Hasse Diagram Generator

User Guide

Contents

1 Introduction

The *Hasse Diagram Generator* module provides a visualization of the structure of the experimental designs using a Hasse diagram. The module determines the structure of the design, summarised by the Layout Structure, and uses this structure to generate a Hasse diagram. This diagram describes the structure of the design and the relationships between the factors that define the design.

The benefits of creating this diagram is that is allows you to:

- See for the experimental factors are related to each other in the design (either crossed, partially crossed, nested or equivalent)
- Allow you to assess the reliability of any statistical tests that will be performed when using the design. By looking at the degrees of freedom of the next lowest random effect, you can judge the reliability of the tests of the fixed factors.
- Provide you with a guide to the final statistical model you can fit to the data generated when using the design
- Identify which interactions can be tested in the final statistical model

It is strongly recommended that the user reviews some of the existing references to gain an understanding of the benefits of producing these designs:

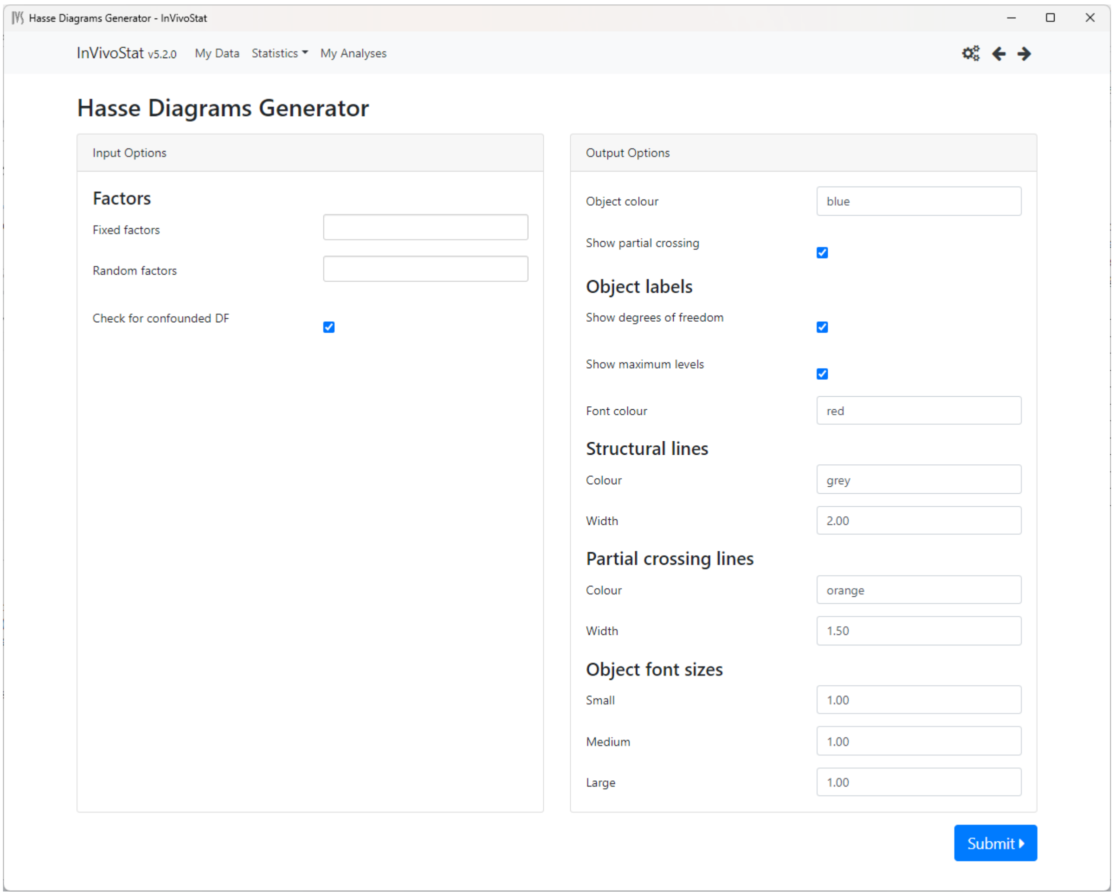
Bate, S.T. and Chatfield, M.J. (2016) Identifying the structure of the experimental design. Journal of Quality Technology 48(4): 343-364.

https://cran.ma.imperial.ac.uk/web/packages/hassediagrams/vignettes/Introduction_to_hassediagrams.html

https://arxiv.org/pdf/2507.05949

2 Hasse Diagram Generator module in InVivoStat

The *Hasse Diagram Generator* module in InVivoStat is available from the Additional Analysis sub-menu on the Statistics drop-down menu entitled ‘Hasse Diagram Generator’. The user interface is:



3 Dataset format and factor levels

The *Hasse Diagram Generator* module accepts data in in the single measures format. For example, in this experiment there are 2 treatment groups and 8 animals per group. Animal were housed in 4 cages, 4 animals per cage. Each treatment group was randomly assigned to two animals in each cage.

Treatment	Cage	Animal
Drug	1	1
Drug	1	2
Drug	2	3
Drug	2	4
Drug	3	5
Drug	3	6
Drug	4	7
Drug	4	8
Control	1	9
Control	1	10
Control	2	11
Control	2	12
Control	3	13
Control	3	14
Control	4	15
Control	4	16

IMPORTANT!
It is vital that the levels of the factors are defined correctly.

The levels of the factors should be unique and have a practical meaning. If this principal is not followed the diagram generated will not be valid.

In this example there are 16 animals in total and hence the Animal factor levels are 1 to 16 (corresponding to the 16 animals) and not 1 to 8 in the control group and 1 to 8 in the drug group. If the latter level definition is used then InVivoStat will assume the experiment involves only 8 animals, and each animal will be tested on both drug and control.

Similarly there are 4 cages in total in the experiment, and hence the Cage factor is at levels 1 to 4.

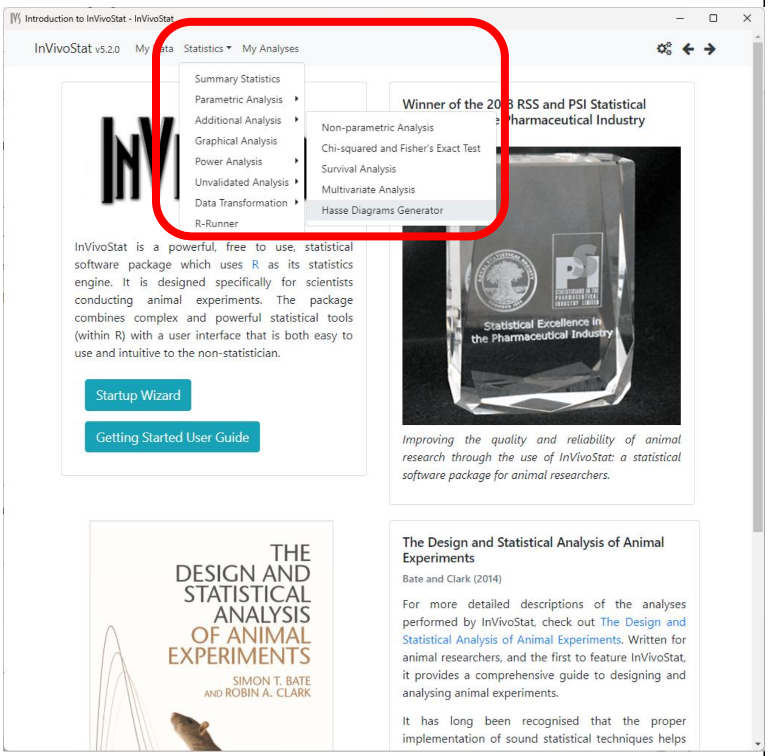
If in doubt remember the factor levels in the design should have a practical meaning and uniquely define the experimental material.

4 Analysis procedure

The steps required to perform an analysis are described in this section.

4.1 Select the analysis module

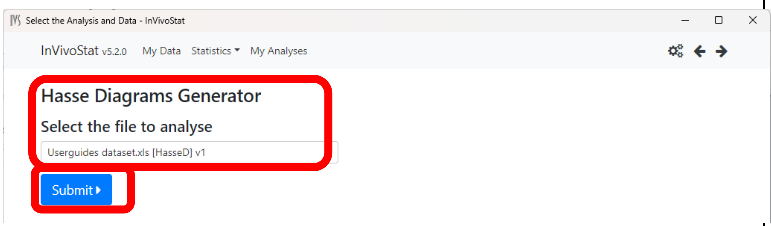
The analysis begins by selecting the Hasse Diagram Generation module from the drop-down list of available modules.



4.2 Select the dataset to be summarised

Once the module is selected, the dataset is chosen from the drop-down list of available datasets.

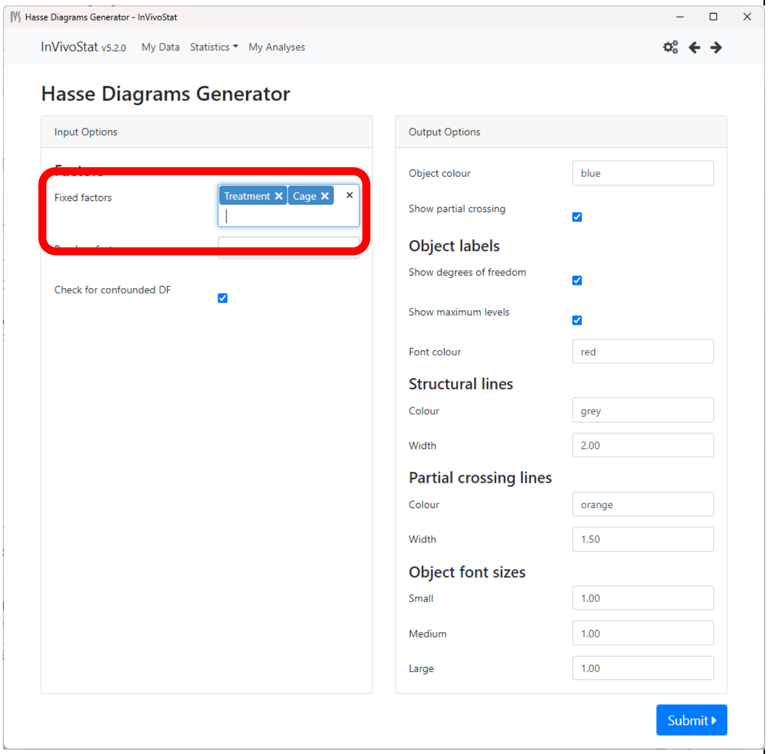
Click ‘Submit’.



4.3 Select the fixed factors

Once the dataset has been selected, the user selects the fixed factors to include in the diagram.

Fixed factors correspond to effects of interest (such as Treatment) and also any effect that will have a fixed and reproducible effect on the response.



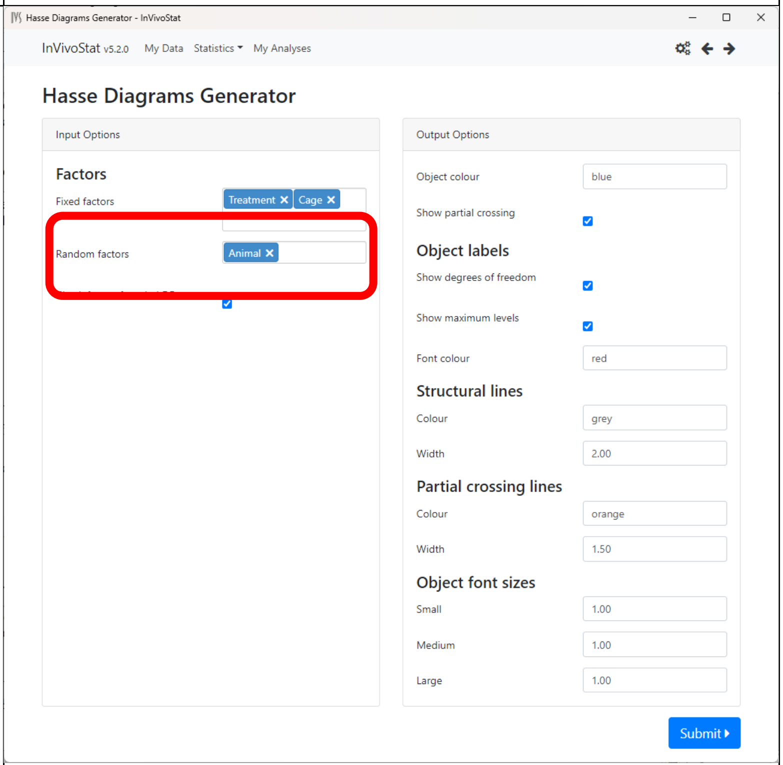
4.4 Select the random factors

The user selects the random factors to include in the diagram.

Random factors correspond to effects that have a random impact on the response and are hence a source of random variability.
The factor (in this case Animal) is a random effect as varying the levels of this factor will introduce random animal-to-animal variability into the response.

The factor that indexes the experimental unit is always a random effect.

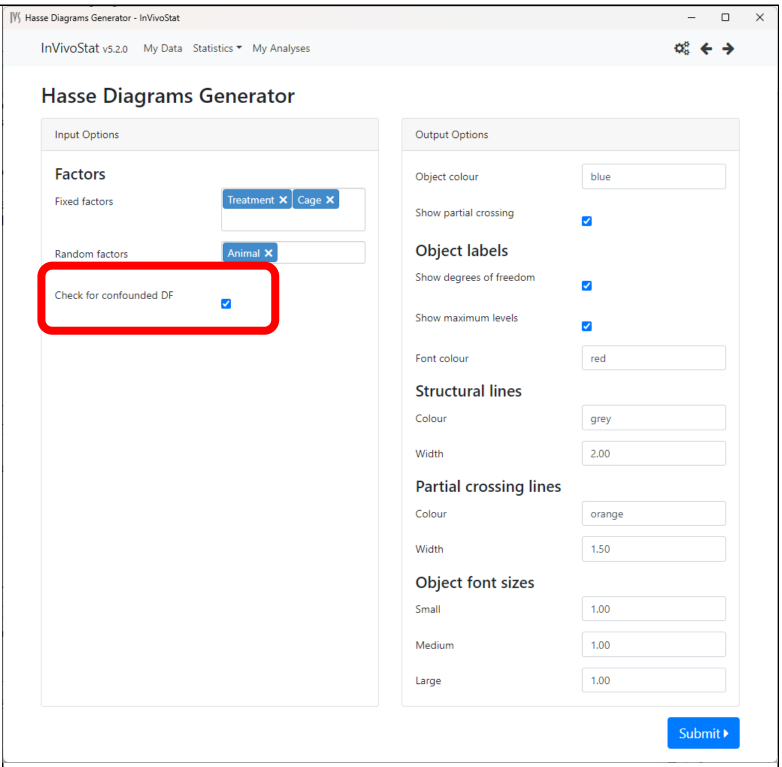
The only difference between random and fixed factors in this module is that random factors will be underlined in the Hasse diagram.



4.5 Check for confounded degrees of freedom

The module will check the design for any inconsistencies in the allocation of degrees of freedom and warn the user when this is the case.

This does increase the length of time to generate the diagram, and the user may decide to de-select this for larger designs.

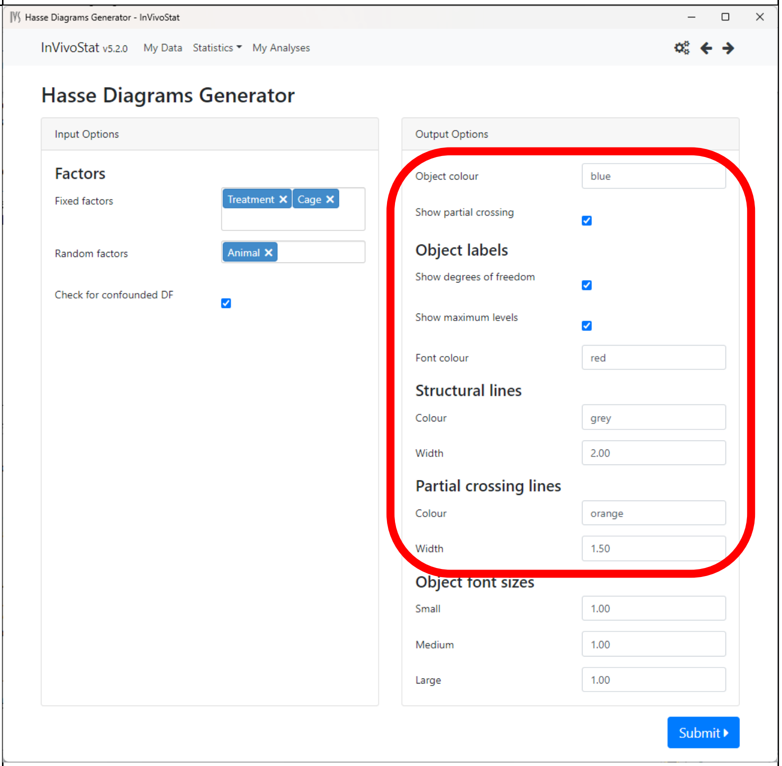


4.6 Controlling the appearance of the Hasse Diagram

The user can change the appearance of the diagram.

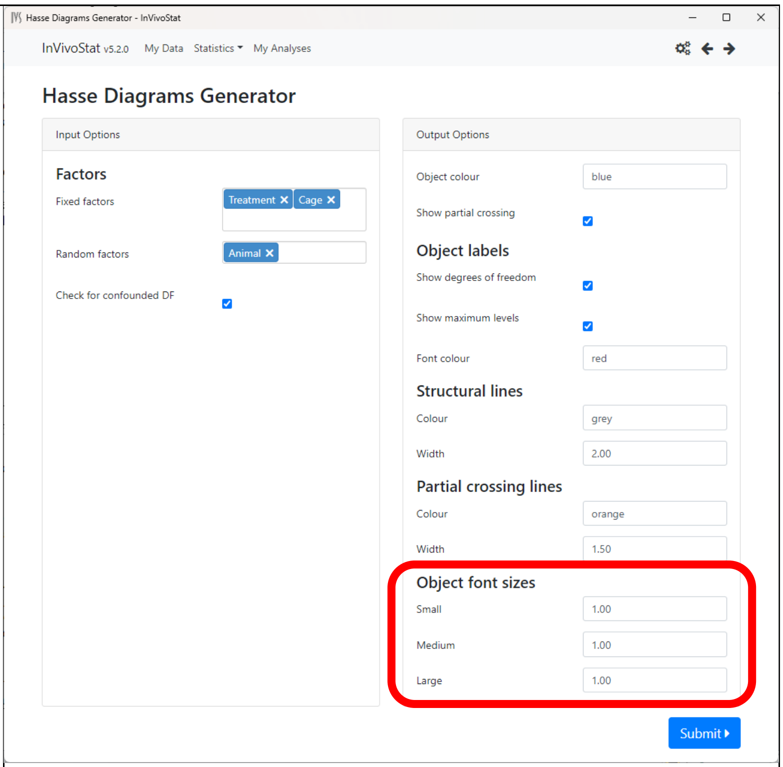
The object font colour can be changed from blue, the object labels font changed from red, the structural lines changed from grey and the partial crossing dotted lines from orange.

The width of the lines appearing on the Hasse diagram can also be edited for smaller/larger designs



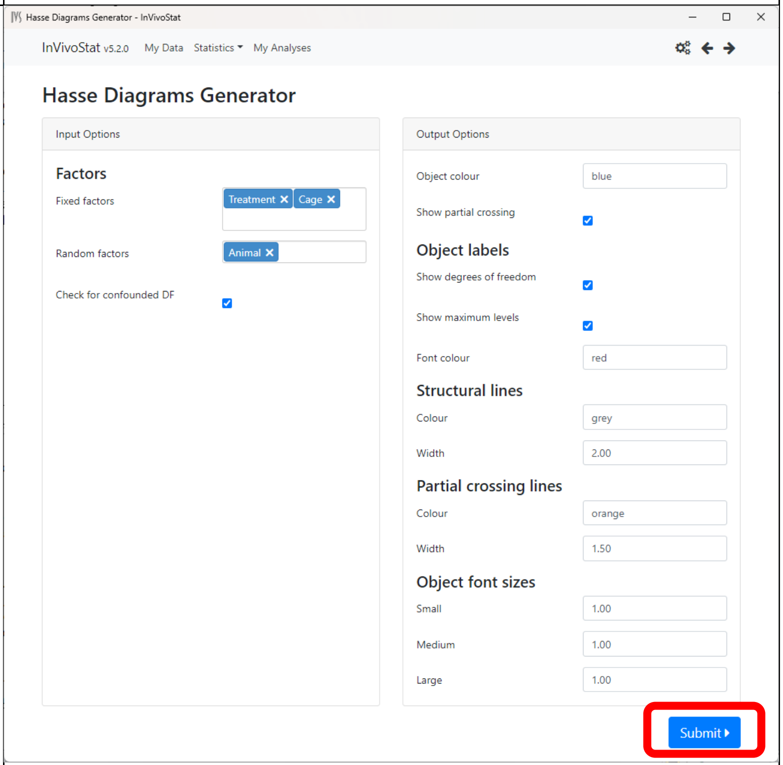
4.7 Controlling the font sizes on the Hasse diagram

Finally the user can increase the font sizes on the Hasse diagram to avoid labels overlapping.



4.8 Run the analysis

Click ‘Submit’ to run the analysis.



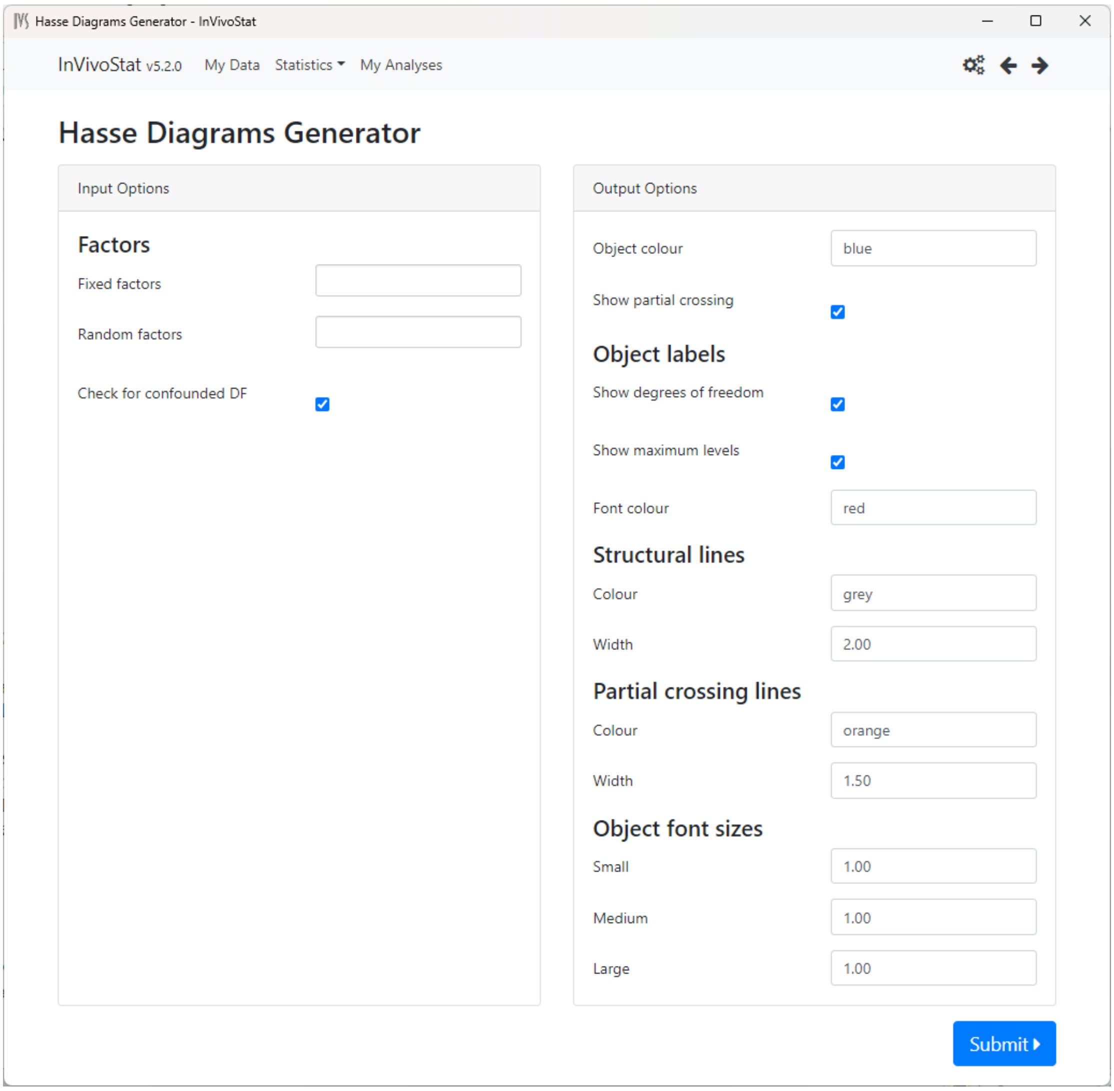
5 Sample Output

The output from the module includes:

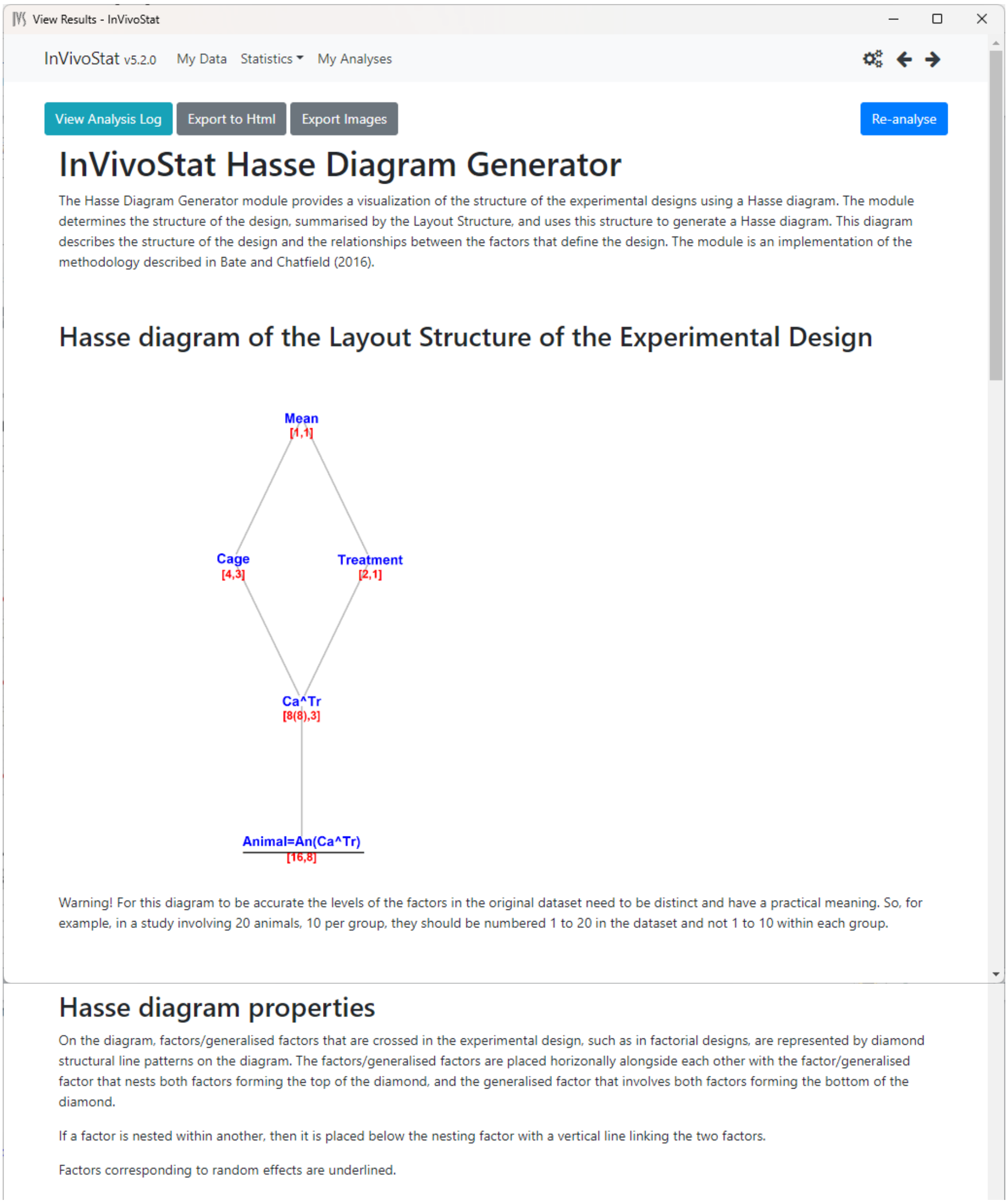
- A description of the module
- The Hasse diagram of the Layout Structr eof the design
- A description of the properties of the Hasse diagram
- A list of useful definitions
- References

6 Test dataset example output

6.1 InVivoStat options



6.2 Sample output



Definitions

For ease of defining key concepts and for introducing notation, consider two factors A and B.

Factor A is said to be nested within factor B, denoted as A(B), if each level of A occurs with one and only one level of B but at least one level of B occurs with multiple levels of A (Montgomery, 2017, Chapter 7) . In this case, A is said to be finer than B, and B is coarser than A.

The two factors, A and B, are fully crossed if all levels of A occur with all levels of B and vice versa (Montgomery, 2017, Chapter 7).

Following Bailey (1996) and Tjur (1984), a generalised factor whose levels correspond to combinations of the crossed factors A and B is defined as: $A \wedge B$.

Two factors, A and B, are partially crossed if they are not fully crossed, but at least one level of A occurs with more than one level of B and vice versa.

Two factors A and B are defined as equivalent if, for every occurrence of a level of A within the design, the same level of B occurs, and vice versa. In other words, the two factors are identical apart from the names of their levels, see Bailey (2008, p. 170) and Tjur (1984).

The layout structure consists of (i) a list of structural objects consisting of the factors that define the experimental design (identified in stage 1), (ii) the generalised factors that are implied by the structure of the experimental design, (iii) a description of the nested, crossed, and equivalent relationships between the factors, as defined by the experimental design.

References

When referring to InVivoStat, please cite 'InVivoStat, version 5.2.0'.

Bailey, R.A. (1996) Orthogonal partitions in designed experiments. Designs, Codes and Cryptography, 8:45–77.

Bailey, R.A. (2008) Design of comparative experiments, volume 25. Cambridge University Press.

Bate, S.T. and Chatfield, M.J. (2016) Identifying the structure of the experimental design. Journal of Quality Technology 48(4): 343-364.

Montgomery, D.C. (2017) Design and analysis of experiments. John wiley & sons.

Tjur, T. (1984) Analysis of variance models in orthogonal designs. International Statistical Review/Revue Internationale de Statistique, pages 33–65.

R references

R Core Team (2025). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/.

Lecoutre, Eric (2003). The R2HTML Package. R News, Vol 3. N. 3, Vienna, Austria.

Michaelides D, Bate S, Chatfield M (2026). hassediagrams: Hasse Diagram of the Layout Structure and Restricted Layout Structure. doi:10.32614/CRAN.package.hassediagrams. doi.org/10.32614/CRAN.package.hassediagrams, R package version 2.0, https://CRAN.R-project.org/package=hassediagrams.