A New Agenda … Values, World Society, Modelling

https://sites.google.com/site/gordonburtmathsocsci/home/a-new-agenda

A New Agenda seeks to explore all aspects of society using all the academic disciplines paying special attention to values ... with special interest in modelling ... not disinterested in practice ... and aspiring to high academic standards.

Commentary, August 2016 No. 32

Olympics … Raiffa … Ireland, politics and mathematics … Bradford, Dublin, London

0 Obituary: Howard Raiffa.

'Influential statistician who changed the rules of game theory by introducing irrational human behaviour.' (The Times)
https://en.wikipedia.org/wiki/Howard_Raiffa

1 Bradford, Dublin, London, September: 4-6, 7-9, 14, October 4

1.1 Peaceful Relations and the Transformation of the World

An Academic-Practitioner Dialogue on Peace in the 21st Century
September 4-6, Bradford, Adam Curle Symposium
www.AdamCurle.co.uk
£10 ticket:
http://www.bradford.ac.uk/social-sciences/events-and-podcasts/conferencesandevents/curle-symposium/booking/

Fourth July 2016 marks the hundredth anniversary of the birth of Adam Curle, peace scholar, Quaker activist international mediator and Founding Chair of Peace Studies

at Bradford. To mark the occasion, Bradford's Peace Studies Division is hosting the Adam Curle Centenary Symposium. Academics and practitioners around the world are invited to a dialogue on peace in the 21st Century in the light of Curle's philosophy and practice.

Curle's approach to Peace Studies was interdisciplinary, drawing on an academic career that spanned anthropology, psychology, education and development. It was also practical , reflecting experience in peacemaking and development in India, Pakistan, Nigeria, Zimbabwe, Sri Lanka and the Balkans. These academic disciplines and practical experiences informed his conception of "peaceful relationships", which he regarded as key to understanding peace and conflict at different levels, from the quest for individual peace to the negotiation of settlements to interstate wars.

Curle drew further inspiration from a range of religious teachings, particularly those of Tibetan Buddhism and he remained a member of the Society of Friends and much of his peace work was conducted with the support of the Quakers. He used these to inform a trenchant critique not only of what he called the "futility" of violence, but also of the materialism and ignorance which he regarded as underlying it. This prompted Curle to regard the broad promotion of development and education as intimately connected to the practice of peacemaking and mediation.

Curle's emphasis on "peaceful relations" is a highly original theorisation of approaches to peace practice, and it has informed the ethos of Peace Studies at Bradford, which Curle created in 1973. In his book, Tools for Transformation, Curle divided his work into three broad strands: peacemaking, social change/development and education, and these will be the three streams of the Centenary Symposium, alongside one on arts and peace to reflect the importance Curle, a musician and poet, gave the arts in peacemaking.

The symposium aims to strengthen interdisciplinary and practice-oriented explorations of peaceful relations in the 21st Century and to assess the ongoing relevance of Curle's ideas to the challenges the world faces today.

1.2 Exile and Memory: Palestinian Refugees and 1948. Ghada Karmi.

September 7, 7-8.30pm, McNeill Theatre, Hamilton Building, Trinity College Dublin. Public Lecture: All Welcome. See below.

1.3 Conflict Research Society conference

September 7-9, Dublin,
http://conflictresearchsociety.org/ourevents/dublin-2016/

Our Annual Conference will be hosted by the International Peace Studies programme of the Irish School of Ecumenics in Trinity College Dublin. We have an exciting line-up of plenary events, some strong panels and a fascinating range of papers, so this promises to be another great conference!

The conference seeks to generate debate and ongoing relationships between scholars and practitioners interested in key issues surrounding the dynamics of violent political conflict, dialogue, diplomacy and peacebuilding. We hope that this year's CRS conference will have a strong policy/practitioner voice in terms of the range of participants, papers and invited keynote contributions. It is also intended that the conference will continue its tradition of being multi-disciplinary and being open to the full range of quantitative and qualitative methodological approaches to the subject.

The following plenary sessions are in the MacNeill Theatre, Hamilton Building – except where indicated.

Wednesday, September 7
7.00-8.30 PM
Public meeting: Dr Ghada Karmi, Institute of Arab and Islamic Studies, Exeter U., Exile and Memory: Palestinian Refugees and 1948 [*Return, A Palestinian Memoir*]

Thursday, September 8
9.30– 10.00
Welcome: Professor Jane Ohlmeyer, Director
10.00-11.00
Peace, conflict and commemoration: The cases of Ireland and Palestine
John Doyle, Dublin City University and Ghada Karmi, University of Exeter
5.15 – 6.45
Irish Peace Process—the Role of Government and Civil Society
Department of Foreign Affairs, the Glencree Centre for Peace and Reconciliation and the Corrymeela Community. Neill lecture room, Trinity Long Room Hub.

Friday, September 9
9.00 – 10.00 AM
Are civil wars like cancer? Implications for the study of conflict
Stathis Kalyvas Yale University
12.00 – 1.00
CRS Book of the Year prize—Dr Kristin Bakke,
Decentralization and Intrastate Struggles: Chechnya, Punjab and Quebec

1.4 Islam and the West: a personal perspective

September 14, 7pm, London, Conway Hall, Red Lion Square. Tickets:
https://conwayhall.org.uk/event/islam-west-personal-perspective/

I am writing to inform you of a cross-cultural peace promotion event in September in London. The Martin Ryle Trust, which works closely with Scientists for Global Responsibility, is holding its first annual lecture: "Islam and the West: a personal perspective" which will be given by Professor Sir Michael Atiyah.

Sir Michael is one of the country's most eminent mathematicians, recipient of the Order of Merit and the Fields Medal among numerous other awards, and outspoken critic of nuclear weapons. In this lecture he will speak

from personal knowledge and life experience. He brings a unique combination of cross-cultural insight, fierce intellect and a passion for peace. We are confident the event will be stimulating and enlightening. We hope very much that you will be able to attend.

Proceeds from the lecture will go towards work in support of peace and justice – please forward to any like-minded persons or organisations.

Following the recent death of our colleague and friend, Prof Sir Tom Kibble, who was a longstanding trustee of the Martin Ryle Trust, we are dedicating this first lecture to Tom's memory, his life-long support of social justice, his friendship and his support of the Trust.

About Professor Sir Michael Atiyah
Michael Atiyah's father was Lebanese and his mother Scottish. Michael grew up in Sudan and Egypt and spent most of his adult life in England, the USA and Scotland. He is a distinguished mathematician and has played prominent leadership roles in science and academia. He is also a noted public intellectual, speaking out with vigour and passion on matters of topical political concern. His talk will emphasise the cultural, scientific and commercial interactions over the centuries, which brought benefits to both sides. But he will also trace the hostility initiated by the crusades, inherited by the colonial era, culminating in the present time in the demonisation of Islam and the rise of extremism on all sides. He will look at the ethical issues involved as well as the political and security aspects.

The Martin Ryle Trust, P O Box 876, Lancaster, LA1 9HR
Trustees: Dr Philip Webber (chair); Dr A Alan Cottey;
Prof Jennifer Nelson, FRS; Ms Vanessa Spedding; Dr Josephine A Stein
Email: mrt@gn.apc.org @MartinRyleTrust facebook.com/MartinRyleTrust
Web: http://www.sgr.org.uk/pages/martin-ryle-trust

1.5 Natural Capital Forum 2016: Making Nature Count

October 4, The Studio, National Concert Hall, Dublin 2.
http://www.naturalcapitalireland.com/news--blogs/news-details-of-2016-natural-capital-conference

This conference brings together some of the leading voices on natural capital from a diverse range of disciplines, including economics, accountancy, business, communications and politics, as well as ecology and environmental science.

Our speakers include the Chief Economic Adviser to the Scottish Government, Dr Gary Gillespie; author and campaigner, Tony Juniper; the Head of Sustainability at the Institute of Chartered Accountants of England and Wales, Richard Spencer; Director of Science at Kew and UK Natural Capital Committee member, Kathy Willis; and Ireland's permanent Ambassador to the UN, David Donoghue, who co-chaired the Sustainable Development Goals.

We will also hear from businesses using natural capital concepts to improve environmental sustainability, representatives from other EU countries on their own

approaches to this emerging agenda, and a selection of Ireland's top researchers in this area.

2 A model of the Olympics

The Olympics is an event involving all the world. What would a world view of the Olympics look like? We cannot rely on the UK press because it concentrates heavily on the performance of the UK. Even when other countries are considered it is usually just the top few. And how should we value a country's performance? Should a league table be based on total medals or just on gold medals? Should it be the number of medals or the 'rate' of medals in relation to population or economic power? The following model is designed to help address these questions by setting out the conceptual foundations.

The past predicts the future

Before looking at other explanations, it is worth noting that in the Olympics as in so much else the best predictions of future performance is past performance. The top ten places (total medals) have been the same in last four Olympics. In the period 1980 to 2016: the top three are the superpowers, USA, Russia and China, with China coming before Russia 2008 and thereafter; the top ten form a continuous band of countries in the North who were primary participants in the Cold War, from USA to Europe (UK, France, Italy, Germany, Russia) to China, South Korea and Japan … and Australia in the South; Germany has slipped a place or two; appearing earlier in the top ten have been Communist Cuba (5 times) and Warsaw Pact Hungary (4), Romania (3), Bulgaria (2), Poland (1), Yugoslavia (1) and Ukraine (1) … also Netherlands (1), Spain (1), Canada (1), New Zealand (1). There have been no countries from South America, Africa, Middle East or South Asia, in the top ten in this period.

The mean number and mean proportion of medals

There are N nations taking part and Y medals to be won.
Let y be the medals won by a particular country.
Then the mean of y is $y^{\wedge}=Y/N$.
Consider p the proportion of medals won by a particular country, $p=y/Y=y/Ny^{\wedge}$.
Then the mean of p is $p^{\wedge}=1/N$.
In 2016, the number of countries N=205 and the number of medals Y=2012.
So the mean number of medals is $y^{\wedge}=9.8$;
and the mean proportion of medals is $p^{\wedge}=0.0049$ (that is, 0.49%) … in other words, equality between the countries would give each country roughly half a per cent of the total number of medals.
[As an aside, 2012 is not divisible by 3 which should be the case if there is gold, bronze and silver for each event. Possibly it is due to joint winners.]

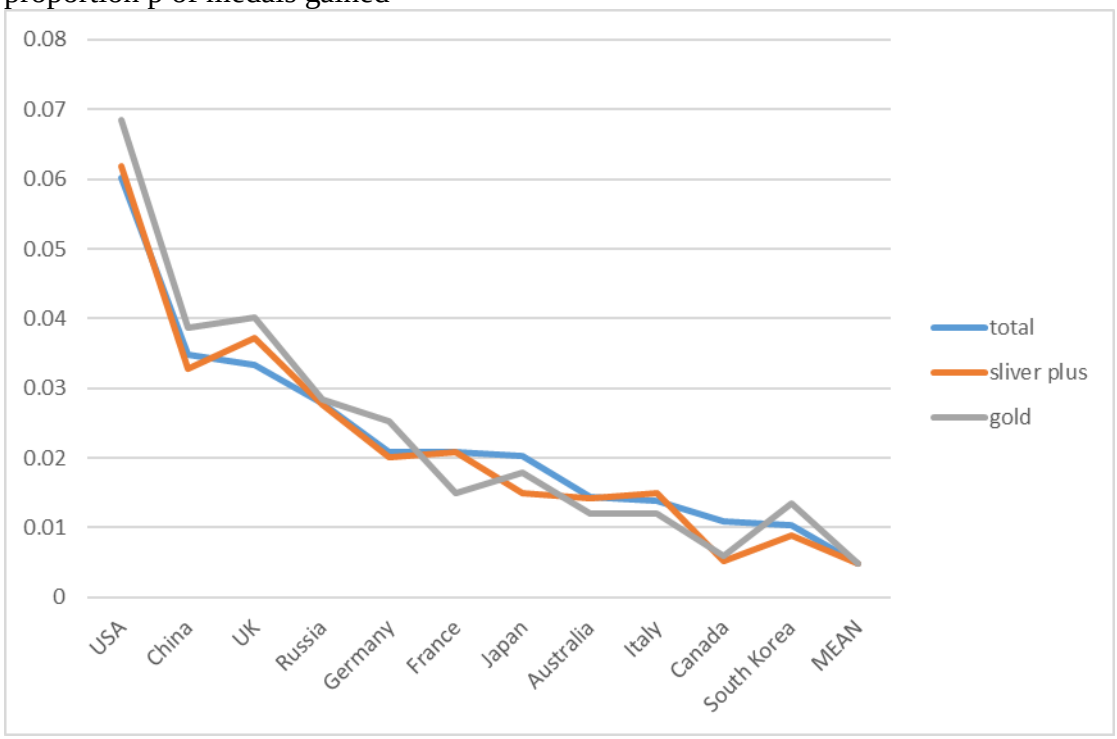
An asymmetric distribution

If the distribution of medals was symmetric about the mean $p^{\wedge}=0.0049$, then 102 of the countries would be above the mean. In fact only 29 countries (14%) were above the mean, 176 (86%) below. Of these 176, 58 countries (28%) received one or more

medals and 127 countries (58%) gained no medals. The median country wins zero medals. (One medal is gained by countries in 78th to 86th place).

We now consider the proportion p of medals gained by the top eleven countries – the proportion of the total medals, the proportion of the *silver plus gold* models and the proportion of gold medals. See Figure 1. The mean p=0.0049 is also shown. Whichever of the three proportions is shown, the profile is similar. The top nation, USA, wins 6% of the medals, twelve times the mean.

Figure 2.1 The proportion p of medals gained by the top eleven countries



. countries listed by total number of medals, decreasing

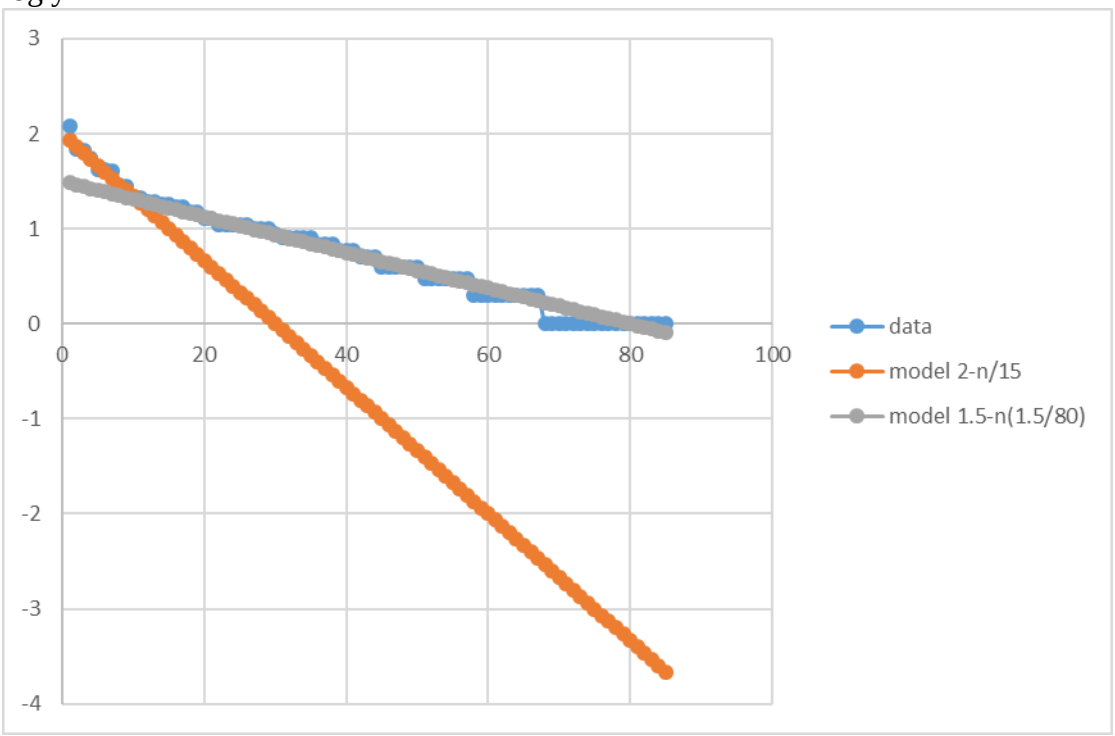
Figure 2 below suggests that the distribution of y, the total number of medals, is a compound distribution. There are two parts, both exponential. The first part covers the first ten or eleven countries and has a steeper decline than the second part which covers the remaining countries. Note that n is the ranking of the country in terms of total medals gained; and y is the total number of medals gained. Logarithms to the base 10 have been used.

. $\log y = 2 - 0.067\ n$

. $\log y = 1.5 - 0.019\ n$

Figure 2.2 The two-part compound exponential distribution for total medals gained

log y



. n

We now move on to consider the factors determining the number of medals gained. We suggest that each nation is characterised by their Olympic strength s. The mean national strength is s^ and the total world strength is S=Ns^. Each country has a relative strength x=s/S. Our model is a simple one. Proportion p of medals equals relative Olympic strength.

. p = x

In turn Olympic strength depends on the allocation a of general strength.

. p = x = ag

We take GDP to be an indicator of general strength.

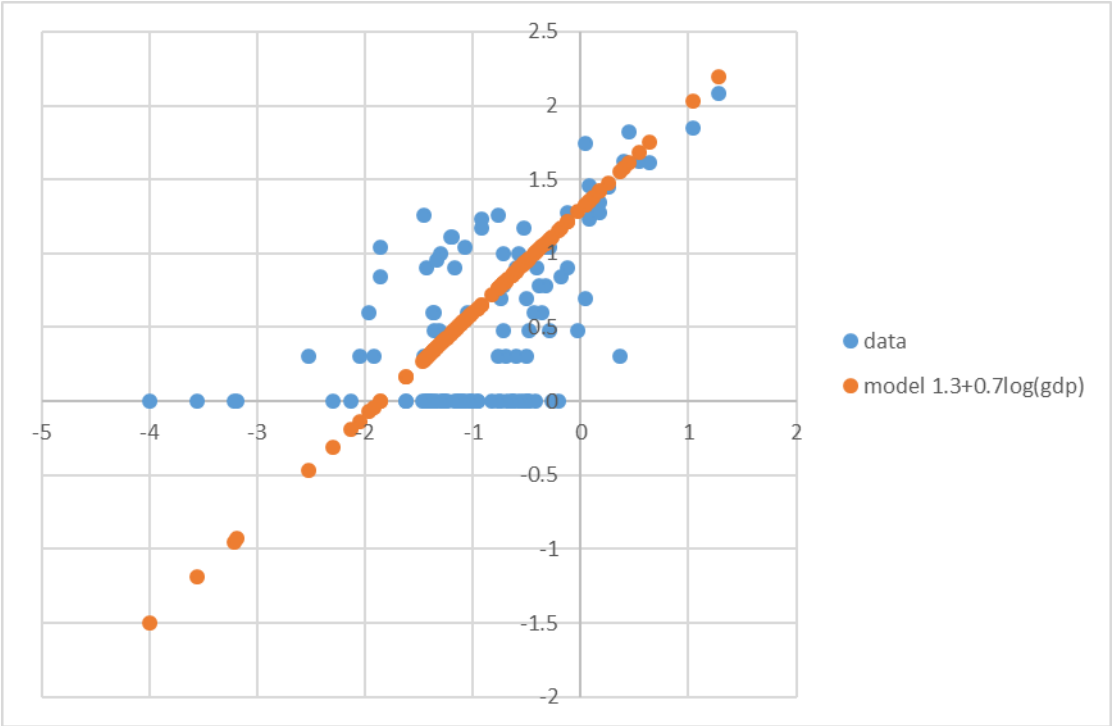
This choice is supported by a study of the correlations between the number of medals and a variety of other variables. Restricting attention to just the top eleven Olympic countries, GDP correlated 0.9 with number of medals. Population correlated only 0.4 and GDP per capita correlated only 0.2 with number of medals. Logarithms of the variables were also considered and multiple regressions carries out. It was finally concluded that taking logarithms was satisfactory.

Plotting logarithms for all the countries gives Figure 2.3, and the following equations has been estimated by eye.

. log (total medals) = 1.3 + 0.7 log (GDP)

Figure 2.3 The number of medals depends on GDP, logarithmically

log y (total medals)



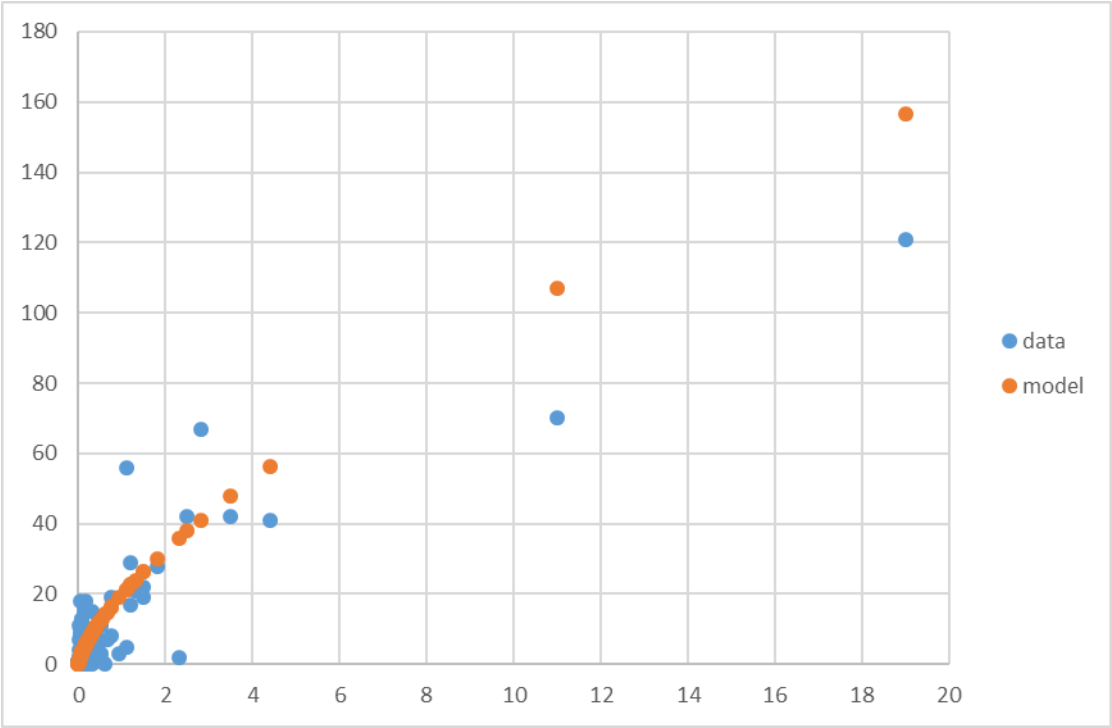
. log g (GDP)

The above equation can be re-expressed as follows. See Figure 2.4

. total medals = $10^{1.3}$ $GDP^{0.7}$

Figure 2.4

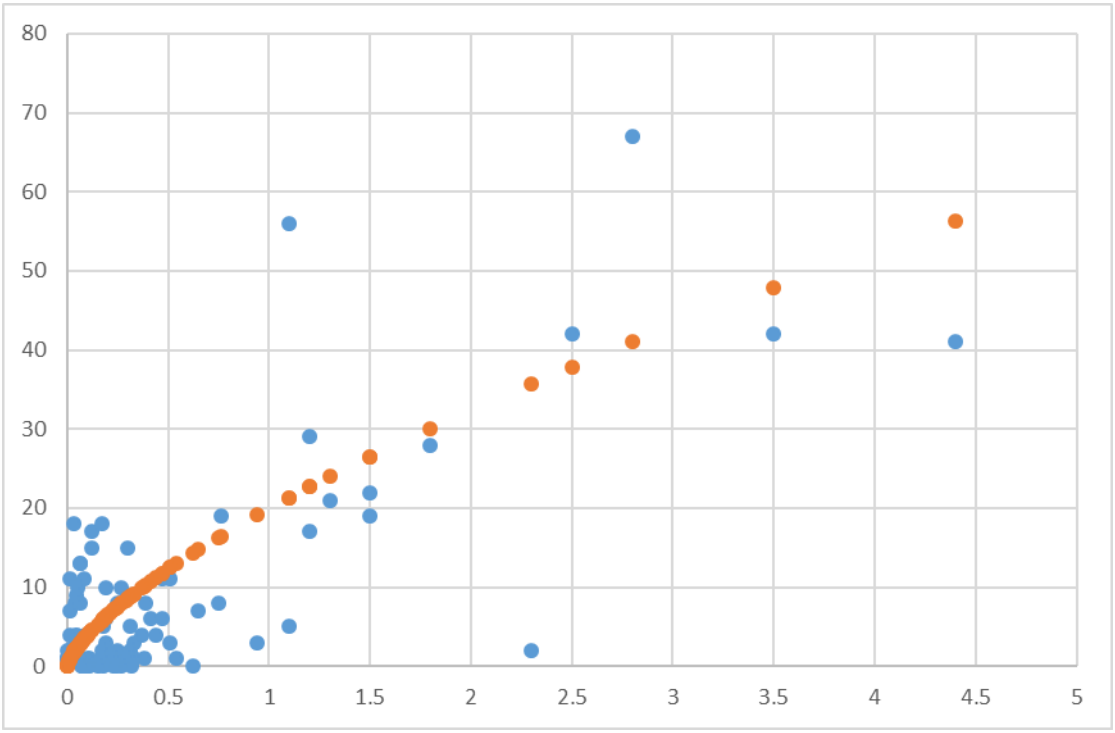
Total medals



GDP

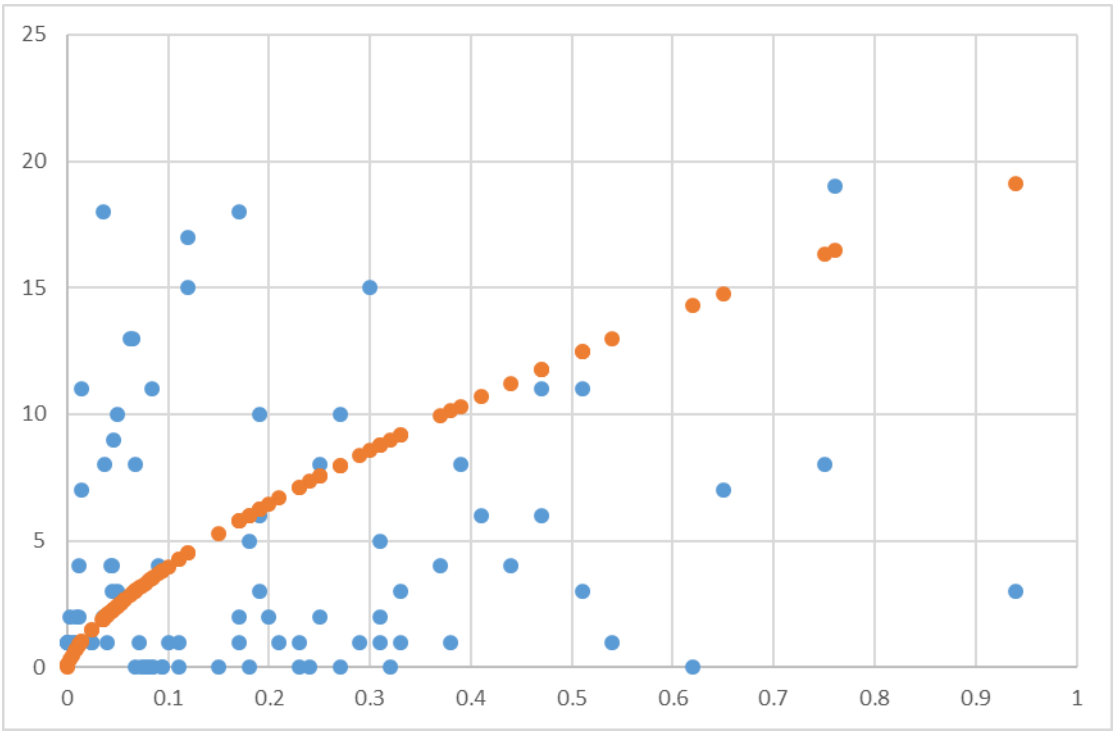
Figures 2.5 and 2.6 look at Figure 2.4 in more detail

Figure 2.5
Total medals



GDP

Figure 2.6
Total medals



GDP

Ireland, Trinity and the three Yearbooks: Values, World Society and Modelling

Gordon Burt, Conflict Research Society

This talk will be given on Friday 9th September 2016, the 10.30-12 panel; Conflict Research Society Annual Conference; ISE Building, Trinity College, Dublin.

Welcome to Ireland! Welcome to Dublin! Welcome to Trinity!

Visit the Hamilton Building! Enjoy a walk along the Royal Canal! Sit under the trees in College Park! Be a Student at the Guinness factory! Go on a pilgrimage to Cork! Read David Attis' book on *Mathematics and the Making of Modern Ireland*!

Visit the Hamilton Building! Named after Ireland's foremost mathematician: William Rowan Hamilton (1805-1865).

Enjoy a walk along the Royal Canal! That's what William Rowan Hamilton and his wife were doing on 16th October 1843. He didn't listen to a word she was saying. He was thinking about a mathematical problem! Just as they were coming to Broom Bridge, suddenly the answer came to him. He was so excited by his discovery that he immediately carved his fundamental equations on a stone of the bridge.

. $i^2 = j^2 = k^2 = ijk = -1$

Slide 1 Enjoy a walk along the Royal Canal!
Brougham [Broom] Bridge
. $i^2 = j^2 = k^2 = ijk = -1$
the mathematics of space
William Rowan Hamilton (1805-1865)

'i', 'j', 'k', '1' … four things … four dimensions … four-dimensional space. So. When you go for your walk along the Royal Canal, be like William Rowan Hamilton and think about the mathematics of space.

Sit under the trees in College Park! Sitting under the trees was what Isaac Newton was doing when an apple fell on his head and he discovered gravity! Of course that was Trinity College, *Cambridge*. A couple of centuries later in Trinity College *Dublin*, our same friend William Rowan Hamilton was thinking, 'when that apple was in the *position* of hitting Newton's head it had a certain *momentum*. So position and momentum are what really matter. The motion of *any* system of things can be described by the position and momentum of all the things.' We now refer to this as the Hamiltonian of the system. And Einstein used this in his general theory of relativity.

Slide 2 Sit under the trees in College Park!
Albert Einstein in his General Theory of Relativity:
'… to show that the field equations correspond to the laws of momentum and energy, it is most convenient to write them in the following Hamiltonian form …'
the mathematics of motion

'… to show that the field equations correspond to the laws of momentum and energy, it is most convenient to write them in the following Hamiltonian form …'

So. Sit under the trees in College Park – and think about Einstein and the mathematics of motion.

Go on a pilgrimage to Cork! … and find out how your computer works! Your computer uses Boolean logic, named after George Boole, the professor at Cork. He and others established the foundations of mathematical logic.

Slide 3 Go on a pilgrimage to Cork!
George Boole, Queen's College Cork
This drink is Guinness.
Guinness is good.
Therefore …
… this drink is good.
The mathematics of logic

So. Go on a pilgrimage to Cork and think about the mathematics of logic.

So much for logic. But what about empirical science? Be a Student at the Guinness factory! Guinness … mmmh! Not Guinness … ughhh! Seven out of ten people think Guinness is better. Seven versus three. I wonder if that difference is statistically significant? Let's do a t-test … Student's t-test to be precise.

'Student'? 'Student' worked as a researcher at the Guinness factory and developed his t-test to compare different brewing mixtures. His real name was W. S. Gossett but he published his work under the pseudonym 'Student' so that no one would know the Guinness connection.

Slide 4 Be a Student at the Guinness factory!
Guinness ratings: 7 3 6 9 5
Non-Guinness ratings: 5 4 8 1 6
Compare means
Look at variances
Use Student's t-test
Is the difference between Guinness and non-Guinness statistically significant?
Student: W. S. Gossett
The mathematics of statistical logic

So. Visit the Guinness factory – and be a Student of the mathematics of *statistical* logic.

In our visits to the Royal Canal, to College Park, to Cork and to the Guinness factory we have celebrated four aspects of mathematics and three Irish mathematicians:

the mathematics of space, William Rowan Hamilton
the mathematics of motion, William Rowan Hamilton
the mathematics of logic, George Boole
the mathematics of statistical logic, 'Student' Gossett

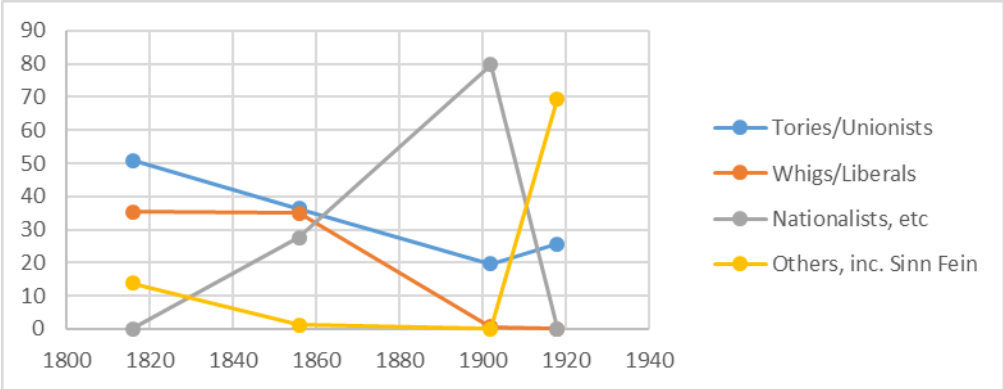
Slide 5 Four aspects of mathematics
Irish mathematics
the mathematics of space
the mathematics of motion
the mathematics of logic
the mathematics of statistical logic

What I want to do now is to focus on the first two of those aspects. I shall apply the mathematics of space and the mathematics of motion to Irish politics.

I shall start with the *mathematics of political motion*: the motion of Irish politics before 1916 and after 1916.

The period 1801 to 1918 saw the succession of three political configurations. In the nineteenth century the electoral dominance of the two British parties, Tories and Whigs, gave way to the dominance of the Home Rule party. The First World War, the postponement of Home Rule and the Easter Rising in 1916 and its suppression were the prelude to Sinn Fein's dominance in the 1918 election – with a Unionist presence in the North.

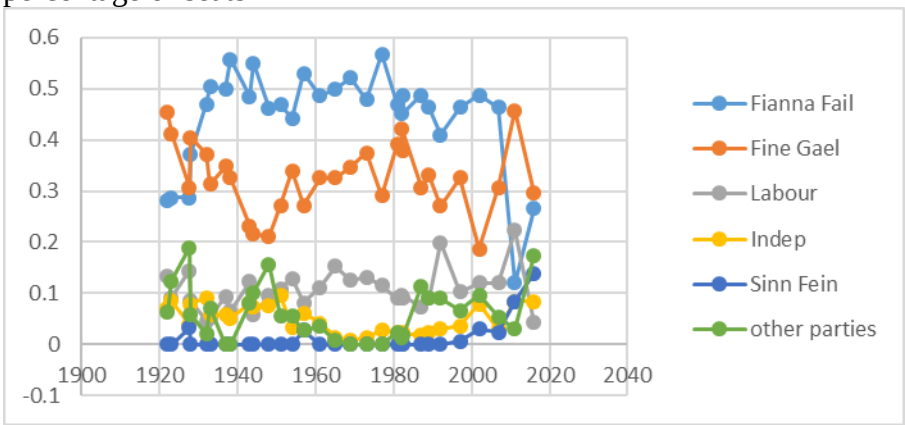
Slide 6 The motion of Irish politics, 1801 to 1918
the succession of three political configurations: 1801-1831, 1832-1880, 1885-1910, and 1918



Source: Coakley, John and Michael Gallagher Eds. (2010) Table 1.1 Irish parliamentary representation, 1801 to 1918, page 11.

A unitary Sinn Fein, the third of the three political configurations of the 1801-1918 period discussed above, gave way in 1922 to the fourth political configuration, a competition between two parties which were soon to become transformed as Fianna Fáil and Fine Gael – and that has continued to the present day. (Politics in Northern Ireland was meanwhile taking a different course).

Slide 7 The motion of Irish politics, 1922-2016; percentage of seats gained
percentage of seats



That gives us the *trajectory of motion* for Irish politics. But, following Isaac Newton, what are the *laws of motion* for Irish politics? In particular what are the laws of motion for the core two-party competition between Fianna Fáil and Fine Gael?

At this point I need to offer you my apologies: I have not carried out the analysis yet. But here's one I have done earlier! I have looked at the laws of motion for UK politics since 1945. I looked at the time series for x, where x is the Conservative vote as a percentage of the combined Conservative and Labour votes. There was an autocorrelation of 0.5 and the equation is given below. This indicates x circling around a single equilibrium of 0.52, that is Conservatives with 52% and Labour with 48% of their combined vote.

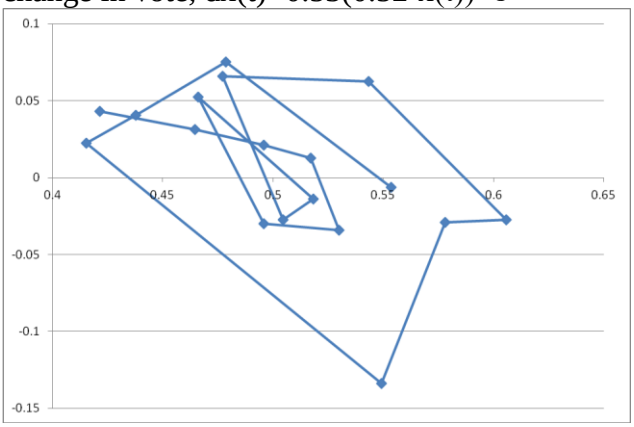
$$dx(t) = 0.53\,(0.52\text{-}x(t)) + \varepsilon \qquad R^2=25\%;\ p=0.04$$

In a rather far-fetched way we can think of the equation as the Hamiltonian for political motion, expressing as it does the relationship between position x (percentage vote) and motion dx (change in the percentage). But that's not quite right in a number of ways …

Note also that we are using Student's mathematics of statistical logic. The 'p=0.04' is saying that a t-test has been used and that the chance of the results being due to chance is 0.04.

Slide 8 The laws of motion for UK politics, 1945-2015
The core 'two party' competition between Conservative and Labour

change in vote, dx(t)=0.53(0.52-x(t))+ε



. vote, x(t) = Cons/(Cons+Lab)

So much for the mathematics of political *motion*. Now for the mathematics of political *space*. Because we are talking about space, we are going to be doing quite a bit of geometry.

Consider the voting in Northern Ireland in the UK general election of 2015. Consider the party voting percentages across constituencies. From these percentages we can mathematically deduce a political space. No other information about the parties is required. Each party and each constituency can be located in this space. To keep things simple we shall look at the most important dimensions of this space. We shall

use principle component analysis to do this – a method which is very similar to factor analysis.

Slide 9 We mathematically deduce a political space
The party voting percentages across constituencies
Parties and constituencies are points in the space.
No other information about the parties is required.
The most important dimensions of this space …
… using principle component analysis / factor analysis.

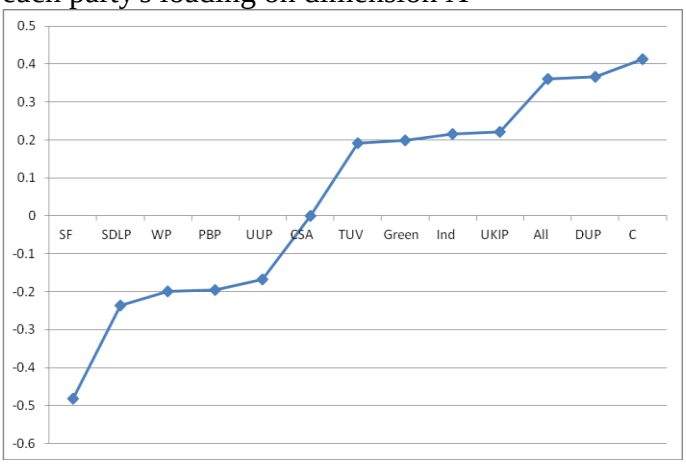
Notice that constituencies are points in the space. One question we might ask is: how are constituencies distributed in political space? A fairly obvious suggestion would be that the constituencies cluster around some average constituency, a bit like the normal distribution. Let's take this as our initial hypothesis.

Slide 10 The question and the hypothesis
Constituencies are points in the space.
Question: how are constituencies distributed in political space?
Hypothesis: constituencies cluster around some average constituency.

Remember: we feed in the percentages and the mathematics gives us the political space. We start our investigations by looking at just one dimension, dimension X, the most important dimension in this political space. The parties are ordered along dimension X with Sinn Fein at one extreme and the DUP and Conservatives at the other, roughly speaking running from the political Left to the political Right. Leftist parties SDLP, WP and PBP are to the left. Rightist parties TUV, Independents are to the right. Greens, CSA and UUP(?) are in the middle.

Slide 11 Political space, Northern Ireland, 2015: parties

each party's loading on dimension X

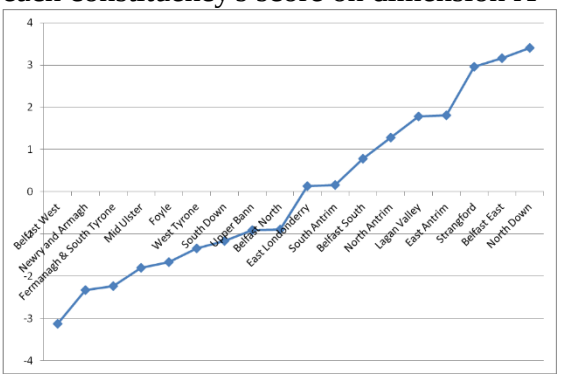


. parties ordered by loading on dimension X
SF; SDLP, WP, PBP, UUP; CSA; TUV, Green, Indep, UKIP; Alliance, DUP, Cons

The different constituencies are also ordered along dimension X. Belfast West and Newry & Armagh at the negative Left(?) extreme and Belfast East and North Down at the positive Right(?) extreme. Belfast West is Sinn Fein and Belfast East is DUP.

Slide 12 Constituencies ordered along dimension X

each constituency's score on dimension X



the constituencies ordered by score on dimension X

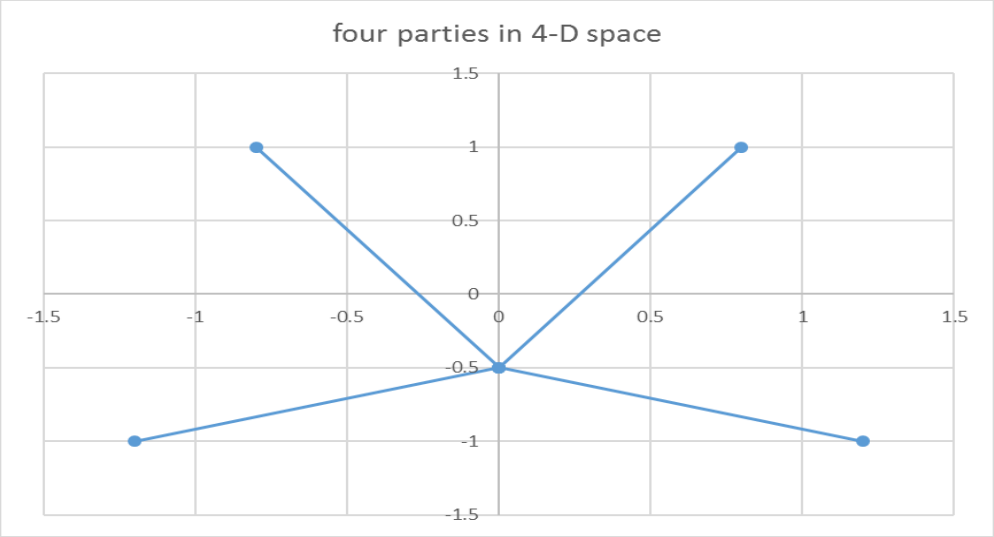
[We can also ask: how does political space relate to geographical space? Just quickly let us note that the political space has a west-east gradient in geographical space.]

I now want to think not just about one dimension but about many dimensions. How should we think of a space which has many dimensions? To answer this question we need to do some geometry. Let me take you rapidly through the following journey, starting with the four main political parties, travelling through 4-dimensional space and ending with a sin curve.

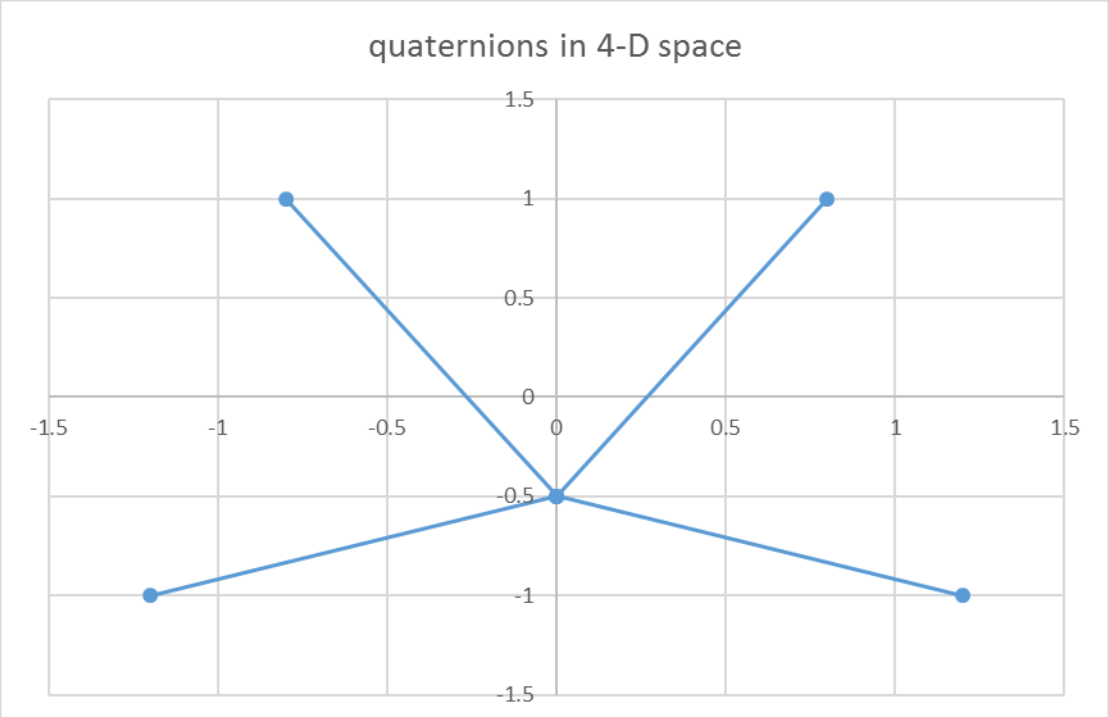
Slide 13 From four main parties to the sin curve

four parties in 4D-space
quaternions in 4D-space
percentage tetrahedron in 4D-space
square bisects tetrahedron (data)
circle in square
tangent square
sin curve (data)

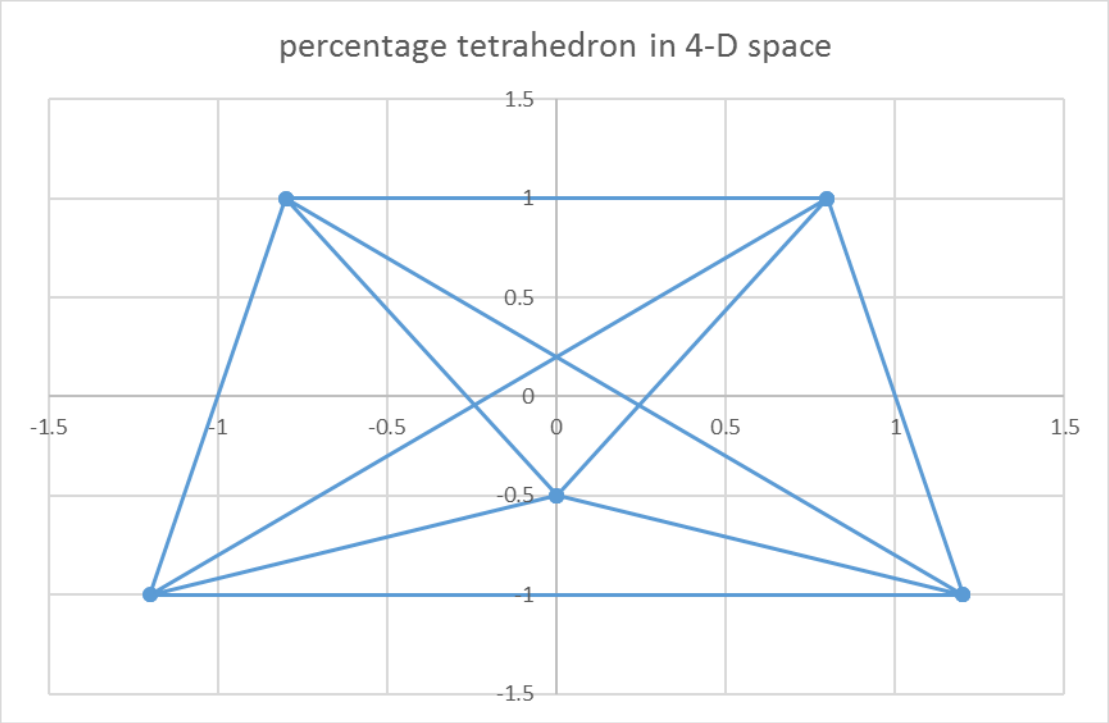
The four main parties in Northern Ireland are DUP, Sinn Fein, SDLP and UUP. We can think of them as pointing in four different directions in 4-dimensional space. Obviously what you are looking at is a 2-dimensional picture. But what it is representing is a 4-dimensional space. It is a truthful presentation in that it is the projection of the 4-dimensional space onto the two-dimensional space. Slide 14:



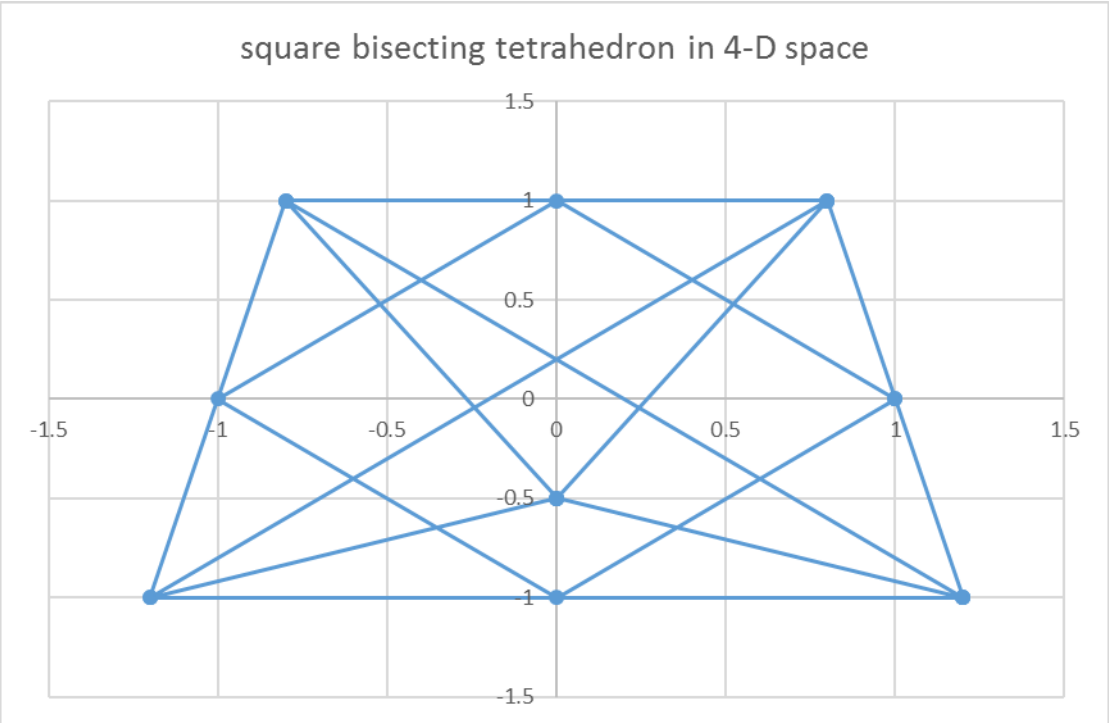
Inspired by Trinity College and William Rowan Hamilton we can think of the directions as corresponding to the quaternions 1, i, j and k. Slide 15:



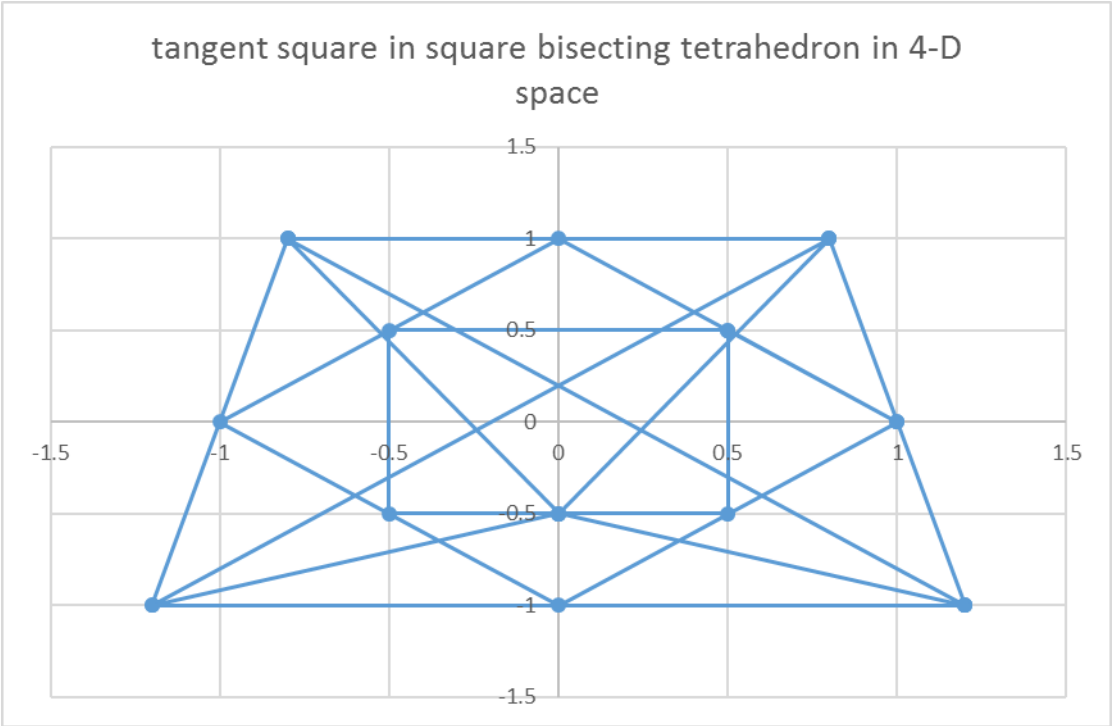
Within this 4-dimensional space there is a 3-dimensional unit tetrahedron with vertices 1, i, j and k. Any point, q=a+bi+cj+dk, on or in tetrahedron is such that a+b+c+d=1. The coefficients can be thought of as weights or percentages and so we can refer to it as the percentage tetrahedron. Slide 16:



Within the tetrahedron there is a square LMNP, the vertices being the midpoints of four of the sides of the tetrahedron. For example, L=(k+1)/2; M=(j+k)/2; N=(i+j)/2; P=(1+i)/2. The square bisects the tetrahedron. Slide 17:



The square has an inscribed circle. The circle meets the square at four tangent points. The four tangent points form the tangent square. Slide 18:



The tetrahedron, the bisecting square, the tangent square and the circle all have the same point as their centre c=(1+i+j+k)/4.

The radius of the circle is 0.25. Any point s on the circle can be expressed as
s =(0.25+0.25cosθ)+(0.25+0.25sinθ)i+(0.25+0.25cosθ)j+(0.25+0.25sinθ)k

The coordinates for 1, i, j and k form a sinusoidal curve as θ goes from 0 to 2π, as θ takes us round the circle.

Well! That completes our journey in 4-dimensional space. We now apply this to the politics.

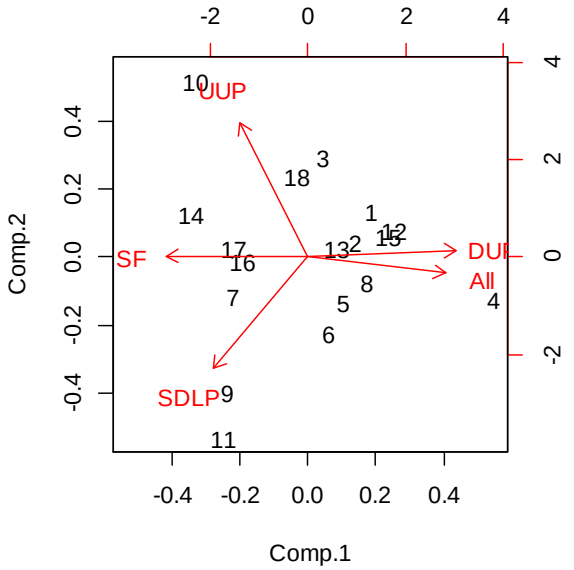
Remember that at the start the four directions were associated with parties in Northern Ireland. So the party percentages should form a sinusoidal curve as θ takes us round the circle.

Slide 19 The percentages for the four parties … a sin curve
The coordinates for 1, i, j and k
(the percentages for the four parties)
form a sinusoidal curve as θ goes from 0 to 2π,
as θ takes us round the circle.

We now see if these theoretical ideas relate to the data. Here are the four main parties as directions in space. (A fifth party, Alliance, is also included). Constituencies are plotted as points in space.

Now recall our hypothesis that constituencies cluster around some average constituency. In the data there is a bit of clustering on the right but otherwise the points are quite scattered. Are they perhaps scattered round the perimeter of a circle? Well, there is some suggestion that they are scattered round the perimeter of a triangle. So we shall just have to make do with that.

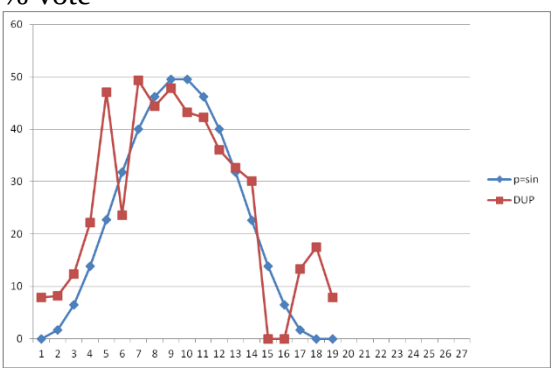
Slide 20 The 4 main parties (+1) and 17 constituencies in political space



If the constituencies had been distributed around a circle then the theory would have predicted that the party percentages round the circle would take a sinusoidal form. They are not round a circle but they are round a triangle. Perhaps that is good enough? And yes it is. The DUP profile is approximately sinusoidal. Sinn Fein's profile is too. The profiles for UUP and SDLP are more spiky.

Slide 21 The DUP profile: approximately sinusoidal

% vote



. constituency n (where θ=2π(n-1)/17)

And that is as far as I have reached in my investigations. I think the results are encouraging. I believe there is something of interest in how constituencies are distributed in political space.

What I have been done in my talk is to apply the mathematics of motion and mathematics of space to the politics of Ireland and the UK. There is much more to be said about this and the mathematics of space and time is one of the major themes in the forthcoming 2015 Yearbook.

Slide 22 Chapters on the mathematics of space and time in the 2015 Yearbook

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7 Social and psychological space - geographical variation
8 Time series: social value, violence and population
9 Nigeria, Greece and Ireland: geography and one-dimensional political space
10 Northern Ireland: multidimensional political space and geography
…
12 Dissatisfied democracy: action, discourse, utility, preference
13 Time series: UK general elections - 2010 to 2015; 1945 to 2015
14 Logic; sets and functions; time and space; mass and value; physics

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Finally let me place this within the overall content of the two Yearbooks and my earlier book on mathematical social science. In many cases there is a very direct correspondence between the chapters in the three books. See Table 1.3.

Slide 23 Correspondence between the chapters in the three books

Topic	CCMSS, 2010	Yearbook 2014	Yearbook 2015
Values	4 to 6	I	I
Guest chapter	-	2	2
Individuals / lit. / psych.	8, 9	2, 3	3, 7
Relationships		4	(3)
Life	13	5	3
‘Our values’	-	6	4
Religion / culture10	2, (6)	5	
World society	8 to 14	II	II
World today	-	7	6
World history	14	8	6
Social	-	-	7
Politics / case studies	4 to 6, 11	9, 10	8 to 13
Economics	12	11	(6)
Gender	-	12	(4)
Sport	-	13	-
Modelling	2-5, 7, 15	14	14
Space			7, 9, 10, 12, 14
Time			8, 13, 14

References

Attis, David. (2014) *Mathematics and the Making of Modern Ireland*!
Trinity College Dublin from Cromwell to the Celtic Tiger. Boston: Docent Press.

Burt, Gordon. (2010) *Conflict, Complexity and Mathematical Social Science*. Bingley: Emerald.
http://bookshop.blackwell.co.uk/jsp/welcome.jsp?action=search&type=isbn&term=1849509727

Burt, Gordon. (2016a) *Values, World Society and Modelling Yearbook, 2014*. Cambridge Scholars.
http://www.cambridgescholars.com/values-world-society-and-modelling-yearbook-2014

Burt, Gordon. (2016b) *Values, World Society and Modelling Yearbook, 2014*. Cambridge Scholars.
In preparation. An overview is provided on pages 5 to 19 in Chapter 1 – see link below. This also provides links to the issues of the *Commentary* in 2015 on which each chapter is based.
https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxnb3Jkb25idXJ0bWF0aHNvY3NjaXxneDo2ZmMxNDU3MGQ5ZGNlZWQ2