Research Methods for Political Science PO3110 (TCD)

HT: Tutorial 9 - Week 11

Letícia Meniconi Barbabela

University College Dublin,
https://github.com/letmeni/research-methods

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Today's topics: Review[1]

- Linear Regression:
  - Basic reminders;
  - Assumptions and diagnostics;
  - Presenting regression tables (see Section 8.9 on Field - 4th Edition - How to report multiple regression);
  - Interpreting results.
- Logistic Regression:
  - Differences and similarities in comparison to linear regression.

[1] Go back to the STATS HT Slides and Field 2013 for more comprehensive review

Linear Regression: basic reminders

- **Rough idea:** Quantitatively summarize the relationship between variables using a linear equation;
- Ordinary Least Squares (OLS): choose $\hat{\beta}_0$ and $\hat{\beta}_1$ such that together they minimize the sum of squared residuals (SSR).
- When interpreting the β for each predictor: size, sign, statistical significance;
- But we are also concerned about the overal model fit:
  - R^2 : proportion of variance in the outcome variable that is shared by the predictor variable.
  - F-test: Tests H_0 that all slopes in the model $= 0$; SPSS provide us with the exact p value.
  - Depending on the fit and on other diagnostics we may want to re-specify model and conduct robustness tests (iterative process);
  - Ultimately we want our "summary" to be robust enough to ground the claims we are making.

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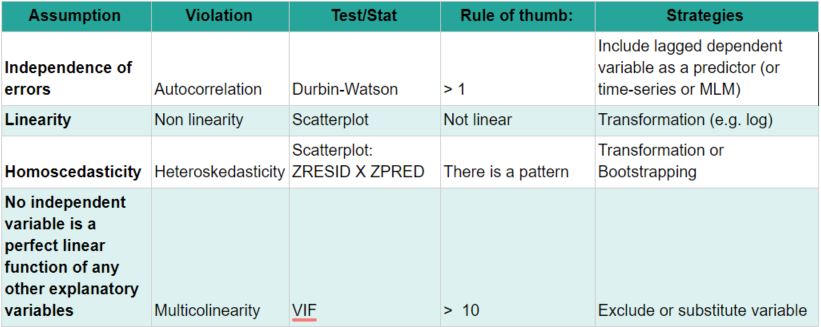
Preparing some diagnostics

When runing linear regressions on SPSS, save variables that will be used for diagnostics: generates table "Residual statistics"

- PRED = Dependent variable values predicted by the specified model;
- RES = Residuals. Difference between observed and predicted variable;
- ZRE = Standardized Residuals;
- SRE = Studentized Reisduals (dividing the residual by an estimate of its standard deviation);
- COO = Cook's distance.

A few assumptions, violations, tests and strategies



Assumption	Violation	Test/Stat	Rule of thumb:	Strategies
Independence of errors	Autocorrelation	Durbin-Watson	> 1	Include lagged dependent variable as a predictor (or time-series or MLM)
Linearity	Non linearity	Scatterplot	Not linear	Transformation (e.g. log)
Homoscedasticity	Heteroskedasticity	Scatterplot: ZRESID X ZPRED	There is a pattern	Transformation or Bootstrapping
No independent variable is a perfect linear function of any other explanatory variables	Multicolinearity	VIF	> 10	Exclude or substitute variable

Other sources of bias

- Influential datapoints: See if maximum values for cooks' distance on "Residual statistics" is larger than 1;
- Outliers:
  - If maximum value for std. residuals on "Residual statistics" is less than 1.96 than no cause for concern;
  - Make a boxplot;
  - Plot residual over predicted values.
- Some suggestions on how to proceed:
  - See if data has error (e.g. missing values not assigned);
  - Consider whether it would make sense to delete the observation (motivated);
  - Report differences in appendix.

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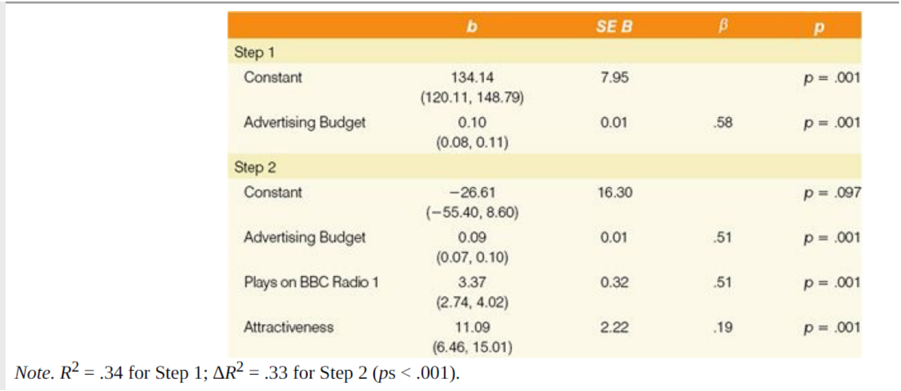
Presenting Regression Table Field 2013 - Section 8.9

This is the exact example given by Field, but please report it in black and white:



	b	*SE B*	*β*	*p*
Step 1				
Constant	134.14 (120.11, 148.79)	7.95		$p = .001$
Advertising Budget	0.10 (0.08, 0.11)	0.01	.58	$p = .001$
Step 2				
Constant	−26.61 (−55.40, 8.60)	16.30		$p = .097$
Advertising Budget	0.09 (0.07, 0.10)	0.01	.51	$p = .001$
Plays on BBC Radio 1	3.37 (2.74, 4.02)	0.32	.51	$p = .001$
Attractiveness	11.09 (6.46, 15.01)	2.22	.19	$p = .001$

Note. $R^2 = .34$ for Step 1; $\Delta R^2 = .33$ for Step 2 (*ps* < .001).

Interpreting linear regression coefficients

Important: you are writing to people, not robots !

- Numeric predictors:
  - Raw coefficient: *A unit increase/decrease is associated to an increase/decrease in Y by xyz units.*This means that the richer the country the more democratic it is ...
  - Standardised coefficient: *A one standard deviation increase/decrease is associated to and increase/decrease in Y of xyz standard deviations.* This means that ...
- Categorical predictors:
  - *on average Group A display xyv points more/less than Group B (reference category);*
- Additionally comment statistical significance of predictors and overall model fit.

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Differences in comparison to linear regression

- Instead of predicting the value of Y, predict the probability of Y ocurring;
- Instead of being continuous the dependent variable is dichotomous;
- Estimation: instead of using OLS, Maximum likelihood estimation.
- Instead of using R-squared as measure of fit, use pseudo R squared: cannot be interpreted in absolute terms as variance explained. Comparison across steps (including predictors individually);
- Instead of interpreting coefficients directly, take into account the transformations used in the estimation strategy: either divide by four rule or interpret odds ratio.
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