Actuaries as Data Experts: Mortality… Measuring Trends… and Making Business Decisions

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SOCIETY OF ACTUARIES®

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Society of Actuaries Research Overview

- Focus on Actuarial Education and Research across current and growing practice areas:

  - Life / Annuities
  - Retirement / Pension
  - Finance / Investment
  - Health
  - Risk Management
  - Property/Casualty

  Predictive Modeling & Analytics
  Climate / Resource Sustainability
  Public Policy Research
  Insurance Regulation Research
  Post-Retirement Needs / Risks
  Academic Knowledge Extension

SOA Research Areas

- Experience Studies
  - Wide variety of life, health and retirement products across broad contingencies
  - Pension Mortality
  - 2017 Commissioners' Standard Ordinary Table for Individual Life Insurance
  - Long Term Care Incidence, Claim Continuance, Claim Utilization

SOA Research Areas

- Practice Area Research
  - Volunteer committees focusing on forward looking research for the profession

Cause of Death	Deaths per 100,000			% Change	
	2016	2017	2018	2016 to 2017	2017 to 2018
Heart	165.5	165.0	162.1	-0.3%	-1.8%
Cancer	155.8	152.5	148.5	-2.1%	-2.6%
Pulmonary	40.6	40.9	39.5	0.7%	-3.4%
Stroke	37.3	37.6	36.9	0.8%	-1.9%
Alzheimer's	30.3	31.0	30.4	2.3%	-1.9%
Diabetes	21.0	21.5	21.2	2.4%	-1.4%
Flu and pneumonia	13.5	14.3	14.8	5.9%	3.5%
Kidney	13.1	13.0	12.8	-0.8%	-1.5%
Liver	10.7	10.9	11.0	1.9%	0.9%
Septicemia	10.7	10.6	10.2	-0.9%	-3.8%
Hypertension	8.6	9.0	8.9	4.7%	-1.1%
Parkinson's	8.0	8.4	8.6	5.0%	2.4%
Pneumonitis	5.2	5.1	4.8	-1.9%	-5.9%
HIV	1.8	1.6	1.5	-11.1%	-6.3%
Subtotal	522.1	521.4	511.2	-0.1%	-2.0%
Other	206.7	210.5	209.0	1.8%	-0.7%
Total	728.8	731.9	720.2	0.4%	-1.6%

SOA Research Areas

- In-House Research
  - Internal staff focusing continuously on key actuarial practice areas
  - US Retirement, US Healthcare, Canadian Retirement, Climate Risk

The Sherlock Holmes Actuarial Perception Exercise (SHAPE?)

- Things that this Actuarial Demographic group likely enjoys
  - Puzzles / Mysteries?
  - Television / Movies / Streaming?
  - Texting?

Respond at **PollEv.com/dalehall778**

Text **DALEHALL778** to **22333** once to join, then text your message

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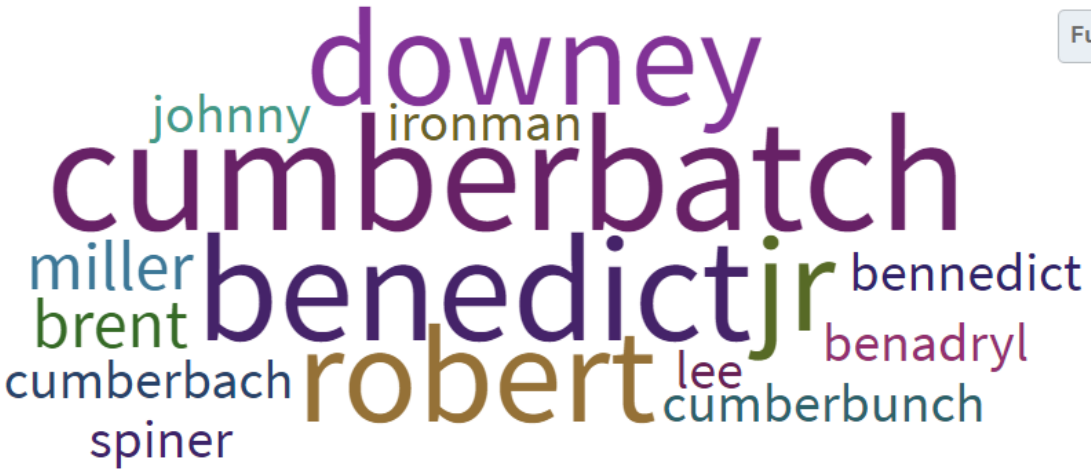
Who Plays The Role of Sherlock Holmes?



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Next

Previous

Poll Everywhere

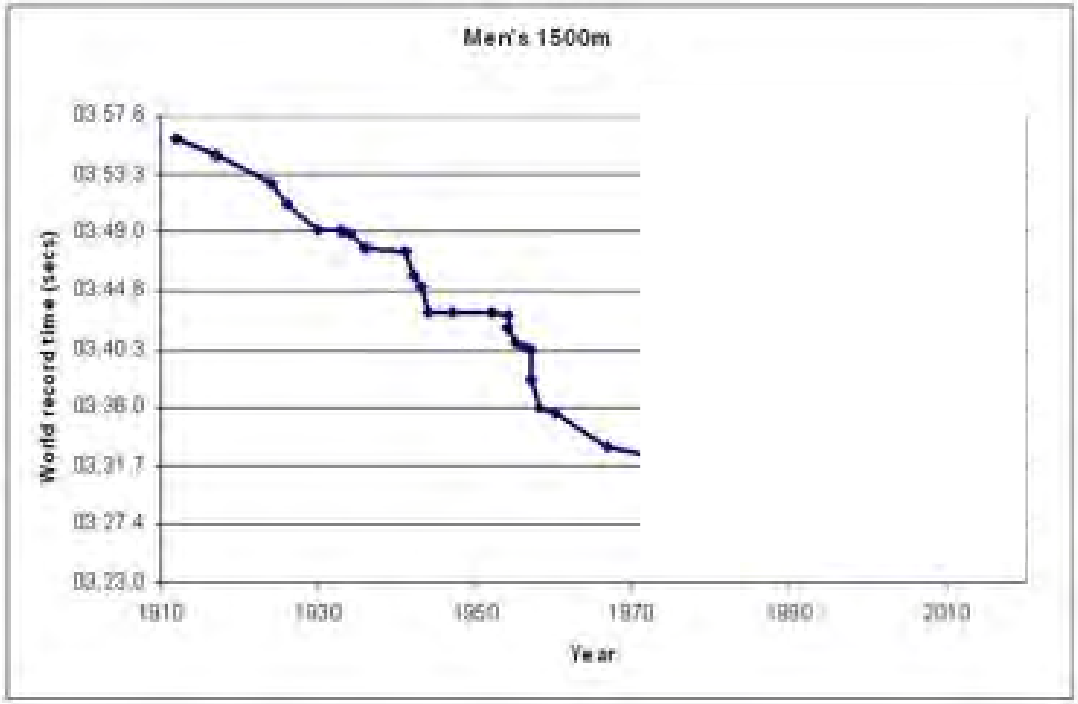
The Sherlock Holmes Actuarial Perception Exercise (SHAPE)

The Sherlock Holmes Actuarial Perception Exercise (SHAPE)

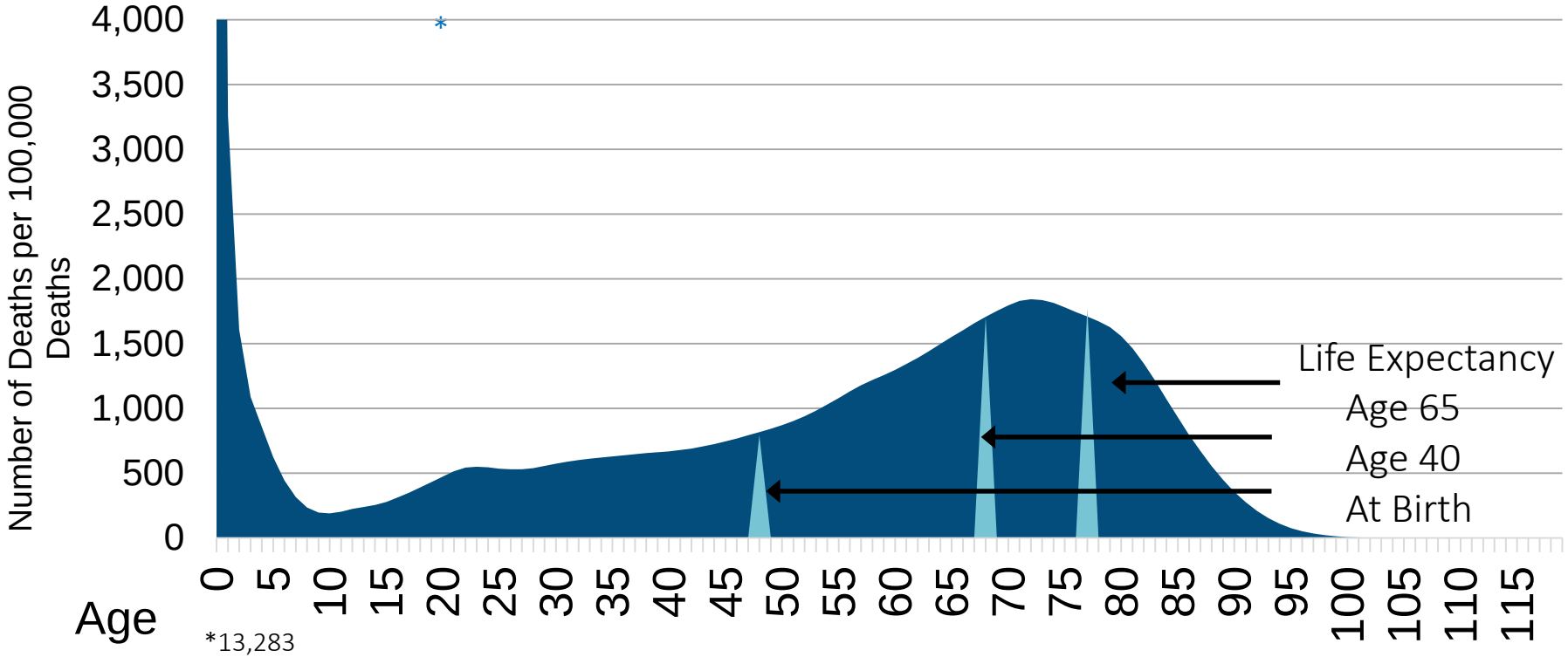
- Takeaways For Actuaries
  - Personal preferences influence our perceptions
  - Holmes: Some of the best data… is the data that is missing
  - Holmes: Be analytical of measuring trends

Trend examples: How fast can we run?

- If it's 1970… what's our estimate for 2010?
- It's 2019… what's our estimate for 2040?
- How far does it make sense to extrapolate?
- What other factors are missing that should be part of our estimation model?



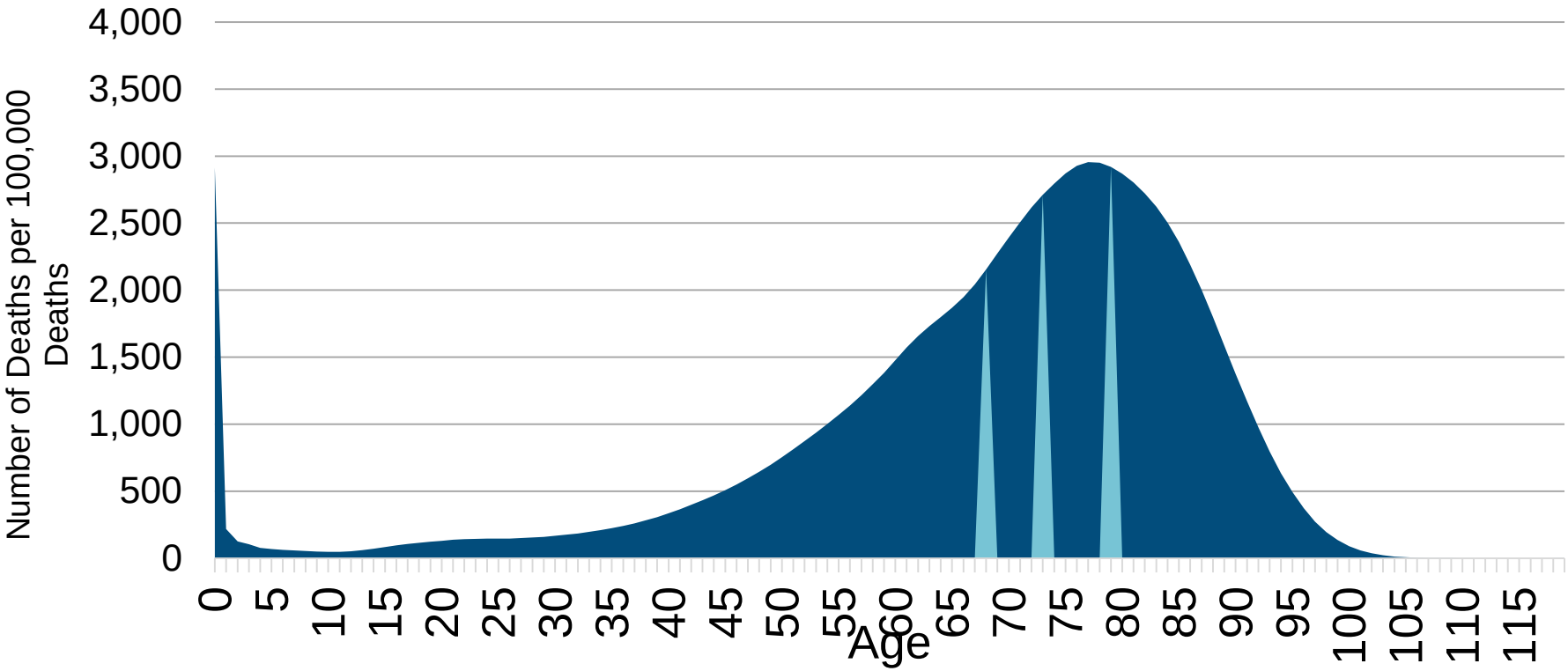
Age at Death in 1900



*13,283

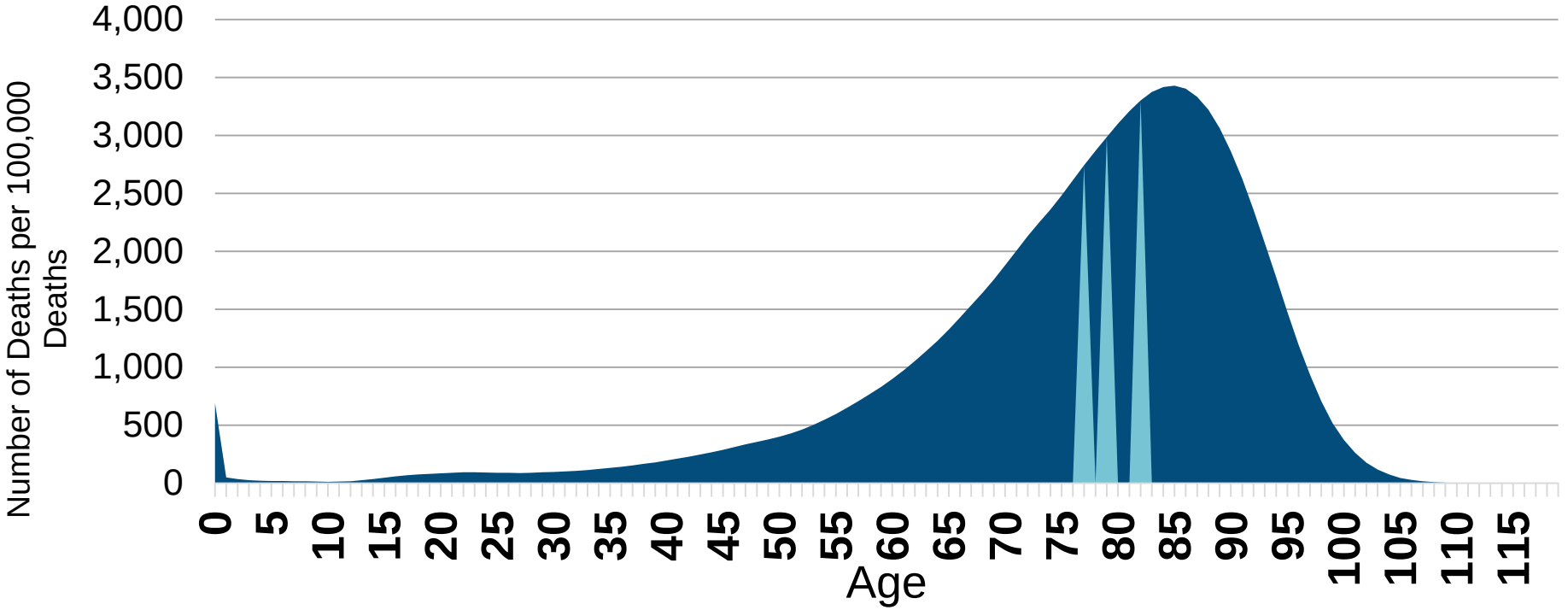
Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

Age at Death in 1950



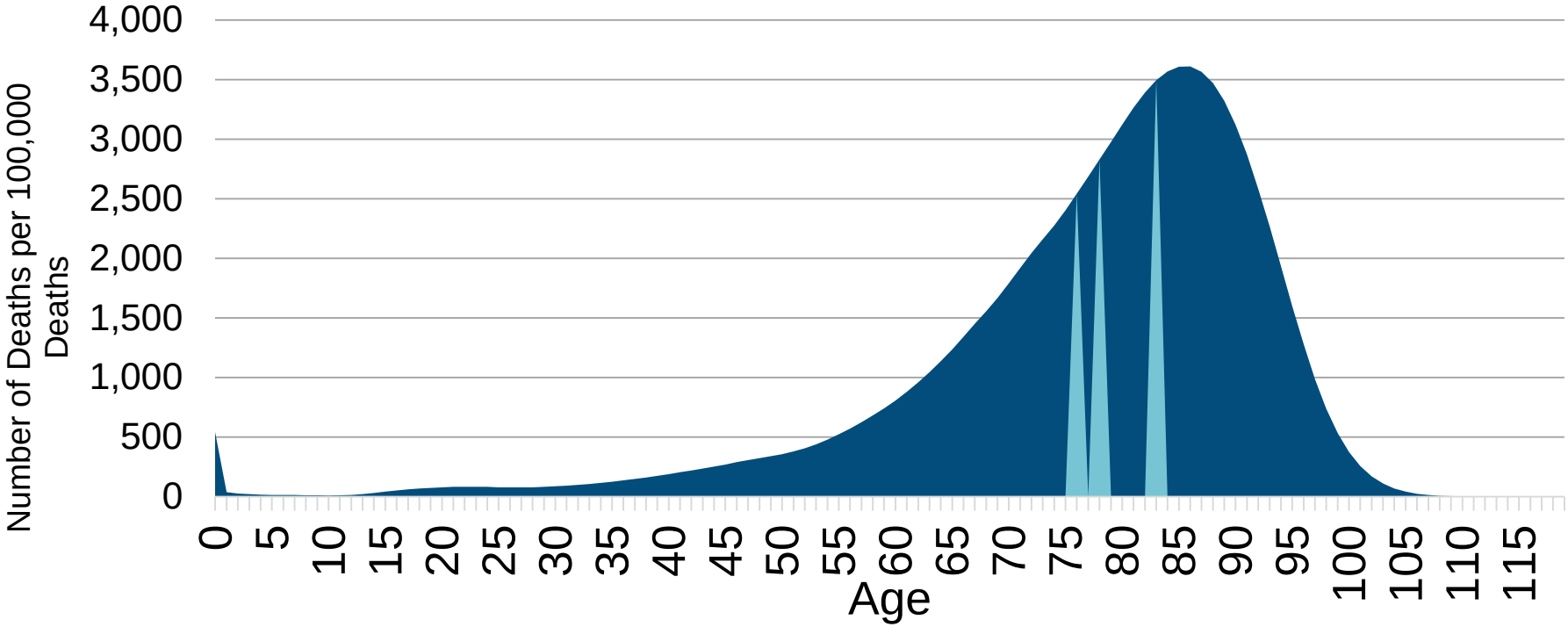
Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

Age at Death in 2000



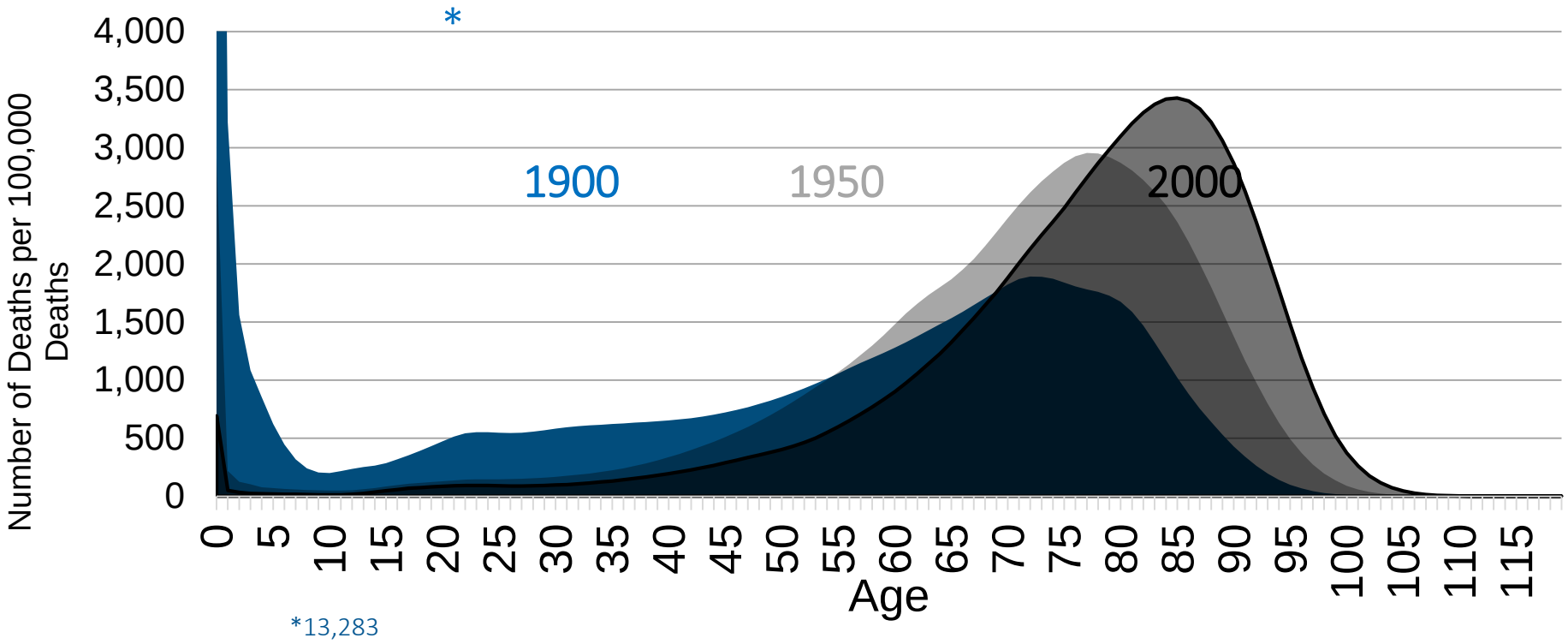
Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

Age at Death in 2010 (Projected)



Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

Changes Over the Century



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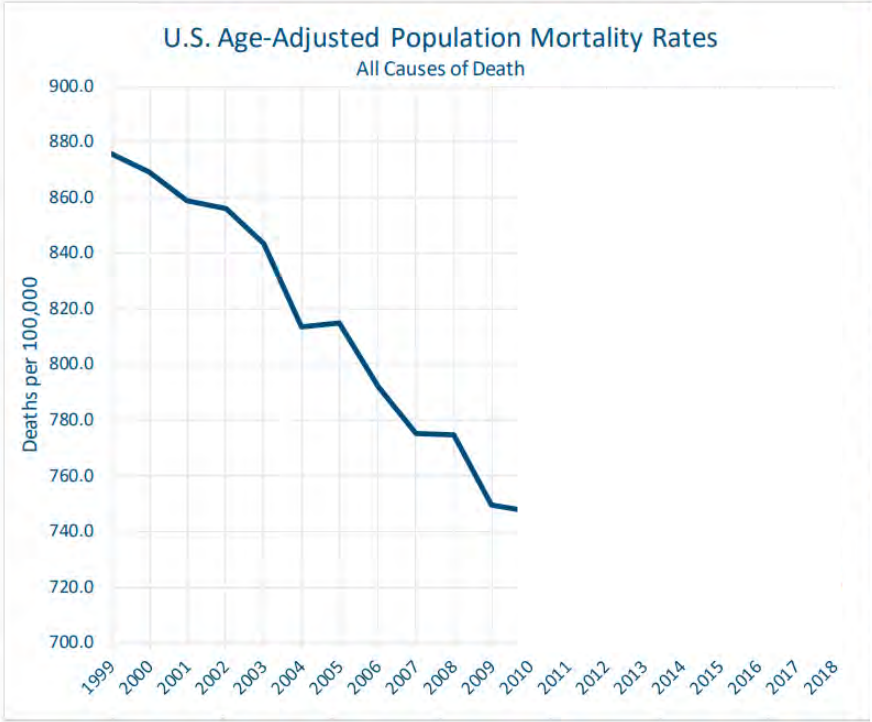
Data: SSA Actuarial Study 120 – Periods 1900-2000, 50% male, 50% female

Trend examples: What is U.S. Population Mortality?

- If it's 2009… what's our estimate for 2018?
- It's 2019… what's our estimate for 2040?
- How far does it make sense to extrapolate?
- What other factors are missing that should be part of our estimation model?

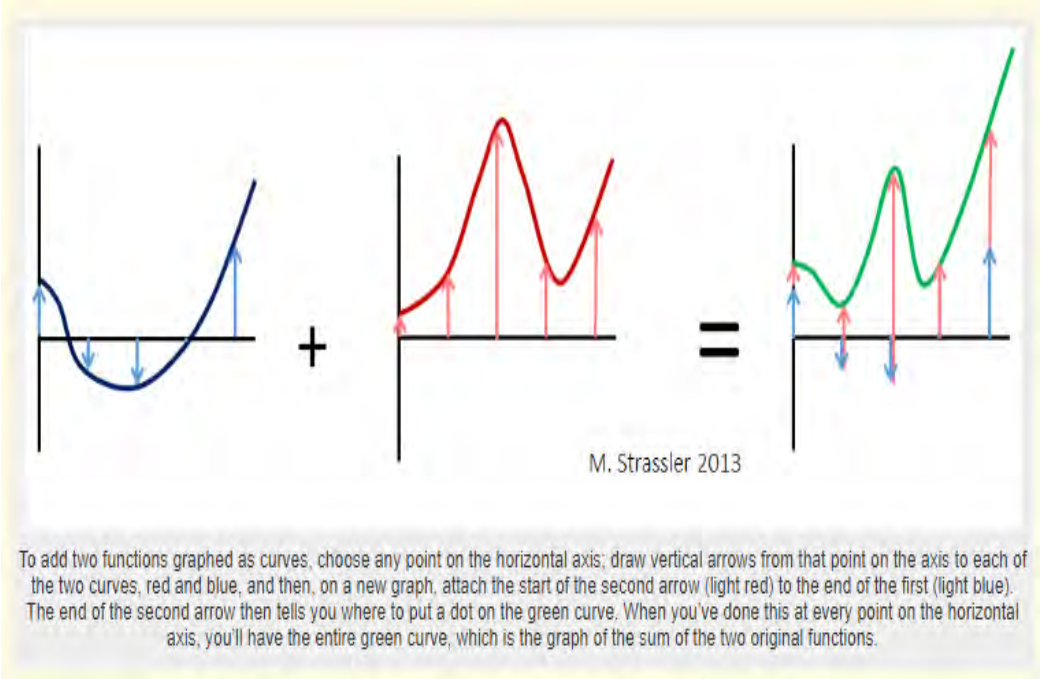


Year	Deaths per 100,000	Year over Year % Change
1999	875.6	n/a
2000	869.0	***-0.8%***
2001	858.8	***-1.2%***
2002	855.9	***-0.3%***
2003	843.5	***-1.4%***
2004	813.7	***-3.5%***
2005	815.0	0.2%
2006	791.8	***-2.8%***
2007	775.3	***-2.1%***
2008	774.9	***-0.1%***
2009	749.6	***-3.3%***

Trend examples: What is U.S. Population Mortality?

- Holmes: Is it better to look at the information in front of us, or its components?
- Leverage off our math skills: Total function as an aggregation of component functions

- Total Population Mortality of Individual Causes of Death?



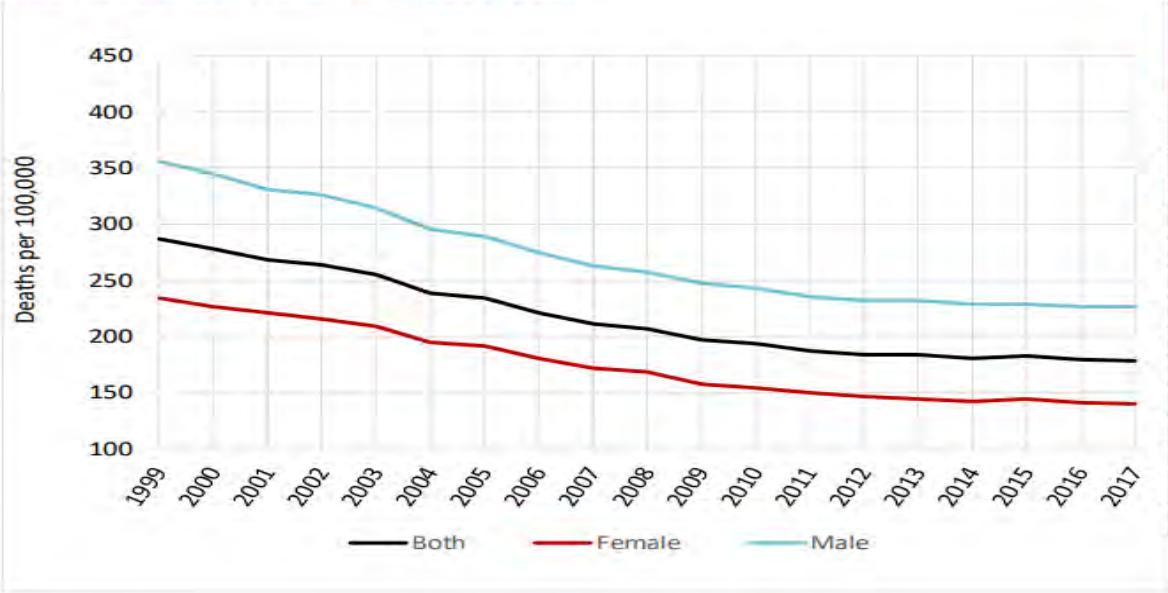
To add two functions graphed as curves, choose any point on the horizontal axis; draw vertical arrows from that point on the axis to each of the two curves, red and blue, and then, on a new graph, attach the start of the second arrow (light red) to the end of the first (light blue). The end of the second arrow then tells you where to put a dot on the green curve. When you've done this at every point on the horizontal axis, you'll have the entire green curve, which is the graph of the sum of the two original functions.

Trend examples: What is U.S. Population Mortality?

5.2 Heart

5.2.1 Total Population Analysis

AGE-ADJUSTED MORTALITY 1999-2017



All Ages	Annual Improvement 1999-2017	2012-2017	2016-2017
Both	2.6%	0.6%	0.2%
Female	2.8%	0.8%	0.5%
Male	2.5%	0.5%	0.0%
Age Group*			
< 1	3.2%	1.9%	-4.2%
1 - 4	2.2%	3.7%	-7.3%
5 - 14	2.4%	-0.5%	4.9%
15 - 24	1.5%	0.6%	3.2%
25 - 34	-0.3%	-1.2%	-5.3%
35 - 44	0.9%	0.3%	1.7%
45 - 54	1.2%	0.7%	3.1%
55 - 64	1.9%	-0.7%	-0.6%
65 - 74	3.2%	-0.2%	-0.1%
75 - 84	3.2%	1.4%	0.8%
85+	2.4%	0.8%	-0.2%

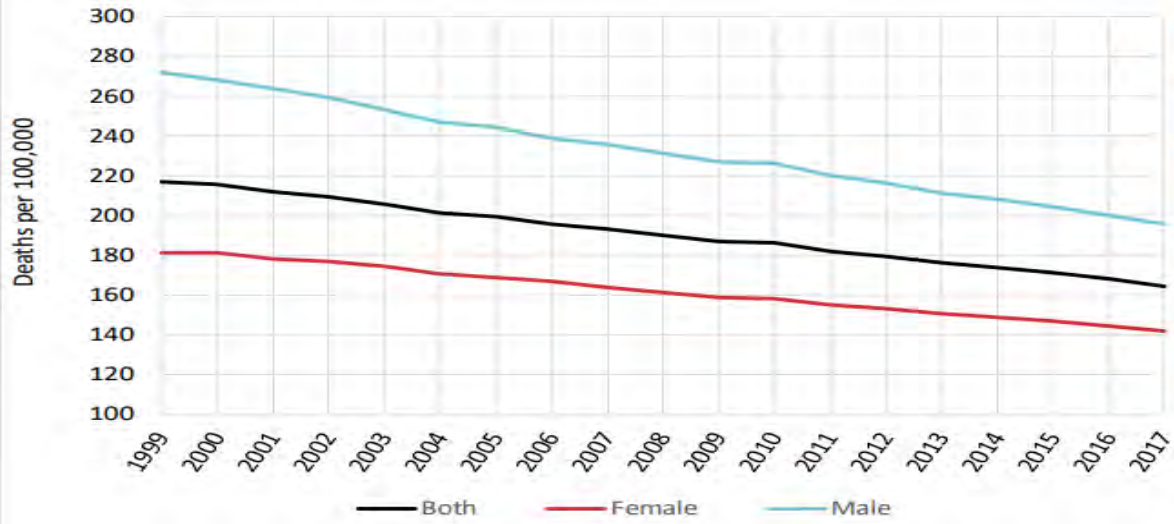
*includes both genders

Trend examples: What is U.S. Population Mortality?

5.3 Cancer

5.3.1 Total Population Analysis

AGE-ADJUSTED MORTALITY 1999-2017



All Ages	Annual Improvement 1999-2017	2012-2017	2016-2017
Both	1.5%	1.7%	2.1%
Female	1.4%	1.5%	1.9%
Male	1.8%	2.0%	2.4%
Age Group*			
< 1	1.2%	2.0%	14.3%
1 - 4	1.6%	3.6%	14.0%
5 - 14	1.0%	1.3%	2.9%
15 - 24	1.9%	2.4%	3.4%
25 - 34	1.2%	1.7%	6.0%
35 - 44	1.8%	1.0%	1.0%
45 - 54	1.8%	3.1%	4.0%
55 - 64	1.7%	1.4%	2.6%
65 - 74	2.1%	2.1%	1.9%
75 - 84	1.3%	1.8%	2.0%
85+	0.7%	0.7%	1.2%

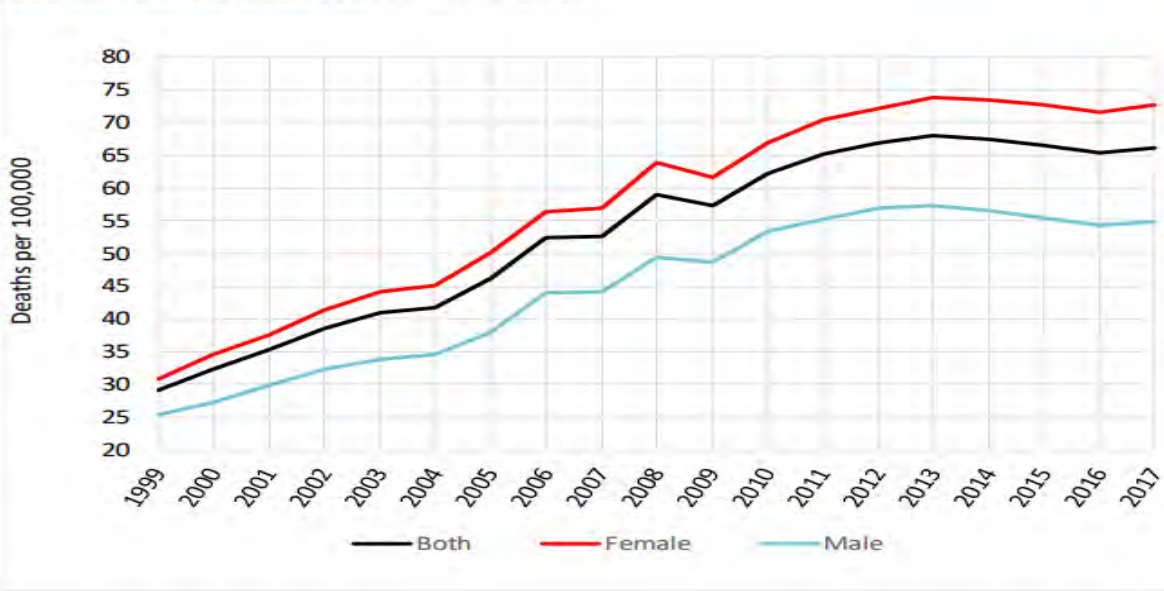
*includes both genders

Trend examples: What is U.S. Population Mortality?

5.4 Alzheimer's/Dementia

5.4.1 Total Population Analysis

AGE-ADJUSTED MORTALITY 1999-2017



All Ages	Annual Improvement 1999-2017	2012-2017	2016-2017
Both	-4.6%	0.2%	-1.3%
Female	-4.9%	-0.1%	-1.6%
Male	-4.4%	0.8%	-1.0%
Age Group*			
< 1	**	**	**
1 - 4	**	**	**
5 - 14	**	**	**
15 - 24	**	**	**
25 - 34	**	**	**
35 - 44	-1.6%	10.9%	-5.2%
45 - 54	-3.3%	5.6%	5.1%
55 - 64	-4.1%	0.3%	-2.0%
65 - 74	-3.6%	-0.7%	-3.0%
75 - 84	-4.2%	1.1%	-0.6%
85+	-4.9%	-0.1%	-1.4%

*includes both genders

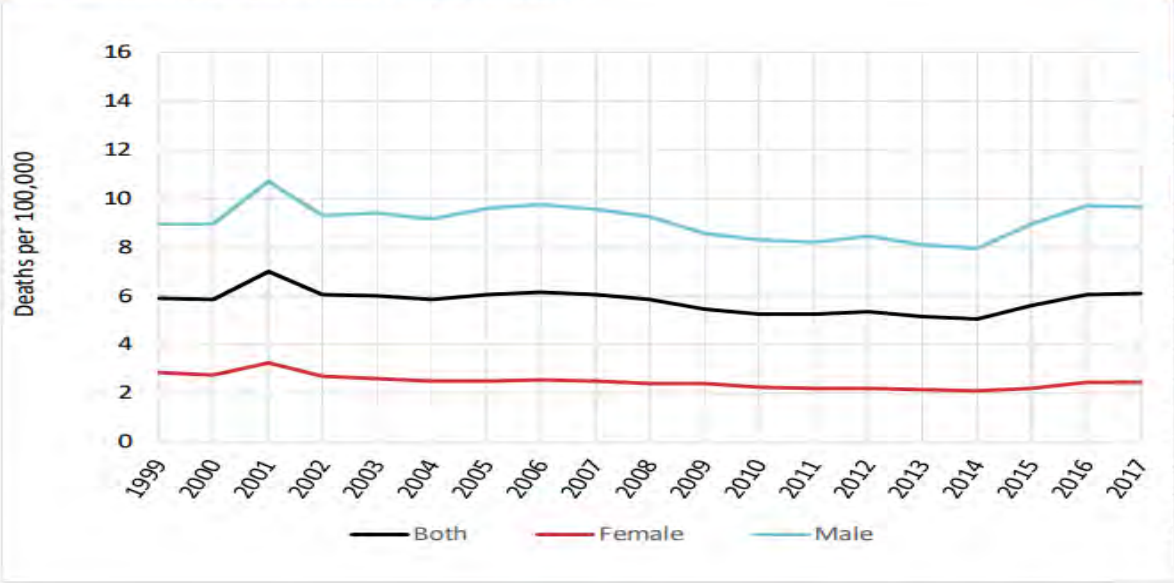
**Less than 10 deaths. See section 3.

Trend examples: What is U.S. Population Mortality?

6.4 Assault

6.4.1 Total Population Analysis

AGE-ADJUSTED MORTALITY 1999-2017



All Ages	Annual Improvement 1999-2017	2012-2017	2016-2017
Both	-0.2%	-2.6%	-0.2%
Female	0.8%	-2.2%	-0.6%
Male	-0.4%	-2.7%	0.4%
Age Group*			
< 1	0.7%	-0.9%	-10.3%
1 - 4	1.4%	2.2%	10.9%
5 - 14	1.5%	-1.3%	-16.0%
15 - 24	0.7%	-1.6%	4.6%
25 - 34	-0.8%	-3.4%	-0.6%
35 - 44	-0.8%	-4.2%	1.5%
45 - 54	-0.9%	-3.0%	-6.7%
55 - 64	-1.1%	-4.4%	-8.9%
65 - 74	1.0%	-0.3%	-4.9%
75 - 84	2.0%	3.2%	12.6%
85+	1.6%	0.6%	5.4%

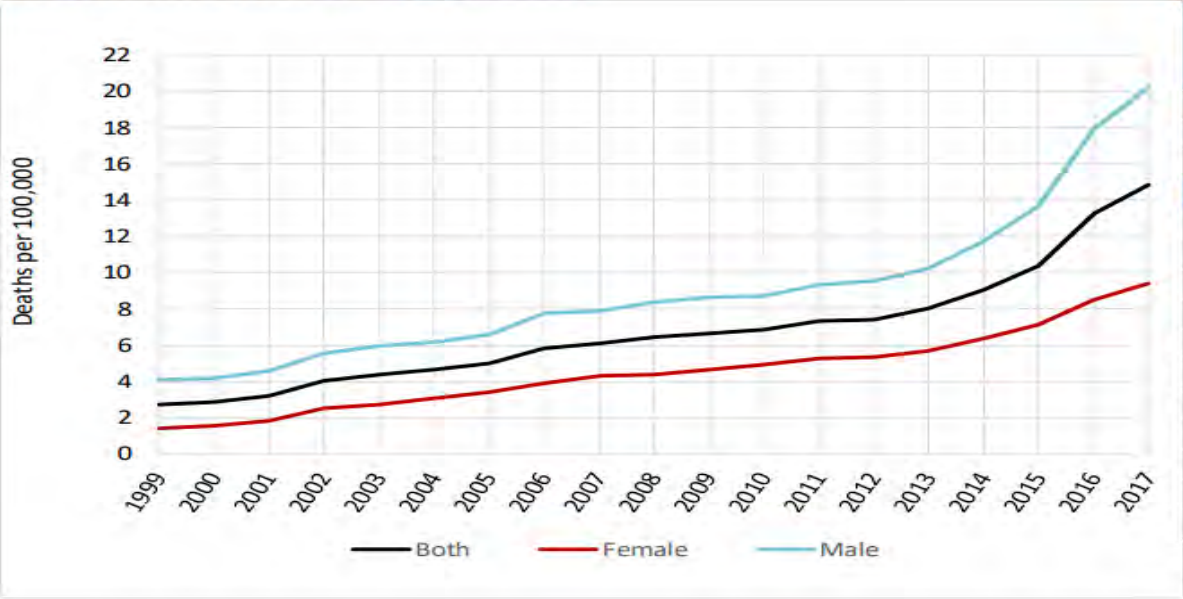
*includes both genders

Trend examples: What is U.S. Population Mortality?

6.5 Opioids

6.5.1 Total Population Analysis

AGE-ADJUSTED MORTALITY 1999-2017



All Ages	Annual Improvement 1999-2017	2012-2017	2016-2017
Both	-9.8%	-14.8%	-11.9%
Female	-11.1%	-12.0%	-10.2%
Male	-9.2%	-16.2%	-12.6%
Age Group*			
< 1	**	**	**
1 - 4	**	**	**
5 - 14	**	**	**
15 - 24	-10.4%	-12.2%	-2.3%
25 - 34	-11.4%	-17.8%	-12.4%
35 - 44	-7.7%	-16.8%	-13.2%
45 - 54	-8.6%	-11.1%	-13.6%
55 - 64	-14.5%	-15.3%	-11.7%
65 - 74	-13.2%	-16.3%	-14.7%
75 - 84	-6.7%	-8.0%	-16.5%
85+	-7.1%	-4.4%	-32.1%

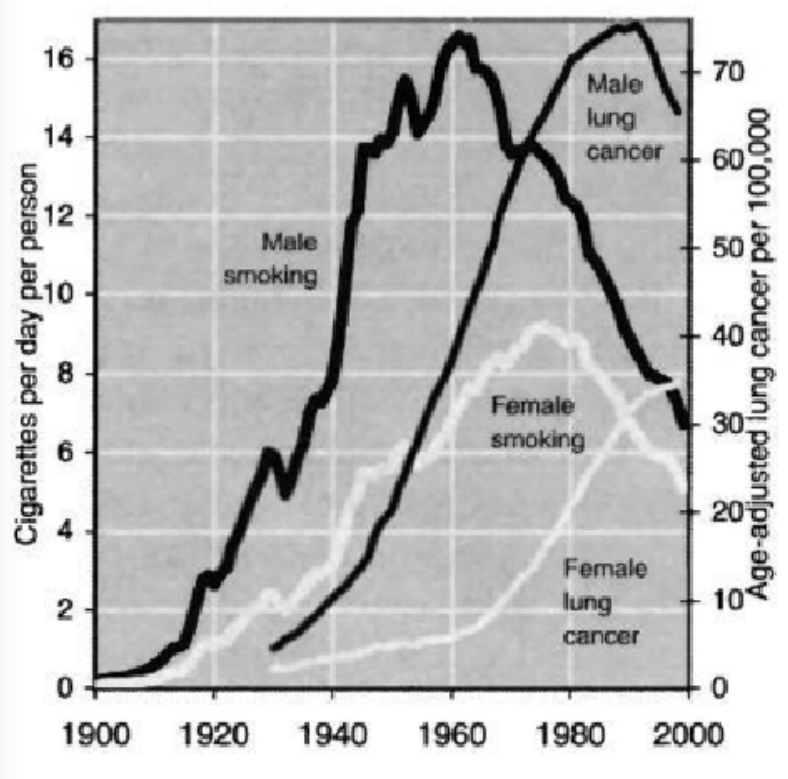
*includes both genders

**Less than 10 deaths. See section 3.

Trend examples: What is U.S. Population Mortality?

- Holmes: As we talk about causes of death, what information might be missing?

- In our actuarial estimations…
- Should we focus on the outcome or focus on the driver of the outcome?



Shifting from Mortality to Mortality Improvement

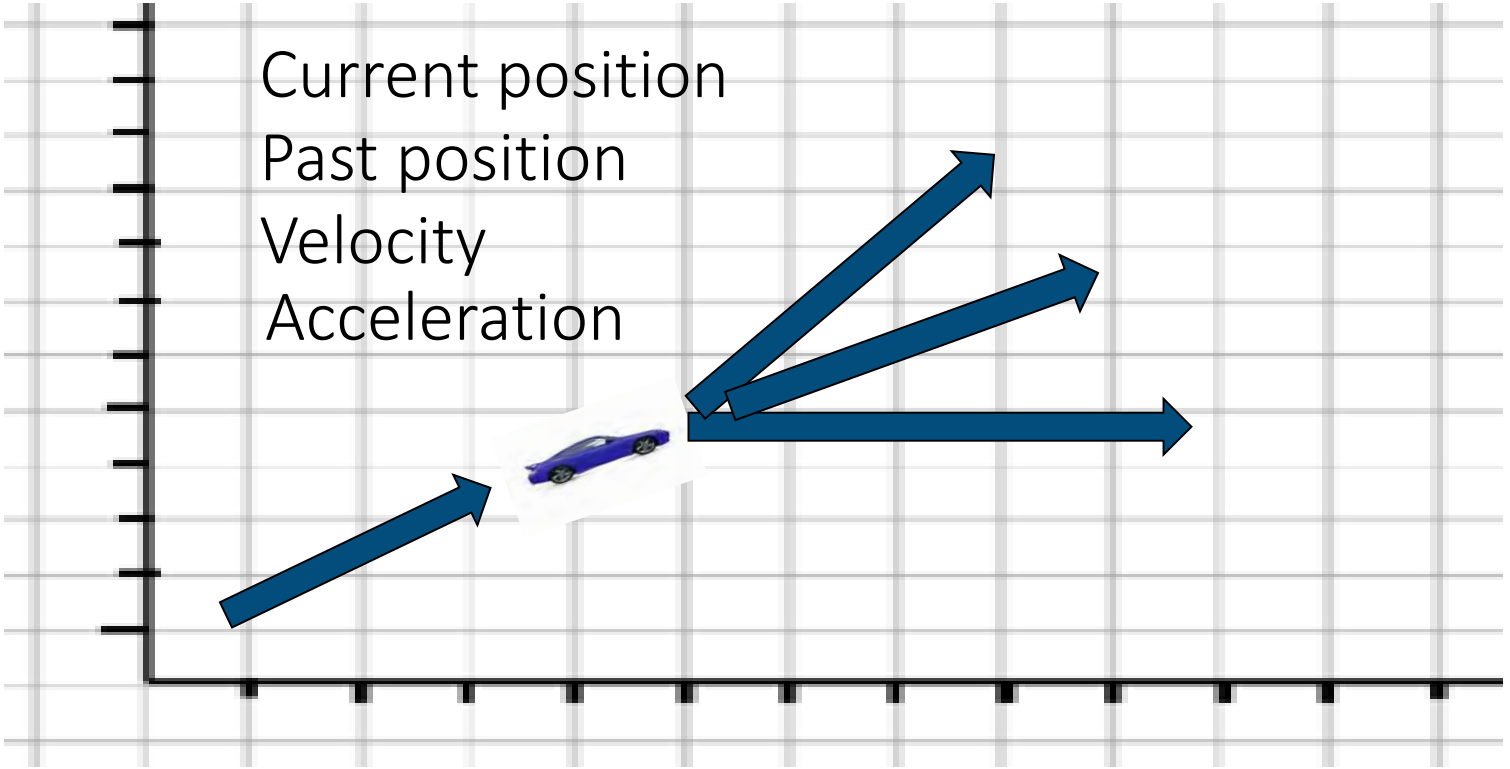
- Increase in mortality improvement studies has been a growing trend
- Population Data vs. Insured / Underwritten / Selected Data
  - US: CDC; Social Security Administration
  - Globally: Human Mortality Database

Shifting from Mortality to Mortality Improvement

- Calculus / Physics comparison to Mortality Improvement modeling…

  - Where are we now?
  - Where are we going to be?

What predicts future position?

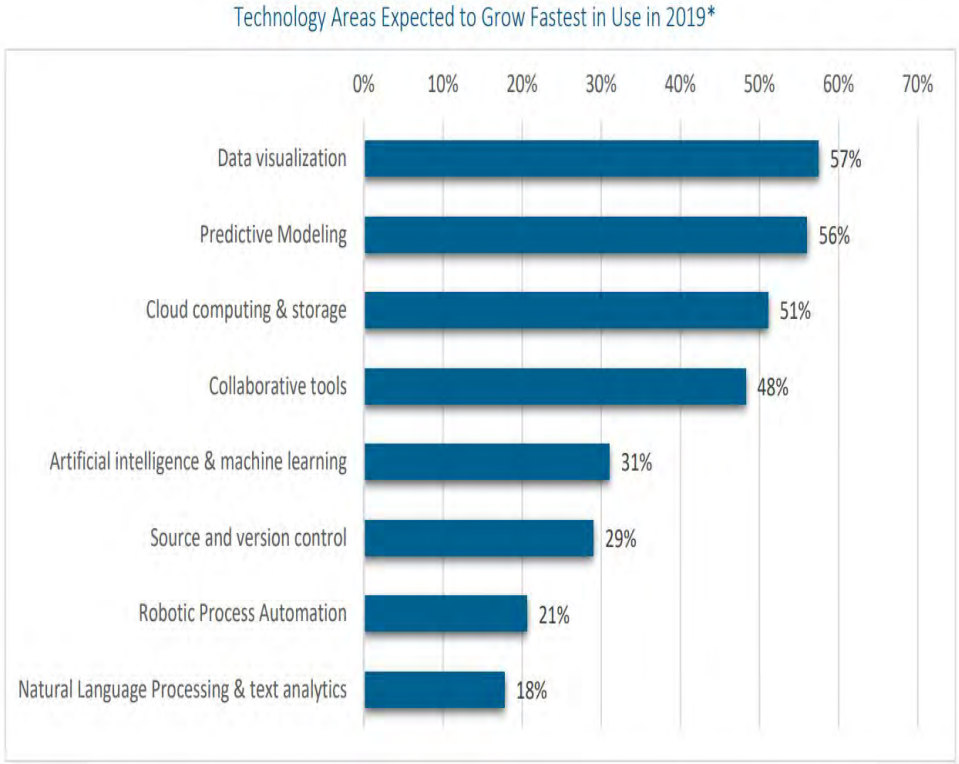


Future Mortality Improvement
Handing in My Report to My Boss: Show Me The Data!!!

- 100% Accurate!!!
- 10% Useful?

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
55	0.0114	0.0109	0.0101	0.0088	0.0072	0.0057	0.0045	0.0036	0.0032	0.0033	0.0038	0.0048	0.0061	0.0074	0.0087	0.0097	0.0105
56	0.0142	0.0140	0.0133	0.0120	0.0103	0.0087	0.0072	0.0060	0.0052	0.0047	0.0048	0.0053	0.0061	0.0072	0.0084	0.0094	0.0102
57	0.0164	0.0166	0.0161	0.0150	0.0134	0.0118	0.0102	0.0088	0.0077	0.0068	0.0064	0.0064	0.0068	0.0075	0.0084	0.0094	0.0101
58	0.0181	0.0187	0.0185	0.0177	0.0163	0.0148	0.0133	0.0118	0.0105	0.0094	0.0085	0.0080	0.0080	0.0083	0.0088	0.0095	0.0102
59	0.0193	0.0202	0.0204	0.0199	0.0189	0.0177	0.0163	0.0148	0.0134	0.0121	0.0109	0.0101	0.0095	0.0094	0.0095	0.0099	0.0104
60	0.0201	0.0212	0.0217	0.0216	0.0210	0.0201	0.0189	0.0176	0.0161	0.0147	0.0134	0.0122	0.0113	0.0107	0.0105	0.0105	0.0107
61	0.0205	0.0218	0.0226	0.0229	0.0226	0.0221	0.0212	0.0200	0.0186	0.0172	0.0157	0.0144	0.0132	0.0122	0.0115	0.0112	0.0110
62	0.0206	0.0222	0.0232	0.0237	0.0238	0.0235	0.0229	0.0220	0.0207	0.0193	0.0178	0.0163	0.0149	0.0137	0.0127	0.0119	0.0115
63	0.0206	0.0223	0.0235	0.0242	0.0245	0.0245	0.0242	0.0234	0.0223	0.0210	0.0195	0.0179	0.0164	0.0150	0.0138	0.0128	0.0120
64	0.0204	0.0223	0.0236	0.0244	0.0249	0.0251	0.0250	0.0245	0.0235	0.0223	0.0209	0.0193	0.0177	0.0162	0.0148	0.0136	0.0126
65	0.0201	0.0221	0.0235	0.0244	0.0249	0.0253	0.0254	0.0251	0.0243	0.0233	0.0219	0.0204	0.0188	0.0172	0.0157	0.0143	0.0132
66	0.0197	0.0217	0.0232	0.0242	0.0248	0.0253	0.0255	0.0253	0.0248	0.0239	0.0227	0.0213	0.0197	0.0181	0.0165	0.0150	0.0137
67	0.0191	0.0212	0.0227	0.0238	0.0246	0.0251	0.0254	0.0254	0.0250	0.0243	0.0232	0.0219	0.0204	0.0188	0.0172	0.0157	0.0143
68	0.0184	0.0205	0.0221	0.0233	0.0242	0.0249	0.0252	0.0252	0.0250	0.0244	0.0236	0.0224	0.0210	0.0195	0.0179	0.0163	0.0149
69	0.0175	0.0197	0.0214	0.0227	0.0237	0.0245	0.0249	0.0250	0.0249	0.0244	0.0237	0.0227	0.0214	0.0200	0.0184	0.0169	0.0154
70	0.0166	0.0188	0.0206	0.0221	0.0232	0.0241	0.0246	0.0247	0.0246	0.0243	0.0237	0.0228	0.0217	0.0204	0.0189	0.0173	0.0158
71	0.0157	0.0180	0.0198	0.0214	0.0227	0.0237	0.0242	0.0244	0.0244	0.0240	0.0235	0.0228	0.0218	0.0206	0.0192	0.0177	0.0162
72	0.0148	0.0171	0.0191	0.0207	0.0221	0.0232	0.0238	0.0241	0.0240	0.0237	0.0232	0.0226	0.0217	0.0206	0.0193	0.0179	0.0164
73	0.0141	0.0164	0.0184	0.0201	0.0215	0.0227	0.0234	0.0237	0.0237	0.0234	0.0229	0.0223	0.0215	0.0205	0.0193	0.0180	0.0166
74	0.0134	0.0157	0.0177	0.0195	0.0210	0.0222	0.0230	0.0234	0.0234	0.0231	0.0226	0.0219	0.0211	0.0202	0.0191	0.0179	0.0166
75	0.0128	0.0152	0.0172	0.0190	0.0205	0.0217	0.0226	0.0230	0.0231	0.0228	0.0223	0.0216	0.0208	0.0199	0.0189	0.0178	0.0166
76	0.0124	0.0148	0.0168	0.0185	0.0201	0.0213	0.0222	0.0226	0.0227	0.0225	0.0221	0.0214	0.0206	0.0197	0.0187	0.0176	0.0165
77	0.0120	0.0144	0.0165	0.0182	0.0198	0.0210	0.0219	0.0224	0.0225	0.0223	0.0219	0.0212	0.0204	0.0195	0.0185	0.0174	0.0164
78	0.0116	0.0141	0.0162	0.0180	0.0196	0.0209	0.0217	0.0222	0.0223	0.0222	0.0218	0.0211	0.0203	0.0193	0.0183	0.0173	0.0162
79	0.0113	0.0138	0.0160	0.0178	0.0195	0.0208	0.0217	0.0221	0.0223	0.0221	0.0217	0.0211	0.0203	0.0193	0.0183	0.0172	0.0161
80	0.0109	0.0135	0.0158	0.0177	0.0195	0.0208	0.0217	0.0222	0.0223	0.0222	0.0217	0.0211	0.0203	0.0194	0.0183	0.0172	0.0161
81	0.0105	0.0132	0.0156	0.0176	0.0195	0.0210	0.0219	0.0224	0.0225	0.0223	0.0219	0.0212	0.0204	0.0195	0.0184	0.0173	0.0161
82	0.0101	0.0129	0.0153	0.0175	0.0195	0.0211	0.0221	0.0226	0.0227	0.0225	0.0221	0.0214	0.0206	0.0196	0.0185	0.0174	0.0162
83	0.0095	0.0124	0.0150	0.0174	0.0196	0.0213	0.0224	0.0229	0.0231	0.0228	0.0223	0.0216	0.0208	0.0198	0.0187	0.0175	0.0163
84	0.0089	0.0119	0.0147	0.0172	0.0196	0.0215	0.0227	0.0233	0.0234	0.0232	0.0227	0.0219	0.0210	0.0200	0.0189	0.0177	0.0164
85	0.0082	0.0113	0.0142	0.0169	0.0195	0.0216	0.0229	0.0236	0.0238	0.0236	0.0230	0.0222	0.0213	0.0202	0.0191	0.0178	0.0165
86	0.0074	0.0106	0.0137	0.0165	0.0193	0.0216	0.0231	0.0239	0.0241	0.0239	0.0234	0.0225	0.0215	0.0204	0.0192	0.0179	0.0166
87	0.0066	0.0099	0.0130	0.0161	0.0190	0.0214	0.0231	0.0241	0.0244	0.0242	0.0237	0.0228	0.0217	0.0205	0.0192	0.0179	0.0166
88	0.0057	0.0090	0.0123	0.0155	0.0186	0.0212	0.0229	0.0240	0.0244	0.0243	0.0238	0.0229	0.0218	0.0205	0.0192	0.0178	0.0165
89	0.0049	0.0082	0.0115	0.0148	0.0180	0.0207	0.0226	0.0237	0.0242	0.0242	0.0237	0.0228	0.0217	0.0204	0.0190	0.0176	0.0162
90	0.0040	0.0073	0.0107	0.0140	0.0173	0.0201	0.0221	0.0233	0.0239	0.0240	0.0235	0.0227	0.0216	0.0203	0.0189	0.0174	0.0160

The Actuary of Today: Data Visualization Artist



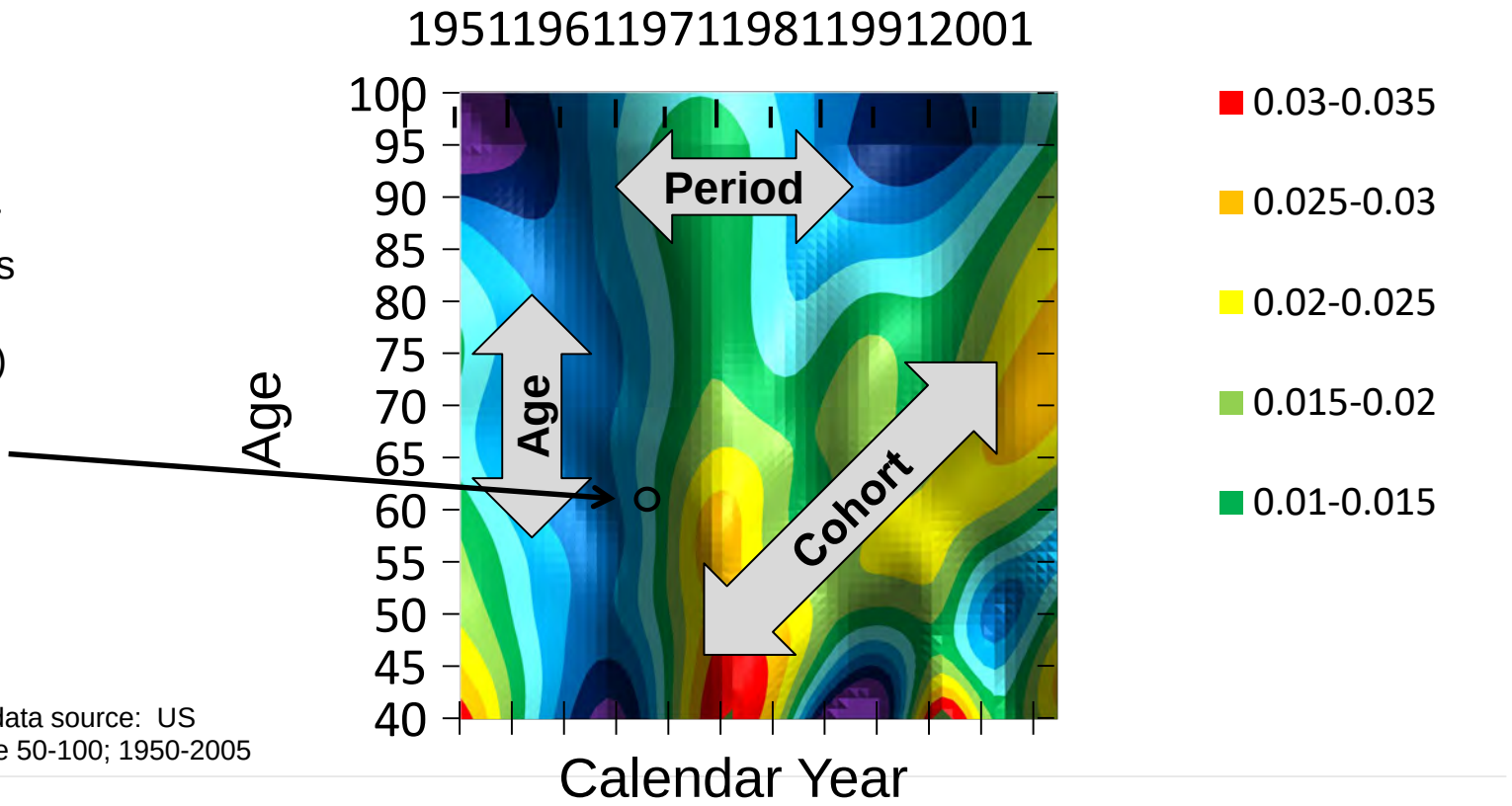
Show Me The Data!!!

- 100% Accurate!!!
- 0% Useful?

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
55	0.0114	0.0109	0.0101	0.0088	0.0072	0.0057	0.0045	0.0036	0.0032	0.0033	0.0038	0.0048	0.0061	0.0074	0.0087	0.0097	0.0105
56	0.0142	0.0140	0.0133	0.0120	0.0103	0.0087	0.0072	0.0060	0.0052	0.0047	0.0048	0.0053	0.0061	0.0072	0.0084	0.0094	0.0102
57	0.0164	0.0166	0.0161	0.0150	0.0134	0.0118	0.0102	0.0088	0.0077	0.0068	0.0064	0.0064	0.0068	0.0075	0.0084	0.0094	0.0101
58	0.0181	0.0187	0.0185	0.0177	0.0163	0.0148	0.0133	0.0118	0.0105	0.0094	0.0085	0.0080	0.0080	0.0083	0.0088	0.0095	0.0102
59	0.0193	0.0202	0.0204	0.0199	0.0189	0.0177	0.0163	0.0148	0.0134	0.0121	0.0109	0.0101	0.0095	0.0094	0.0095	0.0099	0.0104
60	0.0201	0.0212	0.0217	0.0216	0.0210	0.0201	0.0189	0.0176	0.0161	0.0147	0.0134	0.0122	0.0113	0.0107	0.0105	0.0105	0.0107
61	0.0205	0.0218	0.0226	0.0229	0.0226	0.0221	0.0212	0.0200	0.0186	0.0172	0.0157	0.0144	0.0132	0.0122	0.0115	0.0112	0.0110
62	0.0206	0.0222	0.0232	0.0237	0.0238	0.0235	0.0229	0.0220	0.0207	0.0193	0.0178	0.0163	0.0149	0.0137	0.0127	0.0119	0.0115
63	0.0206	0.0223	0.0235	0.0242	0.0245	0.0245	0.0242	0.0234	0.0223	0.0210	0.0195	0.0179	0.0164	0.0150	0.0138	0.0128	0.0120
64	0.0204	0.0223	0.0236	0.0244	0.0249	0.0251	0.0250	0.0245	0.0235	0.0223	0.0209	0.0193	0.0177	0.0162	0.0148	0.0136	0.0126
65	0.0201	0.0221	0.0235	0.0244	0.0249	0.0253	0.0254	0.0251	0.0243	0.0233	0.0219	0.0204	0.0188	0.0172	0.0157	0.0143	0.0132
66	0.0197	0.0217	0.0232	0.0242	0.0248	0.0253	0.0255	0.0253	0.0248	0.0239	0.0227	0.0213	0.0197	0.0181	0.0165	0.0150	0.0137
67	0.0191	0.0212	0.0227	0.0238	0.0246	0.0251	0.0254	0.0254	0.0250	0.0243	0.0232	0.0219	0.0204	0.0188	0.0172	0.0157	0.0143
68	0.0184	0.0205	0.0221	0.0233	0.0242	0.0249	0.0252	0.0252	0.0250	0.0244	0.0236	0.0224	0.0210	0.0195	0.0179	0.0163	0.0149
69	0.0175	0.0197	0.0214	0.0227	0.0237	0.0245	0.0249	0.0250	0.0249	0.0244	0.0237	0.0227	0.0214	0.0200	0.0184	0.0169	0.0154
70	0.0166	0.0188	0.0206	0.0221	0.0232	0.0241	0.0246	0.0247	0.0246	0.0243	0.0237	0.0228	0.0217	0.0204	0.0189	0.0173	0.0158
71	0.0157	0.0180	0.0198	0.0214	0.0227	0.0237	0.0242	0.0244	0.0244	0.0240	0.0235	0.0228	0.0218	0.0206	0.0192	0.0177	0.0162
72	0.0148	0.0171	0.0191	0.0207	0.0221	0.0232	0.0238	0.0241	0.0240	0.0237	0.0232	0.0226	0.0217	0.0206	0.0193	0.0179	0.0164
73	0.0141	0.0164	0.0184	0.0201	0.0215	0.0227	0.0234	0.0237	0.0237	0.0234	0.0229	0.0223	0.0215	0.0205	0.0193	0.0180	0.0166
74	0.0134	0.0157	0.0177	0.0195	0.0210	0.0222	0.0230	0.0234	0.0234	0.0231	0.0226	0.0219	0.0211	0.0202	0.0191	0.0179	0.0166
75	0.0128	0.0152	0.0172	0.0190	0.0205	0.0217	0.0226	0.0230	0.0231	0.0228	0.0223	0.0216	0.0208	0.0199	0.0189	0.0178	0.0166
76	0.0124	0.0148	0.0168	0.0185	0.0201	0.0213	0.0222	0.0226	0.0227	0.0225	0.0221	0.0214	0.0206	0.0197	0.0187	0.0176	0.0165
77	0.0120	0.0144	0.0165	0.0182	0.0198	0.0210	0.0219	0.0224	0.0225	0.0223	0.0219	0.0212	0.0204	0.0195	0.0185	0.0174	0.0164
78	0.0116	0.0141	0.0162	0.0180	0.0196	0.0209	0.0217	0.0222	0.0223	0.0222	0.0218	0.0211	0.0203	0.0193	0.0183	0.0173	0.0162
79	0.0113	0.0138	0.0160	0.0178	0.0195	0.0208	0.0217	0.0221	0.0223	0.0221	0.0217	0.0211	0.0203	0.0193	0.0183	0.0172	0.0161
80	0.0109	0.0135	0.0158	0.0177	0.0195	0.0208	0.0217	0.0222	0.0223	0.0222	0.0217	0.0211	0.0203	0.0194	0.0183	0.0172	0.0161
81	0.0105	0.0132	0.0156	0.0176	0.0195	0.0210	0.0219	0.0224	0.0225	0.0223	0.0219	0.0212	0.0204	0.0195	0.0184	0.0173	0.0161
82	0.0101	0.0129	0.0153	0.0175	0.0195	0.0211	0.0221	0.0226	0.0227	0.0225	0.0221	0.0214	0.0206	0.0196	0.0185	0.0174	0.0162
83	0.0095	0.0124	0.0150	0.0174	0.0196	0.0213	0.0224	0.0229	0.0231	0.0228	0.0223	0.0216	0.0208	0.0198	0.0187	0.0175	0.0163
84	0.0089	0.0119	0.0147	0.0172	0.0196	0.0215	0.0227	0.0233	0.0234	0.0232	0.0227	0.0219	0.0210	0.0200	0.0189	0.0177	0.0164
85	0.0082	0.0113	0.0142	0.0169	0.0195	0.0216	0.0229	0.0236	0.0238	0.0236	0.0230	0.0222	0.0213	0.0202	0.0191	0.0178	0.0165
86	0.0074	0.0106	0.0137	0.0165	0.0193	0.0216	0.0231	0.0239	0.0241	0.0239	0.0234	0.0225	0.0215	0.0204	0.0192	0.0179	0.0166
87	0.0066	0.0099	0.0130	0.0161	0.0190	0.0214	0.0231	0.0241	0.0244	0.0242	0.0237	0.0228	0.0217	0.0205	0.0192	0.0179	0.0166
88	0.0057	0.0090	0.0123	0.0155	0.0186	0.0212	0.0229	0.0240	0.0244	0.0243	0.0238	0.0229	0.0218	0.0205	0.0192	0.0178	0.0165
89	0.0049	0.0082	0.0115	0.0148	0.0180	0.0207	0.0226	0.0237	0.0242	0.0242	0.0237	0.0228	0.0217	0.0204	0.0190	0.0176	0.0162
90	0.0040	0.0073	0.0107	0.0140	0.0173	0.0201	0.0221	0.0233	0.0239	0.0240	0.0235	0.0227	0.0216	0.0203	0.0189	0.0174	0.0160

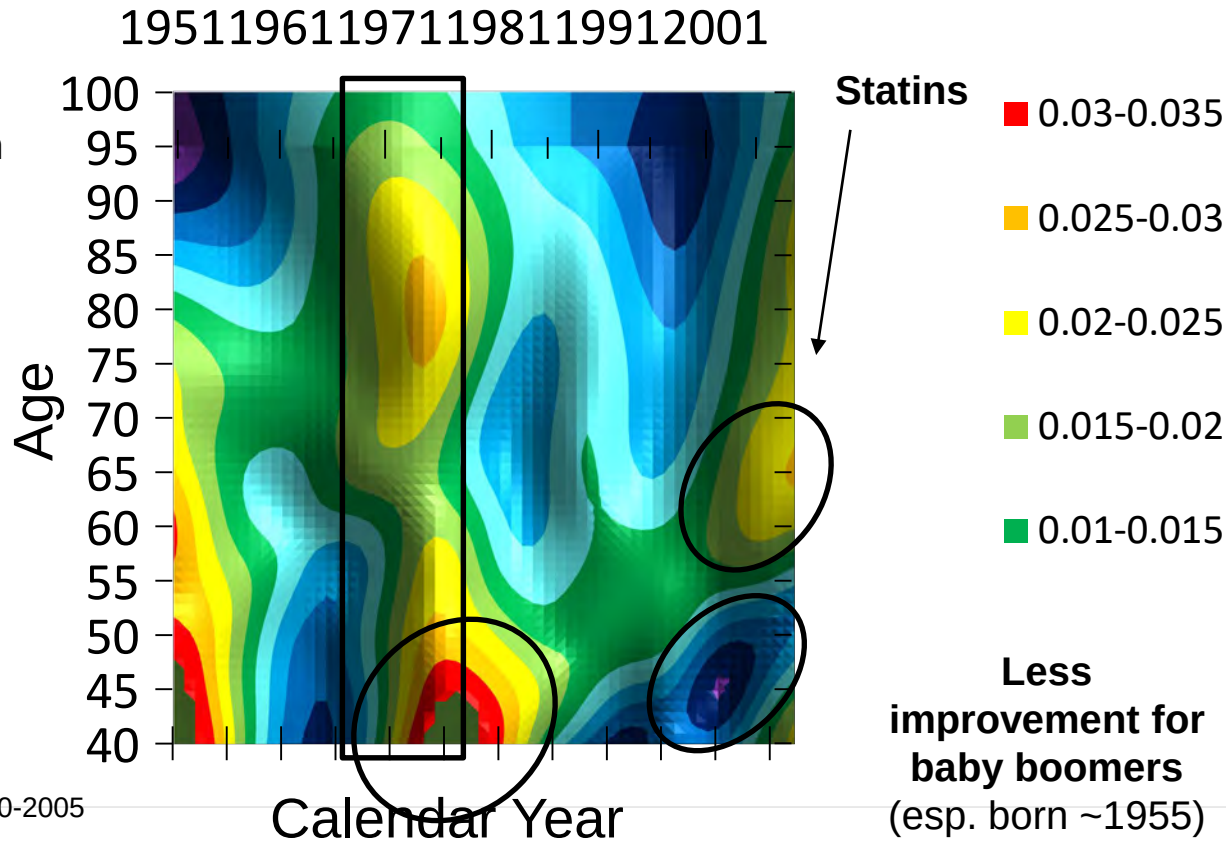
Mortality Improvement Rates

Mortality for 65-year-olds improved (decreased) by 2.5% between 1974-1975



Historical data source: US (SSA) Male 50-100; 1950-2005

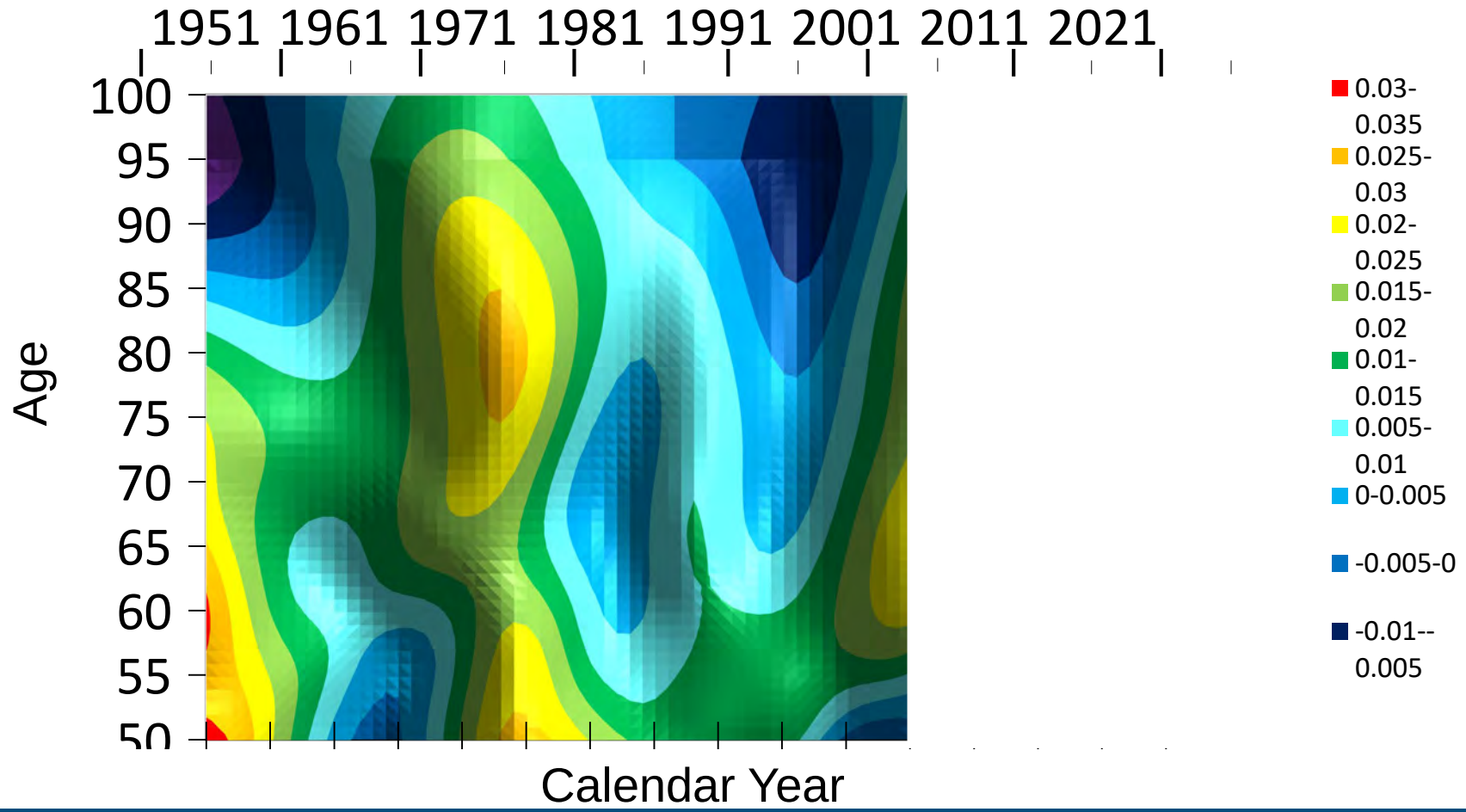
Females: MI Rates



"Silent generation" enjoyed relatively high improvement rates

Less improvement for baby boomers (esp. born ~1955)

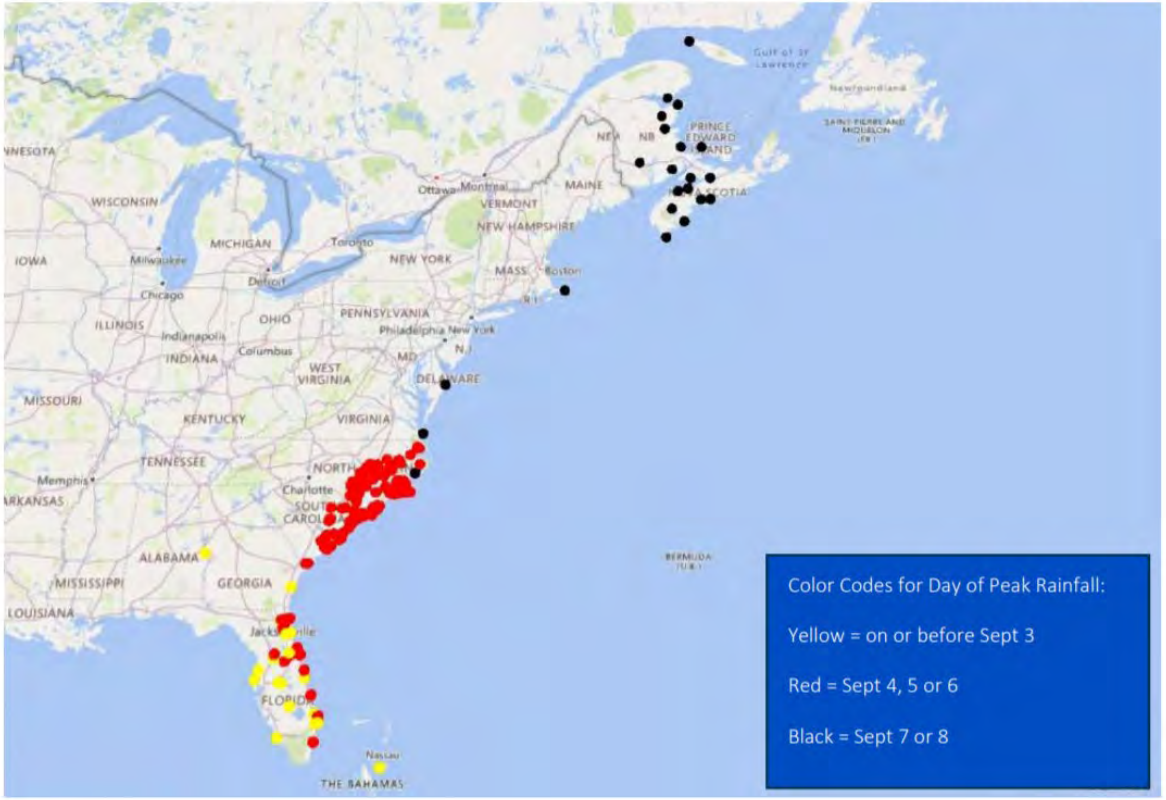
Historical data source: US (SSA) Female 50-100; 1950-2005


1951 1961 1971 1981 1991 2001 2011 2021
100
95
90
85
80
75
70
65
60
55
50
Age
Calendar Year
0.03-0.035
0.025-0.03
0.02-0.025
0.015-0.02
0.01-0.015
0.005-0.01
0-0.005
-0.005-0
-0.01--0.005

Other Examples

- Actuarial Weather Extremes
- Extreme Rainfall from Hurricane Dorian
- September 2019

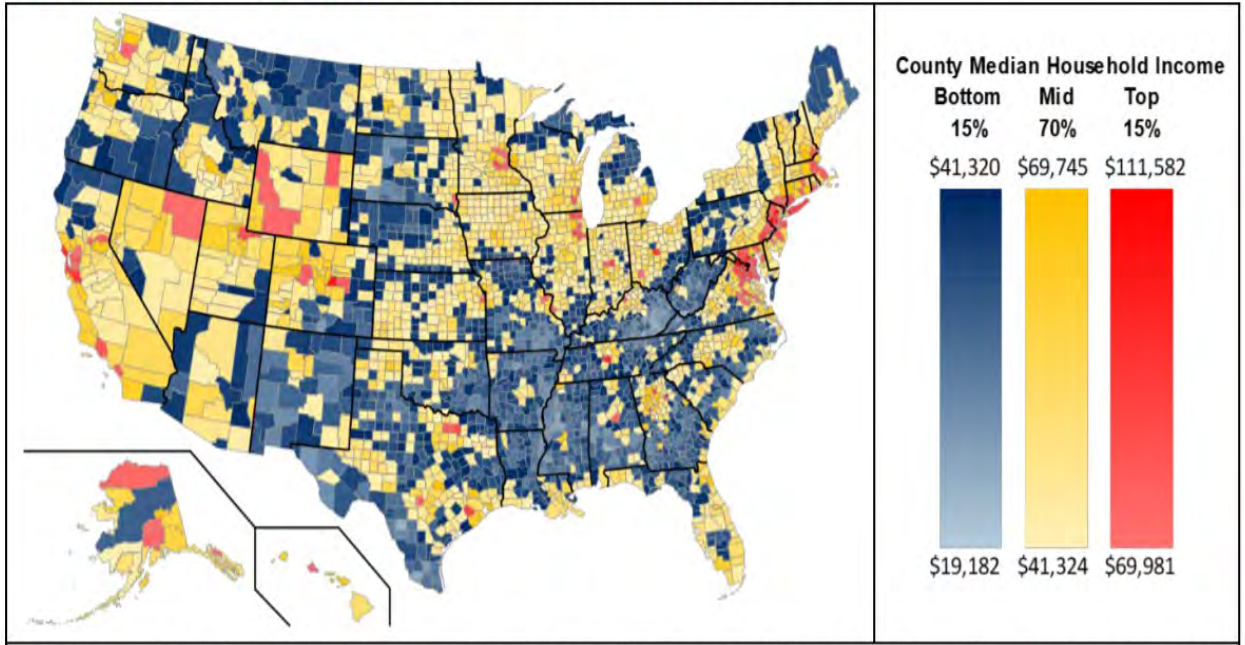
GHCN Weather Stations with At Least 3 Inches of Rain During Hurricane Dorian (source: GHCN data)



Other Examples

- Mortality by Income Level: Top 15% and Bottom 15%
- County Information
- Apply to Diabetes as a Cause of Death
- Homework!!!

U.S. CENSUS BUREAU 2008 COUNTY MEDIAN HOUSEHOLD INCOME ESTIMATES



Robert Mundigl, "Choropleth Map Template USA by Counties," [12/17/2018], Clearly and Simply, available under Creative Commons License BY-NC-SA 3.0. Map is a derivative of original.

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The Why of Data Visualization

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