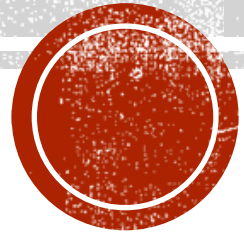
DATA MINING

Regression with panel data



1 TOOLS

1.1 BACKGROUND

- Linear Regression:
  - For every linear model: $Y_i = \alpha + \beta * X_i + U_I$
  - Goal: estimate a model that best fits the true model: $\hat{\alpha}, \hat{\beta}$

- Methodology: OLS(Ordinary Least Squares)
  - To minimize the sum of the squares residuals:
    - $min \sum_{i=1}^{n} (Y_i - \widehat{Y_i})^2$ Where $\widehat{Y_i} = \hat{\alpha} + \hat{\beta} * X_i$
    - Take first derivative to above function: $\begin{cases} \frac{\partial}{\partial X} \sum_{i=1}^{n} (Y_i - \widehat{Y_i})^2 \\ \frac{\partial}{\partial Y} \sum_{i=1}^{n} (Y_i - \widehat{Y_i})^2 \end{cases}$

2 METHODOLOGY

- 2.1 Linear Regression
- 2.1 Non-linear Regression

2.1 LINEAR REGRESSION

- The Fixed Effects Model
  - $GDP_{i,t} = \alpha + \beta_i * X_{i,t} + \Theta_t + U_{i,t}$
- The Radom Effects Model
  - $GDP_{i,t} = \alpha + \beta_i * X_{i,t} + \gamma_t * E_t + U_{i,t}$

➢Where X is repressor, i is county, t is year, Θ is the fixed effects over years, E is dummy variable of the year.

FIXED VS RANDOM

	Pro	Con
Fixed	Can only see the time effect within-year	No assumption needs
Random	Efficient Clearly see the time effect between-year and within-year	We need to assume there is no correlation between time effect and regressor

FIXED OR RANDOM?

- Hausman test
  - H_0:no correlation between regressor and time effect

    or $\text{cov}(X_i , X_{i,t}) = 0$

  - Under H_0: Random effects model is consistent and efficient, while fixed effects model is consistent but not efficient

  - Reject H_0: Random effects model is not consistent, but fixed effects model is still consistent

2.2 NON-LINEAR REGRESSION

- $\text{Log}(\text{GDP}_{i,\,t}) = \alpha + \beta_i * \text{Log}(\text{X}_{i,\,t})$

- Exactly same with Linear regression

3 RESULT

- Coefficient of determination:
  - Linear regression: 98.60%
  - Non-linear regression: 96.74%

```
Fixed-effects (within) regression               Number of obs      =     1,562
Group variable: year                            Number of groups   =        11

R-sq:                                           Obs per group:
     within  = 0.9868                                         min =       142
     between = 0.9584                                         avg =     142.0
     overall = 0.9860                                         max =       142

                                                F(4,1547)          =  28818.17
corr(u_i, Xb)  = -0.0517                        Prob > F           =    0.0000
```

gdpconstant2010us	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
co2emissionskgper2010usofgdp	-1.80e+11	5.79e+10	-3.11	0.002	-2.94e+11	-6.68e+10
foreigndirectinvestmentnetinflow	2.386636	.2353181	10.14	0.000	1.925059	2.848212
laborforce	238.127	84.36844	2.82	0.005	72.63836	403.6155
technicalarticles	3.22e+07	300933	106.94	0.000	3.16e+07	3.28e+07
_cons	1.85e+11	3.89e+10	4.76	0.000	1.09e+11	2.61e+11
sigma_u	2.397e+11					
sigma_e	9.781e+11					
rho	.05668021	(fraction of variance due to u_i)				

F test that all u_i=0: F(10, 1547) = 8.46 Prob > F = 0.0000

- Final model:
  - Linear regression with panel data using fixed effect

$GDP_{i,t}$ = 1.85*10^11 – 1.8*10^11 * CO2 emission + 2.39 * foreign investment + 238.13 * labor force + 3.22*10^7 * technical articles