Course material

Course:

## ENG606 / PHYS 442

Video:

## DOE_lesson7_part2_PBdesign

Concepts (extracted from automatically generated subtitles):

**Matrix of alias. Main effect. Additive model. Best possible estimate of main effects. Main effects. Model matrix. Matrix of essay of adam. Coffee time. Last lesson. Alias of a second degree. Variance coefficient. Second degree present. First contrast. Full fold. Powerful design.**

to video sequence search
(within ENG606 / PHYS 442.)

to video

...

notes

summary

0m 0s

# 4.1.14 Determination of the effects

$$\hat{\alpha} = (X'X)^{-1} X'Y = \frac{1}{N} X'Y$$

$$\hat{\alpha} = \frac{1}{8} \begin{pmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 & 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 & 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 & 1 & -1 & -1 & 1 \\ 1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 \\ 1 & -1 & 1 & -1 & -1 & 1 & -1 & 1 \\ 1 & 1 & -1 & -1 & -1 & -1 & 1 & 1 \\ 1 & -1 & -1 & 1 & -1 & 1 & 1 & -1 \end{pmatrix}^T \begin{pmatrix} 35.7 \\ 32.8 \\ 24.2 \\ 36.5 \\ 30.1 \\ 26.0 \\ 35.5 \\ 22.1 \end{pmatrix} = \begin{pmatrix} 30.4 \\ 1.0 \\ 0.8 \\ 0.7 \\ 1.9 \\ -3.4 \\ 1.2 \\ 3.1 \end{pmatrix}$$

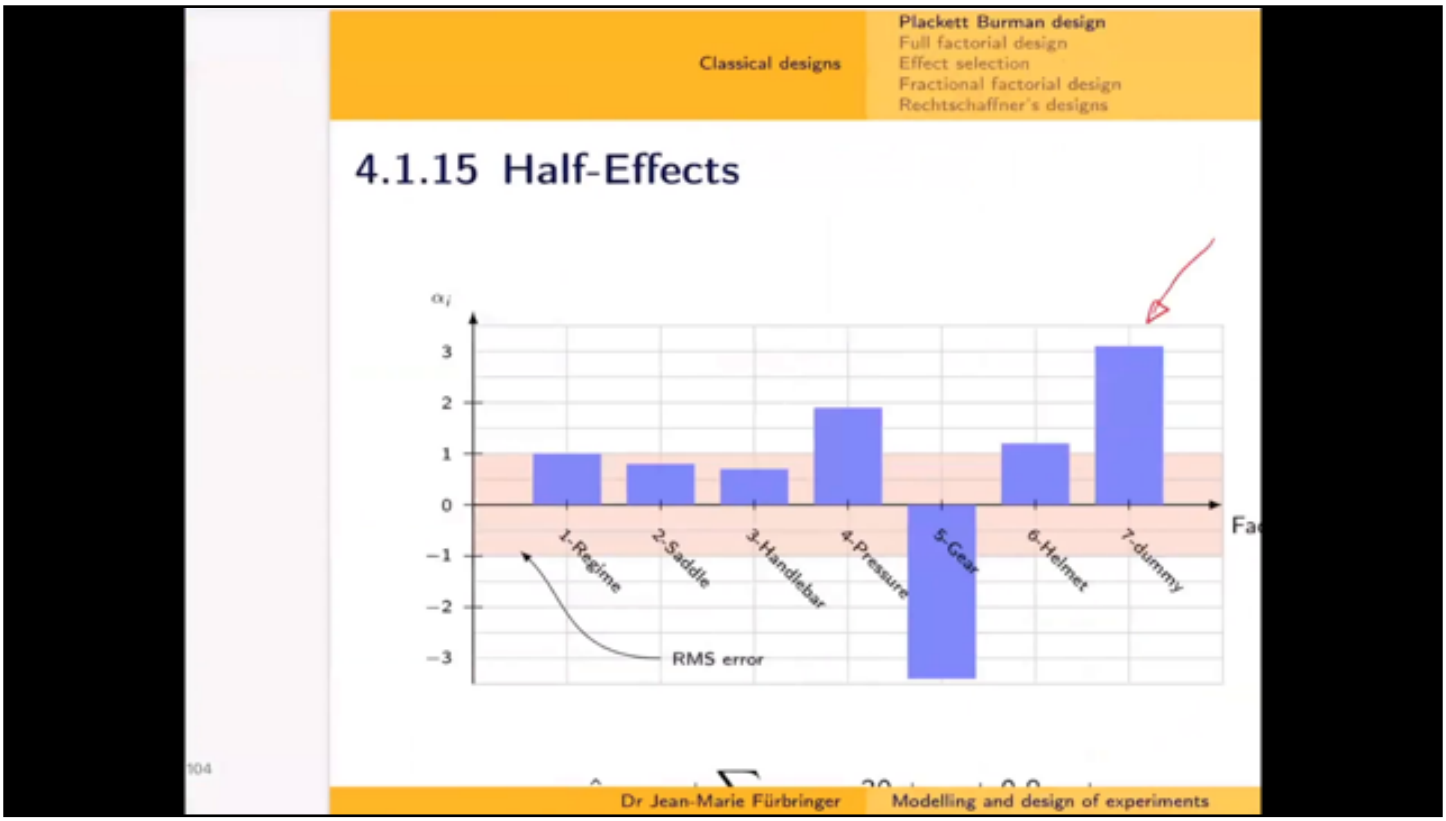


These subtitles have been generated automatically Yeah, so it's this that's multiply element by element.

notes

summary

0m 1s

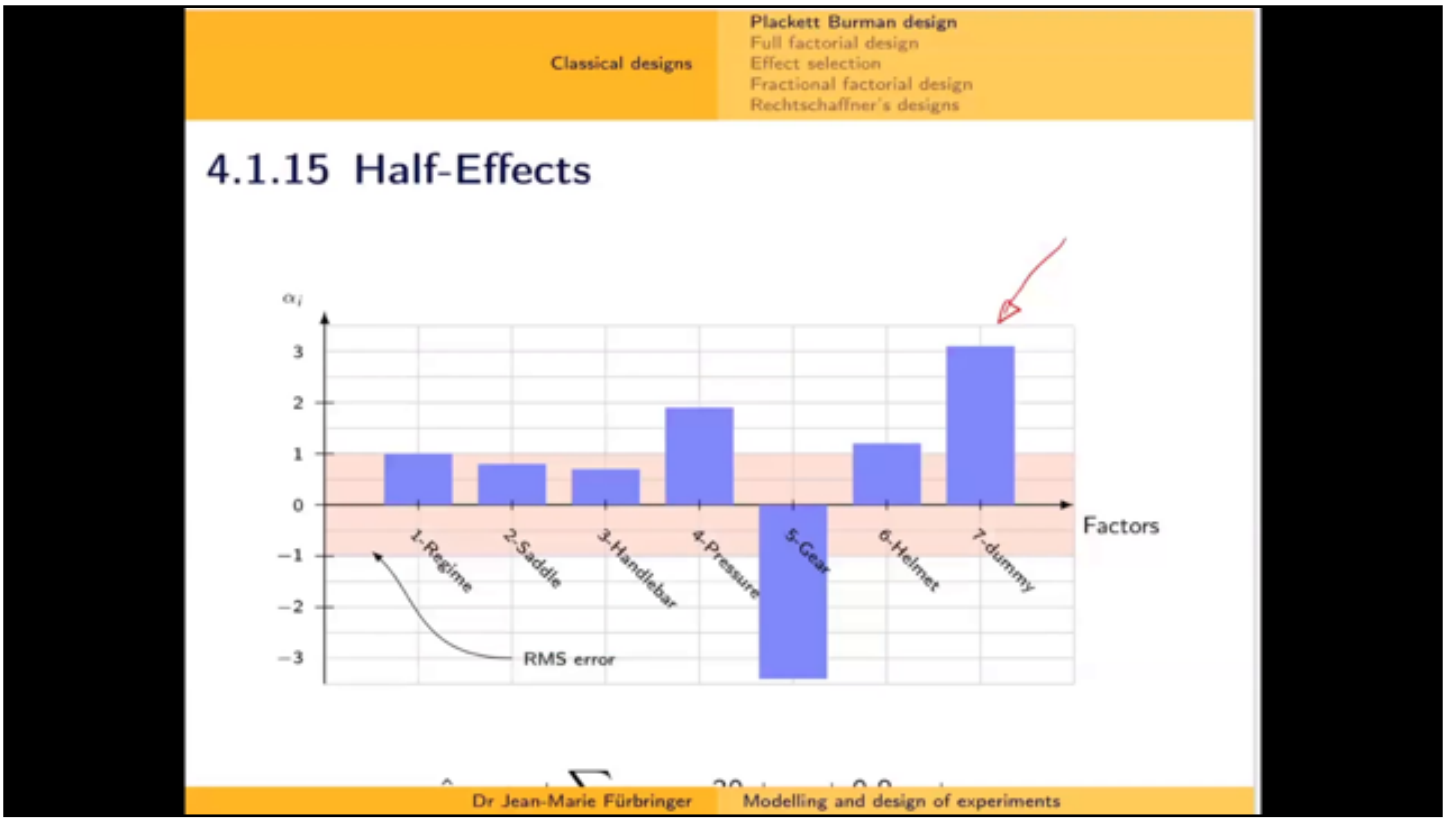



This that gives this and I change my color. Let's okay. So this multiply by this gives this. Yeah. And my dummy could be any other column. The only that I have seven columns. And I'm distributing six factors on the seven columns and the order in which you attribute those column. It's circular. It doesn't make any change. The first one, the last one is treated exactly the same way to have all the coffee time for thinking about why I'm not going to change my color.

notes

summary

0m 5s

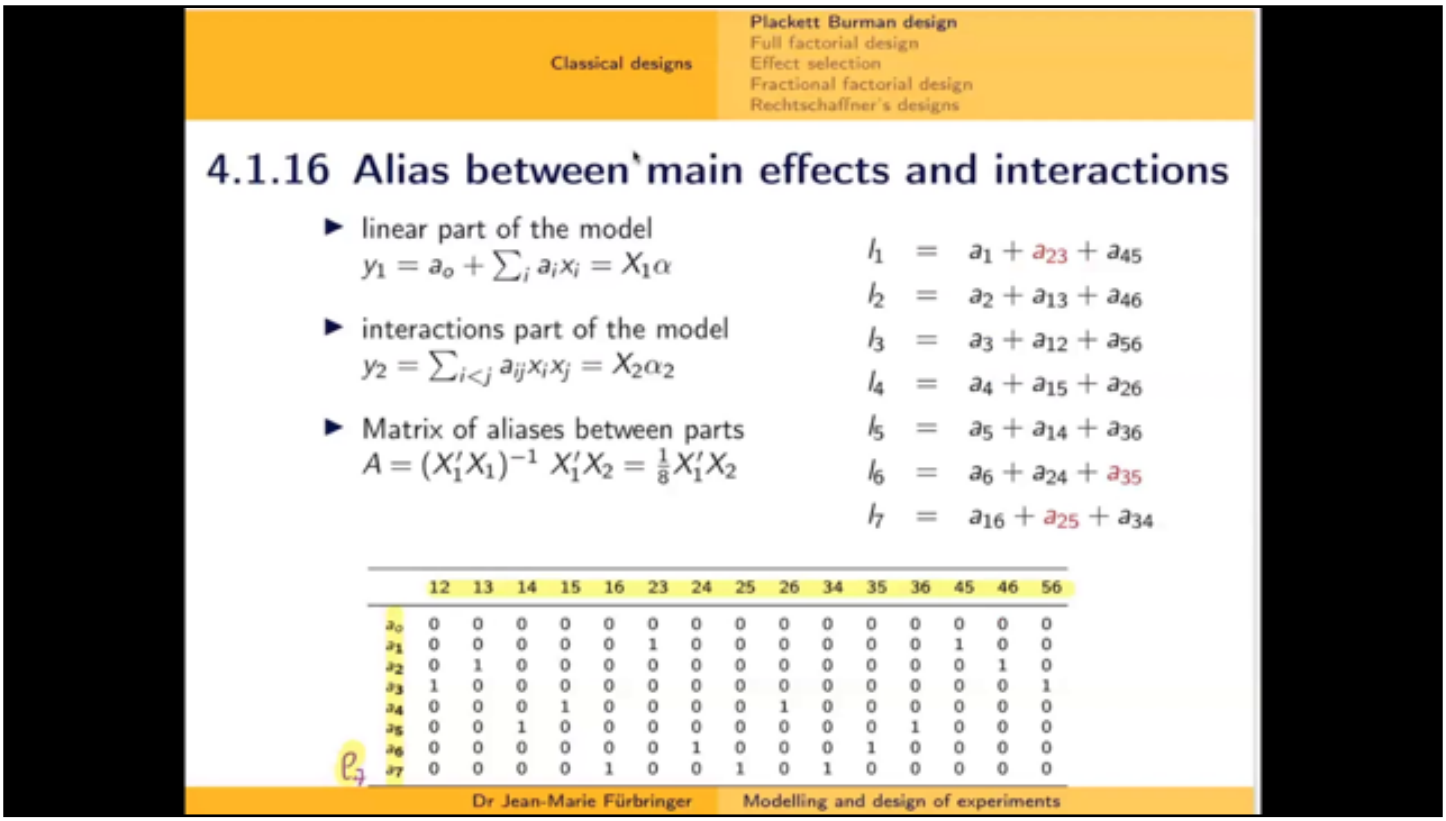



I have all the coffee time for thinking about why, why I have this dummy factor. In fact, I have one button, which is connected to nothing. And it gives me this impression that when I'm moving this button up and down, it's provoking something to speaking electronically. Why? Okay. So you write so explain just a little bit more. There are one keywords that was in the last lesson that we which is with sort of everything is to get how you are you are in the right. Other can also help him. So the keywords, the system is alias. They are alias in the system. You write. In fact, in the dummy factor. So I have alias everywhere. That I also have alias in the dummy factors and the dummy factors doesn't exist. So in this, I only have alias. I only have some interactions and the problem for the problem, the difficulty is the rising because I'm using a design which is usually done for. Additive model, the physics, the real physical model must be additive. And, well, I have instruction between I don't know, but I could have interaction between and it's clear. If I know interaction is quite nice. If I don't know, okay, it could be tricky.

notes

summary

0m 58s

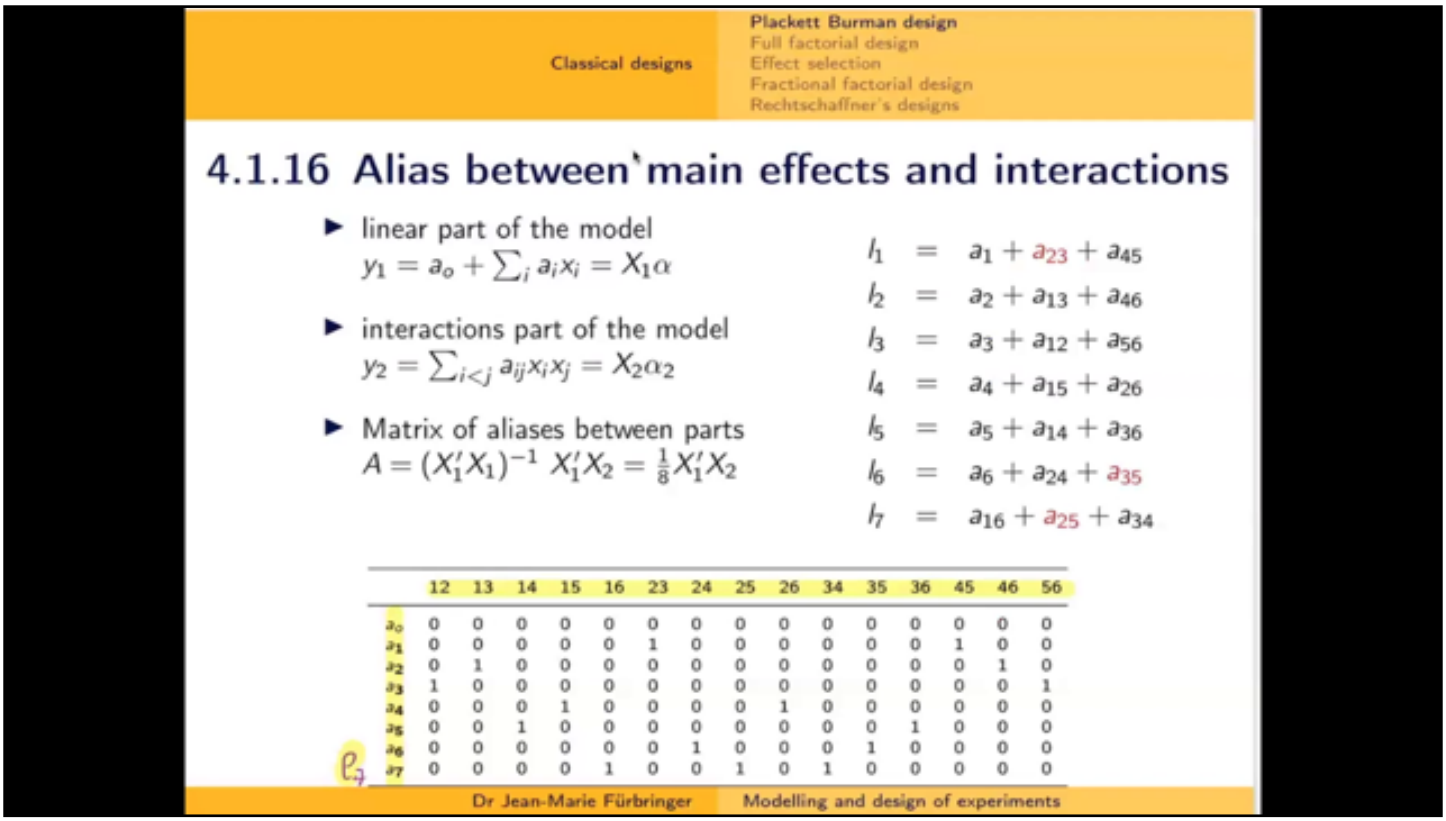



When we use this very powerful design, we need to understand the alias structure for understanding what is alias with what and understanding what we have. So it's a risk if you just applying placate and Berman blindly. And you don't have dummy factors, you could have seven factors, no. Or you have dummy factors, but the dummy factor. Okay, the are not significant. That doesn't mean that you don't have alias in the other. This is the problem. The problem. This is the problem, the situation of this type of designs that they have alias. The interaction, if they exist, are alias with the main effect. So powerful, but risky or risky if you don't know what you are doing. So you need to know what you are doing. So for that, we have to analyze the alias. So I have compute the alias. So what can I have as coefficient in a more complex model? So I have the main effects. There are. They are here. So I have my main effect. I have put all my possible instructions. So you see that in this, I do not have a seven factor. So I do not have an. Yes, I put here a seven, but it doesn't exist. So I could show a call it LL seven or something like that because it doesn't exist in reality. But in the interaction, so I have one, one, two, one, three, et cetera. I don't have interaction with these factors sevens. It doesn't exist. So in this matrix of alias, I'm putting in evidence. What is the relation between my, so now it's the element. I mentioned it last, last lessons, my contrast. So the numbers I get from my, my experiment and my different coefficient. And so if you see a zero, a zero, you can check. There are no alias of instruction. In fact, it would have alias

notes

summary

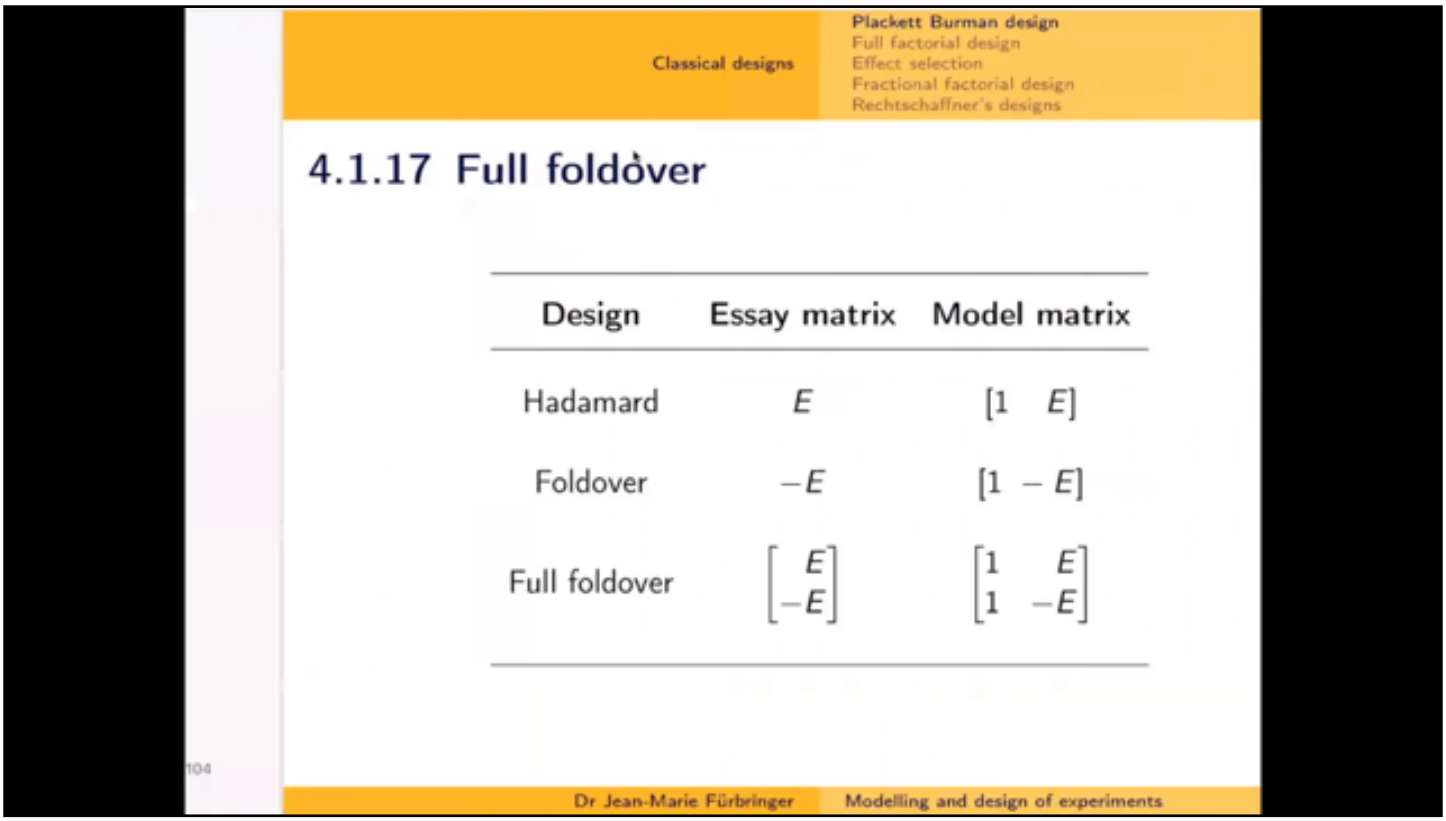
2m 37s




of a second degree is the second degree present, but there are no alias of the main.

notes

summary

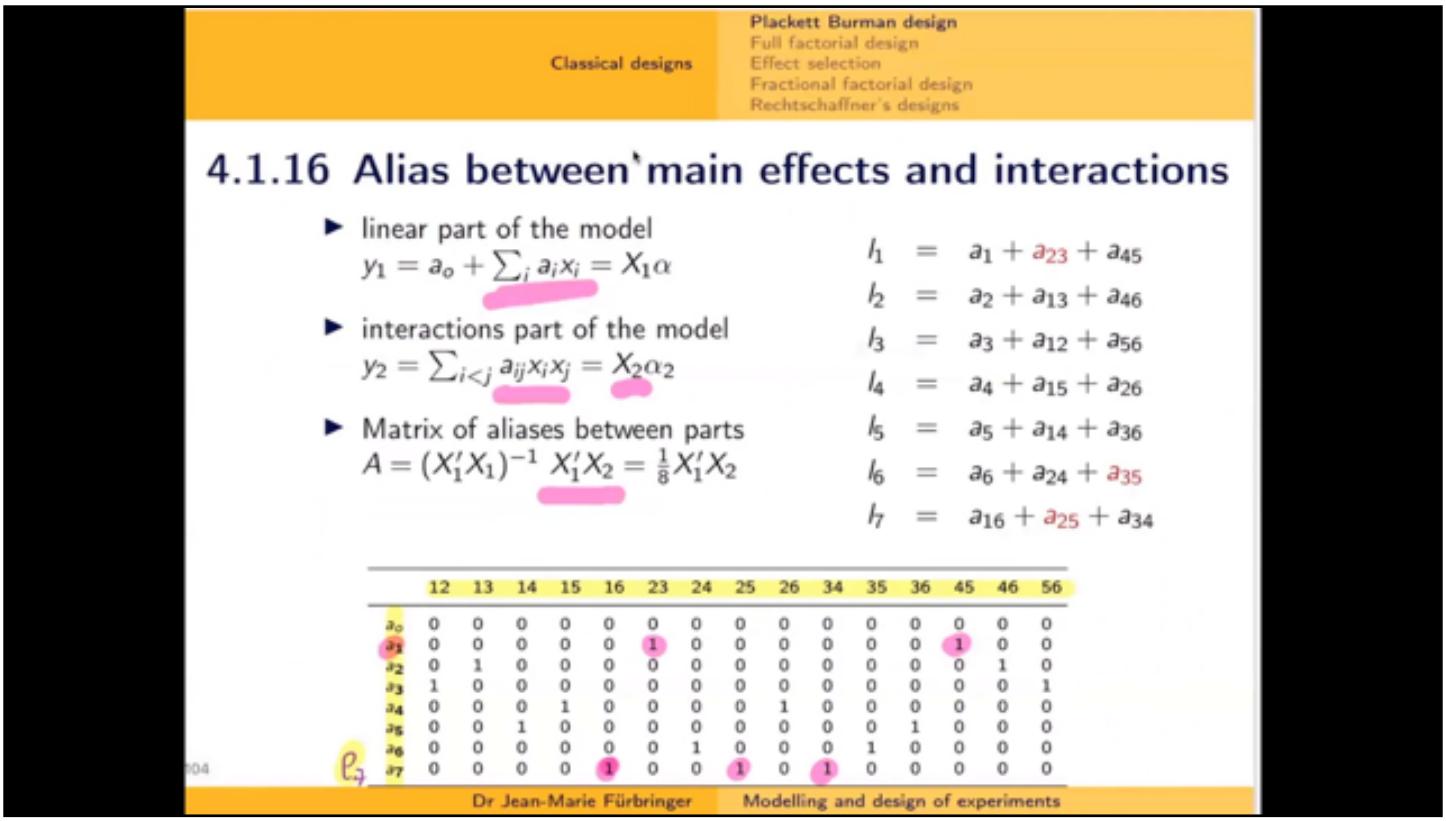



But if you see a one. So a one, you can see that you have an alias between a with between two, three and between four, five. And this is the result of this calculation. X one, which represents the model matrix that we use and X two, which be just the instruction, just the columns corresponding to the instructions. So I write it that X one, this just the constant and the main effect. And the second part will be just what's come from the instructions. So I've calculated this alias. So what interests me is the last one. And you can see that's the last one is the contrast. What I get as a dummy factors effect is in fact the interaction of one six of two, five and three, four.

notes

summary

5m 25s

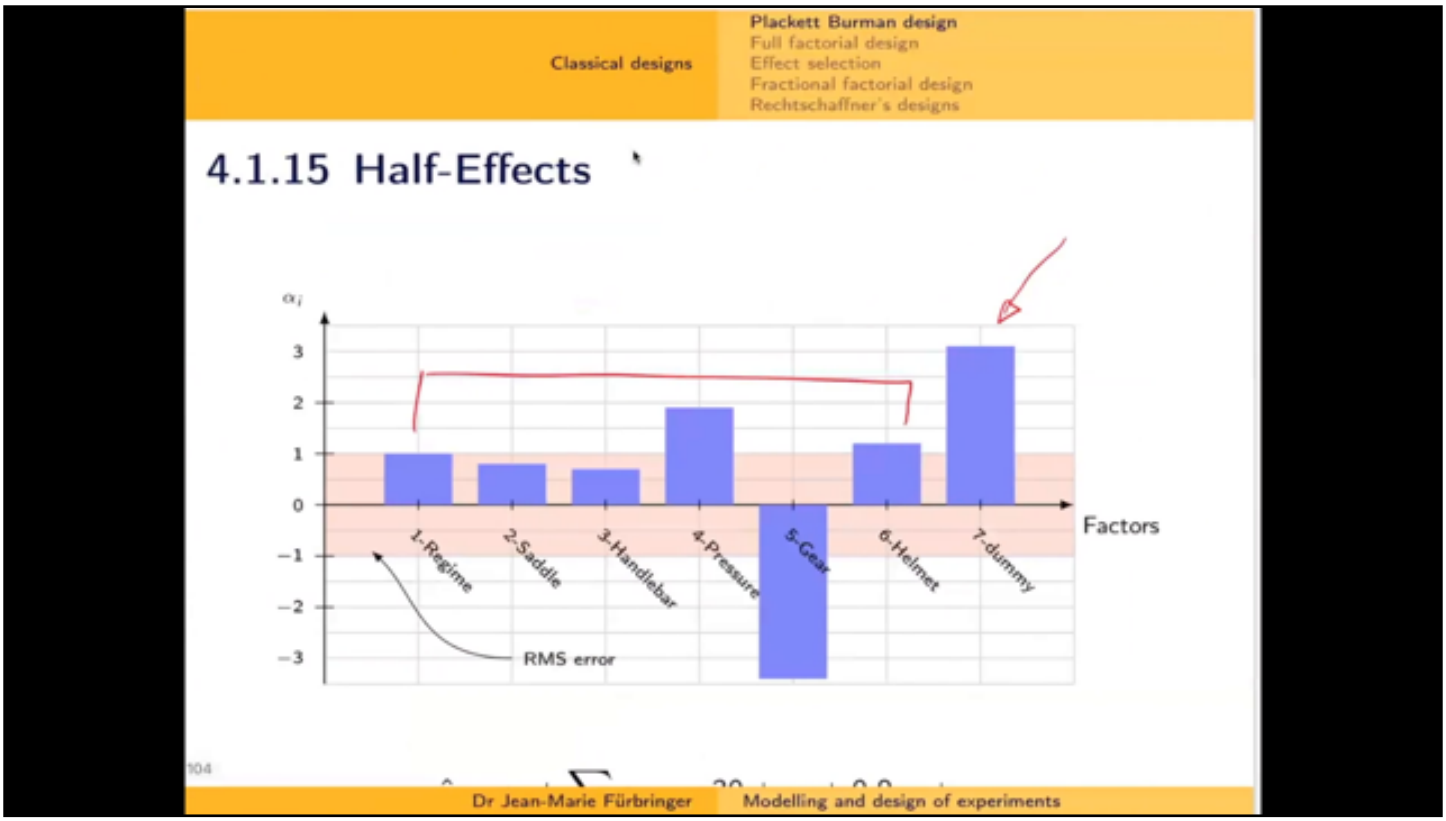



And so what is one six, I say one six. So it was one six. So between the regime and the elements, so probably this instruction is not very interesting.

notes

summary

6m 40s

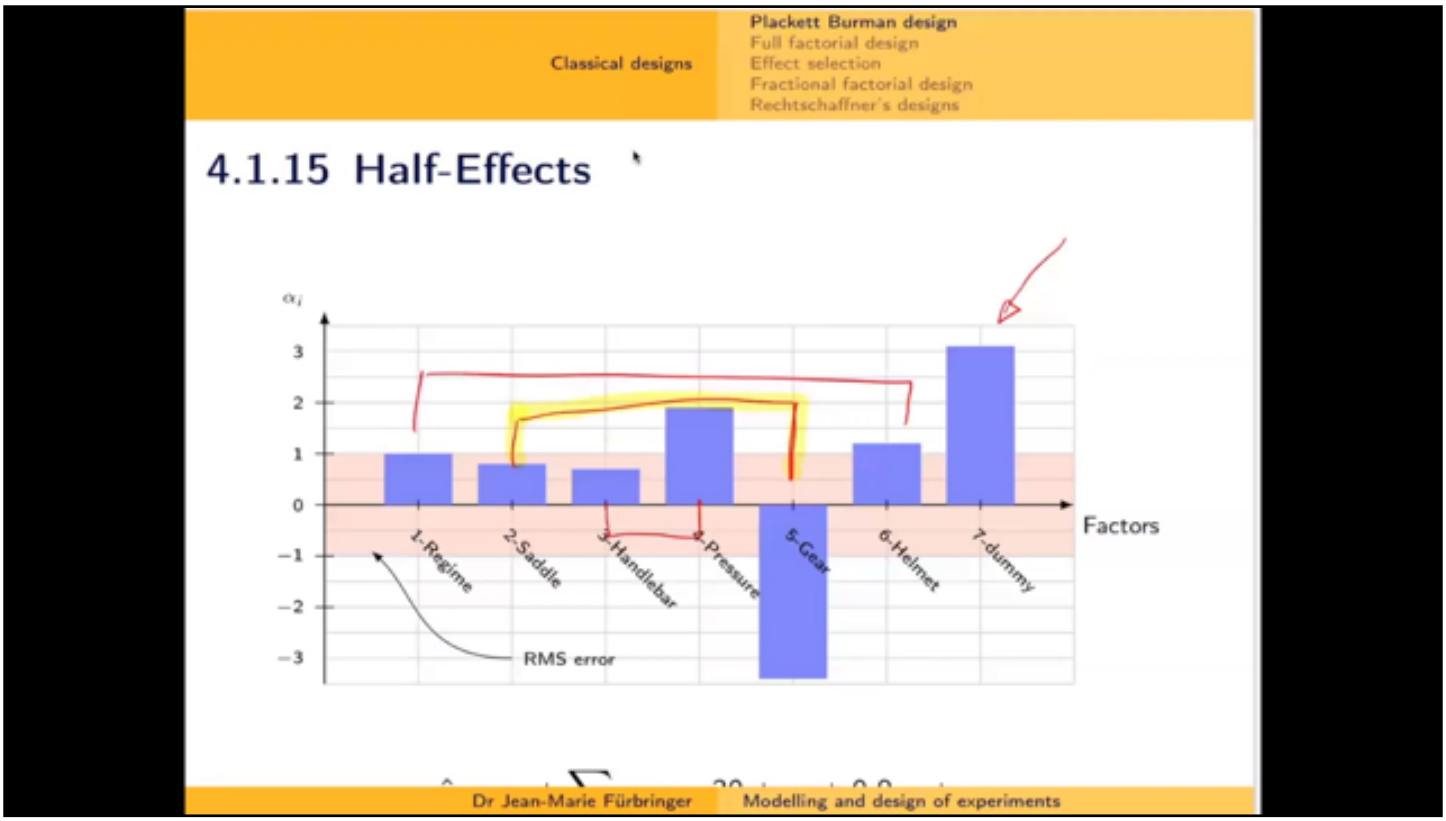



No, doesn't exist very probably one six to five.

notes

summary

7m 1s

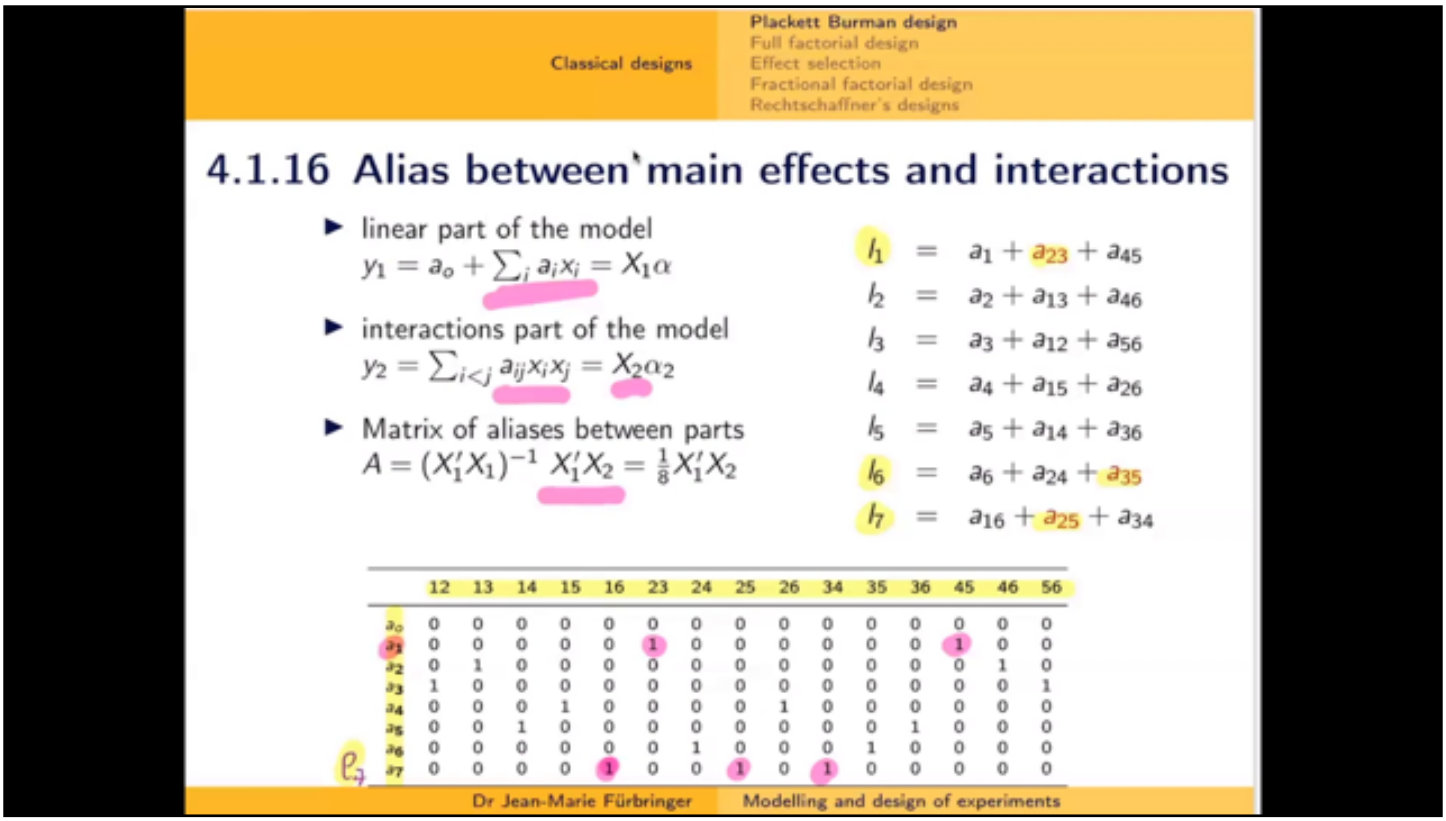



So two and five between the saddle and the gear. Yes, this instruction is possible. You can imagine it's not absolutely I'm not a good, I'm not a specialist in cycles, but I can imagine it's possible. No, it's two mechanical elements and you can imagine that the saddle is related to how you can develop force with your leg. And so it could be in relation with what you have as a gear. For me, it would be acceptable. So let's put this interaction as possible. And the last one is three and four. So three and four. So the relation between no, so between three and four handlebar and pressure. So in this case, it's quite okay.

notes

summary

7m 3s

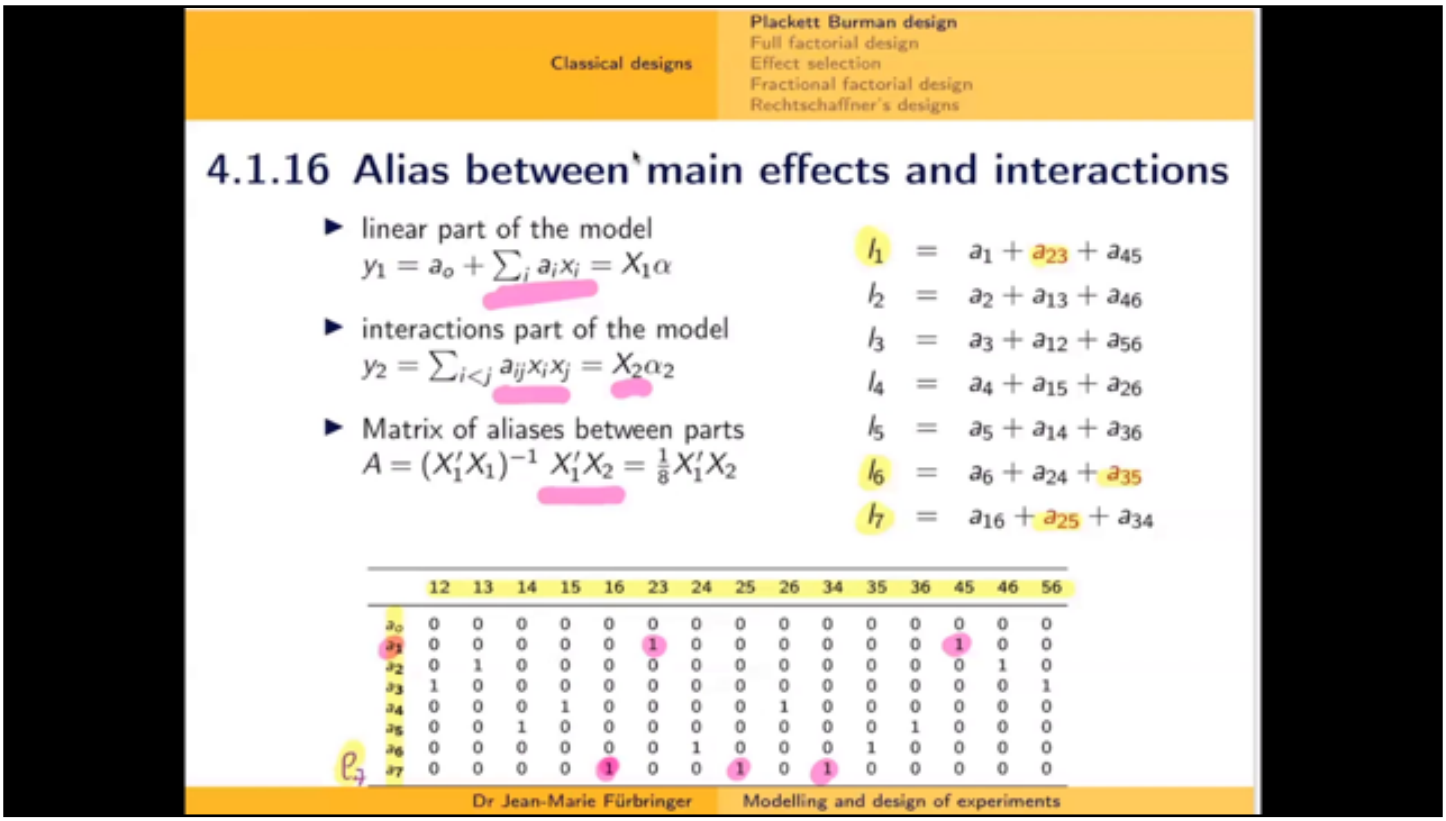



I understand that very probably with interaction is there. But for the other, I can also check for the gear, which is the most important. So with the hidden interaction with the alias interaction, two things can happen. The interaction could be positive and increasing the effects. But so if the effect is negative, it will be decreasing the effect towards zero. Or the interaction could be negative. And so if the effect is positive, it will reduce. So it's putting some doubt on finally all things. So in this situation, first thing, I can check what are the possible interactions that exist. In this case, I have an ally that eventually between two and three. So two and three. So between the handlebar and the saddle, this was the first one I mentioned. And I'm expecting also an interaction between three and three and five on the six. So I'm having some doubt on the first contrast on the six contracts and the seven contrasts. I have some interaction and the only one I can guess is the interaction between two and five in this case. So it's what I mentioned that the Japanese are doing. So if I can Japanese, not all the Japanese is here, some Japanese methods, the Taguchi methods. And so if you have a problem developing in the Toyota industry, they are, if you have sufficient dummy factors, in fact, you could eventually if you know the possible interaction and you, you have made your order of your factors so that the interesting interactions are alone in a part and you have the main effects, you can do something. Direct way is to make another designs to make more experiments to the ally asked your main effects from your interactions. So the L are what I call the contrast. So the contrast is what you get out of your system. And the A are

notes

summary

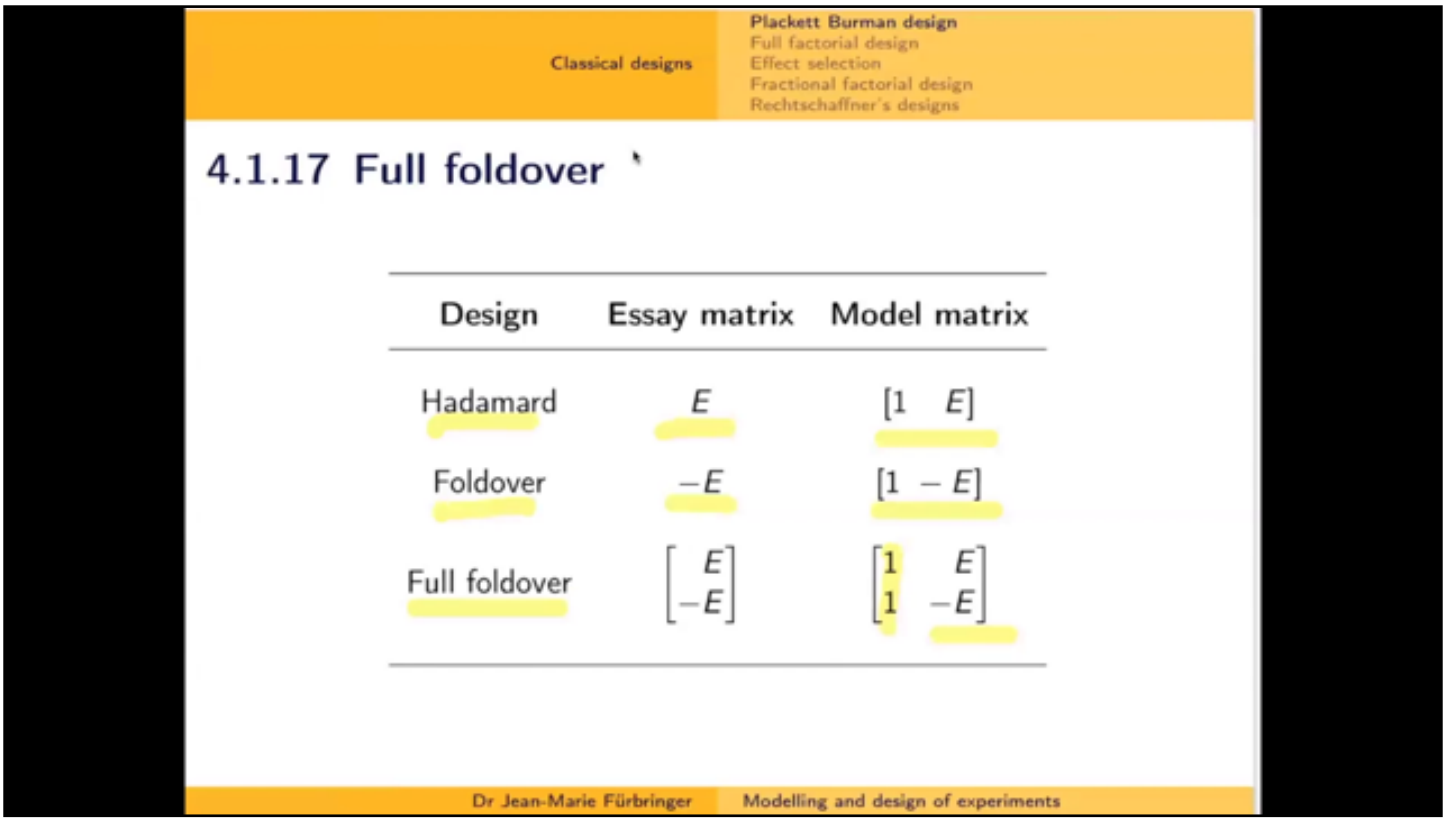
8m 1s




the coefficient of your model. Sometimes they are the same. Sometimes they are different. So it's very interesting of having this concept of contrast.

notes

summary

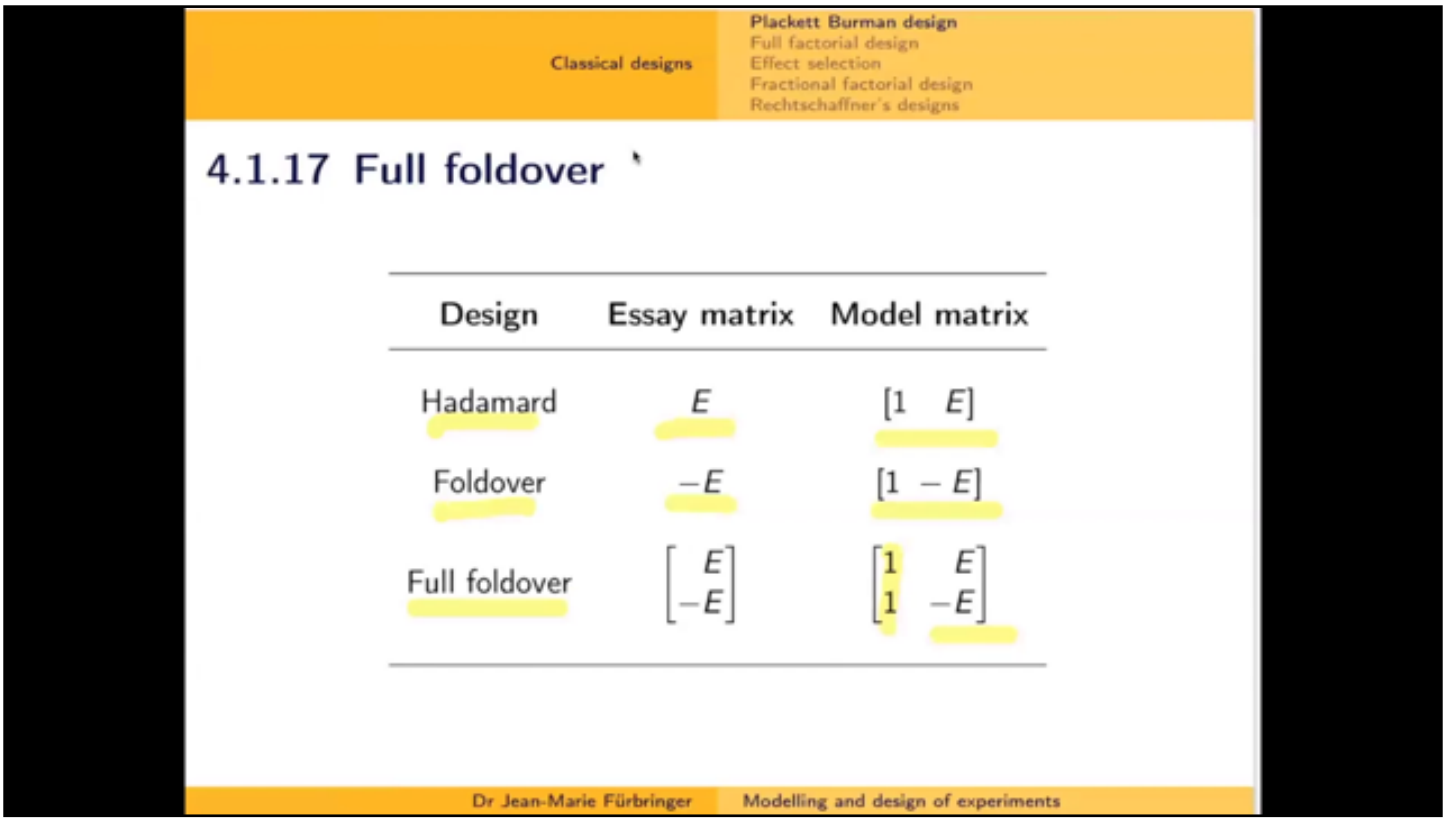



You differentiate what you get out of your linear system and what is the physical, economical, biological reality which is behind with your model. So if you want to deal eyes your main effects from your interaction, you can do what we called a fold over. In fact, all those matrix of essay of Adam are, I tell you that you can change the sign and it's still a matrix of Adam are, we will do the other part of the experiment. We have the black and white and no we have the white and black. All the minors of the matrix of essay. I'm not talking about the column of ones which stays the same. Your constant is your constant, but all the other column, you switch the plus one with the minus one. So we were using the maximum. You are now using the minimum and when you were using the minimum, you are now using the maximum. So it's what I explained here. So you have your matrix of experiment. He you have your matrix of the model which is he plus a column of ones. The fold over you just change the sign of your matrix. So I call it minus E. And then your matrix of the model in this case is a column of one and minus E as a complementary part. So what we call the full fold over. It's not an experiment is to an experiment not eight experiment by 16 experiment. And it's like that I have one column of ones in my matrix of the model and I have one time E and one time minus E. So usually we first make the other mar matrix we look what we have. Eventually, if we know we do not have instructions, it's okay. We don't think small we go on. But if we sing that eventually we have instructions again to

notes

summary

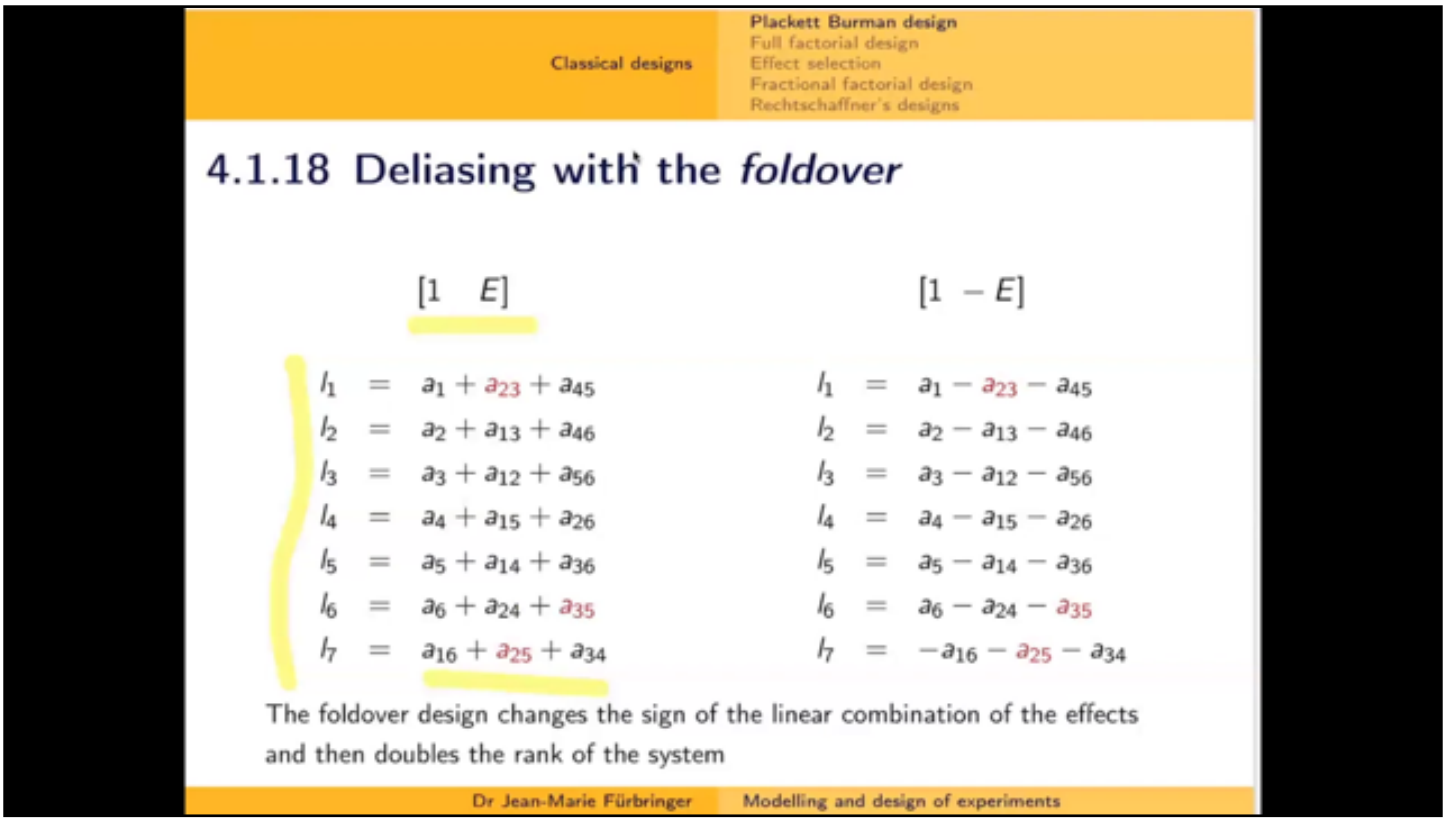
10m 49s




situation, you know what could be this instruction and you check they are not allies with things that are important. The best is when you know the interaction possible interaction and you know the sign of your interaction, you know in which sign it will influence. Sometimes it's possible. Sometimes it's not possible. If you don't know nothing you imagine you have interactions. The solution is full fold over. But it's double price. Okay. So Adam are what we call the fold over. In fact, you never know.

notes

summary

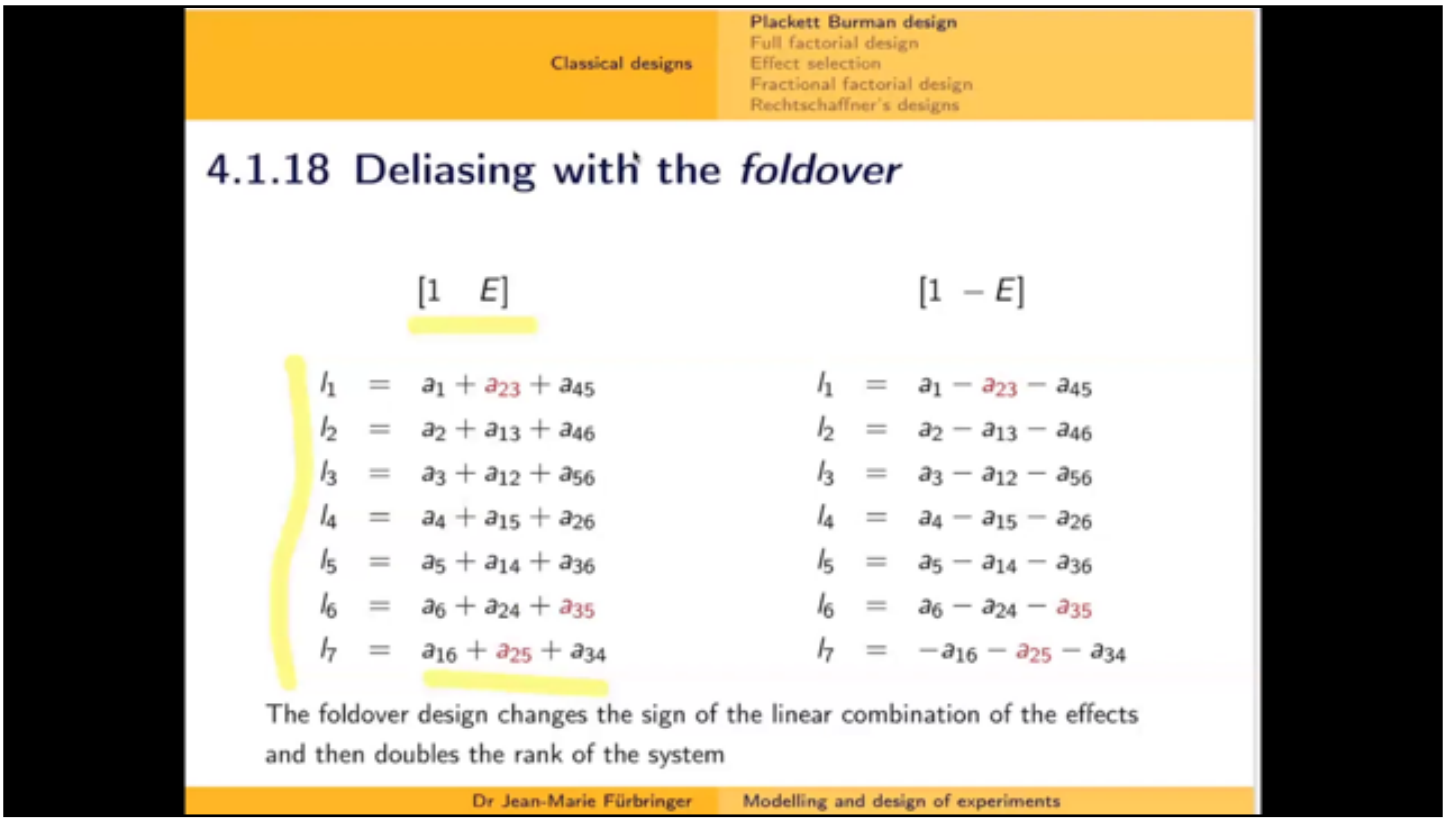



So also something you could have started by the minus E if you want, you perhaps can check the cost. Eventually not all experiment is the same price and perhaps E is more costly or less costly than minus E. Eventually you could do the less costly first or the less than Jews or the quicker because there are some experiments that can do quicker than others etc. You can eventually manage things like that. And when you put all together we have what we call a full fold over and the full fold over let you separate the main effect with instructions from the instructions. And if you have only a few instructions. You can guess the value if you have more or if they are mixed. You cannot separate them but sometimes it's sufficient and the taguchi method is based on that. But you will see Murphy's law working. It's all times the two instructions that trust you. You do everything you can with the whole time. Link together. Okay. So if you realize the Adam are experiments, you have this time. So we call this I call this the table of contrast or the table of aliases. It's this as you want. It was telling me that when I have a contrast L1 was in fact a one plus a two three plus a four five. Etc. And it was telling me that the dummy contrast the result for the dummy factors was a one six plus a two five plus a three four. And the other I changed the sign of the. I've changed the sign of the interactions. So now I have a one minus a two three minus a two five. So making plus and minus in the results in the contrast, I can get them. But usually I don't make this calculation. I just put every the two and experiment and I fit

notes

summary

13m 37s




against the system.

notes

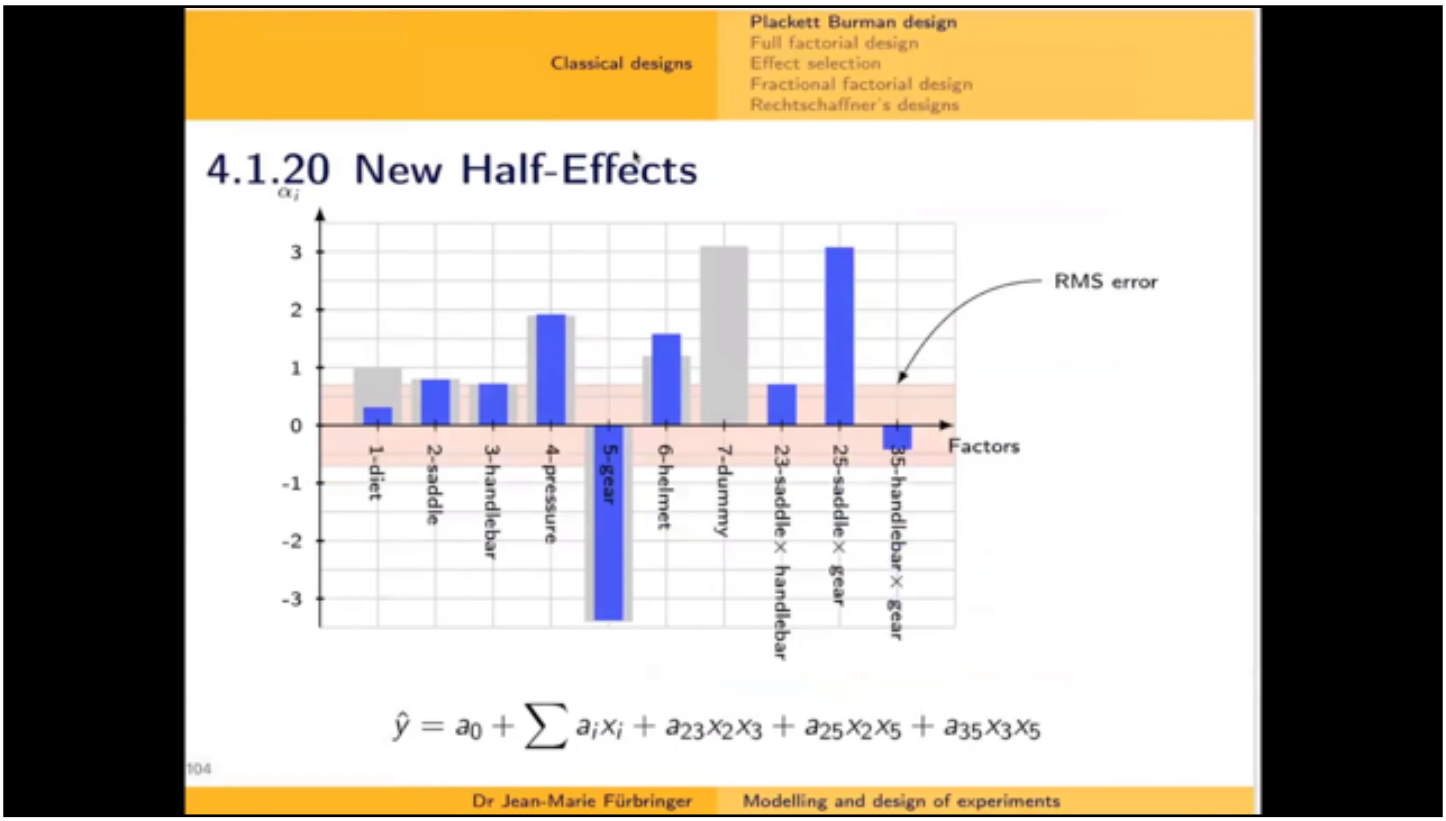
summary


And as I said, even truly you will be here. You have only three additional unknown. So you will solve all the system. But in fact, you have more interaction. In fact, you have 12 15 interactions. You cannot identify all the interactions. So again, if you are able to say no interactions here, no interactions here, it could help you to solve everything with two and experiment. So that means that you have to do eight experiments more. Be careful not to arrive tired to the final race.

notes

summary

16m 13s

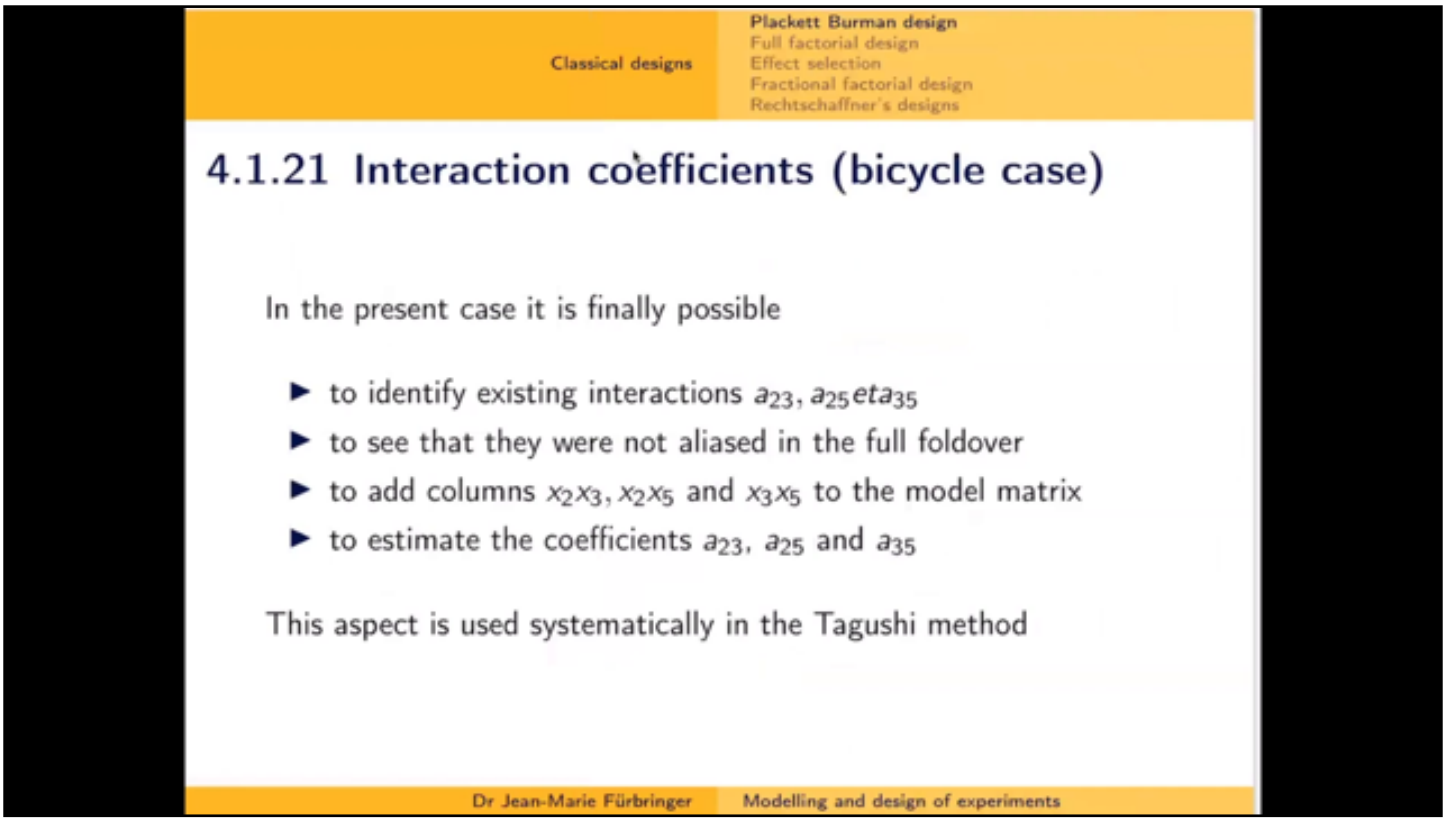



And then you are able to evaluate.

notes

summary

16m 49s

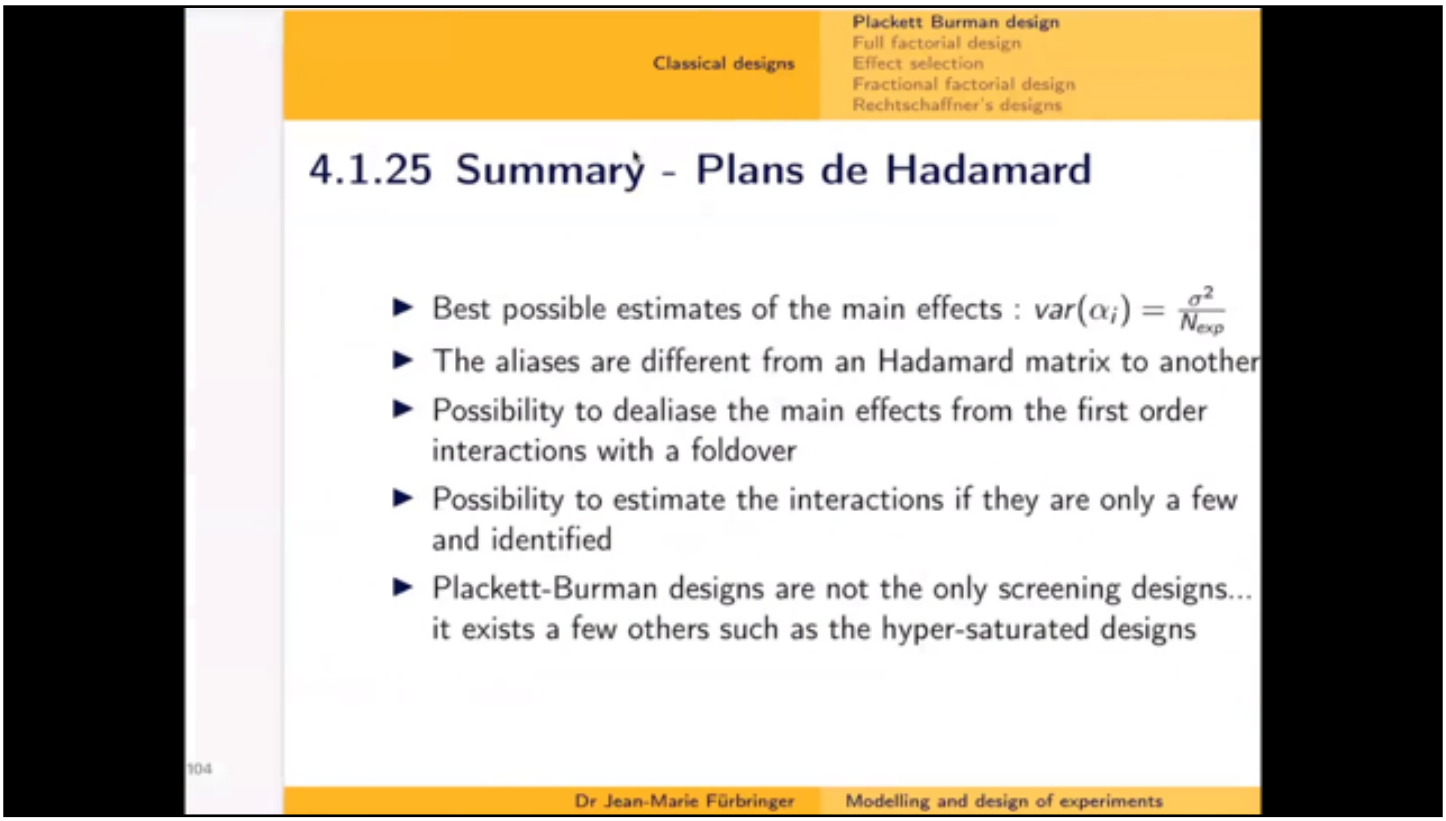



So look in my new graphic. So I have put in gray the old responses. I've put in blue the one when I put all together. It's not interesting to look only the second part. You can if you want, but so the gray is the first part and the blue is both parts together. So it's okay. I see that my diet is still not so important. So it's what what you want. My saddle now just at the level of the significance. So it seems important to make a correct. So it is positive. So I want less time. So I better take the first choice. The handlebar, the same just at the limit. I better take the first situation. So it was a minimum and the bar. The pressure was not changed a lot. The gear was not so much important. The helmet was in fact more important that I have buzzer. And now I'm able to understand that the saddle handlebar interaction is just at the limit of the significance. But the saddle and the gear is in fact a very important interactions. So it's okay because saddle was positive. And the bar was positive and I'm just increasing the benefit. It doesn't change what I have to do. My nut regulation, the setup of my bicycle is not changing the situation. So up fully in this situation, even if I have made only the eight first experiment and not analyze more precisely, it would have been okay. But all are wrong data. So it doesn't prove nothing. But okay, you need to make the full foldover for being certain what are in fact the influence of your interactions. So in the present case, finally, we have identified the existing interactions. Because we knew where we have interaction and we have sufficient degrees of freedom.

notes

summary

16m 50s

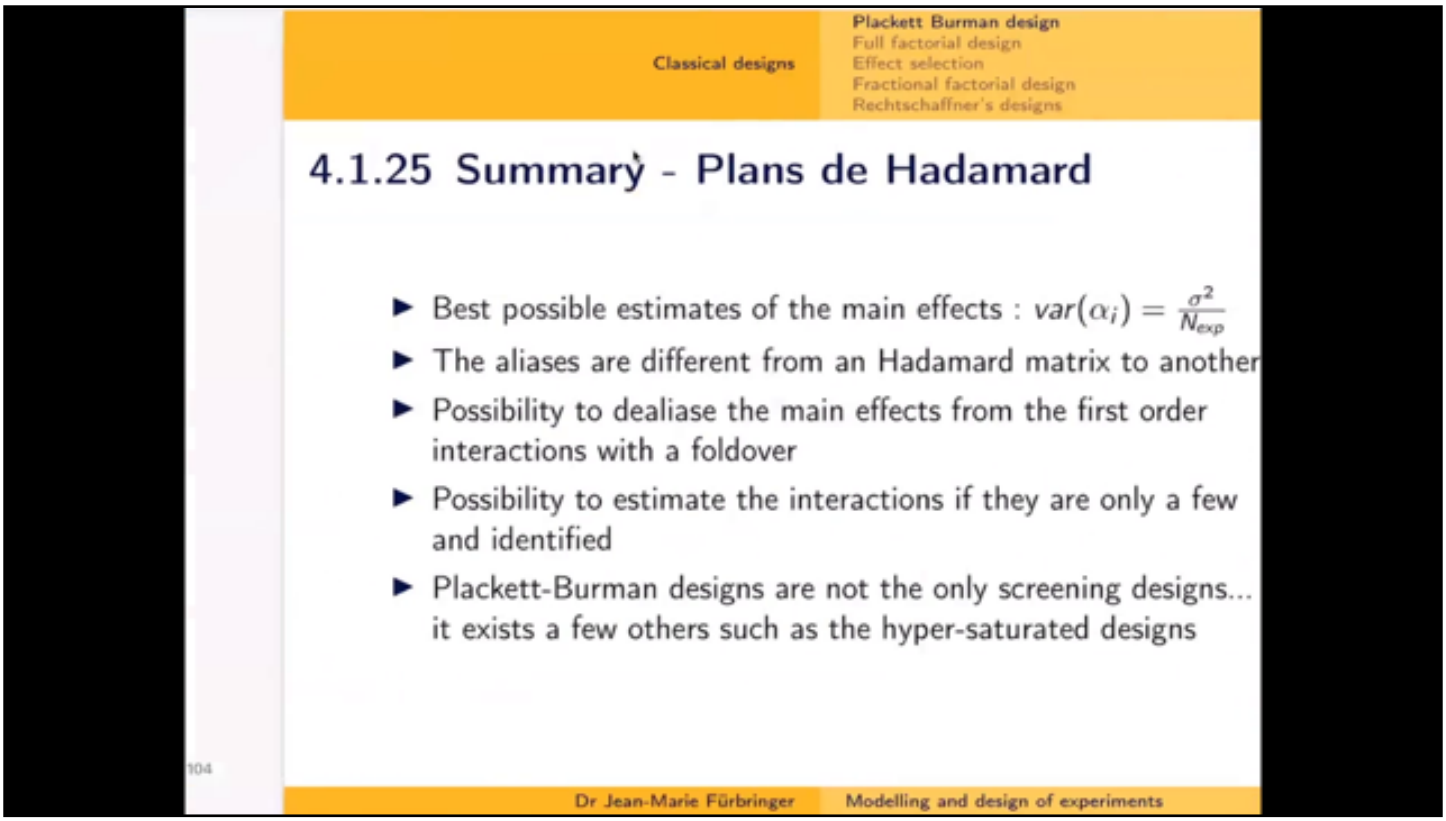



We have seen some effects, not alias. We have been able to reduce the alias. And the model matrix you want to estimate this effect, we have to add the columns of those coefficients. And then finally, we have been able to calculate them. What I mentioned is really parallel to the Taguchi methods. Not that. Not that. Not that. Okay, as a summary for the Adamara, so again, is the best possible estimate of main effects. The variance is the variance coefficient, if you want, so the variance coefficient for the variance is the sigma square. So the variance of your measurement doesn't depend of the design, depend of your experiment divided by the numbers of experiment is the best you can do. The alias are different from a Dama matrix to another. So what I present to you as a scheme, you have to do it for each matrix when you are using and the structure is not the same. Sometimes it's more complicated. Sometimes you have the alias one half of one interaction coefficient here and one half there. So it's not all the time as simple as that I present to you. So you need to make this calculation each time for checking what are the aliases and what is aliased with what. You can deal I asked with a fold over. So remember that this is the most important things to remember. And if you have not too much significant interaction, you sometimes have also the possibility to estimate interactions. But again, it's not the main objective. The main objective was to determine the main effects and being able to eliminate the effects that are not important. And I say that it's not the only thing that exists. It exists other type of designs. Okay, I sell you placenta design is the most simple, the most common to be used. If really it's critical for

notes

summary

19m 1s




you, it exists a few other cases where you have also this capacity of making a screening. They are called hyper saturated design, typically checking all the couples, all the possible couples and things like that. Just to let you know that other things exist too. So it's okay for today.

notes

summary