Mann-Whitney-U-test

non-parametric counterpart of the t-test

Data

- 2 groups/variables

4 required assumptions:

1. Dependent variable must be continuous or categorical (ordinal)
2. Independent variable consists of two categorical independent groups (e.g. female / male, employed/unemployed)
3. unpaired (independency of observations)
4. not normally distributed

Null-hypothesis (H0)

- Samples are not different
  - same distribution AND/OR same location

H1 Hypothesis:

- Samples are different
  - different distribution OR
  - same distribution BUT different location

Calculation

A. Sum of ranks (R1 and R2)
B. U values (U1 and U2)
C. Compare smallest U value to the critical value Uc in Mann-Whitney U Table

n1 \ n2	2	3	4	5	6	7	8
2							0
3				0	1	1	2
4			0	1	2	3	4
5		0	1	2	3	5	6
6		1	2	3	5	6	7
7		1	3	5	6	8	10
8	0	2	4	6	7	10	13

Result

- Reject H0 if U < Uc (P-value < 0.05)

Example

We want to know whether or not a new drug is effective at preventing panic attacks.
A total of **12 patients** are **randomly** split into **two groups of 6** and assigned to receive the **new drug or the placebo.** The patients then r**ecord how many panic attacks** they have over the course of one month.

NEW DRUG	PLACEBO
3	4
5	8
1	6
4	2
3	1
5	9

Figure 1: Number of panic attacks over a month time for each group (n=6)

=> Ranks:

Total Sample: 1, 1, 2, 3, 3, 4, 4, 5, 5, 6, 8, 9

Ranks: 1.5, 1.5, 3, 4.5, 4.5, 6.5, 6.5, 8.5, 8.5, 10, 11, 12

R_1 = sum of ranks for sample 1 = 1.5+4.5+4.5+6.5+8.5+8.5 = 34

R_2 = sum of ranks for sample 2 = 1.5+3+6.5+10+11+12 = 44

U1 = n1*n2 + n1(n1+1)/2 – R1 = 6*6 + 6*7/2 - 34 = 23

U2 = n1*n2 + n2(n2+1)/2 – R2 = 6*6 + 6*7/2 - 44 = **13**

13 > Uc(Table) => not different

https://www.statology.org/mann-whitney-u-test/

Conclusion

The manual test does not work the same as in Python

```
stats.mannwhitneyu(df_setosa['swidth'],df_virginica['swidth'], alternative='two-sided')
```

```
MannwhitneyuResult(statistic=2073.5, pvalue=1.1808768215413658e-08)
```

- Since it tests also for difference in the distribution, not only in the median, you can find difference for groups that would test non-different in t-tests e.g. :

  group 1: 2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2 mean and median = 2
  group 2: 0,0,0,0,0,0,0,0,4,4,4,4,4,4,4,4 mean and median = 2

- Does not give a p-value, use Kolmogorov-Smirnov Test to get a p value

Questions:

- In Python Kolmogorov-Smirnov test gives a significant p-value for the above dataset, while Mann-Whitney does not? Why? The distribution is clearly different…