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Researching Crime and Justice

Session 12: Descriptives Stats and Graphs Lecture

Jose Pina-Sánchez

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Session Goals

- The session is divided in a lecture, a tutorial, and a quiz
- Here, in the lecture we will provide a general recap of basic concepts of data analysis
  - What is a variable and their levels of measurement
  - Descriptive statistics such as the mean, standard deviation, or correlation coefficients
  - Tables such as frequency tables and crosstabs
  - Graphs, considering style guidelines
- In the tutorial we will practice data analysis using SPSS
  - We will explore empirical research questions
  - Using real data, the teaching version of the CSEW

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Quiz

- This lecture and the ensuing practical will prepare you for our first quiz
  - 10 multiple-choice questions
  - About topics covered in this lecture
  - And reproducing exercises from the practical
  - Using SPSS and data from the Crown Court Sentencing Survey
  - You need to get at least 5 correct answers
  - Really simple, you can use the notes from this session
  - No preparation is necessary other than engaging actively with the content covered in this session
  - No questions on graphs are included in the quiz

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First Steps in Data Analysis

- The key building blocks in quantitative data analysis are:
  - Cases - the units composing a population or sample, normally represented by rows in spreadsheets, e.g.

    Students registered at the University of Leeds

    Streets composing the city of Leeds
  - Variables - an element or feature of a given population or sample, normally represented by columns in spreadsheets, e.g.

    Nationality, gender, age, etc. of Leeds students

    Number of crimes recorded, street-lights, traffic, etc. in the streets of Leeds

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- We cannot study the information provided for each case one by one
  - In quantitative research samples tend to be big
  - Instead we seek to summarise that information for the whole sample (or a subgroup of it)
  - That's the essence of most quantitative data analysis

Extracting Information from a Dataset

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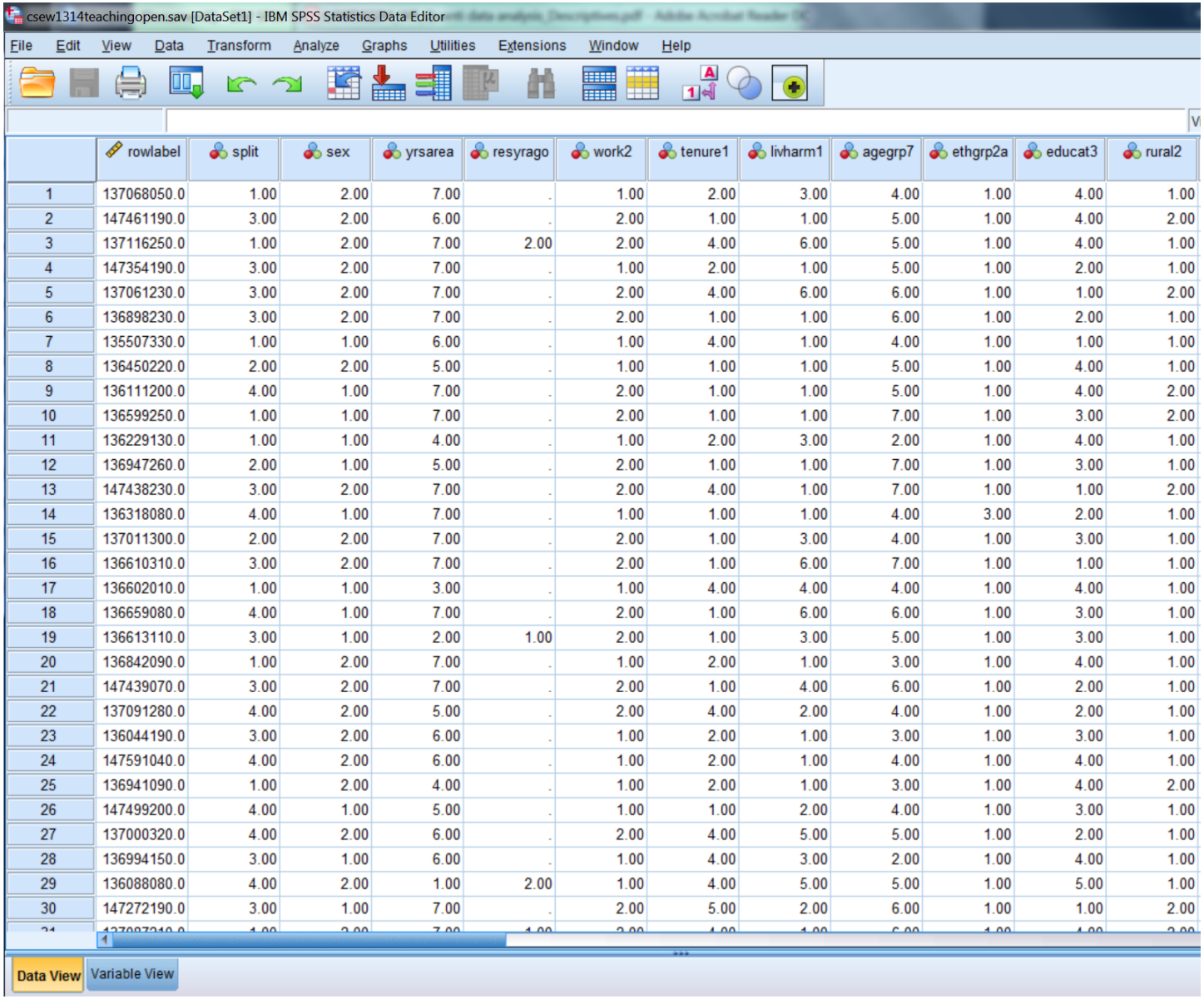

	rowlabel	split	sex	yrsarea	resyrago	work2	tenure1	livharm1	agegrp7	ethgrp2a	educat3	rural2
1	137068050.0	1.00	2.00	7.00	.	1.00	2.00	3.00	4.00	1.00	4.00	1.00
2	147461190.0	3.00	2.00	6.00	.	2.00	1.00	1.00	5.00	1.00	4.00	2.00
3	137116250.0	1.00	2.00	7.00	2.00	2.00	4.00	6.00	5.00	1.00	4.00	1.00
4	147354190.0	3.00	2.00	7.00	.	1.00	2.00	1.00	5.00	1.00	2.00	1.00
5	137061230.0	3.00	2.00	7.00	.	2.00	4.00	6.00	6.00	1.00	1.00	2.00
6	136898230.0	3.00	2.00	7.00	.	2.00	1.00	1.00	6.00	1.00	2.00	1.00
7	135507330.0	1.00	1.00	6.00	.	1.00	4.00	1.00	4.00	1.00	1.00	1.00
8	136450220.0	2.00	2.00	5.00	.	1.00	1.00	1.00	5.00	1.00	4.00	1.00
9	136111200.0	4.00	1.00	7.00	.	2.00	1.00	1.00	5.00	1.00	4.00	2.00
10	136599250.0	1.00	1.00	7.00	.	2.00	1.00	1.00	7.00	1.00	3.00	2.00
11	136229130.0	1.00	1.00	4.00	.	1.00	2.00	3.00	2.00	1.00	4.00	1.00
12	136947260.0	2.00	1.00	5.00	.	2.00	1.00	1.00	7.00	1.00	3.00	1.00
13	147438230.0	3.00	2.00	7.00	.	2.00	4.00	1.00	7.00	1.00	1.00	2.00
14	136318080.0	4.00	1.00	7.00	.	1.00	1.00	1.00	4.00	3.00	2.00	1.00
15	137011300.0	2.00	2.00	7.00	.	2.00	1.00	3.00	4.00	1.00	3.00	1.00
16	136610310.0	3.00	2.00	7.00	.	2.00	1.00	6.00	7.00	1.00	1.00	1.00
17	136602010.0	1.00	1.00	3.00	.	1.00	4.00	4.00	4.00	1.00	4.00	1.00
18	136659080.0	4.00	1.00	7.00	.	2.00	1.00	6.00	6.00	1.00	3.00	1.00
19	136613110.0	3.00	1.00	2.00	1.00	2.00	1.00	3.00	5.00	1.00	3.00	1.00
20	136842090.0	1.00	2.00	7.00	.	1.00	2.00	1.00	3.00	1.00	4.00	1.00
21	147439070.0	3.00	2.00	7.00	.	2.00	1.00	4.00	6.00	1.00	2.00	1.00
22	137091280.0	4.00	2.00	5.00	.	2.00	4.00	2.00	4.00	1.00	2.00	1.00
23	136044190.0	3.00	2.00	6.00	.	1.00	2.00	1.00	3.00	1.00	3.00	1.00
24	147591040.0	4.00	2.00	6.00	.	1.00	2.00	1.00	4.00	1.00	4.00	1.00
25	136941090.0	1.00	2.00	4.00	.	1.00	2.00	1.00	3.00	1.00	4.00	2.00
26	147499200.0	4.00	1.00	5.00	.	1.00	1.00	2.00	4.00	1.00	3.00	1.00
27	137000320.0	4.00	2.00	6.00	.	2.00	4.00	5.00	5.00	1.00	2.00	1.00
28	136994150.0	3.00	1.00	6.00	.	1.00	4.00	3.00	2.00	1.00	4.00	1.00
29	136088080.0	4.00	2.00	1.00	2.00	1.00	4.00	5.00	5.00	1.00	5.00	1.00
30	147272190.0	3.00	1.00	7.00	.	2.00	5.00	2.00	6.00	1.00	1.00	2.00

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Choosing Data Analysis Tools

- There is a huge range of data analysis techniques
  - Measures of centrality, dispersion, association, regression methods, etc.
- It is key to consider which is the most suitable technique
  - We need to consider first the research question we want to answer
  - But also the 'level of measurement' of the variables to be used

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Levels of Measurement

1. Nominal (aka categorical): formed by categories that cannot be ranked;
   e.g. ethnicity

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Levels of Measurement

1. Nominal (aka categorical): formed by categories that cannot be ranked;
   e.g. ethnicity
   - Binary (aka dichotomous): nominal with only 2 categories
     e.g. foreign born;

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Levels of Measurement

1. Nominal (aka categorical): formed by categories that cannot be ranked;
   e.g. ethnicity
   - Binary (aka dichotomous): nominal with only 2 categories
     e.g. foreign born;
2. Ordinal: categories can be ranked but distance between categories is not meaningful;
   e.g. classification in the World Cup

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Levels of Measurement

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   e.g. ethnicity
   - Binary (aka dichotomous): nominal with only 2 categories
     e.g. foreign born;
2. Ordinal: categories can be ranked but distance between categories is not meaningful;
   e.g. classification in the World Cup
3. Scale (aka continuous): values are not grouped within categories but lay on a continuous scale;

Levels of Measurement: Quiz

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	Nominal	Ordinal	Scale
Nationality			
Height			
Level of education			
Days in prison			
Year of birth			
Gender			
Police rank			

Levels of Measurement: Quiz

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	Nominal	Ordinal	Scale
Nationality	✓		
Height			
Level of education			
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Levels of Measurement: Quiz

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Nationality	✓		
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Levels of Measurement: Quiz

	Nominal	Ordinal	Scale
Nationality	✓		
Height			✓
Level of education		✓	
Days in prison			
Year of birth			
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Levels of Measurement: Quiz

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Nationality	✓		
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Level of education		✓	
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Levels of Measurement: Quiz

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Nationality	✓		
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Nationality	✓		
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Year of birth			✓
Gender	✓		
Police rank		✓	

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Descriptive Statistics

- We can use univariate statistics to summarise the information contained in a given variable
  - Measures of centrality to explore questions such as:
    What is the average number of daily crimes in Leeds?
    What is the most common sentence used by Crown Court judges?
  - Measures of dispersion to explore questions such as:
    How variable is the crime rate across streets in Leeds?
    How consistent is sentencing in the Leeds Magistrates' Court?

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    What is the most common sentence used by Crown Court judges?
  - Measures of dispersion to explore questions such as:

    How variable is the crime rate across streets in Leeds?

    How consistent is sentencing in the Leeds Magistrates' Court?
- We can use bivariate statistics to summarise the relationship between two variables
  - Measures of association to answer questions such as:

    Is crime more prevalent in busier streets?

    To what extent is sentence length associated with crime seriousness?

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  - Measures of centrality to explore questions such as:

    What is the average number of daily crimes in Leeds?

    What is the most common sentence used by Crown Court judges?
  - Measures of dispersion to explore questions such as:

    How variable is the crime rate across streets in Leeds?

    How consistent is sentencing in the Leeds Magistrates' Court?
- We can use bivariate statistics to summarise the relationship between two variables
  - Measures of association to answer questions such as:

    Is crime more prevalent in busier streets?

    To what extent is sentence length associated with crime seriousness?
- We can also use tables to answer similar questions on centrality, dispersion, and association
  - Tables are normally used for discrete (non-continuous) variables

Descriptive Statistics

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Univariate Statistics

	Nominal	Ordinal	Scale
Centrality	Mode	Mode, Median, Mean	Mode, Median, Mean
Dispersion		Range, Std. Dev.	Range, Std. Dev.

Descriptive Statistics

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Univariate Statistics

	Nominal	Ordinal	Scale
Centrality	Mode	Mode, Median, Mean	Mode, Median, Mean
Dispersion		Range, Std. Dev.	Range, Std. Dev.

Bivariate Statistics

	Nominal	Ordinal	Scale
Nominal	Cramer's V	Cramer's V	
Ordinal	Cramer's V	Spearman's ρ	Spearman's ρ
Scale		Spearman's ρ	Pearson's r

Univariate Stats: Measures of Centrality

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- Measures of Centrality
  - Mode: the value that occurs most frequently;

    It does not rely on an existing ranking of values
  - Median: if we rank cases of a variable, it is the value lying in the middle;

    It is not affected by outliers (i.e. extreme values)
  - Mean: the sum of all the values divided by the number of cases;

    By far the most commonly used statistic;

    Capable of weighting the distance between values

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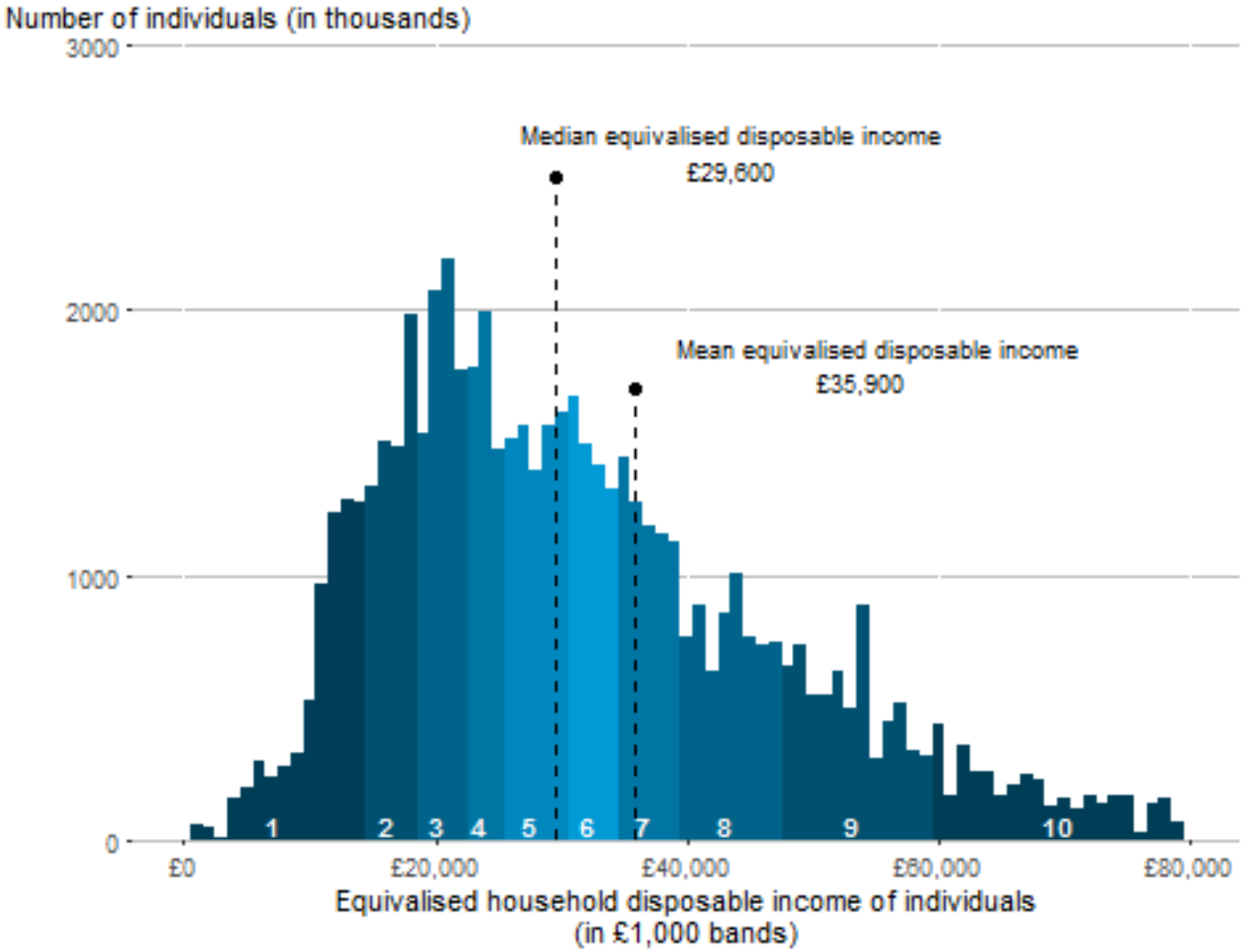
Univariate Stats: Measures of Centrality

Distribution of household disposable income in the UK in 2019



Source: ONS

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Univariate Stats: Measures of Dispersion

- Measures of dispersion
  - Range: difference between the highest and lowest values

    Useful to establish the range of a variable and to detect extreme values
  - Standard deviation: the average dispersion from the mean

    More representative of the overall dispersion in a given variable

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Univariate Stats: Measures of Dispersion

- Measures of dispersion
  - Range: difference between the highest and lowest values

    Useful to establish the range of a variable and to detect extreme values
  - Standard deviation: the average dispersion from the mean

    More representative of the overall dispersion in a given variable
- Remember the measure of inconsistency in sentencing reported by BBC News?
  - What measure of dispersion did they use there?
  - And how did that affect to interpret the level of dispersion?

Univariate Stats: Measures of Dispersion

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Prison sentence 'disparity' warning

22 April 2013 | UK

Some magistrates' courts in England and Wales are four times more likely to send offenders to prison than others, a penal reform charity has said.

In 2011, Northamptonshire courts gave custodial sentences in 6.5% of cases, compared with 1.5% in Warwickshire, research by the Howard League shows.

The Howard League says community sentences are cheaper than custody and deliver better results

Bivariate Stats: Measures of Association

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- We will distinguish between Pearson's and Spearman's correlation coefficients
  - They are interpreted similarly, as a measure of how much and in which direction are two variables associated
  - The former is used when both variables are scale, the latter is used if at least one of the variables is ordinal
  - They can range from -1 (negatively associated) to 1 (positively associated), with a value of 0 representing no association

Bivariate Stats: Measures of Association

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  - They can range from -1 (negatively associated) to 1 (positively associated), with a value of 0 representing no association
- Question: What correlation coefficient would you expect between...
  - Sentence length (number of months in custody) and seriousness of the offence?

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  - What about between sentence length and the number of mitigating factors considered by the judge?

Bivariate Stats: Measures of Association

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  - They can range from -1 (negatively associated) to 1 (positively associated), with a value of 0 representing no association
- Question: What correlation coefficient would you expect between...
  - Sentence length (number of months in custody) and seriousness of the offence?
  - What about between sentence length and the number of mitigating factors considered by the judge?
  - What would be the correlation between sentence length and level of education of the offender?

Tables

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Frequency Tables

Nominal	Ordinal	Scale
✓	✓	

Cross-tabs

	Nominal	Ordinal	Scale
Nominal	✓	✓	✓
Ordinal	✓	✓	✓
Scale	✓	✓	

Tables

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Frequency table

		Count
experience of any crime in the previous 12 months	not a victim of crime	9318
	victim of crime	2358

Tables

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Frequency table

		Count
experience of any crime in the previous 12 months	not a victim of crime	9318
	victim of crime	2358

Cross-tab

		Respondent sex	
		male	female
		Count	Count
experience of any crime in the previous 12 months	not a victim of crime	4228	5090
	victim of crime	1079	1279

Tables

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Cross-tab

		Respondent sex	
		male	female
		Count	Count
experience of any crime in the previous 12 months	not a victim of crime	4228	5090
	victim of crime	1079	1279

Question: Is there a relationship between gender and victimisation? What would you do to facilitate the interpretation of the second table?

Graphs

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- Graphs can be really informative
  - Can be used to explore the above (centrality, dispersion, association)
  - And present findings more effectively: 'A picture is worth a thousand words'
- We have seen how the level of measurement of variables is key in your choice of tables and descriptive stats
- The same applies to graphs, which can also be classified in univariate and bivariate

Graphs: Levels of Measurement

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One-Dimensional Figures

Nominal	Ordinal	Scale
Bar/Piecharts	Bar/Piecharts & Hist.	Hist. & Density Function

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Graphs: Levels of Measurement

One-Dimensional Figures

Nominal	Ordinal	Scale
Bar/Piecharts	Bar/Piecharts & Hist.	Hist. & Density Function

Two-Dimensional Figures

	Nominal	Ordinal	Scale
Nominal	Bar/Piecharts	Histograms	Boxplot
Ordinal	Histograms		Box/Scatterplot
Scale	Boxplot	Box/Scatterplot	Scatterplot

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Style Guidelines

- Pictures are very useful means to convey information
- However, they should be used sensibly, consider the following rules of thumb:

Style Guidelines

- Pictures are very useful means to convey information
- However, they should be used sensibly, consider the following rules of thumb:
  - Graphs need to 'stand on their own', i.e. ought to be understood without having to read the text
  - Hence, good labels, titles and captions are essential
  - Do not include graphs to convey information that could be put more succinctly in text or a table
  - Do not dedicate more than 1/3 of the space a page to tables and graphs, repeatedly
  - Avoid using unnecessary effects
  - Be as transparent and honest as possible

Style Guidelines

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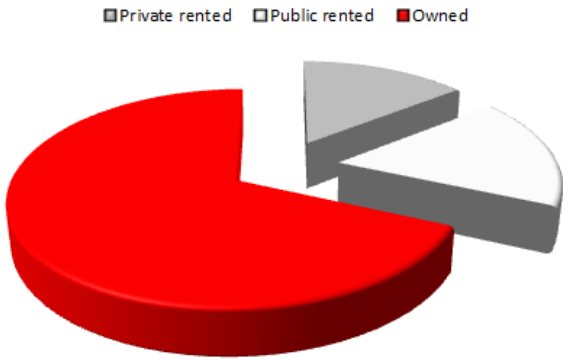

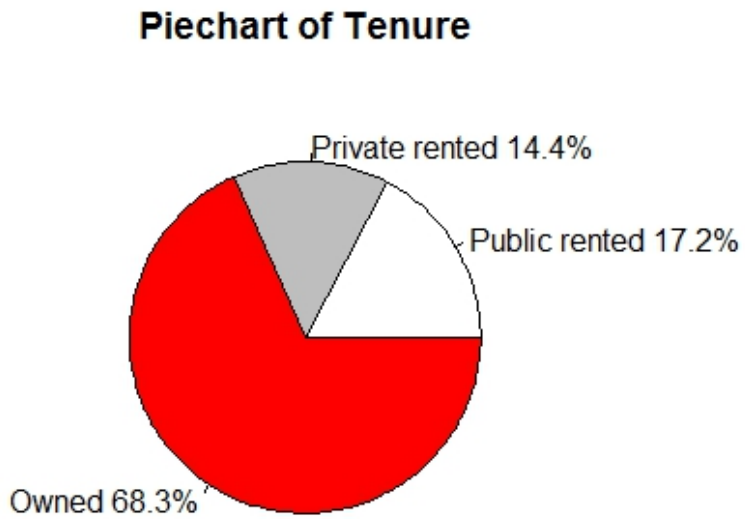

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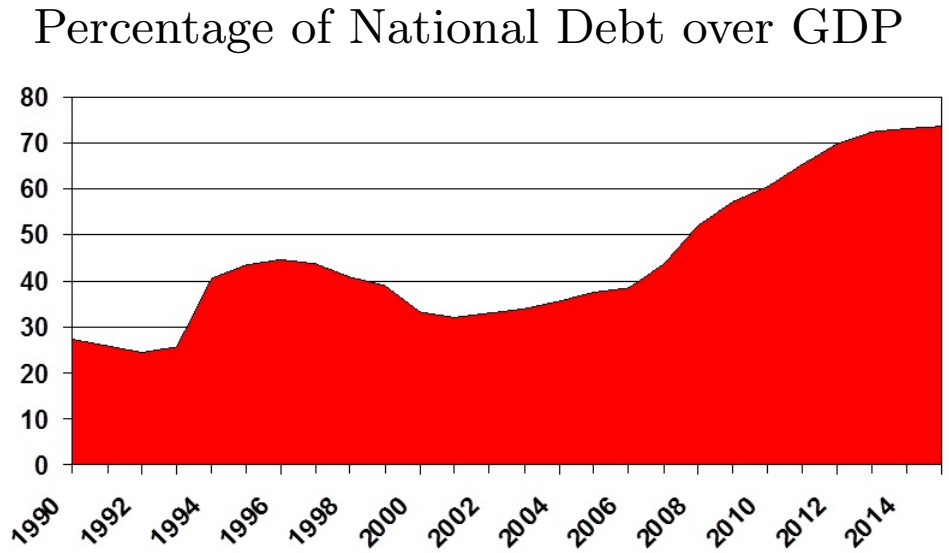
Style Guidelines

Question: Would you use this graph to show that debt has reached a historical high?



Session Goals
Quiz
Data Analysis Intro/Recap
Levels of Measurement
Descriptive Statistics
Tables
Graphs
Style Guidelines
Recap

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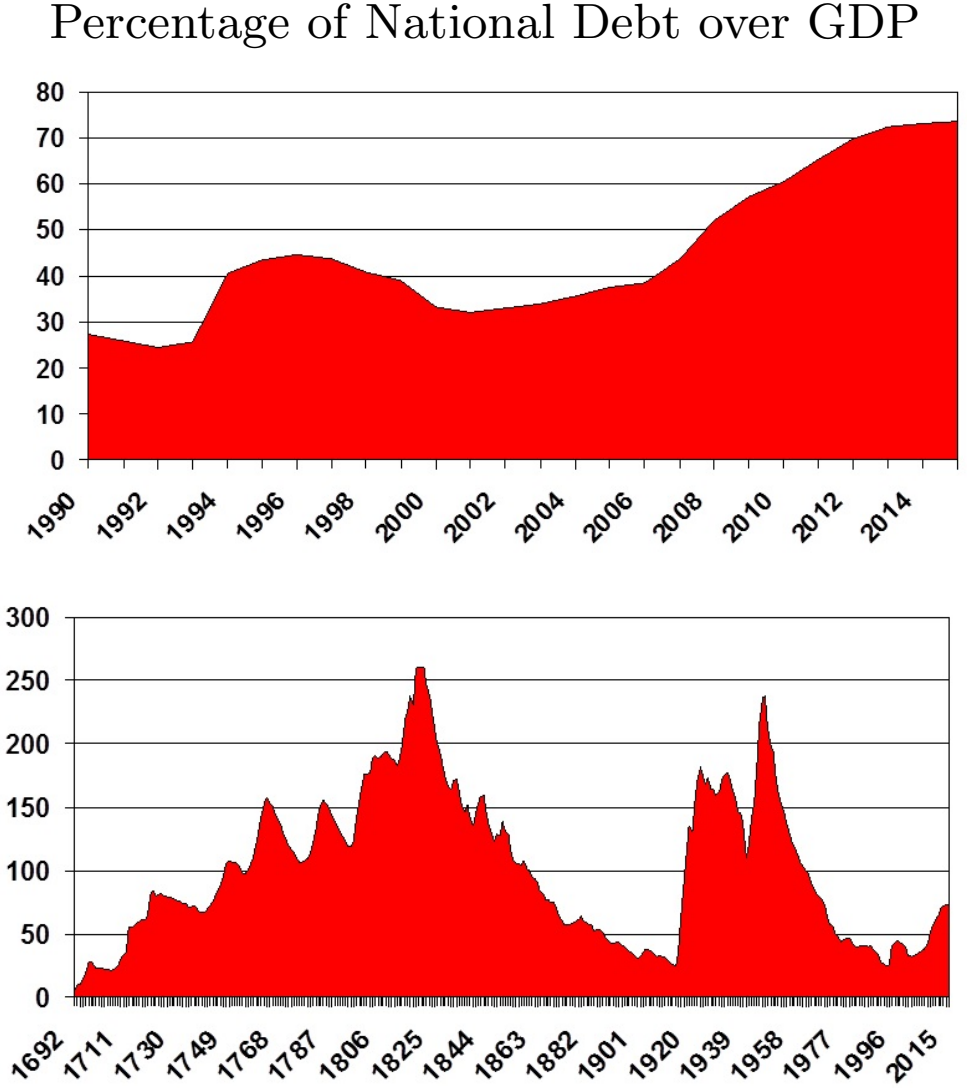

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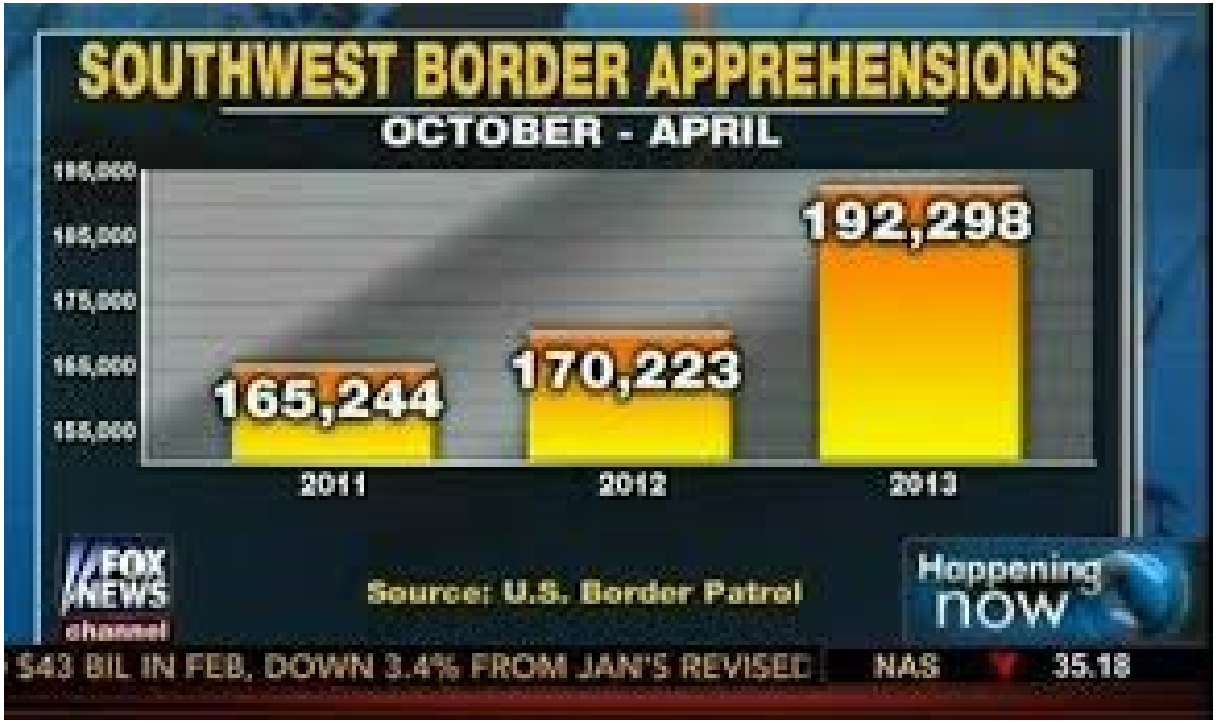

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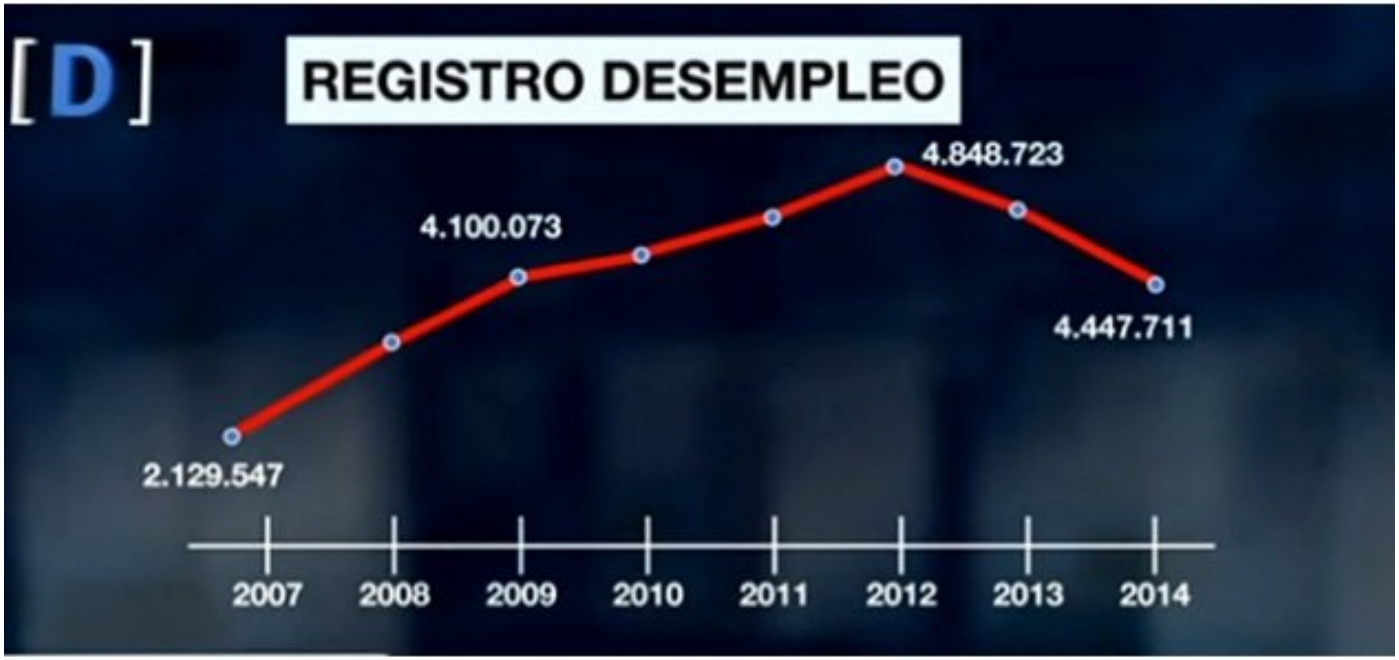

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Recap

- We have learnt some key concepts of data analysis
  - The different levels of measurement used in variables
  - Various univariate and bivariate statistics
  - Tables and graphs
- To review and learn more about the content of today's session
  - See Bryman (2016) Chapter 16
- To prepare for the tutorial you will need to install SPSS
  - See instructions on how to do so in the latest announcement on Minerva
- In our next session we are going to keep practising SPSS
  - But the focus will be on statistical inference
  - To prepare for it read Bryman (2016) Chapter 15