

# Preparing your Data for SEM Estimation

## Basic Steps

Lilian Kojan and André Calero Valdez

updated: 2021-07-12

# Data preparation

1. Data requirements
2. Recoding variables
3. Treating missing values
4. Renaming variables

# Data preparation steps

Basic steps:

- Recoding variables
- Treating missing data
- Renaming variables

Advanced steps:

- Examining data distribution
- Removing low quality responses
- Treating outliers

# Example data

Quality Expectation	Expectation Products	Problem Expectation	Satisfaction Overall	Expectation Fulfillment
7	rather agree	5	6	NA
10	strongly agree	2	10	10
7	rather agree	4	8	7
7	strongly agree	6	10	NA
8	rather agree	1	10	8
10	agree	4	8	NA

# Recoding variables: Numerical

Quality Expectation	Expectation Products	Problem Expectation	Satisfaction Overall	Expectation Fulfillment
7	rather agree	5	6	NA
10	strongly agree	2	10	10
7	rather agree	4	8	7
7	strongly agree	6	10	NA
8	rather agree	1	10	8
10	agree	4	8	NA

# Recoding variables: Data type

Data should be

- numerical

But also...

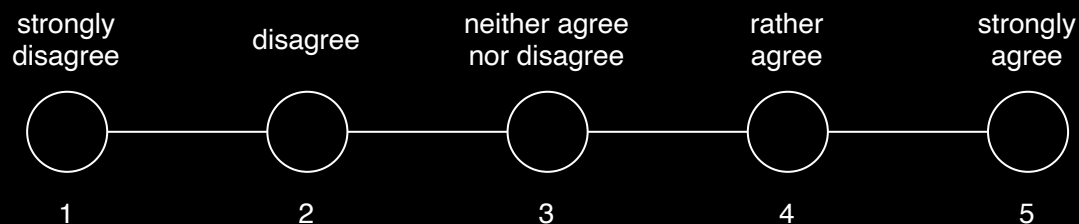
# Recoding variables: Data type

Data should be

- numerical

But also...

... approximately equidistant



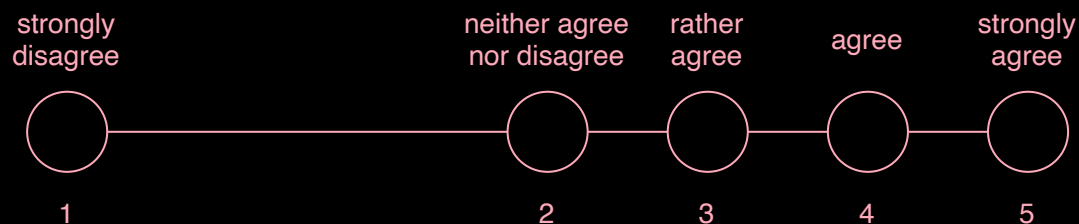
# Recoding variables: Data type

Data should be

- numerical

But also...

... approximately equidistant (i.e., not scaled like this)





# Recoding variables: Data type

Data should be

- numerical
- ordinal scaled
- and the scale should be approximately equidistant

# Recoding variables: Data type

Quality Expectation	Expectation Products	Problem Expectation	Satisfaction Overall	Expectation Fulfillment
7	rather agree	5	6	NA
10	strongly agree	2	10	10
7	rather agree	4	8	7
7	strongly agree	6	10	NA
8	rather agree	1	10	8
10	agree	4	8	NA

# Recoding variables: Data type

```
df <- df %>%                                # assign changes to existing data frame
  dplyr::mutate(                              # add new variable based on existing one
    `Expectation Products` =                # name for the new variable
      dplyr::recode(                         # replace values
        `Expectation Products`,             # variable to replace values in
        "rather agree" = 7,                 # old value = new value
        "agree" = 9,
        "strongly agree" = 10
      )
  )
# because we gave the new variable the same name,
# it replaces the old variable

# use mutate(across(v1:v3), fnc) to recode variables v1 to v3 using fnc
```

# Recoding variables: Data type

Quality Expectation	Expectation Products	Problem Expectation	Satisfaction Overall	Expectation Fulfillment
7	7	5	6	NA
10	10	2	10	10
7	7	4	8	7
7	10	6	10	NA
8	7	1	10	8
10	9	4	8	NA

# Recoding variables: Direction

Quality Expectation	Expectation Products	Problem Expectation	Satisfaction Overall	Expectation Fulfillment
7	7	5	6	NA
10	10	2	10	10
7	7	4	8	7
7	10	6	10	NA
8	7	1	10	8
10	9	4	8	NA

# Recoding variables: Direction

Expectation			Satisfaction	
Quality Expectation	Expectation Products	Problem Expectation	Satisfaction Overall	Expectation Fulfillment
7	7	5	6	NA
10	10	2	10	10
7	7	4	8	7
7	10	6	10	NA
8	7	1	10	8
10	9	4	8	NA

# Recoding variables: Direction

```
df <- df %>%                                # assign changes to existing data frame
  mutate(                                    # add new variable based on existing variables
    `Expectation Products` =                # name for the new variable
      dplyr::recode(                         # replace values
        `1` = 10,                           # old value = new value
        `2` = 9,
        `3` = 8,
        `4` = 7,
        `5` = 6,
        `6` = 5,
        `7` = 4,
        `8` = 3,
        `9` = 2,
        `10` = 1
      )
  )
```

# Recoding variables: Direction

Quicker option:

```
# Reverse scale using mutate() with subtraction:  
# For a scale ranging from 1 to x: x + 1 - scale  
# For a scale ranging from 0 to x: x - scale  
df <- df %>%  
  mutate(  
    `Problem Expectation` = 11 - `Problem Expectation`  
  )
```



# Recoding variables: Direction

Expectation			Satisfaction	
Quality Expectation	Expectation Products	Problem Expectation	Satisfaction Overall	Expectation Fulfillment
7	7	6	6	NA
10	10	9	10	10
7	7	7	8	7
7	10	5	10	NA
8	7	10	10	8
10	9	7	8	NA

# Treating missing values

Expectation			Satisfaction	
Quality Expectation	Expectation Products	Problem Expectation	Satisfaction Overall	Expectation Fulfillment
7	7	6	6	NA
10	10	9	10	10
7	7	7	8	7
7	10	5	10	NA
8	7	10	10	8
10	9	7	8	NA

# Treating missing values

Expectation			Satisfaction	
Quality Expectation	Expectation Products	Problem Expectation	Satisfaction Overall	Expectation Fulfillment
7	7	6	6	NA
10	10	9	10	10
7	7	7	8	7
7	10	5	10	NA
8	7	10	10	8
10	9	7	8	NA

# Treating missing values

Expectation			Satisfaction	
Quality Expectation	Expectation Products	Problem Expectation	Satisfaction Overall	Expectation Fulfillment
7	7	6	6	8
10	10	9	10	10
7	7	7	8	7
7	10	5	10	8
8	7	10	10	8
10	9	7	8	8

# Treating missing values

Expectation			Satisfaction	
Quality Expectation	Expectation Products	Problem Expectation	Satisfaction Overall	Expectation Fulfillment
7	7	6	6	NA
10	10	9	10	10
7	7	7	8	7
7	10	5	10	NA
8	7	10	10	8
10	9	7	8	NA

# Treating missing values

- Impute missing data
- Remove variables containing missing data (Hair et al., 2017)
- Ignore missing data

# Treating missing values

- Impute missing data
- Remove variables containing missing data (Hair et al., 2017)
- Ignore missing data

```
# remove variable with missing data  
df <- df %>%  
  select(!'Expectation Fulfillment')
```

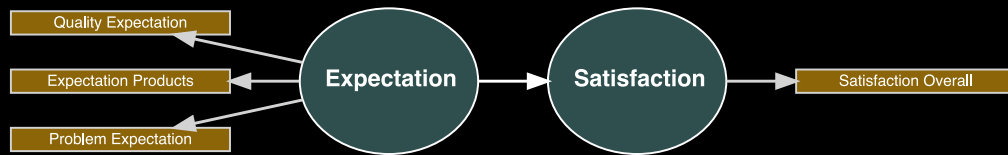
# Renaming variables

Expectation			Satisfaction
Quality Expectation	Expectation Products	Problem Expectation	Satisfaction Overall
7	7	6	6
10	10	9	10
7	7	7	8
7	10	5	10
8	7	10	10
10	9	7	8



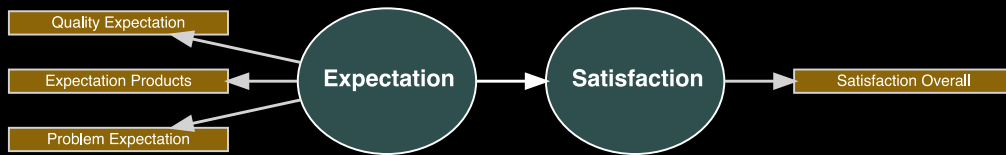
# Renaming variables

Long variable names...

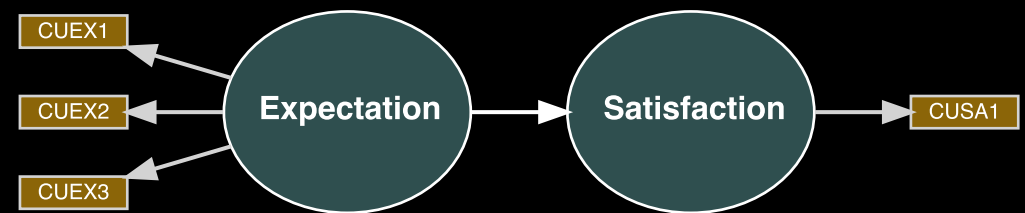


# Renaming variables

Long variable names...



... vs. abbreviated names



# Renaming variables

Long variable names...

```
measurement_model <- constructs(      # define measurement model
  reflective(                         # define a reflective construct
    construct_name = "Expectation",  # construct name
    item_names = c(                  # item names = df variable names
      "Quality Expectation",
      "Expectation Products",
      "Problem Expectation"
    )
  ),
  reflective(
    construct_name = "Satisfaction",
    item_names = c("Expectation Fulfillment")
  )
)
```

# Renaming variables

... vs. abbreviated names

```
measurement_model <- constructs(  
  reflective(  
    construct_name = "Expectation",  
    item_names = multi_items("CUEX", 1:3)    # calls variables with same prefix  
  ),  
  reflective(construct_name = "Satisfaction",  
    item_names = "CUSA1")  
)
```

# Renaming variables

... vs. abbreviated names

```
measurement_model <- constructs(  
  reflective(  
    construct_name = "Expectation",  
    item_names = multi_items("CUEX", 1:3)  
  ),  
  reflective(construct_name = "Satisfaction",  
    item_names = "CUSA1")  
)
```

# Renaming variables

Rename variables associated with the same construct with the same prefix, e.g. for *CUSA* for *Customer Satisfaction*

```
df <- df %>%  
  rename("CUSA1" = "Satisfaction Overall") # new name = old name
```

# Renaming variables

Rename variables associated with the same construct with the same prefix, e.g. for *CUSA* for *Customer Satisfaction*

```
df <- df %>%  
  rename("CUSA1" = "Satisfaction Overall") # new name = old name
```

```
df <- df %>%  
  rename_with(~ paste0("CUEX", 1:3), # function to generate new name  
             .cols = c(1:3))         # apply to columns 1 to 3
```

# Summary

CUEX1	CUEX2	CUEX3	CUSA1
7	7	6	6
10	10	9	10
7	7	7	8
7	10	5	10
8	7	10	10
10	9	7	8

- Data is numerical and unidirectional
- There are no missing values
- Variables are named for use in SEMinR



# Sources for this video

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). A primer on partial least squares structural equation modeling (PLS-SEM) (Second edition). Sage.