# Age standardization

- Direct method
  - ASDR (Death at age x per population at age x) in target population: Dt(x)
  - Reference (standard) population for each age: SP(x)
  - Total reference population: SP=Σ SP(x)
- age-adjusted (direct) mortality rate = Σ(Dt(x)*SP(x)) / SP

- Indirect method
  - ASDR (Death at age x per population at age x) in reference (standard) population: Ds(x)
  - Total number of death in target population: TD
  - Target population for each age: TP(x)
  - CDR in reference population: CDRs
- SMR = TD/ Σ(Ds(x)*TP(x))
- age-adjusted (indirect) mortality rate= SMR*CDRs

# Example of age standardization

- sk <- read.delim("http://minato.sip21c.org/demography-special/deaths.txt")
- Reference (standard) population for each age group (STP) is necessary, so that it's given as STP <- (sk$NSW+sk$NK)/2
- Standard ASDR (ASDRST) is got by STD <- (sk$DSW+sk$DK)/2; ASDRST <- STD/STP
- Sweden's ASDR (ASDRSW) is got by ASDRSW <- sk$DSW/sk$NSW
- Direct method: sum(ASDRSW*STP)/sum(STP)
- Indirect method: (sum(sk$DSW)/sum(sk$NSW*ASDRST))*(sum(STD)/sum(STP))



sk$NSW

| AG | NSW | DSW | NK | DK |
|---|---|---|---|---|
| "0" | 59727 | 279 | 174078 | 3720 |
| "1-4" | 229775 | 42 | 754758 | 1220 |
| "5-9" | 245172 | 31 | 879129 | 396 |
| "10-14" | 240110 | 33 | 808510 | 298 |
| "15-19" | 264957 | 61 | 720161 | 561 |
| "20-24" | 287176 | 87 | 622988 | 673 |
| "25-29" | 311111 | 98 | 733057 | 752 |
| "30-34" | 280991 | 140 | 732312 | 965 |
| "35-39" | 286899 | 197 | 612825 | 1113 |
| "40-44" | 308238 | 362 | 487996 | 1405 |
| "45-49" | 320172 | 643 | 284799 | 1226 |
| "50-54" | 242230 | 738 | 503608 | 2878 |
| "55-59" | 210785 | 972 | 301879 | 3266 |
| "60-64" | 216058 | 1640 | 374317 | 5212 |
| "65-69" | 224479 | 2752 | 256247 | 6866 |
| "70-74" | 222578 | 4509 | 154623 | 6182 |
| "75-79" | 184102 | 6745 | 149917 | 8199 |
| "80-84" | 140667 | 9587 | 88716 | 9013 |
| "85+" | 110242 | 17340 | 58940 | 10627 |

# Table 6-2. Life table for California 1970

| Age interval x to x+1 | Mid-year Population (Px) | Deaths in year (Dx) | ASDR (Mx) = Dx/Px | Fraction of last year lived (ax) | Probability of dying (qx) = Dx / (Px + (1-ax)*Dx) = Mx / (1+(1-ax)*Mx) |
|---|---|---|---|---|---|
| 0 | 340483 | 6234 | 0.018309284 | 0.09 | 0.018009224 |
| 1 | 326154 | 368 | 0.001128301 | 0.43 | 0.001127576 |
| 2 | 312699 | 269 | 0.000860252 | 0.45 | 0.000859845 |
| 3 | 323441 | 237 | 0.000732746 | 0.47 | 0.000732461 |
| 4 | 338904 | 175 | 0.00051637 | 0.49 | 0.000516234 |
| 5 | 362161 | 179 | 0.000494255 | 0.5 | 0.000494133 |
| 6 | 379642 | 171 | 0.000450424 | 0.5 | 0.000450323 |
| . | . | . | . | . | . |
| . | . | . | . | . | . |
| . | . | . | . | . | . |
| 83 | 34439 | 3753 | 0.10897529 | 0.5 | 0.103344302 |
| 84 | 31009 | 3669 | 0.118320488 | 0.5 | 0.111711602 |
| "85+" | 142691 | 22483 | 0.157564247 | --- | 1 |

# Table 6-3. Abridged life table for England and Wales, females 1985

| x | n | ASDR (nMx) | nax | nqx = n*nMx / (1+n*(1-nax)*nMx) | npx = 1-nqx | lx = l(x-1)- nd(x-1) | ndx = lx*nqx | nLx = n*(l(x+1)+ nax*ndx) | Tx = T(x+1)+nLx | ex = Tx/lx |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0.008314 | 0.1 | 0.008252 | 0.991748 | 100000 | 825 | 99257 | 7756161 | 77.562 |
| 1 | 4 | 0.000408 | 0.4 | 0.001630 | 0.998370 | 99175 | 162 | 396311 | 7656904 | 77.206 |
| 5 | 5 | 0.000181 | 0.5 | 0.000905 | 0.999095 | 99013 | 90 | 494842 | 7260592 | 73.330 |
| 10 | 5 | 0.000187 | 0.5 | 0.000935 | 0.999065 | 98924 | 92 | 494386 | 6765751 | 68.394 |
| 15 | 5 | 0.000282 | 0.5 | 0.001409 | 0.998591 | 98831 | 139 | 493807 | 6271364 | 63.455 |
| 20 | 5 | 0.000307 | 0.5 | 0.001534 | 0.998466 | 98692 | 151 | 493080 | 5777557 | 58.541 |
| 25 | 5 | 0.000364 | 0.5 | 0.001818 | 0.998182 | 98540 | 179 | 492254 | 5284477 | 53.628 |
| 30 | 5 | 0.000566 | 0.5 | 0.002826 | 0.997174 | 98361 | 278 | 491111 | 4792223 | 48.721 |
| 35 | 5 | 0.000884 | 0.5 | 0.004410 | 0.995590 | 98083 | 433 | 489335 | 4301111 | 43.852 |
| 40 | 5 | 0.001445 | 0.5 | 0.007199 | 0.992801 | 97651 | 703 | 486496 | 3811776 | 39.035 |
| 45 | 5 | 0.002485 | 0.5 | 0.012348 | 0.987652 | 96948 | 1197 | 481746 | 3325280 | 34.300 |
| 50 | 5 | 0.004210 | 0.5 | 0.020831 | 0.979169 | 95751 | 1995 | 473767 | 2843534 | 29.697 |
| 55 | 5 | 0.007219 | 0.5 | 0.035455 | 0.964545 | 93756 | 3324 | 460470 | 2369767 | 25.276 |
| 60 | 5 | 0.012054 | 0.5 | 0.058507 | 0.941493 | 90432 | 5291 | 438932 | 1909297 | 21.113 |
| 65 | 5 | 0.018259 | 0.5 | 0.087310 | 0.912690 | 85141 | 7434 | 407121 | 1470365 | 17.270 |
| 70 | 5 | 0.029920 | 0.5 | 0.139189 | 0.860811 | 77707 | 10816 | 361497 | 1063244 | 13.683 |
| 75 | 5 | 0.049689 | 0.5 | 0.220993 | 0.779007 | 66891 | 14783 | 297500 | 701747 | 10.491 |
| 80 | 5 | 0.085545 | 0.5 | 0.352367 | 0.647633 | 52109 | 18361 | 214641 | 404247 | 7.758 |
| 85+ | | 0.177987 | | 1 | 0 | 33747 | 33747 | 189606 | 189606 | 5.618 |