A finely stratified log-rank test with effectively-infinite-size comparison groups

[How long did their hearts go on? Survival analysis of the Titanic Survivors]

Background

Erroneous analyses in longevity comparisons [Jazz Musicians, Oscar winners]
Beyond "who survived": longterm effects

Data

Passengers ; Comparison Groups

Methods

Passengers: K-M curves
Comparison Groups: "Cohort from Current" (U.S.) & Cohort(Sweden) Lifetables

Results

Overall; By Gender and Class

Methodological

Stratified log-rank test: each passenger versus effectively infinite comparison group

Peer-review and beyond

BMJ ; Media

James.Hanley@McGill.CA http://www.epi.mcgill.ca

CASI, May 17-19, 2006

Natural Sciences & Engineering Research Council of Canada

Québec Fonds Québécois de la recherche sur la nature et les technologies.

Premature Death in Jazz Musicians: Fact or Fiction?

commonly held view: More liable than other professions to die early from drink, drugs, women, or overwork.

Statistical Study: 70 (82%) of 85 US-born jazz musicians listed in university syllabus exceeded their life expectancy

Spencer FJ. Am J Public Health. 1991 81(6):804-5: Am J Public Health. 1992 82(5):761.

Longevity of popes and artists between 13th & 19th century

Likely, in past centuries, to be better fed, clothed & sheltered, and to had better medical care & to survive longer than most of their contemporary people.

Longevity significantly longer than that of artists (P = 0.02); ... artists had 1.5-fold higher risk of death before age 70 years than Popes (95% CI: 1.08–2.16)

Serraino D, Carrieri M-P: International Journal of Epidemiology 2005; 34: 1435–1436

Survival in Academy Award–Winning Actors and Actresses

Social status is an important predictor of poor health. Most studies of this issue have focused on lower echelons of society

Life expectancy 3.9 years longer for Academy Award winners than for other, less recognized performers (79.7 vs. 75.8 years; P = 0.003).

Donald A. Redelmeier, MD, and Sheldon M. Singh, BSc *Ann Intern Med.* 2001;134:955-962.

titanic.dat
titanic.txt

JSE ARCHIVE
http://www.amstat.org/publications/jse/

Male / Female

Adult / Child

Socio-Economic Class
[1 /2 /3 / unclassified]

Survived?

NAME: Population at Risk and Death Rates for an Unusual Episode
TYPE: Complete record for all of population at risk
SIZE: 2201 observations, 4 variables

The article associated with this dataset appears in the *Journal of Statistics Education*, Volume 3, Number 3 (November 1995).

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How long did their hearts go on? A *Titanic* study

James A Hanley, Elizabeth Turner, Carine Bellera, Dana Teltsch

Several studies have examined post-traumatic stress in people who survive disasters but few have looked at longevity. The 1997 film *Titanic* followed one character, apparently fictional, but the longevity of the actual survivors, as a group, has not been studied. Did the survivors of the sinking of the *Titanic* have shortened life spans? Or did they outlive those for whom 14-15 April 1912 was a less personal night to remember?

Subjects, methods, and results

We limited our study to passengers. We used data from biographies listed in Encyclopedia Titanica, a website that claims to have "among the most accurate passenger and crew lists ever compiled."[1] Of the 500 passengers listed as survivors, 435 have been traced. We calculated the proportion alive at each anniversary of the sinking.

Encyclopedia Titanica | Titanic Passenger and Crew Research | Official Home Page

http://www.encyclopedia-titanica.org/

encyclopedia titanica

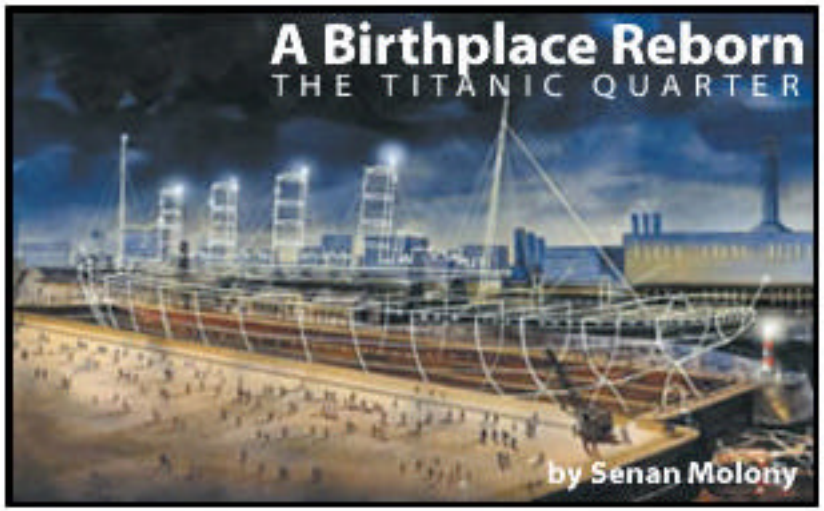
...om network | Effective P...ns homepage | comminication | onlineMed | ibc2006 | WCSJ 2004 -...Information | JSTOR - The

Encyclopedia Titanica

Search

Home | People | Resources | Discussions | Members

Sunday 30th of October 2005



Latest Discussions

165149 posts from **1736** current members. Most

First Class Passengers

We found 346 people . Showing 1 to 346

Name v	Age	Class/Dept	Ticket	Fare	Group	Ship	Joined	Job	Boa	
ALLEN, Miss Elisabeth Walton	29	1st Class	24160	£211 6s 9d			Southampton		2	
ALLISON, Mr Hudson Joshua Creighton	30	1st Class	113781	£151 16s			Southampton	Businessman		
ALLISON, Mrs Bessie Waldo	25	1st Class	113781	£151 16s			Southampton			
ALLISON, Miss Helen Loraine	2	1st Class	113781	£151 16s			Southampton			
ALLISON, Master Hudson Trevor	11m	1st Class	113781	£151 16s			Southampton		11	
ANDERSON, Mr Harry	47	1st Class	19952	£26 11s			Southampton	Stockbroker	3	
ANDREWS, Miss Kornelia Theodosia	62	1st Class	13502	£77 19s 2d			Cherbourg		10	
ANDREWS, Mr Thomas	39	1st Class	112050		H&W Guarantee Group		Belfast	Shipbuilder		
APPLETON, Mrs Charlotte	53	1st Class	11769	£51 9s 7d			Southampton		D	
ARTAGAVEYTIA, Mr Ramon	71	1st Class	17609	£49 10s 1d			Cherbourg	Businessman		22
ASTOR, Colonel John Jacob	47	1st Class	17757	£247 10s 6d			Cherbourg	Property Developer / Real Estate		124
ASTOR, Mrs Madeleine Talmage	18	1st Class	17757	£247 10s 6d			Cherbourg		4	

Miss Elisabeth Walton Allen

Elisabeth Allen

Miss Elisabeth Walton Allen, 29, was born in St. Louis, Missouri, USA, on 1 October 1882, the daughter of George W. Allen, a St. Louis judge, and Lydia McMillan. She was returning to her home in St. Louis with her aunt, Mrs Edward Scott Robert , and her cousin, fifteen-year-old Georgette Alexandra Madill . Miss Madill was the daughter of Mrs Robert from a former marriage.

Miss Allen was engaged in 1912 to a British physician, Dr. James B. Mennell, and was going home to St. Louis to collect her belongings in preparation for moving to England where she would live with her future husband. Miss Allen, Mrs Robert , Miss Madill , and Mrs Robert's maid Emilie Kreuchen all boarded the *Titanic* in Southampton. For the voyage, Miss Allen was in cabin B-5 , along with cousin Miss Madill , while Mrs Robert was across the hall in cabin B-3 . The entire party travelled under ticket number 24160 (£221 16s 9d). She escaped with her relatives in lifeboat 2 , one of the last boats to leave the *Titanic* , under the command of Fourth Officer Joseph G. Boxhall . After the sinking, Elisabeth filed a $2, 427.80 claim against the White Star Line for the loss of personal property in the disaster.

SUMMARY

BORN: SUNDAY 1ST OCTOBER 1882 IN ST. LOUIS MISSOURI UNITED STATES
AGE: 29 YEARS 6 MONTHS AND 14 DAYS.
MARITAL STATUS: SINGLE.
LAST RESIDENCE: IN ST. LOUIS MISSOURI UNITED STATES
1ST CLASS PASSENGER
FIRST EMBARKED: SOUTHAMPTON ON WEDNESDAY 10TH APRIL 1912
TICKET NO. 24160 , £211 6S 9D
CABIN NO. B5
RESCUED (BOAT 2)
DISEMBARKED CARPATHIA: NEW YORK CITY ON THURSDAY 18TH APRIL 1912
DIED: FRIDAY 15TH DECEMBER 1967
CAUSE OF DEATH: HEART FAILURE / DISEASE

Master Hudson Trevor Allison

Grave of Hudson Trevor Allison
Courtesy of Jason D. Tiller
more pictures

Master Hudson Trevor Allison, 11m, was born May 7, 1911 in Westmount, Quebec.

Shortly after Trevor was born, the Allison family travelled to England for business purposes, and it was in England that young Trevor was baptised.

He travelled on the *Titanic* with his father Hudson Allison his mother Bess Allison and sister Loraine . He was also accompanied by a nurse Alice Cleaver .

Of the Allison family, only baby Trevor was saved.

After the sinking, baby Trevor returned home to Canada, where he would be raised by his aunt and uncle, George and Lillian Allison.

Trevor died on 7 August 1929 at the age of 18 in Maine, USA of ptomaine poisoning and was buried beside his father in Chesterville, Ontario.

SUMMARY

BORN: SUNDAY 7TH MAY 1911
AGE: 11 MONTHS AND 8 DAYS.
LAST RESIDENCE: IN MONTREAL QUÉBÉC CANADA
1ST CLASS PASSENGER
FIRST EMBARKED: SOUTHAMPTON ON
WEDNESDAY 10TH APRIL 1912
TICKET NO. 113781 , £151 16S
CABIN NO. C22/26
RESCUED (BOAT 11)
DISEMBARKED CARPATHIA: NEW YORK CITY ON
THURSDAY 18TH APRIL 1912
DIED: WEDNESDAY 7TH AUGUST 1929
CAUSE OF DEATH: PTOMAINE POISONING
BURIED: MAPLE RIDGE CEMETERY CHESTERVILLE
ONTARIO CANADA

Third Class Passengers

We found 708 people . Showing 1 to 708

Name v	Age	Class/Dept	Ticket	Fare	Group	Ship	Joined	Job	Bo	
ABBING, Mr Anthony	42	3rd Class	5547	£7 11s			Southampton	Blacksmith		
ABBOTT, Mrs Rhoda Mary 'Rosa'	39	3rd Class	CA2673	£20 5s			Southampton		A	
ABBOTT, Mr Rossmore Edward	16	3rd Class	CA2673	£20 5s			Southampton	Jeweller		
ABBOTT, Mr Eugene Joseph	14	3rd Class	CA2673	£20 5s			Southampton	Scholar		
ABELSETH, Miss Karen Marie	16	3rd Class	348125	£7 13s			Southampton		16	
ABELSETH, Mr Olaus Jørgensen	25	3rd Class	348122	£7 13s			Southampton	Farmer	A	
ABRAHAMSSON, Mr Abraham August Johannes	20	3rd Class	3101284	£7 18s 6d			Southampton		15	
ABRAHIM, Mrs Mary Sophie Halaut	18	3rd Class	2657	£7 4s 7d			Cherbourg		C	
ADAMS, Mr John	26	3rd Class	341826	£8 1s			Southampton			103
AHLIN, Mrs Johanna	40	3rd Class	7546	£9			Southampton			

Mr Abraham August Johannes Abrahamsson

Mr August Abrahamson, 20, a single man from Dalsbruk (Taalintehdas), Kimito Island, in southwest Finland boarded the *Titanic* at Southampton. He was travelling to Hoboken, New Jersey. He travelled with Eino Lindqvist and Helga Hirvonen. He shared a cabin with 5 other Finns.

At the time of the collision August was asleep, at first he had no intention to go up and investigate the cause, however, he changed his mind and went to the adjacent cabin to warn Eino Lindqvist, when he began to suspect something was wrong.

He went up to the Boat Deck and entered, most likely, lifeboat 15 he later reported hearing stifled explosions as the ship went down.

After his arrival in New York August was quartered at St. Vincent hospital in New York. He went back to Finland but, in 1914, got married and returned to America where he died in 1961.

References

Claes-Göran Wetterholm (1988, 1996, 1999) *Titanic*. Prisma, Stockholm. ISBN 91 518 3644 0

Acknowledgements

Claes-Göran Wetterholm, Sweden

Contributors

Leif Snellman, Finland

SUMMARY

AGE: 20 YEARS
LAST RESIDENCE: IN DAISBRUK FINLAND
3RD CLASS PASSENGER
FIRST EMBARKED: SOUTHAMPTON ON WEDNESDAY 10TH APRIL 1912
TICKET NO. 3101284 , £7 18S 6D
DESTINATION: HOBOKEN NEW JERSEY UNITED STATES
RESCUED (BOAT 15)
DISEMBARKED CARPATHIA: NEW YORK CITY ON THURSDAY 18TH APRIL 1912
DIED: 1961

NOSWORTHY, Mr Richard Cater	21	3rd Class	39886	£7 16s			Southampton	Farm Labourer		
NYSTEN, Miss Anna Sofia	22	3rd Class	347081	£7 15s			Southampton		13	
NYSVEEN, Mr Johan Hansen	60	3rd Class	345364	£6 4s 9d			Southampton	Farmer		
O'BRIEN, Mr Timothy	21	3rd Class	330979	£7 16s 7d			Queenstown			
O'BRIEN, Mr Thomas	27	3rd Class	370365	£15 10s			Queenstown	Farm Labourer		
O'BRIEN, Mrs Johanna "Hannah"	26	3rd Class	370365	£15 10s			Queenstown	Housewife		
O'CONNELL, Mr Patrick Denis	17	3rd Class	334912	£7 14s 8d			Queenstown	General Labourer		
O'CONNOR, Mr Maurice	16	3rd Class	371060	£7 15s			Queenstown	General Labourer		
O'CONNOR, Mr Patrick	23	3rd Class	366713	£7 15s			Queenstown	Farmer		
O'DRISCOLL, Miss Bridget	27	3rd Class	14311	£7 15s			Queenstown		D	
O'DWYER, Miss Ellen "Nellie"	25	3rd Class	330959	£7 17s 7d			Queenstown			
O'KEEFE, Mr Patrick	21	3rd Class	368402	£7 15s			Queenstown	Farm Labourer	B	
O'LEARY, Miss				£7						

Miss Hanora "Nora" O'Leary

Miss Hanora (Nora) O'Leary, 16, was born in Glencollins, Kingwilliamstown, Co. Cork on June 10, 1895. She was the daughter of John O'Leary and Johanna Healy and had five brothers and two sisters. She was going to her sister Ms. Katie O'Leary at 137 W. 11th Street, New York City.

She boarded the *Titanic* at Queenstown (ticket number 330919, £7 16s 7d). She was travelling in a group from the Kingwilliamstown area led by Daniel Buckley, and consisting of Hannah Riordan, Bridget Bradley, Patrick Denis O'Connell, Patrick O'Connor, and Michael Linehan.

Nora was rescued, probably in lifeboat 13.

Nora became a domestic in New York City. Upon returning to Ireland for a visit a few years later, she married Thomas J. (Tim) Herlihy and then remained in Ireland where she raised her son and four daughters. She spent the remainder of her life in Ballydesmond where she died on 18 May 1975. She is buried in the parish churchyard just a few feet from fellow survivor, Daniel Buckley.

Sources

Contract Ticket List, White Star Line 1912 (National Archives, New York; NRAN-21-SDNYCIVCAS-55[279]).
Noel Ray (1999) *List of Passengers who Boarded RMS Titanic at Queenstown, April 11, 1912*. The Irish Titanic Historical Society

Contributors

Cameron Bell, Northern Ireland
Robert L. Bracken, USA
Michael A. Findlay, USA
Noel Ray, Ireland

The largest groups travelling in first and second class were North American or British; most of those in third class were emigrating from Europe to the United States. Unable to find a comparison group with the same mix of backgrounds and selection factors, we created two "next best" comparison groups from available data. We calculated what proportions of an age and sex matched group of white Americans alive in 1912 would be alive at each anniversary. To do so, we converted current (cross sectional) life tables for the years 1912-2000[2] into cohort life tables. We created a second comparison group from life table data for Sweden, which was already in cohort form.[3] Longevity differences were assessed by log rank tests.

Lexis Diagram

German statistician & actuary Wilhelm Lexis (1837–1914)

National Vital Statistics Reports

Volume 51, Number 3 December 19, 2002

United States Life Tables, 2000

by Elizabeth Arias, Ph.D., Division of Vital Statistics

Introduction

There are two types of life tables—the cohort (or generation) life table and the period (or current) life table. The cohort life table presents the mortality experience of a particular birth cohort, all persons born in the year 1900, for example, from the moment of birth through consecutive ages in successive calendar years. Based on age-specific death rates observed through consecutive calendar years, the cohort life table reflects the mortality experience of an actual cohort from birth until no lives remain in the group. To prepare just a single complete cohort life table requires data over many years.

Unlike the cohort life table, the period life table does not represent the mortality experience of an actual birth cohort. Rather, the period life table presents what would happen to a hypothetical (or synthetic) cohort if it experienced throughout its entire life the mortality conditions of a particular period in time. Thus, for example, a period life table for 2000 assumes a hypothetical cohort subject throughout its lifetime to the age-specific death rates prevailing for the actual population in 2000. The period life table may thus be characterized as rendering a "snapshot" of current mortality experience, and shows the long-range implications of a set of age-specific death rates that prevailed in a given year. In this report the term "life table" refers only to the period life table and not to the cohort life table.

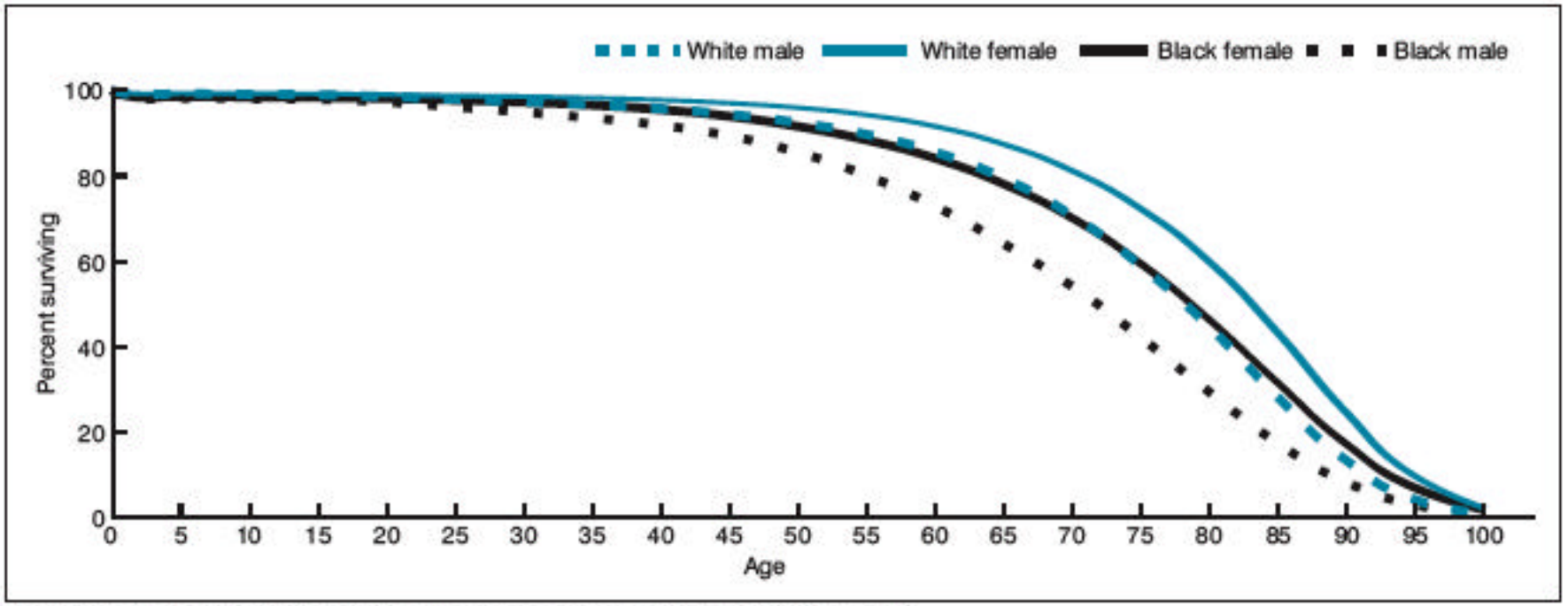


Figure 2. Percent surviving by age, race, and sex: United States, 2000

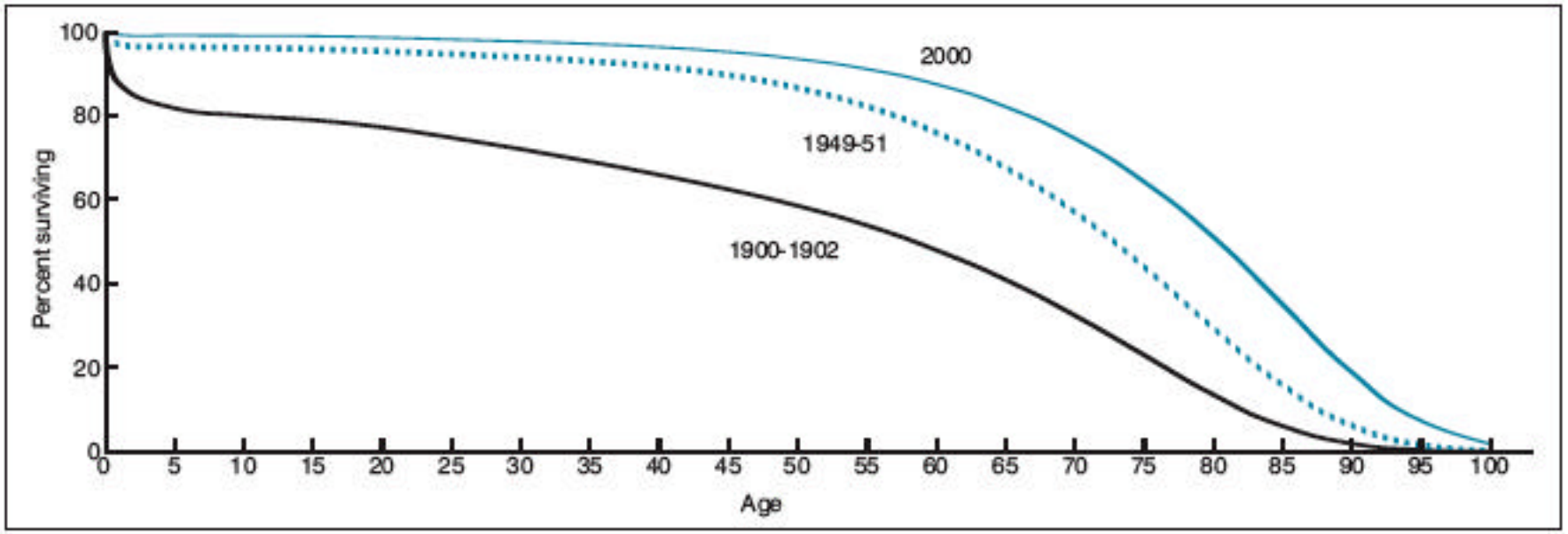


Figure 3. Percent surviving by age: Death-registration States, 1900–1902, and United States, 1949–51 and 2000

Table 6. Life table for white females: United States, 2000

Age	Probability of dying between ages x to x+1	Number surviving to age x
	q_x	l_x
0–1	0.005127	100,000
1–2	0.000414	99,487
2–3	0.000268	99,446
3–4	0.000178	99,419
4–5	0.000154	99,402
5–6	0.000148	99,386
6–7	0.000140	99,372
7–8	0.000134	99,358
8–9	0.000126	99,344
9–10	0.000117	99,332
10–11	0.000109	99,320
11–12	0.000112	99,309
12–13	0.000134	99,298

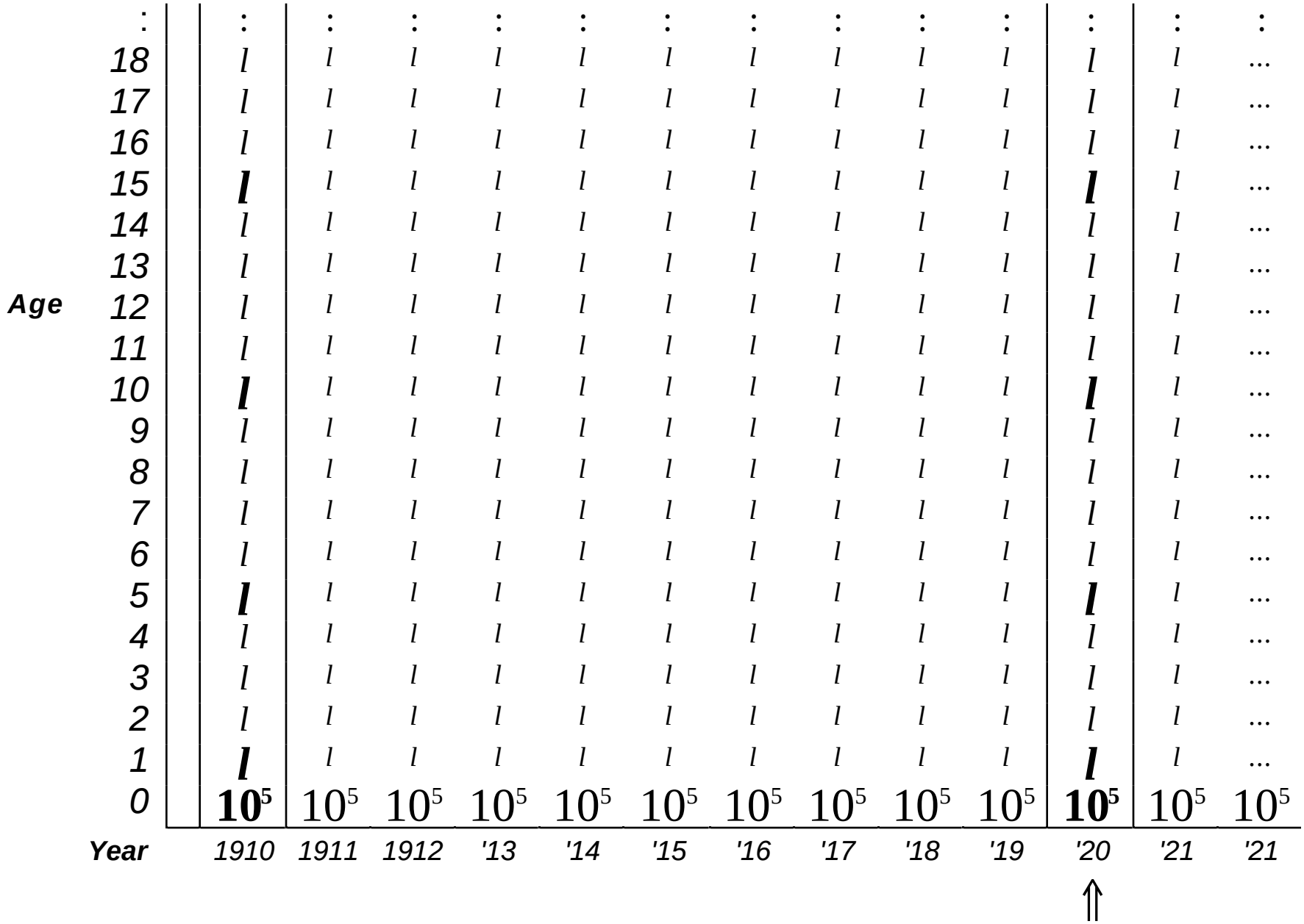
Table 10. Survivorship by age, race, and sex: Death-registration States, 1900–1902 to 1919–21, and United States, 1929–31 to 2000—Con.

[Alaska and Hawaii included beginning in 1959. For decennial periods prior to 1929–31, data are for groups of registration States as follows: 1900–1902 and 1909–11, 10 States and the District of Columbia; 1919–21, 34 States and the District of Columbia. Beginning 1970 excludes deaths of nonresidents of the United States; see Technical Notes]

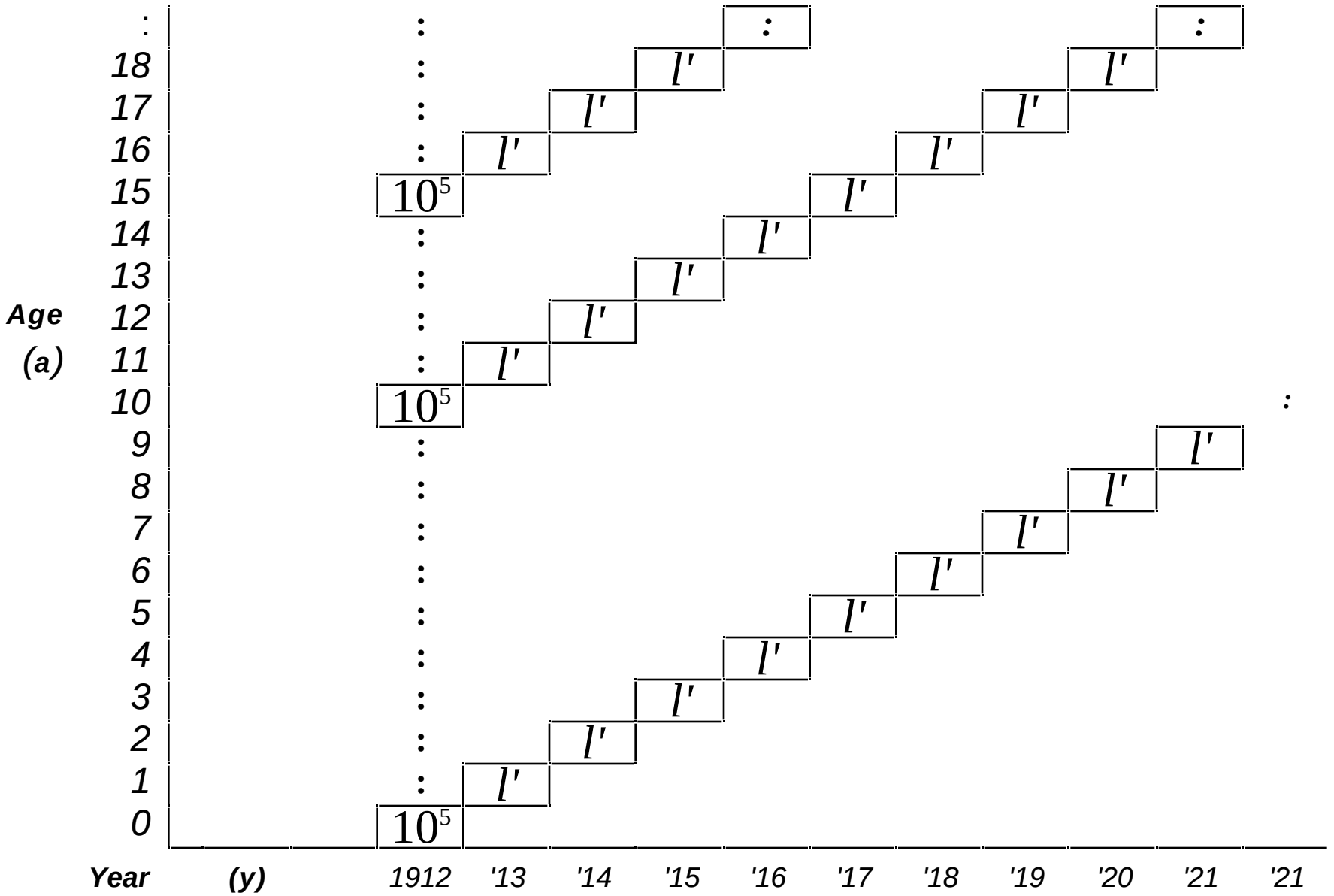
Age, race, and sex	Number of survivors out of 100,000 born alive (l_x)										
	2000	1989–91	1979–81	1969–71	1959–61	1949–51	1939–41	1929–31	1919–21	1909–11	1900–1902
White female											
0	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
1	99,487	99,333	99,035	98,468	98,036	97,645	96,211	95,037	93,608	89,774	88,939
5	99,386	99,187	98,841	98,203	97,709	97,199	95,309	93,216	90,721	85,349	83,426
10	99,320	99,099	98,725	98,042	97,525	96,960	94,890	92,466	89,564	83,979	81,723
15	99,243	99,007	98,618	97,902	97,375	96,756	94,534	91,894	88,712	83,093	80,680
20	99,046	98,795	98,374	97,618	97,135	96,454	93,984	90,939	87,281	81,750	78,978
25	98,831	98,547	98,093	97,299	96,844	96,072	93,228	89,524	85,163	79,865	76,588
30	98,586	98,283	97,802	96,945	96,499	95,605	92,320	87,972	82,740	77,676	73,887
35	98,268	97,939	97,445	96,474	96,026	94,977	91,211	86,248	80,206	75,200	70,971
40	97,777	97,472	96,913	95,762	95,326	94,080	89,805	84,256	77,624	72,425	67,935
45	97,044	96,768	96,065	94,649	94,228	92,725	87,920	81,780	74,871	69,341	64,677
50	95,970	95,608	94,710	92,924	92,522	90,685	85,267	78,572	71,547	65,629	61,005
55	94,283	93,730	92,594	90,383	89,967	87,699	81,520	74,321	67,323	61,053	56,509
60	91,590	90,789	89,451	86,726	86,339	83,279	76,200	68,462	61,704	54,900	50,752
65	87,385	86,339	84,764	81,579	80,739	76,773	68,701	60,499	54,299	47,086	43,806
70	81,163	79,984	78,139	74,101	72,507	67,545	58,363	49,932	44,638	37,482	35,206
75	72,254	70,834	68,712	63,290	60,461	54,397	44,685	37,024	32,777	26,569	25,362
80	59,792	58,454	55,770	48,182	44,676	38,026	28,882	23,053	20,492	15,929	15,349
85	43,112	42,274	38,774	30,490	26,046	21,348	14,487	10,937	9,909	7,152	7,149
90	24,439	24,270	20,996	14,406	10,219	8,662	5,061	3,719	3,372	2,291	2,322
95	9,638	9,495	7,900	4,526	2,203	2,200	1,109	797	721	434	448
100	2,244	2,239	1,858	872	265	294	139	74	63	44	41

Interpolation $\boldsymbol{l}$ **for ages 2,3,4, 6,7,8,9, ... in 1910, 1920, ...**

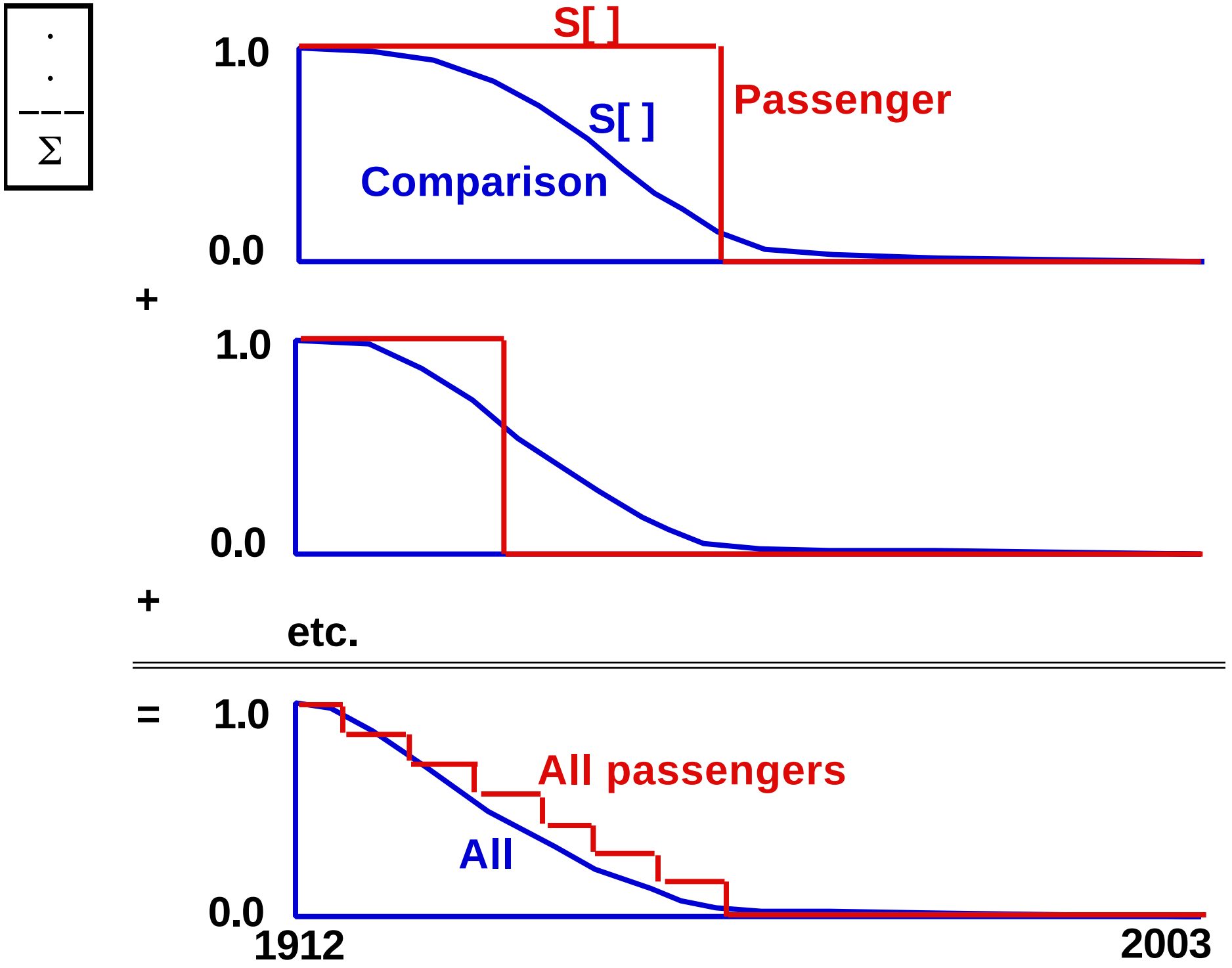
l for entire set of ages for years 1911-1919, 1921-1929, ...



(Synthetic) Cohorts of Persons Alive on April 15, 1912



Pr[> {a+1,y+1} | > {a,y}] = Pr[> a+1 | a] using obs^{d} mortality in year y.


S[ ]
1.0
Passenger
S[ ]
Comparison
0.0
+
1.0
0.0
+
etc.
=
1.0
All passengers
All
0.0
1912
2003

Human Mortality Database

http://www.mortality.org/

Google

Montreal Ga...om network | Effective P...ns homepage | comminication | onlineMed | ibc2006

Data by Country

- Austria
- Belgium
- Bulgaria
- Canada
- Czech Republic
- Denmark
- England & Wales
- Finland
- France
- Germany
  - East
  - West
- Hungary
- Italy
- Japan
- Latvia
- Lithuania
- Netherlands
- New Zealand
- Norway
- Russia
- Slovak Republic
- Spain
- Sweden
- Switzerland
- USA

Human Lifetable Database

The Human Mortality Database

John R. Wilmoth, *Director* — University of California, Berkeley

Vladimir Shkolnikov, *Co-Director* — Max Planck Institute for Demographic Research

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. The project began as an outgrowth of earlier projects in the Department of Demography at the University of California, Berkeley, USA, and at the Max Planck Institute for Demographic Research in Rostock, Germany (see history). It is the work of three teams of researchers in the USA, Germany, and Canada (see research teams), with the help of financial backers and scientific collaborators from around the world (see acknowledgements).

The main goal of the database is to document the longevity revolution of the modern era and to facilitate research into its causes and consequences. To that end, the guiding principles of the HMD include:

Sweden

WARNING: The quality of the data for 1751-1860 are lower than in later years and should be used with caution. For details, please see the "Data Quality Issues" section of the General Comments file.

Data Files Explanation

General Comments

List of Data Sources

1. Births 1749-2003
2. Deaths 1751-2003 Lexis triangles 1x1 5x1
3. Population size (January 1st) 1751-2004 1-year 5-year
4. Exposure-to-risk

   By year of death (period)

   - 1751-2003 1x1 1x5 1x10 5x1 5x5 5x10

   By year of birth (cohort)

   - 1676-1973 1x1 1x5 1x10 5x1 5x5 5x10
5. Death rates

   By year of death (period)

   - 1751-2003 1x1 1x5 1x10 5x1 5x5 5x10

   By year of birth (cohort)

   - 1676-1973 1x1 1x5 1x10 5x1 5x5 5x10
6. Life tables

   By year of death (period)
   1751-2003

   - Female 1x1 1x5 1x10 5x1 5x5 5x10
   - Male 1x1 1x5 1x10 5x1 5x5 5x10
   - Total 1x1 1x5 1x10 5x1 5x5 5x10

   By year of birth (cohort)
   1751-1912

   - Female 1x1 1x5 1x10 5x1 5x5 5x10
   - Male 1x1 1x5 1x10 5x1 5x5 5x10
   - Total 1x1 1x5 1x10 5x1 5x5 5x10
7. Life expectancy at birth 1751-2003

Sweden, Life tables (cohort 1x1), Females

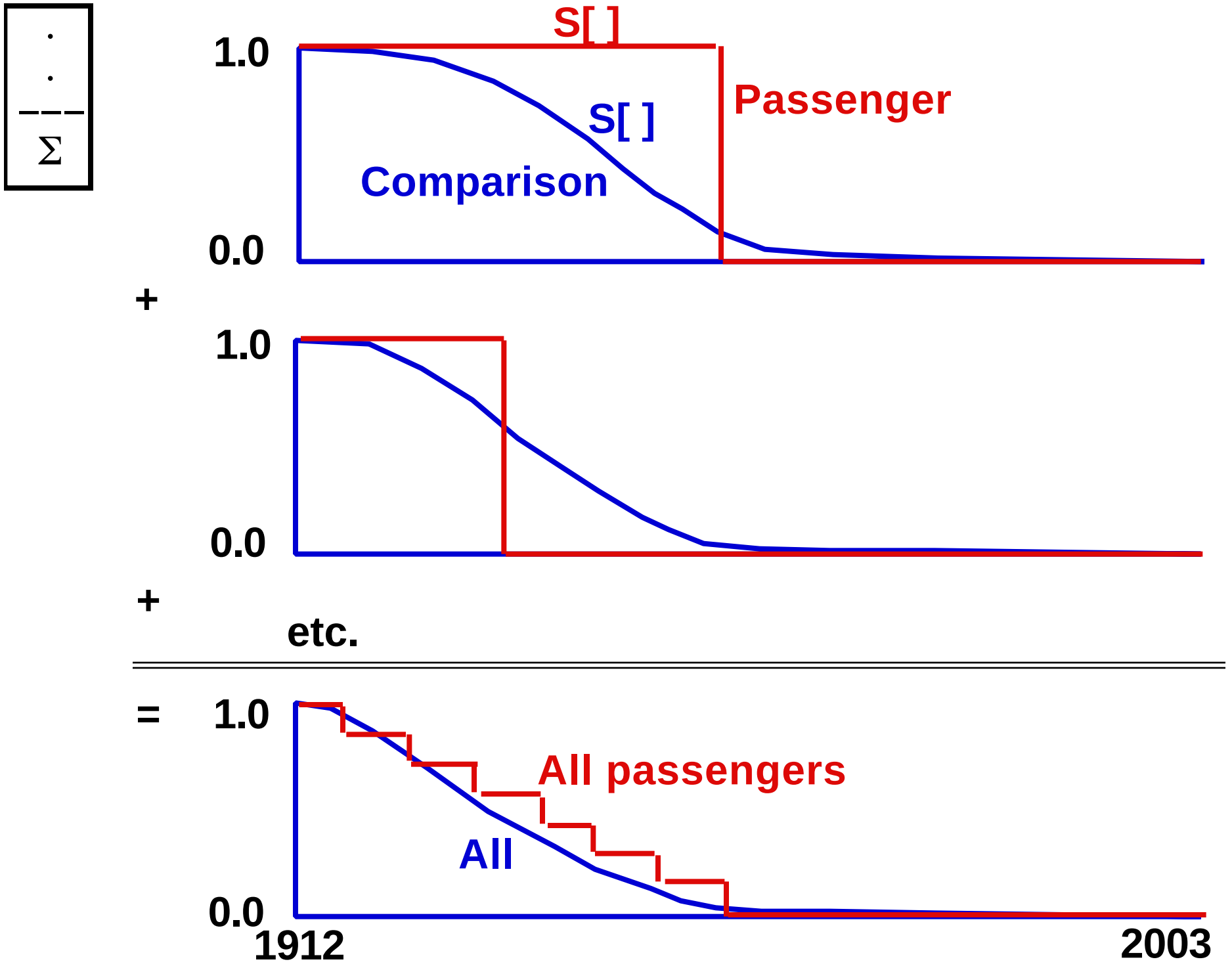
Last modified: 20-Apr-2005, MPv4 (Feb05)

Year	Age		lx	dx	qx	Lx	ex	*l'x* (Re-Scaled)	
1751	0		100000	20834	0.208	86458	35.8		
1751	1		79166	4997	0.063	76416	44.1		
1751	2		74169	2743	0.036	72819	46.0		
....									
1852	0		100000	14957	0.149	90278	46.9		
1852	1		85043	3730	0.043	83014	54.1		
1852	2		81313	2121	0.026	80251	55.6		
....	..		.....	....	.....	.....	....		
1852	60	<	49042(*)	804	0.016	48629	17.3	**100000**	
1852	61		48238(1)	830	0.017	47830	16.6	**98361**	**(1)÷(*)**
1852	62		47408(2)	937	0.019	46937	15.8	**96668**	**(2)÷(*)**
....									
1892	0		100000	9517	0.095	93694	58.0		
1892	1		90483	2514	0.027	89168	63.1		
....	..		.....	....	.....	.....	....		
1892	20	<	79360(*)	410	0.005	79157	52.1	**100000**	
1892	21		78950(1)	341	0.004	78787	51.3	**99483**	**(1)÷(*)**
1892	22		78609(2)	447	0.005	78389	50.5	**99053**	**(2)÷(*)**
1892	23		78162	468	0.006	77932	49.8	.....	
1892	24		77694	372	0.005	77509	49.2	.....	
1892	25		77322	504	0.006	77091	48.4	.....	
1892	26		76818	1185	0.015	76123	47.7	.....	
1892	27		75633	419	0.005	75430	47.4	.....	
1892	28		75214	410	0.005	75017	46.7	.....	
....									

Sweden, Life tables (cohort 1x1), Females

Last modified: 20-Apr-2005, MPv4 (Feb05)

Year	Age	lx	dx	qx	Lx	ex	*l'x* (Re-Scaled)
1912	0 <	100000	6248	0.062	95231	68.7	**100000**
1912	1	93752	1400	0.014	93023	72.3	**93752**
1912	2	92352	701	0.007	92004	72.3	**92352**
1912	3	91651	494	0.005	91402	71.9	**91651**
1912	4	91157	416	0.004	90945	71.3	.....
1912	5	90741	355	0.003	90569	70.6	.....
1912	6	90386	536	0.005	90100	69.9	.....
1912	7	89850	330	0.003	89682	69.3	.....
1912	8	89520	208	0.002	89418	68.5	.....
1912	9	89313	203	0.002	89212	67.7	.....
1912	10	89110	135	0.001	89043	66.9	.....
1912	11	88975	138	0.001	88904	66.0	.....


S[ ]
1.0
Passenger
S[ ]
Comparison
0.0
+
1.0
0.0
+
etc.
=
1.0
All passengers
All
0.0
1912
2003

Hazardous journeys

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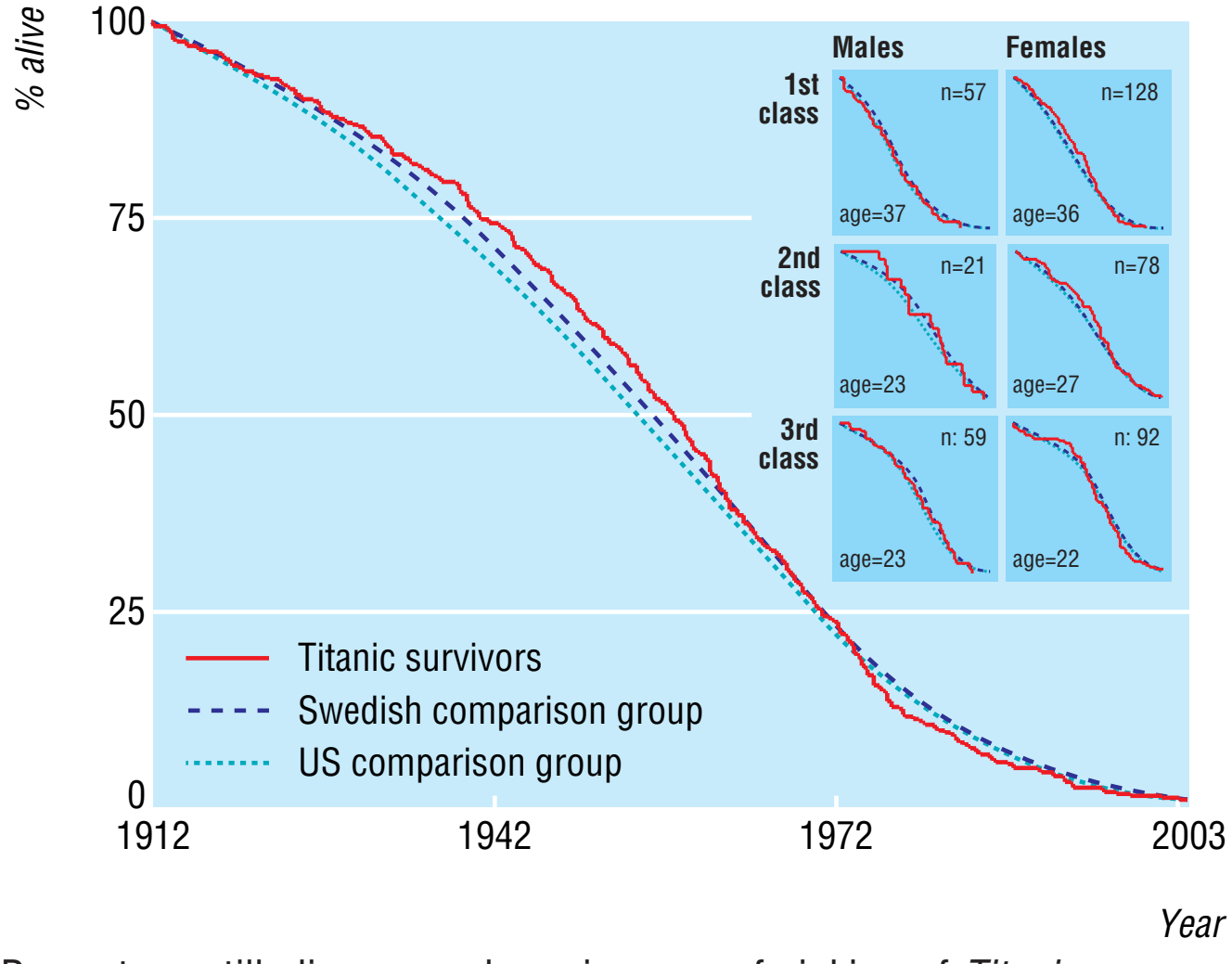
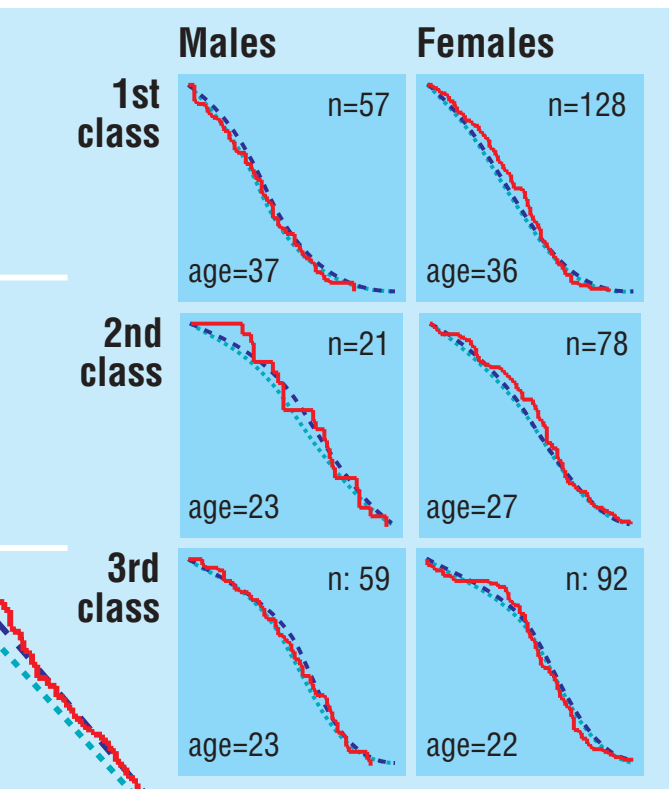


Percentage still alive on each anniversary of sinking of *Titanic* among 435 survivors and Swedish and white American comparison groups matched for age and sex. Inset: analysis by sex and class of travel (n=No of passengers; age=median age in 1912)


Males
Females
1st class
n=57
age=37
n=128
age=36
2nd class
n=21
age=23
n=78
age=27
3rd class
n: 59
age=23
n: 92
age=22

differences were assessed by log rank tests.

The survival of the 435 passengers was slightly, but not significantly, longer than that of the two comparison groups (figure). On average they lived 1.7 years longer than the general population of the United States and 0.5 years longer than that of Sweden. This small advantage was limited to female passengers in first and second class (figure). Five women lived past 100, and the three survivors still alive are now in their 90s. Despite their higher socioeconomic status, male passengers in first class did not outlive similar age males in the general populations.

Comment

The longevity of *Titanic* survivors who could be traced was not remarkably different from that of age and sex matched individuals in the general population. The available life table data did not allow us to match on social class. Nevertheless, those who travelled third class had similar survival to our comparison group. We therefore wonder why males (and maybe even females) in first and second class did not fare considerably better than the general population.

Follow up is complete for 87% of the passengers who survived the sinking; only 65 people, several of them servants to those in first and second class, are still untraced and excluded from our analysis. The quality of the follow up data on those traced seems to be excellent. Most dates of birth, important for age matched comparisons, also seem to be trustworthy.

Although unable to find the perfect comparison group, we avoided errors made in other longevity comparisons.[4 5] For the comparison group, we calculated the remaining lifetimes of people alive in 1912. Since age specific death rates fell substantially during the 20th century, we calculated these remaining lifetimes using the 1912-2000 death rates.

In the closing song of the 1997 film, the heroine tells us that her heart "must go on and on" and tells us twice more that it "will go on and on." The *Titanic* survivors did not have shorter life spans than the general population. Nor did they, despite the determination implied by the lyric, substantially outlive them.

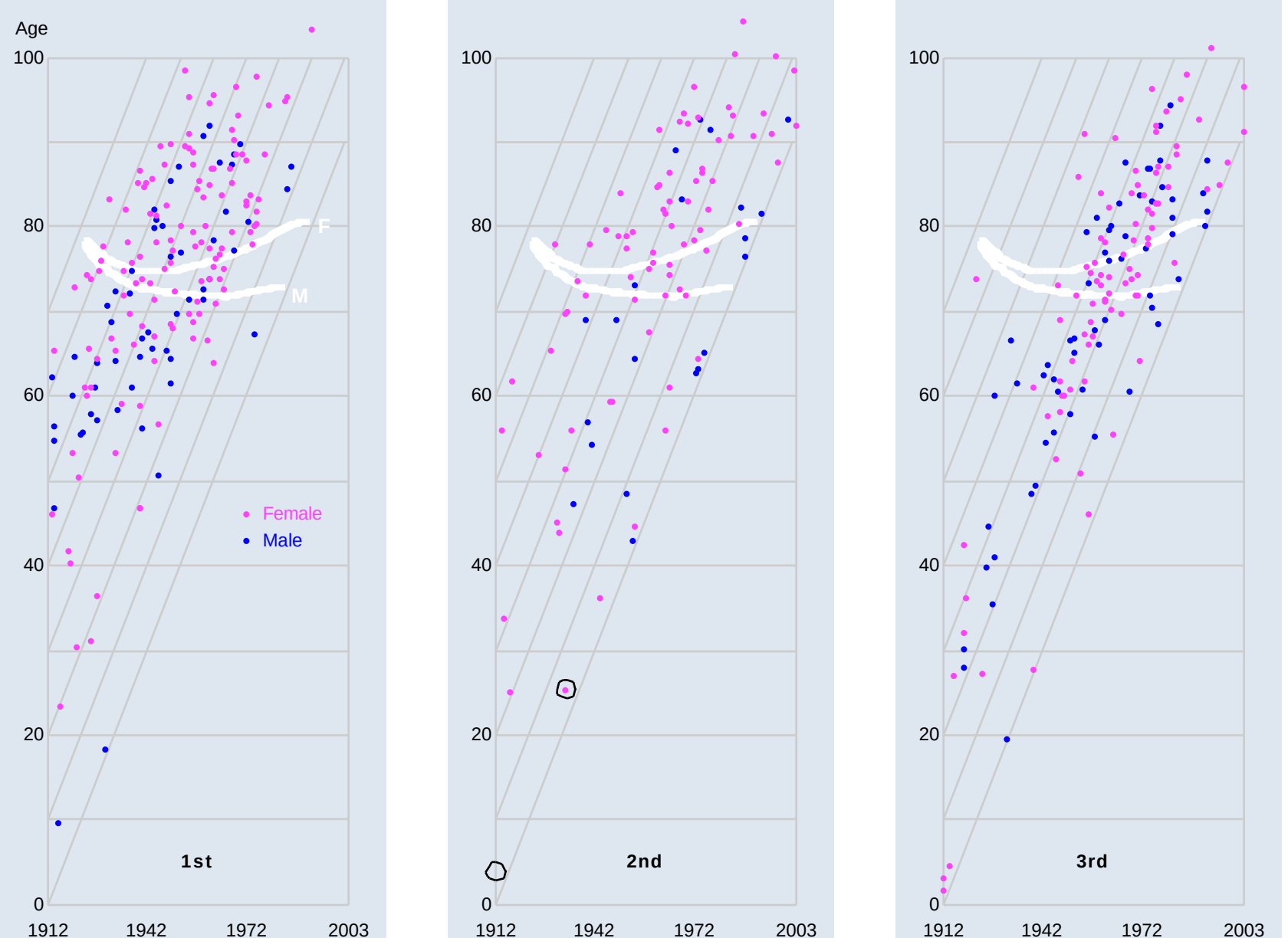

Age
100
80
60
40
20
0
1912
1942
1972
2003
F
M
Female
Male
1st
2nd
3rd

Figure 2

The age at, and year of death for each of the 435 surviving passengers, separated by class and sex. Each passenger is indicated by a dot. A passenger's age at the time of the disaster can be determined by moving the point diagonally downwards and to the left. For example, the circled dot refers to a female in 2nd class who died in 1933 at age 25. Thus, she was aged 4 in 1912 (empty circle), and was born in 1908. All of those passengers between two adjacent diagonal lines were in the same decade of age in 1912. The curved lines give, for comparison, the expected median age of death for comparison people (U.S. whites and Swedish) of the same sex and with same year of birth who were themselves alive ("survivors") in 1912.

Stratified Log-rank test in general...

Stratum	n_1	n_0	lifelines & risksets $t_0 \Downarrow \quad \Downarrow$	Observed X - a b | n_1 c d | n_0 ---|--- n_X n_- | n	Expected|H_0 X - a_E | n_1 | n_0 ---|---	$V[a\|H_0]$ $n_1\ n_0\ n_X\ n_-$ $n^2(n-1)$
1	*2*	*2*	--X . . . ------X . . . . . . -------> . . -------->	1 1 | 2 0 2 | 2 ---|-- 1 3 | 4 0 1 | 1 1 1 | 2 ---|-- 1 2 | 3	1/2 | 2 | 2 ---|-- 1/3 | 1 | 2 ---|--	$2 \times 2 \times 1 \times 3$ $4^2(4-1)$ $1 \times 2 \times 1 \times 2$ $3^2(3-1)$
2	..	..		…	…	…
…	..	..		…	…	…
Σ				$\Sigma\ a$	$\Sigma\ a_E$	$\Sigma\ V[a\|H_0]$

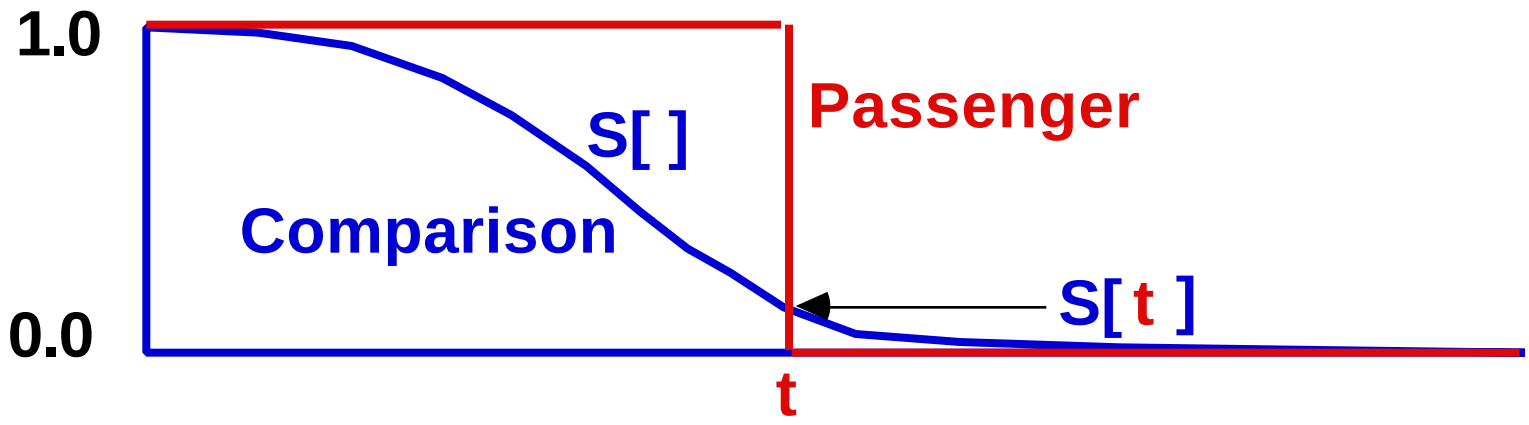
Σ *over all strata:* $\dfrac{\{\Sigma\ a\ -\ \Sigma\ a_E\}^2}{\Sigma\ V[a|H_0]} \sim \chi_1^2$

Stratified Log-rank test 1 stratum [passenger&peers] n_1 = 1 and n_0 >> 1 [déjà dead]

n_1	n_0	lifelines & risksets	Observed X - a b | 1 c d |nnnn 1 nnnn |nnnn+1	Expected | H_0 a_E	V[a|H_0]
1	10^4	X	0	1/10001	
		--X	0	1/ 9001	
		---X	0	1/ 8001	
		----X	0	1/ 7001	
		-----X	0	1/ 6001	
		------X	0	1/ 5001	
		-------X*	1	1/ 4001	
		---------X			
		...			
Σ		* S[t] = 0.4	1	0.916	0.916
death at time t : S[t] × 100% of peers still alive			1	-Log[S[t]]	-Log[S[t]]

Σ *over all 435 passengers:* $\frac{\{\Sigma(1 + \text{Log}[S[t]])\}^2}{-\Sigma\ \text{Log}[S[t]]} \sim \chi_1^2$

Alternatively: Combine $S[\,t_1\,]$, $S[\,t_2\,]$ ... $S[\,t_{435}\,]$ à la Fisher



S[t] = Prob[T > t | Comparison S[ ]) is a 1-sided p-value.

Under Null: $-2 \log [\, S[t] \,] \sim \chi^2_2$

n (= 435) independent p-values: $-\sum 2 \log [\, S[\, t_i \,] \,] \sim \chi^2_{2n}$