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LEARN INTERACT GROW

A cross-country comparison of historical changes in period Life Expectancies and Mortality Improvement rates

> IAA Mortality Working Group – Bridget Browne

Introduction

- Mortality Working Group (MWG) is a permanent working group of the International Actuarial Association.
- Its vision is "The Mortality Working Group will be preeminent international actuarial body to provide insights and knowledge with respect to mortality and trends in mortality."



Introduction

- The Human Mortality Database (HMD) was created to provide detailed mortality and population data to researchers, students, journalists, policy analysts, and others interested in the history of human longevity.
- At present the database contains detailed population and mortality data for the following 37 countries or areas



- » Dept of Demography at UC, Berkeley (USA)
- » Max Planck Institute for Demographic Research (Germany)

Part I

- 1. Period Life Expectancy
 - all countries and years available from HMD
 - Males and Females (and the gap)
 - ages 0, 40 and 65
- In both tabular and graphical format
 - »MS Excel
 - » With documentation
 - » Demonstration







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Part II

- 2. Mortality Improvement Heat Maps
 - Smoothing of the past only, no projections
 - Method: P-splines (using MortalitySmooth package in R)
 - Available:
 - most countries and years available from HMD
 - Males and Females
 - » Commentary from country experts



- » MS Excel
- » Documentation

Heat Maps - introduction

- Use to present changes in mortality rates over age and time
- "At a glance" overview of patterns
- Age/time/cohort
- Samples



All countries, both genders

| P4 144 | (a) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------|--------|----------------|---------|------------|----------|---------|---------|---------|---------|----------------|---------|---------|---------|---------|-----------------------|-----------|---------|---------|---------|---------|------------|---------------|----------|--------|---------|---------|-----------|--------------|----------|---------|----------|---------|------------|---------|----------|----------|
| country | (eii) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sum of MLamooth | | 0.55 | 12.53 | 1 | 133 | 1022 | | 1 | 200 | 0222 | 1283 | 7222 | 17708 | 7227 | 000 | 112 | 1 | Vine | | 172330 | 112228 | 1 | 122 | 10000 | 1222 | 1.1 | - | 22.2 | 1222 | 1000 | | 1337 | | - | - | 100 |
| 90 | 19/0 | 25.20% | 20.074 | 17 00% | 19/4 | 10 27% | 20.40% | 11.07% | 20.40% | 14.10% | 10 70% | 18.50% | 10.19% | 1983 | 1904 | 11 0/4 | 10.001 | 10.15% | 10.20% | 17.155 | 17.4% | 6 175 | 1175 | 2 20% | 6.10% | 100 | 24 124 | 11.446 | 2016 | 44 01% | .M. 2000 | 10.025 | MATES. | 48 75% | 12.45% | ANT BE |
| 89 | 0.005 | 47.93% | 42.97% | 40.07% | 19.305 | 40.655 | 42.665 | 41.455 | 42.23% | 19.10% | M.075 | 20.205 | MASN | 23:16% | 24,38% | 28,08% | 11,255 | 16.46% | 36,995 | MAN | 21.99% | 21.18% | 19.695 | 19.645 | 23.80% | 11.95% | 41.27% | 53.46% | IO.HEN | 65.515 | 67.19% | 66.28% | 66.60% | 68,18% | 72.125 | 77.74% |
| 88 | 0.00% | 53.R8% | 48.86% | 45.91% | 45.08% | 46.38% | 48.59% | 49.36% | 42.40% | 45.71% | 41.33% | 36.23% | 33.16% | 32.58% | 34,46% | 38.80% | 44.56% | 48.21% | 49.02% | 46.99% | 42.10% | 35.34% | 31.41% | 11.745 | 36.29% | 45.03% | 57.14% | 67.98% | 75.80% | 80.63% | 82.46% | 81.59% | 81.20% | #2.95% | 85.83% | 92.77% |
| 87 | 0.00% | 54,96% | 49.90% | 40.93% | 46.10% | 47,40% | 49.68% | 30.68% | 50.13% | 48.03% | 44.38% | 40.15% | 37.91% | 38.00% | 40.61% | 45.53% | 51.75% | 55.83% | 55.92% | 55.06% | 50.21% | 43.39% | 39.52% | 40.02% | 44.92% | 54,14% | 66.86% | 78.19% | 86.32% | 91.27% | 93.02% | 91.92% | 91.38% | 93.19% | 97.30% | 103.82% |
| 86 | 0.00% | 58.20% | 41.11% | 45.16% | 44.41N | 45.85% | 45.35% | 49.70% | 49.63% | 48.16% | 45.28% | 41.90% | 40.44% | 41.29% | 44.45% | 49.89% | 56.59% | 61.00% | 62.37% | 60.71% | 55.98% | 49.23% | 45.44% | 46.115 | 51.24% | 60.77% | 73.82% | 85.41% | 93.57N | 98.61% | 100.22% | 98.85% | 98.18% | 100.10% | 101.63% | 111.67% |
| 85 | 0.00% | 50.69% | 45.55% | 42.69% | 42.15% | 43.94% | 45.88% | 48.72% | 49.21% | 48.34% | 46.12% | 43.42% | 42.60% | 44.02% | 47.69% | 53.59% | 60.69% | 65.45% | 67.13% | 65.72% | 61.21% | 54.61% | 50.95% | 51.72% | 56,91% | 66.48% | 73.54% | 91.07% | 99.20% | 103.94% | 105.27% | 103.58% | 102.72% | 104,72% | 109.58% | 117.215 |
| 84 | 0.00% | 45.94% | 43.74% | 41.02% | 40.83% | 43.16% | 46.78% | 49.25% | 50.33% | 50.00% | 48.25% | 45.96% | 45.57% | 47,40% | 51,46% | 57.75% | 65.23% | 70.34% | 72.35% | 71.24% | 66,99% | 60.61% | 57.07% | 57.84% | 62.93% | 72.27% | 85.01% | 98,17% | 103.91% | 108.25% | 109.17% | 107,06% | 105.94% | 107.95% | 111.09% | 121,25% |
| 85 | 0.00% | 48.25% | 42.98% | 40.435 | 40.65% | 43.54% | 48.03% | 51.19% | 52.82% | 52.93% | \$1,49% | 49,45% | 49.27% | 51.36% | \$5.72% | 62.35% | 70.19% | 75.63% | 77,94% | 77.09% | 73.06% | 66.86% | 63.38% | 64.08% | 68.95% | 77.94% | 90.21% | 100.87% | 108.12% | 111.96% | 112.42% | 109.86% | 108.46% | 110.45% | 115.82% | 124.45% |
| 82 | 0.00% | 48.80% | 43.45% | 41.07% | 41.68% | 45.31% | 50,44% | 34.21% | 56.32% | 56.75% | 55.48% | 53.51% | 53,43% | 55.69% | 60.29% | 67.22% | 75,39% | 81.13% | 83.65% | 12.95% | 79.01% | 72.82% | 69.28% | 63.82% | 74,46% | 83.13% | 95.00% | 105.24% | 112.06N | 115.49% | 115.51% | 112.53% | 110.88% | 112.85% | 118.43% | 127,49% |
| 81 | 0.00% | 50,76% | 45.35% | 43.89% | 44.01% | 48.11% | 53.80% | 58.03% | 60.45% | 61.07% | 59.86% | 57.86% | 57.80% | 60.17% | 64.97% | 72.19% | 80.68% | 86.63% | 約.23% | 88.50% | 64.40% | 77.96% | 74.16% | 74,49% | 78.95% | \$7,49% | 99.25% | 109.35% | 115.99% | 119.19% | 118.93% | 115.64% | 111.79% | 115.78% | 121.59% | 131.06% |
| 80 | 0.00% | 54.32% | 48.87% | 46.64% | 47.69% | 51.99% | \$7.91N | 62.31% | 64,84% | 65.50N | 64.26% | 62.18% | 62.13% | 64.60% | 69.59% | 77.08% | 85.86% | 91.93% | 94.45% | 93.42% | 88.82% | B1.72% | 77.41% | 77.47N | 81.90% | 90.65% | 102.82% | 113.29% | 120.16% | 123.46% | 123.17% | 119.75% | 117.83% | 119.92% | 125.98% | 135.87% |
| 79 | 0.00% | 59,45% | 53.99% | 51.70% | \$2.64% | 36.75% | 62.58% | \$6.77% | 89.16% | 69.70% | 68.37% | 65.26% | 65.24% | 68.81% | 73.98% | 81.72% | 90.73% | 96.79% | 99.01% | 97,40% | 91,93% | 83.77% | 78.71% | 78.47% | \$3.07% | 92,47% | 105.68% | 117.12% | 124,72% | 128.53% | 128.51% | 115.14% | 123.30% | 125.58% | 131.96% | 142.27% |
| 78 | 0.00% | 05,04% | 00.18% | 37.75% | 58.38% | 82.08% | 07.000 | 71.12% | 73.25% | 73.55% | 72.13% | 70.05% | 70.11% | 72,70% | 78.03% | 85.88% | 94,95% | 100.62% | 102.30% | 100.20% | 98.67% | P4.28% | 78.35% | 11.52% | 82.97% | 93.27% | 100.07% | 110.83% | 129.54% | 114.11% | 134,53% | 111.35% | 129.04% | 132.18% | 138.92% | 149.07% |
| 77 | 0.00% | 72.29% | 66.82% | 64.16% | 64.35N | 67.39% | 71.86N | 75.09% | 76.79% | 76.95N | 75.56N | 73.61% | 73.76% | 76.44% | 81.65% | 89.35% | 98.18% | 103.61% | 104.74% | 101.56% | 54.01% | B3.49% | 76.93% | 76.39% | 81.96% | 93.56% | 110.02% | 134,48% | 134.40N | 139.85% | 140.78% | 137.75% | 136.18% | 138.97% | 145.10N | 157,36% |
| 76 | 0.00% | 78.81% | 73.30% | 70.34% | 69.99% | 72.23% | 75.835 | 78.42% | 79.75% | 79.80% | 78.57% | 78.94% | 77.23% | 79.83% | 84.74% | 91.93% | 100.07% | 104.78% | 105.18% | 101.25% | 92.93% | B1.65% | 74.77% | 74.47% | 80.82% | \$9.75% | 111.97% | 128.01% | 139.13% | 145.37% | 146.71% | 143.73% | 142.21% | 145.23% | 157.70% | 164.58% |
| 75 | 0.00% | 84.59% | 78.97% | 75.67% | 74,73% | 76.15% | 78.86% | 80.85% | 81.90% | 82,01% | 81.15% | 80.04% | 80.53% | 82.92% | 87.22% | 98,40% | 100.28% | 103.92% | 103.51% | 99.02% | 50,35% | 79.06% | 72.66% | 72.76% | 80.07N | 54.115 | 114.08% | 111.45% | 143.515 | 150.30% | 151.02% | 148.67% | 147.04% | 150.21% | 158.14N | 170.80% |
| 74 | 0.00% | 89.19% | 83.39% | 79.70% | 78.17% | 78.79% | 80.70% | 82.21% | 83.15N | 83.50% | 83.25% | 82.88% | 83.60% | 85.63W | 88.98% | 93.63M | 98.64N | 100.85% | 99.58h | 94.50% | B6.46% | 75.96N | 70.34% | 71.73N | 80.17N | 95.58% | 116.52% | 134.80% | 147.40N | 154.40% | 155.77% | 152.16% | 150.19% | R6E.621 | 161.72% | 174.91% |
| 73 | 81.00% | 92,74% | 35.68% | 82.58% | \$0.46% | 80.34% | 81.52% | \$2.63% | 83.54% | \$4.24% | 84.71% | 85.15% | 88.10% | 87.68% | 89.88% | 92.70% | 95,51% | 96.10% | 94.01% | 19.21% | 81.65% | 72.位5 | 68.54% | 71.32% | 80.95% | 97,43% | 119,71% | 138,04% | 150.88% | 137.75% | 158.74% | 154.43% | 151.95% | 155.09% | 163.80% | 177.78% |
| 72 | 0.00% | 95,47% | 89.10N | 84.56% | 81.88N | A1,06% | 81,56% | 12.12% | 83.20% | M-22% | \$5.35% | 86.5JN | \$7.66N | 88.74% | 89.78% | 90.76% | 91.35% | 90.38W | 87.61% | #3.02% | 76.55% | f9.37% | 67.08% | 71.38N | 82.26N | 99.64% | 122.04% | 141.19% | 154.0IN | 160.66W | 161.04% | 155.69% | 152.79% | 155-A1N | 164.89% | 179.60% |
| 71 | 0.00% | 97.65% | 90.93% | 85.93N | 82.69% | 81.22% | 81.09% | 81.46N | 82.34% | 83.42N | 64.99% | 85.69N | 87.88N | 88.49% | 88.52% | 87.94% | 86.67% | 84.45% | 81.24% | 77.03% | 71.78% | 66.47N | 65.99% | 71.73N | 83.77N | 101.97% | 124.88% | 144.22% | 156.98% | 163.25N | 162.97% | 156.93% | 153.38% | 156.04N | 163.46N | 181.06% |
| 70 | 0.00% | 99.53% | 92.42% | 86.96% | 83.19% | 81.11% | 80.37% | 10.29% | 80,78% | 81.86% | 83.49% | 85.32% | 85.41% | 86.62% | 85.95% | 94.38% | #1.98% | 79.09% | 75,795 | 72.09% | 67.95% | 64.225 | 65.21% | 72.23% | 85.26% | 104.21% | 127.62% | 147,145 | 159.835 | 165.75% | 164.16% | 157.97% | 159.58% | 156,30% | 165.04% | 182.38% |
| 69 | 0.00% | 101.29% | 93.77% | 87,86% | 83.57% | 80.92% | 79.58% | 78.93% | 78.91% | 79.52% | BQ.76% | 82.24N | 83.02% | 82.96% | 82.05% | 80.28N | 77.755 | 74,95% | 71,99% | 68,88% | 65.57% | 62,85% | 64.01% | 72.71% | 86.53% | 106.16% | 190.09% | 149.93% | 162.65% | 168.33% | 166.92% | 159.27% | 154.33% | 156.91% | 166.94% | 181.95% |
| 68 | 0.00% | 102.70% | 94.79% | 88.42% | 83.63N | 80.43N | 78.49% | 77.21% | NE27N | 76.49% | 77.00% | 77.84% | 78.24% | 78.07% | 77.35% | 76.04% | 74.22% | 72.12% | 69.81% | 67.28% | 64.47% | 62.20% | 64.63% | 73.06N | 87.46N | 107.73% | 132.29% | 152.52% | 165.32% | 170.8IN | 166.92% | 160.54% | 155.02% | 157.43N | 167.69% | 185.27% |
| 07 | 0.00% | 103.42% | 30.135 | 88.335 | 83.00% | 73,37% | 70.755 | 14.825 | 73.47% | 72.71% | 72.53% | 12.125 | 72.82% | 72.70% | 72.54% | 72.17% | 71.59% | 70.51% | 08.97% | 00.925 | 64,30% | 01.995 | 64,48% | 73.15% | 87.99% | 108-80% | 134.125 | 154.815 | 167.73% | 171.55% | 170.53% | 161.27% | 155,04% | 15/175 | 107.55% | 115.025 |
| 66 | 0.00% | 103.10% | 94.425 | 87.25% | 81.53% | 11.40% | 74.05% | 71.50% | 09.60% | 68.52% | 67.65% | 87.4/% | 07.54% | 07.83% | 68.36% | 69.14% | 69.93% | 09.99% | 19,175 | b7.42% | oil.65% | 01.96% | 64.17% | 12.8/% | 38.02% | 105.87% | 105.52% | 158.70% | 107.07% | 174.02% | 1/1.93 | 150,95% | 151.00% | 130.43% | 165.80% | 108 20 % |
| 85 | 0.00% | 101.41% | 52.33% | 84.55% | 78.75% | 73.75% | 69.58% | 66.97% | 04.73% | 03.32% | 62.68% | 62.69% | 03.18% | 04.12% | 60.00% | 67.40% | 09.5078 | 70.47% | 70.13% | 68.43% | 63.30% | 01.84% | 63.35% | 72.05% | 87.49% | 109.56% | 136.43% | 128.115 | 171,00% | 1/9.428 | 171.15% | 139,18% | 130.04% | 151.32% | 101.71% | 180.53% |
| 04 | 0.00% | 96,07% | 89.00% | 8117% | 74.43% | 05.54% | 04.37% | 01.025 | 28,845 | 57.81% | \$7.91% | 58,9479 | 00,43% | 02.3479 | 04,71% | 07.53% | 70.37% | 71,83% | 71.58% | 09.3978 | 60.80% | 01.395 | 02.41% | 70.73% | 80.33% | 103.025 | 136.875 | 138.30% | 171.72% | 1/5.78% | 109.49% | 133,467 | 145.12% | 144,31% | 154.715 | 175.82% |
| 63 | 0.00% | 93.94% | 34.29% | 76.15% | 65.33% | 62.70% | 37.61% | 24.11% | 52.27% | 52.10% | 21.38% | 30.28% | 32.23% | 02.58% | 60.67% | 69.12% | 72.31% | 73.87% | 75.52% | 70.76% | 00.10% | 80.59% | 60.82% | 65.51% | 84.59% | 107.30% | 1953/76 | 129.14% | 171-58% | 1/4.08% | 100.33% | 150,12% | 137.81% | 138.07% | 140.3/% | spe./un |
| 02 | 0.00% | 87.70% | 78.0376 | 10.55% | 02.85% | 20.01% | 20.3778 | 40.55% | 43.04% | 40.0478 | 49.00% | 24,0471 | 10.147 | 44.000 | 07.89% | 71.73% | 74,2076 | 70,19% | 72.1378 | 71.897 | 00.21% | 29,323 | 38.857 | 60.00% | D2.50% | 100.21% | 133./1% | 120.0076 | 1/0.01% | 171.36% | 102.3378 | 114 000 | 128.79% | 125.85% | 194.3976 | 109-107 |
| 01 | 0.0074 | 01.35% | IL INT | OR CON | 20.017 | 43.5/78 | 41,407 | 60.000 | 19.00% | 41.003 | 40.707 | 20.000 | 00.35% | 00.00% | 70.0079 | 79,79479 | 00.364 | 70.07% | 77.925 | 12.017 | 00.1176 | 20.437 | 20.7074 | 61.679 | 75.15% | 101.00% | 134.10% | 107-009 | 100.175 | 100.37% | 107.78% | 110.007 | LINBYN ING | 104.000 | 113.006 | 122 205 |
| 50 | 0.00% | AD 676 | 63.66% | 51.005 | MIN | 10 715 | 27.425 | 10 105 | 11.196 | 16.055 | AL TON | RA TIN | 61.075 | 71.544 | TTOOK | 01-14% | 01.774 | d1 02% | 30.005 | 72.0419 | 65.26% | KE STA | 43.00% | KE TEK | TD KIN | 00 18K | 130 078 | ittatk | 143 144 | HAT SEE | 146.65% | 111 405 | 101 844 | 08.366 | 103 104 | 172 onk |
| 58 | 0.007 | 68 8666 | 83 10% | 16175 | 40.00M | 15.576 | 10 645 | 10.004 | 39.0178 | 16 118 | 14 475 | SEAM | 65.96% | 73.2470 | 11/1/2/10 | 01.144 | 88, 398 | 06/20/E | En Kato | 34.135 | 64 675 | KI ANK | 411 7195 | AT SHE | 12.007 | 64 578 | 15 118 | LOLIDON INC. | 152.00% | 152.000 | 140.30% | 114.97% | AL DITE | 11.63% | 105.201 | 116 255 |
| 59 | 0.0056 | 60.00% | 62 576 | 45.49% | 20 785 | 20 454 | 10.07/1 | 17 146 | TA COM | 15 755 | 45 40% | 57 755 | 60.00% | 76 125 | 01 0.00 | DU LAN | 10.762 | 05 27% | P1 025 | 72.00% | 62 52% | 51 545 | 47.126 | 53 106 | 00.04 A | 60.526 | 100 758 | 142 085 | 153 755 | 151 085 | 114 076 | 100 526 | 97.01/0 | 91 176 | 00.42% | 111 16% |
| 55 | 0.00% | 57.064 | ADOR | AL ANSI | 20.126 | 11 144 | 31.754 | 17.264 | 10.104 | 34.044 | AT 195 | SD ANK | 31.165 | 70.4474 | 03 61% | 17.045 | 87.354 | 15 70% | ph ext | 12 005 | 63.06% | AD STR. | 11.116 | AL ANK | 10 100 | OL DAY | 115 1256 | 137 784 | 107.104 | M SIS | 120.00% | 103 726 | 07,40% | 75.87% | BE ATK | Insats |
| 55 | 0.00% | 55.99% | 49.30% | 45 58% | 17.94% | 12.68% | MAIN | 28.104 | 11 APR | 10.54H | 49.16% | 61.67% | 72.11% | 79.995 | 85.11% | 88.10% | AR SIN | 85 70% | 80.19% | 71.68% | F0.04% | 45.91% | 40.1195 | AL FAN | 58.14% | \$1.07% | 110.41% | 112/165 | tat link | 118.3/5 | 121,49% | 67 539 | 77.12% | 71.64% | 81.03% | 103.935 |
| | • | and the second | | A Property | and a | 10.00.0 | 10.01.0 | 10.003 | 10.001 | MAN | 40.400 | 41.47.4 | 10.014 | 10.014 | and the second second | pit. June | 10.017 | 43.704 | 00.477 | T LOUGH | (M) (Maile | | 49,977 | 44.467 | Jean | 41,0174 | PROVIDE N | 111.0/1 | e1.0.4 | 10000 | 111414 | TO JUN | 11.44.00 | 1.04.0 | 01.06.0 | AVAILA |
| ICA WAS | 20 | 14 тс | | | \ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

All countries, Female and Male



Austria, Female and Male



WASHINGTON DC

Russia, Female and Male



Conclusion

- Novel presentation of mortality data
- Accessible to users to explore
- Helps identify patterns: similarities and differences => better estimate the future
- Further work

