

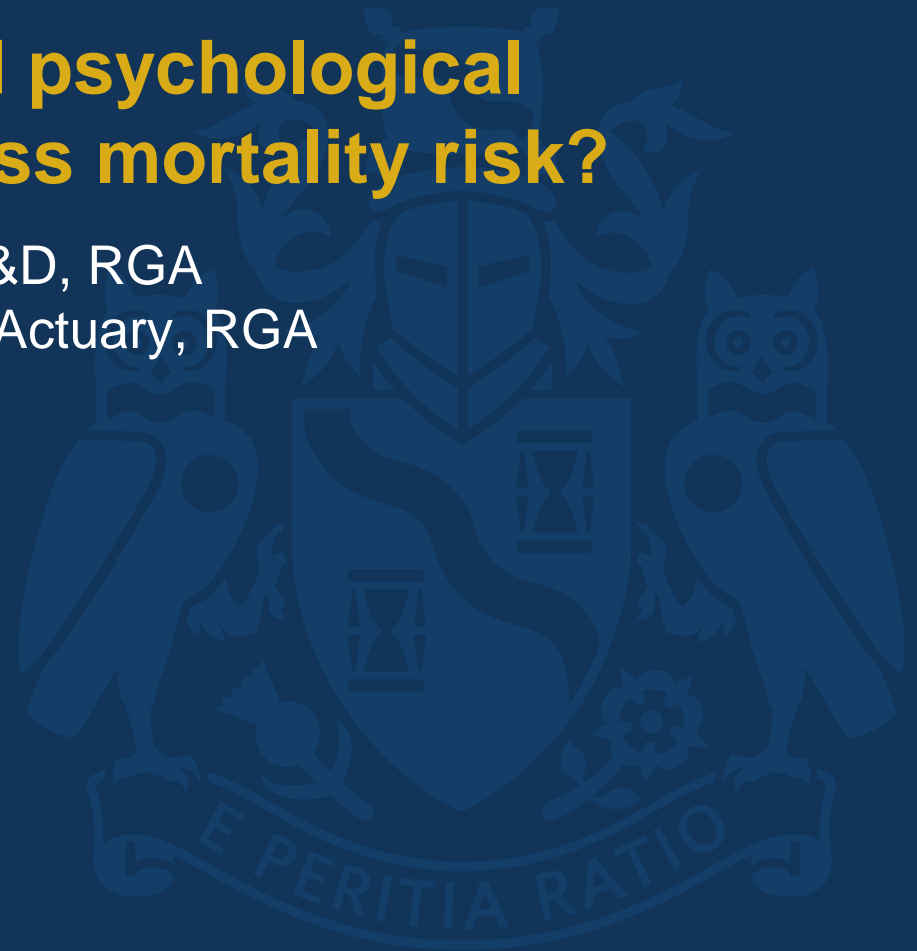


Institute
and Faculty
of Actuaries

Should behavioural and psychological factors be used to assess mortality risk?

Peter Banthorpe, Global Head of R&D, RGA

Chris Falkous, Biometric Research Actuary, RGA



What we're not talking about today

Anti-Selection



Fraud and Non-Disclosure



Persistency

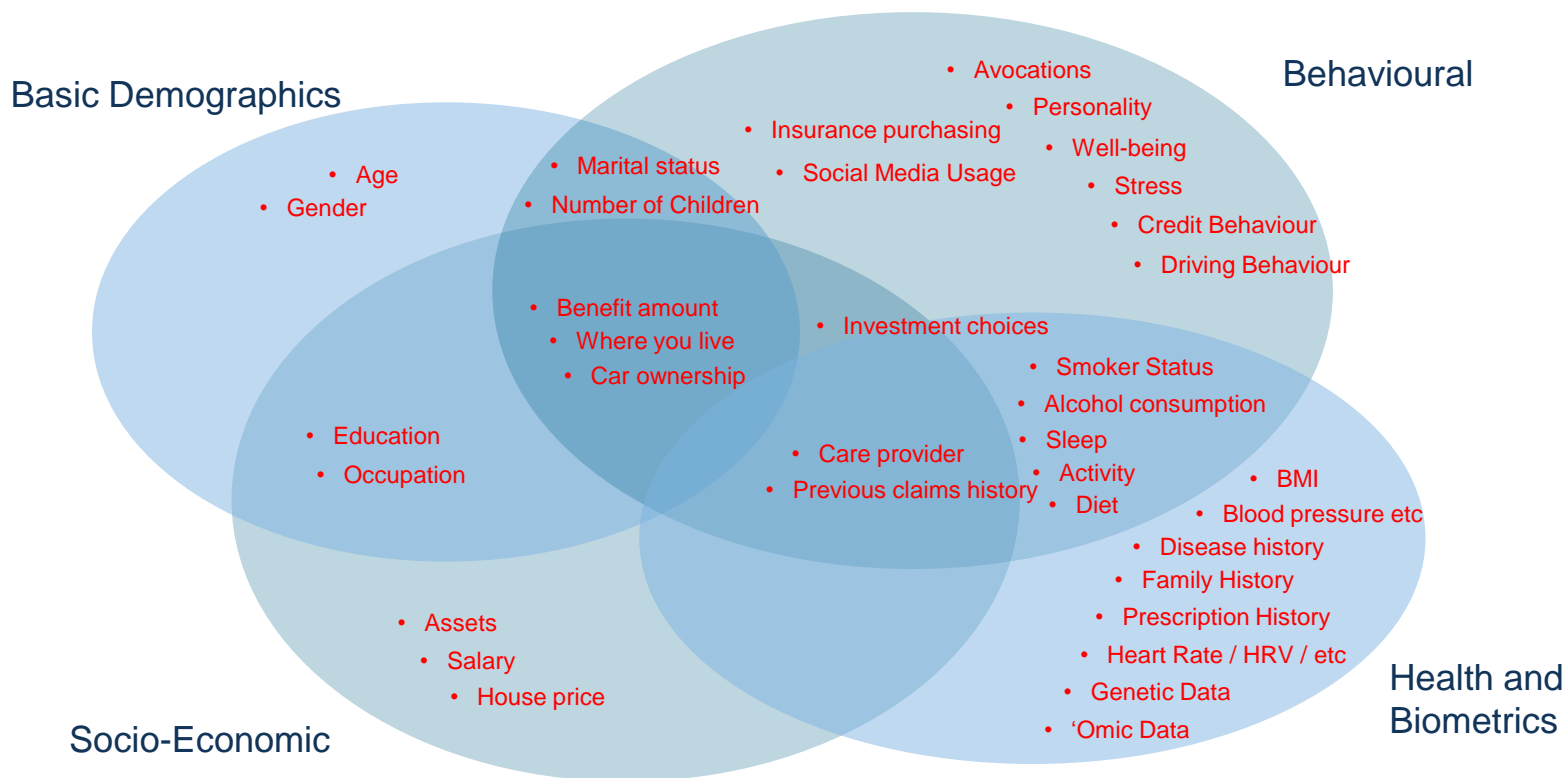


Behavioural Design



Institute
and Faculty
of Actuaries

Many things influence or help predict longevity



Not intended to be fully exhaustive



Institute
and Faculty
of Actuaries

Why talk about this now?

This is happening now



TransUnion / RGA Mortality Study

Credit-Based Solutions for Life Insurance

Scott Rushing FSA, MAAA
Vice President & Actuary,
Global Research and Development
RGA Reinsurance Company

John Buppert
Vice President of Sales – Insurance
TransUnion

Understand Causal Paths



Value from Social Media?



Wearables



New Competitors



Should we do it?



Institute
and Faculty
of Actuaries

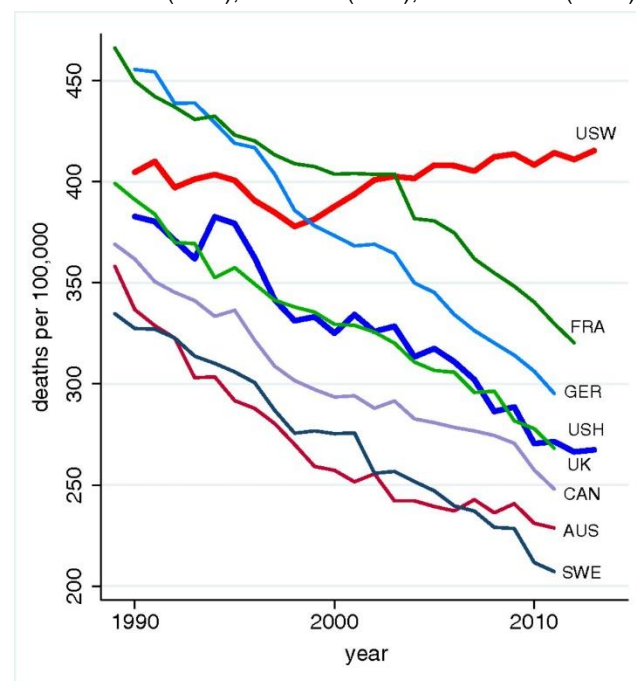
Reductions in Wellbeing associated with Adverse Population Mortality Trends

Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century

Anne Case¹ and Angus Deaton¹

Self-reported declines in health, mental health, and ability to conduct activities of daily living, and increases in chronic pain and inability to work, as well as clinically measured deteriorations in liver function, all point to growing distress in this population.

All-cause mortality, ages 45–54 for US White non-Hispanics (USW), US Hispanics (USH), and six comparison countries: France (FRA), Germany (GER), the United Kingdom (UK), Canada (CAN), Australia (AUS), and Sweden (SWE).



Institute
and Faculty of Actuaries



Institute
and Faculty
of Actuaries

Personality



Personality

- What is personality?
- Differences in personality
 - Genetics
 - Environment (shared vs non-shared)
 - Interaction (gene expression affected by environment)
- Increasing stability over time
- It is possible to change personality
 - Trauma, parasitic infection, pharmaceutical effects
 - Life events (marriage, work, bereavement)

• Source: Briley and Tucker-Drob (2014)



Institute
and Faculty
of Actuaries

Assessing personality

What's Your Personality Type?

Use the questions on the outside of the chart to determine the four letters of your Myers-Briggs type.
For each pair of letters, choose the side that seems most natural to you, even if you don't agree with every description.

1. Are you outwardly or inwardly focused? If you:

- Could be described as talkative, outgoing
- Like to be in a fast-paced environment
- Tend to work out ideas with others, think out loud
- Enjoy being the center of attention

then you prefer
E
Extraversion

- Could be described as reserved, private
- Prefer a slower pace with time for contemplation
- Tend to think things through inside your head
- Would rather observe than be the center of attention

then you prefer
I
Introversion

2. How do you prefer to take in information? If you:

- Focus on the reality of how things are
- Pay attention to concrete facts and details
- Prefer ideas that have practical applications
- Like to describe things in a specific, literal way

then you prefer
S
Sensing

- Imagine the possibilities of how things could be
- Notice the big picture, see how everything connects
- Enjoy ideas and concepts for their own sake
- Like to describe things in a figurative, poetic way

then you prefer
N
Intuition

ISTJ
Responsible, sincere, analytical, reserved, realistic, systematic. Hardworking with sound practical judgment.

ISTP
Action-oriented, logical, analytical, spontaneous, reserved, independent. Enjoy adventure, skilled at understanding how mechanical things work.

ESTP
Outgoing, realistic, action-oriented, curious, versatile, spontaneous. Pragmatic problem solvers and skillful negotiators.

ESTJ
Efficient, outgoing, analytical, systematic, dependable, realistic. Like to run the show and get things done in an orderly fashion.

ISFJ
Warm, considerate, gentle, responsible, pragmatic, thorough. Devoted caretakers who enjoy being helpful to others.

ISFP
Gentle, sensitive, nurturing, helpful, flexible, realistic. Seek to create a personal environment that is both beautiful and practical.

ESFP
Playful, enthusiastic, friendly, spontaneous, tactful, flexible. Have strong common sense, enjoy helping people in tangible ways.

ESFJ
Friendly, outgoing, reliable, conscientious, organized, practical. Seek to be helpful and please others, enjoy being active and productive.

INFJ
Idealistic, organized, insightful, dependable, compassionate, gentle. Seek harmony and cooperation, enjoy intellectual stimulation.

INFP
Sensitive, creative, idealistic, perceptive, caring, loyal. Value inner harmony and personal growth, focus on dreams and possibilities.

ENFP
Enthusiastic, creative, spontaneous, optimistic, supportive, playful. Value inspiration, enjoy starting new projects, see potential in others.

ENFJ
Caring, enthusiastic, idealistic, organized, diplomatic, responsible. Skilled communicators who value connection with people.

INTJ
Innovative, independent, strategic, logical, reserved, insightful. Driven by their own original ideas to achieve improvements.

INTP
Intellectual, logical, precise, reserved, flexible, imaginative. Original thinkers who enjoy speculation and creative problem solving.

ENTP
Inventive, enthusiastic, strategic, enterprising, inquisitive, versatile. Enjoy new ideas and challenges, value inspiration.

ENTJ
Strategic, logical, efficient, outgoing, ambitious, independent. Effective organizers of people and long-range planners.

3. How do you prefer to make decisions? If you:

- Make decisions in an impersonal way, using logical reasoning
- Value justice, fairness
- Enjoy finding the flaws in an argument
- Could be described as reasonable, level-headed

then you prefer
T
Thinking

- Base your decisions on personal values and how your actions affect others
- Value harmony, forgiveness
- Like to please others and point out the best in people
- Could be described as warm, empathetic

then you prefer
F
Feeling

4. How do you prefer to live your outer life? If you:

- Prefer to have matters settled
- Think rules and deadlines should be respected
- Prefer to have detailed, step-by-step instructions
- Make plans, want to know what you're getting into

then you prefer
J
Judging

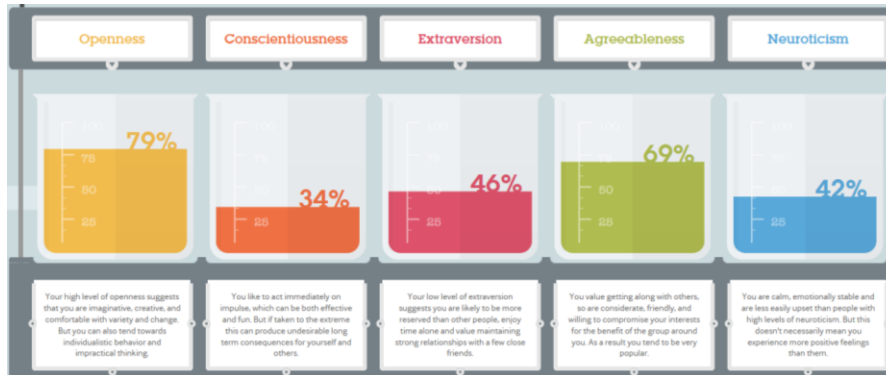
- Prefer to leave your options open
- See rules and deadlines as flexible
- Like to improvise and make things up as you go
- Are spontaneous, enjoy surprises and new situations

then you prefer
P
Perceiving

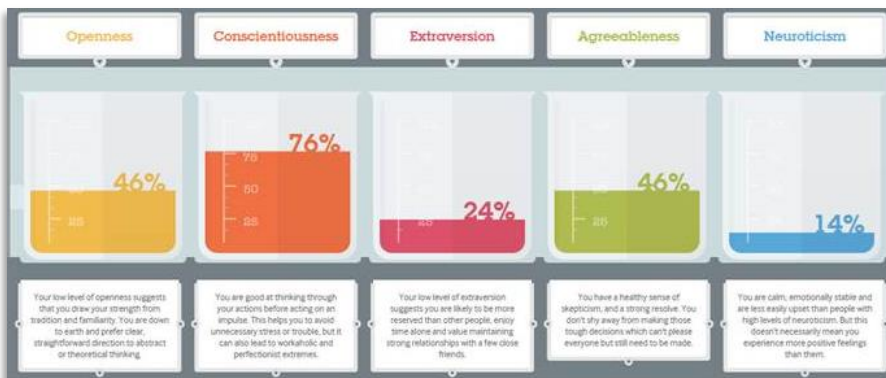


Institute
and Faculty of
Actuaries

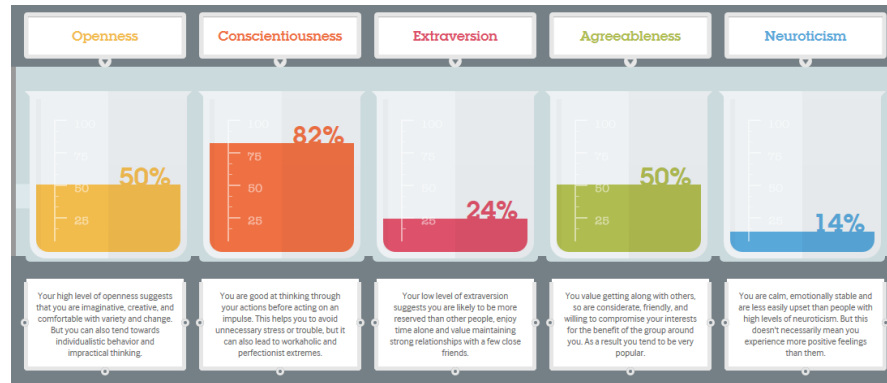
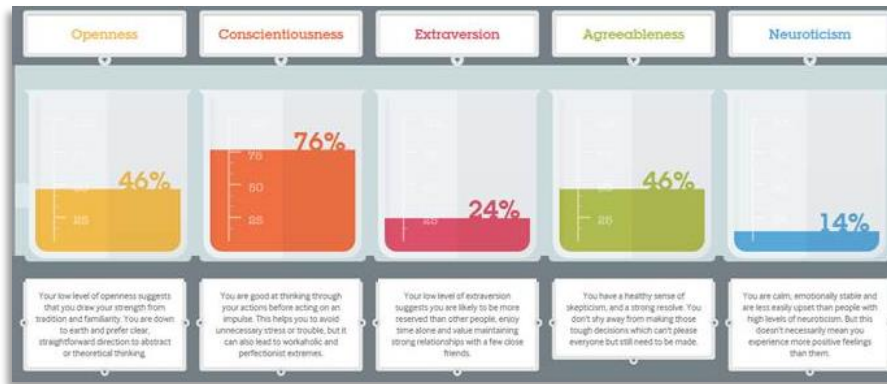
The Big 5 Personality Inventory



“MasterCard, in their 2014 Advisors report, found that candidates accepted via VisualDNA’s personality data were 23% less likely to default on their borrowing...”



The Big 5 Personality Inventory



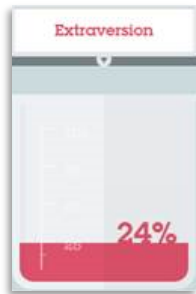
The Big 5 and mortality



- Earlier studies found it generally unrelated to mortality
- More recent investigations have found a protective effect



- Tendency to be hostile and aggressive predicts mortality
- Otherwise, studies generally found no association



- Few studies have found an association



- Mixed results
- Some studies have found a positive association, some negative

Conscientiousness and mortality

- Relevant to many Biopsychosocial processes
 - Engaging in healthy behaviour
 - Choose healthier environments
 - Select and maintain healthier friendships
 - Better educations, more successful careers, higher income
 - Moderates detrimental effect of unhealthy stressors
 - Gene x environment interactions
 - Compound effect of individual, tiny differences

Source: Friedman and Kern (2014)



Institute
and Faculty
of Actuaries

Conscientiousness in childhood

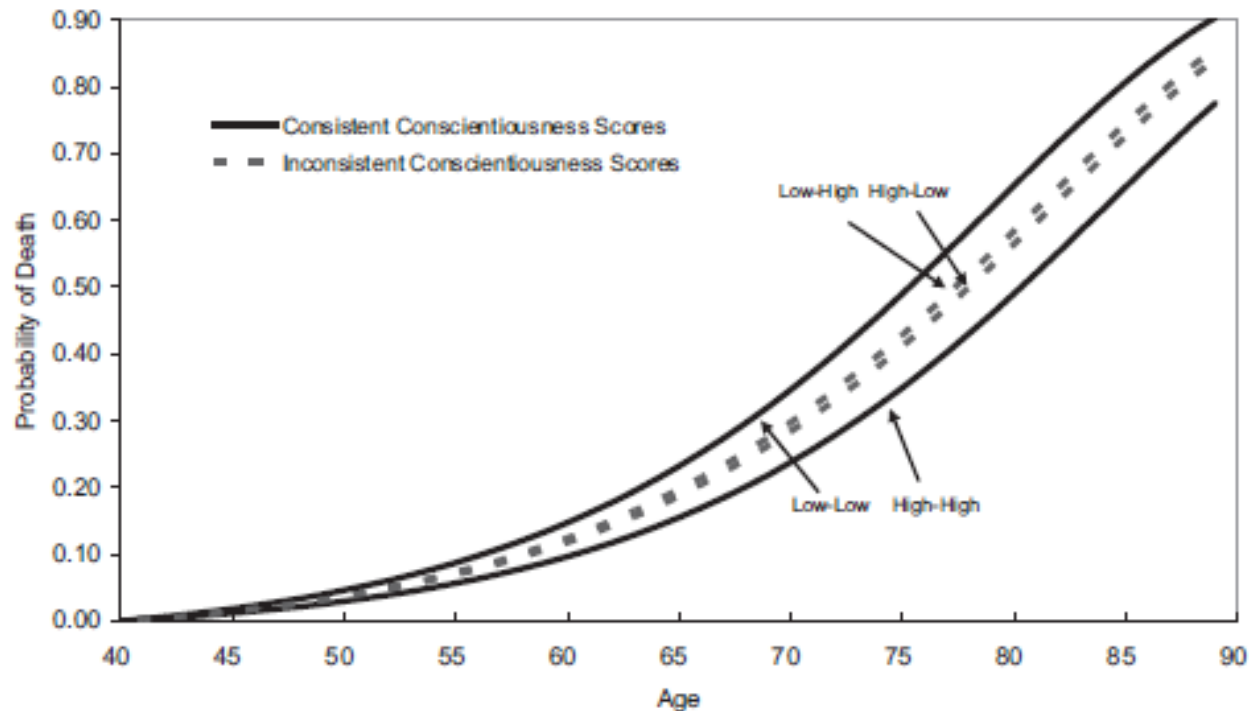


Figure 3. Estimated probability of a Terman participant's dying (1950–2000) by a given age, by conscientiousness at two time points.



Institute
and Faculty
of Actuaries

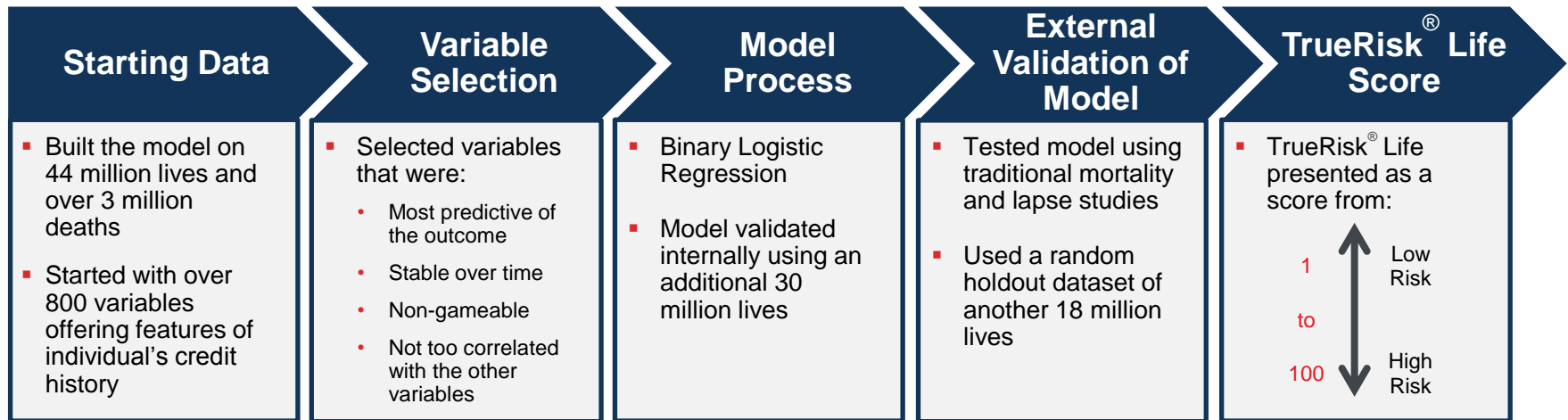
Conscientiousness in adulthood

High conscientiousness related to lower risk of death

When controlling for	Mortality risk between highest and lowest levels of conscientiousness	Other significant indicators of lower risk of death (p<0.01)
Nothing	≈ 3.2x	High neuroticism Low agreeableness High extraversion
Age, sex, race, education, marital status	≈ 2.4x	
Age, sex, race, education, marital status, smoking, alcohol use, waist circumference	≈ 3.2x	



TRL Model Creation Process



- Data comes from de-personalized 1998 credit archive (90% of the US population)
- Model calibrated to actual deaths occurring over a 12-year period

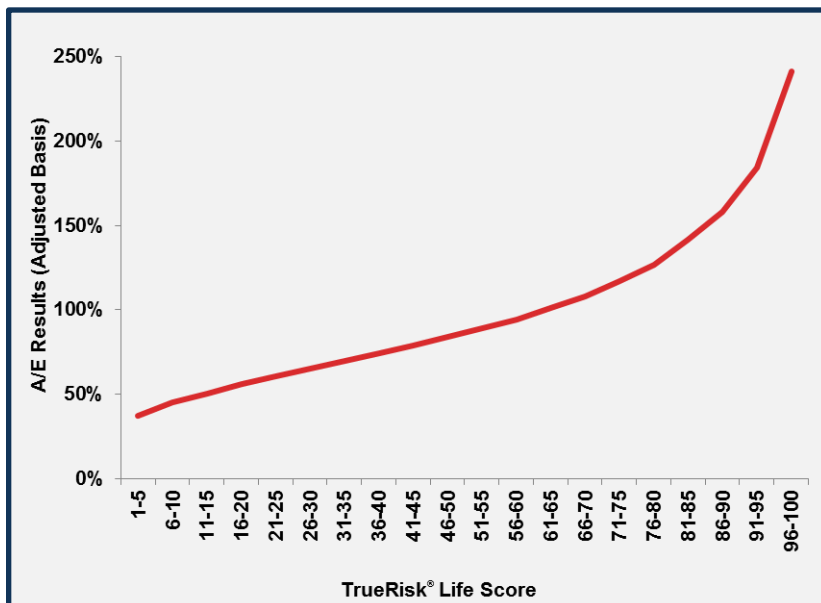
TransUnion & RGA built and tested TrueRisk[®] Life on 92 million individuals



Institute
and Faculty
of Actuaries

Model Validation – Population Study

Overall Mortality



Details

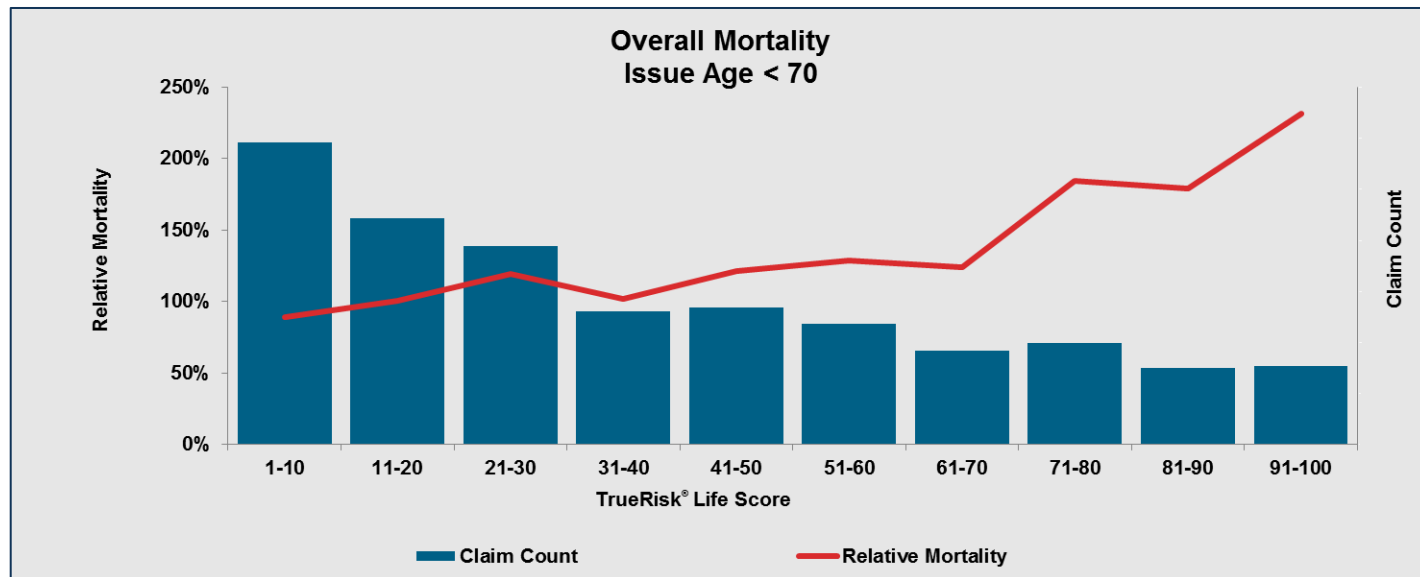
- Mortality study performed on holdout sample of 18 million lives using a 1998 TransUnion archive and studying the lives during 1999-2010
- Score buckets are set to be uniform across the population
- Study shows 5 times segmentation (96-100 compared to 1-5)
- SSMDf used as source of deaths; used population mortality tables



Institute
and Faculty
of Actuaries

TRL Model Validation – Insured Lives Study

Mortality of the 91-100 group is 2.6 times higher than the 1-10 group



Term, UL & VUL; Face Amounts ≥ \$100,000; Issue Ages < 70



Institute
and Faculty
of Actuaries

TRL Model Validation – Insured Lives Study

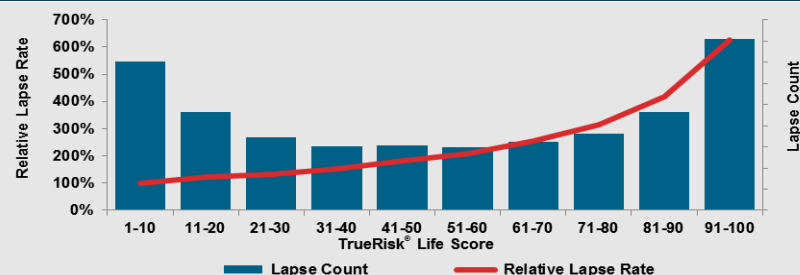
Details

- Term, UL and VUL
- Face amounts \geq \$100k
- Issue Ages < 70

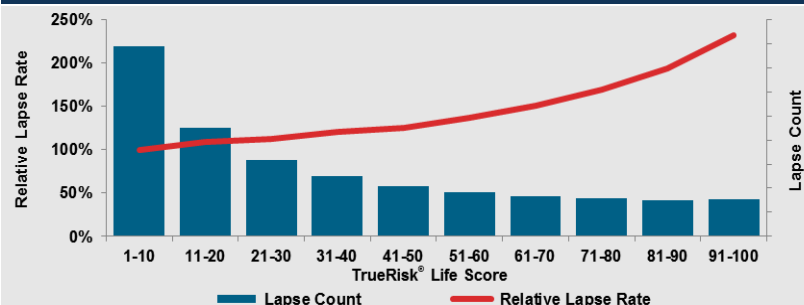
Results

- Lapse rate of 91-100 group is 6 times higher than 1-10 group in durations 1-2
- Continued segmentation seen in later durations, but less dramatic
- Similar results seen when looking at the curves by issue age band

Overall Lapse Results (Durations 1-2)



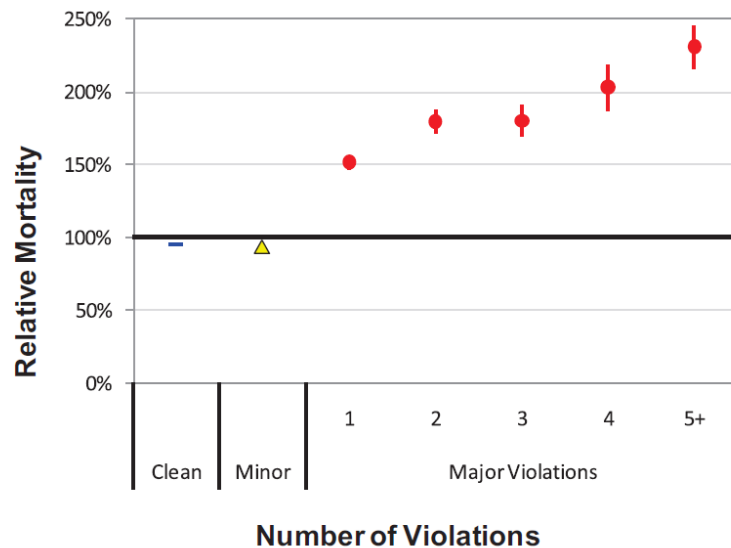
Overall Lapse Results (Durations 3+)



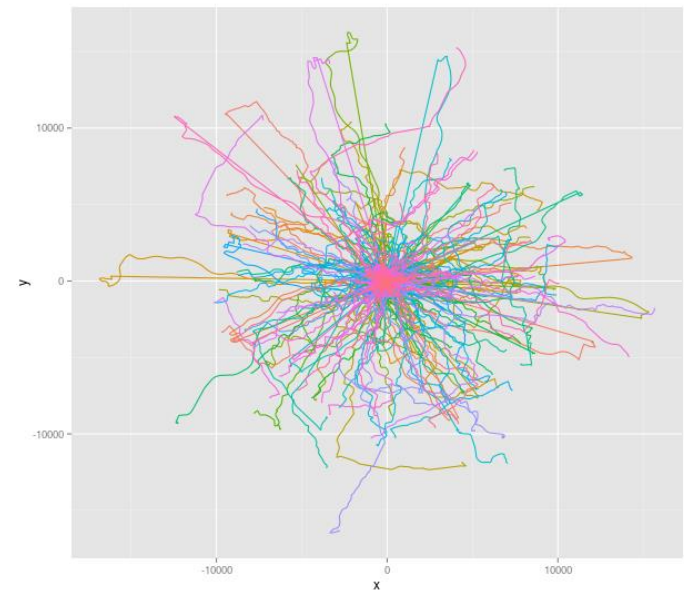
Institute
and Faculty
of Actuaries

Driving habits – another behavioural risk classifier

Motor vehicle records indicate relative risk



Telematic data to identify a driver signature



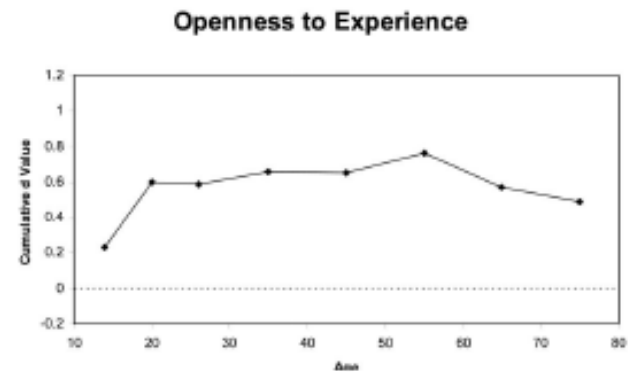
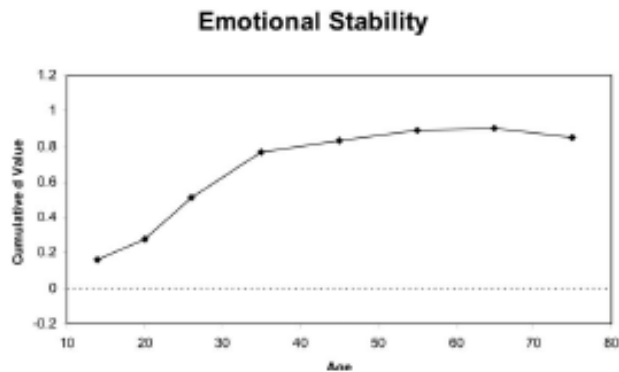
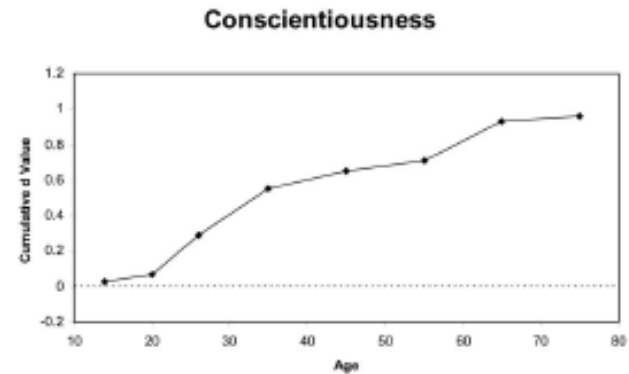
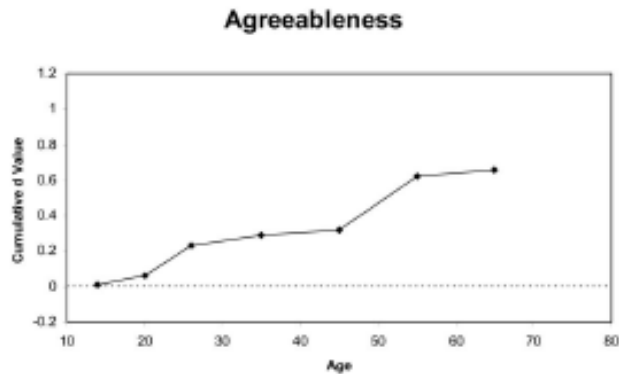
Source: Rushing and Rozar. [An Analysis of Motor Vehicle Records and All-Cause Mortality](#). RGA 2012.

Source: Axa sponsored competition on Kaggle.



Institute
and Faculty
of Actuaries

Personality changes over time

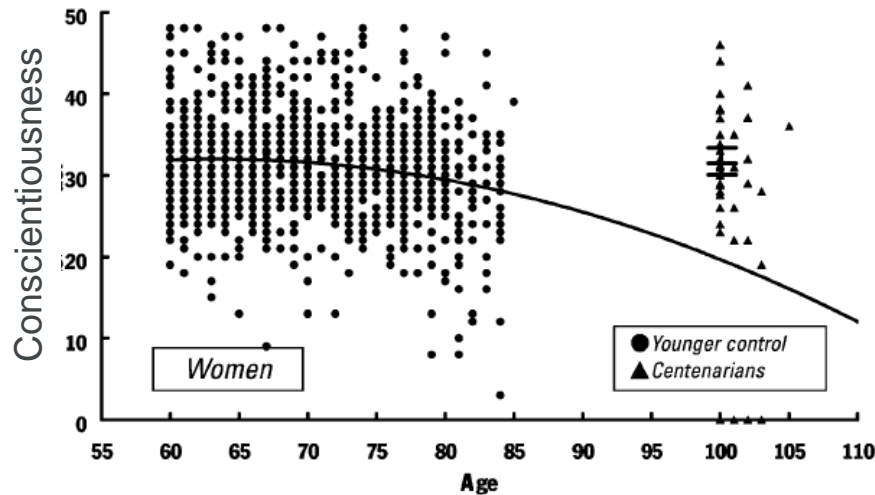
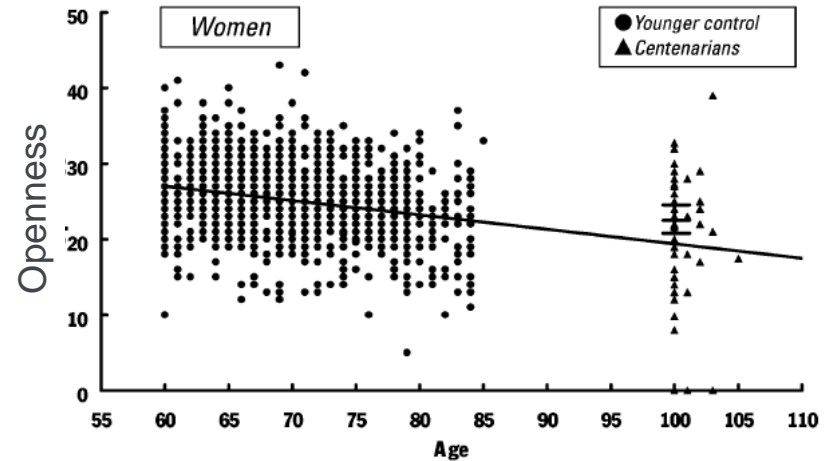
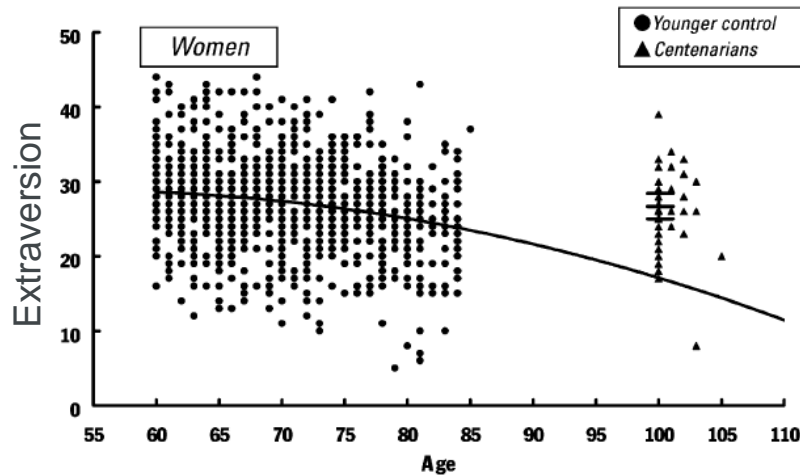


Source: Roberts, B. W., Walton, K. E., & Viechtbauer, W. (2006). Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies



Institute
and Faculty
of Actuaries

Personality and the oldest old



Institute
and Faculty of Actuaries






Institute
and Faculty
of Actuaries

Subjective well-being and stress



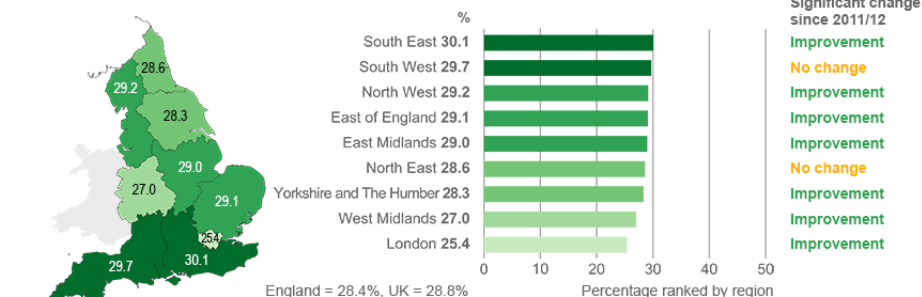
Subjective Well-Being

Evaluative (life satisfaction)	Hedonic (moods/emotions)	Eudemonic (purpose/meaning)
<p><i>“I’ve got a great job, great family, great friends, I live in a great home, I eat great food and drink great wine...</i></p> <p><i>my life is great!”</i></p>	 	

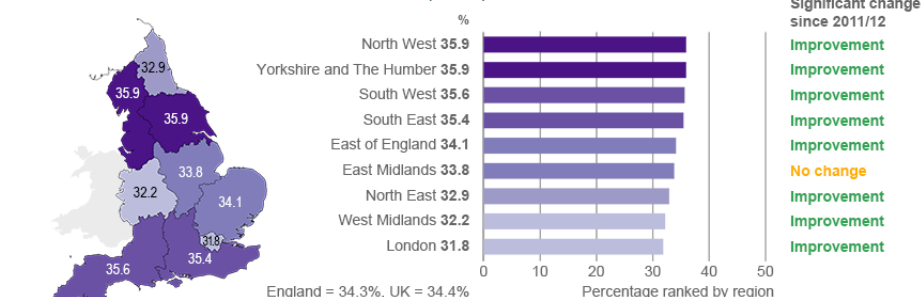


Subjective Well-Being in England

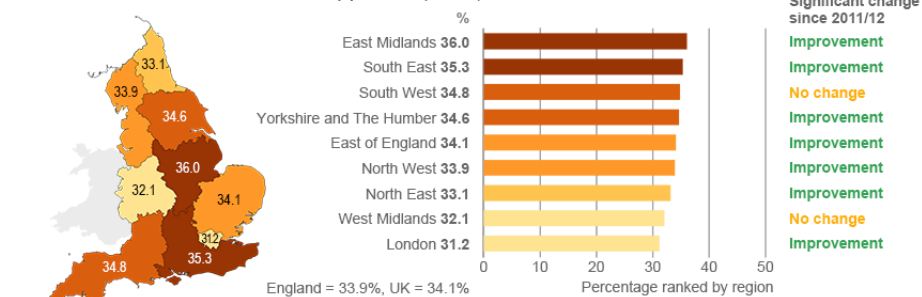
Life Satisfaction (9–10),¹ 2014/2015



Worthwhile (9–10),¹ 2014/2015



Happiness (9–10),¹ 2014/2015

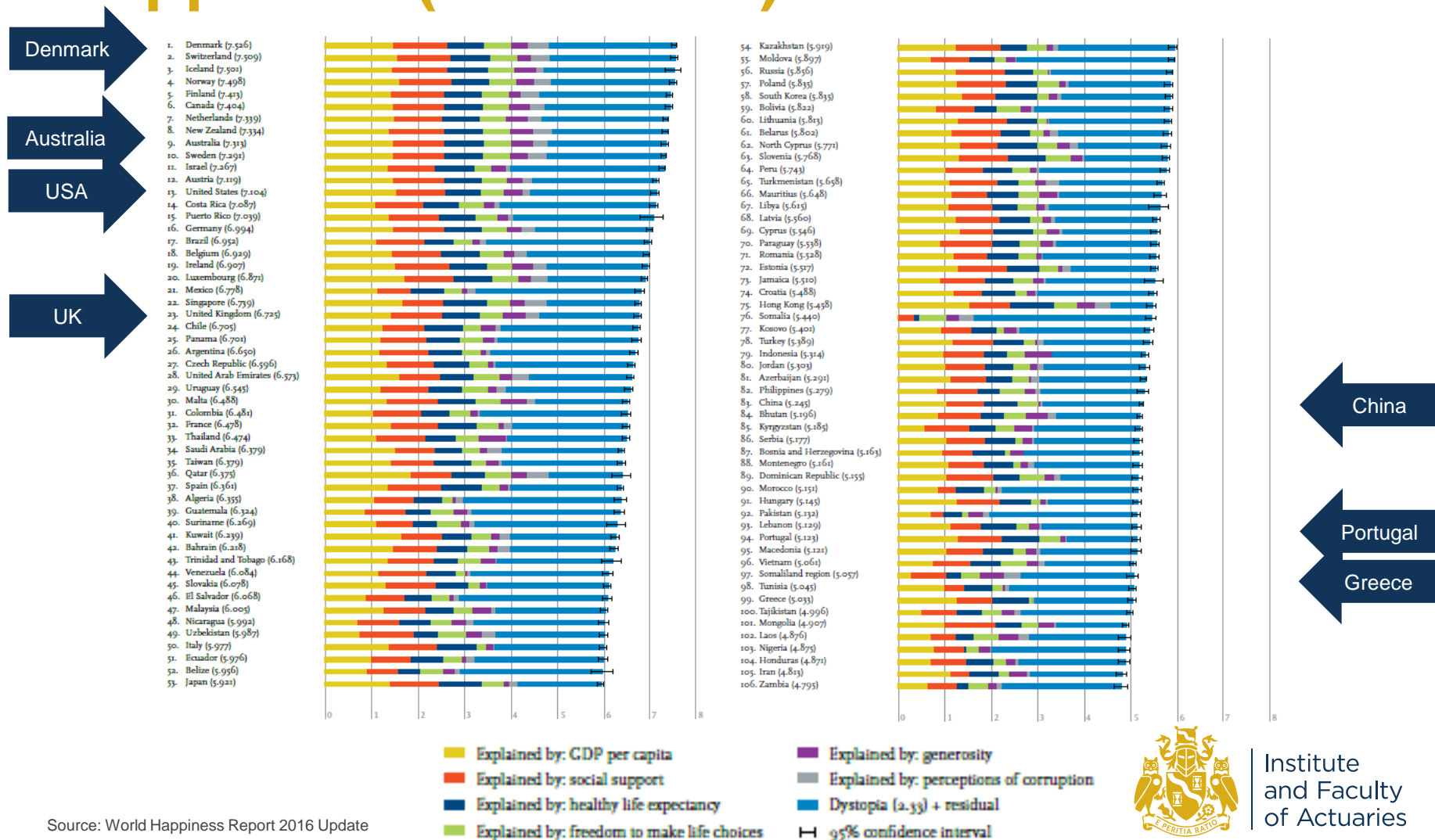


Source: ONS



Institute
and Faculty
of Actuaries

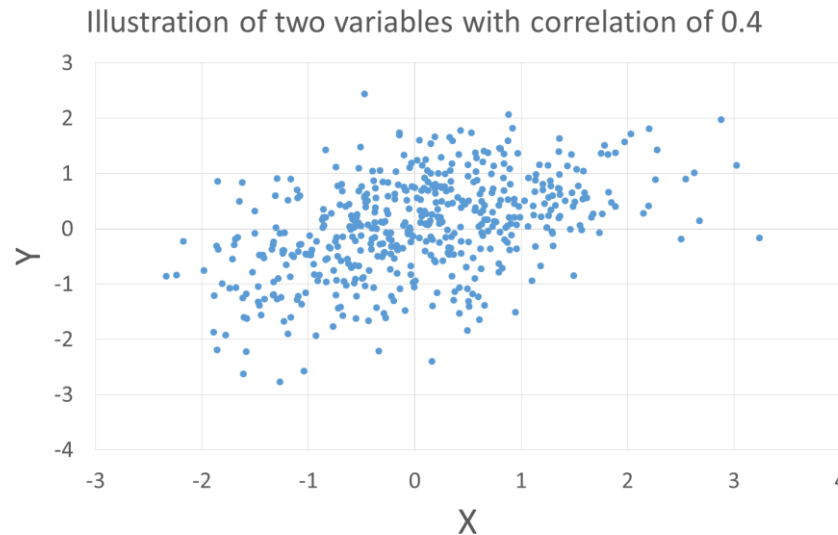
Happiness (evaluative) around the world



Source: World Happiness Report 2016 Update

Personality and Subjective Well-Being

Personality trait	Correlation with		
	Positive affect	Negative affect	Life satisfaction
Neuroticism	-0.41	0.66	-0.39
Extraversion	0.45	-0.31	0.27
Conscientiousness	0.42	-0.31	0.28



Source: Albuquerque, de Lima, Matos and Figueiredo (2011): Personality and subjective well-being: What hides behind global analyses?



Institute
and Faculty
of Actuaries

Subjective Well-Being and mortality

- Diener and Chan (2011)
- “... the case that subjective well-being influences health and longevity in healthy populations is compelling...”



Subjective Well-Being and mortality

The impact of eudemonic wellbeing

When controlling for	Mortality risk of lowest quartile of eudemonic wellbeing to highest
Age, gender	≈ 0.42
Age, gender, demographic and health indicators	≈ 0.62
Age, gender, demographic and health indicators, depression and health behaviours	≈ 0.70

Source: Steptoe, Deaton and Stone (2015): Subjective wellbeing, health, and ageing.



Institute
and Faculty
of Actuaries

What things can we measure?



Institute
and Faculty
of Actuaries

Social media data

Well-being and problematic Facebook use

Seydi Ahmet Satıcı^{a,*}, Recep Uysal^b

^aAnadolu University, Educational Faculty, Department of Psychological Counseling and Guidance, Eskişehir, Turkey
^bYildiz Technical University, Educational Faculty, Department of Psychological Counseling and Guidance, Istanbul, Turkey

Our Twitter Profiles, Our Selves: Predicting Personality with Twitter

Daniele Quercia[§] Michal Kosinski[†] David Stillwell* Jon Crowcroft[§]

[§]The Computer Laboratory, University of Cambridge, UK

[†]The Psychometrics Centre, University of Cambridge, UK

*School of Psychology, University of Nottingham, UK

Mining Facebook Data for Predictive Personality Modeling

Dejan Markovikj

Faculty of Computer Science
and Engineering
Ss. Cyril and Methodius University
Rugjer Boshtkovikj 16
Skopje, Macedonia
dejan@markovikj.com

Sonja Gievska

Faculty of Computer Science
and Engineering
Ss. Cyril and Methodius University
Rugjer Boshtkovikj 16
Skopje, Macedonia
sonja.gievska@finki.ukim.mk

Michal Kosinski

The Psychometrics Centre
University of Cambridge
Psychology, Free School Lane
Cambridge CB2 3RQ
United Kingdom
mk583@cam.ac.uk

David Stillwell

The Psychometrics Centre
University of Cambridge
Psychology, Free School Lane
Cambridge CB2 3RQ
United Kingdom
ds617@cam.ac.uk

Characterizing Geographic Variation in Well-Being Using Tweets

H. Andrew Schwartz*, Johannes C. Eichstaedt*, Margaret L. Kern, Lukasz Dziurzynski, Megha Agrawal
Gregory J. Park, Shrinidhi K. Lakshmikanth, Sneha Jha, Martin E. P. Seligman, and Lyle Ungar

University of Pennsylvania

hansens@seas.upenn.edu, jeich@sas.upenn.edu

Richard E. Lucas

Michigan State University

Predicting Personality from Twitter

Jennifer Golbeck*, Cristina Robles*, Michon Edmondson*, and Karen Turner*
^{*}University of Maryland: {jgolbeck,crobles,michonk,kturner}@umd.edu

What does your selfie say about you?

Lin Qiu^{a,*}, Jiahui Lu^a, Shanshan Yang^a, Weina Qu^b, Tingshao Zhu^b

^aDivision of Psychology, Nanyang Technological University, Singapore

^bInstitute of Psychology, Chinese Academy of Sciences, China

Online networks and subjective well-being¹

Fabio Sabatini^{2 *}

Francesco Sarracino³

Personality and Patterns of Facebook Usage

Yoram Bachrach
Microsoft Research
yobach@microsoft.com

Michal Kosinski
University of Cambridge
mk583@cam.ac.uk

Thore Graepel
Microsoft Research
thoreg@microsoft.com

Pushmeet Kohli
Microsoft Research
pkohli@microsoft.com

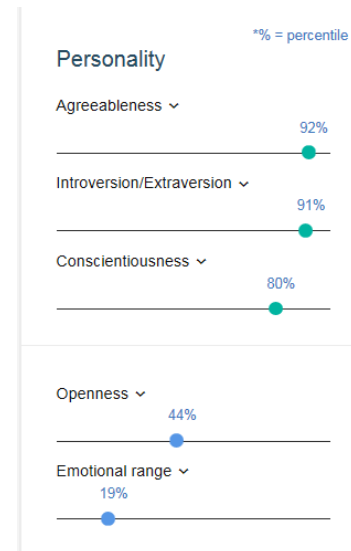
David Stillwell
University of Cambridge
ds617@cam.ac.uk



Institute
and Faculty
of Actuaries

Try it yourself...

- mypersonality.org
 - University of Cambridge Psychometrics Centre
 - Data on 6m personality test results and 4m Facebook profiles
- IBM Watson Personality Insights



Institute
and Faculty
of Actuaries

Smartphone apps







Understanding the impact of personality traits on mobile app adoption – Insights from a large-scale field study

Article in Computers in Human Behavior - April 2016
Impact Factor: 2.69 · DOI: 10.1016/j.chb.2016.04.011

READS
50

4 authors:

 Runhua Xu ETH Zurich 13 PUBLICATIONS 8 CITATIONS SEE PROFILE	 Remo M. Frey ETH Zurich 7 PUBLICATIONS 2 CITATIONS SEE PROFILE
 Elgar Fleisch ETH Zurich 457 PUBLICATIONS 3,539 CITATIONS SEE PROFILE	 Alexander Ilic University of St.Gallen 33 PUBLICATIONS 157 CITATIONS SEE PROFILE

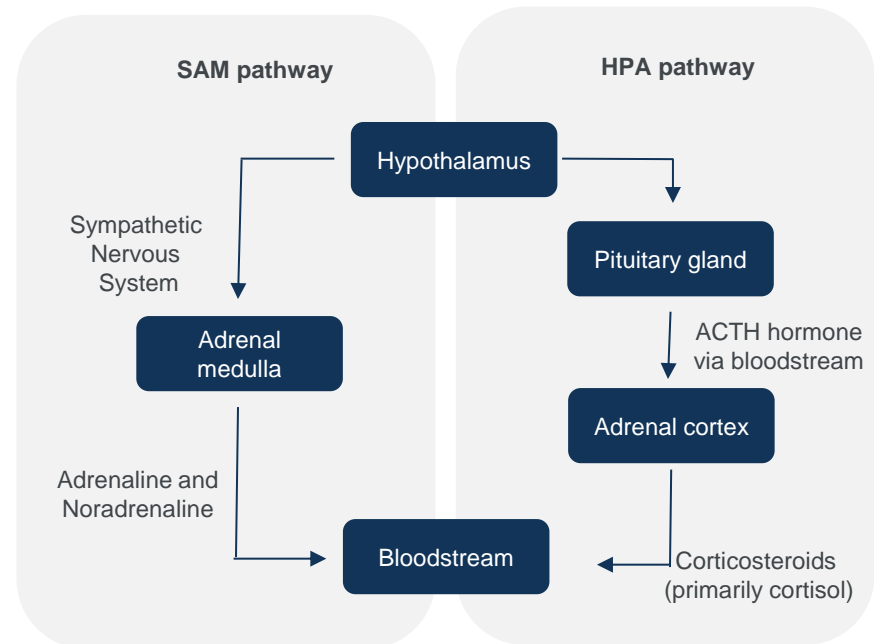


Institute
and Faculty
of Actuaries

Stress

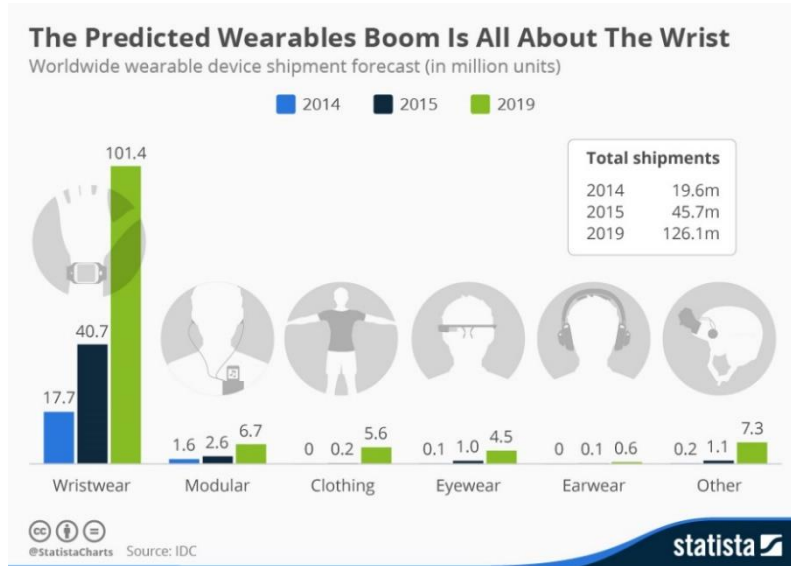
$$\frac{{}_t p_x q_{x+t} {}_t p_y q_{y+t} + {}_t p_x q_{x+t} (1 - {}_t p_y) + {}_t p_y q_{y+t} (1 - {}_t p_x)}{1 - (1 - {}_t p_x)(1 - {}_t p_y)} + X$$

- A Complex Process
 - Biological aspects
 - Psychological aspects
 - Social aspects
 - Acute stress
 - Chronic stress
 - Resilience
- Linked to:
 - Higher CVD Mortality and Morbidity
 - AIDS/HIV



Institute
and Faculty
of Actuaries

Wearables, health scores and behavioural change



Institute
and Faculty of Actuaries

Enjoyment of wearing the device varies by psychometric profile



For more details of Insights visit <https://www.insights.com/>



Institute
and Faculty
of Actuaries



Institute
and Faculty
of Actuaries

Should insurers use this data?



Holding and using (Big) Data – Peter's 4 R's

Regulations

- Increasing focus
- Data Protection Regulations
- Anti-discrimination legislation
- Profiling versus Decisions



How Data Makes Insurance Work Better for You

1. THE DIGITAL REVOLUTION AND BIG DATA pg6

The world is changing at an unprecedented pace – so just what is so different about data these days, and why does that affect the insurance industry?

2. UNDERSTANDING YOU pg10

Insurers need to understand you in order to provide you with products and services that really work for you.

3. GETTING THE RIGHT PRICE pg14

Getting the right insurance isn't simply about getting the right product, it's also about getting it at the right price, which fairly reflects your circumstances.

4. ENABLING YOU TO MAKE THE RIGHT DECISIONS TO MINIMISE YOUR RISK pg18

Insurers take on risk on behalf of their customers, and are keen to use the changing digital world to help customers understand and control the risks they face.

5. IMPROVING THE CLAIMS PROCESS pg22

Insurers want to use data and technology to make the claims process as easy and flexible as possible, and to combat fraud more effectively.

6. HOW WE TREAT YOUR DATA pg26

Using data innovatively means that insurers have to continue to build a trusting relationship with their customers, which involves being transparent about how we use your data.

Source: [How Data Makes Insurance Work Better For You](#), Association of British Insurers. Accessed February 2016



Institute
and Faculty
of Actuaries

Holding and using (Big) Data – Peter's 4 R's

Regulations

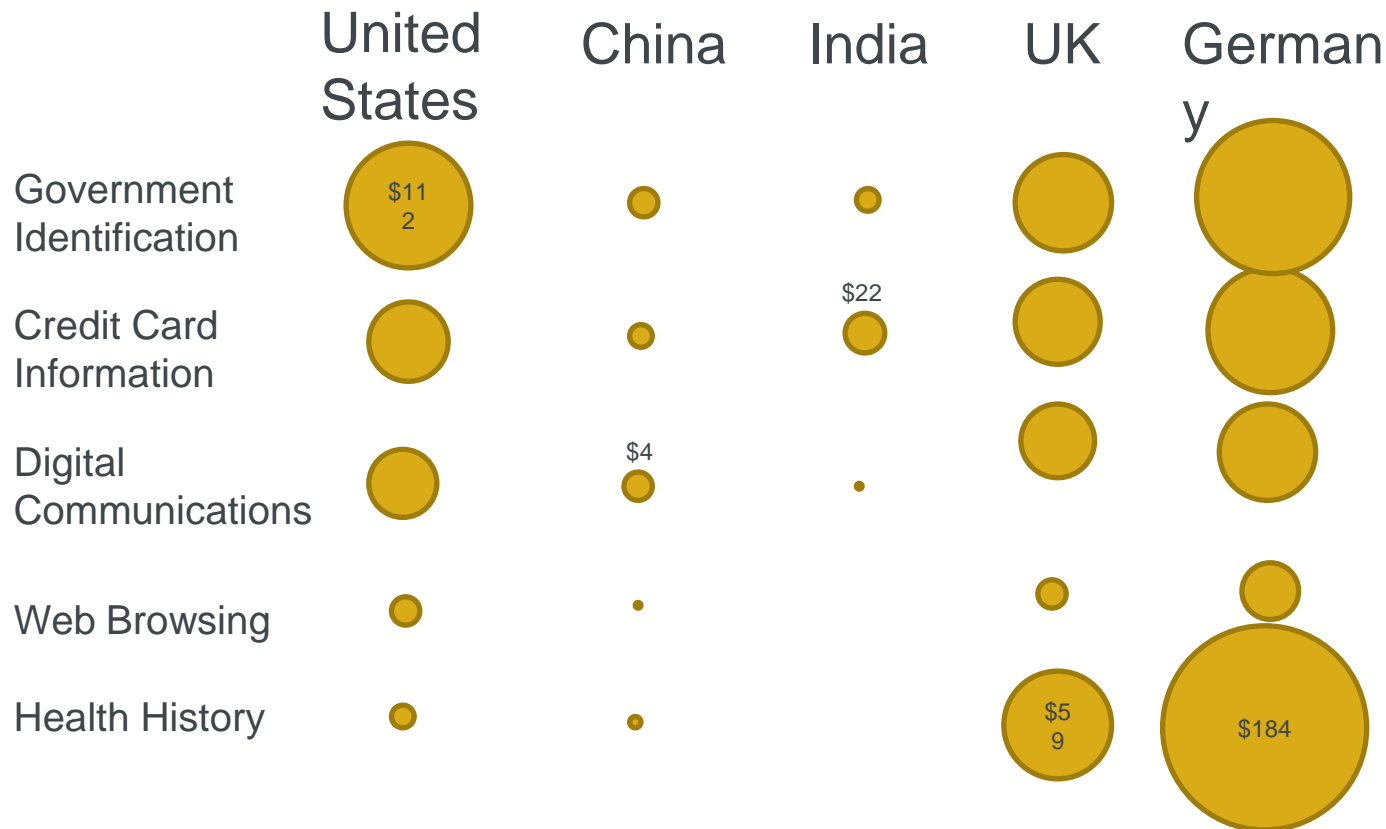
- Increasing focus
- Data Protection Regulations
- Anti-discrimination legislation
- Profiling versus Decisions

Reasonable Expectations

- Fairness
- Country Specific
- Industry and data specific
- What have you told the client
- Does it benefit the consumer?



Approximate amount people would pay to protect each data type (US\$)



Source: Customer Data: designing for Transparency and Trust, May 2015. Morey, Forbath and Schoop.

Original source included other types of data, all with low amounts (e.g. search history, location, purchase history, contact information).

Researchers used purchasing parity rather than exchange rates to convert all amounts to U.S. dollars



Institute
and Faculty
of Actuaries

Holding and using (Big) Data – Peter's 4 R's

Regulations

- Increasing focus
- Data Protection Regulations
- Anti-discrimination legislation
- Profiling versus Decisions

Reasonable Expectations

- Fairness
- Country Specific
- Industry and data specific
- What have you told the client
- Does it benefit the consumer?

Risks

- Reputational damage
- Financial Penalties
- Theft / Mis-use / Loss
- Data governance procedures and culture



Holding and using (Big) Data – Peter's 4 R's

Regulations

- Increasing focus
- Data Protection Regulations
- Anti-discrimination legislation
- Profiling versus Decisions

Reasonable Expectations

- Fairness
- Country Specific
- Industry and data specific
- What have you told the client
- Does it benefit the consumer?

Risks

- Reputational damage
- Financial Penalties
- Theft / Mis-use / Loss
- Data governance procedures and culture

Rewards

- Consumer
- Company (Red vs Blue Ocean)
- Employee
- Regulator





Institute
and Faculty
of Actuaries

Conclusions



Conclusions

- Looked at 5 factors of personality and 4 aspects of SWB
- Self-reported information can be manipulated
- Hard to validate and challenge responses to personality tests or SWB surveys
- Look instead to objective measures linked to personality or SWB
- Credit behaviour is cutting edge
- Availability, access, understanding and manipulation of data
- “Do the right thing”
- Regulations, Risks, Reasonable expectations, Rewards

Be responsible custodians of data and give your customers what they want



Institute
and Faculty
of Actuaries

Questions

Comments

Expressions of individual views by members of the Institute and Faculty of Actuaries and its staff are encouraged.

The views expressed in this presentation are those of the presenter.



Institute
and Faculty
of Actuaries