Mortality Methods

Tools, Techniques & Concepts

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Agenda

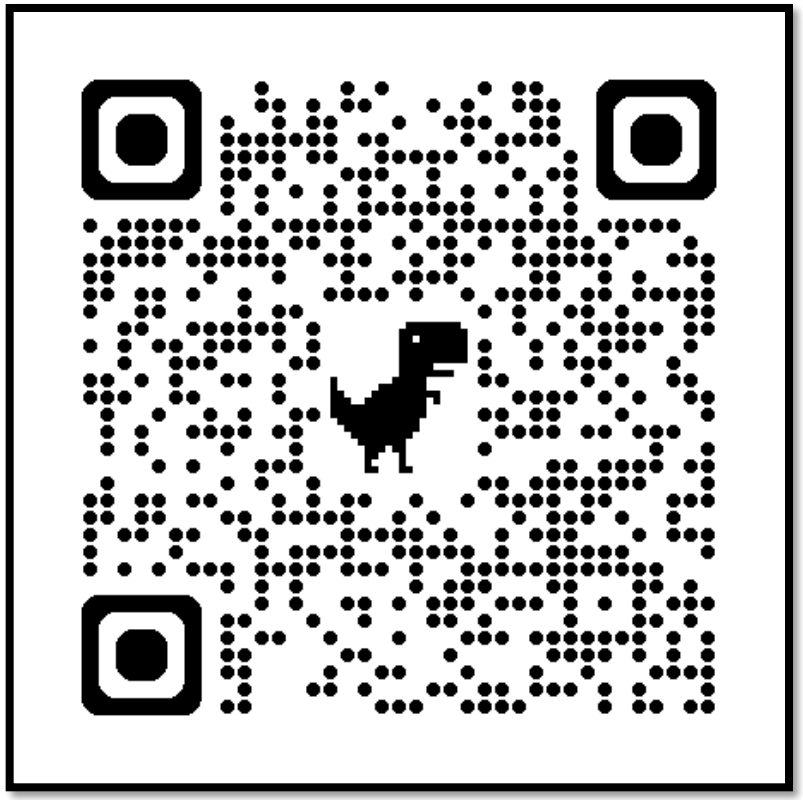
1 Risk Assessment on the Fly

- Novel risk assessment challenges and how to assess them
  - Fast calculation of Mortality Ratio (MR) or flat extra from studies / graphs
  - Adjustments based on age differences (Proportional LE method)

2 Technical Aspects of Life Risk Assessment

- Select Periods
- Table Ratings/Flat Extra conversion
- The “fall off” of ratings
- Combining debits of different causes: Should you add together?

Risk Assessment on the Fly

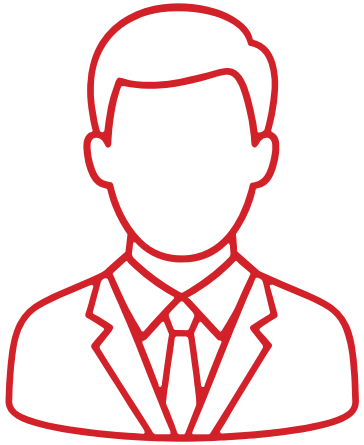


QR Code to access Google Drive with:

1. This presentation
2. Outline
3. Excel Spreadsheet on Multiple
4. Excel on World Survival

Motivating Case #1

58-year-old agent is applying for **$1M** of life insurance on himself.



He recently had a examination by his family physician.

Because his BMI was elevated (29) and his LFTs were slightly abnormal (ALT: 52, AST:43) his physician ordered a liver ultrasound with elastography.

This produced a diagnosis of hepatic steatosis with fibrosis - the liver stiffness measurement was 16 kPa.

As per the advice of the reinsurance manual, the underwriter declined. The agent is now demanding evidence that his liver situation is sufficiently dangerous as to warrant decline (when his doctor told him it was “OK”).

You look for studies in the medical literature and find…

Liver Stiffness & Mortality Risk

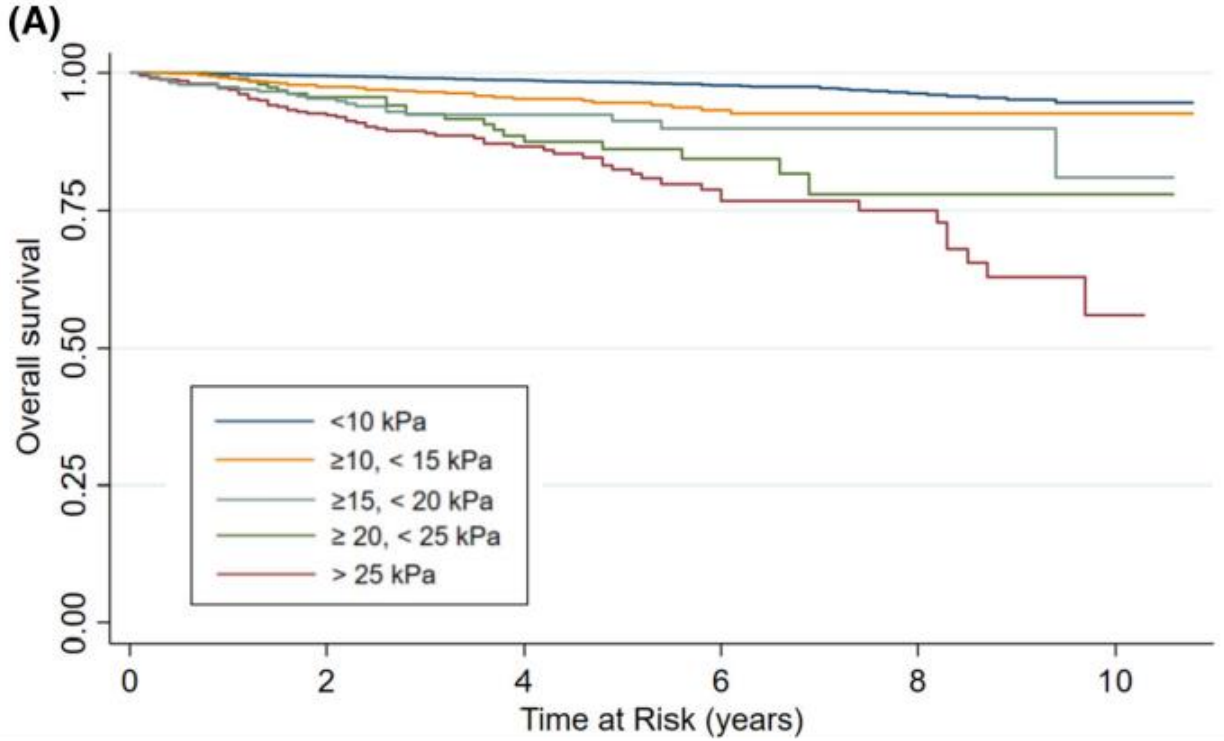
Key Case Facts:
Liver stiffness = 16kPa

- Australian study of 6,431 people
- Mean age of 60
- 217 deaths over 20k person-years of follow up

How can we go from this survival curve to a mortality ratio without spending hours of time?

3 Steps:

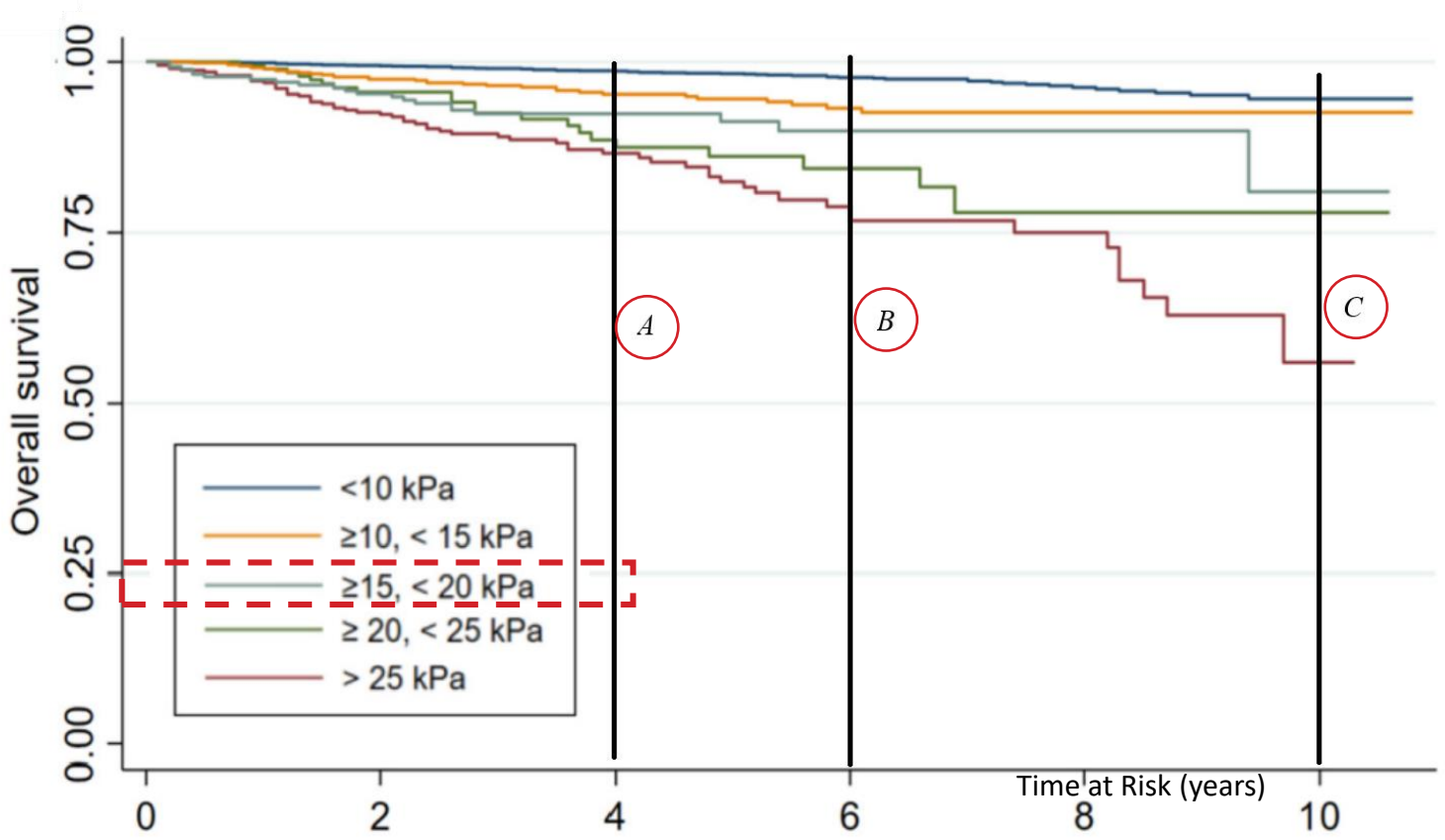
- Measure
- Annualize
- Ratio



Source: Braude, et al. Liver International. 2023;43:90–99.

Where/What Would You Measure?

Key Case Facts:
Liver Stiffness = 16kPa



# of Years

A: 4

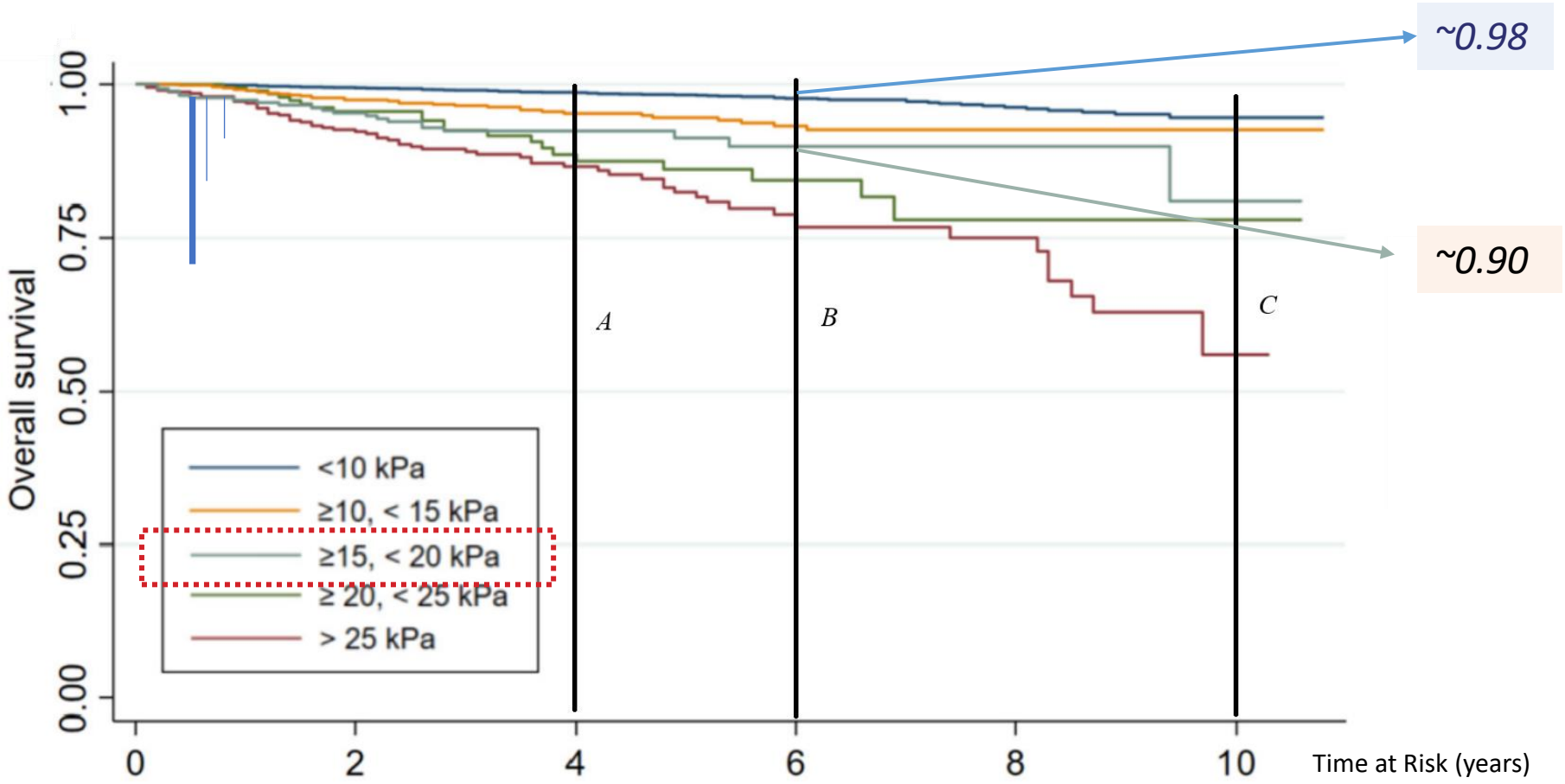
B: 6

C: 10

Caution when the "steps" get large

Where/What Would You Measure?

Key Case Facts:
Liver Stiffness = 16kPa



Steps 2 & 3: Annualize and Ratio

Key Case Facts:
Liver Stiffness = 16kPa

After you measure you come up with:

$P_{0\text{-}6}$ (<5 kPa) = 0.98

$P_{0\text{-}6}$ (15-20 kPa) = 0.9

$Q_{0\text{-}6}$ (<5 kPa) = 0.02

1 - $P_{0\text{-}6}$ (<5 kPa)

$Q_{0\text{-}6}$ (15-20 kPa) = 0.1

1 - $P_{0\text{-}6}$ (15-20 kPa)

Is the Mortality Ratio (MR)=5?

Annualize:

Take the 6th root:

$\boldsymbol{p}_{0\text{-}6}$ (<5 kPa) = $0.98^{\wedge(1/6)}$ = 0.9966

$\boldsymbol{p}_{0\text{-}6}$ (15-20 kPa) = $0.9^{\wedge(1/6)}$ = 0.9826

$\mathbf{q}_{0\text{-}6}$ (<5 kPa) = 1- 0.9966 = 0.0034

$\mathbf{q}_{0\text{-}6}$ (15-20 kPa) = 1- 0.9826 = 0.0174

MR = 0.0174/0.0034 = 5.11

Case 1 Notes:

Why did this work?

The study had an age range very close to our applicant's age

What if it had not?

Adjusting for age differences

- The proportional life expectancy (PLE) technique

The study came with its own, natural, comparison group (the group with normal liver stiffness)

What if it had not?

Creating a comparison population

- Easier than you remember

Motivating Case #2

Your company has a product that is a combination of permanent life insurance with a long term care rider.

It is set up to allow an offer to anyone with an anticipated mortality risk of Table 8/H or less as long as there are no severe morbidity concerns.

A 61-year-old woman recently applied and, due to her history of ischemic cardiomyopathy with an EF of 36%, she was declined.

The agent has appealed the case all the way to the head of US business, and you are now asked to provide justification for believing the mortality ratio is higher than Table 8/H (200 debits or 300%).

How can you do this without taking all day?

Article

Key Case Facts:
61-Year-Old Woman, EF of 35%

Table 1 Baseline data by aetiology of heart failure in all individuals

Variable	Total (*n* = 30 946)	IHD (*n* = 17 778)	Non-IHD (*n* = 13 168
Age (years)	72.6 (12.2)	74.6 (10.4)	69.8 (13.7)
Age group			
<60 years	4367 (14.1%)	1596 (9.0%)	2771 (21.0%)
60 to <70 years	6633 (21.4%)	3567 (20.1%)	3066 (23.3%)
70 to <80 years	9698 (31.3%)	6062 (34.1%)	3636 (27.6%)
≥80 years	10 248 (33.1%)	6553 (36.9%)	3695 (28.1%)
Sex			
Male	20 081 (64.9%)	12 023 (67.6%)	8058 (61.2%)
Female	10 865 (35.1%)	5755 (32.4%)	5110 (38.8%)

Swedish study of
Ischemic HD vs. non-IHD
Between 2000 & 2012

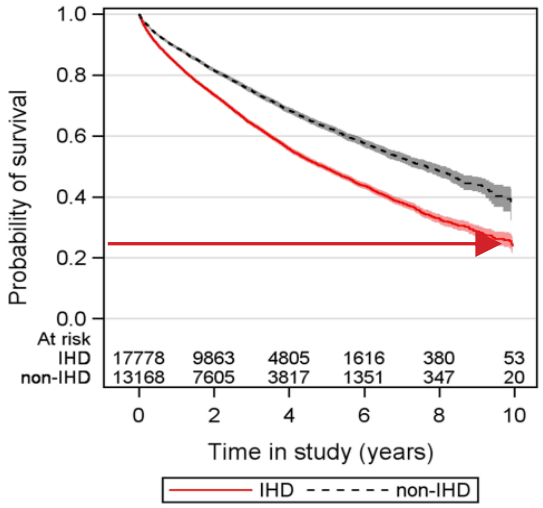


Table 3 Adjusted Cox proportional hazards models for time to death: IHD vs. non-IHD for selected subgroups

	Model 1		Model 2		Model 3	
	HR (95% CI)	*P*-value	HR (95% CI)	*P*-value	HR (95% CI)	*P*-value
All individuals	1.23 (1.18–1.28)	<0.0001*	1.18 (1.13–1.23)	<0.0001*	1.16 (1.11–1.22)	<0.0001*
Sex						
Male	1.25 (1.18–1.31)	0.40**	1.19 (1.13–1.26)	0.45**	1.16 (1.10–1.23)	0.83**
Female	1.20 (1.13–1.28)		1.16 (1.09–1.23)		1.15 (1.08–1.24)	
Age (group)						
<60 years	1.58 (1.34–1.88)	<0.0001**	1.62 (1.36–1.92)	<0.0001**	1.56 (1.30–1.87)	<0.0001**
60 to <70 years	1.48 (1.33–1.65)		1.43 (1.28–1.59)		1.42 (1.27–1.59)	
70 to <80 years	1.29 (1.20–1.39)		1.24 (1.15–1.33)		1.18 (1.09–1.28)	
≥80 years	1.16 (1.10–1.23)		1.11 (1.05–1.17)		1.10 (1.04–1.17)	
EF (group)						
<30%	1.55 (1.44–1.67)	<0.0001**	1.43 (1.32–1.54)	<0.0001**	1.39 (1.28–1.51)	<0.0001**
30–39%	1.30 (1.20–1.41)		1.24 (1.14–1.35)		1.20 (1.10–1.31)	
40–49%	1.09 (1.00–1.19)		1.06 (0.98–1.16)		1.12 (1.02–1.23)	
≥50%	1.03 (0.96–1.12)		1.00 (0.92–1.08)		0.96 (0.88–1.04)	
HF duration						
<6 months	1.16 (1.09–1.23)	0.71**	1.19 (1.12–1.26)	0.75**	1.18 (1.11–1.26)	0.37**
≥6 months	1.18 (1.11–1.24)		1.17 (1.11–1.24)		1.14 (1.07–1.21)	

CI, confidence interval; EF, ejection fraction; HF, heart failure; HR, hazard ratio; IHD, ischaemic heart disease; IQR, inter-quartile range; non-IHD, non-ischaemic heart disease.
Model 1: adjusted for age and sex (unless subgroup variable). Model 2: additionally adjusted for EF (group) and HF duration (unless subgroup variables). Model 3: additionally adjusted for index period, smoking, hypertension, atrial fibrillation, diabetes, lung disease, creatinine clearance, haemoglobin, systolic blood pressure, New York Heart Association class, angiotensin-converting enzyme inhibitors/angiotensin-converting enzyme inhibitors, beta-blockers, mineralocorticoid receptor antagonists, diuretics, digoxin, statins, oral anticoagulants, peripheral artery disease, stroke/transient ischaemic attack, cancer, follow-up specialty, and device therapy. For categorical variables, missing values were treated as a single, unknown category. For continuous variables, missing values were not imputed and therefore excluded from Model 3. Missing data in the analysis of HF duration, Model 3: 2595 (8.4%). Missing data in the analysis of other variables, Model 3: 2399 (7.8%).
**P*-value.
***P*-value for interaction.

Silverdal J, Sjöland H, Bollano E, Pivodic A, Dahlström U, Fu M. Prognostic impact over time of ischaemic heart disease vs. non-ischaemic heart disease in heart failure. ESC Heart Fail. 2020 Feb;7(1):264-273. doi: 10.1002/ehf2.12568. Epub 2020 Jan 7. PMID: 31908162; PMCID: PMC7083496.

Generate an Estimate

Key Case Facts:
61-Year-Old Woman, EF of 35%

- **Measure:** P_{10} ~ 25% for IHD
- **Annualize:** p = 0.25^(1/10) = 0.87

  q = 0.13
- **Ratio:**
  - To what? No non-disease comparator in the article
  - Use the Swedish population
  - P'_{10} = 0.49647, p' = 0.932, q' = 0.068
  - MR = 0.13 / 0.068 = 1.91

World Survival Calculator

Uses the Human Mortality Database to calculate expected survival for any available country and year

Input

A	B	C	D	E
				Choose:
Choose Country:			Country:	SWE
Select Year of Table to use:				2006
			% Mortality	100
%male	67%	0%	0%	0%

Age	Enter n for each cell below
54	1596
64	3567
74	6062
84	6553

Output

n	q	P'	
17778	0	1	0
16875.29	0.050777	0.949223	1
15910.55	0.057169	0.894957	2
14994.06	0.057602	0.843405	3
14032.38	0.064138	0.789311	4
13082.63	0.067682	0.735889	5
12168.08	0.069906	0.684446	6
11252.02	0.075284	0.632918	7
10402.55	0.075495	0.585136	8
9601.416	0.077013	0.540073	9
8826.241	0.080735	0.49647	10

Case #2

Key Case Facts:
61-Year-Old Woman, EF of 35%

- 1.91 = 91 debits
  - **Are we "good to go?"**
- Average age of study = 74
- Age of applicant = 61

So, how can we figure what the debits load should be for someone this much younger than the study group?

The Proportional Life Expectancy (PLE) Method

$$\mathbf{MR_{age1} * ex_{age2}/ex_{age1} = MR_{age2}}$$

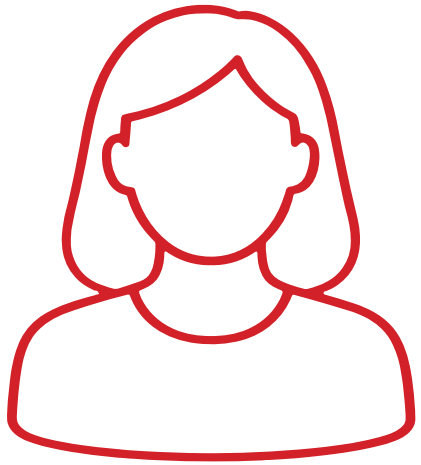
For age1 = 74 and age2 = 61, from 2006 Swedish life table (weighted average of ⅔ male and ⅓ female LEs):

1.91 * 21.95 / 11.92 = 3.52

(252 debits, Table J)

Motivating Case #3

50-year-old female



An applicant has appealed a rating decision on a recent case.

The PI is female, age 50 in normal health except that a brain image for headache revealed an incidental finding of a 7.5 mm aneurysm in the left middle cerebral artery.

You offered insurance at a substandard rate according to your underwriting manual. The PI wants justification for the rating.

You find a recent review article on unruptured intracranial aneurysm.

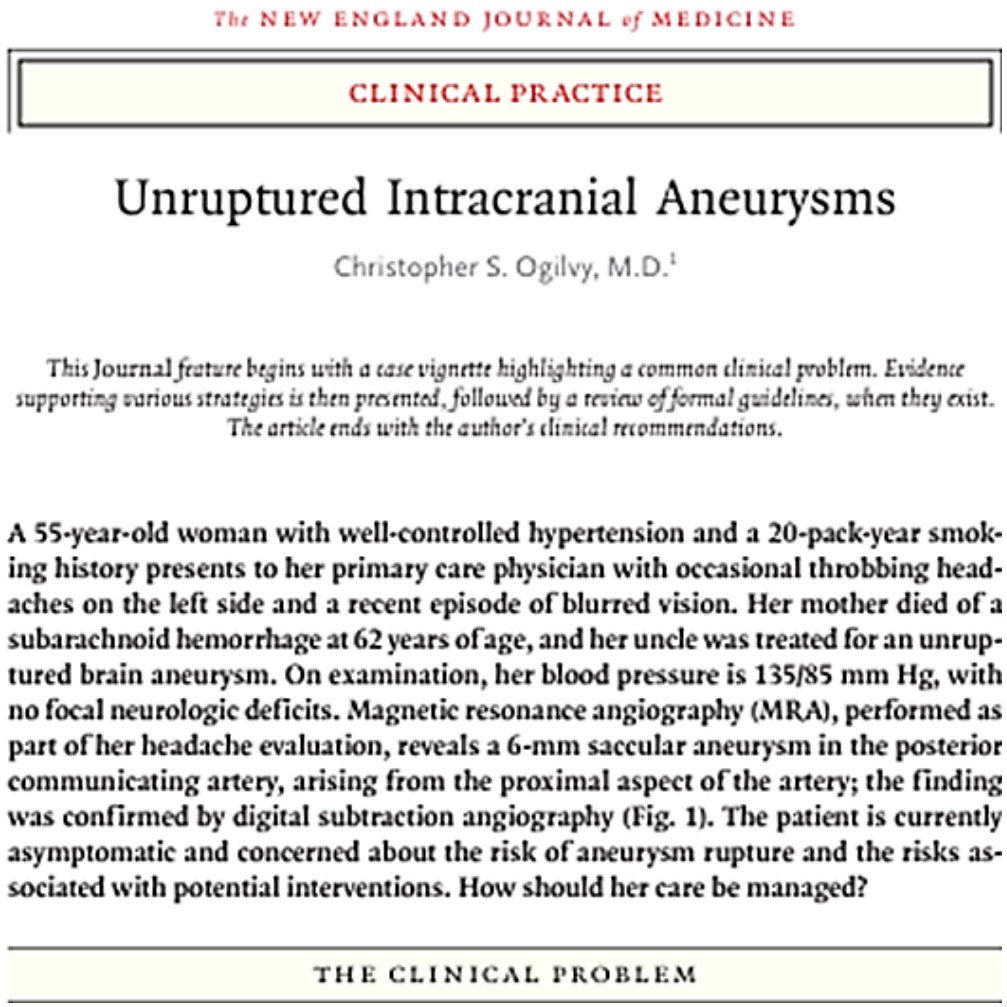
Does it support your rating?

Unruptured Intracranial Aneurysm

Clinical risk stratification
=
Evidence-based underwriting

Clinical problem is management decision

Risk of rupture aligns with morbidity and mortality risk assessment



The NEW ENGLAND JOURNAL of MEDICINE

CLINICAL PRACTICE

Unruptured Intracranial Aneurysms

Christopher S. Ogilvy, M.D.[1]

This Journal feature begins with a case vignette highlighting a common clinical problem. Evidence supporting various strategies is then presented, followed by a review of formal guidelines, when they exist. The article ends with the author's clinical recommendations.

A 55-year-old woman with well-controlled hypertension and a 20-pack-year smoking history presents to her primary care physician with occasional throbbing headaches on the left side and a recent episode of blurred vision. Her mother died of a subarachnoid hemorrhage at 62 years of age, and her uncle was treated for an unruptured brain aneurysm. On examination, her blood pressure is 135/85 mm Hg, with no focal neurologic deficits. Magnetic resonance angiography (MRA), performed as part of her headache evaluation, reveals a 6-mm saccular aneurysm in the posterior communicating artery, arising from the proximal aspect of the artery; the finding was confirmed by digital subtraction angiography (Fig. 1). The patient is currently asymptomatic and concerned about the risk of aneurysm rupture and the risks associated with potential interventions. How should her care be managed?

THE CLINICAL PROBLEM

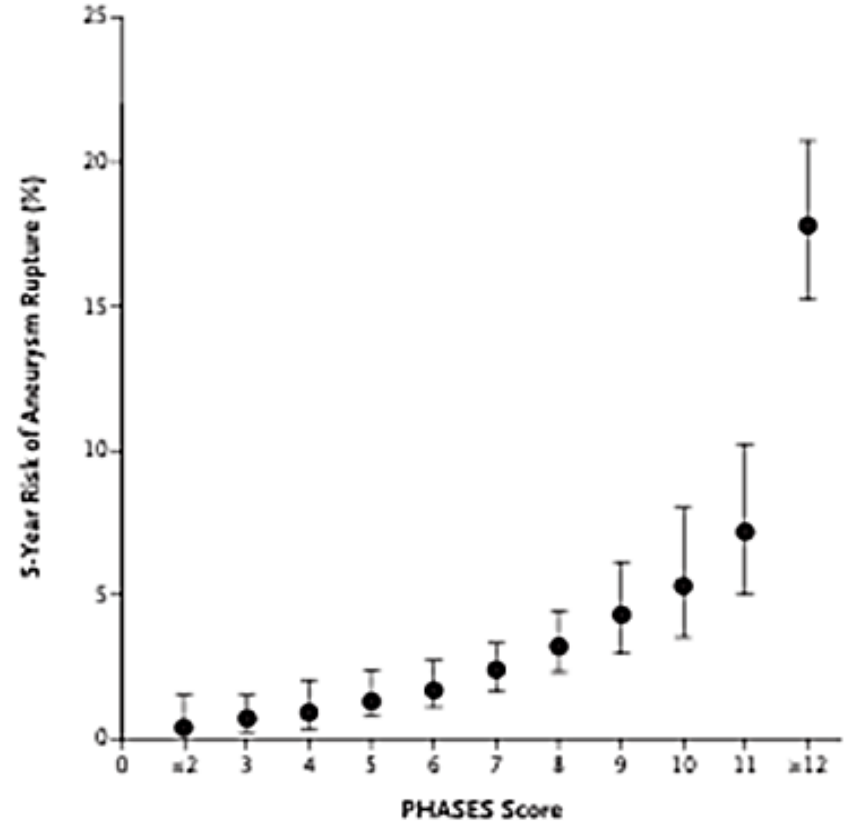
Risk Models

Table 2. Scoring Systems That Form the Basis of the Clinical Rationale for Monitoring Aneurysm Growth and Rupture.*

Aneurysm Growth	Aneurysm Rupture		
ELAPSS Scoring System[32]	PHASES Scoring System[33]	Finnish Scoring System[10]	UCAS Scoring System[34]
Earlier SAH Yes — 0 No — 1 Location of aneurysm ICA, ACA, or AComA — 0 MCA — 3 PComA or posterior circulation — 5 Age ≤60 yr — 0 >60 yr — 1 (per 5-yr interval after 60 yr) Population North America, China, Europe (other than Finland) — 0 Japan — 1 Finland — 7 Size of aneurysm, mm 1.0 to 2.9 — 0 3.0 to 4.9 — 4 5.0 to 6.9 — 10 7.0 to 9.9 — 13 ≥10.0 — 22 Shape of the aneurysm Regular — 0 Irregular — 4	Population North American, European (not Finnish) — 0 Japanese — 3 Finnish — 5 Hypertension No — 0 Yes — 1 Age <60 yr — 0 ≥70 yr (per 5 yr) — 1 Size <7.0 mm — 0 7.0 to 9.9 mm — 3 10.0 to 19.9 mm — 6 ≥20.0 mm — 10 Earlier SAH from another aneurysm No — 0 Yes — 1 Site of aneurysm ICA — 0 MCA — 2 ACA, PComA, or posterior circulation — 4	Age at diagnosis <40 yr — 2 Smoking status at baseline Current smoker — 2 Maximum diameter of UIA ≥7 mm — 3 Aneurysm location ACA — 5 ICA — 4 PComA — 2	Age <70 yr — 0 ≥70 — 1 Sex Male — 0 Female — 1 Hypertension No — 0 Yes — 1 Location ICA — 0 ACA or VA — 1 MCA or BA — 2 AComA or ICA–PComA — 3 Daughter sac No — 0 Yes — 1
Score and Growth Risk	**Score and Rupture Risk**		
Score <5 3-yr risk: 5.0% 5-yr risk: 8.4% Score of 5–9 3-yr risk: 7.8% 5-yr risk: 13.0% Score of 10–14 3-yr risk: 11.7% 5-yr risk: 19.3% Score of 15–19 3-yr risk: 17.5% 5-yr risk: 28.1% Score of 20–24 3-yr risk: 25.8% 5-yr risk: 39.9% Score ≥25 3-yr risk: 42.7% 5-yr risk: 60.8%	Score ≤2 5-yr risk: 0.4% Score of 3 5-yr risk: 0.7% Score of 4 5-yr risk: 0.9% Score of 5 5-yr risk: 1.3% Score of 6 5-yr risk: 1.7% Score of 7 5-yr risk: 2.4% Score of 8 5-yr risk: 3.2% Score of 9 5-yr risk: 4.3% Score of 10 5-yr risk: 5.3% Score of 11 5-yr risk: 7.2% Score ≥12 5-yr risk: 17.8%	Score of 0 Annual risk: 0% 10-yr risk: 0% 30-yr risk: 0% Score of 1–4 Annual risk: 0.6% 10-yr risk: 3% 30-yr risk: 18% Score of 5–8 Annual risk: 2.2% 10-yr risk: 16% 30-yr risk: 49% Score of 9–12 Annual risk: 6.8% 10-yr risk: 60% 30-yr risk: 80%	Score of 0 3-yr risk: 0.2% Score of 1 3-yr risk: 0.4% Score of 2 3-yr risk: 0.6% Score of 3 3-yr risk: 0.9% Score of 4 3-yr risk: 1.4% Score of 5 3-yr risk: 2.3% Score of 6 3-yr risk: 3.7% Score of 7 3-yr risk: 5.8% Score of 8 3-yr risk: 7.6% Score of 9 3-yr risk: 17%

* Scores in the ELAPSS (earlier subarachnoid hemorrhage, location of aneurysm, age, population, and size and shape of aneurysm) system range from 0 to 40, with higher scores indicating a greater risk of growth. Scores in the PHASES (population, hypertension, age, size of aneurysm, earlier subarachnoid hemorrhage, and site of aneurysm) system range from 0 to 22, with higher scores indicating a greater risk of rupture. Scores in the Finnish system range from 0 to 12, with higher scores indicating a greater risk of rupture. Scores in the UCAS system range from 0 to 15, with higher scores indicating a greater risk of rupture. AComA denotes anterior communicating artery, and UIA unruptured intracranial aneurysm.

Five-year Risk of Rupture PHASES Score



PHASES Score	Hazard Ratio for Rupture over 5 Yr (95% CI)
≥2	0.4 (0.1–1.5)
3	0.7 (0.2–1.5)
4	0.9 (0.3–2.0)
5	1.3 (0.8–2.4)
6	1.7 (1.1–2.7)
7	2.4 (1.6–3.3)
8	3.2 (2.3–4.4)
9	4.3 (2.9–6.1)
10	5.3 (3.5–8.0)
11	7.2 (5.0–10.2)
≥12	17.8 (15.2–20.7)

Figure 3. Five-Year Risk of Intracranial Aneurysm Rupture According to PHASES Score.

The PHASES score is based on population, hypertension, age, size of aneurysm, earlier subarachnoid hemorrhage, and site of aneurysm.[18] Scores range from 0 to 22, with higher scores indicating a higher risk of rupture.

Parameters

Mortality Projection

- 50% of cases survive rupture (at 3 mos.)
- 5-yr cumulative Q M NS age 60 ~ 1%
- If mortality up to T-2 is standard, then 1.5% rupture risk/0.75% Q is acceptable.
- PHASES 6 fits standard class
- Phases > 9 expect intervention

Phases	Annual Mortality (q)
7	0.7%
8	1.5%
9	2.6%

Rating Structure

Rupture risk, with adjustment for age > 70,
is independent of age/sex

Flat extra fits best

Caveats

1. Is it precise?
2. Undetected ICA is not rare, so rupture from known lesion is not entirely extra mortality
3. Used a typical age to define standard
4. Profit?

Technical Aspects

Mortality Tables
&
Selection Period

Mortality Tables

Which One to Use?

US Life Tables	Valuation Basic Table (VBT)	Commissioners Standard Ordinary (CSO)
National Vital Statistics Reports [General Population]		

Mortality Tables

Which One to Use?

US Life Tables

- Official data on vital events in the United States
- Covers births, deaths, marriages, divorces, etc.
- Leading causes of death

Valuation Basic Table

- Mortality tables used in the life insurance industry to estimate the expected mortality rates of policyholders.

Commissioners Standard Ordinary

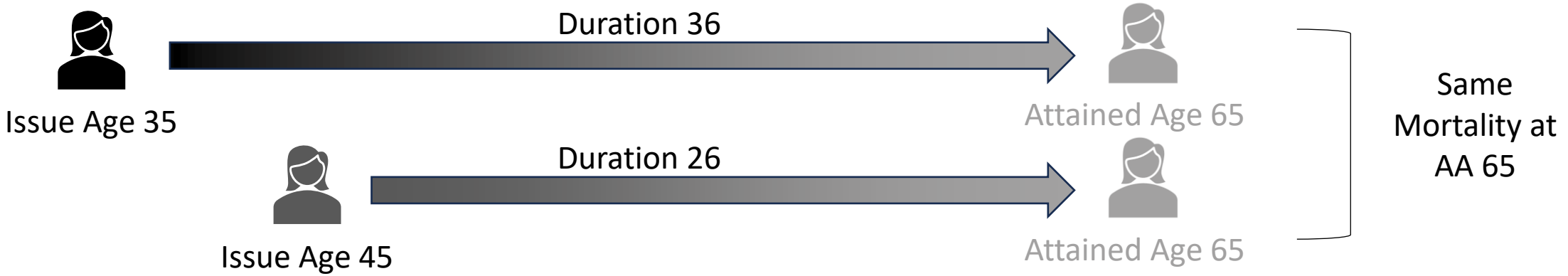
- Mortality Rates with Margin used for regulatory purposes
- These tables are used to determine the minimum reserve requirements for life insurance policies.
- Used 7 Pay Premium Test, MEC, and setting minimum Reserves

Valuation Basic Table (VBT)

- **Where to find:** https://www.soa.org/resources/experience-studies/2015/2015-valuation-basic-tables/
- **Base Table Variations:**
  - Smoker Distinct vs Uni-smoke
  - Age Nearest Birthday (ANB) vs. Age Last Birthday (ALB)
  - Gender
- **Additional Variations**
  - Relative Risk Tables: i.e. to account for different risk classes.
  - E.g. RR90 would be ~90% of the base table and grades into the base table by Attained Age 94.

Selection & Ultimate Table

- VBT/CSO mortality tables are based on a concept of Select & Ultimate.
- Select is the Selection period (traditionally ~25 Years) and then rates are Ultimate.
- This would indicate that ‘underwriting selection’ exists for 25 years before wearing off.
- Ultimate rates mean those that are:



Note – This is the VBT design. Individual company views do vary.

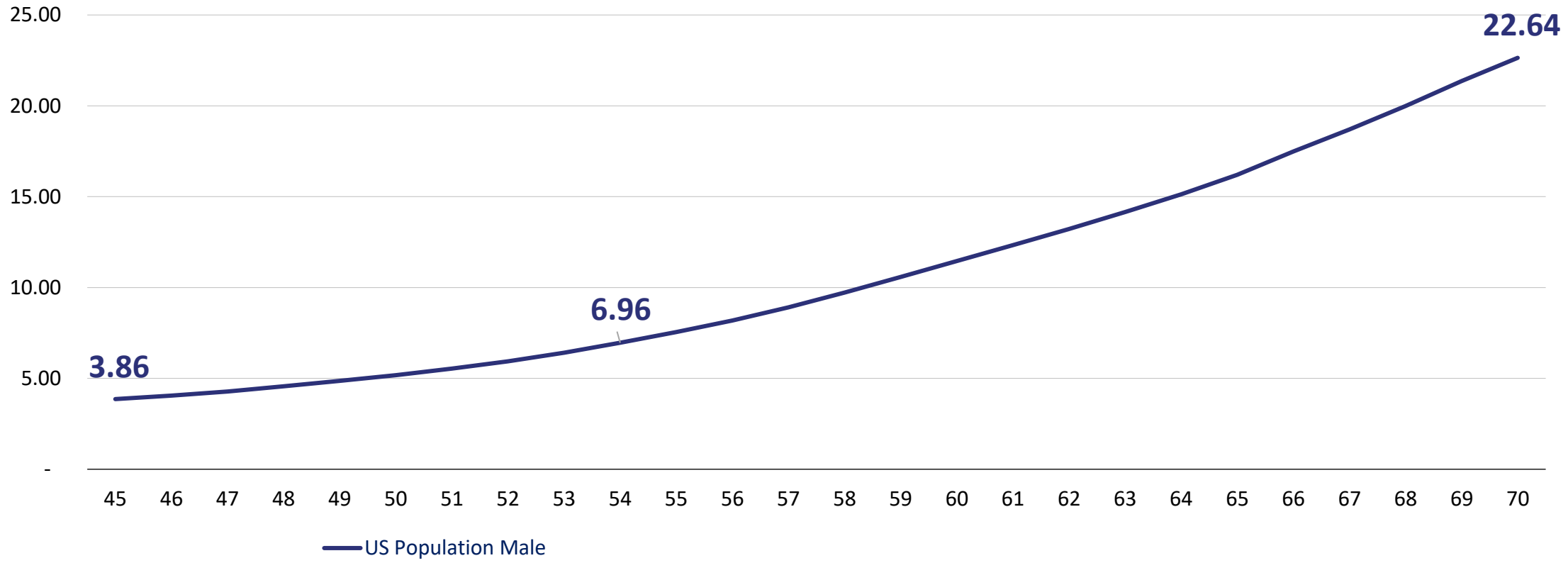
AA = Attained Age

How to Read a Select & Ultimate (S&U) Table

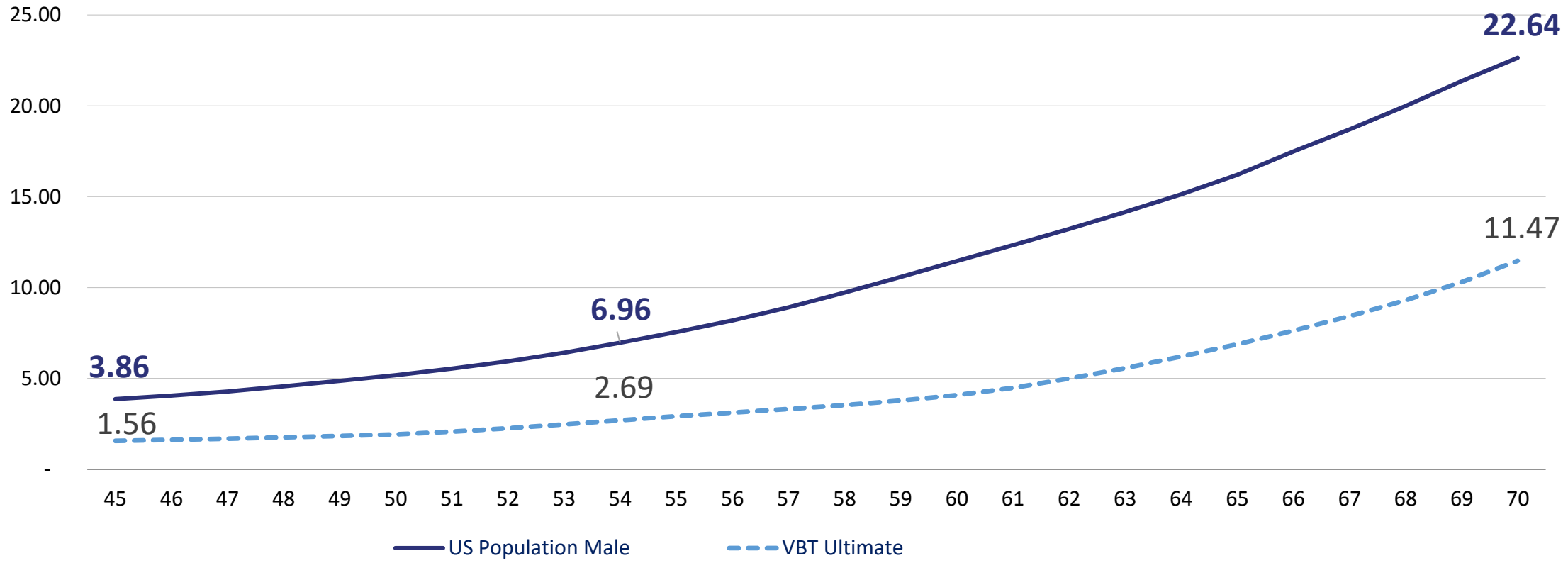
Iss. Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Ult.	Att. Age
30	0.16	0.17	0.22	0.26	0.28	0.31	0.34	0.39	0.45	0.56	0.64	0.70	0.75	0.85	0.93	1.03	1.16	1.25	1.34	1.47	1.65	1.86	2.09	2.35	2.64	2.91	55
31	0.13	0.15	0.22	0.26	0.28	0.31	0.34	0.41	0.49	0.59	0.65	0.71	0.78	0.87	0.96	1.10	1.23	1.33	1.44	1.60	1.79	2.03	2.28	2.57	2.87	3.12	56
32	0.14	0.15	0.23	0.27	0.30	0.32	0.38	0.44	0.54	0.64	0.70	0.75	0.82	0.91	1.03	1.17	1.30	1.42	1.56	1.73	1.95	2.21	2.49	2.79	3.08	3.32	57
33	0.14	0.16	0.24	0.29	0.31	0.35	0.41	0.49	0.59	0.68	0.73	0.78	0.86	0.97	1.10	1.24	1.39	1.52	1.67	1.87	2.11	2.40	2.71	3.01	3.29	3.53	58
34	0.15	0.17	0.26	0.30	0.34	0.40	0.46	0.54	0.64	0.72	0.76	0.81	0.92	1.05	1.18	1.33	1.48	1.62	1.80	2.02	2.30	2.62	2.94	3.24	3.51	3.78	59
35	0.15	0.17	0.28	0.33	0.38	0.43	0.48	0.59	0.68	0.75	0.79	0.88	1.00	1.13	1.27	1.42	1.58	1.74	1.94	2.20	2.51	2.86	3.19	3.49	3.76	4.08	60
36	0.15	0.19	0.30	0.36	0.42	0.48	0.54	0.64	0.72	0.78	0.86	0.96	1.08	1.22	1.36	1.52	1.69	1.87	2.10	2.41	2.76	3.13	3.46	3.76	4.08	4.48	61
37	0.15	0.20	0.32	0.40	0.46	0.51	0.60	0.69	0.75	0.84	0.94	1.05	1.18	1.32	1.47	1.63	1.82	2.03	2.31	2.66	3.05	3.42	3.75	4.08	4.48	4.99	62
38	0.15	0.23	0.36	0.42	0.49	0.57	0.66	0.73	0.81	0.92	1.03	1.15	1.29	1.44	1.59	1.77	1.98	2.23	2.57	2.97	3.37	3.75	4.08	4.48	4.95	5.56	63
39	0.16	0.26	0.39	0.46	0.53	0.63	0.71	0.79	0.89	1.01	1.14	1.26	1.41	1.57	1.74	1.93	2.18	2.49	2.88	3.31	3.72	4.08	4.48	4.91	5.53	6.20	64
40	0.17	0.30	0.43	0.51	0.59	0.68	0.76	0.85	0.97	1.12	1.25	1.38	1.55	1.73	1.91	2.13	2.43	2.80	3.24	3.69	4.08	4.48	4.88	5.45	6.16	6.88	65
41	0.19	0.35	0.47	0.55	0.64	0.73	0.81	0.92	1.06	1.22	1.36	1.51	1.70	1.90	2.11	2.38	2.74	3.17	3.64	4.08	4.48	4.87	5.37	6.08	6.81	7.62	66
42	0.22	0.39	0.51	0.59	0.69	0.77	0.86	0.99	1.16	1.32	1.47	1.64	1.86	2.09	2.34	2.67	3.10	3.58	4.06	4.48	4.86	5.31	5.91	6.65	7.49	8.42	67
43	0.26	0.43	0.54	0.65	0.74	0.82	0.92	1.08	1.26	1.43	1.59	1.79	2.05	2.31	2.60	3.00	3.50	4.01	4.48	4.86	5.27	5.82	6.53	7.36	8.28	9.30	68
44	0.31	0.46	0.58	0.71	0.79	0.87	1.00	1.18	1.36	1.53	1.72	1.96	2.26	2.56	2.90	3.36	3.91	4.43	4.85	5.25	5.73	6.42	7.25	8.17	9.17	10.30	69
45	0.35	0.49	0.63	0.77	0.84	0.94	1.10	1.29	1.47	1.65	1.88	2.16	2.49	2.82	3.22	3.74	4.33	4.84	5.25	5.72	6.27	7.15	8.11	9.13	10.21	11.47	70
46	0.41	0.51	0.68	0.83	0.91	1.03	1.22	1.42	1.59	1.80	2.07	2.39	2.74	3.11	3.57	4.13	4.74	5.23	5.71	6.23	6.94	8.01	9.06	10.17	11.44	12.86	71
47	0.45	0.53	0.73	0.90	1.00	1.16	1.37	1.55	1.73	1.99	2.30	2.65	3.01	3.42	3.92	4.53	5.16	5.70	6.19	6.81	7.74	9.00	10.15	11.42	12.84	14.52	72
48	0.49	0.56	0.80	0.97	1.11	1.32	1.52	1.69	1.90	2.21	2.57	2.92	3.30	3.74	4.29	4.96	5.62	6.18	6.77	7.55	8.70	10.13	11.40	12.82	14.47	16.46	73
49	0.51	0.61	0.87	1.06	1.25	1.48	1.67	1.84	2.10	2.48	2.86	3.20	3.58	4.06	4.67	5.39	6.09	6.71	7.42	8.39	9.77	11.36	12.80	14.43	16.34	18.67	74
50	0.52	0.68	0.96	1.16	1.40	1.64	1.81	2.01	2.34	2.78	3.16	3.48	3.88	4.42	5.10	5.87	6.61	7.30	8.17	9.36	10.95	12.63	14.33	16.32	18.55	21.14	75
51	0.53	0.77	1.06	1.28	1.55	1.77	1.93	2.18	2.61	3.10	3.46	3.83	4.22	4.83	5.59	6.42	7.20	8.01	9.07	10.46	12.18	13.98	15.96	18.28	20.91	23.85	76
52	0.53	0.88	1.18	1.42	1.70	1.88	2.06	2.39	2.91	3.43	3.78	4.19	4.64	5.37	6.21	7.09	7.93	8.88	10.16	11.77	13.65	15.58	17.78	20.44	23.47	26.83	77
53	0.53	0.99	1.31	1.60	1.85	2.00	2.24	2.65	3.24	3.77	4.16	4.59	5.17	6.03	6.95	7.91	8.88	10.12	11.45	13.22	15.25	17.44	19.95	22.95	26.34	30.13	78
54	0.54	1.09	1.46	1.81	1.99	2.17	2.47	2.96	3.60	4.14	4.55	5.06	5.88	6.87	7.89	8.88	10.08	11.37	13.04	14.98	17.16	19.84	22.88	26.26	29.78	33.90	79
55	0.55	1.17	1.63	1.96	2.14	2.32	2.69	3.34	4.00	4.55	5.06	5.76	6.76	7.87	8.87	10.03	11.30	12.88	14.84	17.08	19.53	22.63	26.01	29.70	33.90	38.26	80

This is an extract of the table shown to demonstration the table structure
2015 VBT Male Nonsmoker ANB Mortality Rates per 1000

Comparison: Select vs. Select & Ultimate

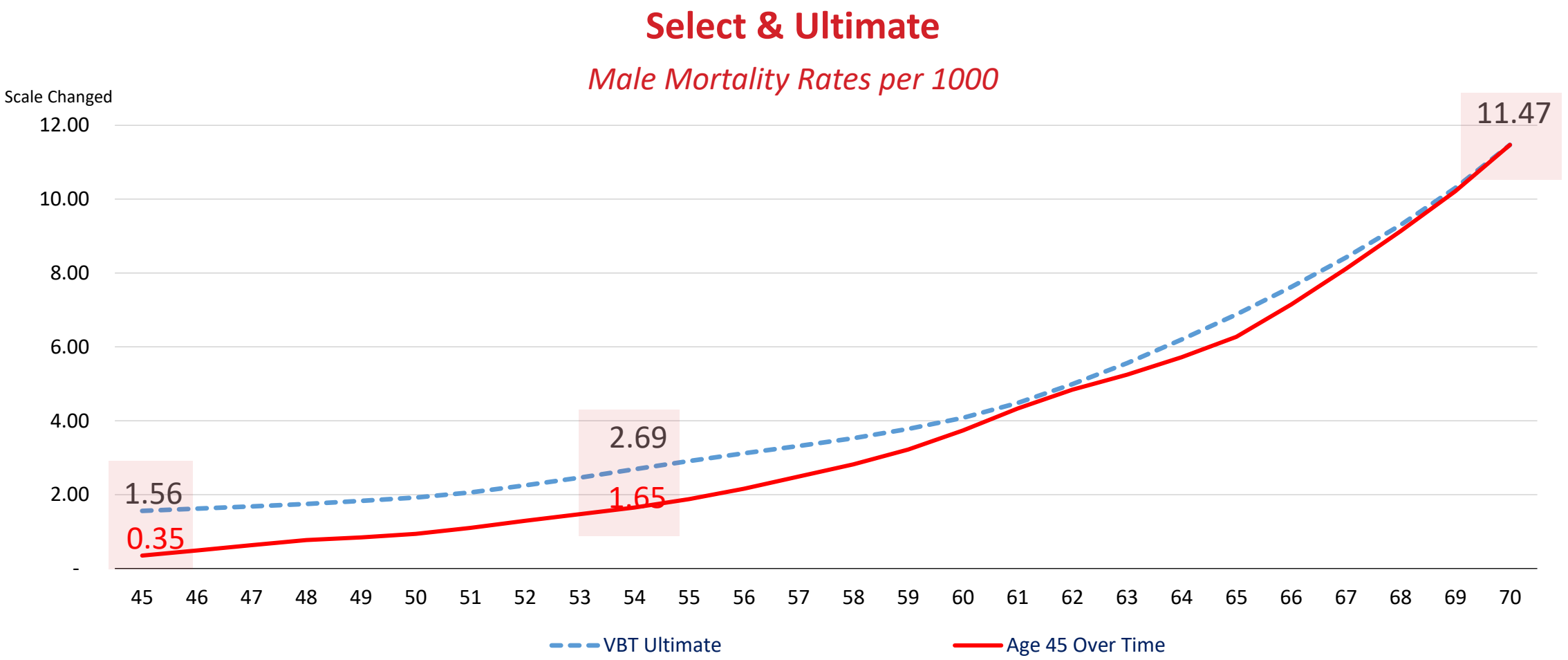


Comparison: Select vs. Select & Ultimate



Insurance tables are Male NS, ANB

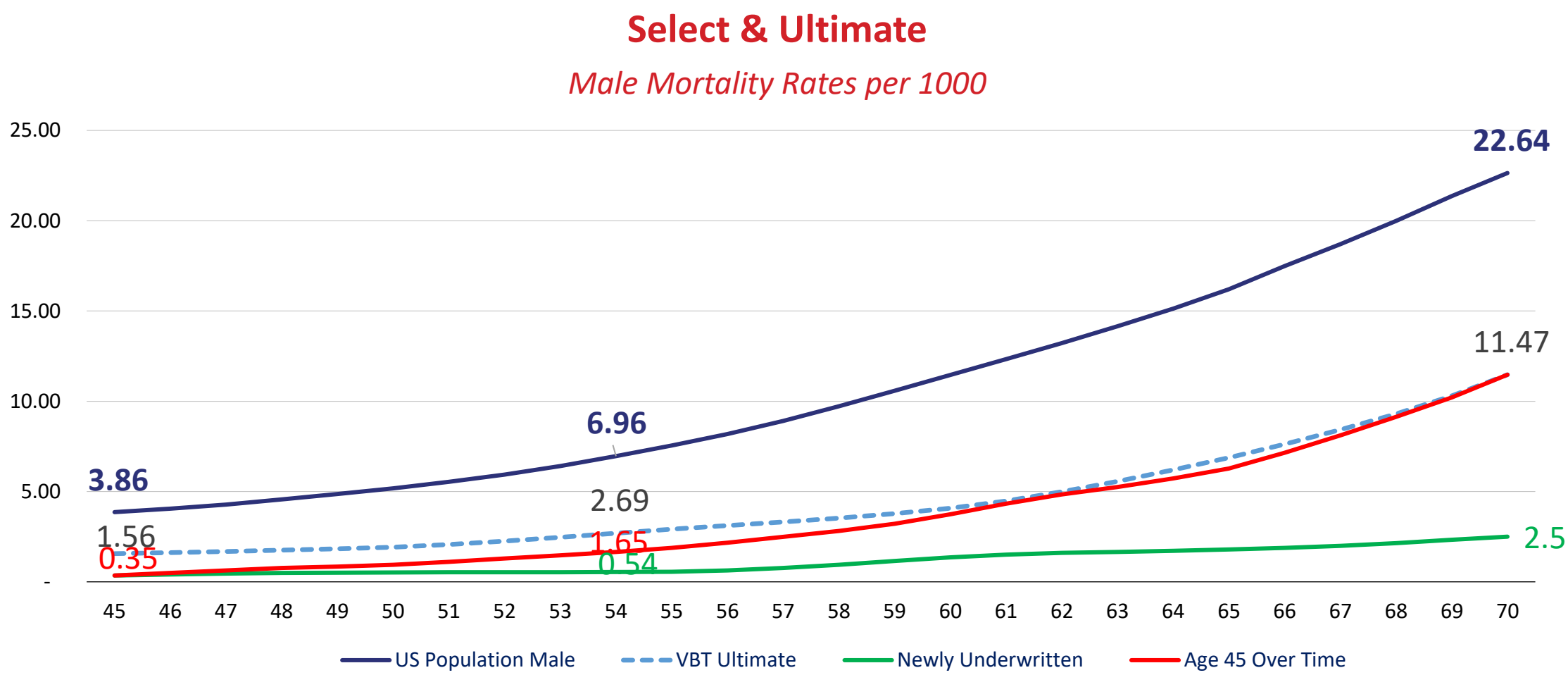
Comparison: Select vs. Select & Ultimate



Comparison: Select vs. Select & Ultimate

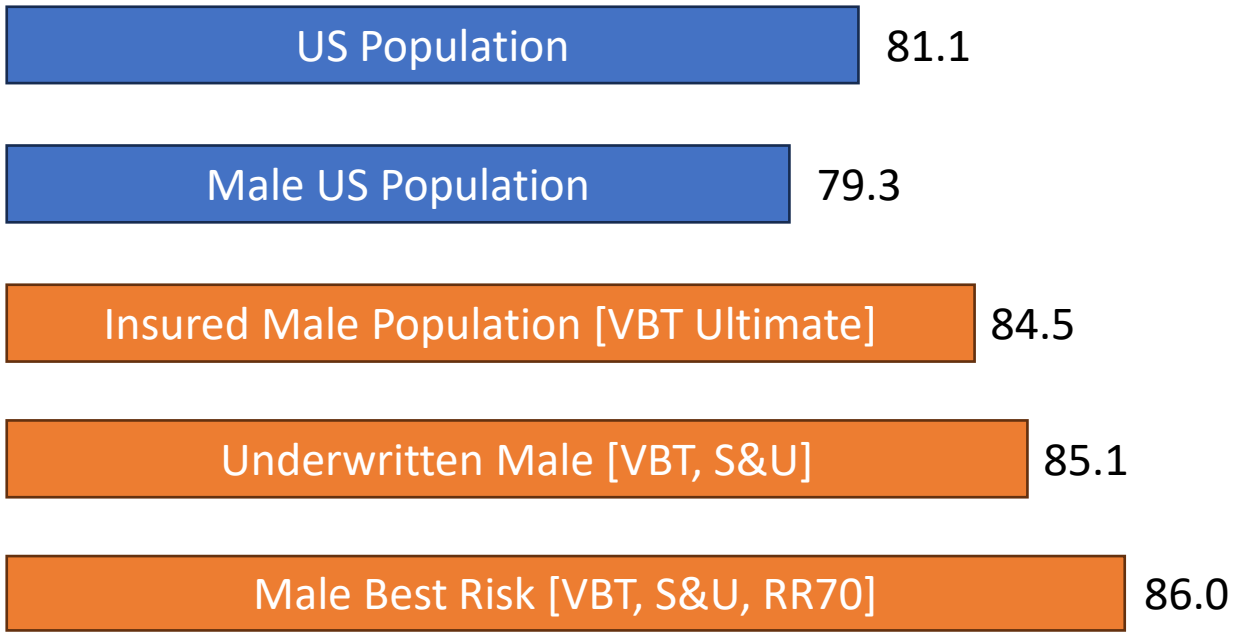
Insurance tables are Male NS, ANB

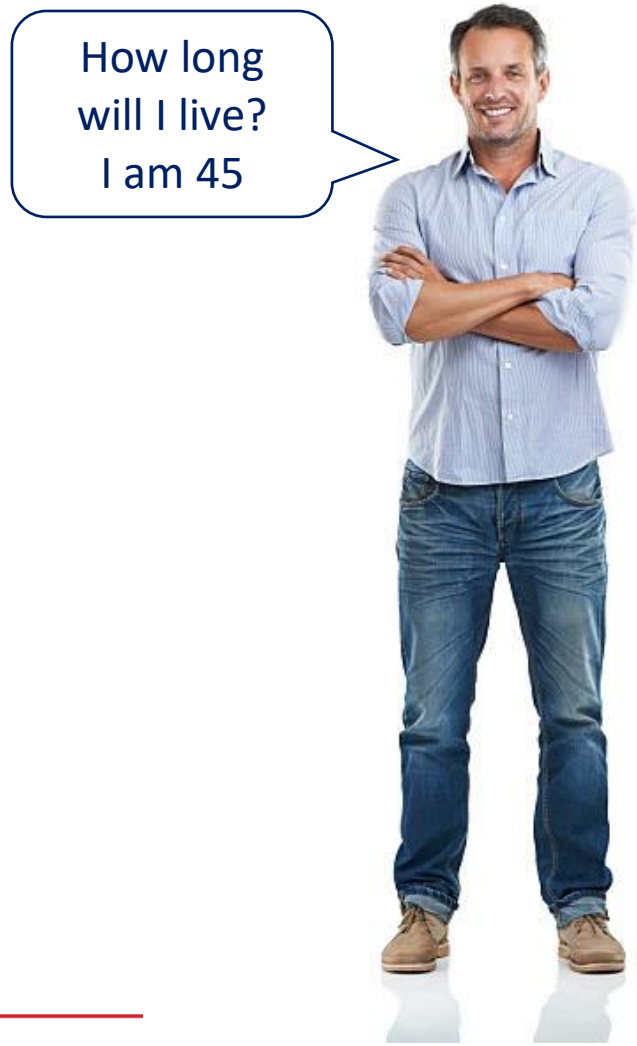
Comparison: Select vs. Select & Ultimate



Insurance tables are Male NS, ANB

Life Expectancy: How Long Will I Live?





Is 1 Year Difference a Big Deal?

Example

Face Amount : $1,000,000

Company Investment Rate : 5%

Investment Earnings on 1 Year Delay of Death

$50,000

$1m * 5%

Table Rating vs. Flat Extra

[Equivalence]

Table Rating & Flat Extras

Table Ratings

- **Multiplies** against the base mortality table
- Ideal for chronic or long-term health conditions
- Generally permanent
- Likely commissionable on Term & Whole Life
- On UL, depends on how companies define Target (Commissionable) Premium

Flat Extras

- **Added** to the base mortality table
- Ideal for hazards risks / occupations
- Can be Temporary or Permanent
- Commission generally not paid for Temporary Flat Extras

Table Rating and Flat Extras [Mortality]

Male, NS Issue Age 50, ANB

Table Ratings

Attained Age	Base Mortality	Table B [150%]
50	0.52	0.78
55	1.64	2.46
60	3.16	4.74
65	5.87	8.81
70	10.95	16.43
75	21.14	31.71

Flat Extras

Attained Age	Base Mortality	$5 per $1000 Flat Extra
50	0.52	5.52
55	1.64	6.64
60	3.16	8.16
65	5.87	10.87
70	10.95	15.95
75	21.14	26.14

Difference
~7.0x
~2.7x
~1.7x
~1.2x
~0.97x
~0.82x

Flat Extras & Table Ratings capture different risks, thus hard to convert from one to the other in any precise way.

Combining Debits

Example

An applicant has moderate heart disease rate +100 and a history of dysplastic nevi, one melanoma in situ with a strong family history of melanoma – worth 50 more debits.

Should the case be rated at +150 (combine the debits)?

OR

+100 as the primary death cause has been accounted for?

Arguments

+100: Primary Impairment

- Since the primary impairment has been accounted for, adding the second impairment would be improper since the applicant can only die from one cause.

+150: Combined Impairment

- While it is true that a given person can only die from one thing, risk assessment considers a large group of similar people, not just one person
- In a large group similar to the example, some in the group would die of CAD and some of melanoma and some of other causes.
- Can a person survive multiple simultaneous (independent) risks?
- Multiply P, don't add Q

Mathematical Demonstration

Inputs	
Baseline Mortality Rate:	0.0187
Debits from Impairment 1	200
Debits from Impairment 2	100
Debits from Impairment 3	

Total Debits (Old):	300

42M NS First Duration 2015VBT	0.00024
80M SM First Duration 2015VBT	0.01873
90M General USLT	0.1

Mortality rate from Impairment 1:	0.0374	Survival of Impairment 1:	0.9626
Mortality rate from Impairment 2:	0.0187	Survival of Impairment 2:	0.9813
Mortality rate from Impairment 3:	0	Survival of Impairment 3:	1

Baseline Survival:	0.9813

Overall Survival:	0.926935
Overall Mortality:	0.073064
New mortality ratio:	3.907199
New Debits:	290.7

Difference (old minus new):	9.3

Adding Debits Is More Correct Than Not

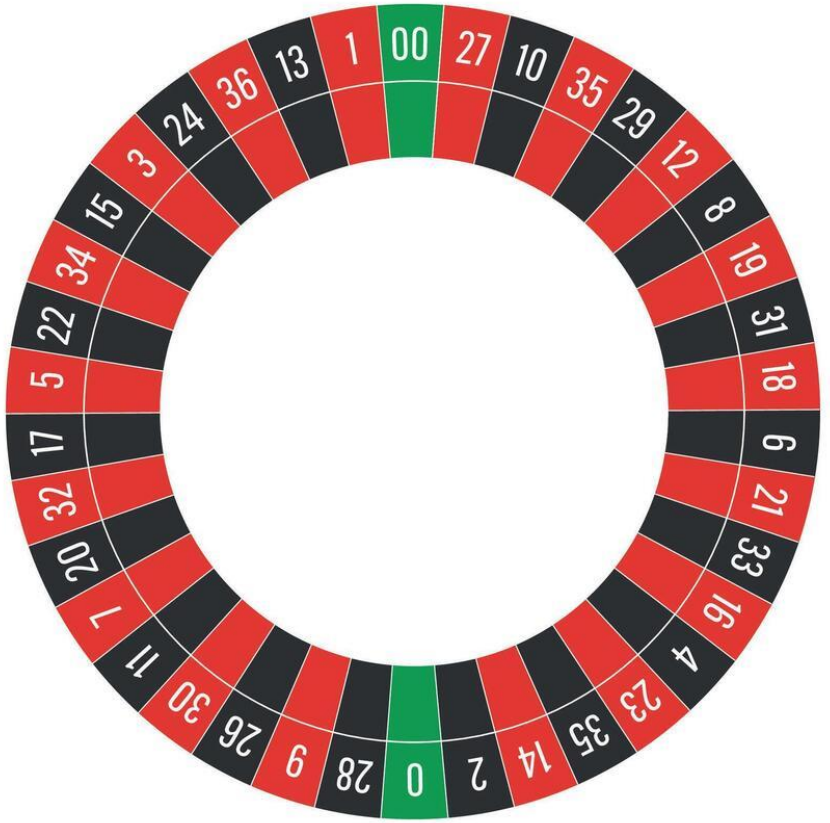
Combining Debits Does Slightly Over-estimate Total Risk

- Effect is very small when the baseline risk is low (which it nearly always is)
- Only becomes significant with much older applicants (about age 80+) with highly rated conditions

Which Game do you want to play?

Single Zero

Double Zero



Recap

1. Risk Assessment on the Fly
   - Case example on Liver Stiffness Measurement & watching out for ‘Steps
   - Ischemic cardiomyopathy and using World Survival Calculator
2. Select Periods
3. Table Ratings and Flat Extras
4. Duration of Table and Flat extras
5. Combining debits of different medical treatments
   ~~“You can only die from one condition”~~

Thank You!

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