Lesson 02: Understanding Distribution Shape in the Mann–Whitney U Test

When using the **Mann–Whitney U Test**, the **shape of the two distributions** being compared plays a crucial role in **what exactly** the test is telling you. This depends on whether the two distributions have **similar shapes** (e.g., both slightly skewed in the same way) or **different shapes** (e.g., one symmetric and one heavily skewed).

1. Why Shape Matters?

The Mann–Whitney U test works by ranking all data points from both groups together and comparing **the rank sums**. If one group systematically has **higher ranks**, it suggests that group tends to have larger scores.

However, this "tendency to have larger scores" can come from two different things:

1. A shift in **central tendency** (one group's scores are generally higher → difference in medians).
2. A change in **distribution shape or spread** (one group's data are more variable, skewed, or clustered).

That's why **before interpreting** a Mann–Whitney test, you must check whether the two groups have **similarly shaped distributions**.

2. Checking Shape in SPSS

In **SPSS**, you can check this by:

1. **Visual inspection:**
   o Go to *Graphs → Legacy Dialogs → Boxplot* or *Explore*.
   o Create side-by-side boxplots or histograms for the two groups.
   o Compare the shapes: Are both roughly symmetric? Or is one skewed left/right?
2. **Numerical indicators:**
   o Check *Descriptives → Explore* to view skewness and kurtosis.
   o Similar skewness signs and magnitudes usually indicate similar shapes.

Once you know whether the shapes are similar or different, interpret the **Mann–Whitney U test** accordingly.

Case 1: When the Two Distributions Have Similar Shapes

If both groups' distributions have **similar shapes** (e.g., both slightly right-skewed or both symmetric), the Mann–Whitney U test can be **interpreted as a test of median differences**.

Scenario:
A researcher compares **reading comprehension scores** (out of 50) between:

- Group A: Students taught using **explicit grammar instruction**
- Group B: Students taught using **task-based learning**

The data are **non-normal** but both groups' distributions are slightly right-skewed and **similarly shaped**.

SPSS Output (simplified):

- U = 210.5
- Asymp. Sig. (2-tailed) = .018
- Median (Group A) = 31.0
- Median (Group B) = 36.5

Interpretation:
Because both distributions have similar shapes, the difference can be attributed to the **medians**. A Mann–Whitney U test showed a significant difference in reading comprehension scores between students taught through task-based learning (Median = 36.5) and those taught through explicit grammar instruction (Median = 31.0), **U = 210.5, p = .018**. This indicates that the task-based group performed significantly better overall.

Case 2: When the Two Distributions Have Different Shapes

If the distributions are **not similarly shaped** (for instance, one is symmetric while the other is highly skewed or spread out), the Mann–Whitney U test no longer represents a comparison of medians. Instead, it detects **differences in the overall distribution** — meaning one group tends to have **higher or lower ranks**, but not necessarily a different median.

Scenario:
A researcher compares **students' anxiety ratings** (on a 1–5 Likert scale) between:

- Group A: Students in **online oral presentations**
- Group B: Students in **in-person oral presentations**

The distributions differ:

- The **online group**'s ratings cluster toward *high anxiety (4–5)* (right-skewed).
- The **in-person group**'s ratings spread more evenly across 1–5.

SPSS Output (simplified):

- U = 155.0
- p = .041
- Median (online) = 4.0
- Median (in-person) = 3.5

Interpretation:
Even though the medians are close (4.0 vs 3.5), the **shape** difference shows that the distributions vary overall — the online group's responses are more concentrated at the high end.
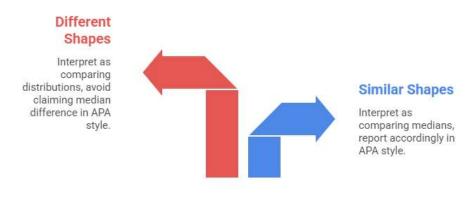A Mann–Whitney U test indicated a significant difference in the **distribution** of anxiety ratings between online and in-person presentation groups, **U = 155.0, p = .041**.
However, because the distributions have different shapes, the result reflects **differences in overall response patterns**, not in medians.

In summary:

- Always **visualize** your data before running Mann–Whitney U.
- If **shapes are similar**, interpret the test as comparing **medians** (central tendency).
- If **shapes differ**, interpret it as comparing **distributions** (spread, skewness, response patterns).
- Report accordingly in APA style — avoid claiming a "median difference" when shapes differ.

How to interpret Mann-Whitney U test results?

Different Shapes

Interpret as comparing distributions, avoid claiming median difference in APA style.

Similar Shapes

Interpret as comparing medians, report accordingly in APA style.

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