

# SOCIAL NETWORK ANALYSIS for DATA SCIENTISTS

today's menu: LAB: ERGM2 (LECTURE LAB 10)

Your lecturer: Claudia

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# Menu'



- TerMometer
- The Intensity of the Effects
- 7 steps Research Flow

# TerMometer



<https://www.menti.com/alh367nr3ap3>

code: 4163 0041



# *The Intensity of the Effects*

# Interpreting model results

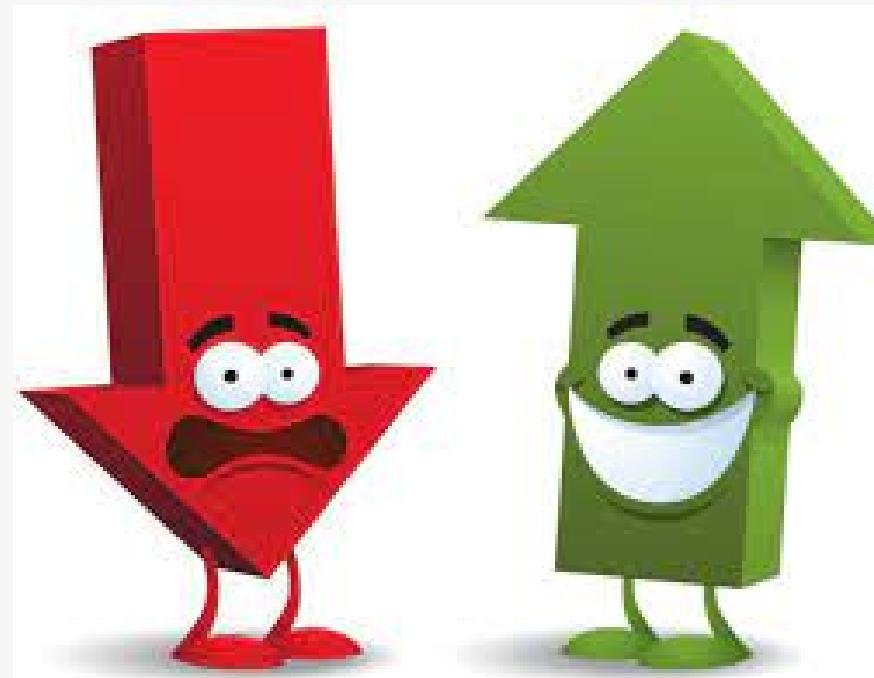


1.  $\theta > 0$  and stat. signif. -> X increases  $P(1)$  and decreases  $P(0)$
2.  $\theta < 0$  and stat. signif. -> X decreases  $P(1)$  and increases  $P(0)$
3.  $\theta$  not stat. signif. -> X does not affect  $P(1)$  and  $P(0)$

# Binary

The sign of  $\theta$  provides us with a binary interpretation:  
the probability of the edge forming

- Increases
- Decreases



# Ok, sure... How much!?

The number tells us "how much" ---- Intensity



# How much ... or "The extent to which..."



**x predicts y**

- The odds that x predicts (y) edge formation
- The probability that x predicts (y) edge formation

# Odds ratios (Memo: Bootcamp!)



ERGMs work with log scale, right?

Well, to interpret our coefficients we need to exponentiate it. Makes sense, doesn't it?

When you exponentiate you estimate the odds of something to happen --

ODDS = probability of success

FORMULA

$$\text{OR} = \exp(\theta)$$

# Odds Ratios meaning (Memo: Bootcamp!)



If the coefficients are statistically significant it is possible to comment on the odds of the effect taking place

**Interpretation:**

An increase of 1 in  $X_1$  increases the log odds with  $\theta_1$  (log odds) and it makes the odds of the effect taking place  $\exp(\theta_1)$  times larger.

# Consider that...



Odds Ratio is a measure of the strength of association with an exposure and an outcome.

1. OR > 1 means greater odds of association with the exposure and outcome.
2. OR = 1 means there is no association between exposure and outcome.
3. OR < 1 means there is a lower odds of association between the exposure and outcome.

# Probabilities



It measures the probability of an effect taking place

FORMULA:

$$P = \frac{\exp(\theta)}{1+\exp(\theta)}$$

WARNING: if you want to use % the result needs to be multiplied by 100.

# Back to Florence



Let's see the intensity of some effects



# Dyadic independent model

```
m <- ergm::ergm(flom ~ edges + nodecov("Wealth"))
```



# Coefficients



$\theta$

```
summary(m)
```

Call:

```
ergm:::ergm(formula = flom ~ edges + nodecov("Wealth"))
```

Maximum Likelihood Results:

	Estimate	Std. Error	MCMC %	z value	Pr(> z )
edges	-2.594929	0.536056	0	-4.841	<1e-04 ***
nodecov.Wealth	0.010546	0.004674	0	2.256	0.0241 *

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Null Deviance: 166.4 on 120 degrees of freedom

Residual Deviance: 103.1 on 118 degrees of freedom

AIC: 107.1 BIC: 112.7 (Smaller is better. MC Std. Err. = 0)

# Coefficient interpretation



Edges -2.595

$\theta < 0$  and stat. signif.  $\rightarrow$  X decreases  $P(1)$  and increases  $P(0)$

Wealth 0.011

$\theta > 0$  and stat. signif.  $\rightarrow$  X increases  $P(1)$  and decreases  $P(0)$

We still don't know anything about the intensity!!!

# Odds Ratios



$\exp(\theta)$

```
snafun::stat_ef_int(m, type = "odds")
```

	Estimate	Odds	Std.Error	Pval
edges	-2.595	0.075	0.536	0.000
nodecov.Wealth	0.011	1.011	0.005	0.024

manually estimating edges odds ratios

```
exp(-2.594929)
```

```
[1] 0.07465118
```

# Odds Interpretation



## edges 0.075

An increase of 1 in **the number of edges** increases the log odds with  $-2.595$  and it makes the odds of the effect taking place 0.075 times larger.

OR < 1 means that the odds of forming edges in this network is small.

## nodecov.Wealth 0.011

An increase of 1 in **wealth** increases the log odds with  $0.011$  and it makes the odds of the effect taking place 1.011 times larger.

OR > 1 means that the odds of wealth influencing marriage are bigger

OR = 1 means there is little association between wealth influencing marriage.

# Probabilities



$\exp(\theta)/(1 + \exp(\theta))$

```
snafun::stat_ef_int(m, type = "prob")
```

	Estimate	Prob	Std.Error	Pval
edges	-2.595	0.069	0.536	0.000
nodecov.Wealth	0.011	0.503	0.005	0.024

## manually estimating edges probabilities

```
exp(-2.594929) / (1 + exp(-2.594929))
```

```
[1] 0.0694655
```

# Probabilities Interpretation



```
0.069 * 100
```

```
[1] 6.9
```

```
0.503 * 100
```

```
[1] 50.3
```

**6.9 % prob of forming edges**

small prob, so it is consistent with the OR result

**50.3 % prob that wealth predicts marriage**

it's a bit more than 1/2 so it is consistent with the OR result

# 7 steps Research Flow

# *Let's organize our research in steps*



1. Literature research/ Questions & Hypotheses (based on the literature) [- data collection]
2. Data Exploration + terms selection
3. Running models (baseline, exploratory models, final model)
4. MCMC diagnostics of the best selected model
5. Goodness of fit
6. Interpreting results
7. Write up about your research telling how this journey went

TIP: Rely on these steps for your report

*See you on Wednesday!*



