

# **Tutorial 06, Hilary Term**

Research Methods for Political Science (PO3600)

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<http://muellerstefan.net/research-methods>

What predicts wealth (measured as GDP per capita)?

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Dependent variable: GDP per capita (US\$) 2002 (UNDP 2004)

Independent variables:

- FM\_Lit2002: Adult illiteracy rate (% ages 15 and above) 2002 (UNDP 2004)
- F\_Work2002: Female economic activity rate (% ages 15 and above) 2002 (UNDP 2004)
- SDI: Social Diversity Index, primary data source 2001 (Okediji 2005)

# Regression Coefficients

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1052.329	3854.899		-.273	.786
	Adult literacy rate (female rate as % of male rate) 2002 (UNDP 2004)	72.153	28.127	.276	2.565	.012
	Female economic activity rate (% ages 15 and above) 2002 (UNDP 2004)	-89.083	34.071	-.302	-2.615	.011
	Social Diversity Index, primary data source 2001 (Okediji 2005)	3266.519	2976.317	.126	1.098	.276

a. Dependent Variable: GDP per capita (US\$) 2002 (UNDP 2004)

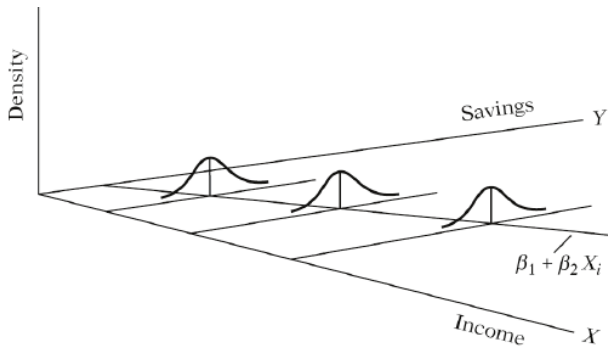
**Residuals Statistics<sup>a</sup>**

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-1615.23	6343.40	2927.33	2056.694	84
Residual	-5941.399	23353.250	.000	4386.110	84
Std. Predicted Value	-2.209	1.661	.000	1.000	84
Std. Residual	-1.330	5.227	.000	.982	84

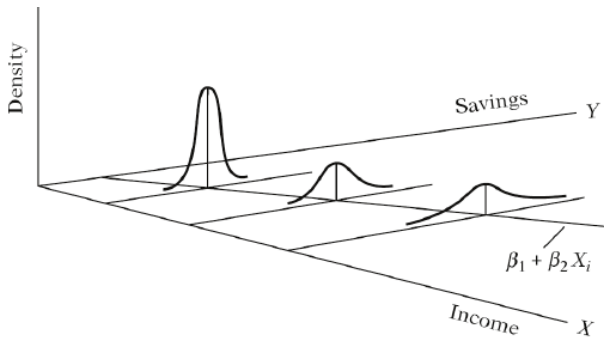
a. Dependent Variable: GDP per capita (US\$) 2002 (UNDP 2004)

1. **Influential data points/outliers**
2. Independence/**autocorrelation** (errors associated with one observation not correlated with errors in any other observation)
3. **Linearity** (relationship should be linear)
4. **Homoscedasticity** (constant error variance)
5. Normality (errors should be normally distributed)
6. Model specification
7. Multicollinearity (predictors are highly correlated)
8. Leverage (extent to which predictor differs from mean of predictor)

# Recap: Homoscedasticity



# Recap: Heteroscedasticity

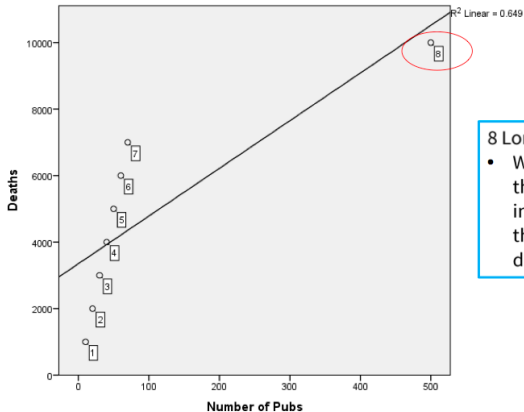


**Homoscedasticity:** Variance of the residuals is homogeneous across levels of the predicted values.

- Plot of ZRESID and ZPRED
- Interpret the plot



# Outliers vs. Influential Points



8 London boroughs.

- We want to know if the number of pubs in the area predicts the number of deaths.

# Outliers vs. Influential Points

pubs	mortality	ZRE_1	COO_1
10	1000	-1.33839	.21328
20	2000	-.87895	.08530
30	3000	-.41950	.01814
40	4000	.03995	.00015
50	5000	.49940	.02294
60	6000	.95885	.08092
70	7000	1.41830	.17107
500	10000	-.27966	227.14286

This is *not* an outlier.  
It has a **small** residual.

But it has a BIG  
influence (the  
computation for  
Cook's distance is  
huge).

## Cook's Distance

- How much the predicted scores for other observations would differ if the observation in question were not included?
- Cook's Distance: influence of an observation and is proportional to the sum of the squared differences between predictions made with all observations in the analysis and predictions made leaving out the observation in question.
- A common rule of thumb is that an observation with a value of Cook's D over 1.0 has too much influence.

# Check for influential points

**Residuals Statistics<sup>a</sup>**

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-1615.23	6343.40	2927.33	2056.694	84
Std. Predicted Value	-2.209	1.661	.000	1.000	84
Standard Error of Predicted Value	515.610	1654.260	947.708	230.056	84
Adjusted Predicted Value	-1793.46	6830.28	2909.38	2076.405	84
Residual	-5941.399	23353.250	.000	4386.110	84
Std. Residual	-1.330	5.227	.000	.982	84
Stud. Residual	-1.383	5.337	.002	1.005	84
Deleted Residual	-6428.279	24339.891	17.951	4594.516	84
Stud. Deleted Residual	-1.391	6.608	.025	1.113	84
Mahal. Distance	.117	10.392	2.964	2.007	84
Cook's Distance	.000	.301	.012	.040	84
Centered Leverage Value	.001	.125	.036	.024	84

a. Dependent Variable: GDP per capita (US\$) 2002 (UNDP 2004)

- Assumption: observations are independent
- Durbin-Watson statistic should be between 1.5 and 2.5

- Perfect multicollinearity: SPSS will remove one predictor
- High multicollinearity when two of the independent variables are highly correlated
- Standard errors will be large: more uncertainty in the model
- Check multicollinearity by calculating Variance Inflation Factor (VIF):  $VIF > 5$  is definitely cause for concern!

## Exercise: Categorical Predictors and Interaction Terms

1. Use the ANES 2016 pilot dataset (available on Blackboard)
2. Download the codebook: <https://tinyurl.com/anescodebook>
3. Create summary statistics of the following variables: `pidid` `educ`, `gender`
4. Create new variable called `piddummy` which is based on `pidid` and coded binary: 1: Democrat; 0: Not Democrat. Pay attention to missing values and recode them as system missing

```
ftobama                                Feeling thermometer - Barack Obama
-----
      type:  numeric (byte)
      label:  ftobama, but 92 nonmissing values are not labeled

      range:  [0,100]                                units:  1
unique values: 101                                missing.: 0/1,200
unique mv codes: 1                                missing.*: 2/1,200

      examples: 3
                  31
                  70    70 - Fairly warm or favorable feeling
                  90
```



# Check Codebook

```
-----  
pidld                                         Party ID - Republican first  
-----  
  
      type: numeric (byte)  
      label: pidld  
  
      range: [1,4]                               units: 1  
      unique values: 4                          missing.: 0/1,200  
      unique mv codes: 1                       missing.*: 612/1,200  
  
      tabulation: Freq.   Numeric   Label  
                   229       1   Democrat  
                   123       2   Republican  
                   195       3   Independent  
                    41       4   Something else  
                   612       .b   [9]Not Asked
```

```
-----  
educ                                                    Education  
-----
```

```
      type:  numeric (byte)  
      label:  educ  
  
      range:  [1,6]                units:  1  
unique values: 6                missing .:  0/1,200
```

```
      tabulation:  Freq.   Numeric  Label  
                   102       1      No HS  
                   411       2      High school graduate  
                   257       3      Some college  
                   106       4      2-year  
                   202       5      4-year  
                   122       6      Post-grad
```

```
-----
gender                                     Gender
-----
      type:  numeric (byte)
      label:  gender

      range:  [1,2]
unique values: 2                                units: 1
                                         missing : 0/1,200

      tabulation:  Freq.   Numeric  Label
                   570       1      Male
                   630       2      Female
```

# Create a New Variable

Recode into Different Variables: Old and New Values

**Old Value**

☒ Value:

☐ System-missing

☐ System- or user-missing

☐ Range:

through

☐ Range, LOWEST through value:

☐ Range, value through HIGHEST:

☐ All other values

**New Value**

☐ Value:

☒ System-missing

☐ Copy old value(s)

**Old --> New:**

```
1 --> 1
9 --> SYSMIS
2 thru 4 --> 0
```

☐ Output variables are strings Width:

☐ Convert numeric strings to numbers ('5' -> 5)

## Exercise: Categorical Predictors and Interaction Terms

1. Dependent variable: `ftobama` (feeling thermometer for Obama)
2. Independent variables: `piddummy`, `educ`, `gender`
3. Explain the coding of these variables
4. Interpret these coefficients (in substantive terms!)

## Exercise: Categorical Predictors and Interaction Terms

1. Re-run the model with a `gender*piddummy` interaction
2. Interpret the coefficient of the interaction

SPSS Regression Diagnostics: <https://stats.idre.ucla.edu/spss/seminars/introduction-to-regression-with-spss/introreg-lesson2/>

Doing it all in R: [https://github.com/stefan-mueller/research-methods/blob/master/code/ht05/ht\\_05\\_replicate\\_spss.R](https://github.com/stefan-mueller/research-methods/blob/master/code/ht05/ht_05_replicate_spss.R)