

# Analysis Summary

## ***Purpose of the analysis***

The purpose was to check whether there is a significant difference in the duration of tool window open episodes depending on the type of opening: manual (opened by the user) or automatic (opened by the IDE).

## ***Handling of unclean data***

- **Closure without prior opening** → ignore it (no episode).
- **Opening without closure (at the end of the record)** → the cycle is not saved.
- **Multiple openings and closings in an episode** → everything goes into one cycle, and the result is averaged using the median.
- **Lack of necessary data** (e.g. user ID, timestamp, type of opening) → do not consider this row.

## ***Assumptions***

- A single session is defined as a fragment of the record consisting of at least one open and at least one close. Each session can contain multiple opens and multiple closes.
- The session type (manual/auto) is defined by the most frequent type of tool window opening occurring in this fragment of the record, which determines the episode.

## ***Strategy for matching pairs***

### **1. Organising data**

Firstly, we sort all events in order – first by user, then by time. This gives us a chronological history of tool window openings and closings for every user.

### **2. Iteration through users**

For each user separately, we look for complete episodes that we can include in the statistics.

- **Starting a session:** The episode starts with the first opened event encountered in the user's sequence.
- **Processing events:**
  1. We go through all of the events for the user in time order.
  2. When we encounter an opened event, we add its timestamp to the open\_times list and its type to open\_types.
  3. Until we encounter the ending condition of the cycle, each successive opened or closed event goes into the same 'basket' (buffer)
- **Ending and saving a cycle:** an episode is saved only when:
  - we reach the last user event, or
  - the next event is a new opening

## ***Strategy for calculating durations***

We store all the timestamps for opening and closing events in separate lists (open\_times and close\_times). For each episode, we calculate the median timestamp from each list, then subtract the median opening time from the median closing time to obtain the duration of the single session. Also, we convert units of time into minutes so that the later results are more readable. This approach is necessary because, in cases with multiple opens and closes, we cannot reliably determine which timestamps correspond to each other, so taking the median provides a robust estimate of the typical start and end times.

## Summary statistics

	MANUAL	AUTO
Count	615	1007
Mean	34.6165205962	186.8693916832
Median	0.2153833333	3.6603166667
Std	244.0167473993	820.4655464604
Var	59544.1730113164	673163.7129285079
Min	0.0002500000	0.0025666667
Max	3702.3609666667	14938.3699166667
SEM	9.8397049506	25.8550637723
95% CI	(15.2929624799, 53.9400787125)	(136.1333562911, 237.6054270754)

### Mean, median, standard deviation and variance:

It can be observed that in both cases the mean differs significantly from the median. While the means are quite high, the medians are very low. In addition, the high values of standard deviation and variance indicate a very large dispersion of data, especially this in the “auto” group. This implies that the vast majority of window opening episodes were very short, and the mean is inflated by a small number of extremely high results.

### Minimum and maximum:

A very wide range of results in both categories – from a few seconds to several days. This confirms the conclusions from the point above.

### Standard Error of the Mean:

The SEM indicator suggests that the mean is better estimated for “manual” episodes, even though we have fewer such sessions. This is because the spread of durations is much greater for “auto” data, which increases the SEM.

### Confidence Interval (95%):

The CI tells us the range within which we can expect the mean value for the entire user population, with a 95% probability. From the result, we can conclude that the average durations of “auto” and “manual” episodes differ significantly (the intervals have no overlap).

**Overall conclusion:** We can say with a high degree of certainty that a typical manual session is much shorter than a typical automatic session.

## Further analysis

### Shapiro-Wilk test

*Manual*: statistic = 0.1221757827, pvalue = 2.155695305931276e-46

*Auto*: statistic = 0.2269427299, pvalue = 1.8356150045312375e-53

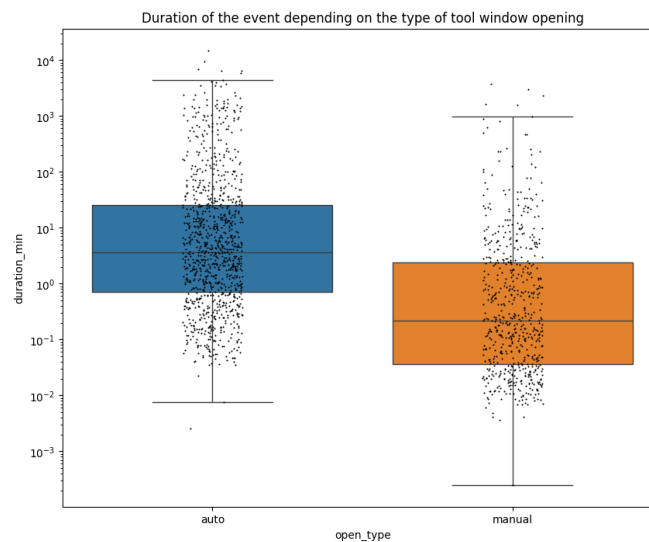
In both cases, we have very low p-values (much smaller than 0.05), which means that the distribution of the episode lengths is not a normal distribution in either case. In order to compare the distributions for the “auto” and “manual” data types, we will not use the Student's t-test, but instead we will use the Wilcoxon–Mann–Whitney test, which can be applied for any distribution.

### Wilcoxon–Mann–Whitney test

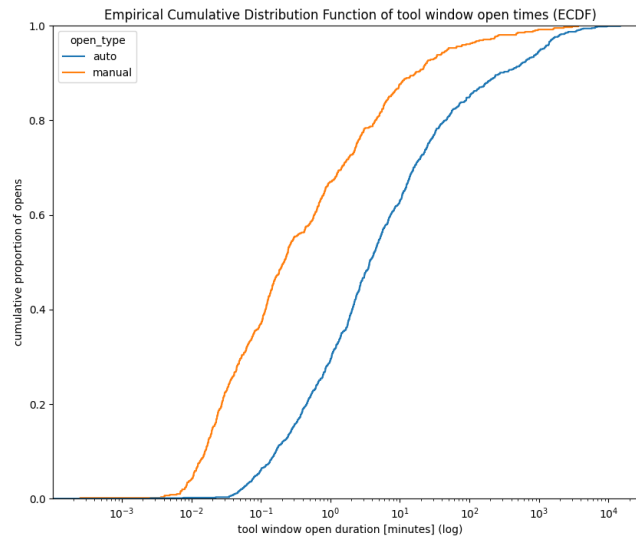
p-value: 1.2399536646141942e-66

We are dealing with an extremely low p-value (much smaller than 0.05), which means that the difference between the lengths of manual and automatic sessions is statistically significant.

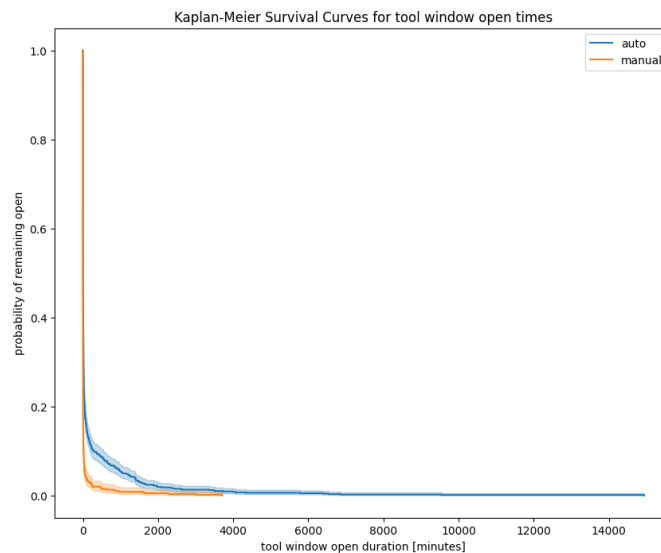
## Visualisations



**The box plot** confirms earlier assumptions. It is clear that the median of manual episodes is lower than the median of automatic episodes. In addition, the interquartile range is much greater for automatic sessions, which also have more outliers.



**The ECDF plot** shows the cumulative proportion of sessions relative to their duration (log scale on the x-axis). Manual sessions increase very quickly at short durations, indicating most end within seconds or minutes, while the curve for auto sessions rises more slowly, showing that many of them last longer than manual openings.



**The Kaplan-Meier survival curves** show the probability of a tool window remaining open over time. Manual sessions drop sharply, indicating most windows close within the first few minutes, while auto sessions decline more slowly, showing many last longer and some remain open for extended periods.

## Overall conclusions

**Manual sessions are short and relatively uniform, whereas auto sessions are longer, more variable, and include extreme cases. The type of window opening significantly affects how long it stays open, as confirmed by all three visualization and statistical tests.**