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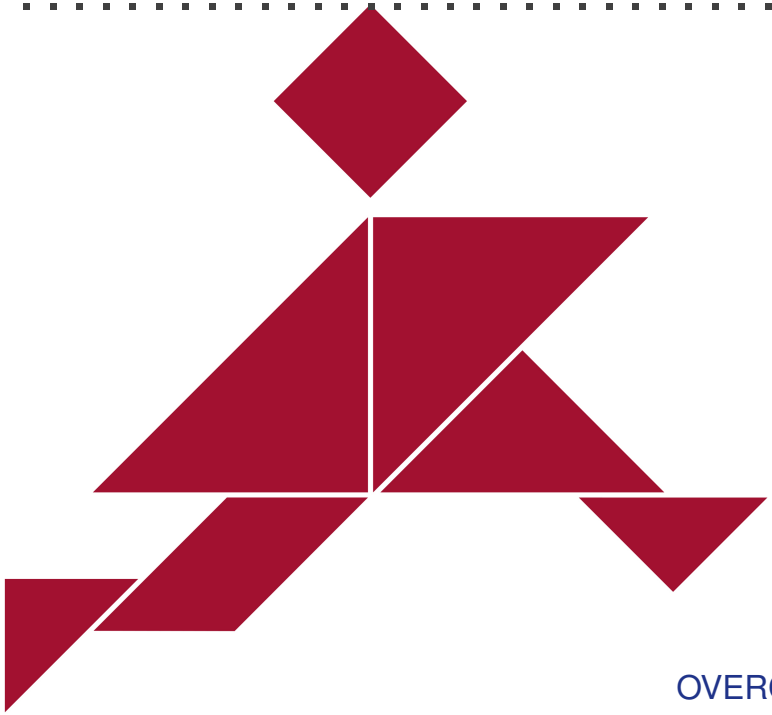
MISSING DATA: AN OVERVIEW OF MODERN METHODS



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HSE, Moscow, 27.12.2016

LIVES
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OVERCOMING VULNERABILITY: LIFE COURSE PERSPECTIVE

- Education
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MISSING DATA
MISSING DATA EVERYWHERE!
nerator.net

OVERVIEW

- Introduction
- Classification of missing data (MD)
- Testing the MD mechanism
- Treatments of MD
- Bibliography

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Introduction

Classification of MD

Testing the MD mechanism

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Bibliography

INTRODUCTION

- Definition of MD
  - Missing data are data whose collect was planned, but not realized
  - Examples : longitudinal and transversal cases

obs/var	V_{i1}	V_{i2}	V_{i3}	V_{i4}	obs/var	V_{1t_j}	V_{2t_j}	V_{3t_j}	V_{4t_j}
1	x	x	x	x	1	x	.	x	x
2	x	x	x	.	2	.	x	.	x
3	x	x	.	.	3	x	x	.	.
4	x	.	.	.	4	.	x	x	.

TABLE – Monotone and arbitrary pattern

INTRODUCTION(2)

- Why handle MD ?
  - Example of the Russian median salary
- How to handle MD ?
  - Test the MD mechanism
  - Apply a method
    1. listwise and pairwise deletion
    2. single and multiple imputation
    3. others methods

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CLASSIFICATION OF MD

- Classification of Rubin (1972)
- Missing completely at random (MCAR)
  - $Pr(Y_{mis}|Y, X) = Pr(Y_{mis})$
- Missing at random (MAR)
  - $Pr(Y_{mis}|X, Y) = Pr(Y_{mis}|X, Y_{obs})$
- Missing not at random (MNAR)
  - $Pr(Y_{mis}|X, Y) = Pr(Y)$
- Huge impact on the method to be used for handling missing data
- Mixture of mechanisms

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TESTING THE MD MECHANISM

- Difficult to test something that does not exist
- First step : determine if MD is MCAR or not
- Easiest : sample groups difference by using a *t-test*
  - problematic when there are more than 2 variables
- Little (1988)
- Jamshidian&Yuan (2014)

TESTING THE MD MECHANISM

- Limits
  - Developed for transversal cases
  - Not applicable to some type of data (non-numerical)
  - Not robust to a change of distributions
  - Not applicable to MNAR

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TREATMENTS OF MD

- Deletion methods
  - Listwise deletion or complete-case analysis
    1. Definition
    2. Only for MCAR
    3. MCAR is unrealistic in longitudinal studies (Kromrey & Hines, 1994)
  - Pairwise deletion or available-case analysis
    1. Definition
    2. Generally more effcient than listwise for MCAR
    3. Relatively big bias for MAR and MNAR
    4. Not well implemented in usual software
    5. Variance-covariance matrix could be not positive definite in relatively small samples (Wothke, 1993)
    6. Not efficient in longitudinal contexts (Fitzmaurice et al., 2009)

TREATMENTS OF MD (2)

- Imputation methods
  - Simple imputation
    1. Imputation by the mean, median, mode, (Haitovsky,1968)
    2. Hot deck and cold deck imputations
    3. Regression imputation

- ...
  - Simple regression imputation
    1. $Y = aX1 + bX2 + cX3$
    2. $Y = [Y_obs, Y_mis]$ is the dependent variable X_1, X_2, X_3 are the independent variables
    3. a,b,c are coefficients
    4. biased coefficients and standard errors (Allison, 2010)
    5. use of random effect in order to increase the variance of the data

TREATMENTS OF MD (3)

- Imputation methods
  - Multiple imputation
    1. One of the most efficient technique for dealing with MD
    2. Impute several times each MD
    3. Better reproduce the true but unknown variability of the unobserved values
    4. For instance by using several single imputation...
    5. ... or by using multiple imputation by chained equations (for all types of data, Van Buuren et. al, 2000 ; White, et al., 2011))

Thank you for your attention!

Any questions?!

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