Generating missing values for simulation purposes: A multivariate amputation approach

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Amputation

Amputation is the generation of missing values in complete data

Overview:

- Why?
- What?
- How?

```
require(mice)
?ampute
```

Amputation: Why?

Evaluation of missing data methodologies:

1. Simulate complete data set
2. Generate missing values
3. Deal with missing data with new method
4. Compare statistical inferences

But also:

- Planned missing data survey designs
- Investigate measurement errors
- See effect missing data on your analyses

Amputation: What?

- Proportion
- Amputed variables

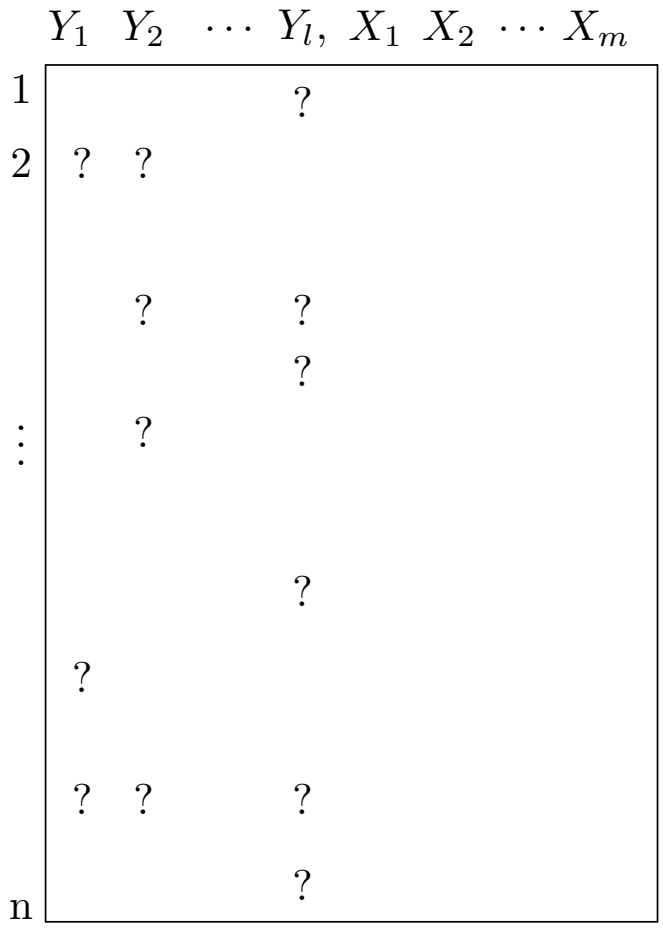
Amputation: What?

- Proportion
- Amputed variables
- Mechanism

MCAR : Mis not related to X or Y at all

MAR : Mis related to X but not to Y

MNAR : Mis related to Y

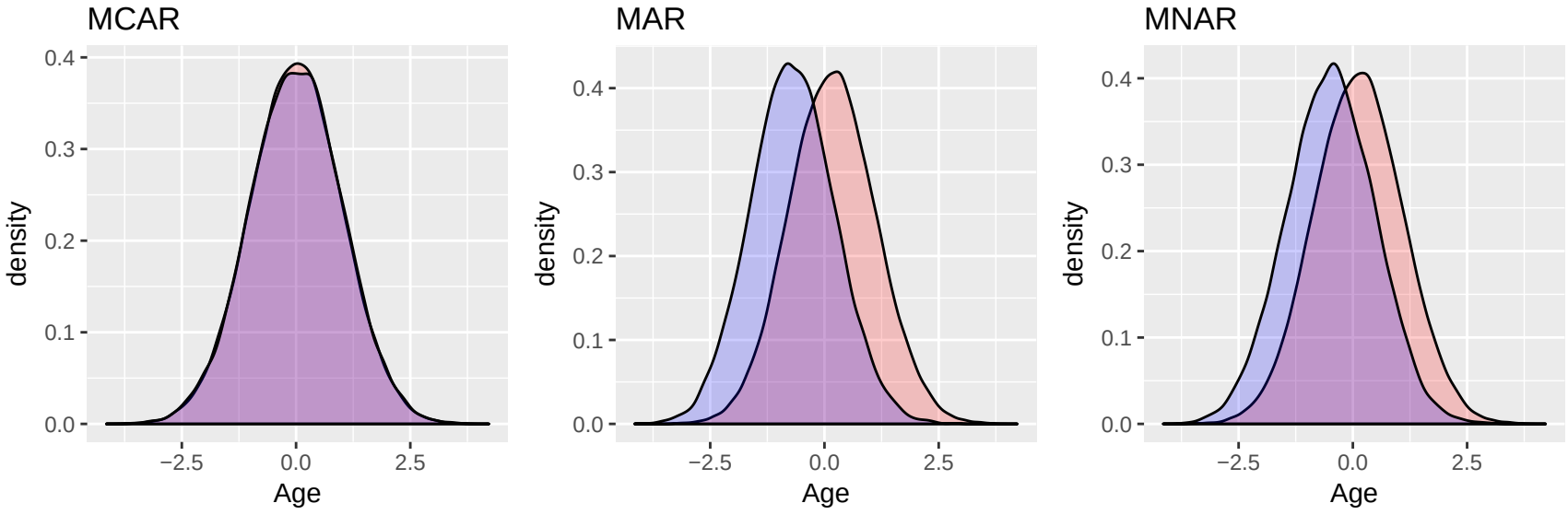


Amputation: What?

```
# Customers Phone Company
head(customer_data)
```

```
##       Income    Minutes         Age
## 1         NA  1.9237723  0.4174930
## 2 -0.6322071 -0.2409715  0.2492411
## 3 -0.9443980 -1.2539681 -0.5233141
## 4         NA  3.1223591  1.2705289
## 5 -0.4703926  0.5594291 -0.9440021
## 6 -0.3342031 -0.7998914 -0.1937294
```

Amputation: What?



$$\text{MCAR} : Pr(Income = missing) = 0.5$$

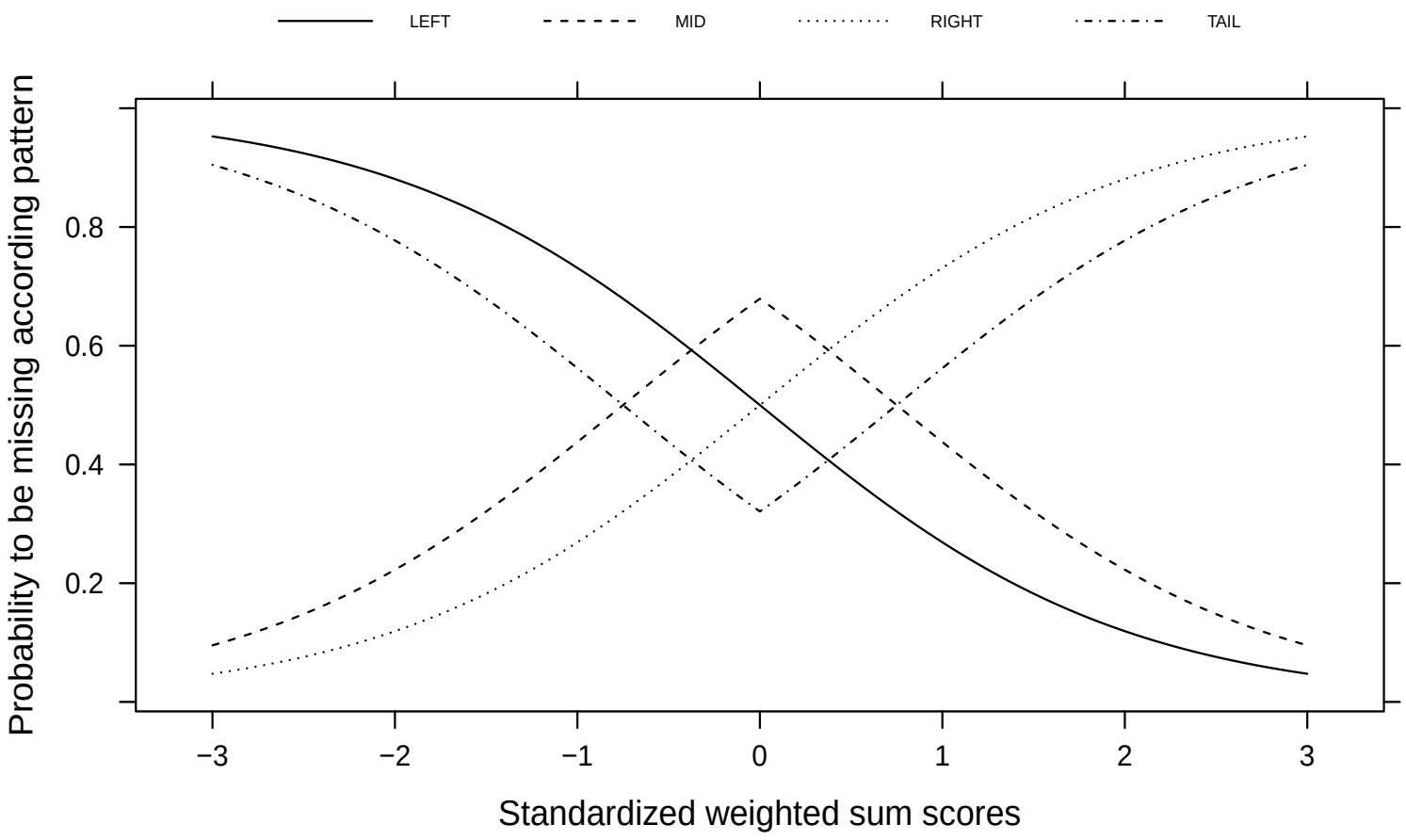
$$\text{MAR} : Pr(Income = missing) = Age$$

$$\text{MNAR} : Pr(Income = missing) = Income$$

Amputation: What?

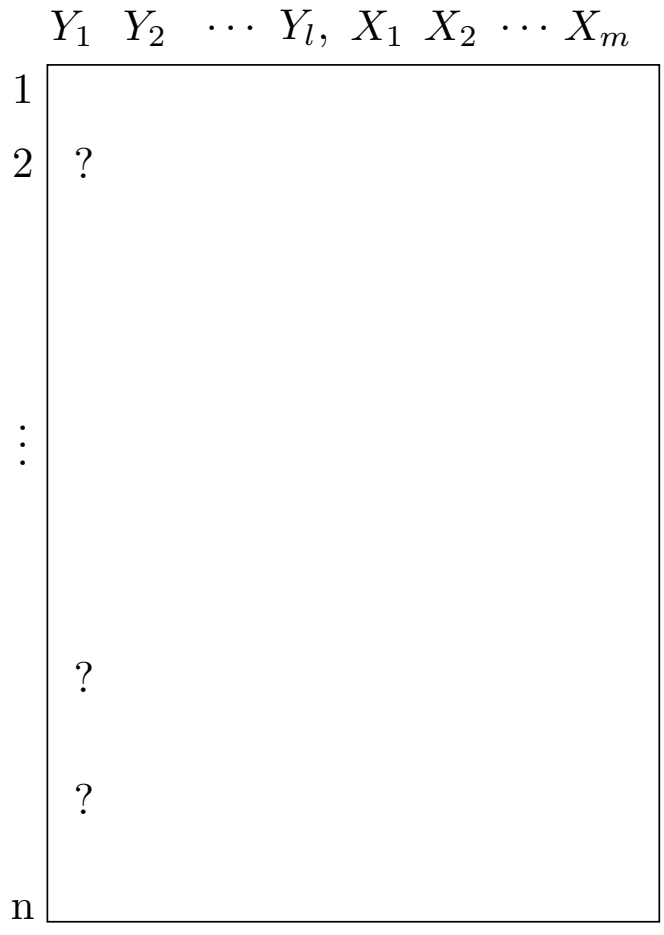
- Proportion
- Amputed variables
- Mechanism
- Influencing variables
- Severity
- Missingness distribution

Amputation: What?



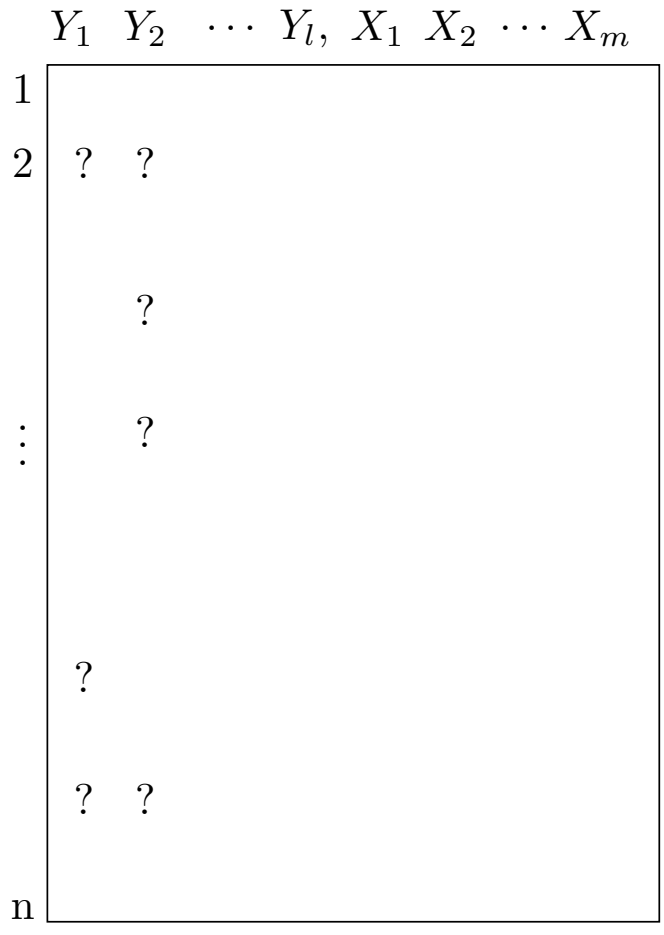
Amputation: How?

1. Y_1



Amputation: How?

1. Y_1
2. Y_2



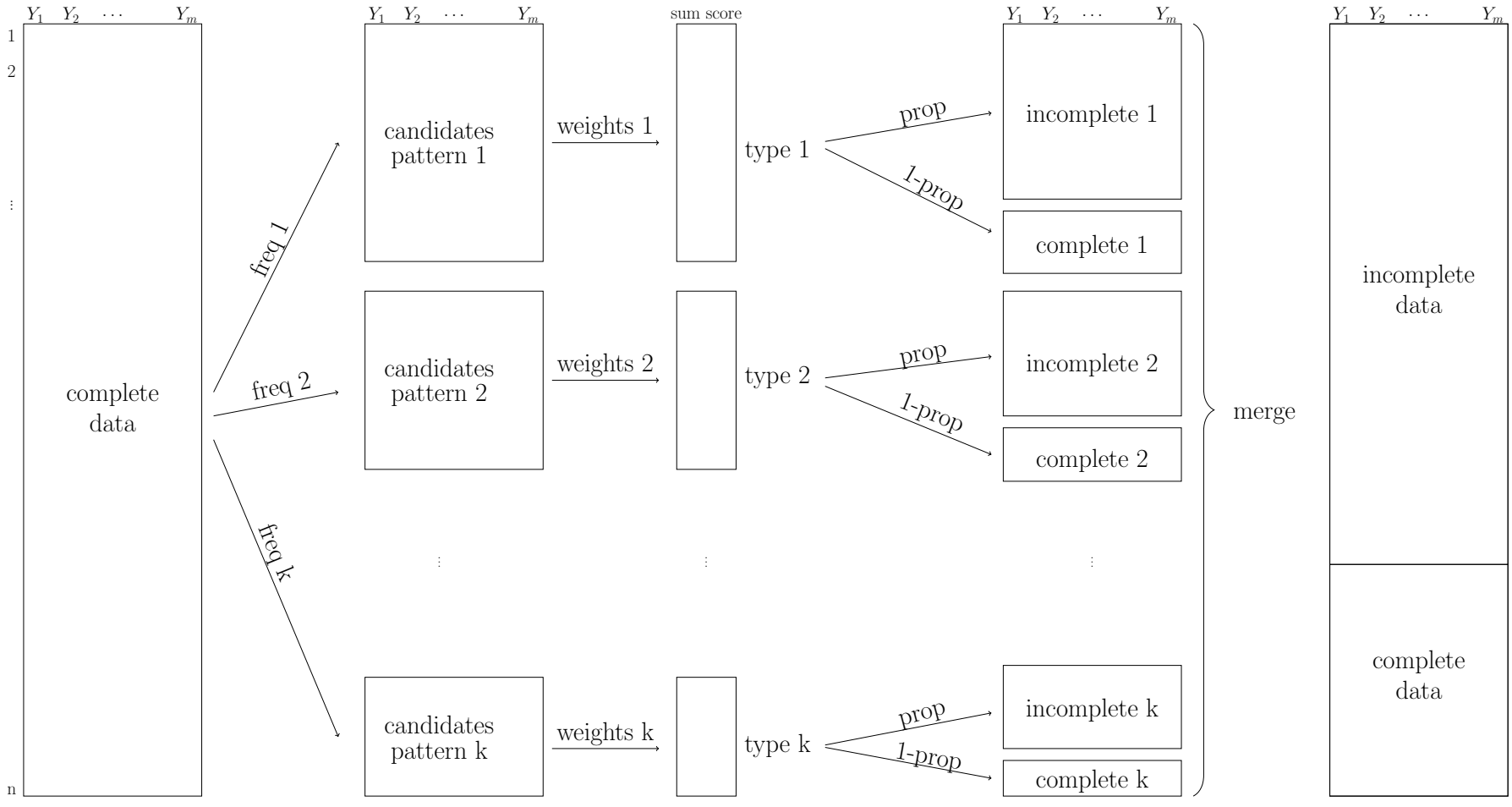
Amputation: How?

1. Y_1
2. Y_2
3. ...
4. Y_l

	Y_1	Y_2	$\cdots$	Y_l,	X_1	X_2	$\cdots$	X_m
1				?				
2	?	?						
		?		?				
				?				
$\vdots$		?						
				?				
	?							
	?	?		?				
n				?				

Amputation with ampute

Multivariate Amputation:



Amputation with ampute

```
ampute(data, prop = 0.5, patterns = NULL, freq =
NULL, mech = "MAR", weights = NULL, cont = TRUE, type
= NULL, odds = NULL, bycases = TRUE, run = TRUE)
```

```
amp <- ampute(data)
class(amp)
```

```
## [1] "mads"
```

Amputation with ampute

```
head(amp$amp)
```

```
##       Income    Minutes         Age
## 1  0.8250012  1.9237723          NA
## 2 -0.6322071 -0.2409715  0.2492411
## 3 -0.9443980 -1.2539681 -0.5233141
## 4         NA  3.1223591  1.2705289
## 5 -0.4703926  0.5594291 -0.9440021
## 6 -0.3342031         NA -0.1937294
```

Documentation

```
require(mice)
?ampute
```

Vignette:

https://github.com/RianneSchouten/Amputation_with_Ampute

Contact:

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Additional slides

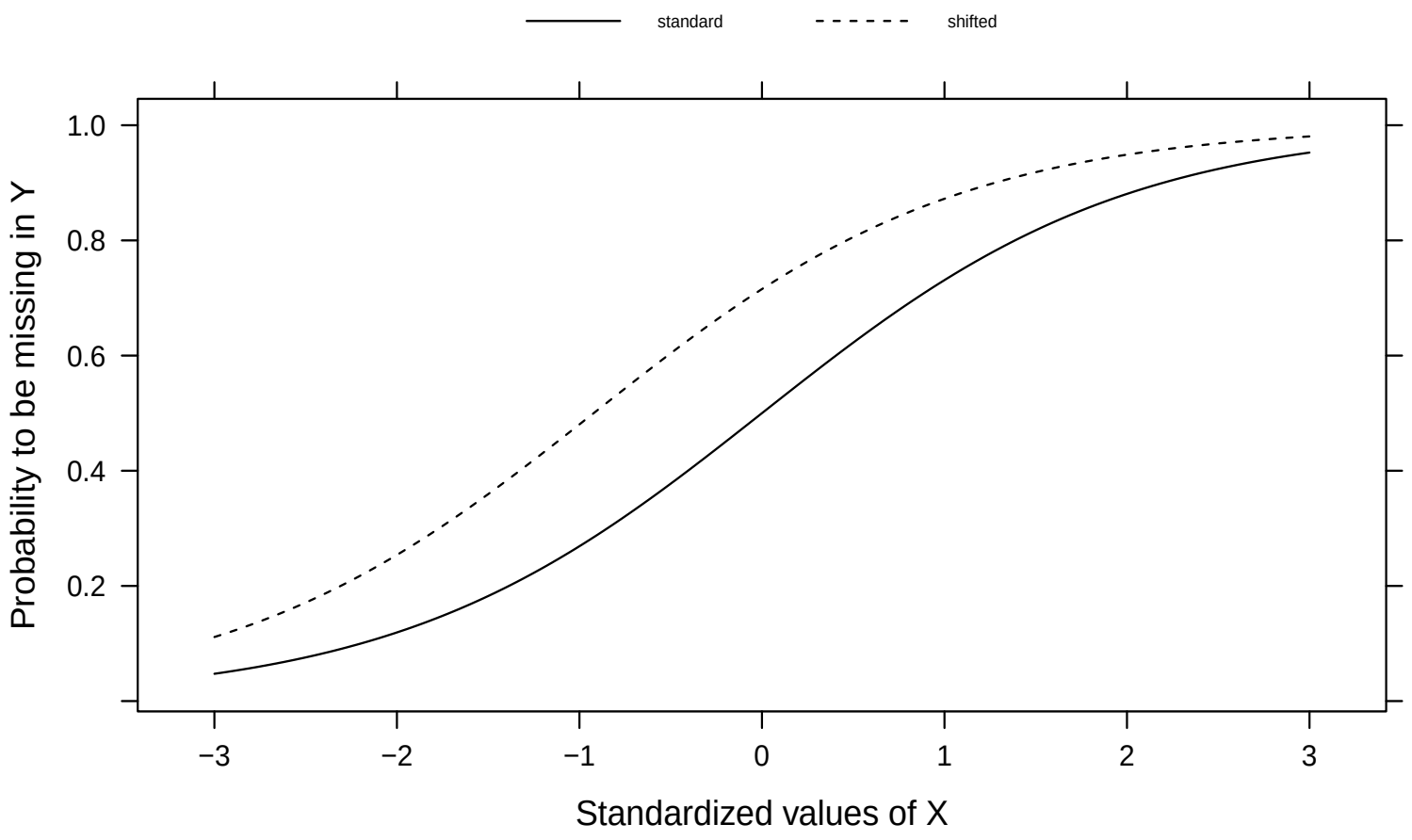
A missing data pattern is a specific combination of variables with missing values and variables without missing values.

0: incomplete variable

1: complete variable

```
mypat <- matrix(c(0, 0, 1,
                  0, 1, 1),
                nrow = 2, byrow = TRUE)
```

Additional slides



Additional slides

Table 1: Generation of MAR missingness on 2 variables with standard and shifted stepwise univariate amputation (SUA) and multivariate amputation (MA)

		%mis		complete case analysis			multiple imputation		
cor	condition	int	obt	bias	ciw	cov	bias	ciw	cov
0.5	standard SUA	50	29	-0.146	0.144	0.028	-0.002	0.156	0.940
	shifted SUA	50	50	-0.233	0.172	0.000	-0.007	0.204	0.917
	MA with `ampute`	50	50	-0.207	0.172	0.002	-0.005	0.193	0.936