

HOW TO DESIGN PIG TRIALS?

7 KEY PRINCIPLES FROM PIGWEB

INTRODUCTION

Standardisation of experimental procedures (e.g., sample collection methods) and experimental design practices (e.g., correct identification of the experimental unit) is essential for ensuring high data quality and reproducibility.

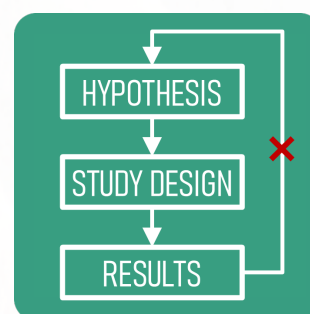
To improve data quality in experimental pig research, the PIGWEB project has established comprehensive guidelines for experimental design. These PIGWEB guidelines integrate existing resources (e.g., books and journals), methodologies used by PIGWEB partners, challenges faced by pig researchers, and power analyses based on PIGWEB partners' data. Presented as seven key principles, the guidelines aim to enhance the quality, reproducibility, and reliability of pig research by promoting more rigorous and standardized experimental design practices within the pig research community.

PIGWEB GUIDELINES

1. Clear hypothesis formulation

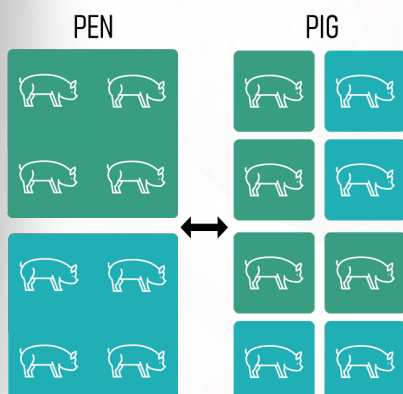
Ensure the hypothesis is well-defined before the experiment begins.

Formulating a clear hypothesis before starting an experiment is essential to maintain the scientific integrity of a study. It ensures that the design, data collection, and analysis are focused on testing a specific question, and prevents practices like HARKing (hypothesizing after results are known). A well-defined hypothesis reduces the risk of bias, enables an accurate interpretation of the results, and contributes to transparency of the study, allowing other researchers to replicate or build upon the findings.



2. Correct identification of the experimental unit

Properly distinguish between the experimental and the observational unit.



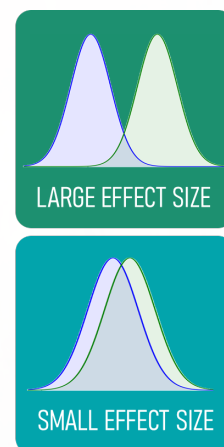
The experimental unit refers to the smallest unit to which a treatment is allocated independently, while the observational unit is the entity from which measurements or observations are made. When a treatment is allocated to a pen of animals, measurements at the individual animal level are not necessarily independent, making the pen the experimental unit. In contrast, when treatments are allocated at the individual animal level (e.g., through automatic feeders with individual feeding), the experimental unit is the pig. Correctly identifying the experimental unit ensures accurate statistical analysis, prevents sample size miscalculations, and avoids incorrect conclusions.



3. Appropriate sample size

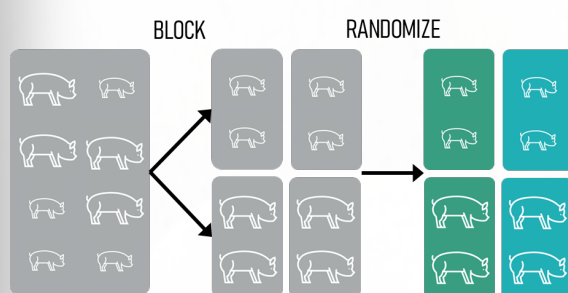
Conduct a power analysis to ensure the study is adequately powered to detect true effects.

Determining an appropriate sample size through a power analysis is essential for designing statistically robust experiments. Proper sample size calculation is crucial to obtain meaningful and reliable results while optimizing resources used. The power of an experiment not only depends on the experimental unit, the variation among experimental units, but also on the expected effect size. When a small effect size is expected, more experimental units will be needed compared to when a large effect size is expected. Tailored power analyses, using accurate assumptions of the variation and relevant differences, rather than relying on prior studies or ethical recommendations, is thus important. To calculate the number of animals or pens required in an experiment, depending on the experimental unit of your design, various online free tools such as G*Power are available, calculating the necessary sample size for various statistical tests.



4. Effective blocking and randomization

Use blocking to control for known sources of variability; apply randomization to assign treatments within blocks.



Blocking and randomization help to control variability and reduce bias. Blocking groups experimental units with shared characteristics (e.g., body weight, sex or age) to minimize variability from known factors. Within these blocks, randomization ensures that treatments are assigned to experimental units without bias. This combination accounts for both known and unknown sources of variability, improving the

accuracy and reliability of results.

5. Blinding

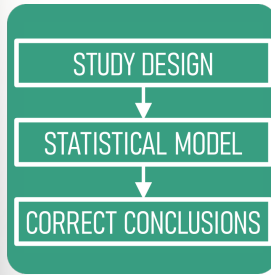
Implement blinding, where possible, to reduce subjective bias in experiments.

Blinding is a critical practice in experimental design that involves hiding treatment assignments from those conducting the study or analysing the data (e.g., using coded feed labels instead of treatment names). For subjective measurements, blinding is particularly critical to ensure unbiased outcomes. While full blinding is ideal, it is not always feasible. Partial blinding—where only some individuals (e.g. observers) are blinded—can still enhance objectivity.



6. Proper statistical analysis

Use appropriate statistical models that align with the study design to make valid conclusions.



As the British statistician George Box said in 1976, “All models are wrong, but some are useful.” This highlights the importance of using models that, while inherently imperfect, are tailored to the experimental design to provide meaningful insights. Statistical analyses must consider factors like repeated measures, nested designs, and random effects. Incorrect or misaligned statistical analyses can lead to incorrect conclusions. Consulting a statistician during the design and analysis phase ensures that chosen models are well-suited to the experimental structure and objectives.

7. Transparent reporting

Report all details on the experimental design, statistical methods, and data exclusions.

Transparent reporting involves providing full details about the experimental design, statistical methods, and any deviations from the original plan, including data exclusions or adjustments. This is crucial to ensure transparency and reproducibility of the study. Researchers should avoid cherry-picking favourable results or overinterpreting the research findings (spinning). Reporting all outcomes, including non-significant results, ensures a complete and unbiased representation of the study, reinforcing scientific integrity. In addition, to further enhance transparency and reproducibility, it is recommended to use repositories for e.g. data or statistics.



CONCLUSION

By emphasizing these critical principles, the PIGWEB guidelines serve as a valuable resource for pig researchers designing new experiments, promoting scientific integrity and high-quality research.

KEY MESSAGES

- ✓ Define a clear hypothesis
- ✓ Identify the correct experimental unit
- ✓ Use a power analysis to determine the sample size
- ✓ Apply blocking and randomization
- ✓ Implement blinding where possible
- ✓ Choose the right statistical methods
- ✓ Ensure transparent reporting

For more information: <https://www.pigweb.eu/deliverablesmilestones> (Deliverable 2.4)



The PIGWEB project has received funding from European Union's Horizon 2020 research and innovation programme under Grant Agreement No 101004770.