DATASET 1

Summary of ANOVA Test

	Df	Sum Sq	Mean Sq	F value	Pr(> F)
menu	3	0.7549	0.25164	2.975	0.0444
Residuals	36	3.0450	0.08458		

An ANOVA test was conducted to compare the performance of different menu styles on users with time as dependant variable and menu as independent variable. There were 4 different menu styles - toolglass, flowmenu, toolpalette, controlmenu. From the Anova test, we can get that $F(3, 36) = 2.975$, $p = 0.0444$. Since p value < 0.05, there is a statistical significant difference in the mean time between different menu styles.

Pairwise comparisons using t tests with pooled SD
(between time and menu)

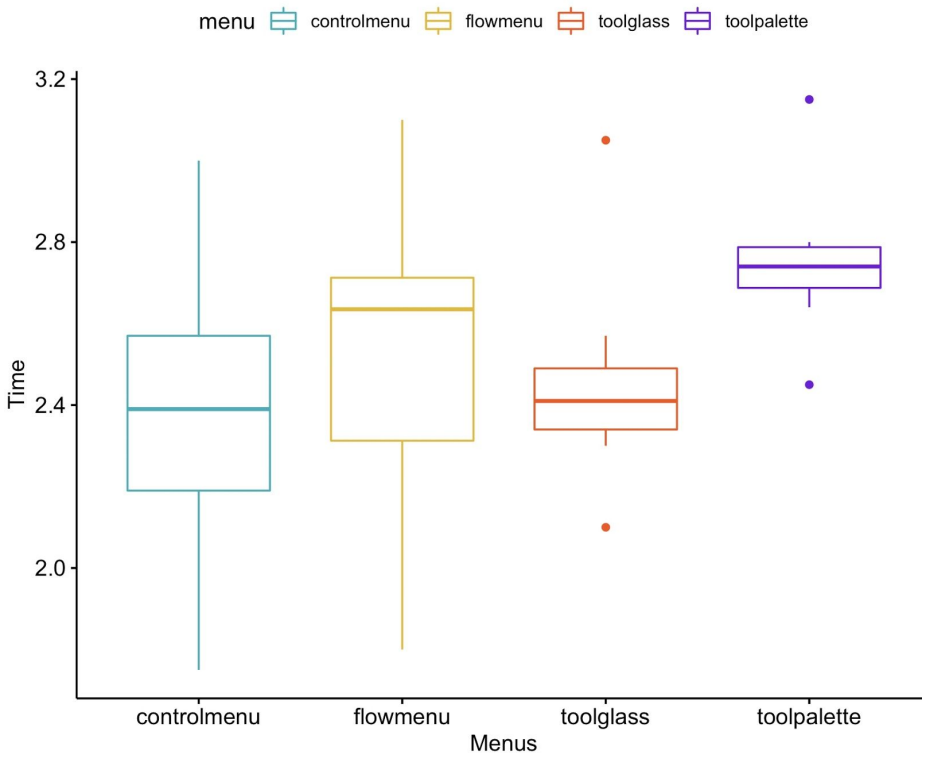
	controlmenu	flowmenu	toolglass
flowmenu	1.000	-	-
toolglass	1.000	1.000	-
toolpalette	0.047	0.596	0.173

P value adjustment method: **bonferroni**

These results indicate that there is a statistically significant difference between the toolpalette and controlmenu ($p = 0.047 < 0.05$). Also, the difference between distributions - (flowmenu and controlmenu) , (toolglass and controlmenu) , (toolglass and flowmenu) is 100% coming from random since their p-value = 1. Hence, these three pair of distributions very likely are the same. For the remaining distributions (toolpalette, flowmenu) and (toolpalette, toolglass) , they are considered conventionally statistically similar as their p-value > 0.05.

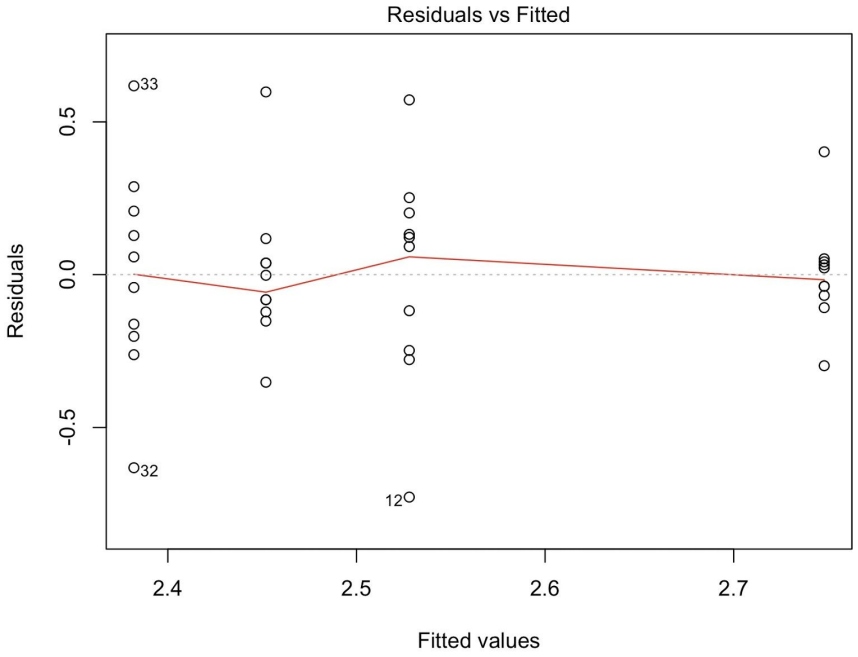
Visualizations:

Plot 1A



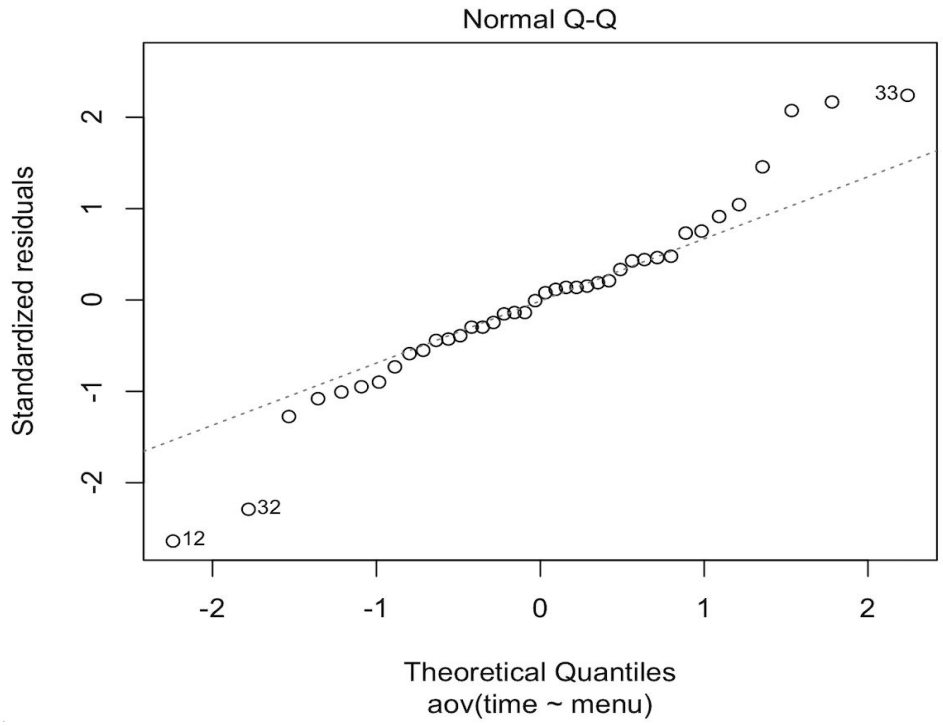
The above boxplots shows the summary of the distribution of each menu with respect to time. This plot makes it easy to compare the shape, the central tendency, and the variability of the time taken for each menu. The ends of the box are the first and third quartiles and the box spans the interquartile range. The median time is marked by a line in the middle inside this box. The vertical line ends show the two extreme times– lowest time and highest time. It can be observed that Tool palette is significantly slower than others**.** Also, Control menu is faster than FlowMenu but it is not significant. Also, Toolglass is faster than flowmenu and it can also be noted that Control menu is faster than Toolglass.

Plot 1B



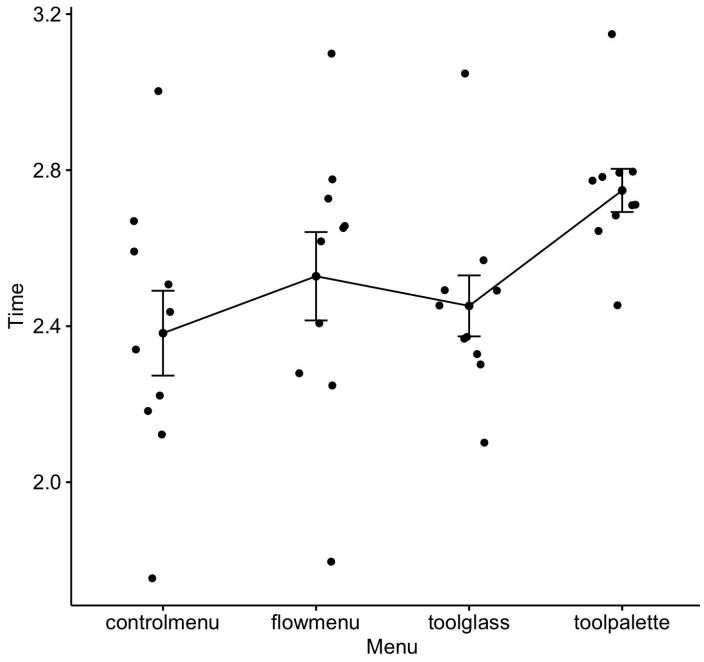
Above is a scatter plot of residuals on the y axis and fitted values (estimated responses) on the x axis. The plot is used to detect nonlinearity, outliers and unequal error variances. Here, we can observe there is no evident and significant relationships between residuals and fitted values (the mean of each groups) and hence we can assume the homogeneity of variances. Points 33, 32, 12 are detected as outliers, which can severely affect normality and homogeneity of variance. It can be useful to remove outliers to meet the test assumptions.

Plot 1C



In the above plot, along with a 45 degree reference line, the quantiles of the residuals are plotted against the quantiles of the normal distribution. To check the assumption that the residuals are normally distributed, the normal probability plot of residuals is used. Approximately,it follow a straight line.

Plot 1D



Above graph plots means as individual points and approximates 95% confidence intervals using user-supplied means and standard errors or 95% CIs. It provides little feedback via the console and the plot concerning errors and ways to make the plot better polished.

DATASET 2

Summary of MANOVA Test for Dataset 2

Error: user
Df Pillai approx F num Df den Df Pr(>F)
Residuals 1

Error: user:menu
No error degrees of freedom

Df
menu 3

Error : Within

	Df	Pillai	approx F	num Df	den Df	Pr(>F)
menu	3	0.4486	3.0844	6	64	0.01026
Residuals	32					

A MANOVA was conducted to compare the effectiveness of four menu styles - toolglass, flowmenu, toolpalette, controlmenu. We can say that there is a statistical significant difference in the mean time and error among different menu types as *p*-value = 0.01026 < 0.05.

Pairwise comparisons using t tests with pooled SD

Between time and menu :

	controlmenu	flowmenu	toolglass
flowmenu	1.0000	-	-
toolglass	1.0000	1.0000	-
toolpalette	0.0093	0.0602	0.1429

P value adjustment method: **bonferroni**

These results indicate that there is a statistically significant difference between the toolpalette and controlmenu (p = 0.0093 < 0.05). Also, the difference between distributions - (flowmenu and controlmenu) , (toolglass and controlmenu) , (toolglass and flowmenu) is 100% coming from random since their p-value = 1. For the remaining distributions (toolpalette and flowmenu) and (toolpalette and toolglass) , they are considered conventionally statistically similar as their p-value > 0.05.

Between error and menu :

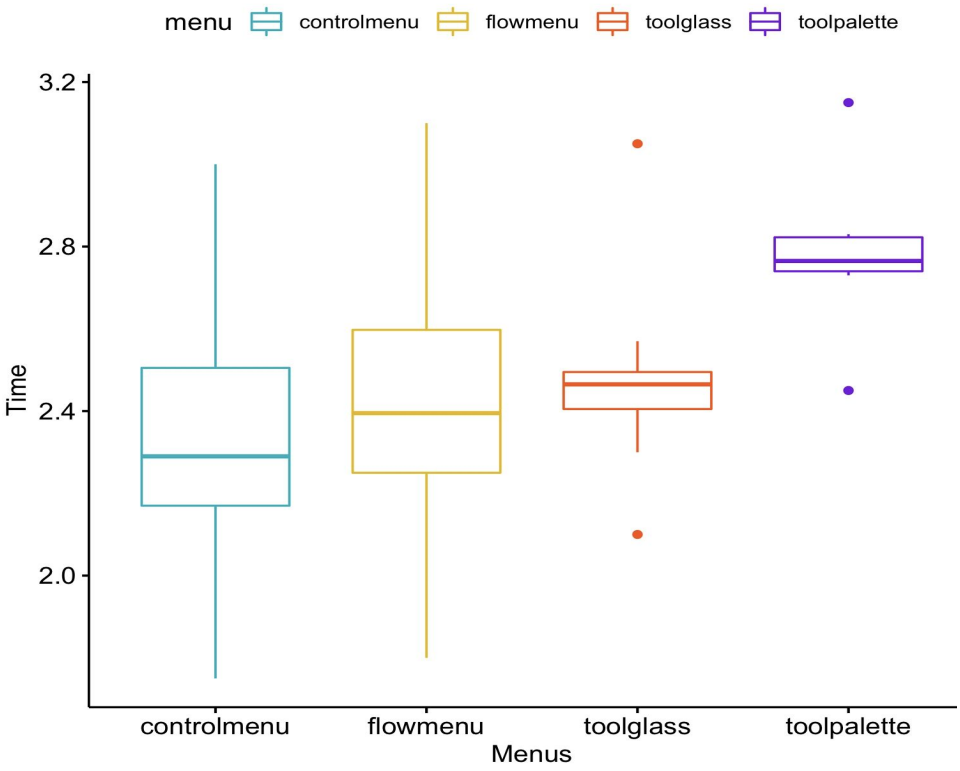
	controlmenu	flowmenu	toolglass
flowmenu	0.28894	-	-
toolglass	5.2e-09	2.4e-06	-
toolpalette	0.00372	0.58125	0.00044

P value adjustment method: **bonferroni**

These results indicate that there is a statistically significant difference between the toolpalette and controlmenu (p = 0.00372 < 0.05), toolglass and controlmenu (p = 5.2e-09 < 0.05), toolglass and flowmenu (p = 2.4e-06 < 0.05), toolpalette and toolglass (p = 0.00044 < 0.05). Also, the distributions - (flowmenu and controlmenu) , (toolpalette and flowmenu) ,are considered conventionally statistically similar as their p-value > 0.05.

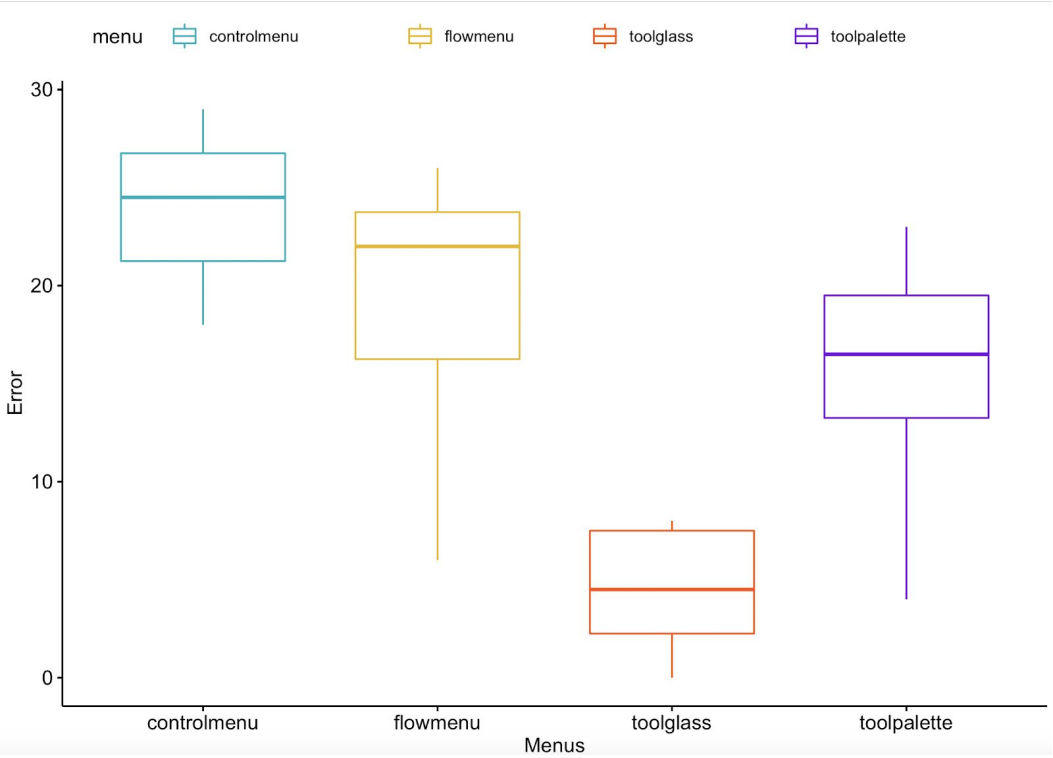
Visualisations :

Plot 2A



The above boxplots shows the summary of the distribution of each menu with respect to time. This plot makes it easy to compare the shape, the central tendency, and the variability of the time taken for each menu. The ends of the box are the first and third quartiles and the box spans the interquartile range. The median time is marked by a line in the middle inside this box. The vertical line ends show the two extreme times– lowest time and highest time taken. It can be observed that Tool palette is significantly slower than others. Also, Control menu is faster than FlowMenu but it is not significant. Also, Toolglass is faster than flowmenu and it can also be noted that Control menu is faster than Toolglass. More precisely, both Control Menu and Toolglass were perceived as being faster than the tool palette, but only the control menu was perceived as being faster than Toolglass.

Plot 2B



The above boxplots shows the summary of the distribution of each menu with respect to error. This plot makes it easy to compare the shape, the central tendency, and the variability of the error for each menu. The ends of the box are the first and third quartiles and the box spans the interquartile range. The median time is marked by a line in the middle inside this box. The vertical line ends show the two extreme times– lowest time and highest time taken.Toolglass was significantly less error prone than any other menu technique. Also, Control menu has maximum error compared to others. Also, Toolpalette has less error than flowmenu.