Regional Mortality in the United States at Ages 80 and Older: An Analysis of Direct Estimates over Period 1959-2011

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Data

- Death rates for ages 80 and over and for years 1959-2011
- States of the United States (excl. Alaska)
- 13 high-longevity countries with good data (Thatcher *et al*., 1998): Austria, Denmark, England and Wales, Finland, France, Germany (West), Iceland, Italy, Japan, the Netherlands, Norway, Sweden, and Switzerland.

Data for the United States

- Deaths: Mortality Detail Files (individual death certificates records), years 1959-2014
- Survivor estimates: population estimates by Census Bureau and Survivor Ratio Method (90+) (Thatcher, R. et al. 2002)

Data processing: NCHS Research and Development Center Hyattsville, Maryland

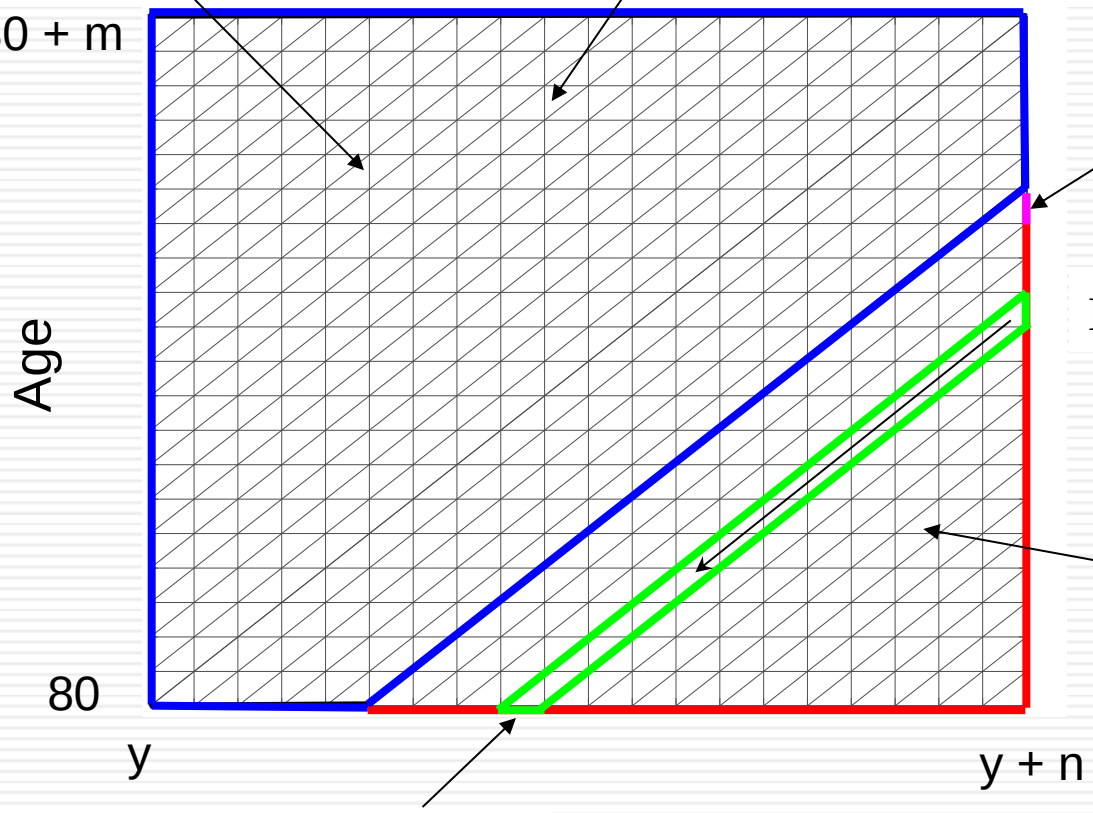
Abbreviations used for states of the United States, countries, statistical areas and aggregates

Name	Ab.	Name	Ab.	Name	Ab.	Name	Ab.
Alabama	AL	Louisiana	LA	Ohio	OH	Austria	AT
Arizona	AZ	Maine	ME	Oklahoma	OK	Denmark	DK
Arkansas	AR	Maryland	MD	Oregon	OR	England and Wales	UK
California	CA	Massachusetts	MA	Pennsylvania	PA	Finland	FI
Colorado	CO	Michigan	MI	Rhode Island	RI	France	FR
Connecticut	CT	Minnesota	MN	South Carolina	SC	Germany (West)	DW
Delaware	DE	Mississippi	MS	South Dakota	SD	Iceland	IS
District of Columbia	DC	Missouri	MO	Tennessee	TN	Italy	IT
Florida	FL	Montana	MT	Texas	TX	Japan	JP
Georgia	GA	Nebraska	NE	Utah	UT	the Netherlands	NL
Hawaii	HI	Nevada	NV	Vermont	VT	Norway	NO
Idaho	ID	New Hampshire	NH	Virginia	VA	Sweden	SE
Illinois	IL	New Jersey	NJ	Washington	WA	Switzerland	CH
Indiana	IN	New Mexico	NM	West Virginia	WV	13-country aggregate[2)]	EJ
Iowa	IA	New York	NY	Wisconsin	WI	12-country aggregate[3)]	EU
Kansas	KS	North Carolina	NC	Wyoming	WY		
Kentucky	KY	North Dakota	ND	United States[1)]	US		

1) Data for United States includes Alaska. 49 states + D.C.
2) The 13-country aggregate includes pooled data for Austria, Denmark, England and Wales, Finland, France, Germany (West), Iceland, Italy, Japan, the Netherlands, Norway, Sweden, Switzerland.
3) The 12-country aggregate includes the same countries as the 13-country aggregate except Japan.

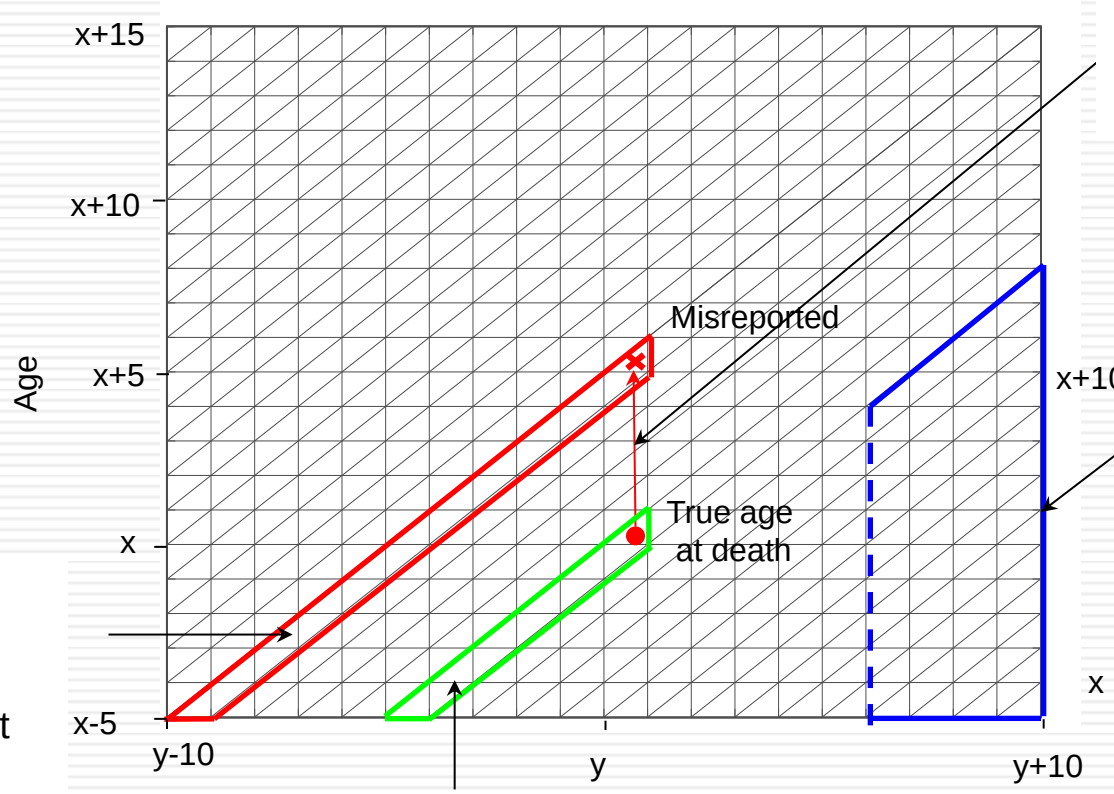
Color scheme used in figures: Northeastern states are shown in cyan, Midwestern states in green, Southern states in brown, Western states in magenta, and the 13 high-longevity countries in blue. The United States and the 13-country and 12country-aggregate are shown in **bold font**.

Almost Extinct Cohort Method



How age misreporting affects the almost extinct cohort method?

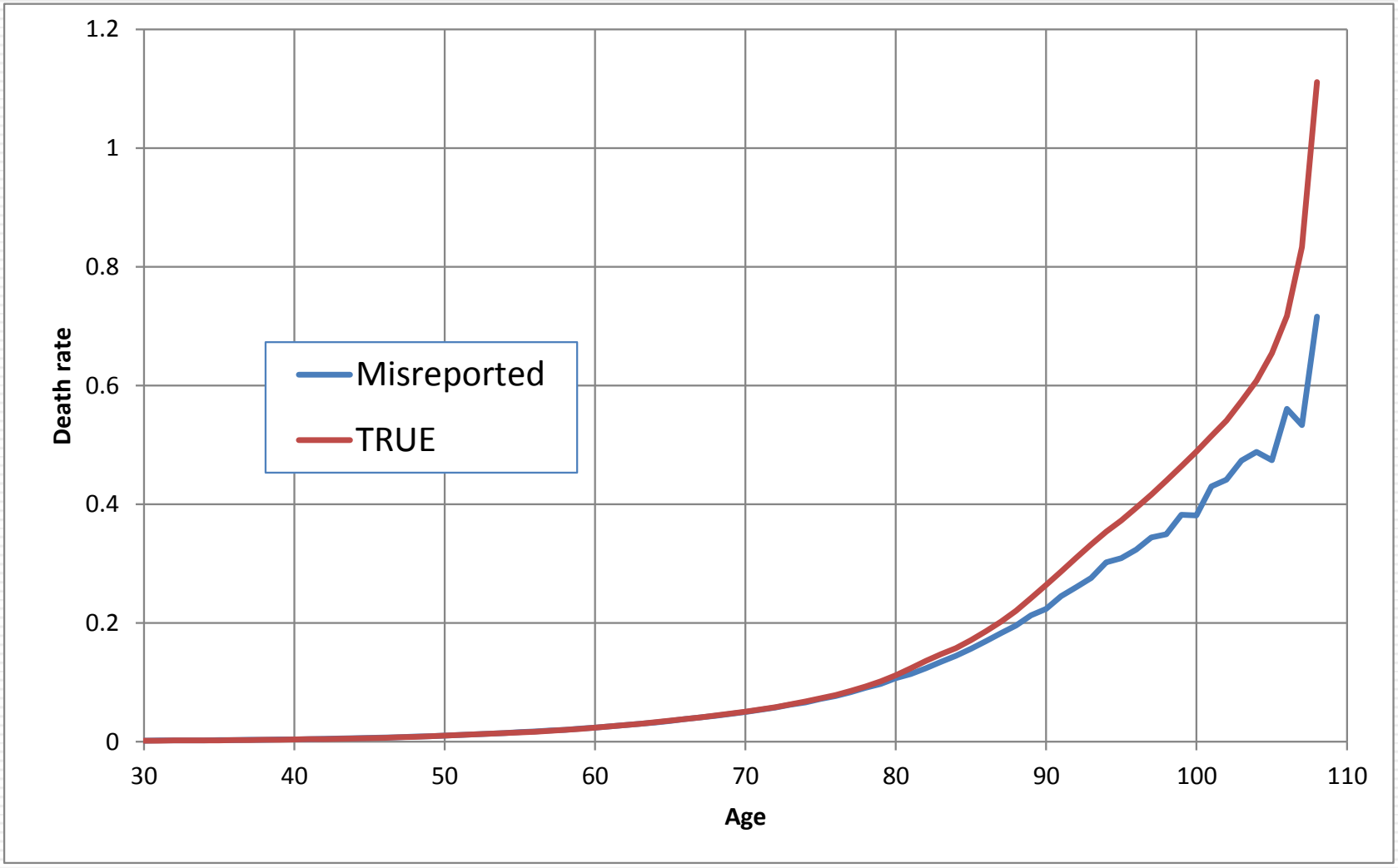
Effect of age misreporting on mortality estimates produced by the almost extinct cohort method



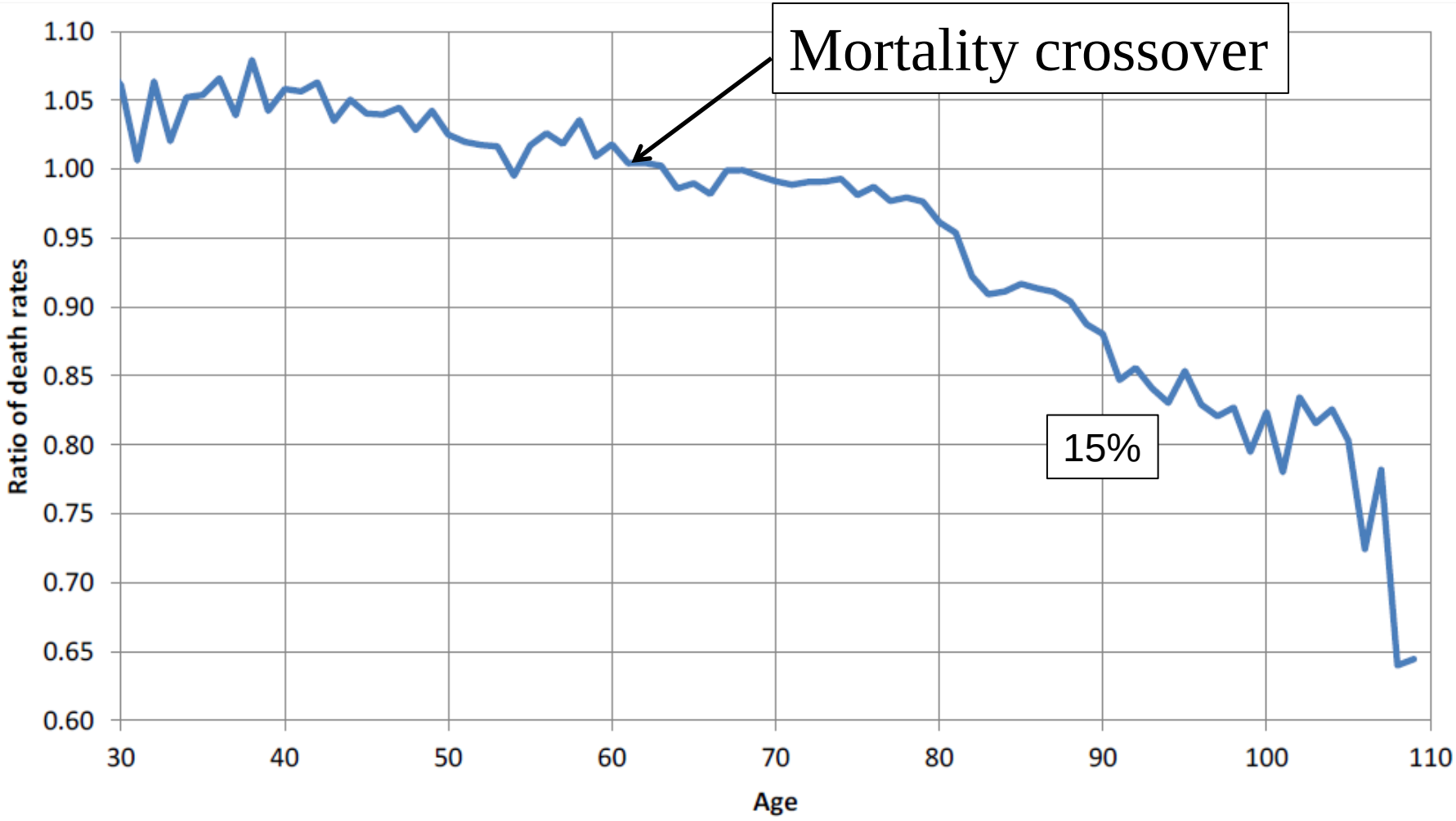
Simulation Study

- $\text{Age}_{\text{obs.}} = \text{Age}_{\text{true}} + \Delta$
- Single cohort (or stationary population)
- Mortality: the U.S. 1960 male decennial life table with e_0=66.8 (NCHS, 1964)
- Age misreporting is **symmetrical**, $\Delta \sim N(0, 3.04)$ with the 90% of the probability mass lying between -5 and 5. No net overstatement or understatement of age at death.

True and Misreported Death Rates



Ratio of Death Rates in Population with Simulated Age Misreporting to True Death Rates



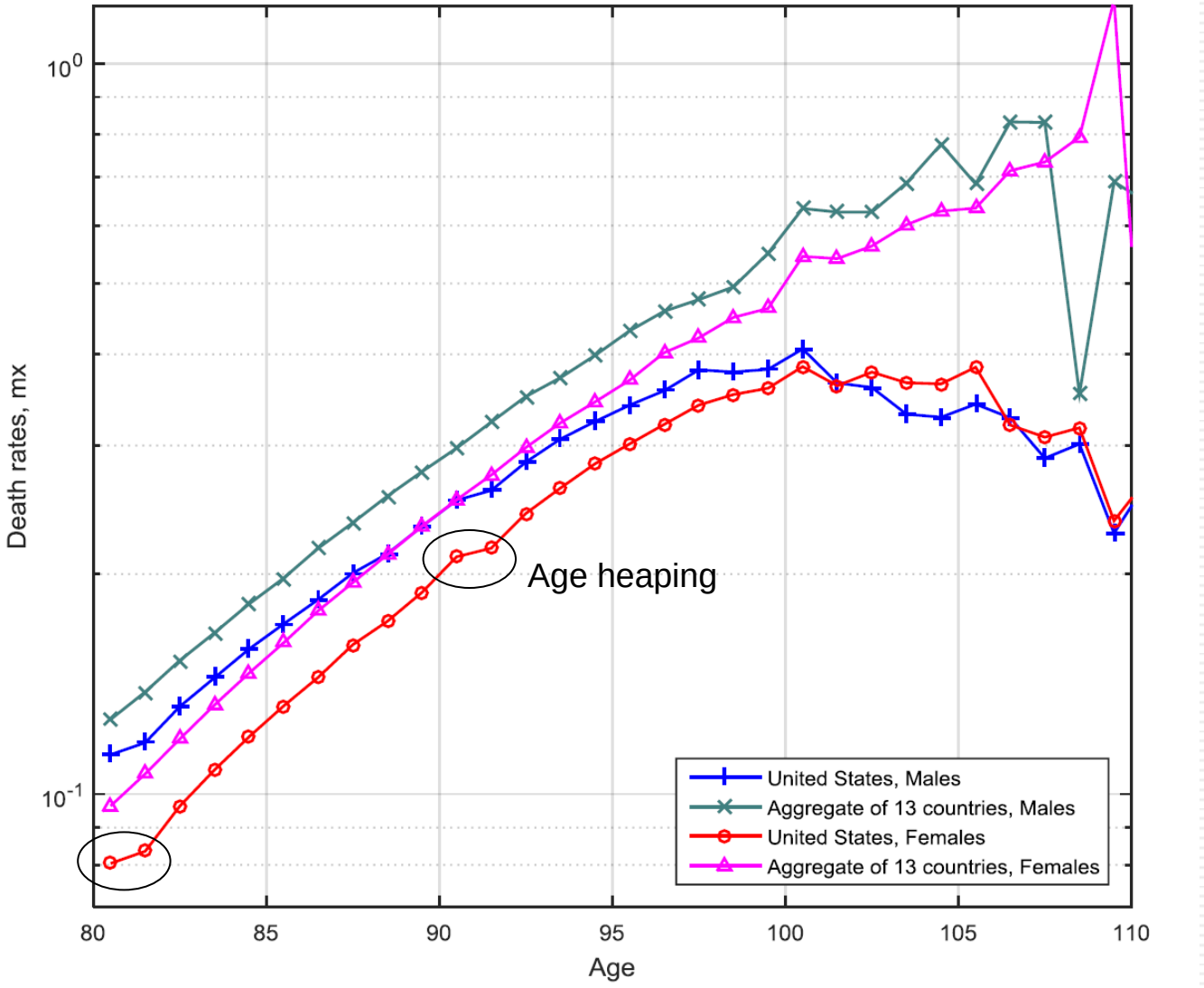
In general, results are similar to that of Preston *et al.* (1999)

Common manifestations of age misreporting at advanced ages

- Implausibly low death rates
- Implausibly slow rates of mortality increase with age or even declines in death rates with age

Period 1959-1969

Death Rates in the United States and the Aggregated Data for 13 Countries, 1959-1969



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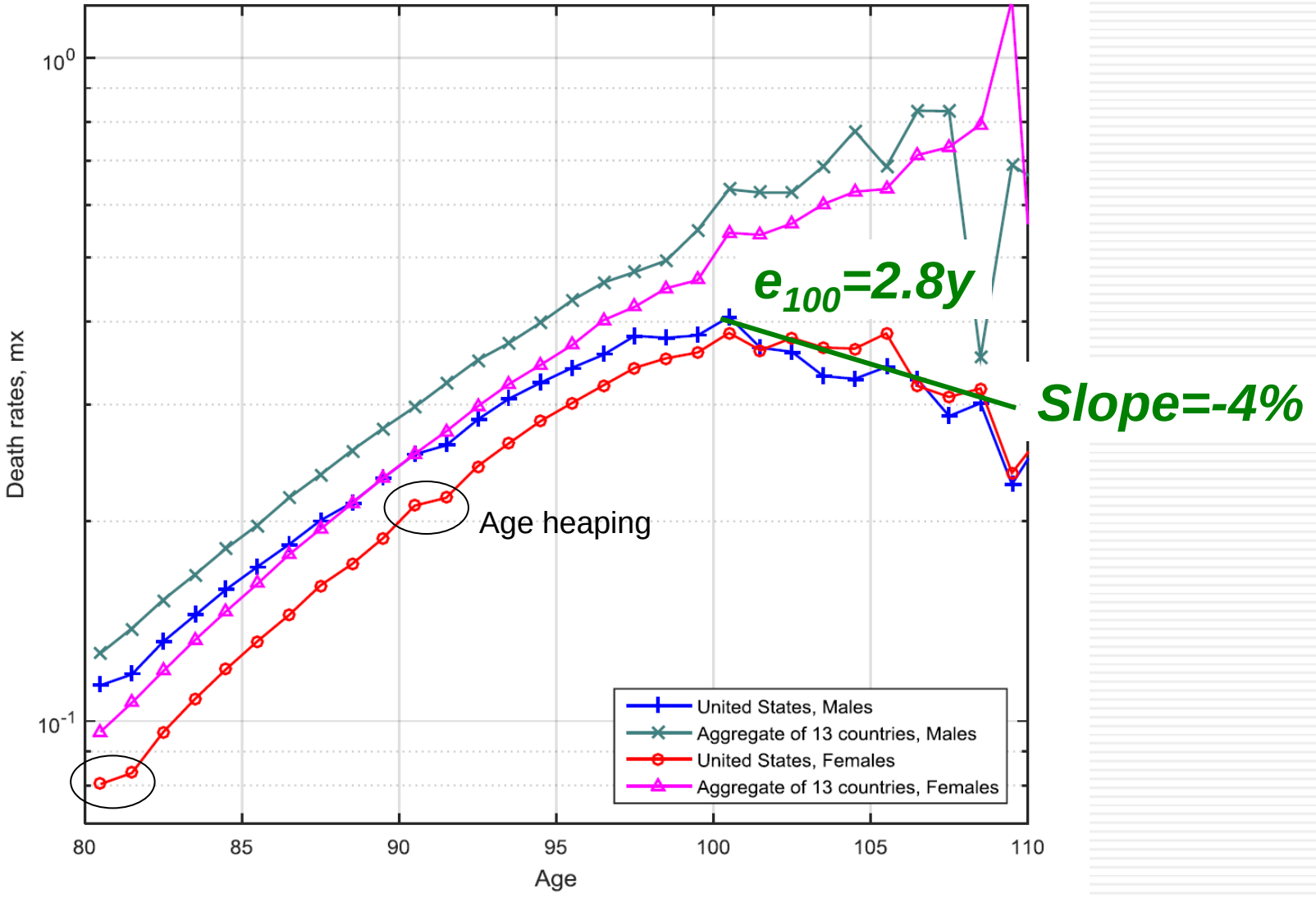
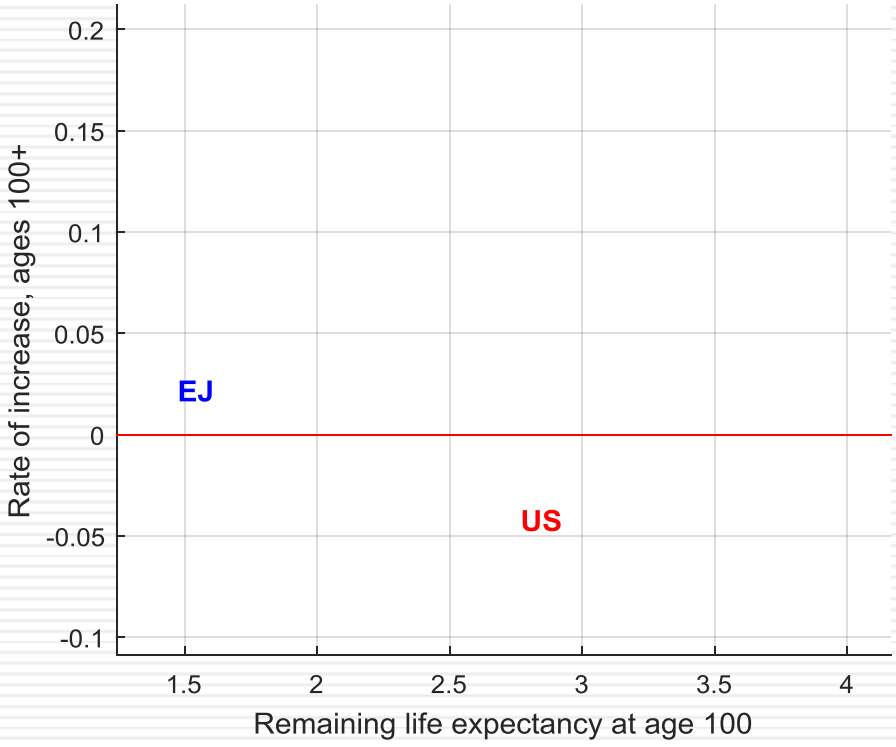
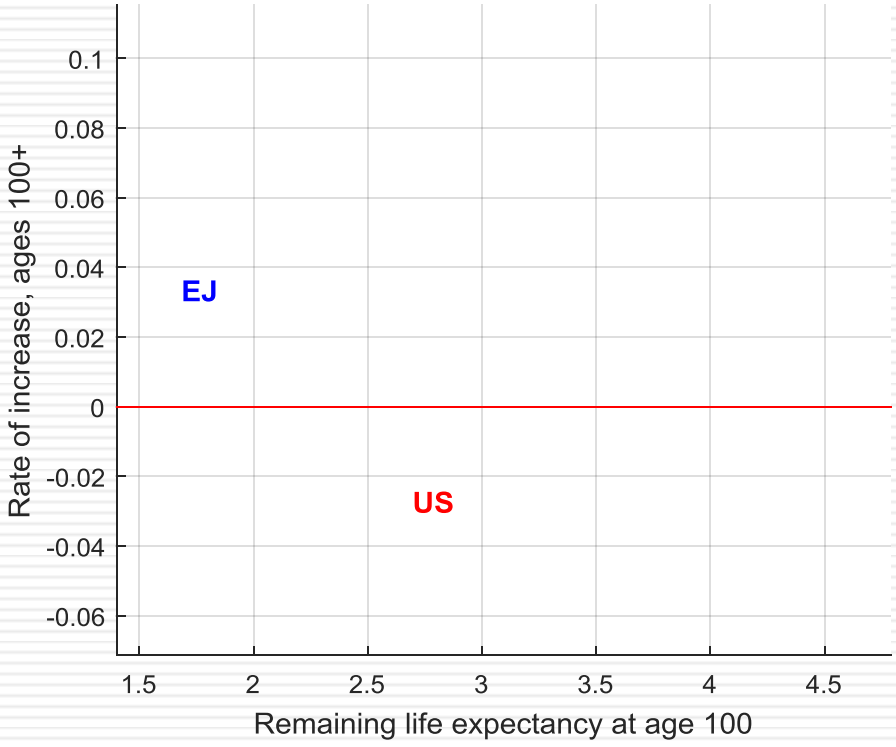


Rates of Mortality Increase with Age vs. Mortality Level
Period 1959-1969, Ages 100 and over

Males



Females



Poisson regression was used to compute rates of mortality increase with age. Only the estimates based on 100 or more deaths are included.

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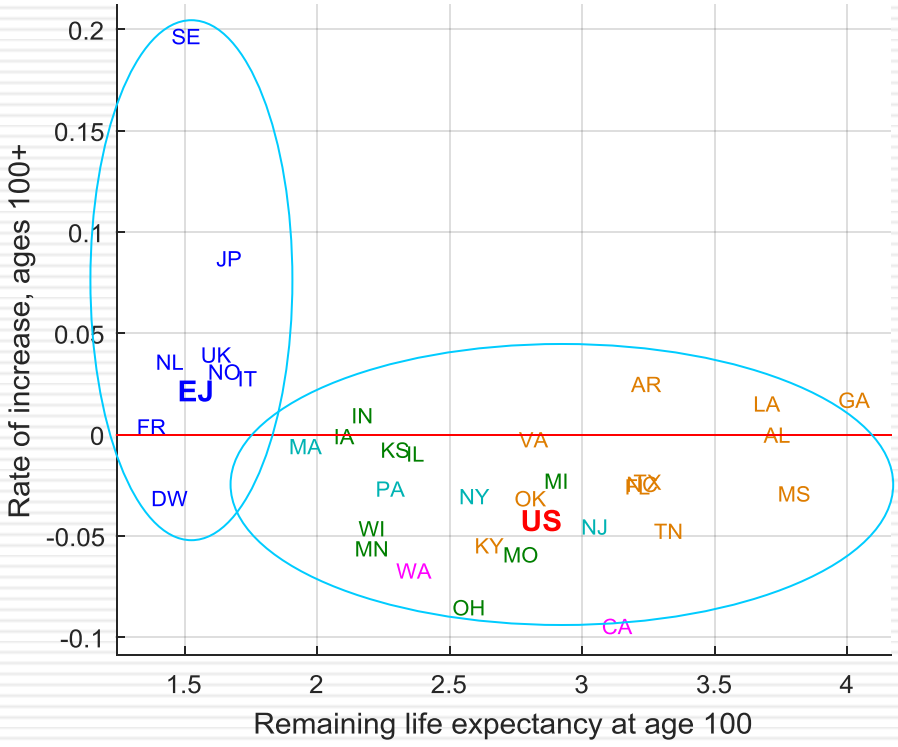

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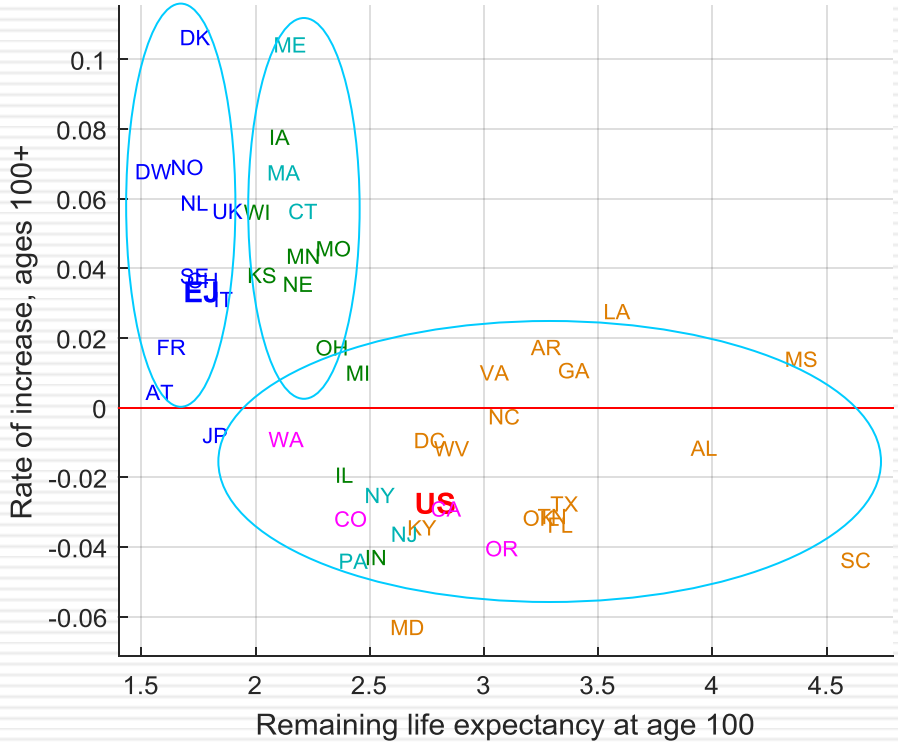

Color scheme: Northeastern states are shown in cyan, Midwestern states in green, Southern states in brown, Western states in magenta, and the 13 high-longevity countries in blue. The United States and the 13-country and 12country-aggregate are shown in **bold font**.

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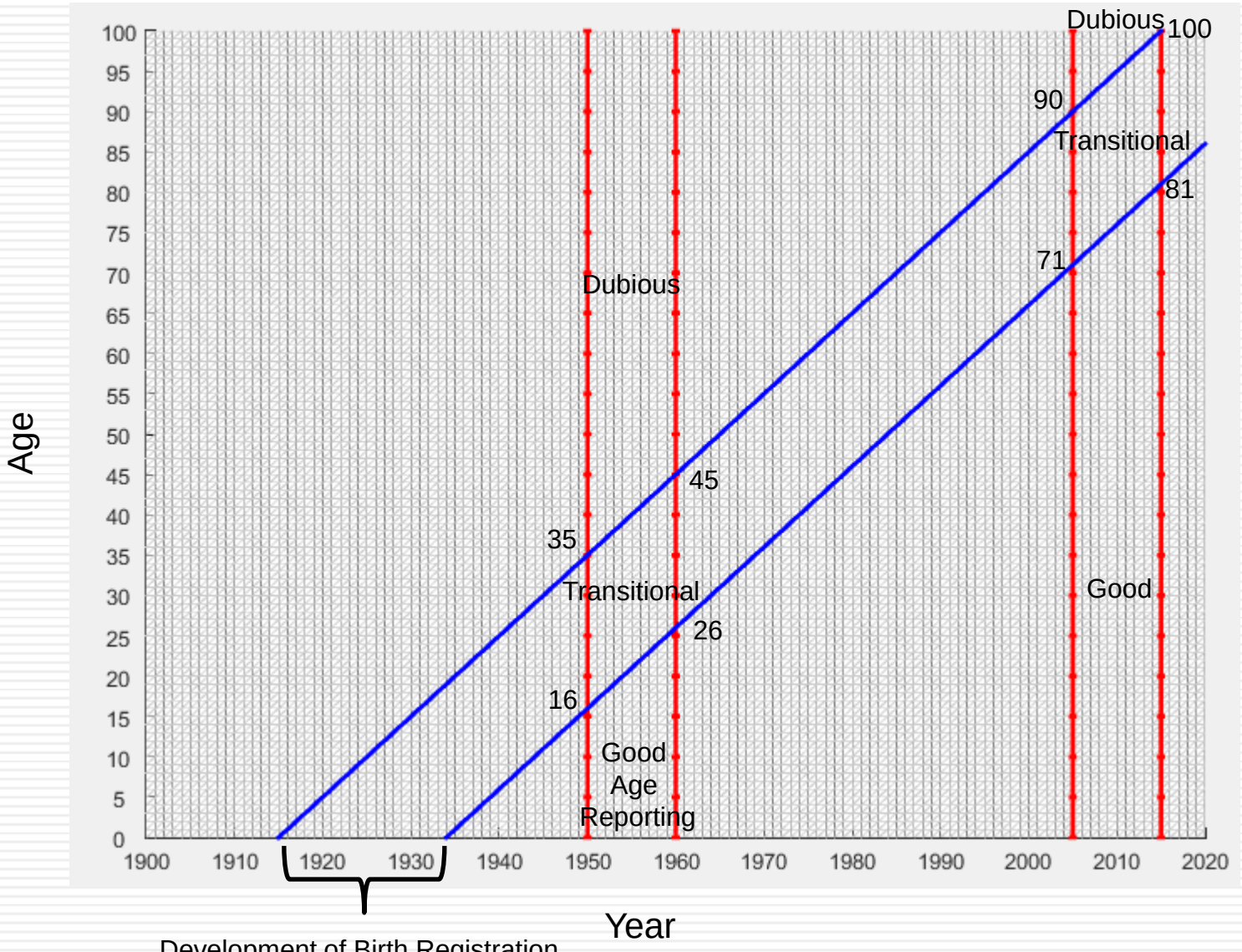
Period 1959-1969: conclusions

- Mortality estimates produced by the almost extinct cohort method for states of the United States appear to be implausible both in terms of levels and rates of mortality increase over age
- No particular state stands out as a state with good quality data
- Southern states appear to be beset by more data problems than Northeastern or Midwestern states, an observation generally consistent with development of the birth registration system in the United States (Hetzel, 1997).
- The data for males are of inferior quality as compared with the data for females

Changes in death rates from 1959-1969 to 2000-2011: any signs of improvement in data quality?

Development of Birth Registration System in the United States



(Hetzel, 1997).

Common manifestations of changes in data quality over time

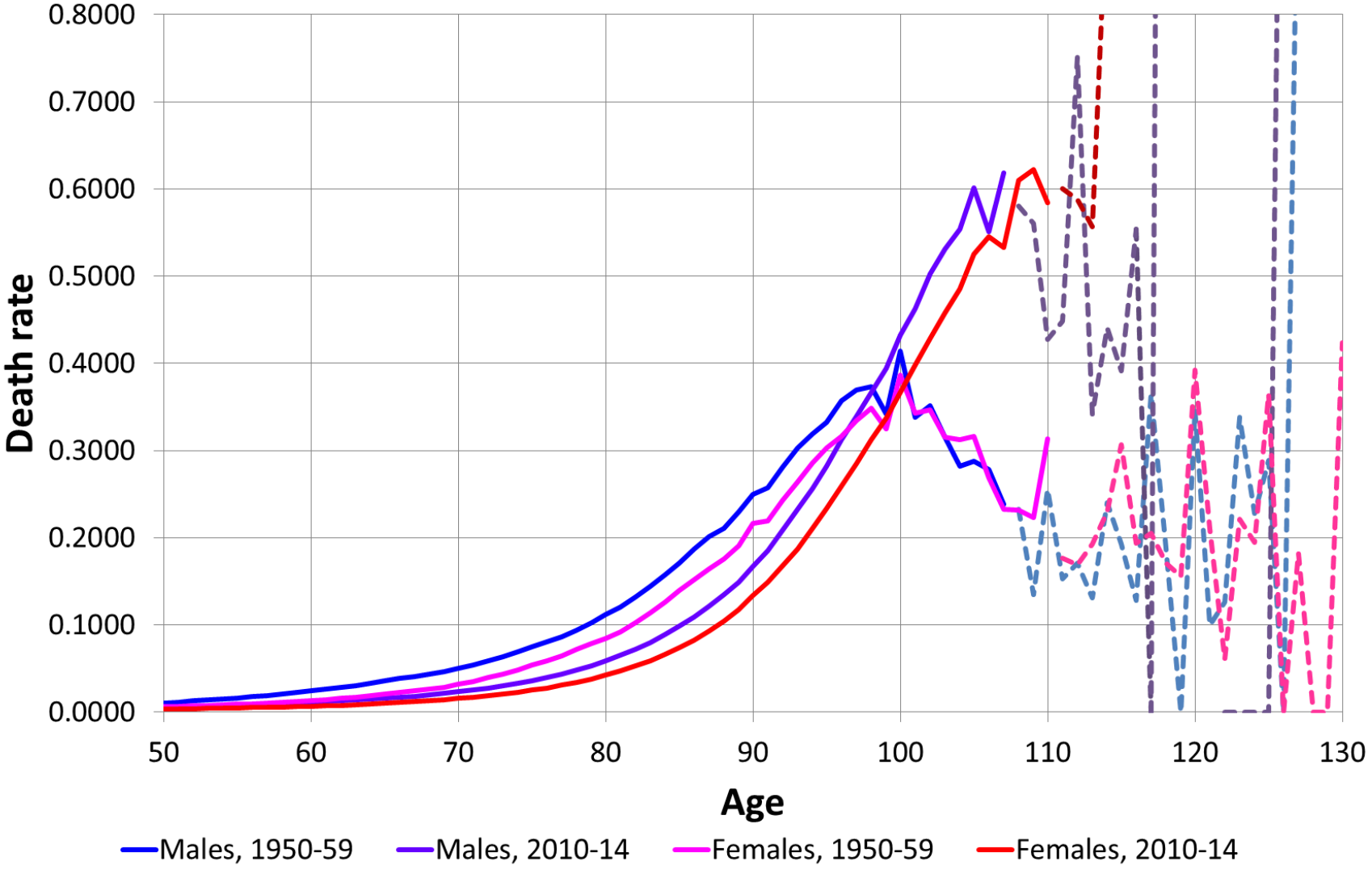
If quality of age reporting is improving over time:

- Death rates go up ↑
- Rates of mortality increase with age go up ↑

If progress is made in reducing mortality over time:

- Death rates go down ↓
- Rates of mortality increase with age go up ↑

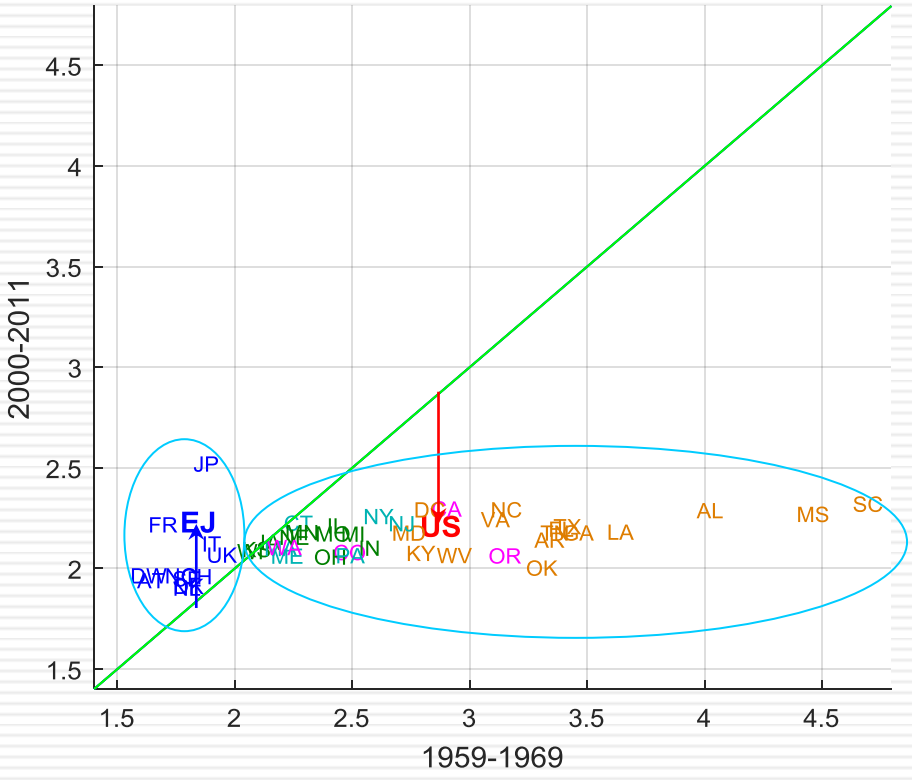
Direct U.S. mortality estimates in 1950-59 and 2010-2014



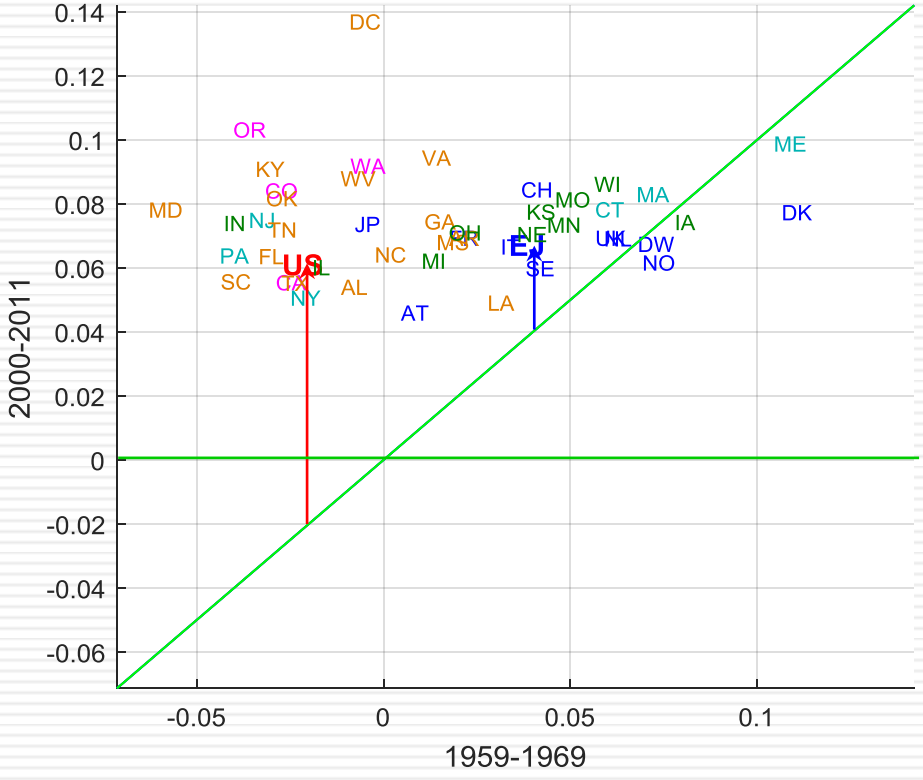
Changes between 1959-1969 and 2000-2011

Females, ages 100 and older

Life expectancy at age 100



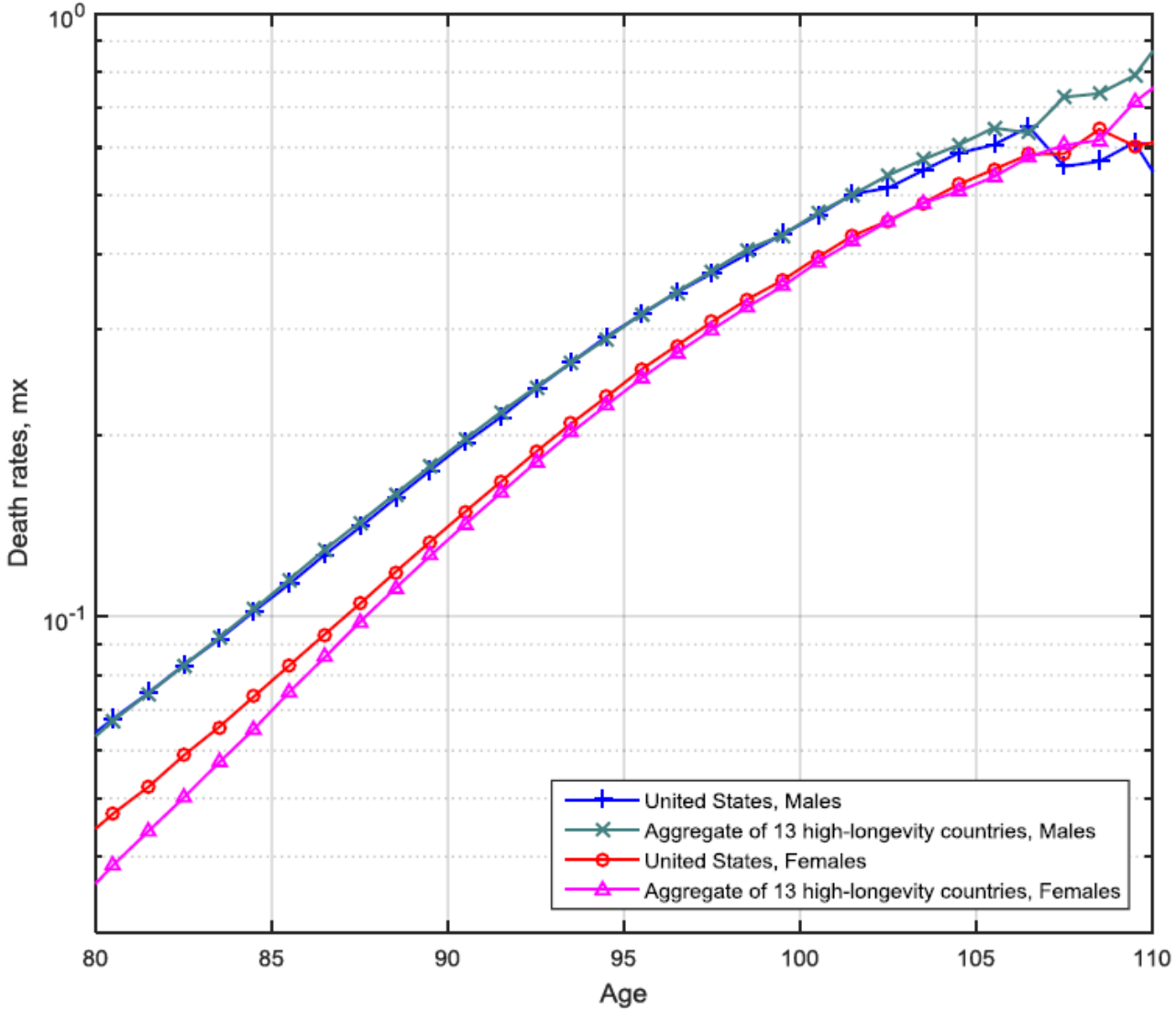
Rates of Mortality Increase with Age, 100+



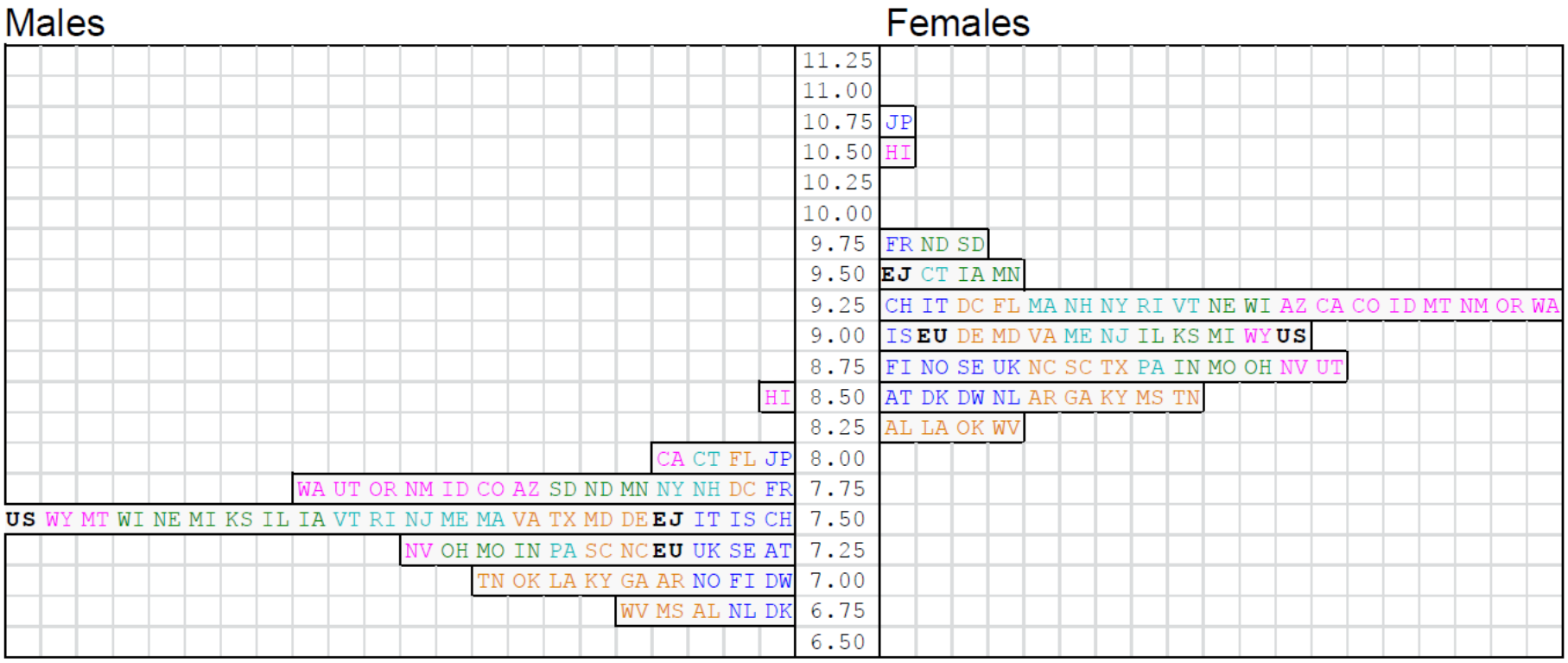
1) Only the estimates based on 100 or more deaths are included.

U.S. data quality significantly improved from 1959 to 2011

Death Rates in the United States and the Aggregated Data for 13 Countries, 2000-2011



Distribution of Life Expectancy at Age 80 in States of the United States and in the 13 High-Longevity Countries, 2000-2011



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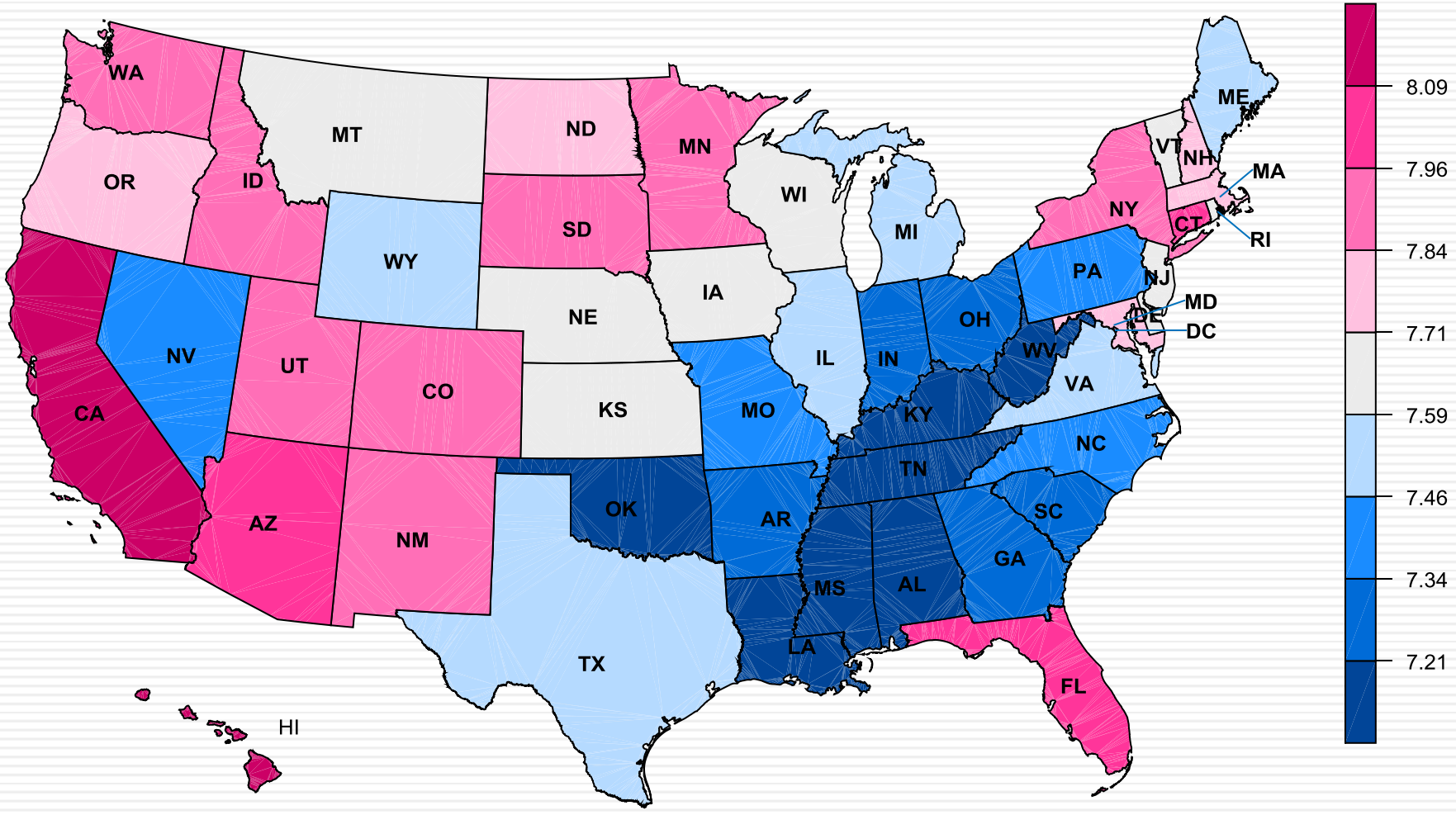
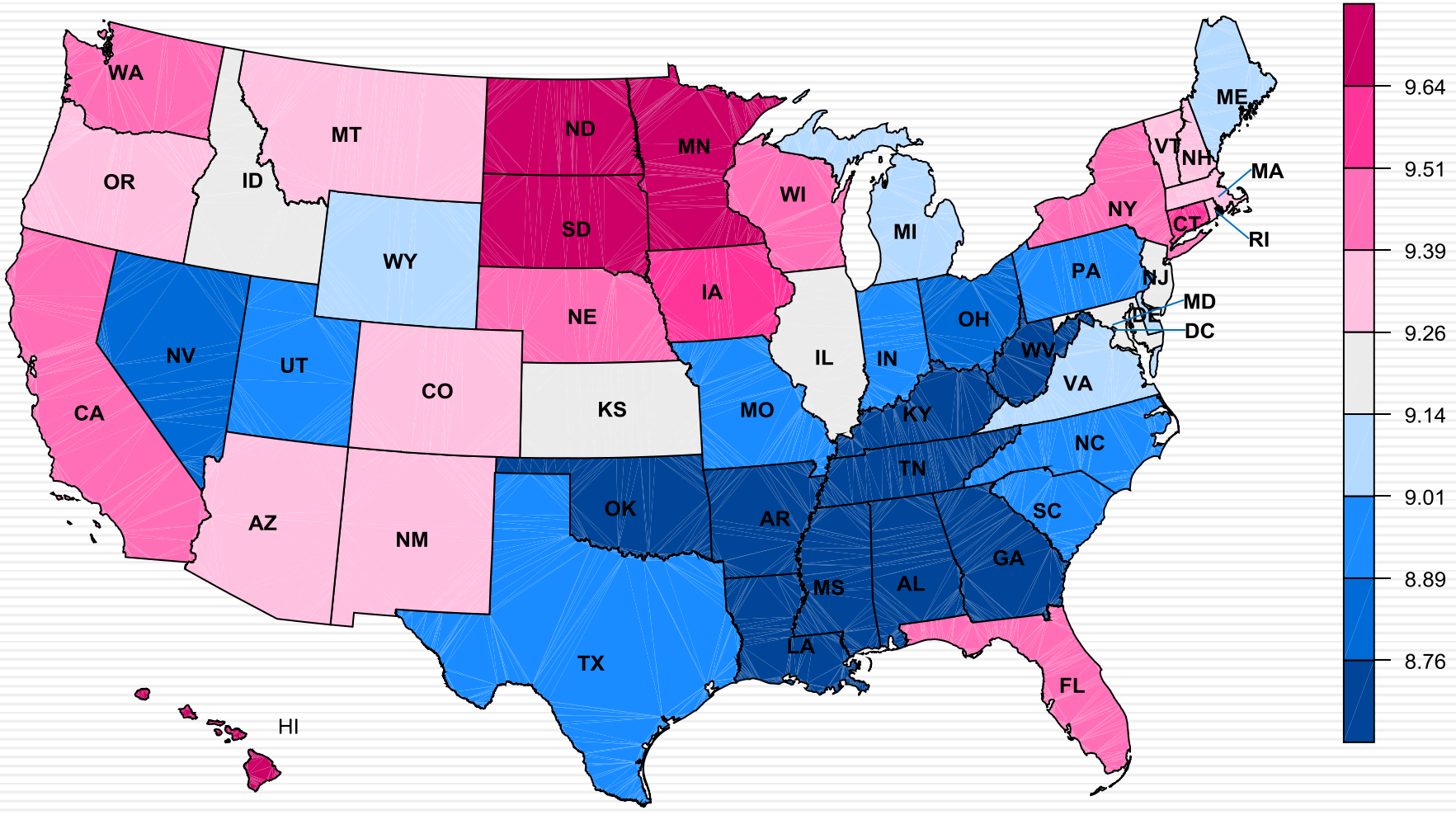
Life expectancy at Age 80 by State of the United States, 2000-2011, Males



Life expectancy at Age 80 by State of the United States, 2000-2011, Females



Conclusions

- The Almost Extinct Cohort Method produced no useful estimates for states of the United States for the period 1959-1969 due to data quality problems
- Data quality in United States significantly improved from 1959 to 2011
- Levels of mortality in the United States in 2000-2011 are very similar to the average levels of mortality in the high-longevity countries (except for Japanese females)
- In general, mortality is higher in Southern states, extending northeastward into Appalachia, and lower in Western and Northeastern states
- Hawaii is a state with exceptionally low death rates

Credits and Acknowledgments

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- Mortality estimates for states of the United States were computed by Mila Andreeva at the National Center for Health Statistics Research Data Center, Hyattsville, Maryland. The authors wish to thank Patricia Barnes, Elizabeth Arias and the entire staff of the NCHS Research Data Center for overall support of the project
- Data for United States, Sweden, Denmark and Japan are from Mortality Trends (www.mortalitytrends.org)
- Data for Austria, England and Wales, Finland, France, Germany (West), Iceland, Italy, the Netherlands, Norway, and Switzerland are from Human Mortality Database (www.mortality.org) and Kannisto-Thatcher Database on Old Age Mortality (http://www.demogr.mpg.de/databases/ktdb/)