The Actuarial Profession
making financial sense of the future

Emerging Trends in Longevity and Mortality
Greg Becker and Garth Lane

From fast food to fast runners: changing mix, clouding conclusions

September 2011

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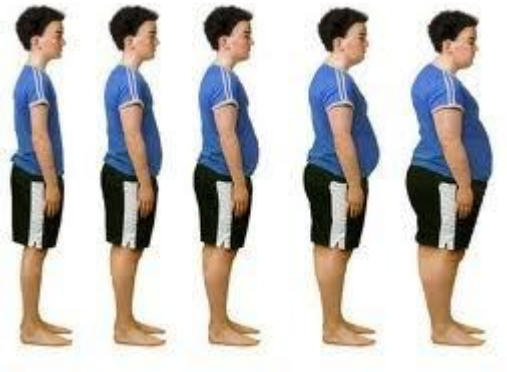
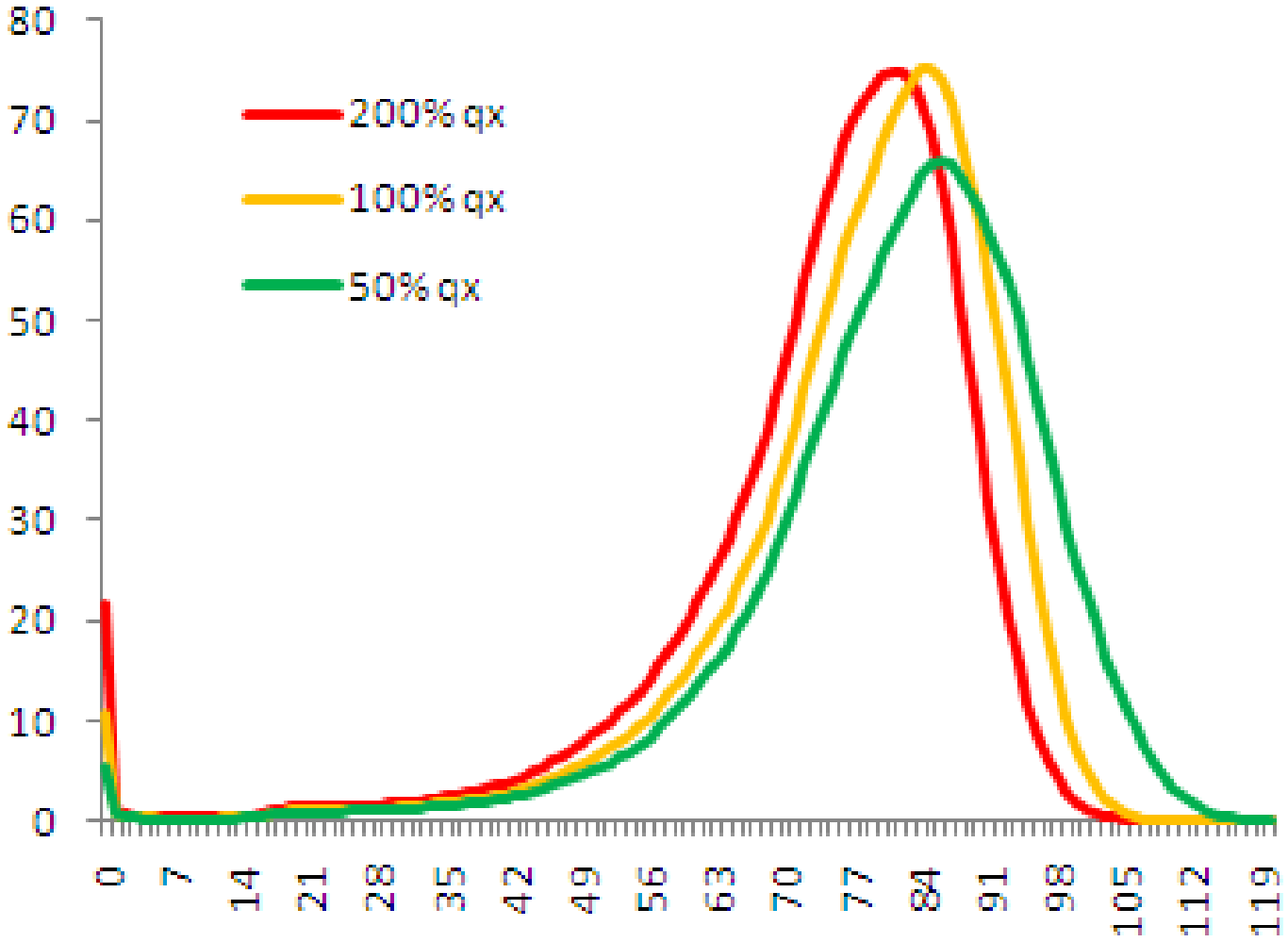
Agenda

1. Longevity Models
2. Heterogeneity (model risk)
   - Generational Heterogeneity
   - Heterogeneity in sub-Populations
3. Predicting the future
   - Cohorts
   - Causal Effects
4. Conclusions



Graph illustrating Longevity and distribution



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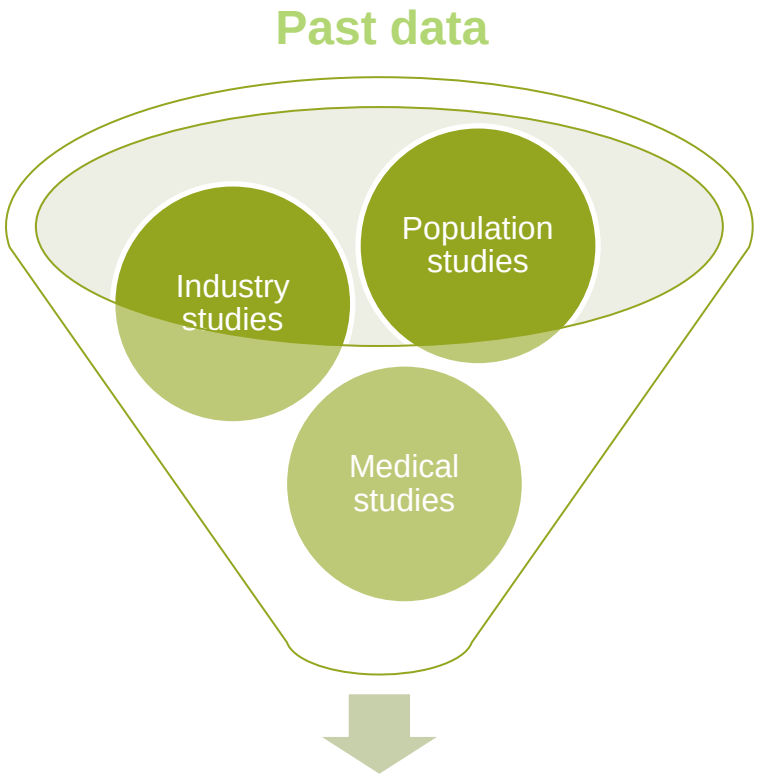
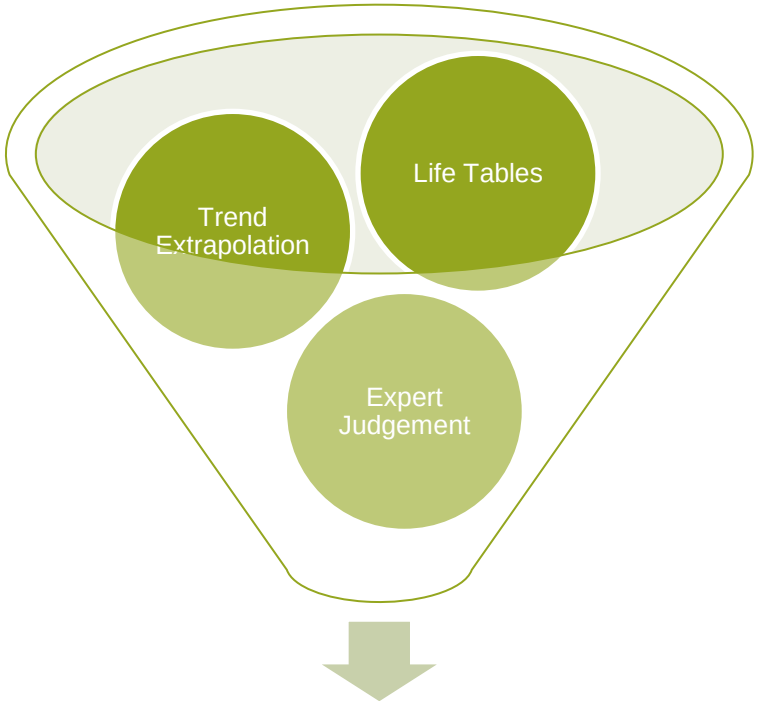
We need models: Otherwise how do we estimate life expectancy improvements?



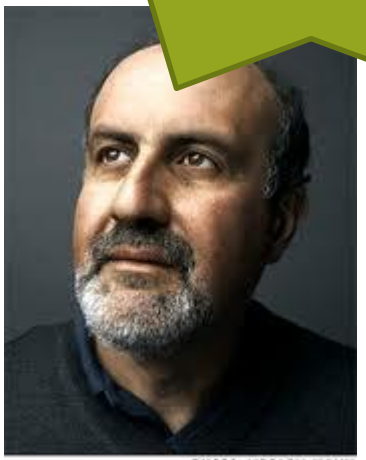
Life tables

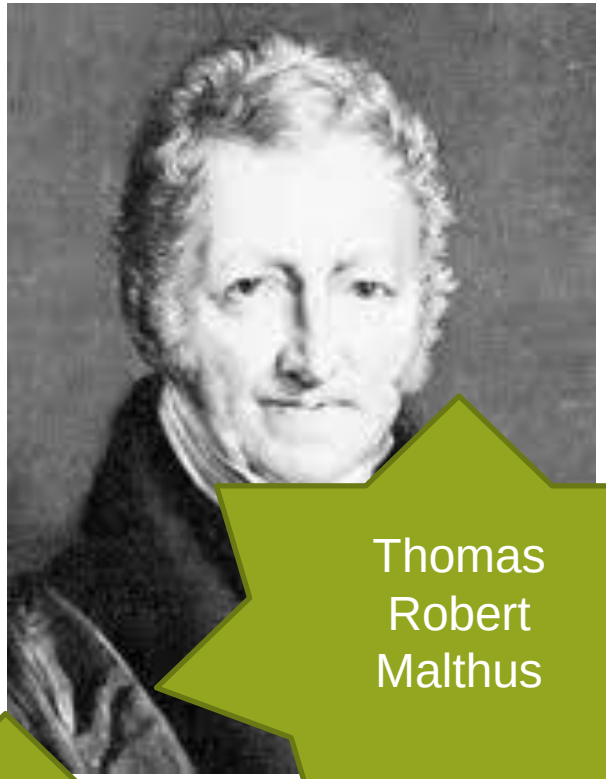


Future life tables

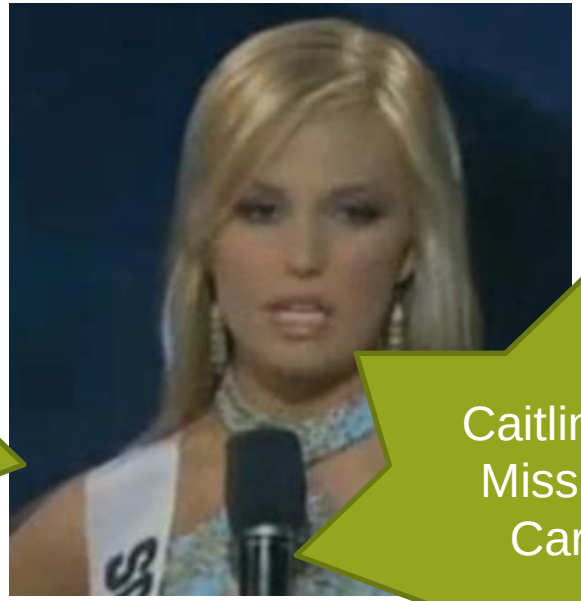
Who's who?

Nassim Taleb





Thomas Robert Malthus



Aubrey De Grey

Caitlin Upton Miss South Carolina

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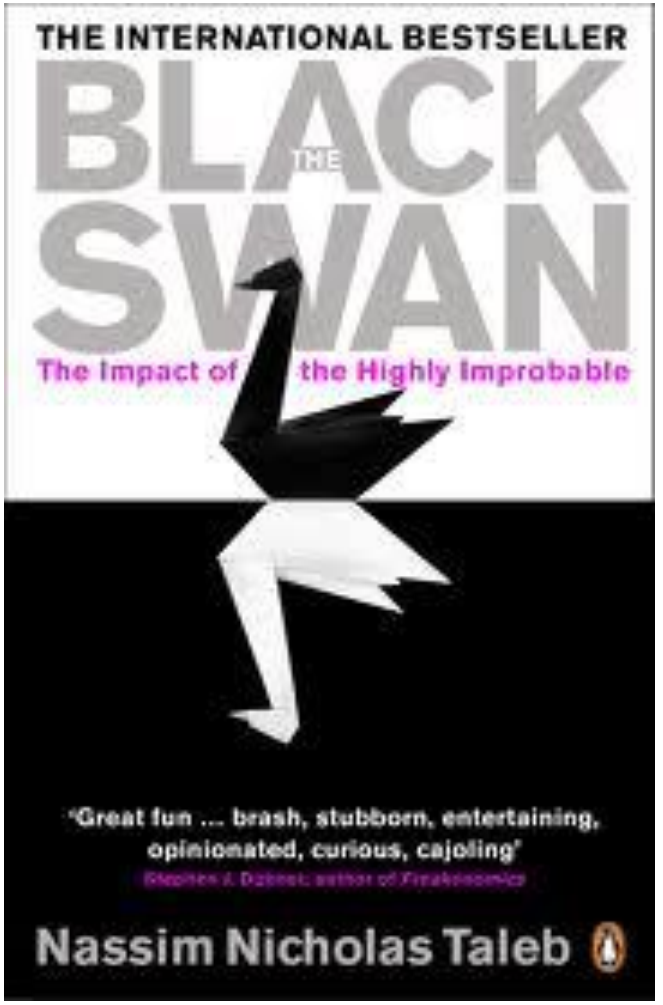
http://www.youtube.com/watch?v=jJrwuGXz_Ak

Black Swans – another name for model risk?



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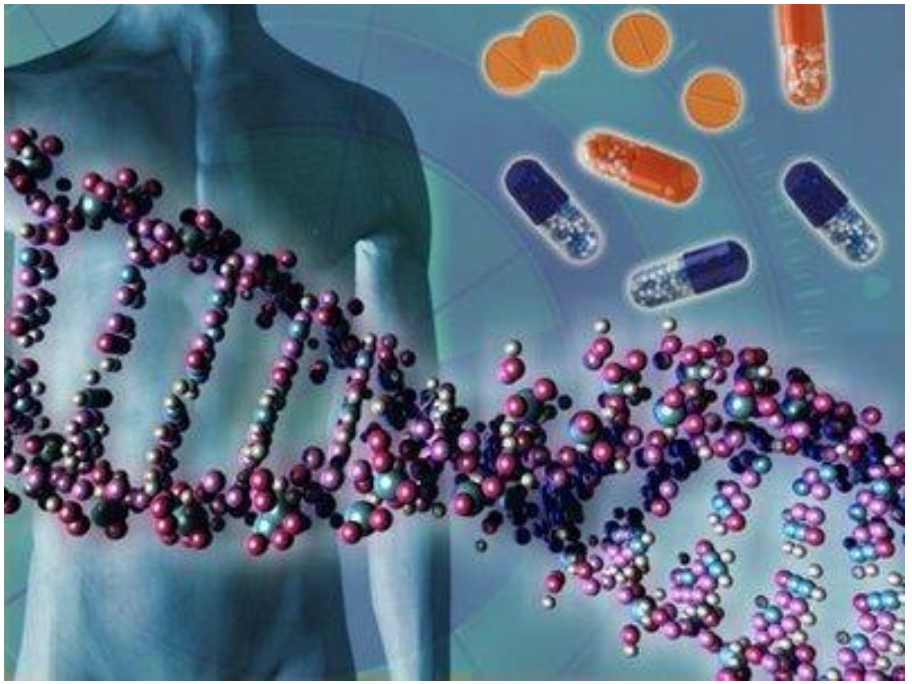
AIDS

Genomics



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http://www.esquire.com/the-side/feature/famous-world-explorers-072709

What do we '*know*'?

1. Measured expectations of life are increasing
2. This measure is improving faster for certain ages than others and differs between males and females
3. Certain cohorts seem to have faster improvement rates – the so-called 'golden generations'
4. Everybody dies

It ain't what you know that hurts you but what you do know that ain't so

Systems Theory Paradigm

Donald Rumsfeld on Longevity

- There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we know we don't know. But there are also unknown unknowns. There are things we don't know we don't know.
- "I would not say that the future is necessarily less predictable than the past. I think the past was not predictable when it started."

"We do know of certain knowledge that you will either be alive a long time, alive a short time or you will be dead."

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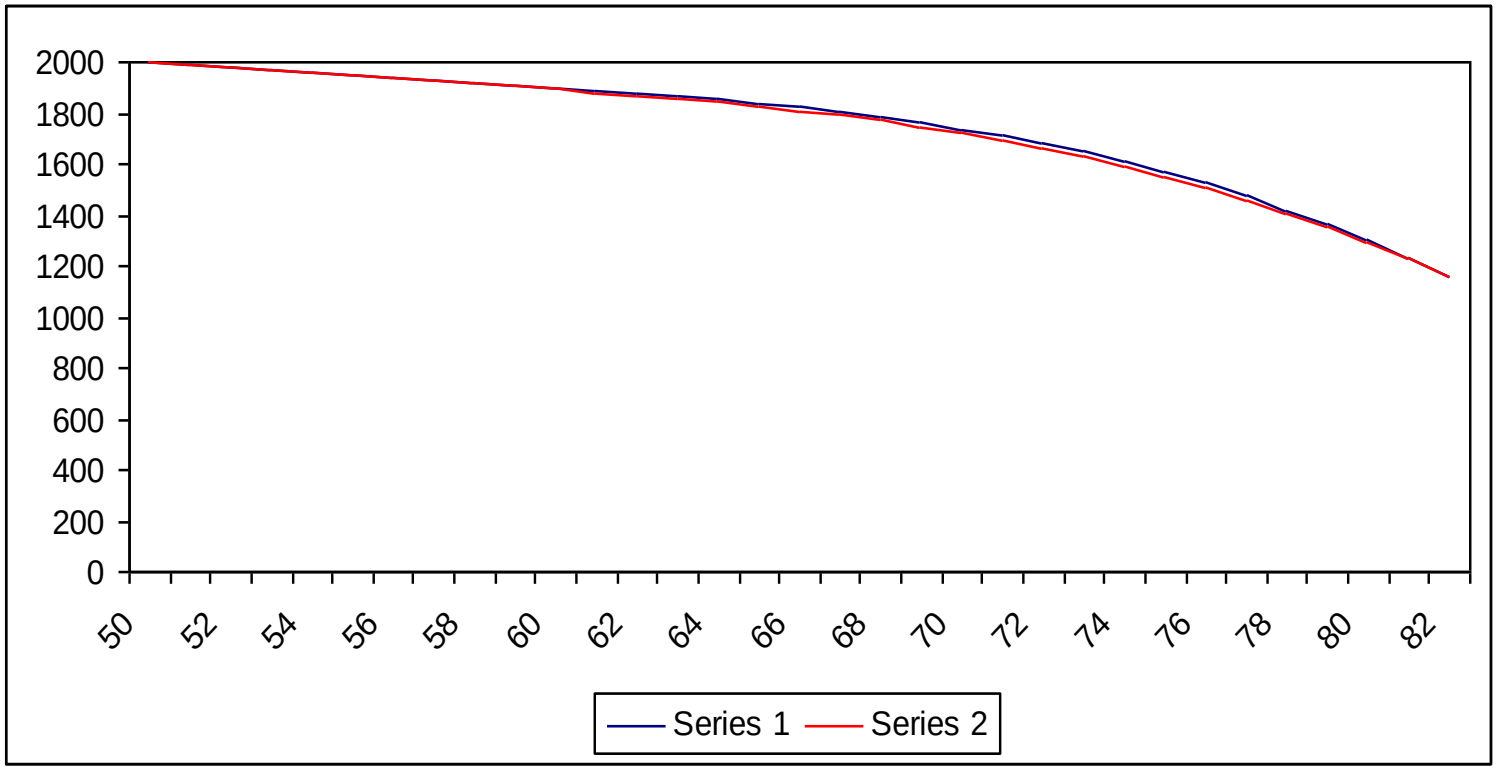
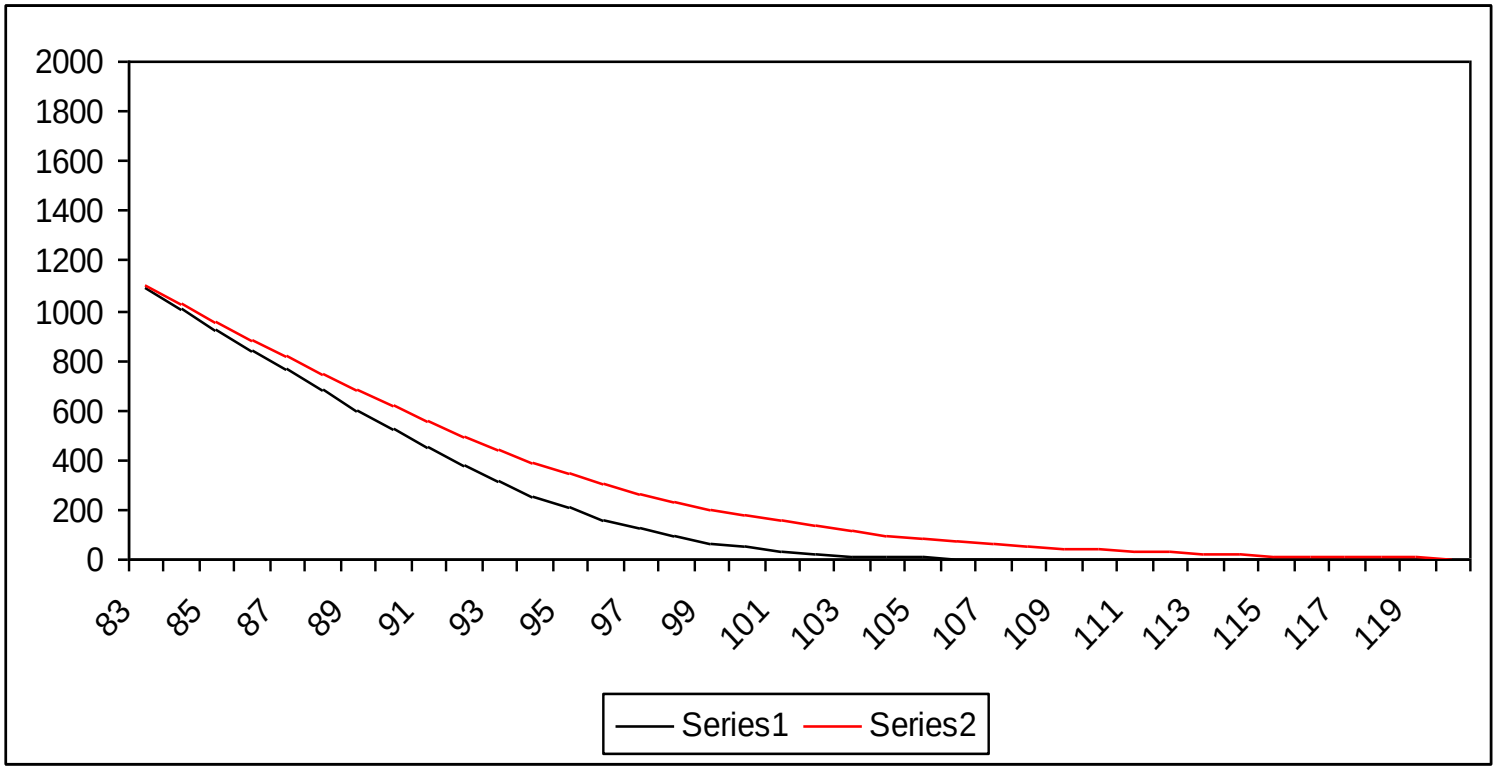
http://www.brainyquote.com/quotes/quotes/d/donaldrums148142.html http://politicalhumor.about.com/cs/quotethis/a/rumsfeldquotes.htm

Heterogeneity – A model breaker?



Curves look the same?

Heterogeneity – A model Breaker



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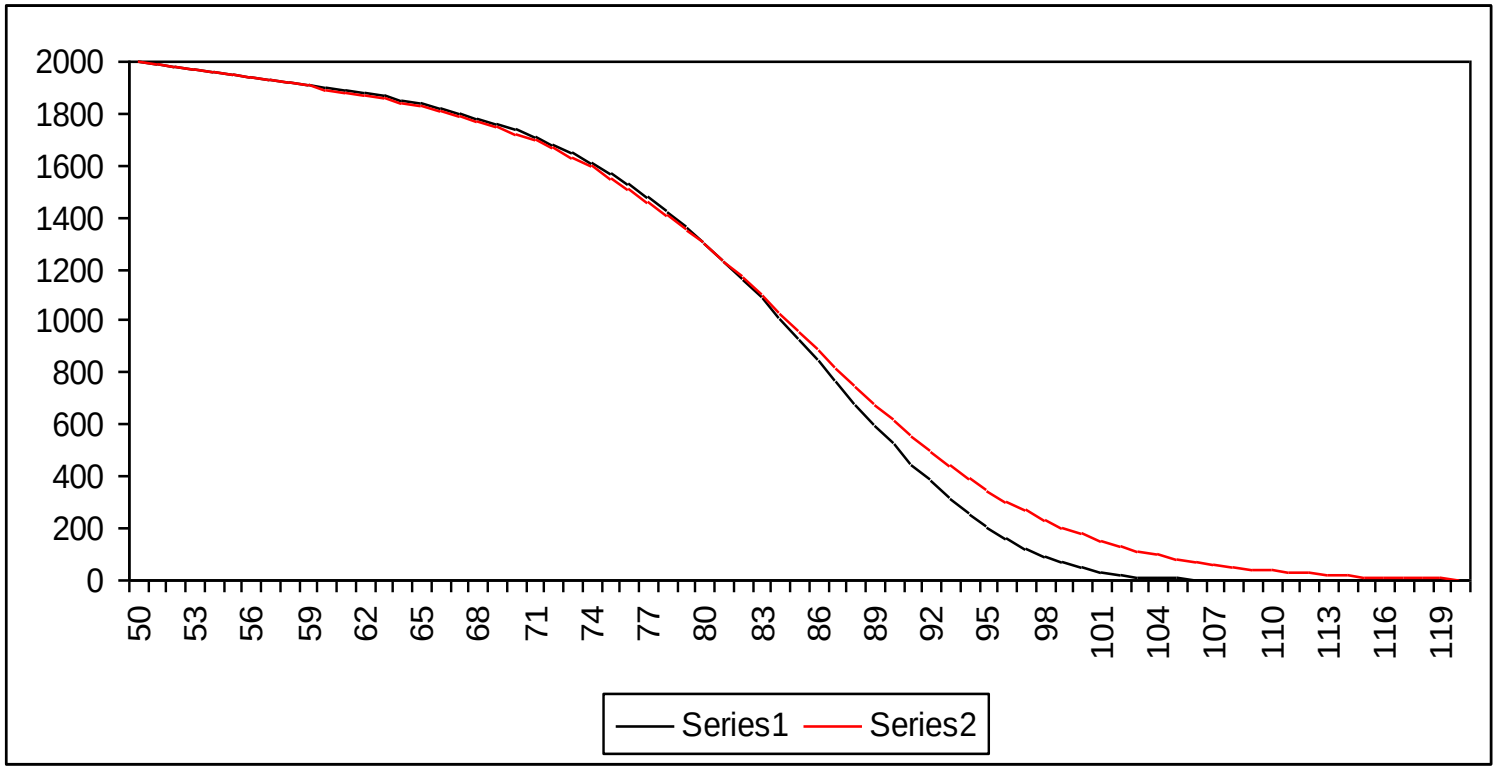
Heterogeneity - a Model Breaker

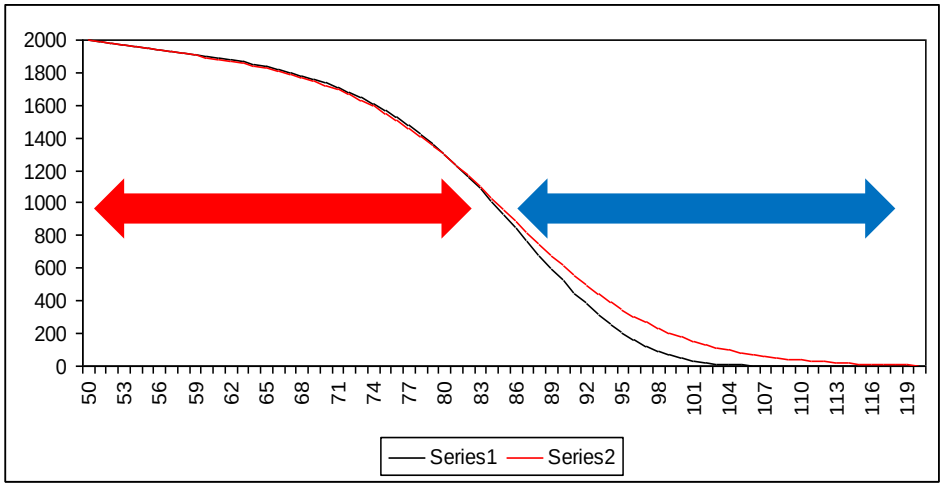


The two graphs are different time periods for the same two series

What is the difference between Series 1 and Series 2?

- Each series reflects the survival of 2000 lives from age 50
- Series 1 assumes that everyone has the same qx profile
- Series 2 assumes that there are 3 kinds of people
  - Some with standard qx mortality
  - Some with higher mortality and
  - Some with lower mortality

After 30 years, one would not have the data to separate the models and identify which is most accurate!



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Fast Food and Fast Runners

- Metaphors
  - Heterogeneity within sub populations
  - Healthy and non-Healthy lives
  - Differential Attitudes towards Health Consciousness
  - Relative ability to select against people placing bets on longevity
  - ‘Golden’ cohorts vs ‘Normal’ cohorts
- We need to distinguish between what we know and what we assume we know!

Generational Heterogeneity

- Can be anomalous
  - Early period record keeping
  - Misclassification of cause of death
- Key Generational analysis – so called cohort analysis
  - Aggregate population analysis
  - P-Spline
  - Heatmaps
  - Postcode differentiation (socio economic proxy)
  - Stochastic projections

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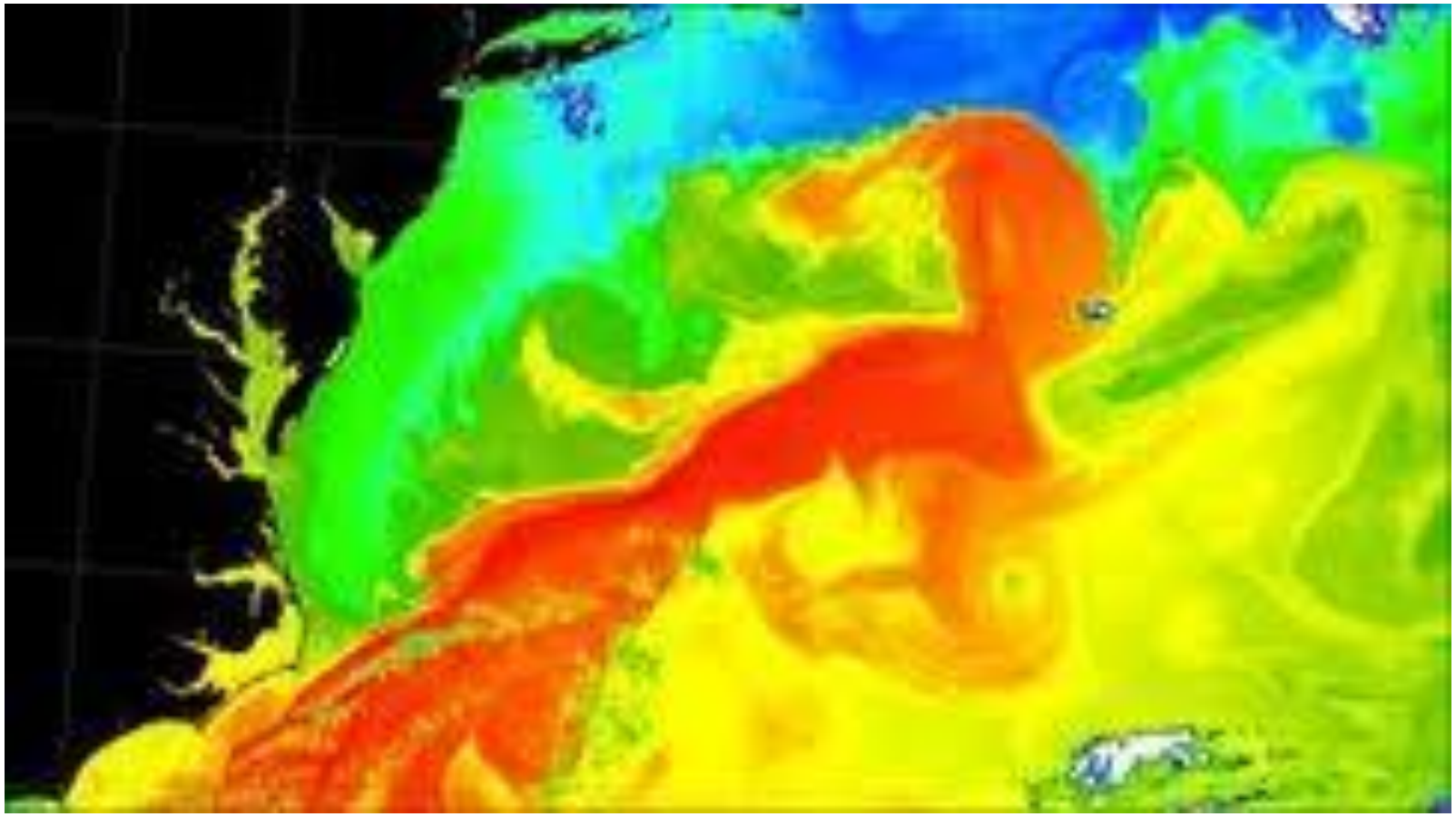
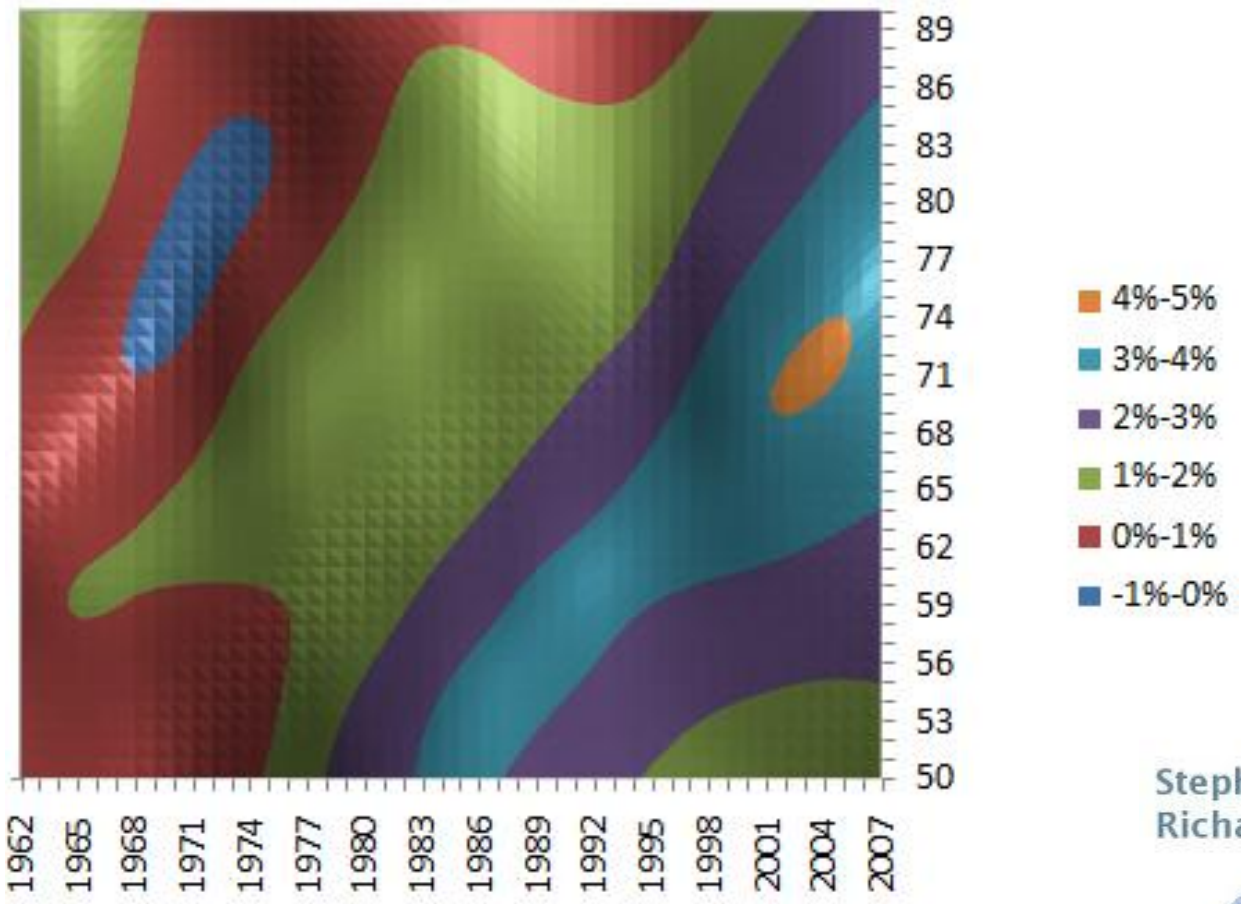
Generational Heterogeneity: Heatmaps



Cohort effect it is not

This is the gulf stream off the coast of Europe

Real Heatmap?



Improvement heatmap for males in England & Wales.

Source: Own calculations using smooth 2D age-period *P*-spline model applied to ONS data for males in England and Wales, 1961–2007. (Richards S www.longevitas.co.uk)

Generational Heterogeneity: Willets 2003

Furthermore, an analysis of patterns of cigarette smoking suggests that there is a degree of inevitability in some element of likely future improvement, especially for mortality at older ages from conditions strongly linked to smoking

There are a number of reasons to believe that the cohort effect will have an enduring impact on rates of mortality improvement in the U.K. in future decades”

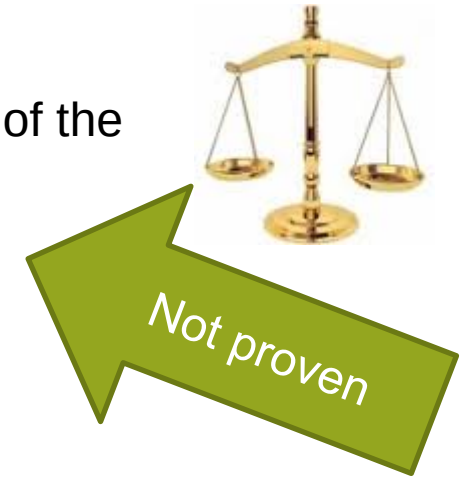
Generational Heterogeneity: Murphy 2009

As exploratory techniques, graphical and statistical modelling methods may suggest the existence of cohort patterns (or indeed period ones, although a review of the literature suggests that this is rarely if ever done, since the overwhelming interest is in establishing cohort effects), but they do not elucidate the underlying causes.

Generational Heterogeneity: Murphy 2009

"In an authoritative consensus view of this area, the British National Statistician (Dunnell, 2008, p19) accepts the existence The 'Golden Generations' of the 'golden generations', but concludes that there are still only a series of explanatory hypotheses that include:

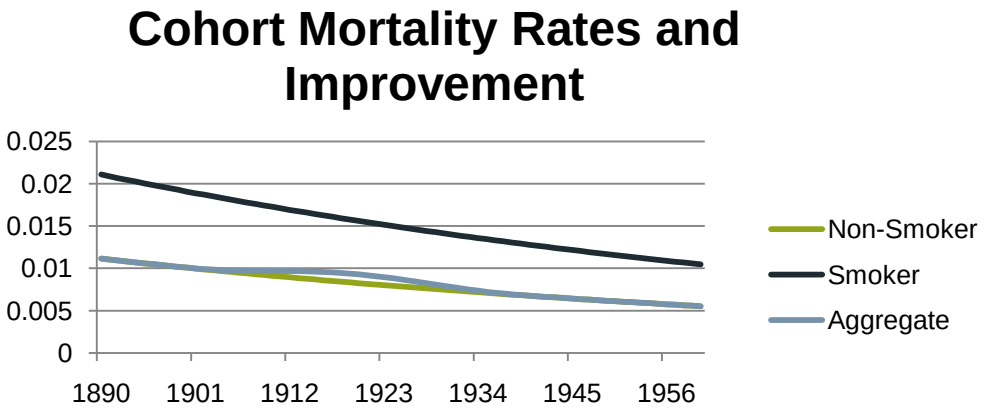
1. Changing smoking patterns between generations
2. Better diet and environmental conditions during and after the Second World War
3. Those born in periods of low fertility facing less competition for resources as they age
4. Benefits from the introduction in the late 1940s of the Welfare State
5. Benefits from medical advances.."

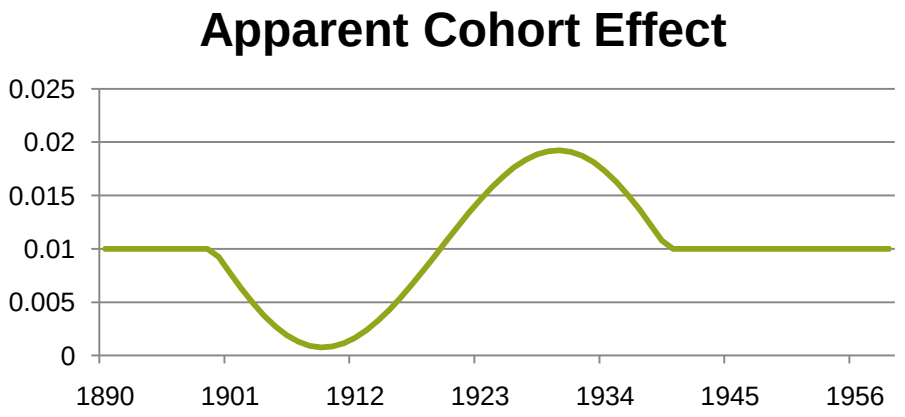


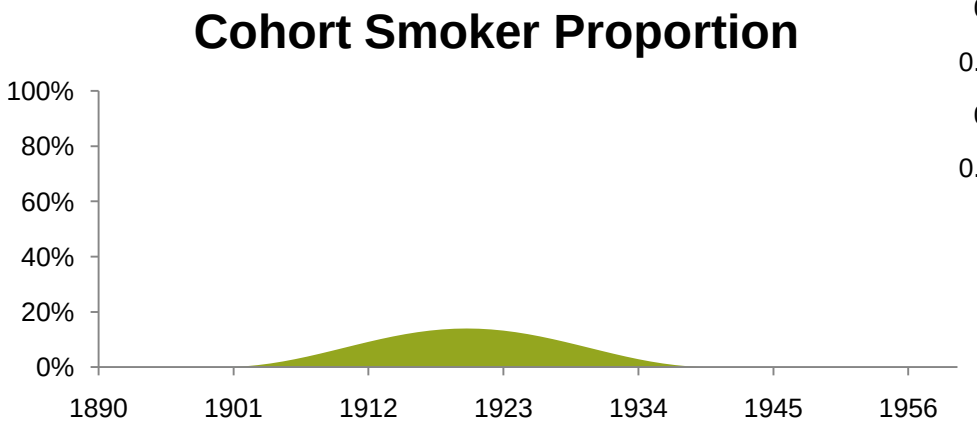
Generational Heterogeneity: Murphy 2009

"The analysis presented here suggests that the evidence for the existence of cohort effects based on an analysis of simple mortality tables using increasingly sophisticated computational techniques has sometimes been over-interpreted, and that there has been a lack of attention to the underlying mechanisms. If the changes are driven by some as yet unidentified series of events that occurred many decades ago, it is unclear whether such effects will continue until the highest ages"

Generational Heterogeneity: Murphy 2009





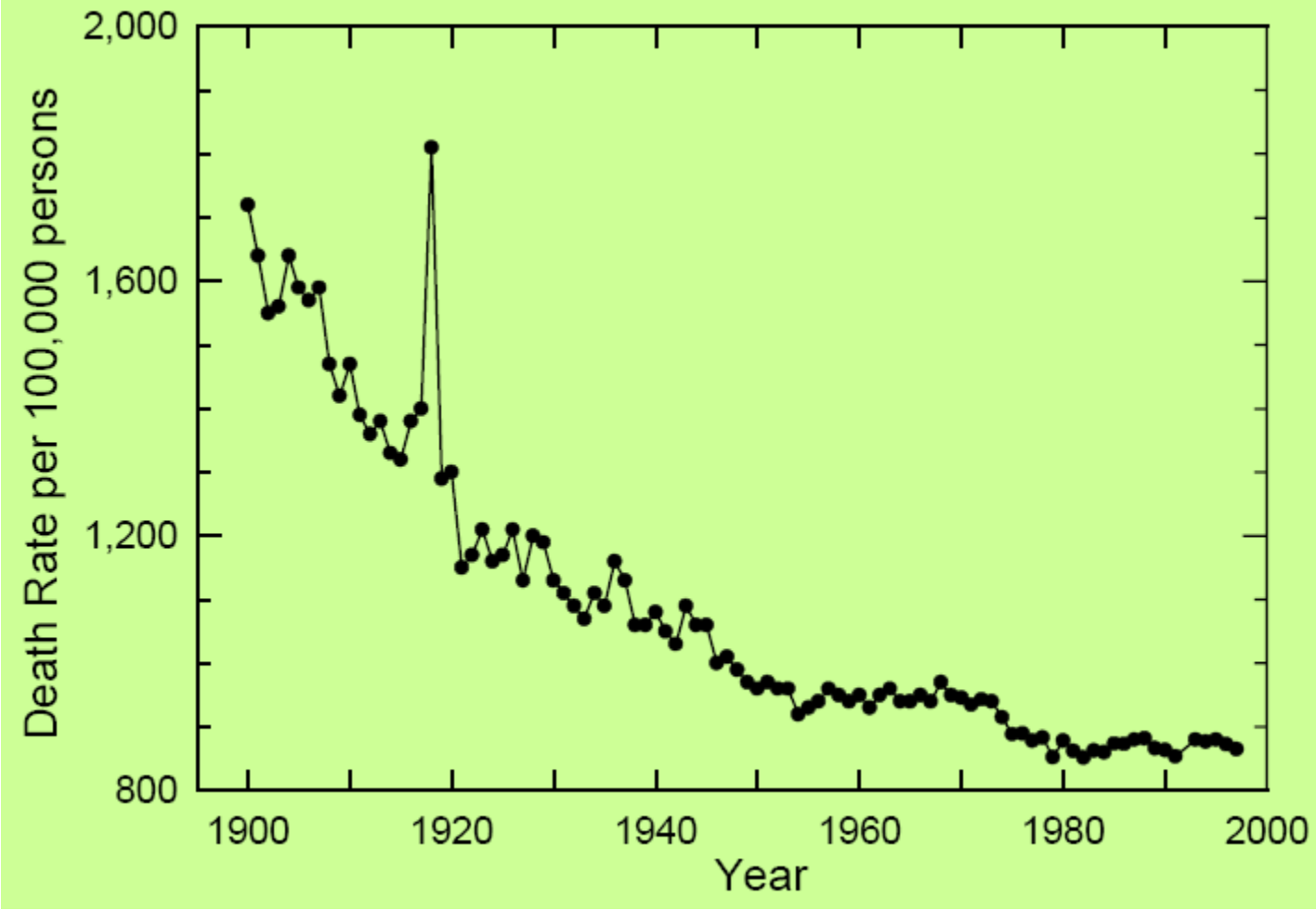


Generational Heterogeneity: Medical Advances

- In 2001 Ausubel, Meyer and Wernick examined US mortality since 1900
- Fitted logistic curves to underlying causes of mortality
- Used a competing risks model
- Examined problems with data carefully and identified areas of bias
- No age adjustment

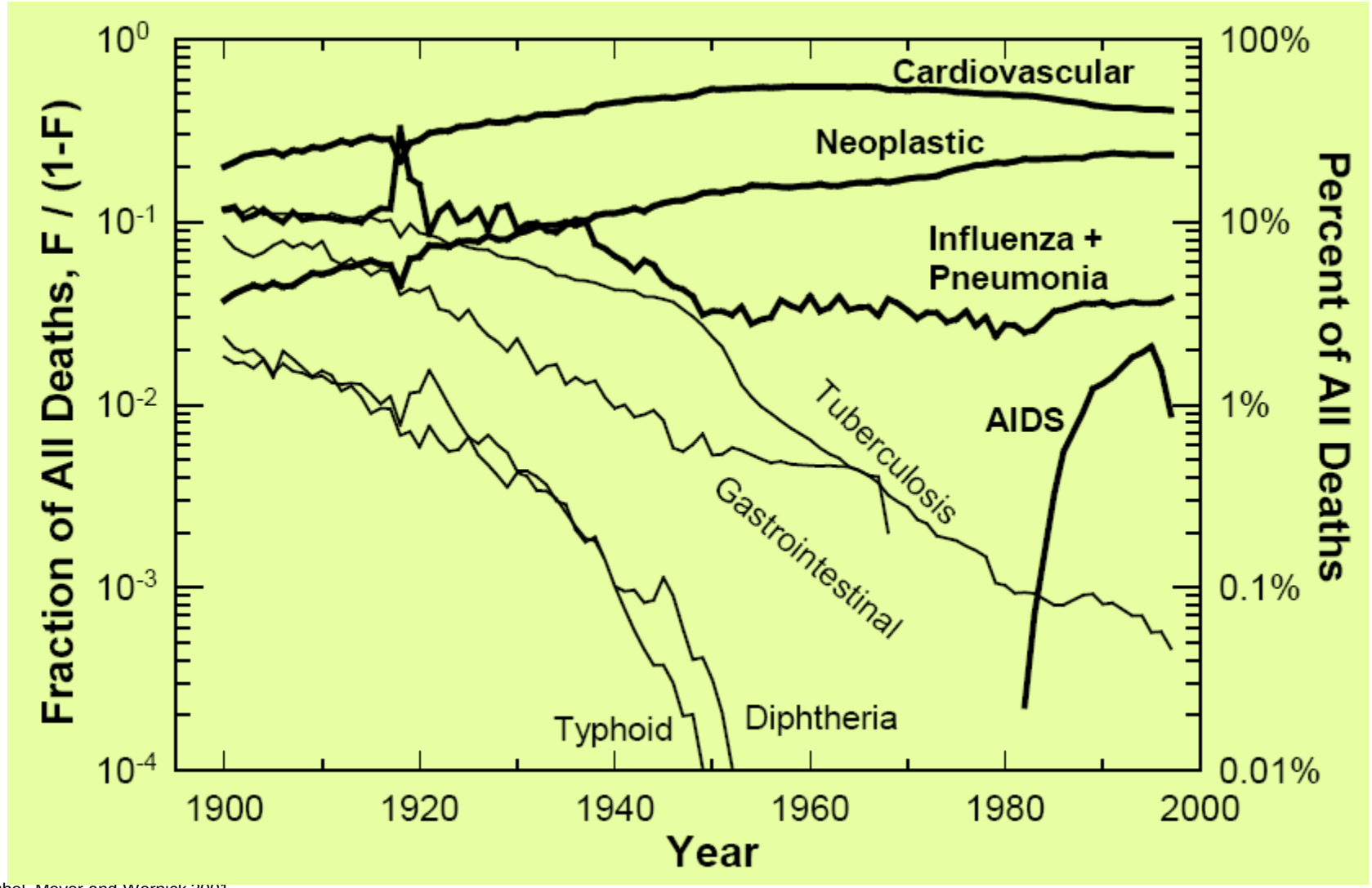
Death and the Human Environment: The United States in the 20th Century
Jesse H. Ausubel
Perrin S. Meyer
Iddo K. Wernick

Generational Heterogeneity: Medical Advances



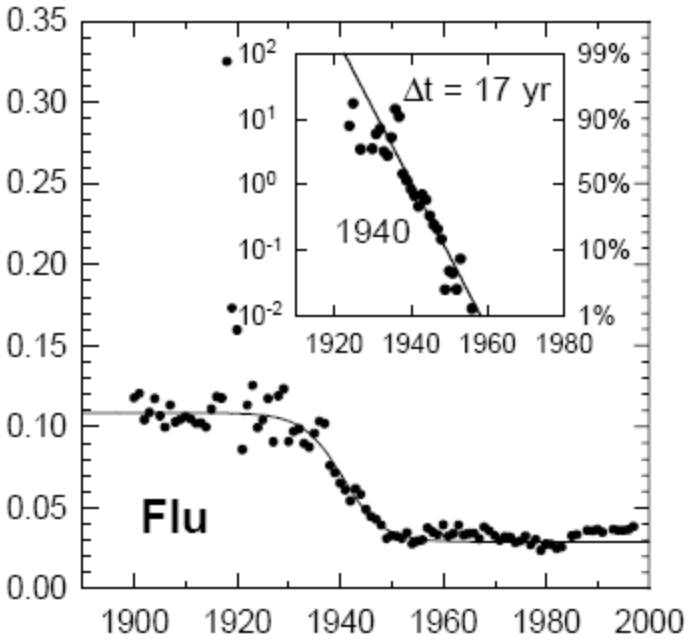
Ausubel, Meyer and Wernick 2001

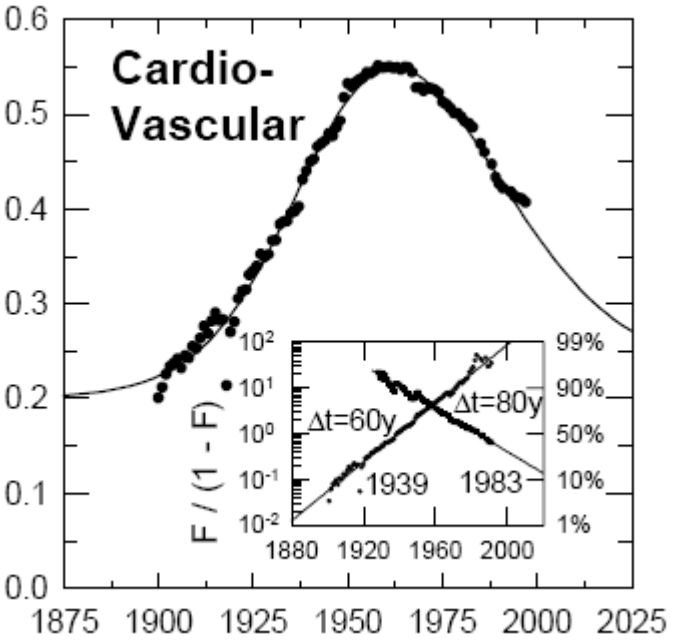
Generational Heterogeneity: Medical Advances



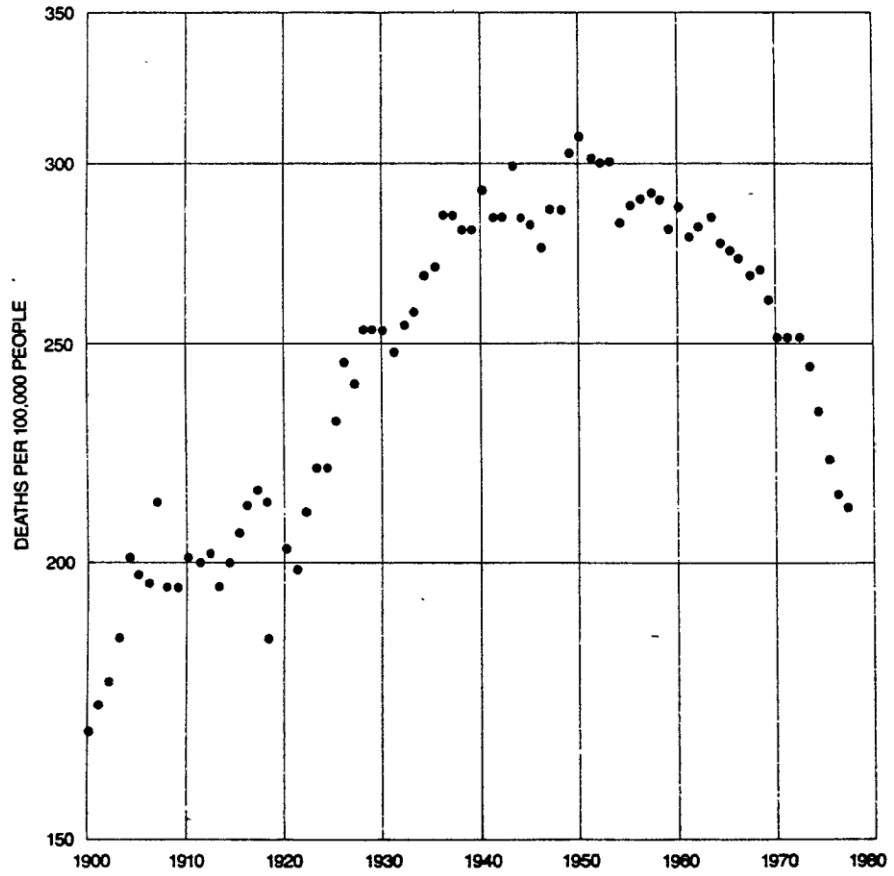
Ausubel, Meyer and Wernick 2001

Generational Heterogeneity: Medical Advances





Generational Heterogeneity: Rise and fall of Ischaemic Heart Disease in the US



Stallones: Scientific American 1980

Age adjusted to 1940 census

Log scale on vertical axis

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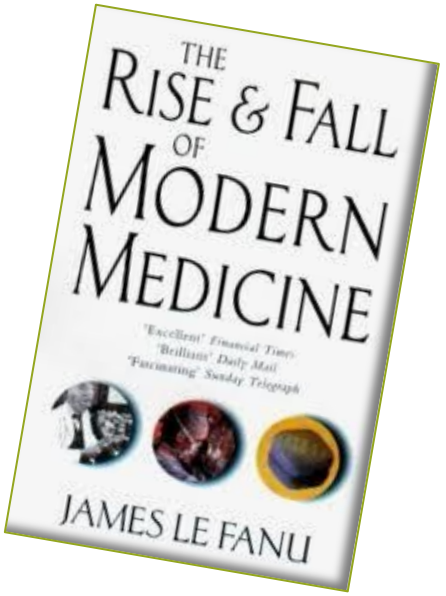
Medical Advances or an Epidemic of Heart Disease?

- Caused by inflammation in a generation affected by the Spanish flu that took decades to work its way through?
- A period effect as illustrated by Murphy?
- Can we venture that there is no golden generation, merely a diseased generation returning to health?
- Did antibiotics help?
- James Le Fanu claimed this was an epidemic in his book “The rise and fall of Modern Medicine”



Medical Advances or an Epidemic of Heart Disease?

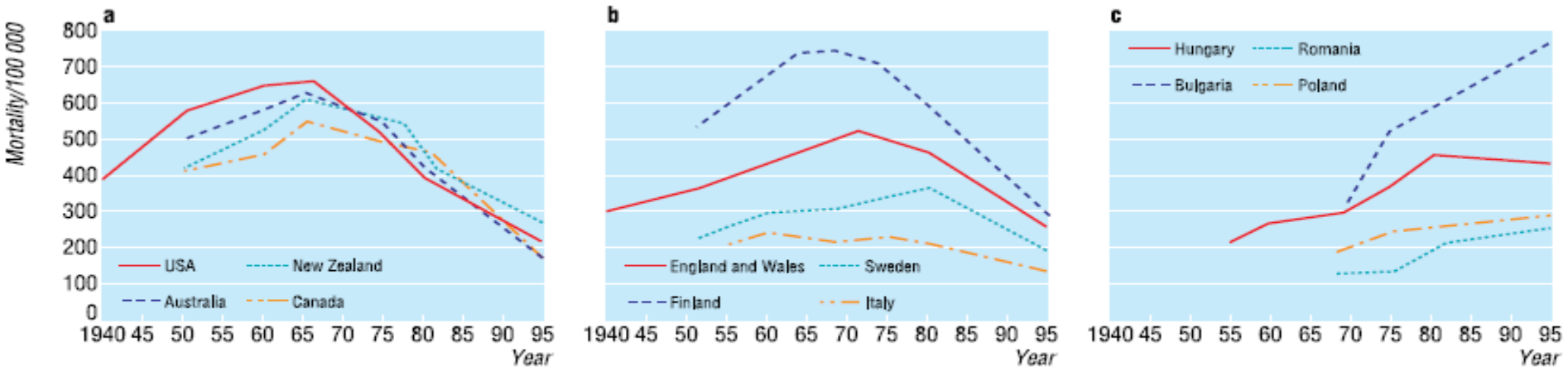


Fig 1 Mortality from coronary heart disease (per 100 000) in men aged 45-64 in (a) the United States, Canada, Australia, and New Zealand; (b) western European countries; and (c) eastern European countries

BMJ 2002

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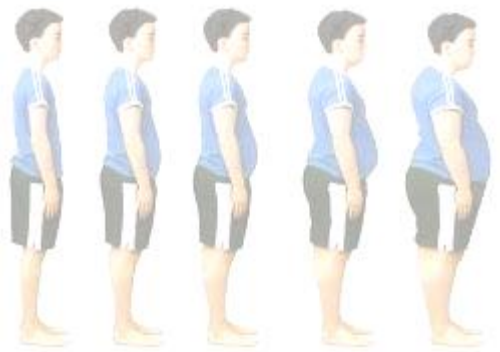
Sub-population Heterogeneity

- Fast-food eaters and fast runner in the literal sense
- Active inclusion in the sub-population versus passive inclusion
- Movement between groups
- Long term health effects or benefits
- Clouded by presence of ‘knowledge’ that ain’t so
- Counterintuitive outcomes



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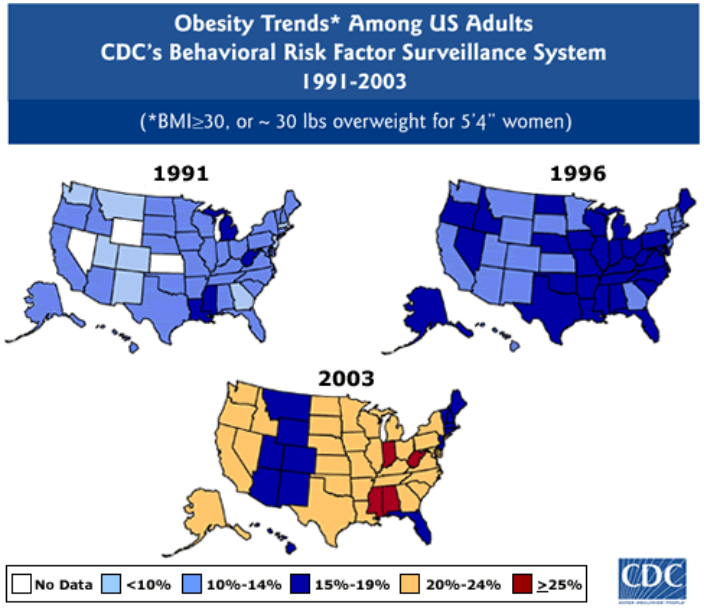
Woody Allen on Health
clip from Sleeper

Not just an American problem...

Rank	Countries	Amount (top to bottom)
#1	United States:	30.6%
#2	Mexico:	24.2%
#3	United Kingdom:	23%
#4	Slovakia:	22.4%
#5	Greece:	21.9%
#6	Australia:	21.7%
#7	New Zealand:	20.9%
#8	Hungary:	18.8%
#9	Luxembourg:	18.4%
#10	Czech Republic:	14.8%
#11	Canada:	14.3%
#12	Spain:	13.1%
#13	Ireland:	13%
#14	Germany:	12.9%
#15	Portugal:	12.8%
#16	Finland:	12.8%
#17	Iceland:	12.4%
#18	Turkey:	12%
#19	Belgium:	11.7%
#20	Netherlands:	10%
#21	Sweden:	9.7%
#22	Denmark:	9.5%
#23	France:	9.4%
#24	Austria:	9.1%
#25	Italy:	8.5%



http://lamarguerite.wordpress.com/2008/07/04/can-americans-downsize/ http://www.getamericafit.org/statistics-obesity-in-america.html

Sub-population heterogeneity: Fast Food Eaters

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89 Share

24 February 2011 Last updated at 10:45

Hospital obesity admissions increase by 30% in a year

The number of people admitted to hospital in England for obesity-related reasons rose by more than 30% last year.

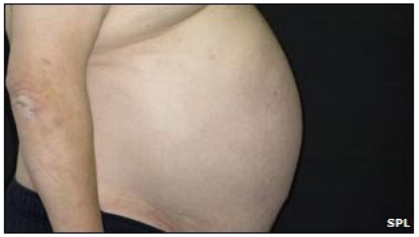
But NHS statistics also show the increase in obesity rates in adults seen in recent years may be flattening out.

Experts believe it is too early to say if rates of obesity are now decreasing.

The health watchdog NICE recently advised that more cases of serious obesity should be treated in hospital.

There has also been a change in the way hospital procedures are recorded, meaning more obesity-related operations make their way into the statistics.

The number of weight-loss hospital procedures (bariatric operations) carried out in England rose by 70%, from just over 4,200 in 2008/09 to just over 7,200 in 2009/10.



Experts say more cases of obesity should be treated

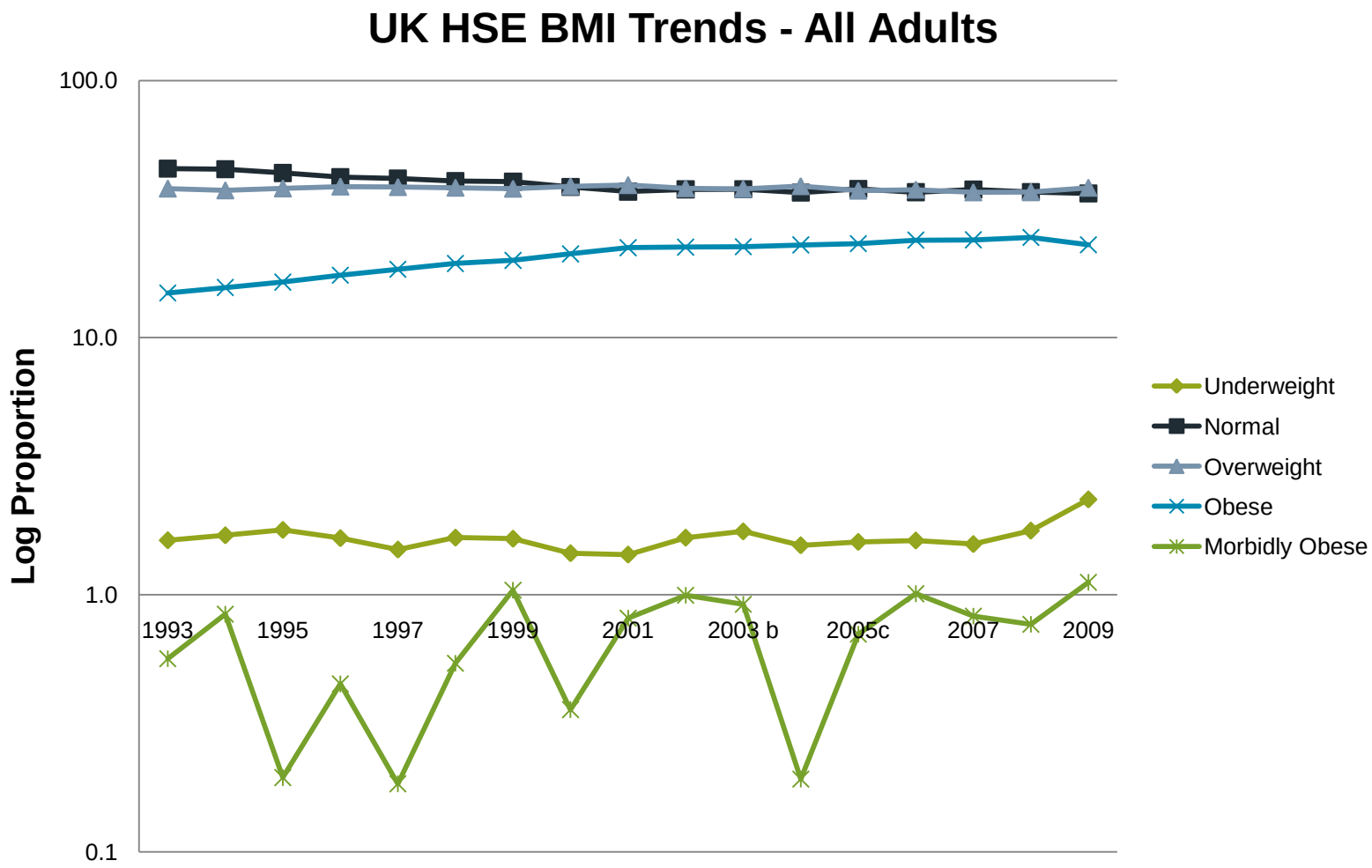
Related Stories

How obesity is reshaping our world

Patients 'too fat for ambulances'

http://www.bbc.co.uk/news/health-12566504

Sub-population heterogeneity: Fast Food Eaters



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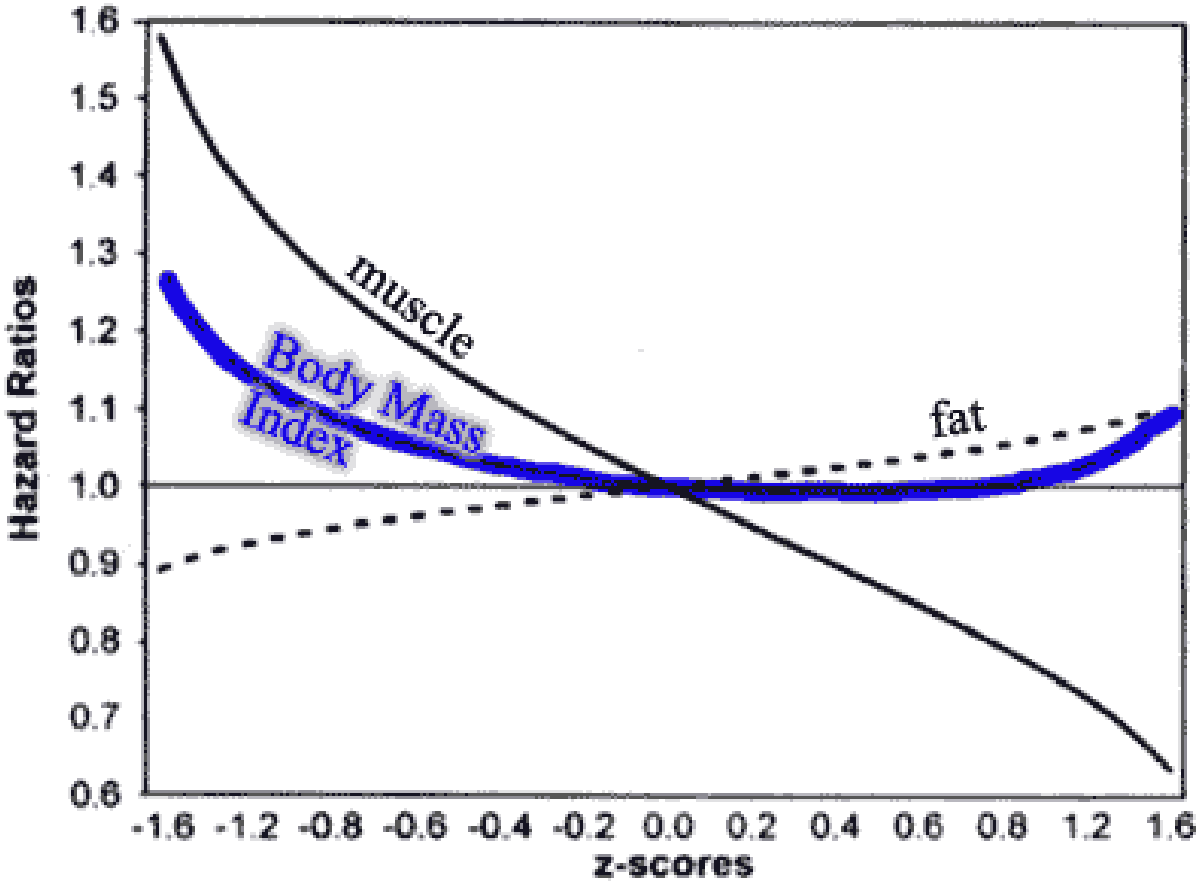
Obesity all Bad ?



National Health and Nutrition Examination Surveys (NHANES I and NHANES II) follow-up studies

Hazard Ratio for all cause mortality

Lowest Hazard at BMI of 27.5!

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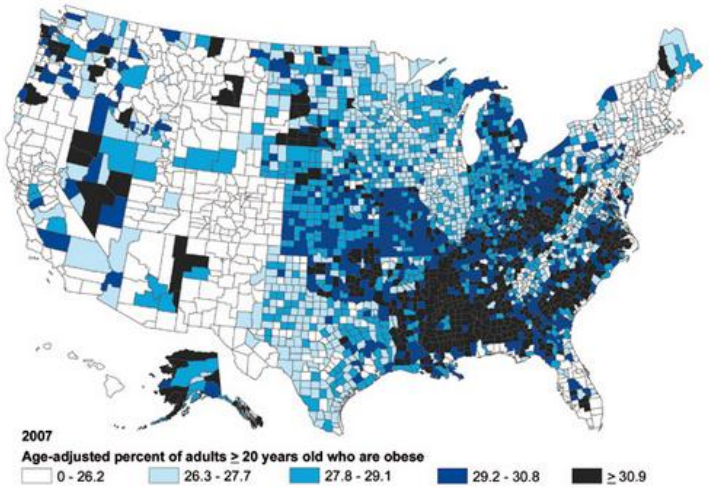
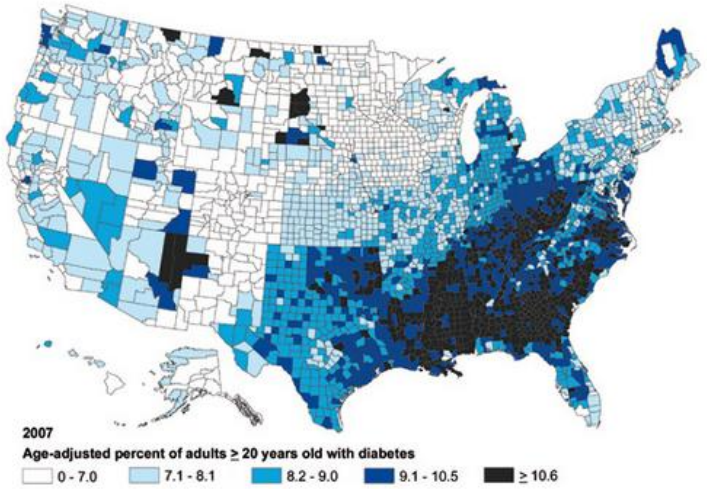
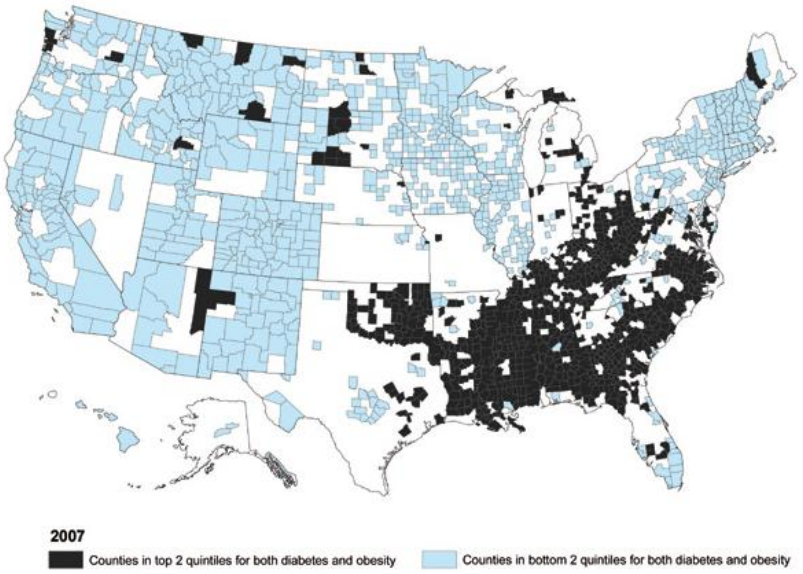
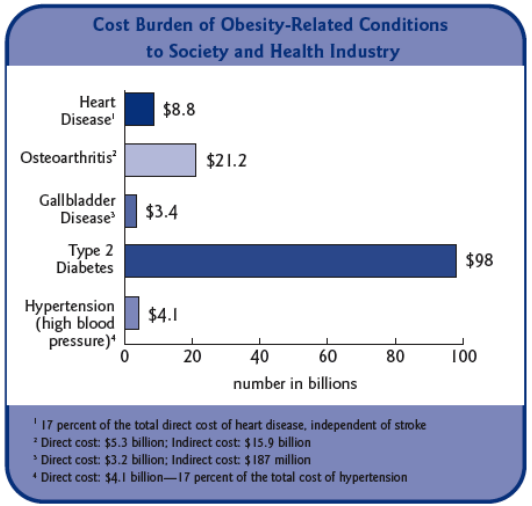
Diabetes and obesity – a link?







References: National Institute of Diabetes & Digestive & Kidney Diseases (NIDDK),WebMD.com, Center for Disease Control.



http://www.getamericafit.org/statistics-obesity-in-america.html

Sub-population heterogeneity: Fast Runners

- The picture of health?
- Will this convert into longevity?
- Will extreme exercise stress reduce age spans

Sub-population heterogeneity: Fast Runners

- Long distance runners and skiers lived longer than reference cohorts(LE= 2.8–5.7 years longer; OR=0.59)
- ice-hockey and basket-ball players track and field jumpers, short and middle-distance runners and hurdlers survived longer than reference cohorts (LE = 4.0 years longer; SMR= 0.68)
- Not so good for footballers and power-lifters and abusers of steroids and other supplements
- The big question is whether these elite athletes have been selected essentially through their genetic fitness for these activities?

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Fast Runners – Calorific Restriction

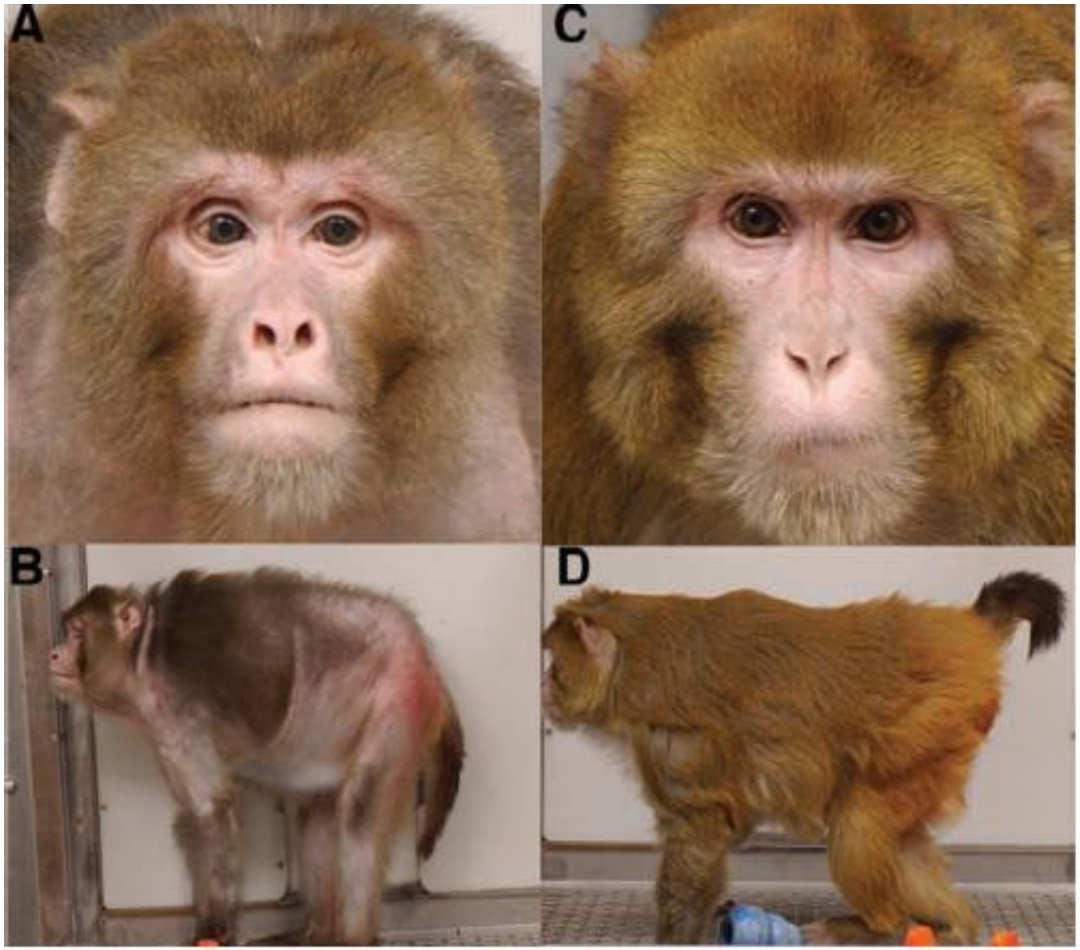

Fig. 1. Animal appearance in old age. (**A** and **B**) Photographs of a typical control animal at 27.6 years of age (about the average life span). (**C** and **D**) Photographs of an age-matched animal on CR.

- Works for rats
- Works for monkeys
- Will it work for you?

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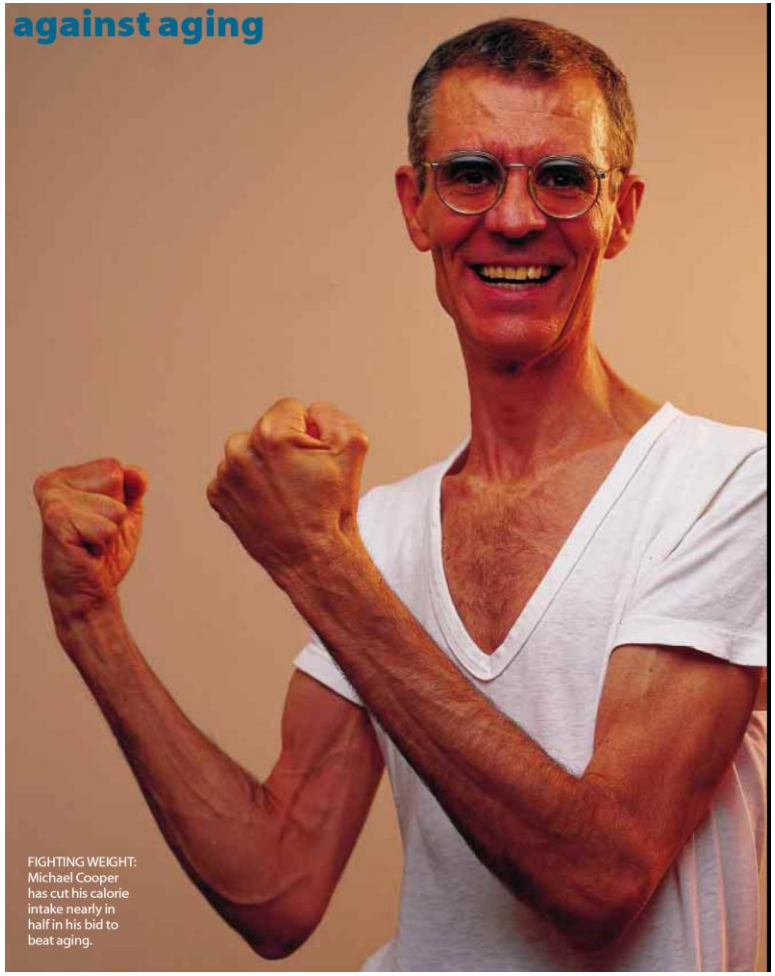
Fast Runners – Calorific Restriction



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2009 – Is it really working ?

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How easy is it to significantly affect one's own longevity?

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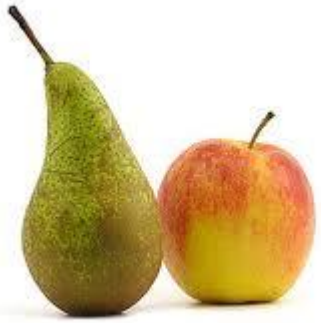
Can the Fast Runners rely on Modern Medicine and Epidemiology?

- Eggs are bad for you
- Eggs are good for you (2009)
- Saturated fat is bad for your heart
- “There’s no connection whatsoever between cholesterol in food and cholesterol in blood. And we’ve known that all along. Cholesterol in the diet doesn’t matter unless you happen to be a chicken or a rabbit” – Ancel Keys 1997
- Statins reduce the number of incidences of heart related events (absolute effects low – relative effect high)
- Statins don’t affect total mortality end-points but have numerous side-effects – Cochrane 2010

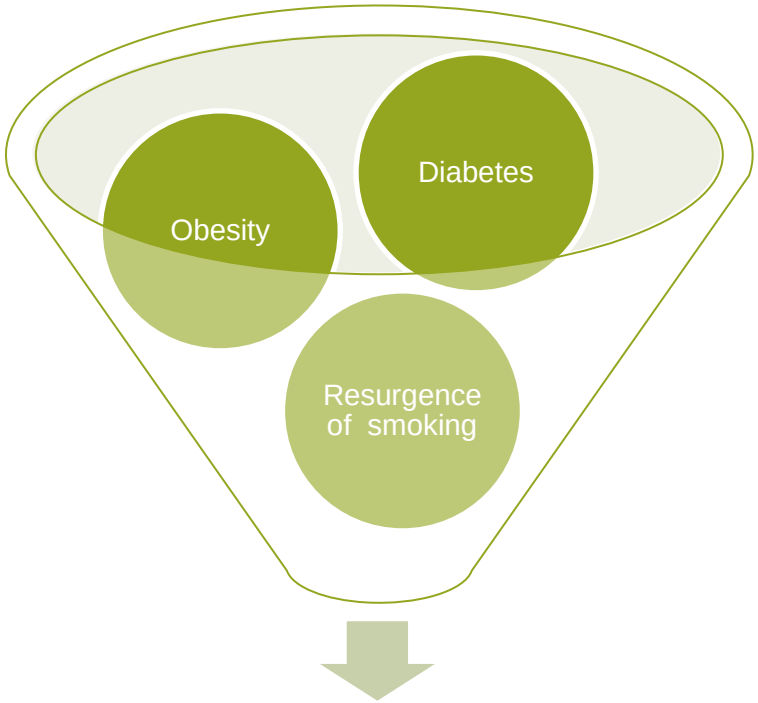
Are the Fast Food Eaters really destined for an early grave?

- Chocolate
- Saturated Fat
- Salt
- Apples versus Pears
- BMI



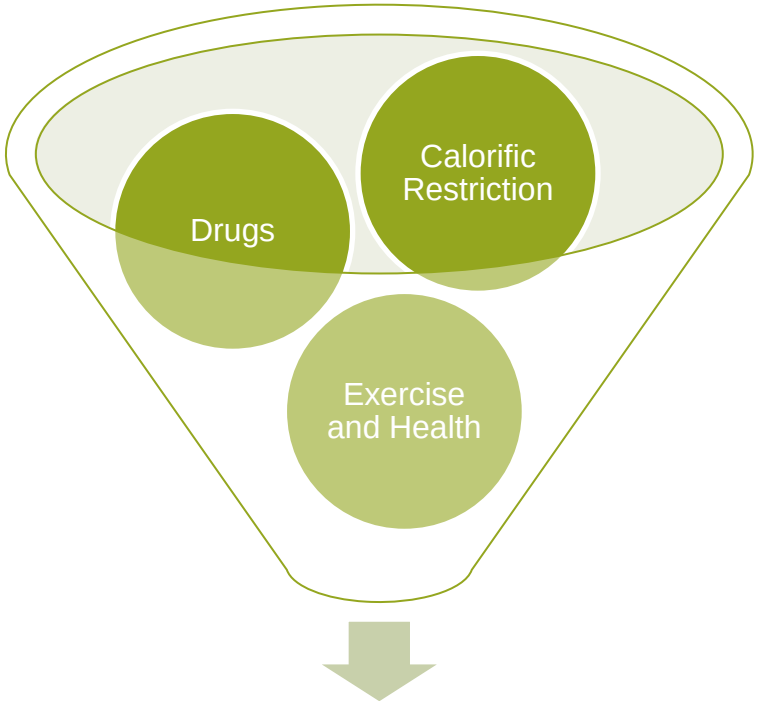
Predicting the Future: Heterogeneity Blender

Certainty Blender

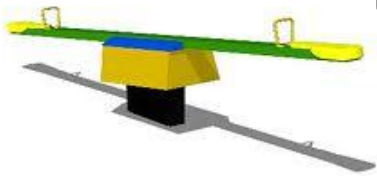


Period Effect

Speculative Blender



Uncertain Outcome



Conclusions

- It is stating the obvious but be very careful of heterogeneity
- Without proven causes why should we extrapolate cohort effects?
- Without a quantum leap in our ability to affect ageing (a ‘black swan’) the diseases of old age are not going away.
- Infectious disease may make a comeback
- There does not seem to be an elixir
- The pendulum has possibly swung too far towards high estimates of longevity improvement
- We would advocate Moderation in everything

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Questions or comments?

Expressions of individual views by members of The Actuarial Profession and its staff are encouraged.

The views expressed in this presentation are those of the presenters who can be reached at:

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