BioMedStatX User Guide

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This guide explains how to use the BioMedStatX application: from launching the program, importing data, running statistical analyses, customizing plots, and exporting results. All information is focused on the user interface, available statistics, and practical workflow - no programming or code knowledge required.

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1. Launching the Application

- Locate the `BioMedStatX.exe` file in your installation directory.

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  Double-click to start. A Qt-based GUI window will open with the menus: File, Analysis, and Help.

  Note for Linux/macOS users: A convenient launcher script is available at the repository root: `start.sh` (UNIX) and `start.bat` (Windows). On Linux/macOS the script will prefer a native binary if present and otherwise will run the Python source `Source_Code/statistical_analyzer.py`.

  Example: from the repo root run `./start.sh` (make executable with `chmod +x start.sh` if necessary).

-> Example Excel template: the sample spreadsheet is included in the repository docs as `docs/StatisticalAnalyzer_Excel_Template.xlsx` (or run `./scripts/move_template.sh` / `scripts\move_template.bat` to move it into `docs/` if it's still in the repo root).

2. Importing Data

1. In the **File** menu, select **Browse** to choose your data file (Excel `.xlsx`/`.xls` or CSV `.csv`).
2. For Excel files, select the worksheet you want to analyze. For CSV, this step is skipped.
3. Click **Load** to import your data into the application.

Step 1: Click the "Browse…" button (highlighted in red, number 1) in the top right to select your Excel or CSV data file. This is the first step in the workflow and starts
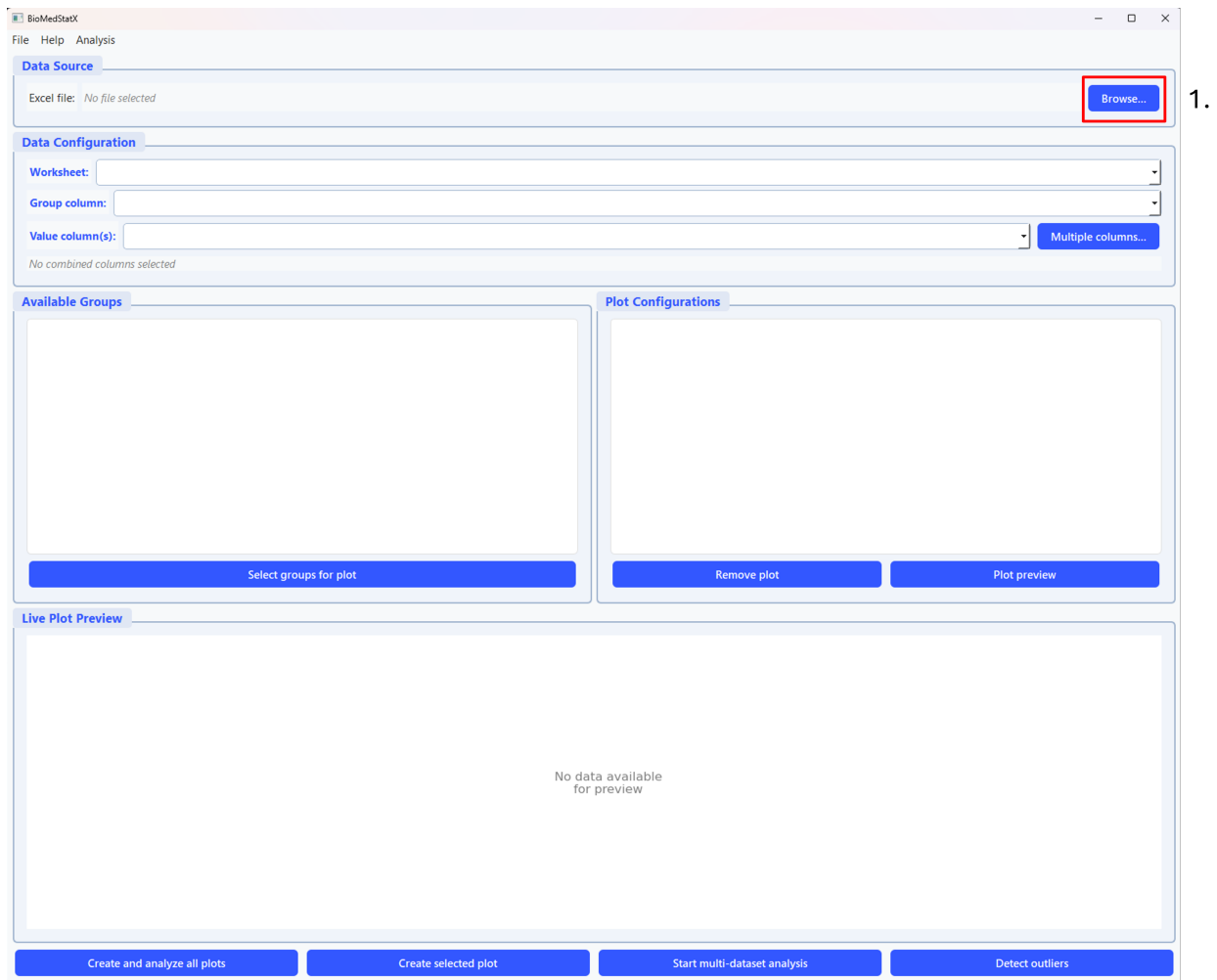
Figure 1: Step 1: Import Data - Browse Button

the data import process.

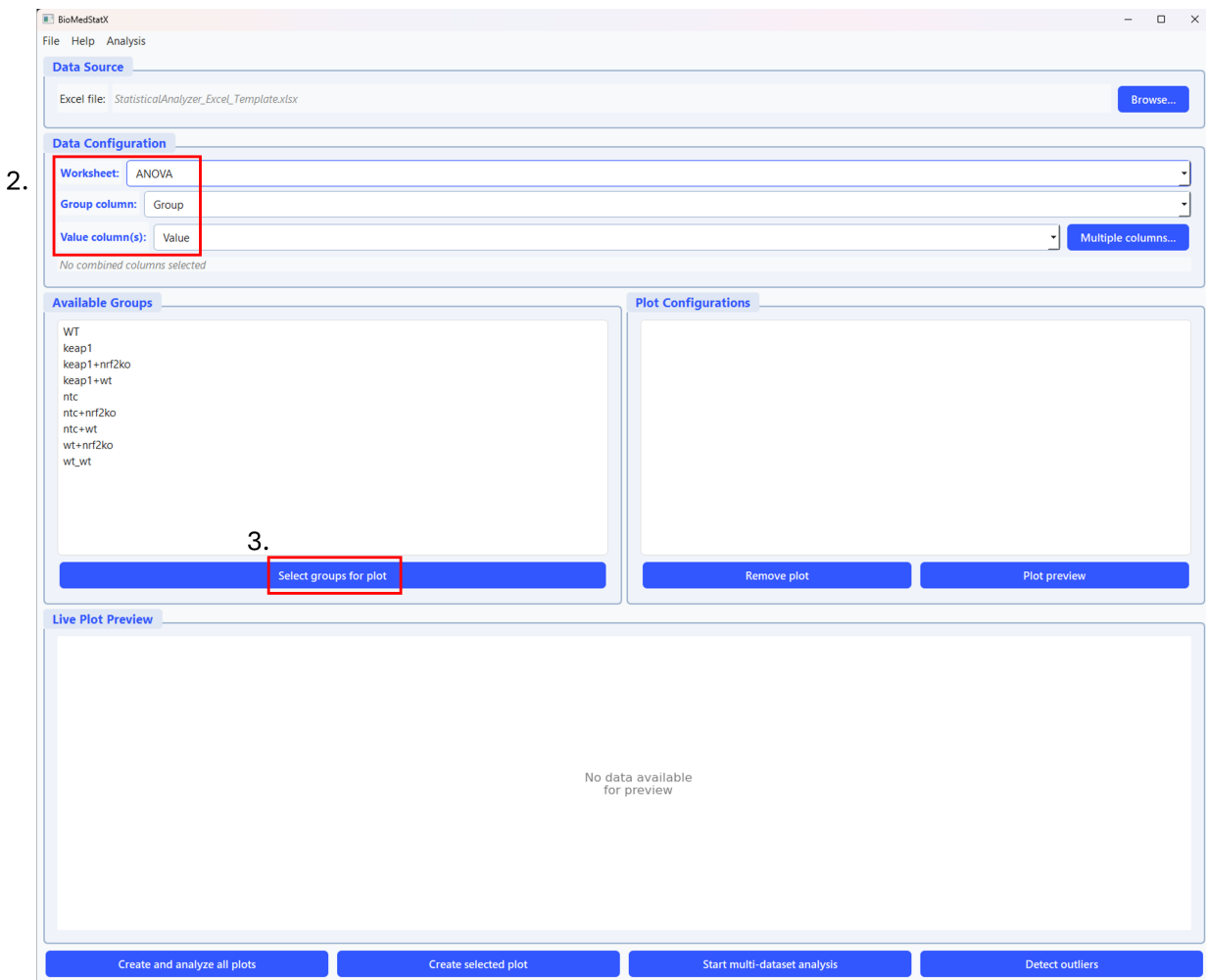## 3. Selecting Groups & Measurement Columns

Figure 2: Step 2: Select Worksheet, Group, and Value Columns

Step 2: First, select the worksheet, group column, and value column in the Data Configuration section (number 2 in the picture). Then, click the "Select groups for plot" button (number 3 in the picture) to choose which groups to include in your plot.

Step 3: In the group selection dialog, select the groups you want to display in the plot by checking the boxes (number 4 in the picture). Then click "OK" to confirm your selection.

Step 4: In the configure plot window, you can set the file name (number 5 in the picture), change the group order, select if the sample are dependent and select if you want to create a plot (number 6 in the picture). If you do not create a plot, the analysis results in the comprehensive excel sheet only.
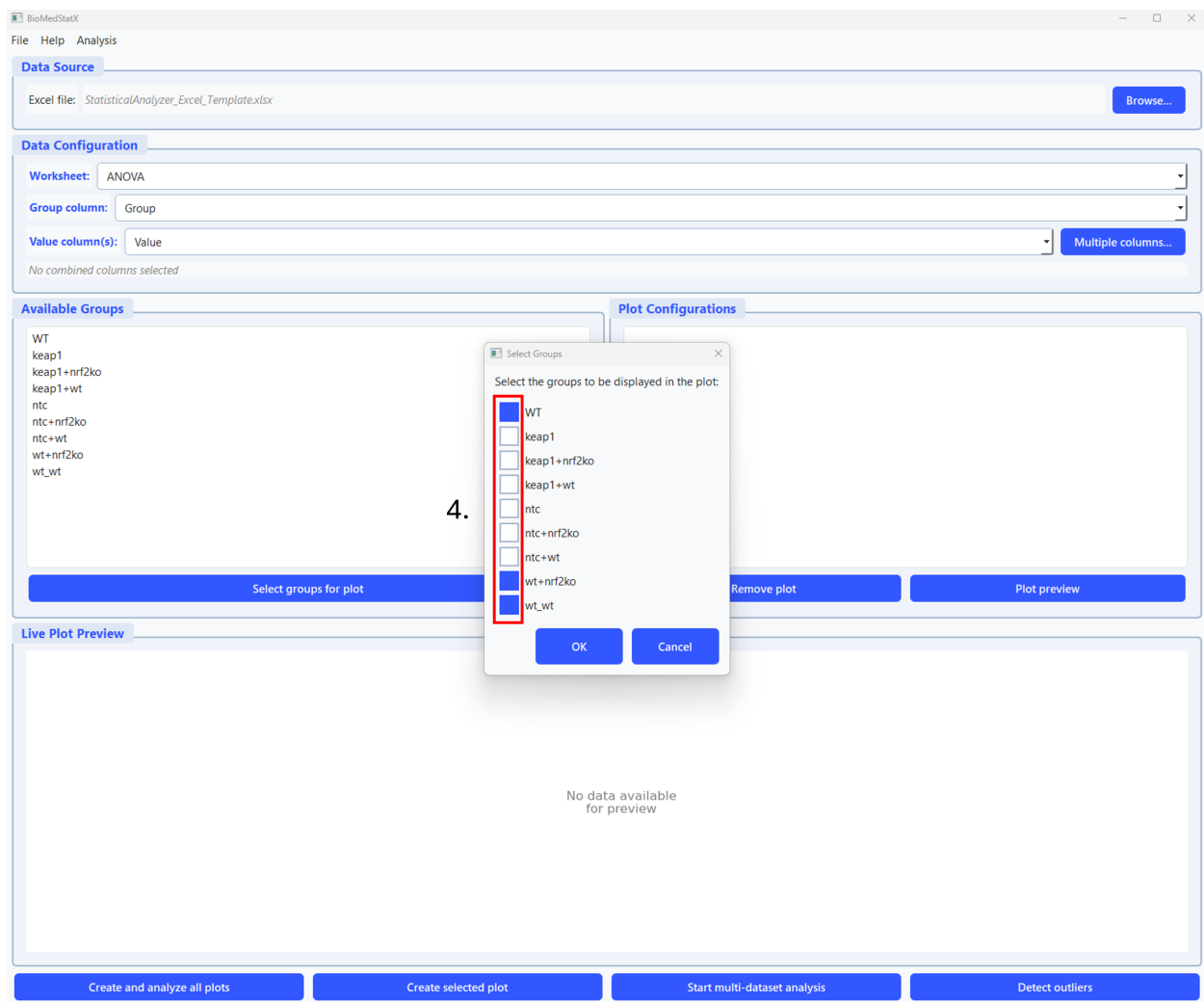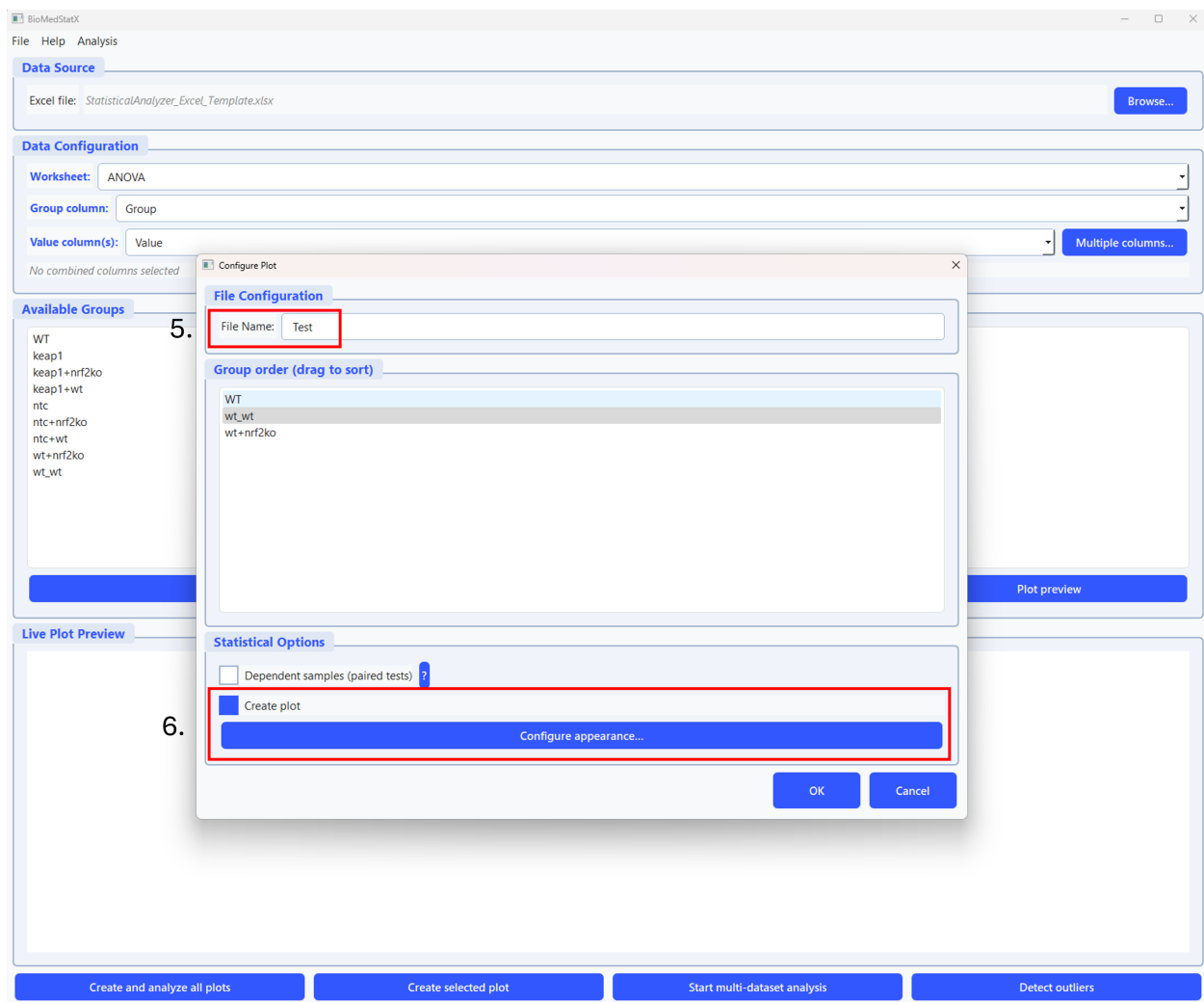
Figure 3: Step 3: Select Groups for Plot

Figure 4: Statistical Analysis Selection

4. Plotting & Customization

BioMedStatX creates publication-ready plots for your results. Supported plot types include: - Bar charts (with error bars) - Violin plots - Boxplots - Overlayed individual data points (with lines for paired data)

Plot Customization

Use the **Plot Settings** dialog to adjust: - Plot title and axis labels - Figure size (width, height, DPI) - Colors and hatches for each group - Error bar style (SD/SEM, caps/lines) - Significance annotations (letters, brackets, custom comparisons) - Legend position, font size, and title - Background and grid style - Data point style (jitter, strip, swarm) - Overlay options (paired lines, custom annotations)

Figure 5: Plot Customization Settings

Step 5: In the plot settings dialog, adjust titles, axis labels, colors, error bars, and more. Preview changes and save or export the customized plot. All changes are
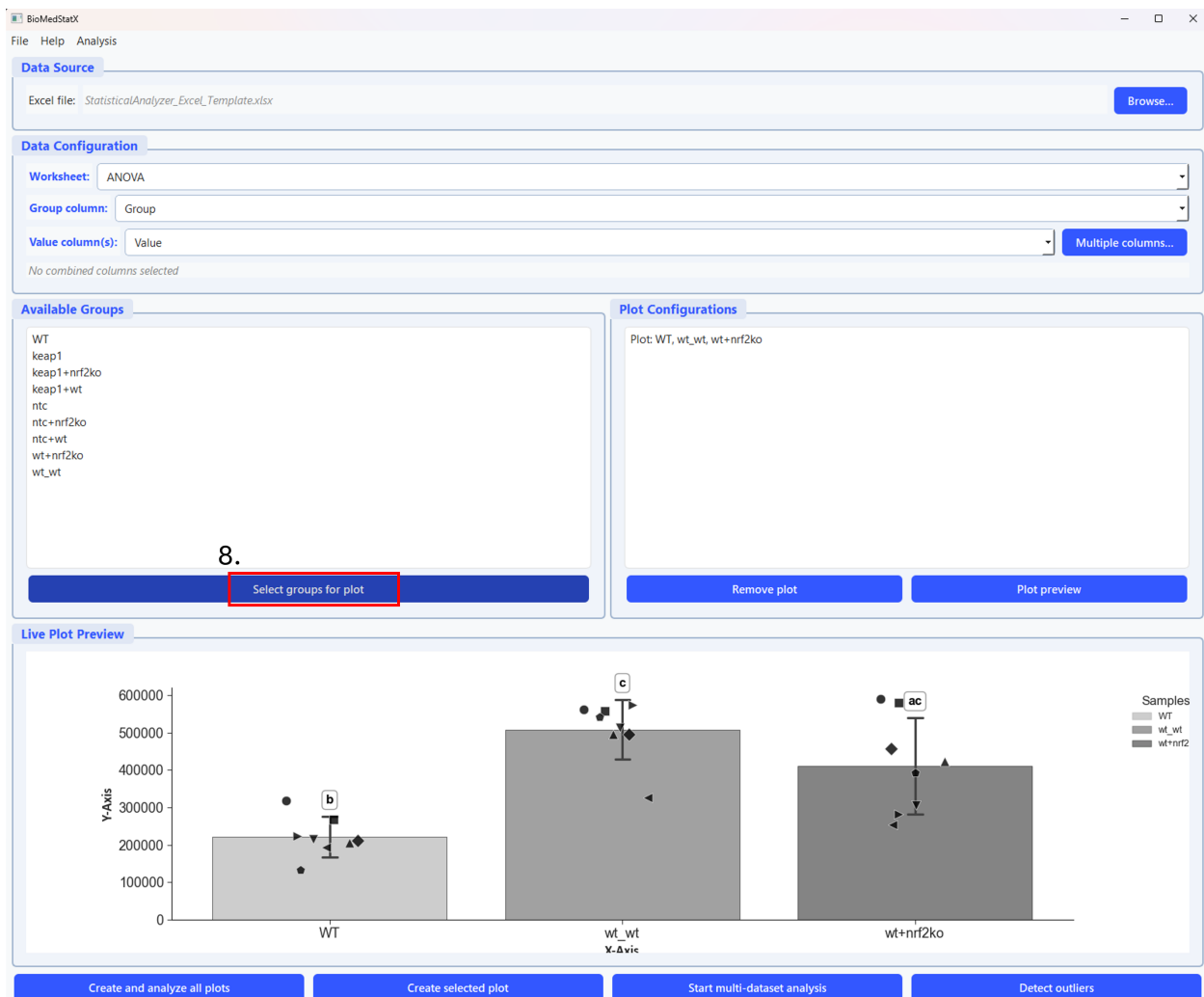
shown in a live preview before saving.

Figure 6: Post-Hoc Analysis Results

Step 6: It is possible to create different plots from the same dataset if needed (number 6 in the picture).

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5. Statistical Analyses

BioMedStatX automatically selects the appropriate statistical test based on your data and design. Supported analyses include:

- Two-group comparisons (independent or paired)
- Multi-group comparisons (one-way, two-way, repeated measures, mixed designs)
- Parametric and non-parametric alternatives (e.g., t-tests, ANOVA, Mann-Whitney, Kruskal-Wallis)
- Advanced ANOVAS (TwoWay, Mixed, Repeated-Measures)

You do not need to choose the test yourself—the software guides you and explains the result in plain language.
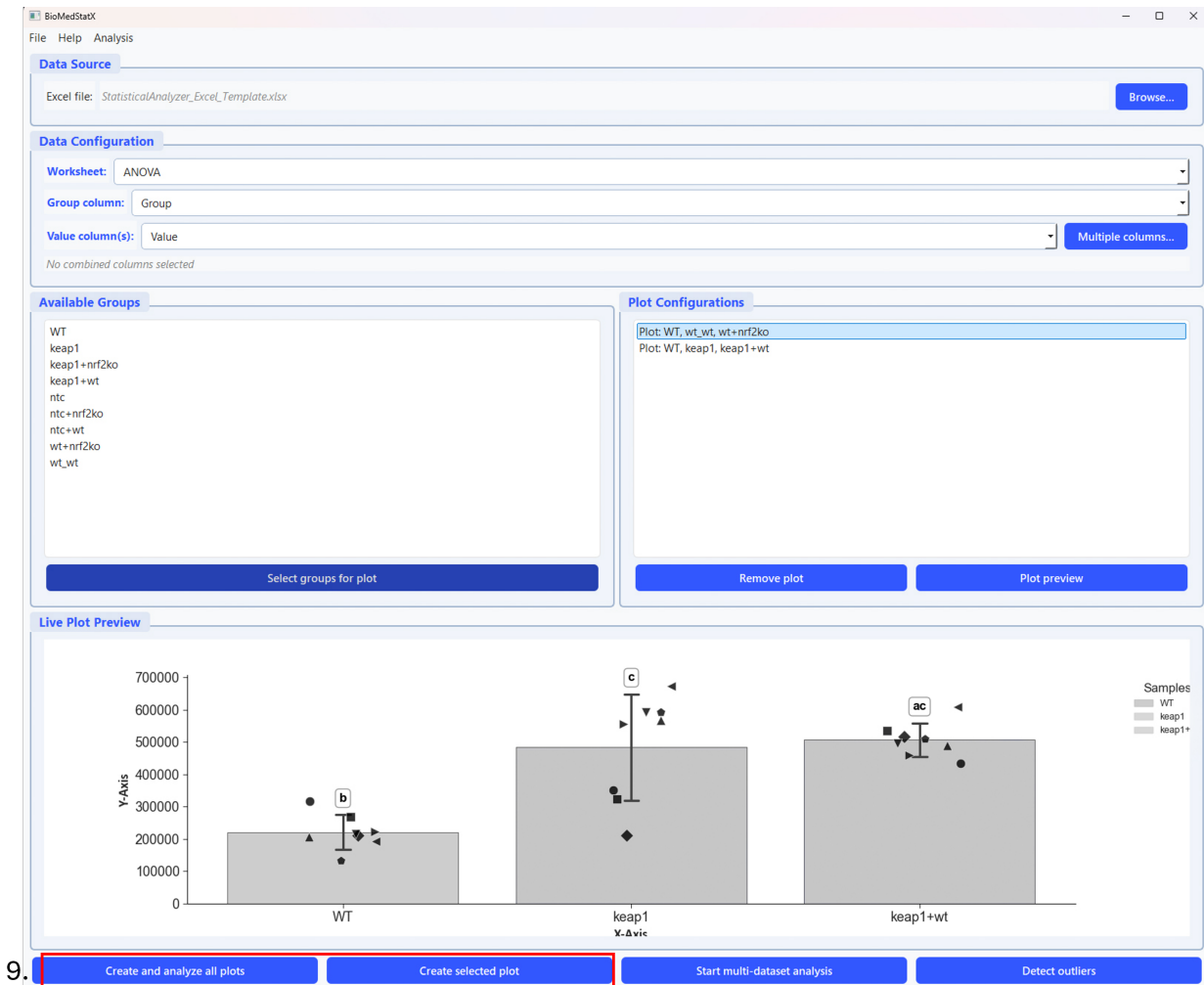

Figure 7: Decision Tree Visualization

Step 7: Click the button (number 9 in the picture) to start the analysis. You can analyse the selected plot or create and analyze all plots.

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6. Assumption Checks & Data Transformations

Before any statistical test, the app automatically checks for normal distribution and equal variances. If your data does not meet these assumptions, you will be prompted to apply a transformation (log, Box-Cox, or arcsine-sqrt) to improve suitability for analysis. You can skip or accept the suggested transformation.

Step 8: If the assumptions for a parametric test are not met, choose one of the three possible transformations (number 10 in the picture).
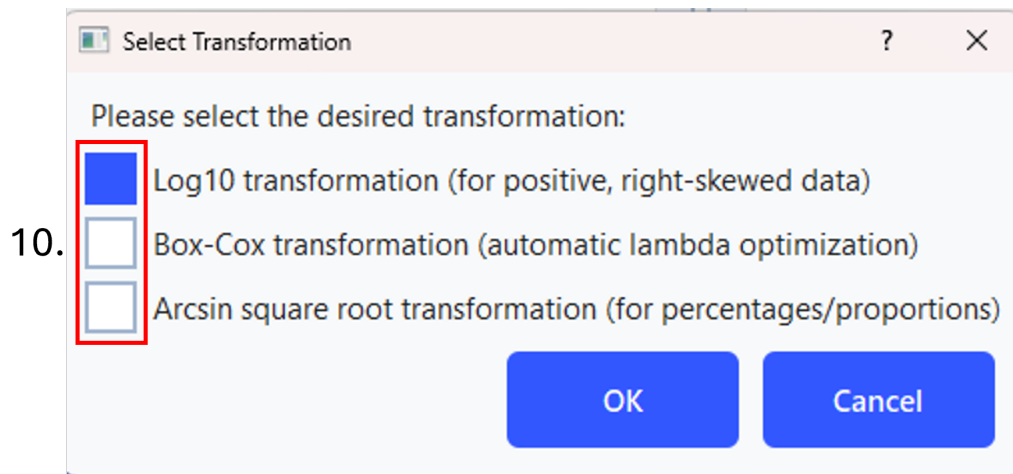
Figure 8: Export Results to Excel

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7. Post-Hoc Comparisons

If a group comparison is significant, the app automatically performs post-hoc tests (e.g., Tukey, Dunn, Bonferroni, or Dunnett) to show which groups differ. Results are clearly displayed in the results table and as annotations on the plots.
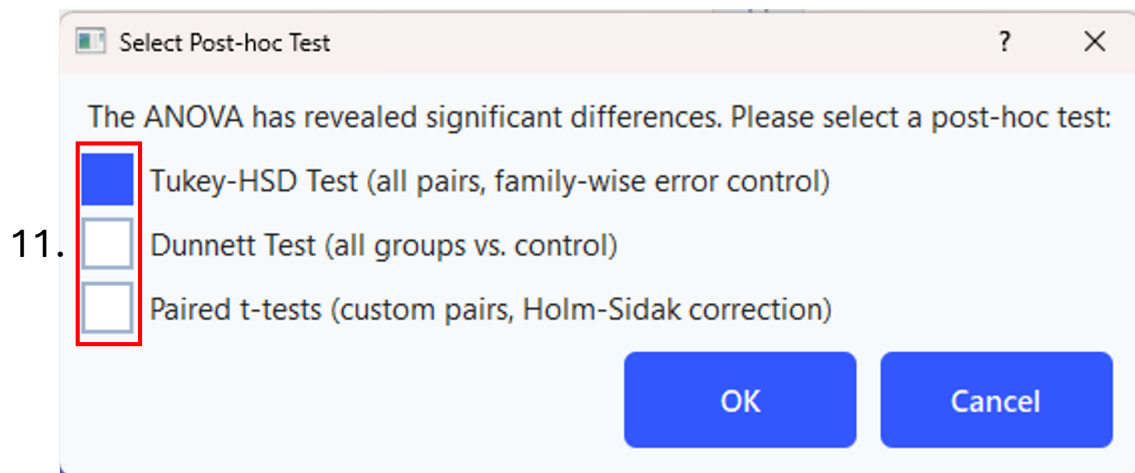

Figure 9: Export Results to Excel

Step 9: After the parametric or non-parametric test was performed and revealed a significance, you need to choose on of the post-hoc tests (number 11 in the picture).

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8. Decision Tree Visualization

The statistical decision process is visualized by a decision tree. The app displays a graphical flowchart showing which tests were chosen and why, with the actual path highlighted. The image is included into the excel workbook.

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9. Exporting Results

After your analysis, all the results are exported automatically in a comprehensive excel file. The exported file contains: - A summary of all tests and p-values - Assumption checks - Main results and effect sizes - Descriptive statistics for each group - The decision tree image - Raw data snapshots - Pairwise comparisons - A chronological analysis log Each sheet is clearly named for easy navigation.
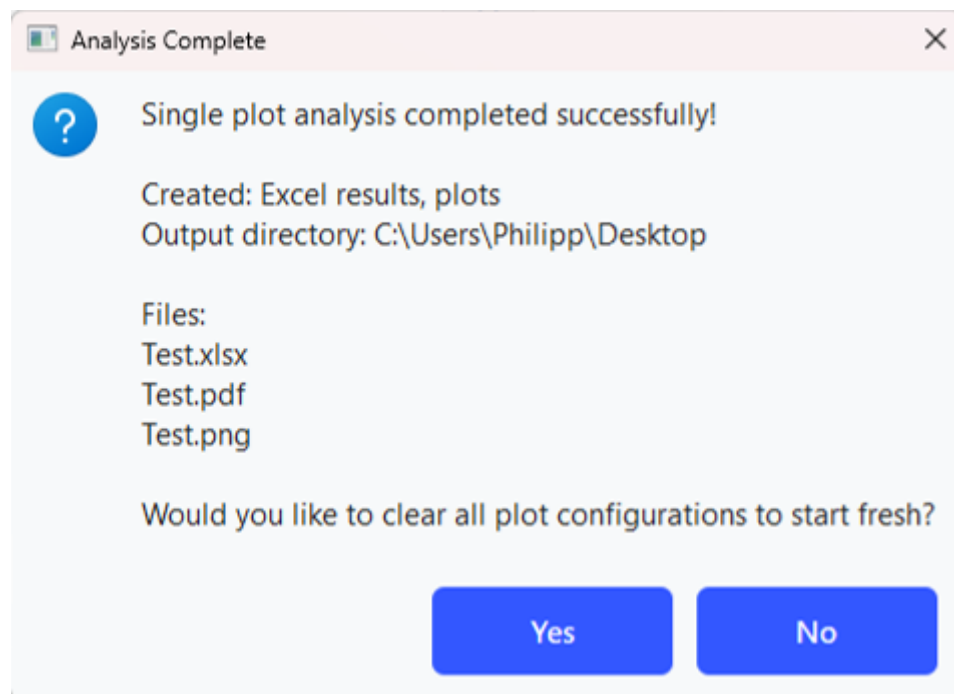

Figure 10: Complete Workflow Overview

Step 10: Final message after a successful analysis.

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10. Outlier Detection (Optional)

Under **Analysis -> Detect Outliers**, you can identify and flag outliers in your data using: - Modified Z-Score Test - Grubbs' Test - Single-pass or iterative mode

Results are exported to Excel for further review.

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11. Multi-Dataset Analysis

If you load an excel file with a group coloumn and several value coloums (e.g. different genes from a RT-qPCR) is is possible to analyse all the genes in one go. 1. Load the data as explained. 2. Choose the "Multiple columns..." button. 3. In the Select Measurements Window select the "Separate analysis per dataset with shared excel file" and the datasets you want to compare 4. Next, click on the Start multi-dataset analysis button and now the application follows the same workflow as for a single analysis

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12. Quick Workflow

1. **Launch** the application.
2. **Browse** and **Load** your data file.
3. **Select** worksheet (if Excel), group column, and measurement columns.
4. **Choose** analysis type (basic or advanced).
5. **Check** assumptions; apply transforms if needed.
6. **Review** plots and decision tree.
7. **Export** results; locate your results files in your working folder.

Tips & Best Practices

- Ensure your group column has consistent, non-empty labels.
- Use data transformations for highly skewed data if prompted.
- For paired designs, confirm equal sample sizes per group.
- Use the **Analysis Log** sheet in the exported Excel file for troubleshooting and detailed steps.
- Preview your plot settings before exporting for best results.

Happy analyzing!