happiness Rank"] <= 3) & (df["Year"] == 2015)
      df_2015_3 = df.loc[mask].reset_index(drop = True)

      df_2015_3
```

```
[19]:
```

	Country	Happiness Rank	Happiness Score	Economy (GDP per Capita) \
0	Switzerland	1	7.587	1.39651
1	Iceland	2	7.561	1.30232
2	Denmark	3	7.527	1.32548

	Social Support	Health Life Expectancy	Freedom \
0	1.34951	0.94143	0.66557
1	1.40223	0.94784	0.62877
2	1.36058	0.87464	0.64938

	Trust (Government Corruption)	Generosity	Year
0	0.41978	0.29678	2015
1	0.14145	0.43630	2015

2 0.48357 0.34139 2015

```
[22]: mask = (df["Happiness Rank"] >= 151) & (df["Year"] == 2020)

dflow_2020_3 = df.loc[mask].reset_index(drop = True)

dflow_2020_3
```

```
[22]:
```

	Country	Happiness Rank	Happiness Score	Economy (GDP per Capita)	\
0	Zimbabwe	151	3.2992		0.786571
1	South Sudan	152	2.8166		0.742536
2	Afghanistan	153	2.5669		0.746286

	Social Support	Health Life Expectancy	Freedom	\
0	0.763093	0.556173	0.711458	
1	0.553707	0.510000	0.451314	
2	0.470367	0.525900	0.396573	

	Trust (Government Corruption)	Generosity	Year
0	0.810237	-0.072064	2020
1	0.763417	0.016519	2020
2	0.933687	-0.096429	2020

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