

# QUANTITATIVE RESEARCH METHODS

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Lecture 6

# contents



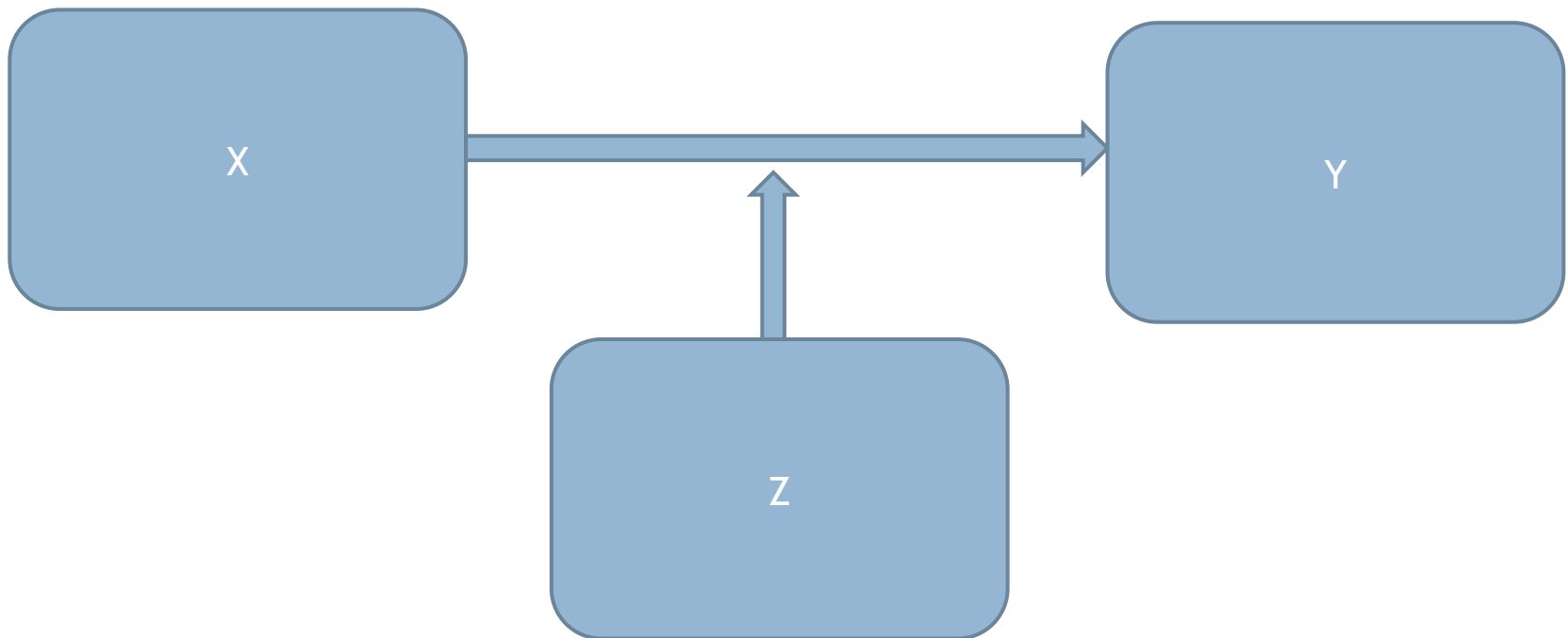
- Interaction / moderation analysis
- Mediation analysis

INTERACTION



# Interaction effect

= moderation



# Interaction effect

- Is the relationship between X and Y different for different values of Z?
- 1. Calculate an interaction term of X and Z (multiply X with Z)
- 2. Include main and interaction effects in equation
- 3. Center variables to be able to interpret the intercept and beta coefficients

# Interaction equation

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$$Y_i = b_0 + b_1x_1 + b_2x_2 + b_3x_1x_2 + \varepsilon_i$$

# Compare models

	Model without interaction	Model with interaction
Constant	37.227***	49.808***
Horsepower	-.0318**	-.120***
Weight	-3.878***	-8.216***
Weight * Horsepower		.027***
R2	.815	.873

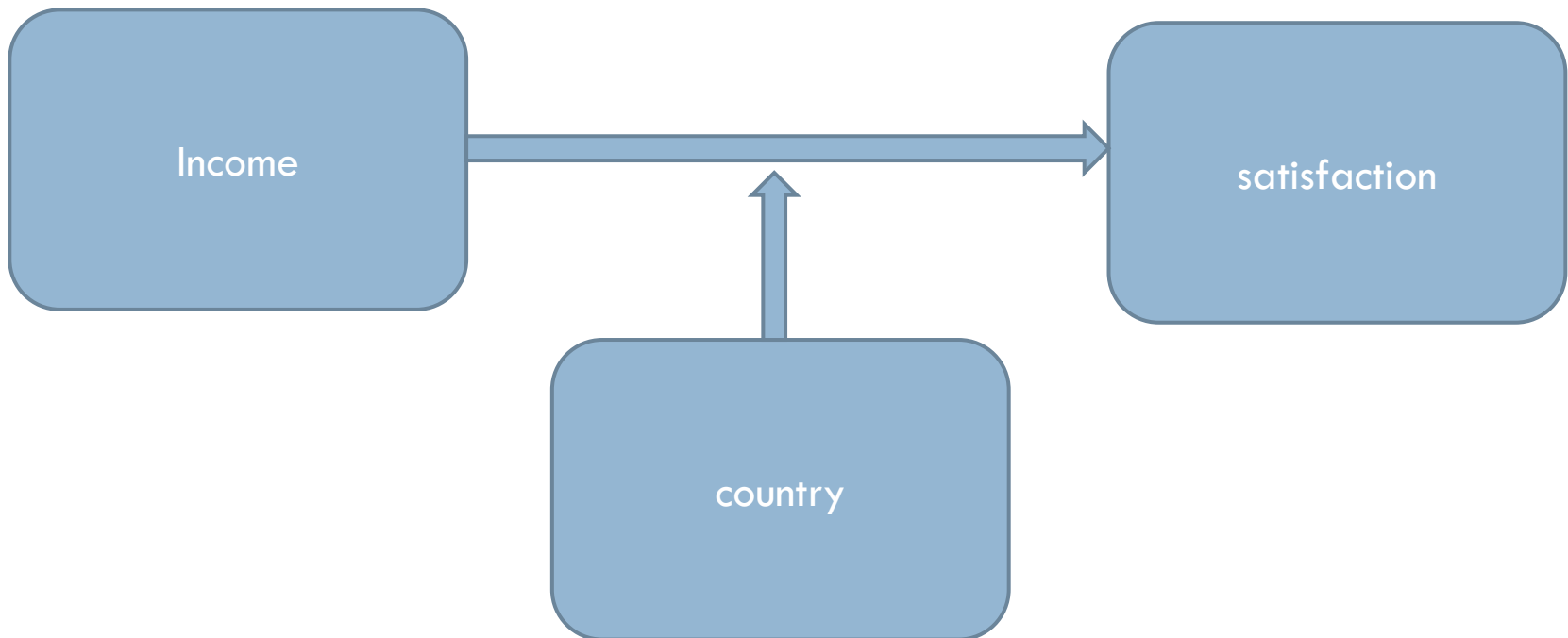
# Interpretation

- Holding constant changes meaning when a moderation effect is added
- The main effects can only be interpreted as the other variables (i.e. interaction effect) is held constant
- This only happens when the main effects are zero (if they are not, the interaction effect changes as well)
- These zero values do not always have **meaning!**



# Exercise 6\_1.r

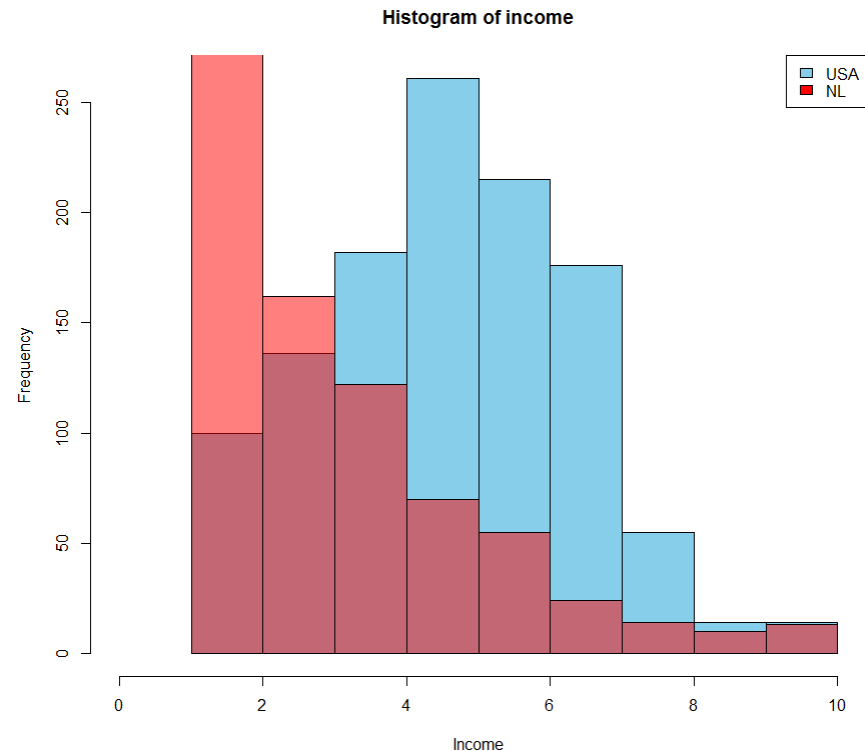
Test & interpret the interaction effect:



# Exe 6\_1.r

## Use plots:

```
plot(incUSA, col='skyblue', xlab="Income",  
     main="Histogram of income", xlim=c(0,10))  
plot(incNL, col=rgb(1,0,0,1/2), xlim=c(0,10), add=T)  
legend("topright",  
       c("USA", "NL"),  
       fill=c("skyblue",  
              "red"))
```



# Exe 6\_1.r

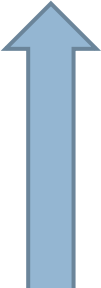
- Explore differences between countries
- Calculate interaction term
- Solve multiple regression with interaction term
  - ▣ Check with lm function
  - ▣ Interpret effects
- Assess model fit

# INTERACTION

Mean centering

# Interaction equation

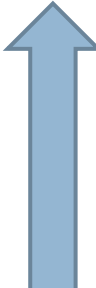
$$Y_i = b_0 + b_1x_1 + b_2x_2 + b_3x_1x_2 + \varepsilon_i$$



An increase of 1 in  $X_1$   
leads to an increase of  
 $b_1$  in  $Y$  when  $X_2$  is zero

# Interaction equation

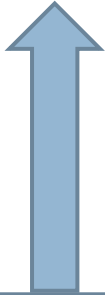
$$Y_i = b_0 + b_1x_1 + b_2x_2 + b_3x_1x_2 + \varepsilon_i$$



An increase of 1 in X2  
leads to an increase of  
b2 in Y when X1 is zero

# Interaction equation

$$Y_i = b_0 + b_1x_1 + b_2x_2 + b_3x_1x_2 + \varepsilon_i$$



An increase of 1 in  $X_1$   
and  $X_2$  leads to an  
increase of  $b_3$  in  $Y$

# Example: house with rooms

- $Y$  = price
- $X_1$  = number of rooms
- $X_2$  = square meters

$$Y_i = b_0 + b_1x_1 + b_2x_2 + b_3x_1x_2 + \varepsilon_i$$

$b_3$  = increase in rooms for house of zero square meters

Example taken from Woolridge



# Example: house with rooms

Therefore mean center:

$$Y_i = b_0 + \delta_1 x_1 + \delta_2 x_2 + b_3(x_1 - \mu_1)(x_2 - \mu_2) + \varepsilon_i$$

$$\delta_1 = b_1 + b_3\mu_2$$

$b_3$  now describes an increase in rooms for an house of **average** square meters

Example taken from Woolridge

# Exe 6\_2.r

- Center your variables around the mean or another meaningful value (NOT the dummy variable)
- Calculate the interaction term using centered variables & add to the model
- Test the model using the `lm` function
  - ▣ Interpret the results (compare to uncentered solution, solution without interaction term)
- Assess model fit

# ASSIGNMENT



# Assignment 1

- Think of a reasonable model to explain green behavior (measured by willingness to pay)
- Include at least two variables
  - ▣ Select two item scales that you think are interesting (both at interval level)
- Add a moderator variable to explore country effects
- Estimate the regression coefficients with lm function
- Interpret the coefficients and model fit

# Next lecture

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- GLM: logit link
- Tablet dataset