

Feedback intermediary report Assaraf Balastegui

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November 8, 2024

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1 Abstract

In this document, we give a feedback on an intermediary report of modelling and design of experiments made to understand the behavior and the design of the resistances inside a multi-inductance box. This intermediary report gives an analysis when pairs of inductances are switched on in the far right column of the multi-inductance box (1H, 2H, 3H, and 4H). The feedback is written for each section of the report, highlighting the positives and giving possible improvements in the form of bullet points. The clarity of the report, the description of what is done, the consistency, and coherence are reviewed in this feedback.

2 Introduction

Positive points:

- Clearly defined the main steps of the whole project and what is done in this intermediary report.

Improvements:

- You give a lot of detail of the box of inductance but don't mention how you collect the data. A phrase could be added to mention the multimeter.
- In another section, you can add a picture of the inductance box to clearly visualise its columns and rows configurations.
- You can also add a mindmap to deepen our understanding in your strategy.

3 Statistical Model

Positive points:

- Good idea to present your measured resistances for all your configurations in appendix (but you could add some of them in the main part of the report to make it clearer).
- Discussion on the correlation matrix: possible co-linearity suggested between the coefficients.
- Good idea to standardize the matrix of experiment which got rid of the non-diagonal elements of the dispersion and correlation matrix.
- Did the same statistical analysis for the interacting model.
- Discussion of Figure 6: motivate 'Theoretical model' section.

Improvements

- No need to add a subsection when there is only one subsection.
- Adding more details about what a 2^2 factorial design and a linear model with (without) interaction is, would add clarity to the report.
- You say that your design is executed to study the interactions between each pair of inductors, but you start by studying the model without interaction.
- You should introduce what are the statistical parameters you computed, what are they used for (dispersion matrix, correlation matrix, VIF).
- There is no strict "acceptable range" for dispersion matrix coefficients, as it depends on the specific goals and structure of the experiment, hence explaining why you believe 75% and 100% is high would be interesting.
- You should add the units of the computed coefficients (Ω) in your tables.
- Figure 3 and Figure 6 are unclear, what does the y axis represent? What is $ER1$ and $ER2$? How is the relative effect calculated?
- Discussion of Figure 3 is unclear: the relative effects correspond to some kind of normalisation so we don't really understand what you mean when talking about the size range. Why is this 'size range' expected for the linear model without interactions?
- No reason is given for pursuing an interacting model. You could do the fit on 3 of the 4 data points (since you only need 3 for a_0, a_1, a_2) and then comparing the prediction of the model for the 4th with the real data would show the ineffectiveness of this model.
- In Figure 4, there misses a_{12} . You do a complete analysis with this coefficient without naming it.
- In the interacting model you rewrite a lot of the same ideas as in the non interacting model, this could have been shortened.
- " $VIF_{int} = (4, 4, 4, 4)$ suggests co-linearity that could compromise the model". We have seen in the course that the limit is 5-6.
- Calculating the variance function would add another layer of analysis (explains where the model is most accurate).

4 Theoretical model

Positive points:

- Presented the final circuits for the 2-switches models.
- Computed the relative error on R_{11} .

Improvements:

- You should have used less space to explain and illustrate the foundations of the theoretical model in order to detail what was commented in the statistical model. It results in an asymmetry in what you decide to clarify: the statistical matrices, a more complex concept is hardly explained as opposed to the foundations of the theoretical model. If you assume the reader is familiar with these then the introduction to circuit theory can be summed up in a paragraph.
- When you did your measurements, you saw that there was a resistance with both switches off so no need to present Figure 10 which does not model the $I = \{2H - 4H, 1H - 4H, 2H - 3H, 1H - 3H\}$ pairs, as you can see from the data you provided there is resistance even when both switches are turned off. Here turning off both switch yields $R = 0\Omega$. Later on, you added Figure 11 that takes into account this offset.
- The order of presenting the circuits is confusing: you mix your discussion and Figures. You present a potential circuit for the I pairs (which you know is wrong), then go on to give one of the possible correct circuit for the remaining more complex configurations of switches with a resistance in parallel, and then finish by going back to the I pairs and correcting the flawed circuit. Why not present the correct circuit in the first place? Furthermore, the name of the Figures are unclear (11 and 12).
- Title of Table 5 is unclear: say that these are the predicted values. The relative error is computed w.r.t. what? Say that it is with the observed value R_{11} .
- The comparison (relative error) of the predicted result for R_{11} to the real ones could be put in the text instead of the appendix. This is true for the overall report, adding a few values as an example would make the report clearer overall.
- You computed the relative error on the parallel model but you didn't do it on the summative model. You should explain why.

5 Link between the statistical and theoretical model

Improvements:

- "And in theory what can be seen in figure 11 and equation 5, for 1H-2H and 3H-4H switches; and 2 resistances in series for the rest ." Missing a part of the sentence. A comparison is missing between the models: what is identical? What isn't? What link can be made or not between the two models?
- A non negligible analysis is made on data in annexe. It shouldn't be in annexe if you analyse it this much.
- Confusion: $a_0 \leftrightarrow R_4$ ok, $a_1 \leftrightarrow R_1$ don't correspond, $a_2 \leftrightarrow R_2$ don't correspond. It should be : $a_0 \leftrightarrow R_4$, a_1 no physical correspondence, $a_2 \leftrightarrow R_1$, a_{12} no physical correspondence. You also say a_{12} corresponds to... then a_{12} doesn't correspond to anything. There is no a_{12} in

the non-interacting model so you confuse the reader. You should compare the data yourself instead of letting the reader compare it him/herself.

- Overall it is short and confusing, we are having a hard time understanding both paragraphs. We would break this section into two paragraphs, one comparing the non-interacting statistical model with figure 12 and the other one comparing the interacting statistical model with figure 11.

6 Next steps

Positive points:

- A clear goal, 4 switches and then whole system is good.

Improvements:

- We would suggest laying out a plan as to how you envision to achieve the set out goals.
- "With regards to the theoretical model, a combination of the parallel and in-series circuits suggested for the pairs 1H-2H/3H-4H and 1H-3H/1H-4H/2H-3H/2H-4H respectively should be explored to theorize the actual layout of a whole column of switches and how the latter interacts with the other columns of the box." We don't understand this. Do you mean turning on all switches in the column and see if it corresponds to some kind of combinations of the two proposed circuits?

7 Conclusion

Positive points:

- Increasing the number of experiments to lower the variance is a good idea.

Improvements:

- You say that "a theoretical model was developed and analysed with respect to the laid out mathematical framework" but you made no link between this mathematical framework when you presented the theoretical model.
- You don't talk about the "Link between the statistical and theoretical model" and "Next steps" sections.
- You have references that aren't mentioned in the text.

8 Closing thoughts

The report has a lot of promising elements, there are however a few changes that we would suggest.

You are not consistent when it comes to talking about the model and or switches with sometimes vague notions such as "simple model" or "2 switch model", we would advise sticking to one to ease the comprehension. The same is true when it come to clarifying what is shown on the figures (ex: "ER1").

Little to no discussion on the errors (statistical and experimental) which is a key idea in DOE. While adding the values to the appendix saves place, constantly referring the reader to it, instead of citing a few key figures, makes the report hard to understand.

Again, the report shows potential and we wish you the best of luck for the final report.