# Getting to know QM:
## The Multiple Faces of Quantitative Methods in Higher Education Social Science Subjects

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# Outline

**1. A World of Numbers**

    - A Constructed World

**2. Redrawing**

    - ANT

    - Doing

**3. Doing QM: Duck and Rabbit**

**4. Speaking QM: Fantasy or Fact(?)**

**5. (Re)Presenting QM**

# Outline

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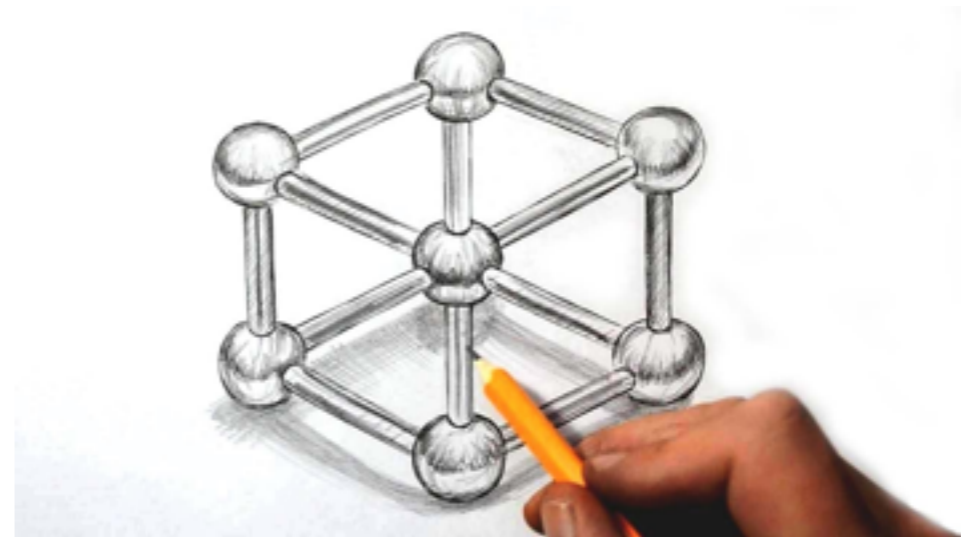
**2. Redrawing**

    - ANT

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**3. Doing QM: Duck and Rabbit**

**4. Speaking QM: Fantasy or Fact(?)**

**5. (Re)Presenting QM**

# A World of Numbers

- From 1997-2012 there has been a 10 percentage point rise in the number of jobs requiring quantitative skills (Mason *et al.*, 2015).

- 1/2 of all students fail GCSE mathematics, and only 15% take it in some form after GCSE (Vorderman *et al.*, 2011)

- Q-Step: Nuffield Foundation, ESRC & HEFCE joined to fund a £15.5 million programme that aims to respond to the "market failure to attract students and teachers into quantitative social science training"(Nuffield Foundation, n.d.: 2)

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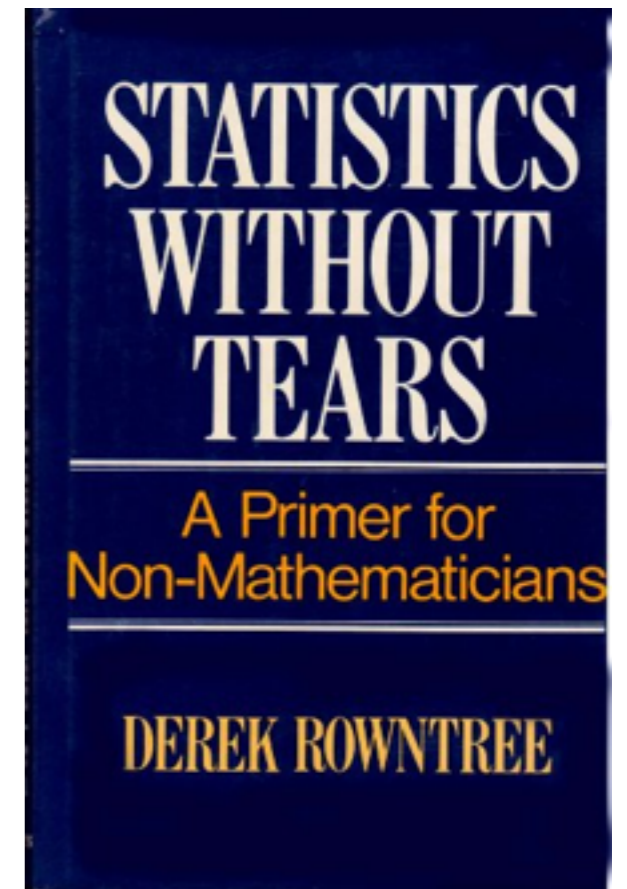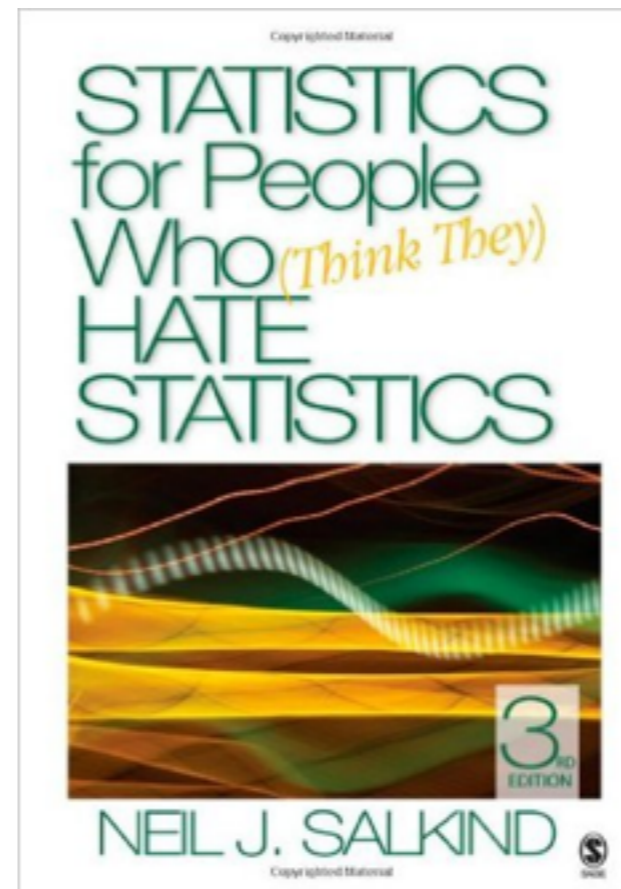
# It's a hard world…
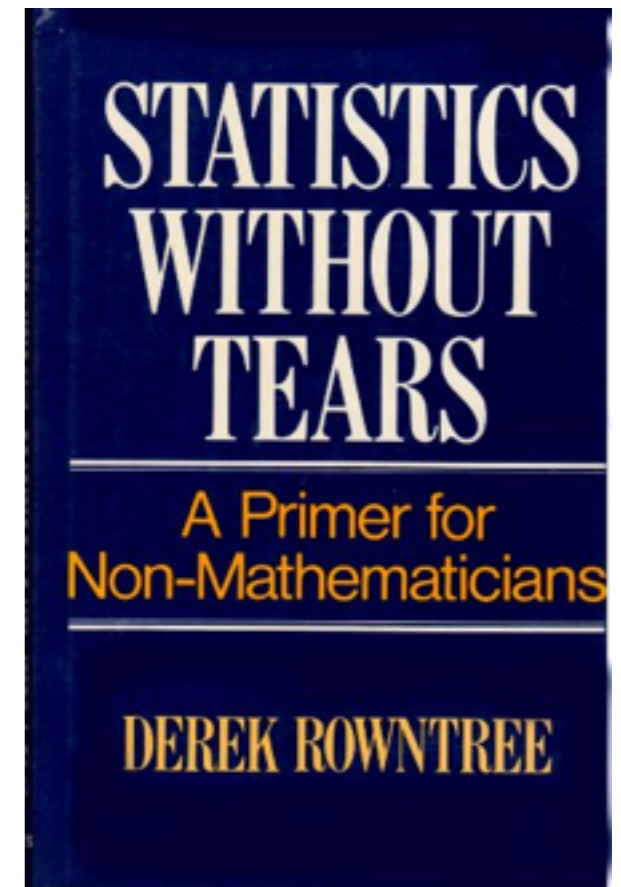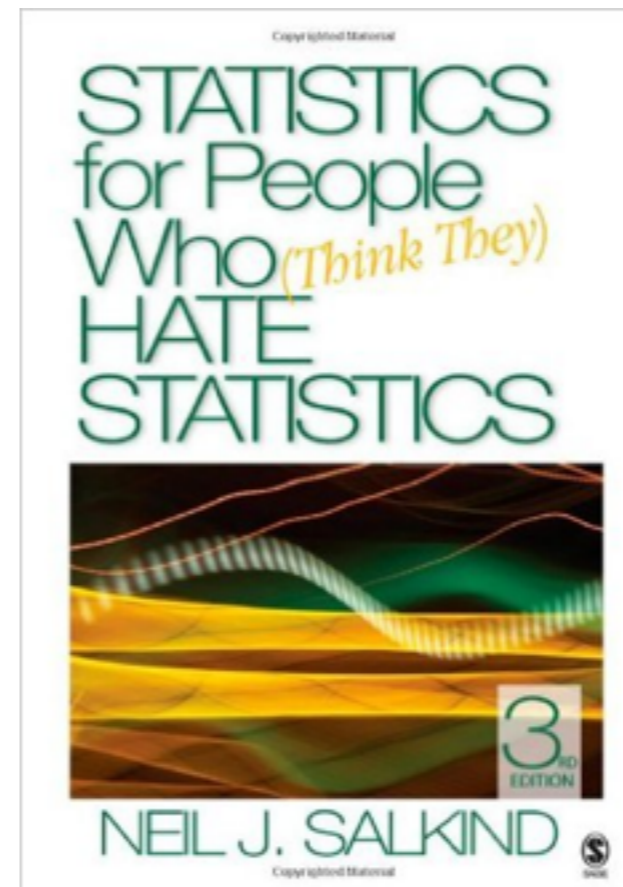
# It's a hard world…

- Quantitative methods are often rated as one of the hardest modules students take during their degree (Murtonen & Lehtinen, 2003).

- Students: quantitative reasoning; numerical thinking; maths/stats anxiety

- Staff: maths/stats anxiety; mixed ability classes; limits on teaching time; heavy workload.

# Conquering this world

Garfield & Ben-Zvi (2007) - Key Principals

1. Knowledge is constructed through practical *doing*.
2. Doing must be *practiced*, and improved through confronting *errors*
3. Students should receive constant and helpful *feedback*.
4. *Technology* can be used to aid visualisation and exploration of data.
5. Difficulties in learning basic probability are often underestimated
6. Student understanding is often over estimated by teachers.



- Embedding skills (Grawe, 2011)
- Using real datasets (Adeney & Carey, 2011)
- Assessments that promote statistical literacy, reasoning, and thinking (Garfield, 1994)

# A Constructed World

# A Constructed World



- Devoid of cultural attitudes

- Assumes a non-problematic transfer of knowledge

- Human centred representations of the teaching environment

- Assume a unified thing called "quantitative methods"

# How to redraw?

# What is Actor-Network Theory?

Emerged in response to Kuhn, Strong Programme of Sociology.

Draws on Ethnomethodology, Continental Philosophy (Deluze & Guattari; Serres)

a "ruthless appliance of semiotics" (Law 1999: 3)

"a sensibility, a set of empirical interferences in the world, a worldly practice or craft" (Law & Singleton, 2012: 2)

# Speaking Actor-Network Theory?



Translation | Enrolment
(Callon, 1986)

Hybrid actor
(Latour, 1994)

# Implications of this?

Performative (over representative) idiom
Representing, producing, correspondence vs
Powers, capacities, performances situated in material agency
(Pickering, 1995)

Discontent with earlier "per-forms", embodiment, new
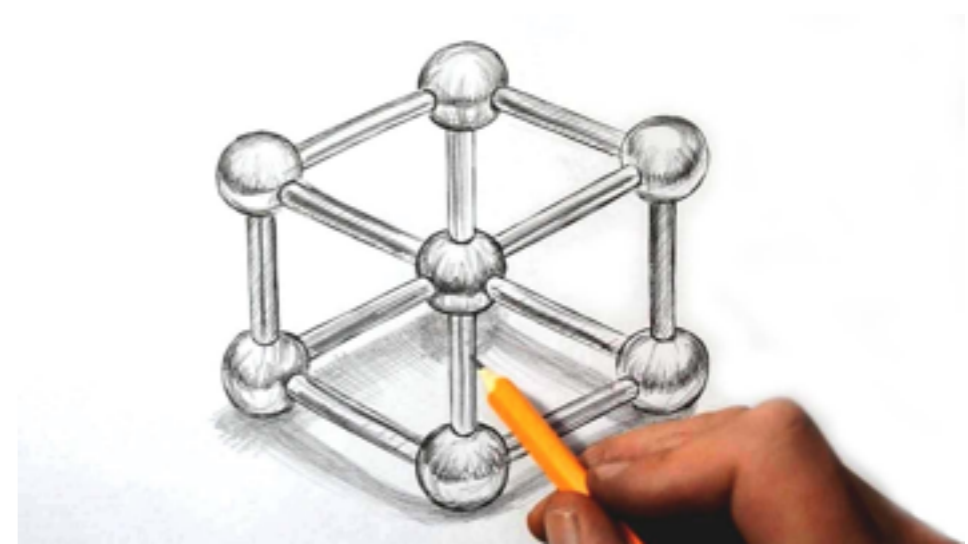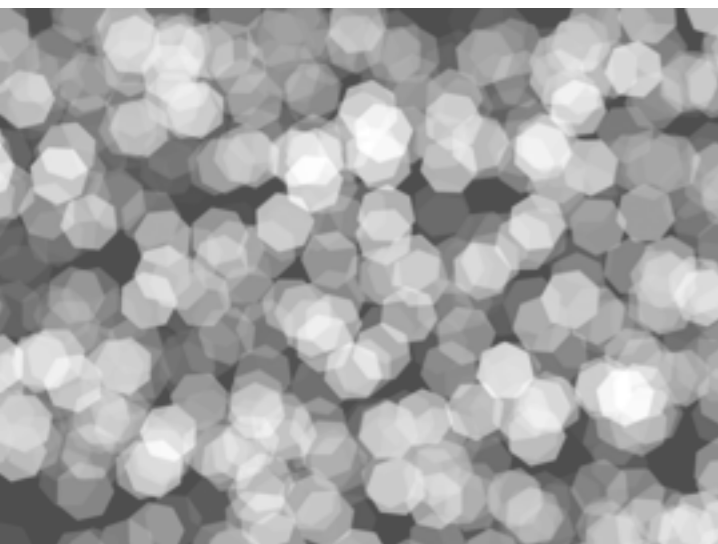pontentialities (Thrift & Dewsbury; 2000: 411)

Multiplicity & Complexity
Harvey's (2004) overlapping absolute, relative and relational
space.

# Redrawing with ANT: Why?

1. Offers a way of adopting a networked (relational) understanding of the world.
2. Foregrounds non-human and human actors (symmetry).
3. Understands networks as dynamic and performed (enrolment & translation).

**ANT in Education**

- Fenwick & Edwards (2010): ANT, post-ANT, and ANT-ish. ANT as a way of intervening in educational issues.

- 3 areas: 1) Arguing for ANT 2) Mapping the networks 3) Emphasising the actors involved.

**Research Questions:**

1. <u>What</u> are the actor-networks that make up quantitative methods? How are these actor-networks performed, conceptualised, and created by actors?

2. How do these actor-networks <u>vary</u> between disciplines?

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## Research Questions:

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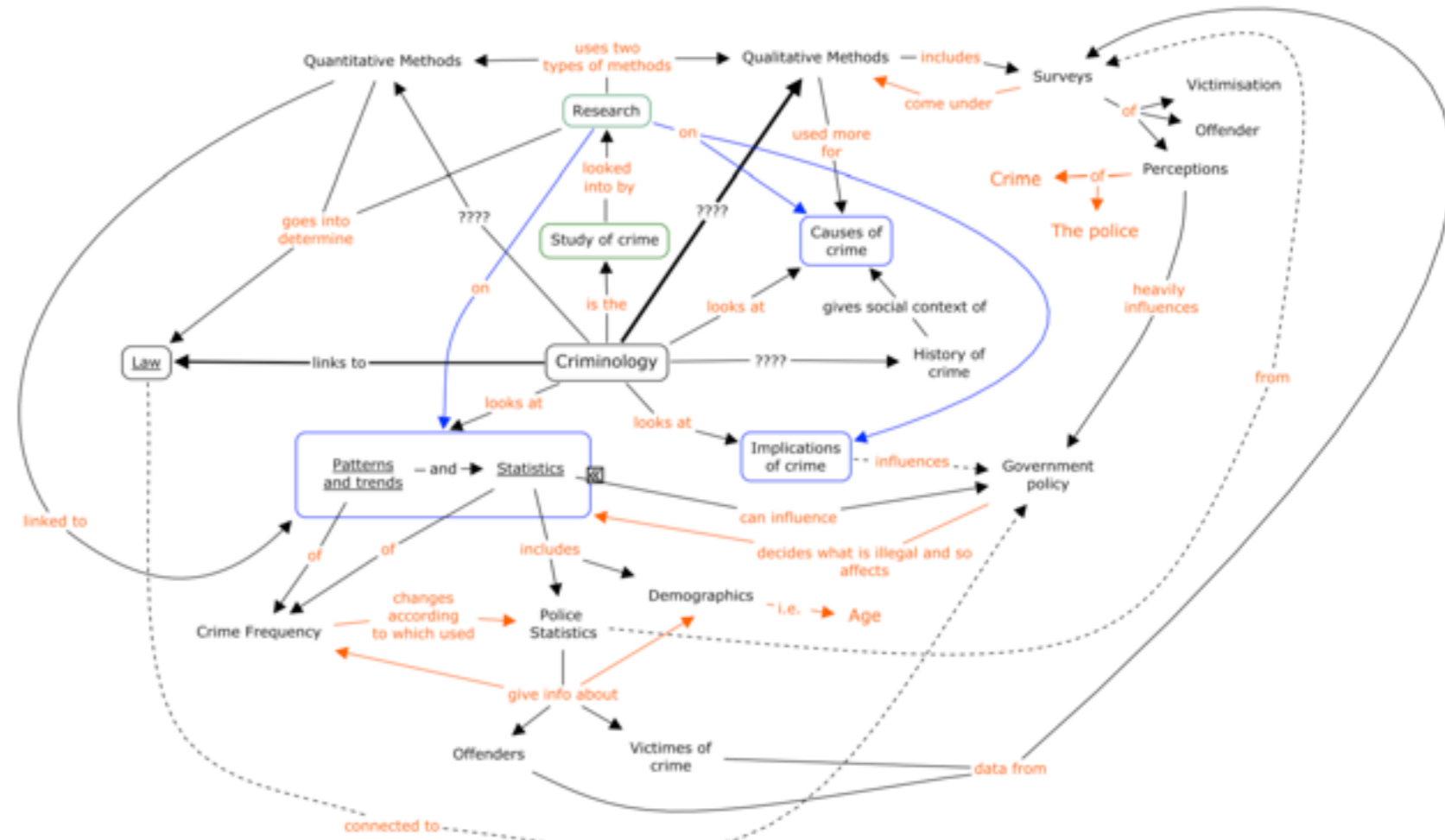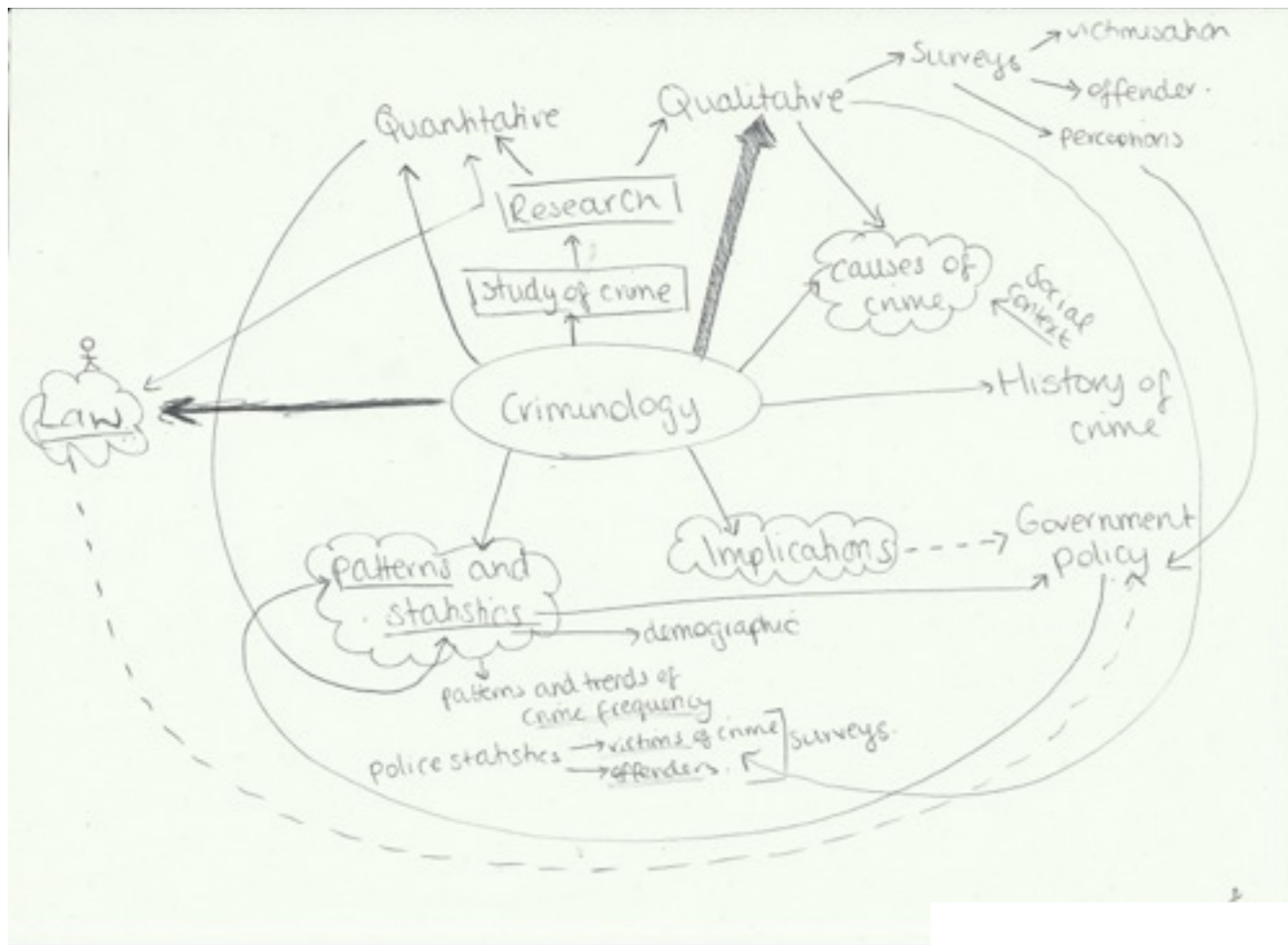2. How do these actor-networks <u>vary</u> between disciplines?

# Doing

Methods: Observation (59hrs), document analysis, interviews (32), concept mapping (Canas & Novak, 2006)

Context: 16 modules across Criminology, Economics, Geography, Psychology over one academic year in a top ten UK university.

- Wagner *et al.* (2011) call for further research into quantitative methods teaching in the social sciences.

# CMaping
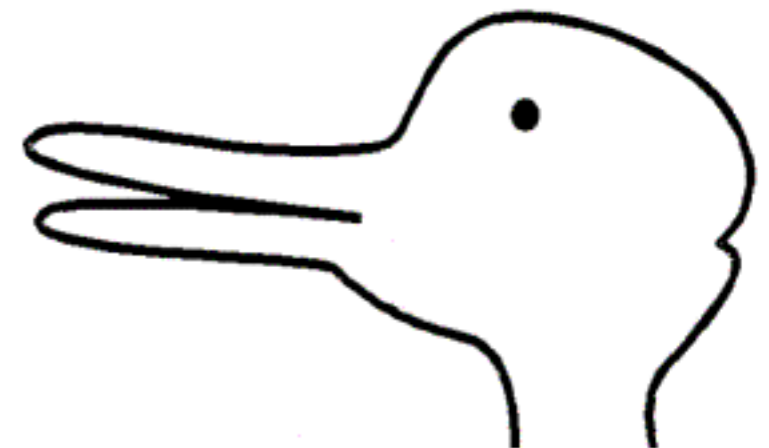
# Getting to Know QM

# The Duck

*If it looks like a duck, swims like a duck, and quacks like a duck then it probably is a duck*

# The Duck

- What is a Duck?
  Characteristics of QM?

- How is a duck like this?
  How does QM look like this?

- What does it mean to swim like a duck?
  What are the actions of QM?
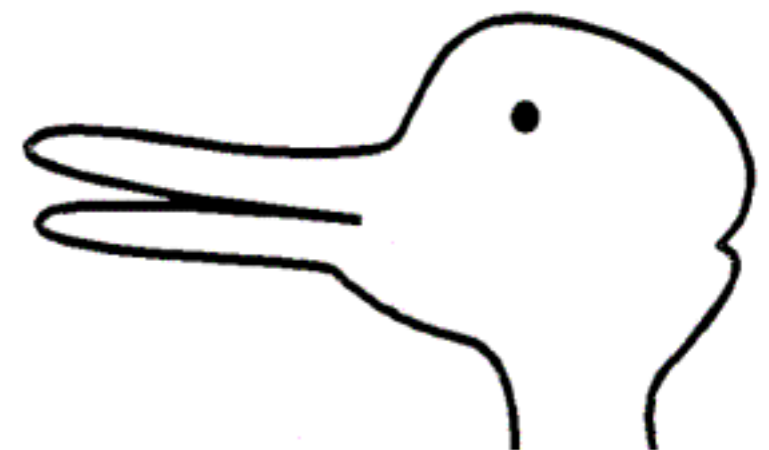
# Characteristics of QM?

1. Linear & fixed knowledge

*You know, at the start correlation and so on, **going up to statistical modelling** [yeah] but then there's also complimentary but different set of skills which are quantitative skills Crim, Staff. CRIM4_31_510: 192: 46*

*Aims and scope: A full first course in statistics and data analysis from a non-mathematical viewpoint. Covering both parametric and non-parametric methods, **up to and including** generalised linear models.*
*Geog, PGT Course Description: 157: 262*

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2. Learnt through doing

*The lecturer continues saying: "Chi-squared test says you've got to calculate this thing called a Chi-Squared test statistic, **and this is how we do this"***
*Geog, 1st year module, lecture: 111:19*

# How does QM look like this?
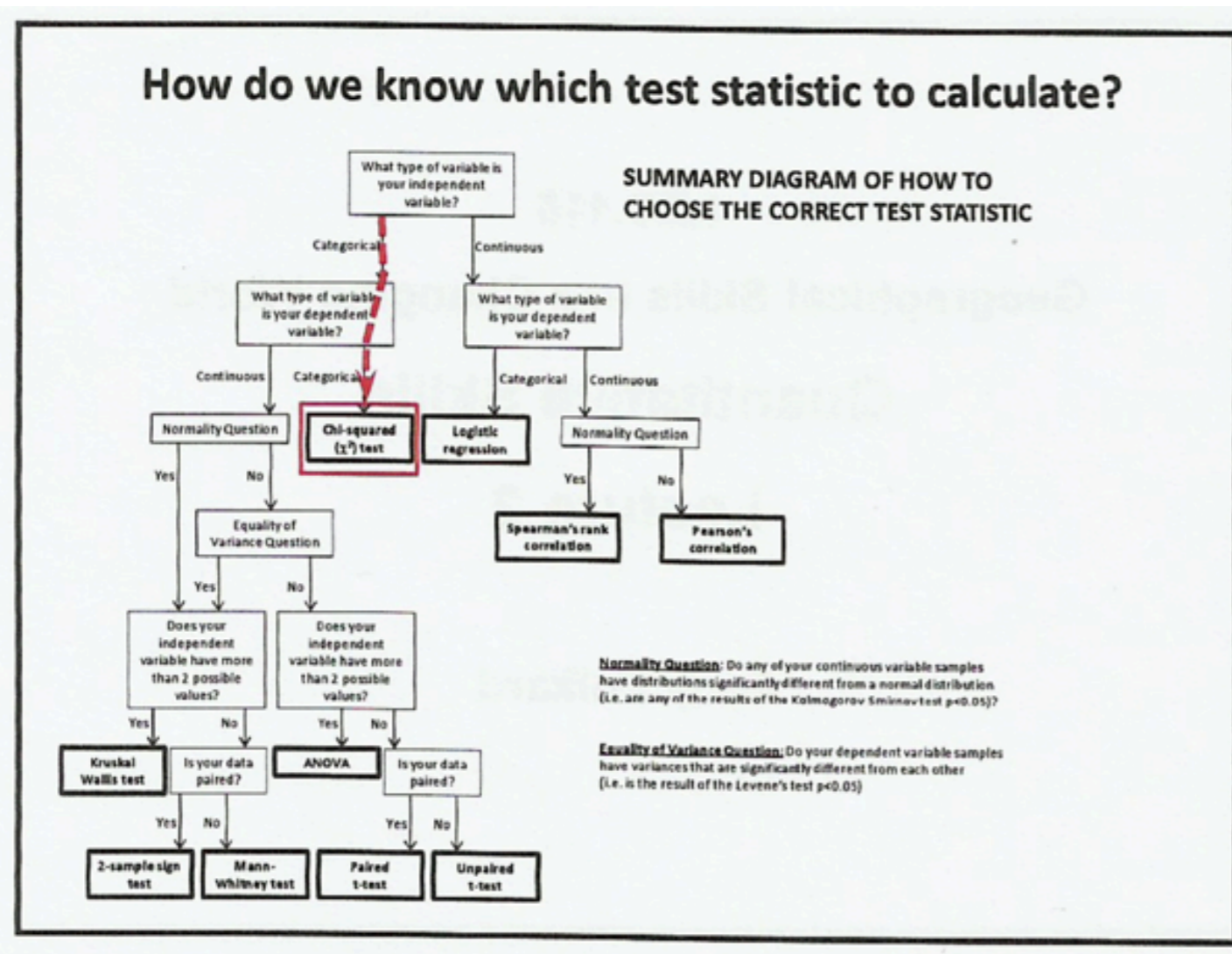


1.  <u>Linear & fixed knowledge</u>

    Flow charts, worksheets fix QM into sequences.

2.  <u>Learnt through doing</u>

    Assignments, worked examples, exercise sheets

# What does it mean to look like this?

1. Linear & fixed knowledge  ······ Flow charts, worksheets fix QM into sequences.  ······► Something to be followed

2. Learnt through doing  ······ Assignments, worked examples, exercise sheets  ······► Obtaining correct answers

# The Rabbit

# Characteristics of QM?

1.  Dynamic, Mischievous, Iterative

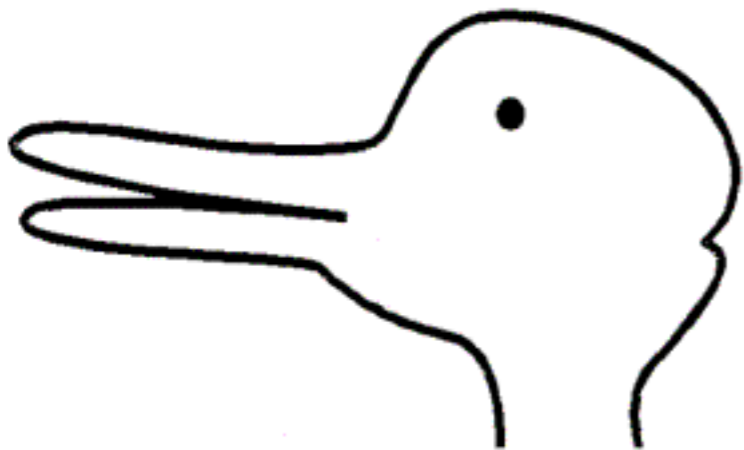*Whilst working through [the worksheet] student's type in the code from the sheet, **after hitting enter one student exclaims "Yay!"** when the final scatter plot is displayed. One student says to the other "I keep forgetting to put quotation marks in".*

*The students continue varying between writing line by line the code, and several lines of code before running it.*

*Student 1 remarks: There's such a lot of code to make a decent looking plot. Student 2, after clicking enter: **Oh it didn't like that.***

*Psyc, Master's module, workshop: 103: 42*

# How does QM look like this?

Software

*He goes onto say that before they have been dealing with 10s of observations, they're moving onto dealing with data sets that are comprised of 1000s of observations, **which are "straightforward to handle in R",** but not other software's such as SPSS*
*Psyc, Master's module, workshop: 103: 5*

# What does it mean to look like this?

Dynamic, data hungry, iterative ..... Software .......▶ Tuning QM to speak through outputs

```
Tweets.R x
Source on Save
1  if (require('twitteR')==FALSE) {
2     install.packages(twitteR)
3  }
4  library('twitteR')
5
6  home.dir <- 'c:/Users/mosemad1.ONEONTA/My Documents/BigData/R/'
7  load(file=paste(home.dir, "TermSearch.RData", sep=""))
8  registerTwitterOAuth(twitCred)
9
10 q.col <- "fracking"
11 n.col <- 100
12
13 tweets <- searchTwitter(q.col, n=n.col, cainfo=paste(home.dir, "cacert.pem", sep=""))
14 dataTweets = twListToDF(tweets)
15 data <- data.frame(dataTweets$text, dataTweets$created, dataTweets$screenName, dataTweets$id)
16 names(data)[names(data)=="dataTweets.text"] <- "text"
17 names(data)[names(data)=="dataTweets.created"] <- "created"
18 names(data)[names(data)=="dataTweets.screenName"] <- "screenName"
19 names(data)[names(data)=="dataTweets.id"] <- "id"
20
21 write.csv(data, file=paste(home.dir,"ModTweets.csv", sep=""), append=FALSE, row.names=FALSE, sep=",")
22 print(data)
23
```

### Correlations

| | | | Total competency score before starting their job | Age Groups |
|---|---|---|---|---|
| Spearman's rho | Total competency score before starting their job | Correlation Coefficient | 1.000 | .254[*] |
| | | Sig. (2-tailed) | . | .034 |
| | | N | 70 | 70 |
| | Age Groups | Correlation Coefficient | .254[*] | 1.000 |
| | | Sig. (2-tailed) | .034 | . |
| | | N | 7 | Double-click to activate |

*. Correlation is significant at the 0.05 level (2-tailed).

Tuning - Pickering (1995)

A good ANT account is a narrative or a description or proposition where all the actors <u>do something</u> and don't just sit there.

Latour, 2005: 128

# Statistics Words

Passive:

'Equipped', 'use', 'apply', 'run' QMs

'Manipulate', 'transform', 'perform', 'solve', 'build'

$$2 > -3$$
$$0.999\ldots = 1$$
$$\infty \quad + \quad -$$
$$\times \quad \div$$
$$\pi \approx 3.14$$
$$\sqrt{2} \quad 1 + 2 \cdot 3 \quad 5^2$$
$$(1 - 2) + 3$$
$$5(2 + 2) \quad 101_2 = 5_{10}$$

# Statistics Words

<u>Personified:</u>

'Introduced', 'get to know', 'familiarity', 'interpret', tinkering

<u>Fantasy/Fiction:</u>

'Throws out', 'surgeries', 'forced', 'stuck in', 'chucked out', 'crunched', 'beast'

# (Re)Presenting QM

Work in progress but…

- Multiple faces of QM.

- As other actors are used to enrol students into the learning of QM the concept of what QM is gets translated.

- The linear and doing nature of QM becomes about performances of following, and searching for correct answers, that give power to numbers.

- The mischievous nature of QM with software becomes about tinkering and tuning of user and software on a quest for outputs, forcing numbers into the background.

- Words used to talk about QM equally highlight multiplicity.

# (Re)Presenting QM

Still there are…

- Problems of pinning ANT networks into linear accounts

- Blending ANT and Pickering's (1995) Dance of Agency

# Thanks for listening

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