Tutorial 3 - Linear Models

I hope this tutorial will help you master linear models. Don't hesitate to ask me questions if you need further clarification. That's what I'm here for.

Learning objectives:

Familiarize yourself with R's functions for creating linear models, as well as with data exploration and checking model application conditions.

I. DATA EXPLORATION

1. Getting started

- Download the dataset « pokemon_sub.csv ».

2. Exploration steps

Sampling effort

Use the table function on R to check for EACH qualitative variable that you have enough data per modality. Here we have only one qualitative variable : type1.

Here's an example:

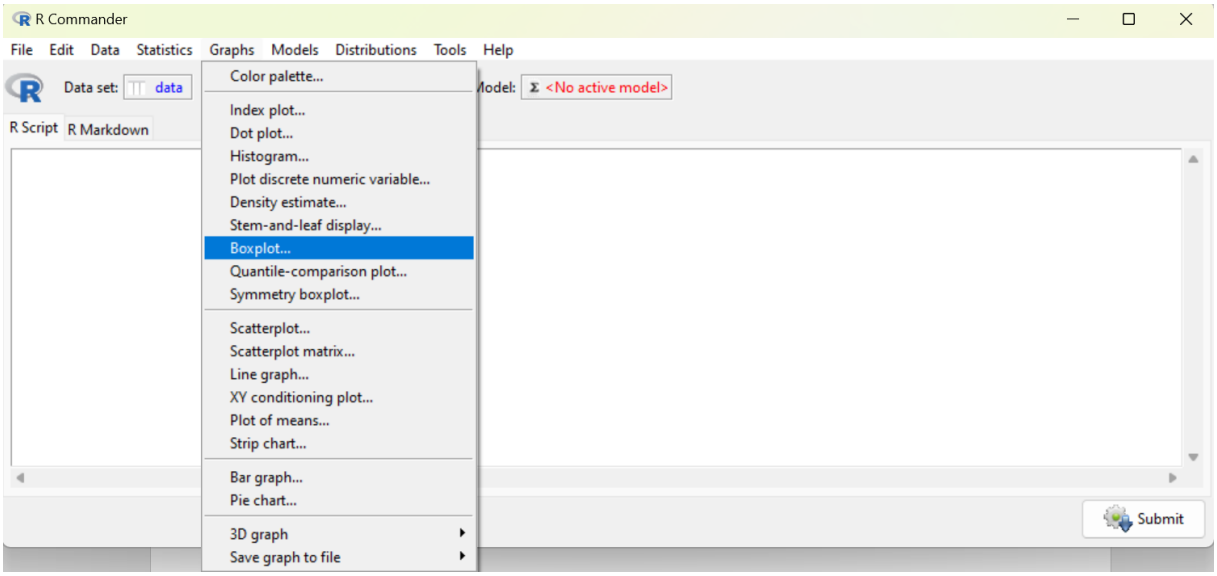
```
table(data$type1)
```

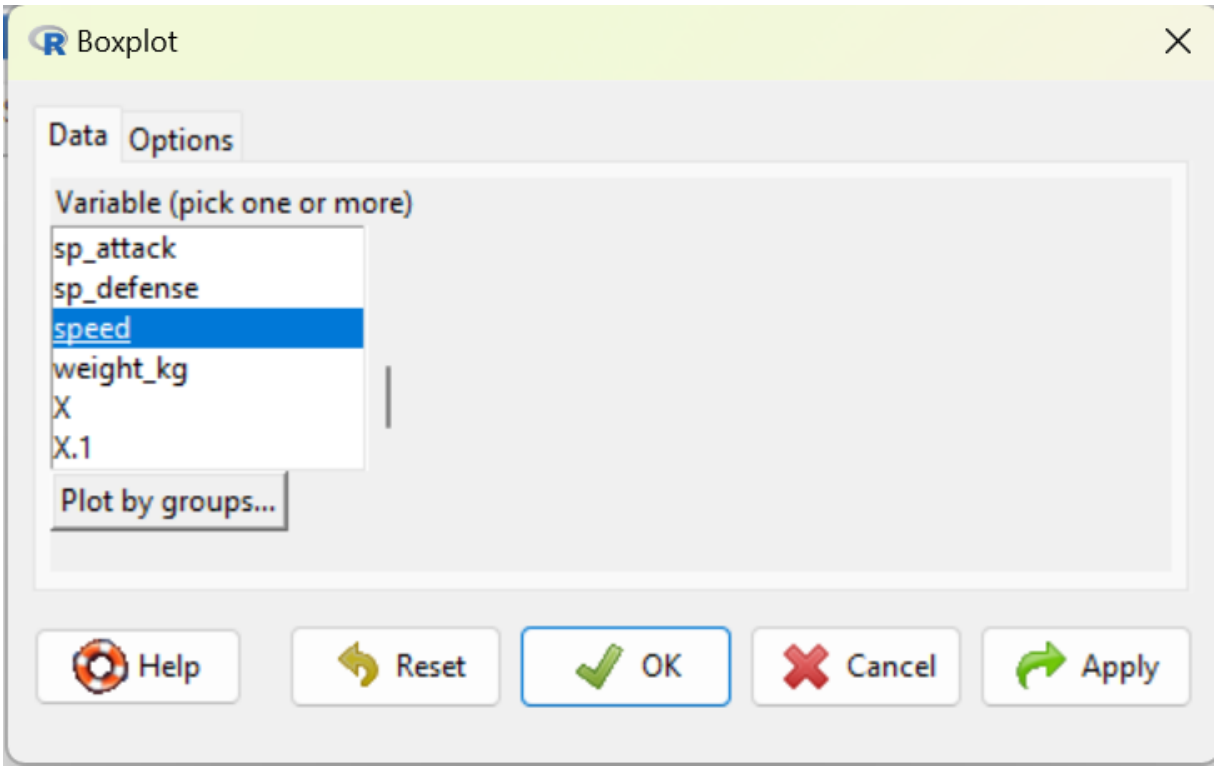
Outliers in quantitative variables

For the presence of extreme data, take each quantitative variable and make a boxplot.

For example : the variable speed.

BUTTON CLICK TEAM





And then OK.

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```
boxplot(data$speed)
```

Study of the relationships between the response variable and the explanatory variables

i. When the explanatory variable is qualitative

You can plot the response variable as a function of the qualitative explanatory variable.

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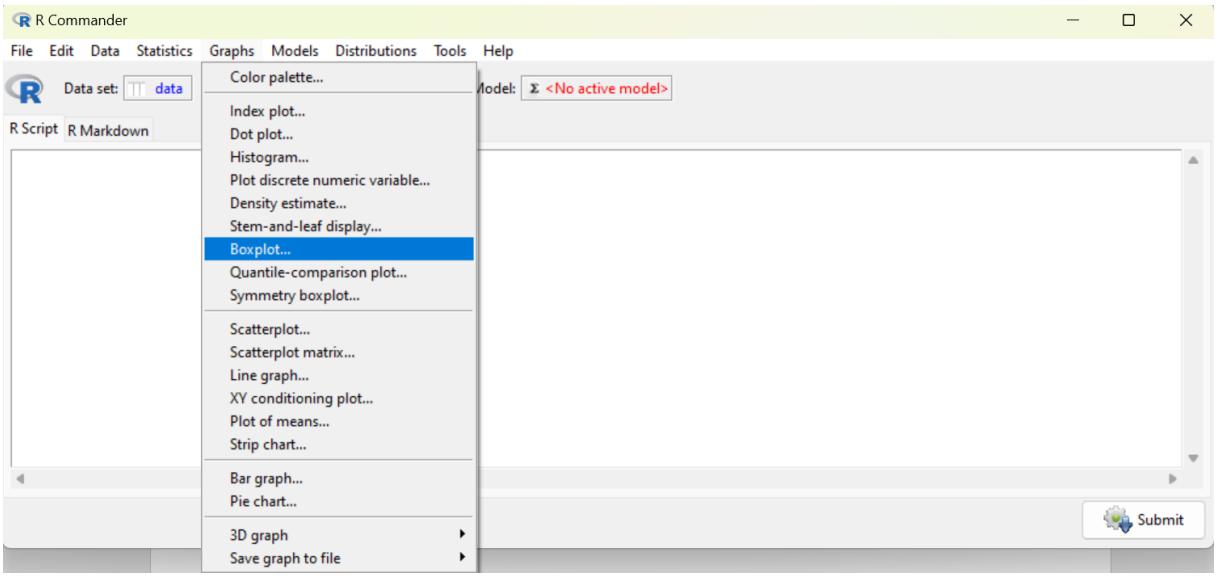
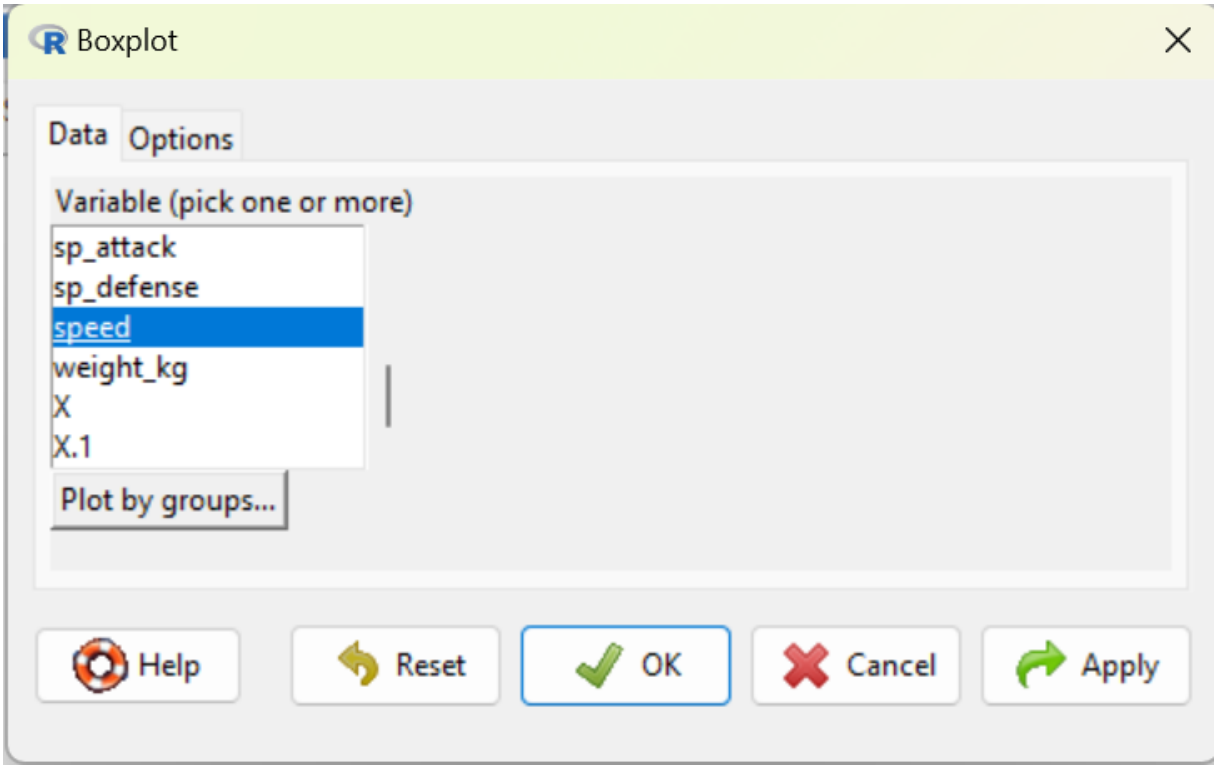
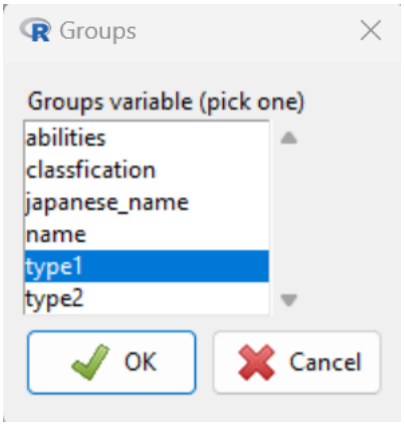




The click on Plot by groups



Then OK.

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```
boxplot(data$speed ~ data$type1)
```

ii. When the explanatory variable is quantitative

You can plot the scatterplot (dotplot) of the response variable against the quantitative explanatory variable.

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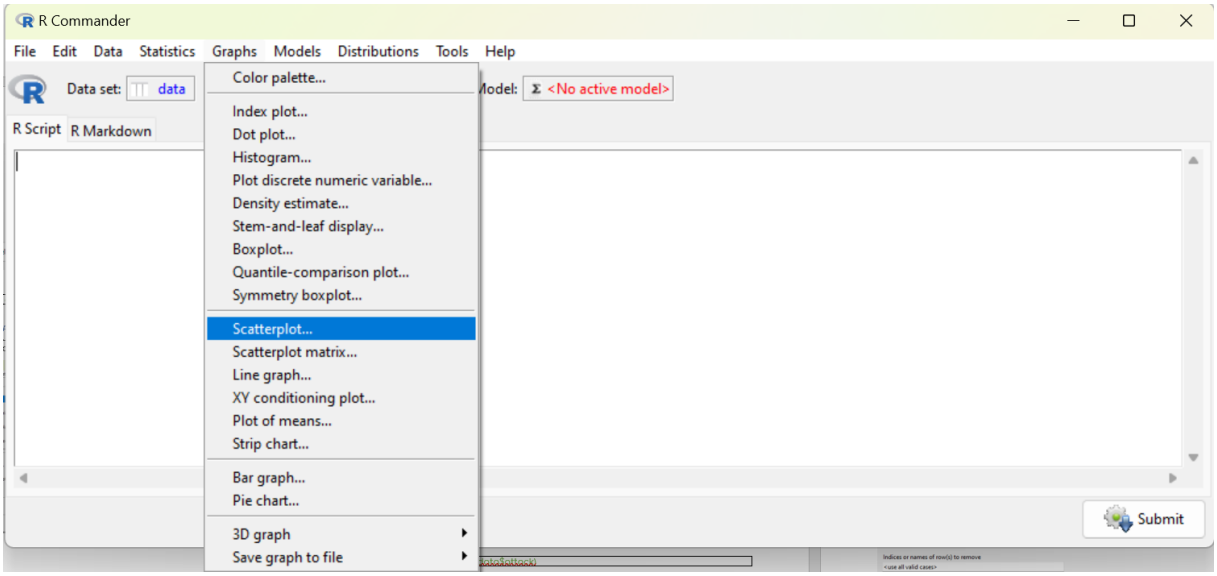

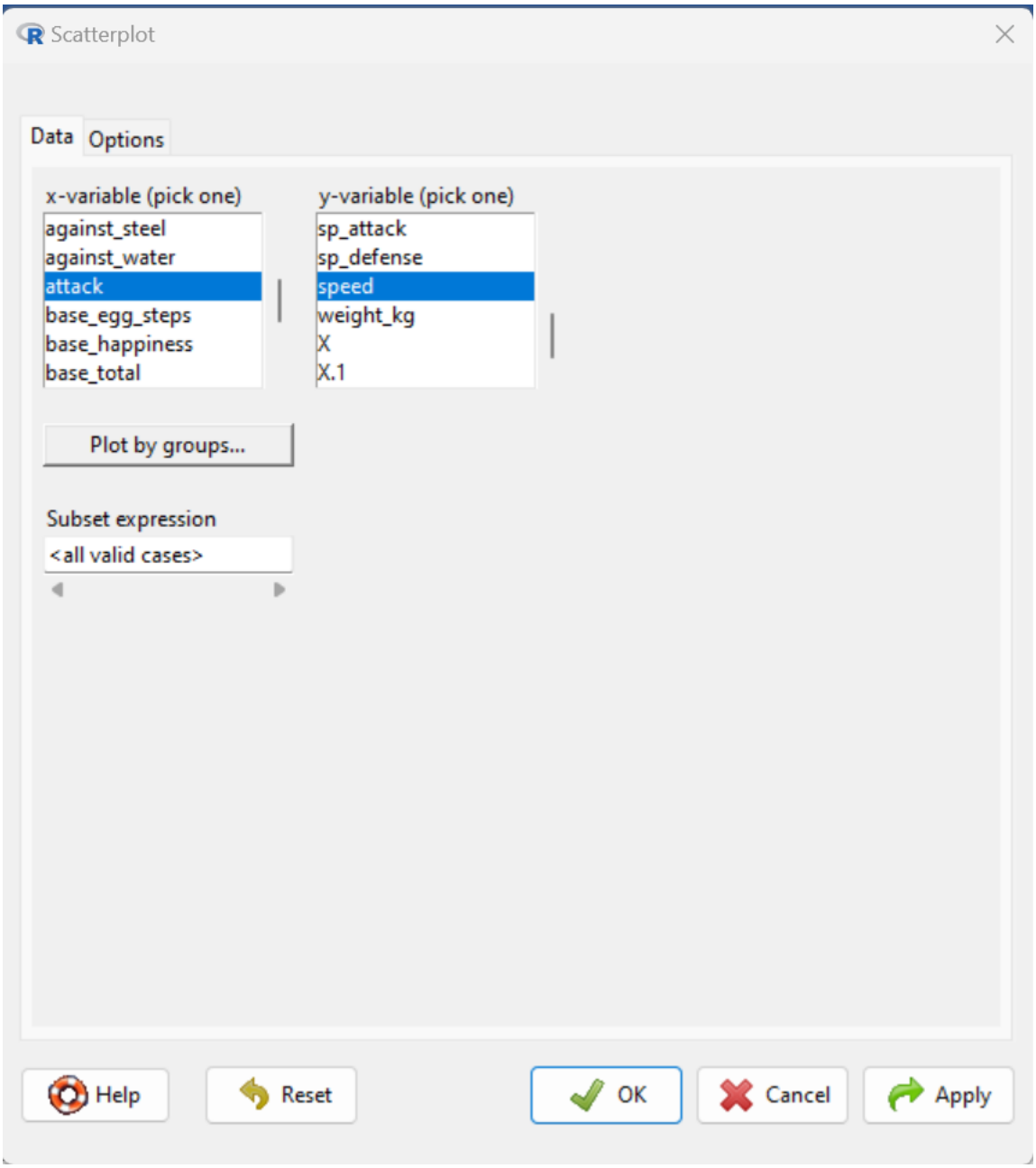

And then click on OK.

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```
plot(data$speed ~ data$attack)
```

I let you do the same for the variable height.

3. Run the model

Let's run the model to investigate the potential significant effects.

We write the model and run it

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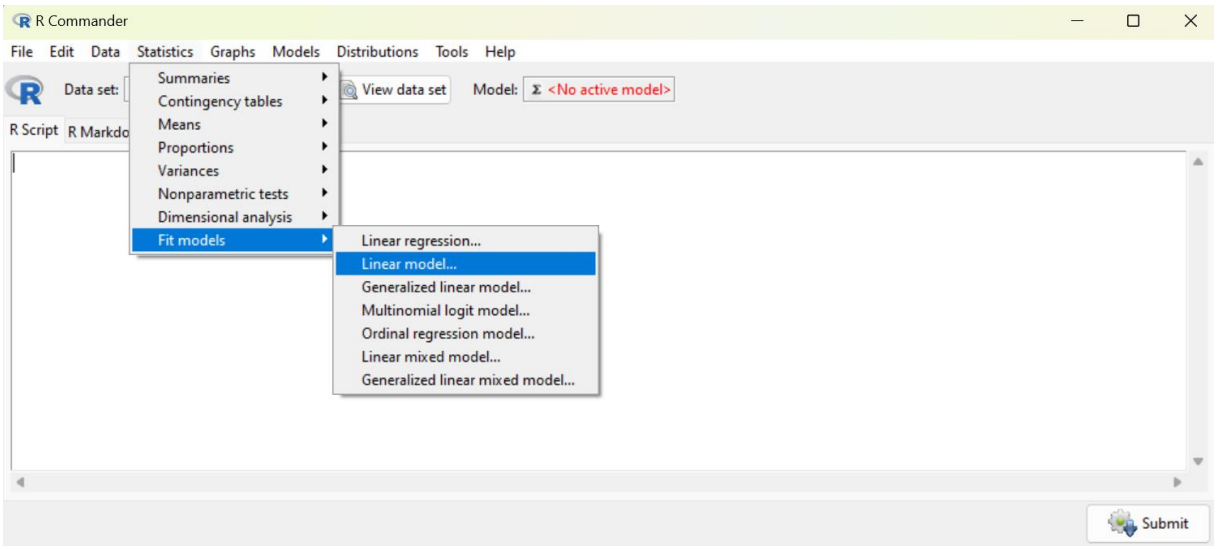

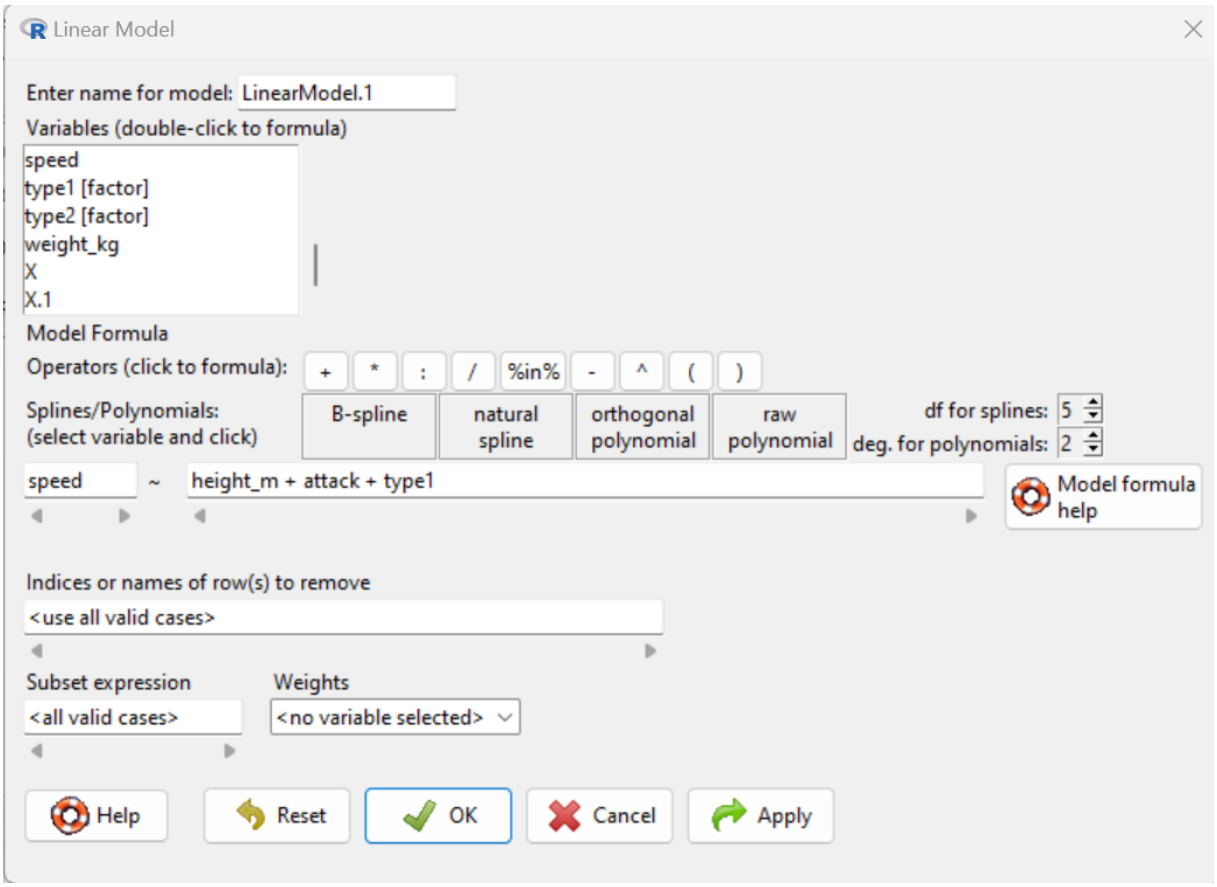

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The lm() function takes as argument a formula of the form y ~ x, where y is the dependent variable and x is the independent variable.

```
mod <- lm(speed ~ height_m + attack + type1, data = data)
```

We retrieve the ANOVA table

The ANOVA table is what gives us access to the significativity of the variables/parameters.

We all switch to TEAM CODING.

Retrieve the ANOVA table using the Anova function (from the 'car' package).

If you have called your model 'mod', this gives :

```
Anova(mod)
```

I'll leave you to interpret the Anova table.

Recover the model summary

The model summary allows you to retrieve the model's R^2 (~ information, % variation of response variable explained by explanatory variables), as well as certain pairwise comparisons (for a qualitative explanatory variable) or the slope (for a quantitative expanatory variable).

Retrieve the summary table with the summary function.

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In the previous procedure, R has already returned it to you.

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```
summary(mod)
```

Interpret the model's R^2? What can we say about it?

Interpret the summary of the model? What can you say about it?

4. Run post-hocs tests

If the differences are significant, then we perform multiple comparison tests, also known as post-hoc tests.

Download the emmeans package.

Use the emmeans function to perform post-hoc/multiple comparison tests.

```
emmeans(mod,pairwise~type1)
```

5. Application condition check

You need to check that the model meets the conditions of application (linearity, normality, homoscedasticity and outliers).

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```
par(mfrow=c(2,2)) #to get the four graphs on the same page
plot(mod) #graphs to check application conditions on the residuals
```

6. Adapt

If the application conditions are not right, adapt.

If you need to remove a specific line, you can do it on excel or directly on R. Here is the code to remove for example line 13

```
data2 <- data[-13, ]
```

II. BONUS

I'll leave you to do the same for the question of factors influencing happiness in Pokemon or test your new skills on another dataset.