SWEDISH
PENSIONS AGENCY

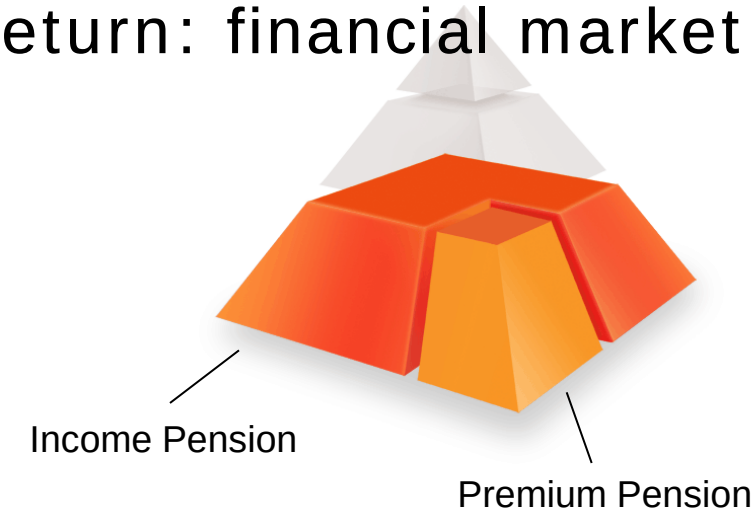
Two components in the Public Pension

Income Pension

- Notional defined contribution (NDC)
- Pay-as-you-go
- Return: wage index
- Automatic balancing

Premium Pension

- Defined contribution (DC)
- Pre-funded system
- Return: financial market



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PENSIONS AGENCY

Retirement

- Flexible from the age of 61, no upper limit
- Income Pension or Premium Pension, or both
- Premium Pension:
  - Single life or joint life
  - Variable (VA) or With Profit (WPA) annuity
- Guaranteed Pension from 65

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Annuity factor I

- Annuity factor (a) = Capital needed now to pay out 1 SEK life-long
- One pensioner:

  a = 1 + 1 + 1 + ….. = ?
- Statistical approach - 1 000 pensioners:

  1000 * a = 1000 + 990 + 979 + …..
- One statistical pensioner:

  a = 1 + 0,990 + 0,979 + ….. = 21,05
- Future payments discounted with assumed rate of return:

  a = 1 + 0,990 / 1,039 + 0,979 / (1,039 * 1,039) + ….. = 13,80

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Annuity factor II

- Annuity factor = Capital needed now to pay out 1 SEK life-long
- So, if I have 13,80 I can pay a statistical pensioner 1 per year
- If I have 13 800 I can pay 13 800/13,80 = 1000 per year etc.
- That is: Yearly amount = Capital / Annuity factor

- Annuity factor depends on:
- Expected life length/mortality
- Expected rate of return of investment

Annuity factor III

The exact formula for the annuity factor a_x at age x years is

$$a_x = \int_0^{\infty} e^{-\delta t} \cdot \frac{l(x+t)}{l(x)} dt$$

where $l(x)$ is the survival function

$$l(x) = e^{-\int_0^x \cdot \mu(t) dt}$$

and $\mu(x)$ is the mortality function μ

$$\mu(x) = a + b \cdot e^{c \cdot x}$$

For $x > w$, $\mu(x)$ merges with a straight line with a slope of k.

This formula applies to single life, i.e. no co-insured.

Pension amounts

- Pension amount:

  Yearly amount = Capital / Annuity factor

- *If exacty 65 years old (single life):*

  3 066 SEK/year = 50 000 SEK / 16,31 (Income Pension)
  3 624 SEK/year = 50 000 SEK / 13,80 (Premium Pension - VA)
  3 053 SEK/year = 50 000 SEK / 16,38 (Premium Pension - WPA)
  2 100 SEK/year = 50 000 SEK / 23,81 (Premium Pension - WPA guaranteed)

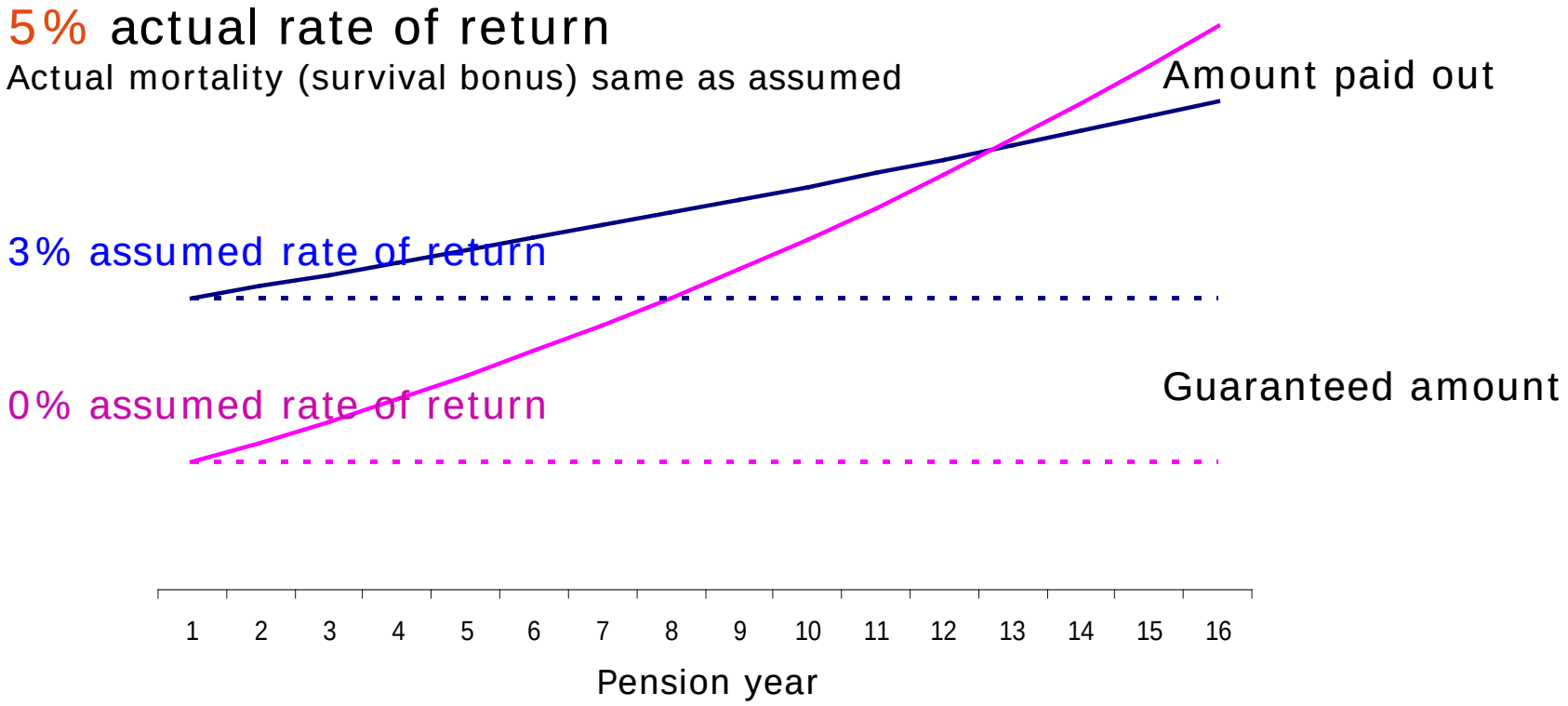
Assumptions for Annuity factor

	Income Pension	Premium Pension - VA	Premium Pension - WPA	Premium Pension – WPA guaranteed
Mortality	Observed last 5 years before retirement (19,4 from 65)	Prognosis Main (21,0 from 65)	Prognosis Main (21,0 from 65)	Prognosis Low (23,5 from 65)
Rate of return	Real income growth 1,6%	Prognosis 4,0 %	Prognosis 2,3%	Fixed 0%
Costs	-	Prognosis 0,1%	Prognosis 0,1%	Prognosis 0,1%

Discussion points I

- Mortality:
  - Observed or prognosis?
  - Which prognosis?
- Rate of return:
  - Front or end loaded pensions?
- Who decides?

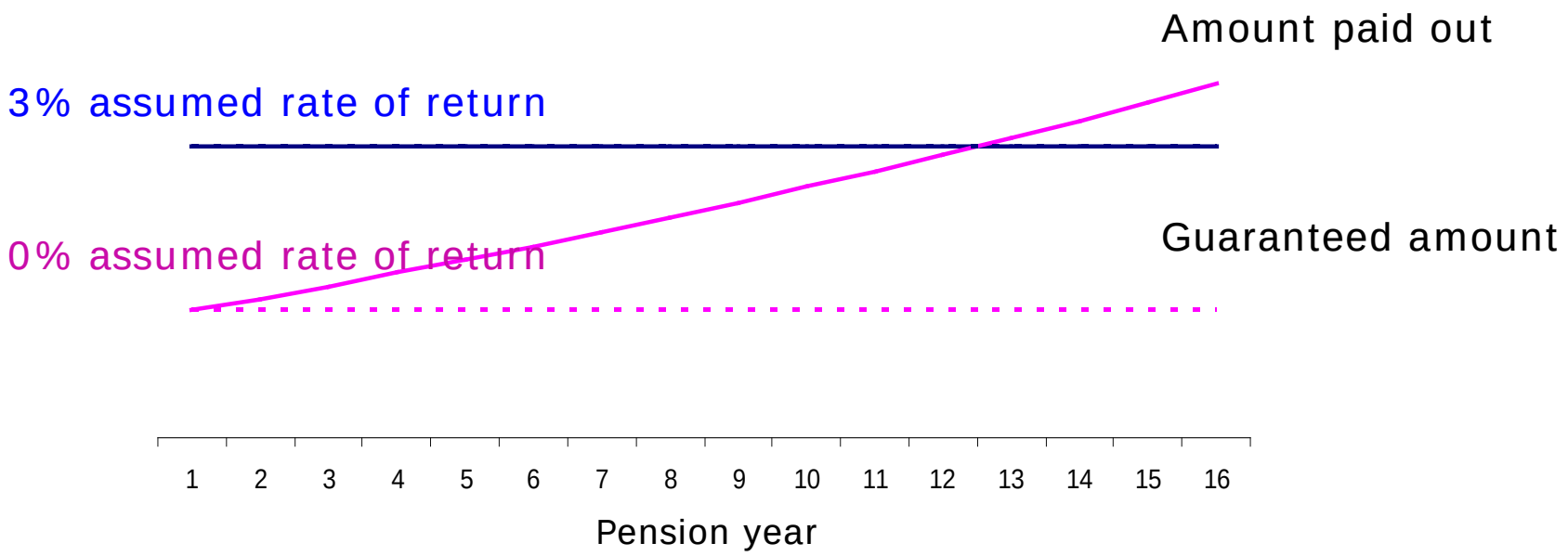
Pension amount over time I



Pension amount over time II

3% actual rate of return

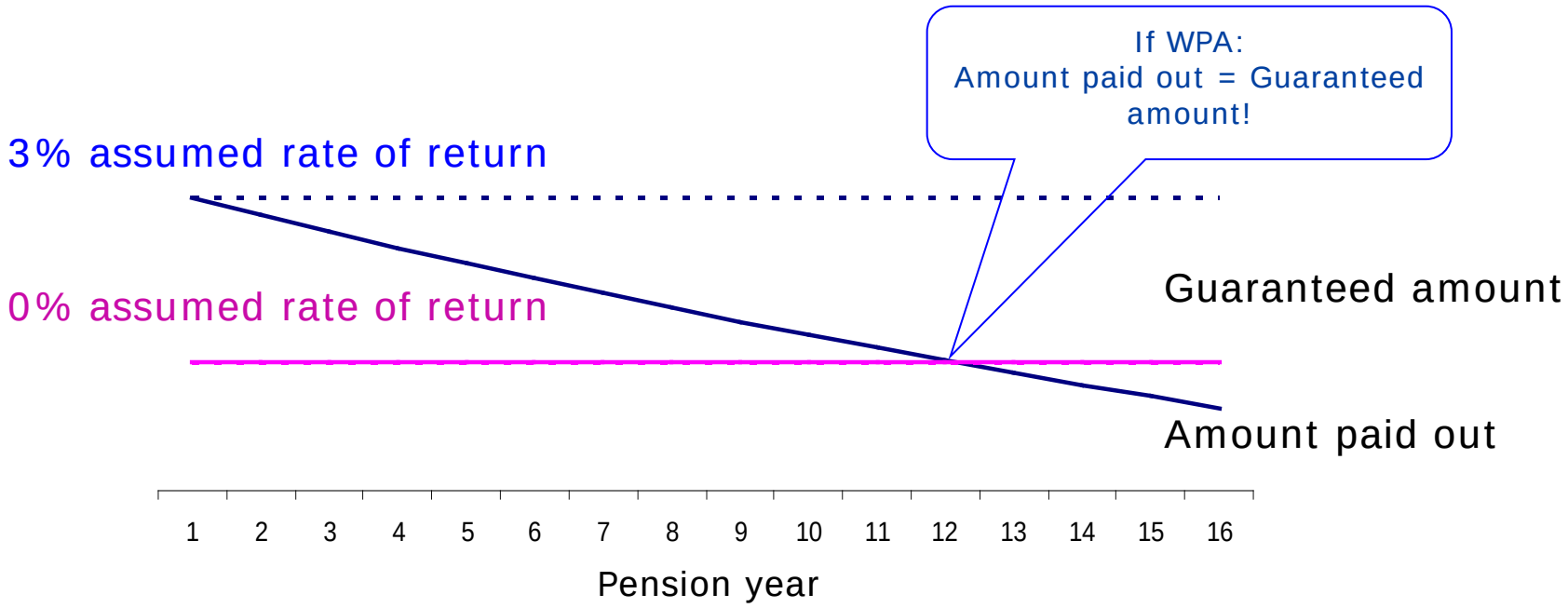
Actual mortality (survival bonus) same as assumed



Pension amount over time III

0% actual rate of return

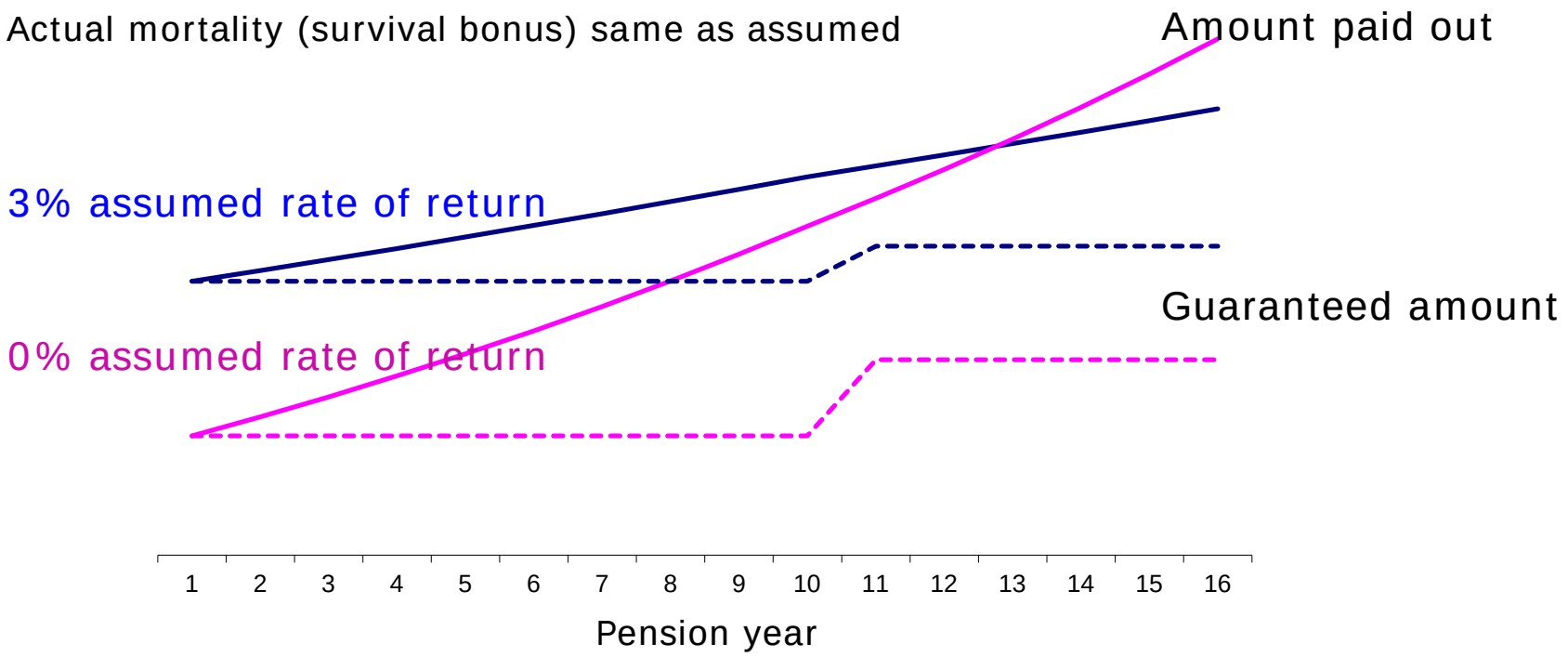
Actual mortality (survival bonus) same as assumed



Higher guaranteed amounts

5% actual rate of return

Actual mortality (survival bonus) same as assumed



Discussion points II

- Guarantees:
  - With or without?
  - Level and construction?
  - Who pays for it?

- Matching of liabilities and assets (ALM):
  - When is it possible?

SWEDISH PENSIONS AGENCY

Observed and expected life lengths

Pehr Wargentin (1717-1783)

TAB. I.

UTDRAG

AF

År Öfver Torneå Moderkyrko FÖRSAMLINGS KYRKO-BOK uti Torneå HÄRAD Wäster-bottns LÅN, och Hernösands STIFT, öfver the, therstädes FÖDDE och DÖDE, samt NYGIFTE Personer, År 1765.

MÅNADER.	DÖPTE. Äkta Barn. Söner.	Äkta Barn. Döttrar.	Oäkta Barn. Söner.	Oäkta Barn. Döttrar.	Summa. Söner.	Summa. Döttrar.	BEGRAFNE. Barn under 10. år. Man-Kön.	Barn under 10. år. Quin-Kön.	Barn under 10. år. Summa	Ungdom och Ogift Folk. Man-Kön.	Ungdom och Ogift Folk. Quin-Kön.	Ungdom och Ogift Folk. Summa	Gift Folk. Man-Kön.	Gift Folk. Quin-Kön.	Gift Folk. Summa	Summa. Mank.	Summa. Quink.	HJONELAG. Uplöste genom Döden.	HJONELAG. Wigde Par.
Januarius	////	/			4.	1.	///	/	4.				//	///	5.	5.	4.	////	4.
Februarius	////	//			4.	2.		//	2.	/		1.	/	////	5.	2.	6.	//	1.
Martius	/	/////		//	1.	5.		//	2.	//		2.		/	1.	2.	3.	/	4.
Aprilis	/////	/			5.	1.	/	/	2.				///	/	4.	4.	2.	///	7.
Majus	///	///			3.	3.	/		1.				/	/	2.	2.	1.	//	1.
Junius	///	//			3.	2.	////	/	5.				/	/	2.	5.	2.	//	
Julius	///	///			3.	3.	/	/	2.							1.	1.		
Augustus	//////	////			6.	4.	//	///	5.		/	1.	//		2.	4.	4.	//	
September	/	/////			1.	5.	/		1.							1.			
October	///	///			3.	3.		//	2.					/	1.		3.	/	
November	/////	/////			5.	5.	//		2.				/	/	2.	3.	1.	/	3.
December	////	////	/		5.	4.		///	3.	/		1.	/		1.	2.	3.	/	1.
Summa:	42.	46.	1.	2.	43.	48.	15.	16.	31.	4.	1.	5.	12.	13.	25.	31.	30.	19.	21.

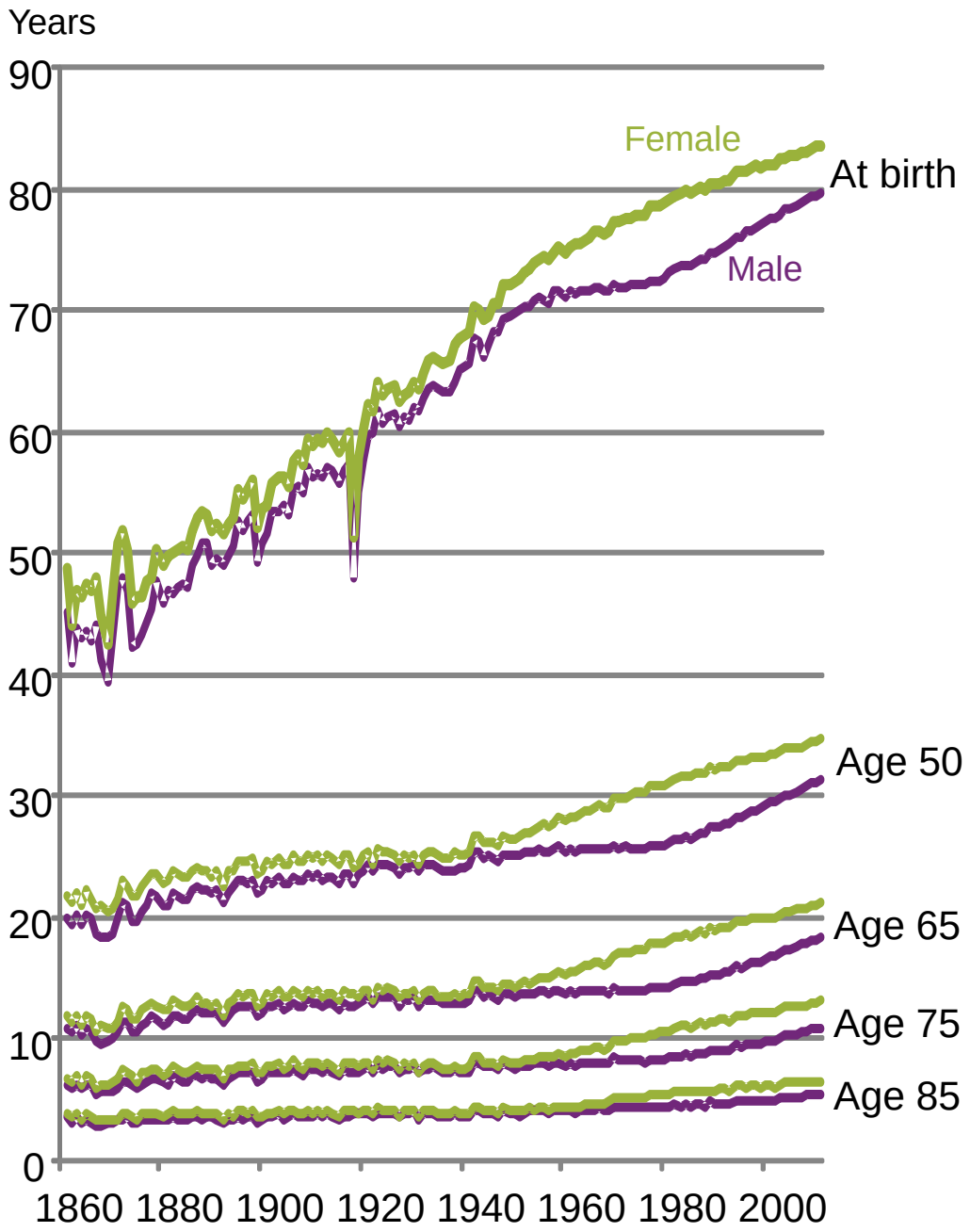
Års-Summan af FÖDDE. 81. Års-Summan af DÖDE. 61.

ANMÄRKNINGAR.

A. TWILLINGAR uptagas i föregående numer bland the Döpte; Men här nämnes allena, huru många äkta Hustrur, eller ock Qvinfolk, tillika födt 2. eller flere Barn, Söner eller Döttrar.

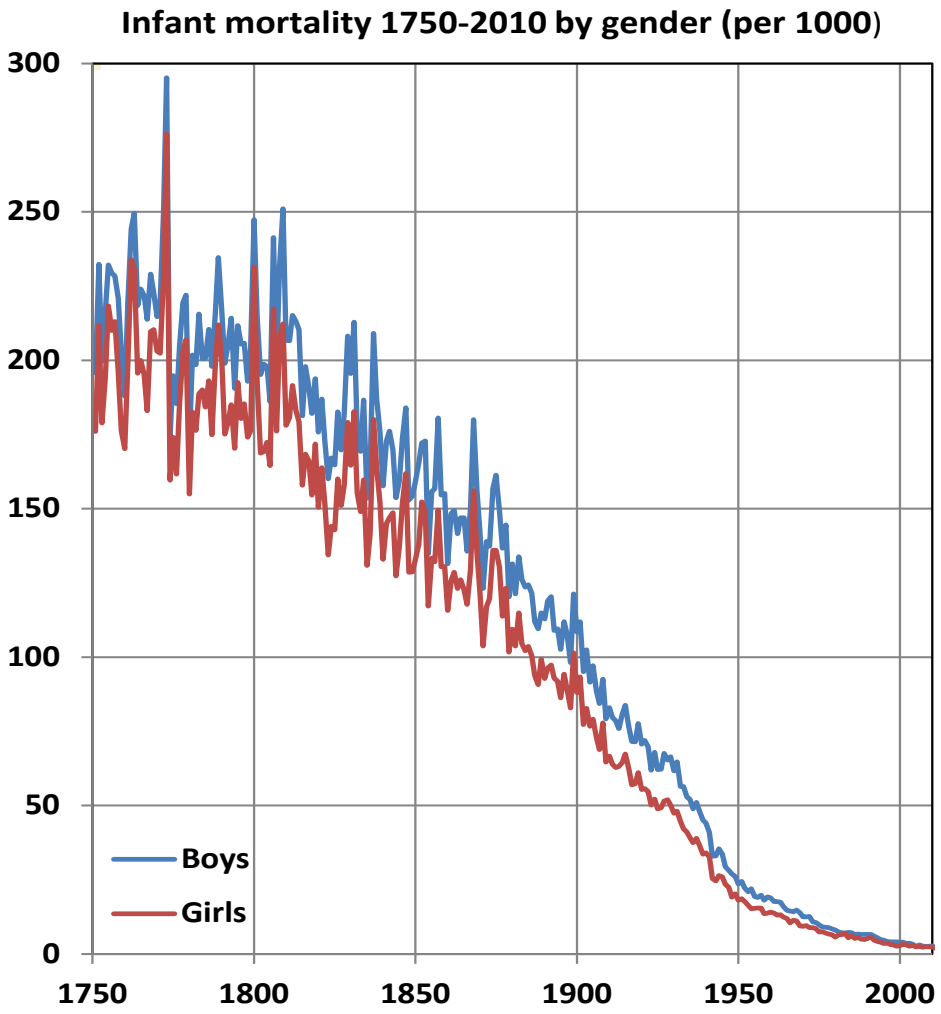
II. Besynnerliga händelsen af någons VÅDELIGA Död.
6 Personer drunknat, alla af Mankön.
1. Man af Åskan ihjälslagen.

Life expectancy
1861 – 2011

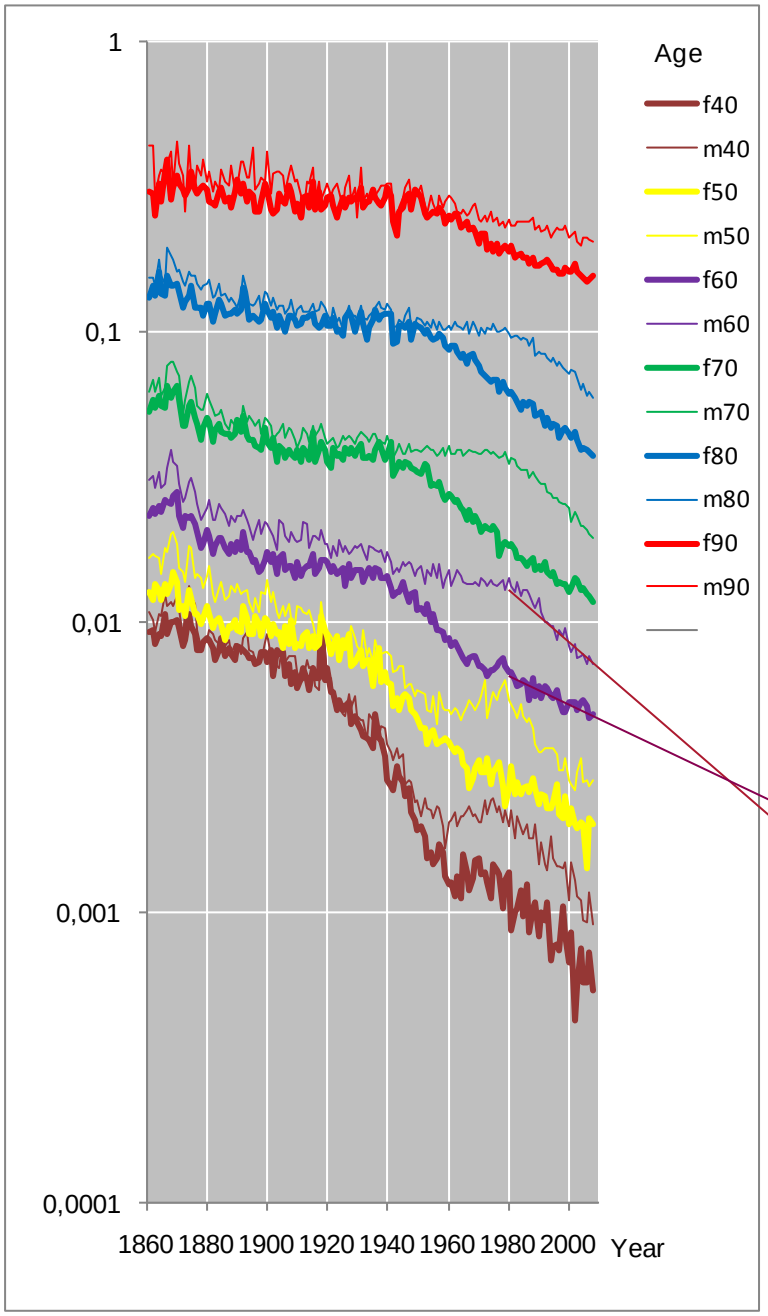


Source: Statistics Sweden

Deaths per 1000 born alive



Source: Statistics Sweden



Source: Statistics Sweden

Mortality same period.

Use of trend 1980-2010 gives higher female mortality in the future!

Not realistic – different approach needed.

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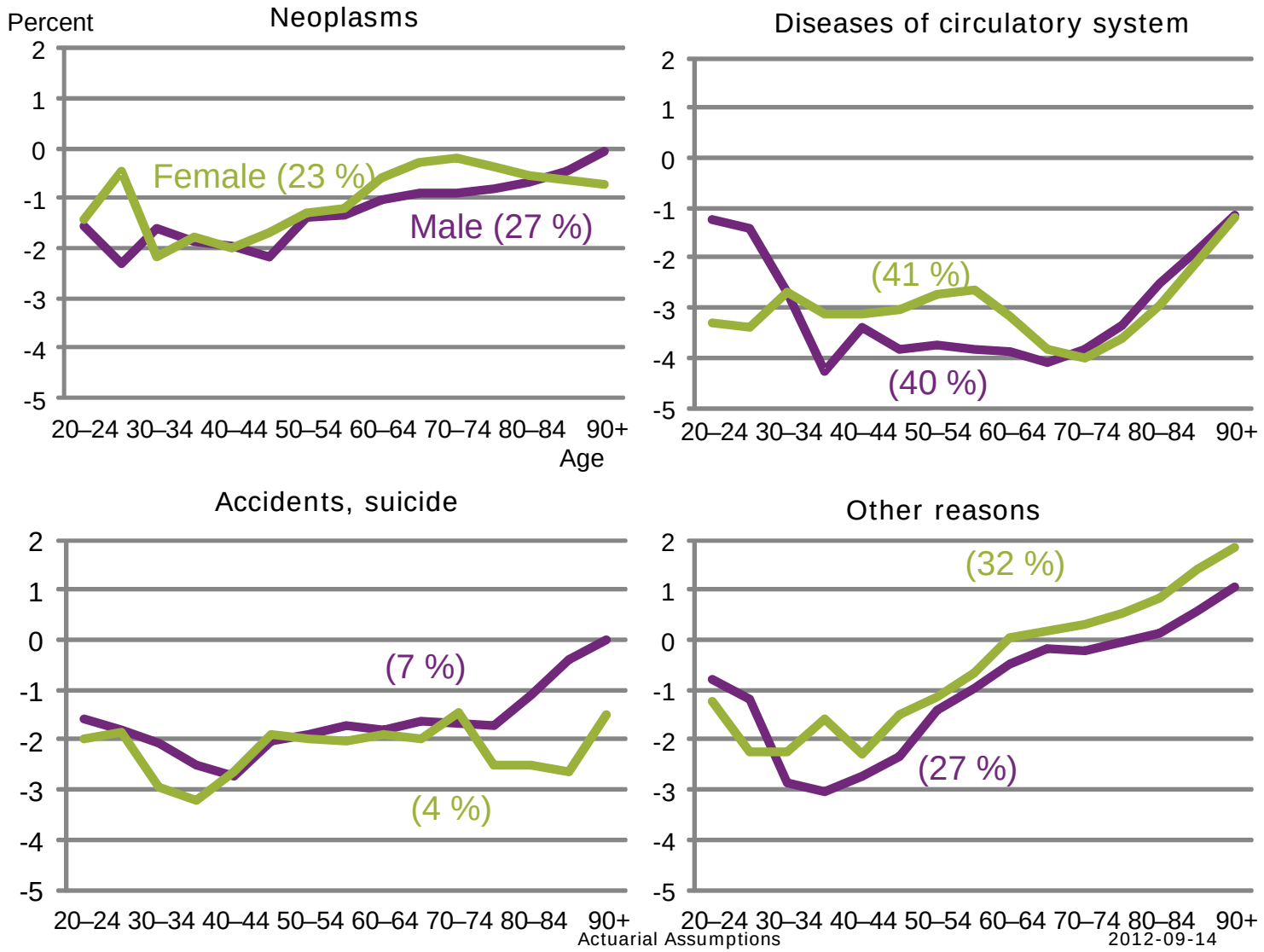
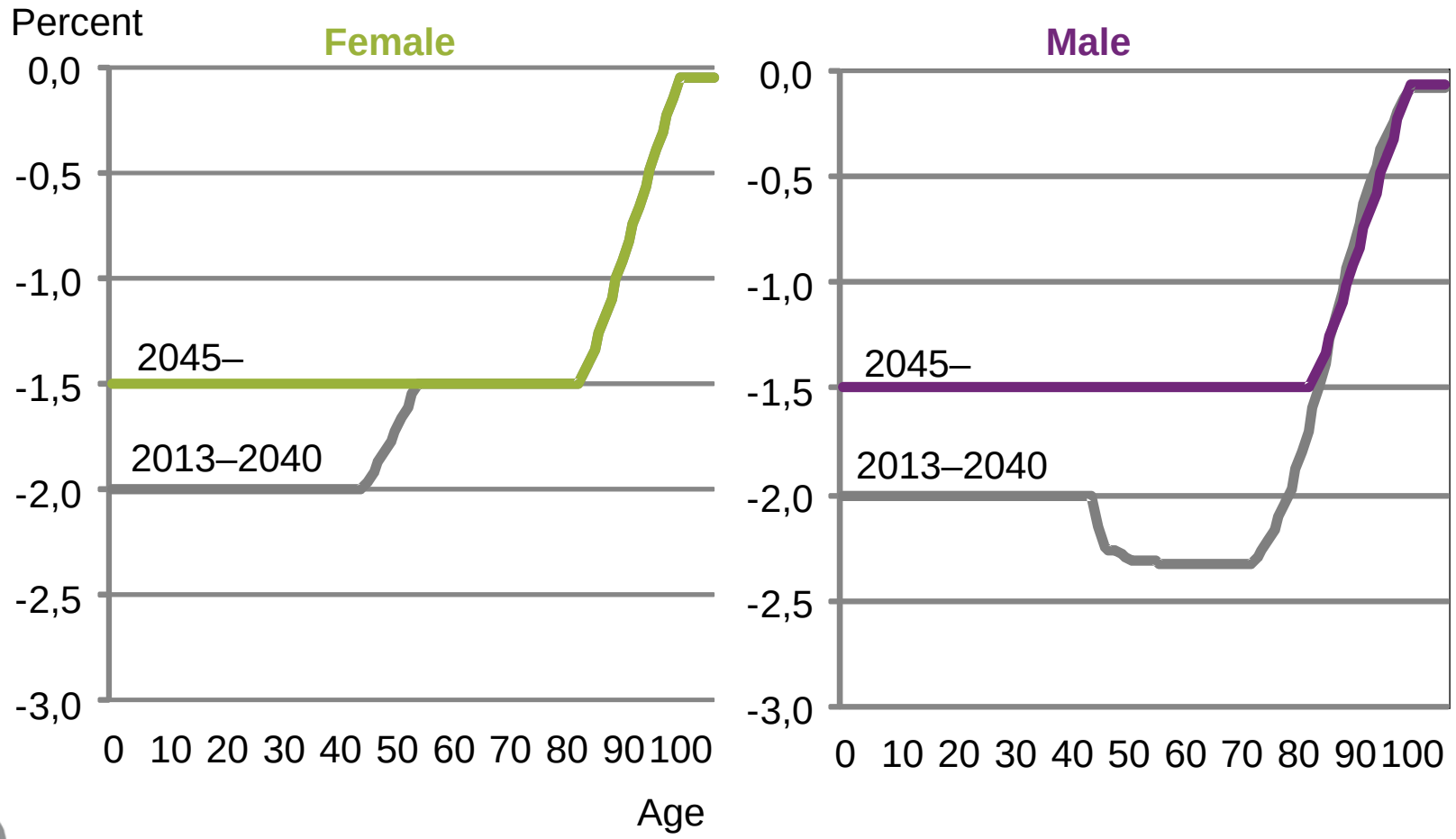
Yearly change of death rate for different death reasons per gender and age between 1980 and 2010



Source: Statistics Sweden

Assumed yearly reduction of death rate per gender, age and period

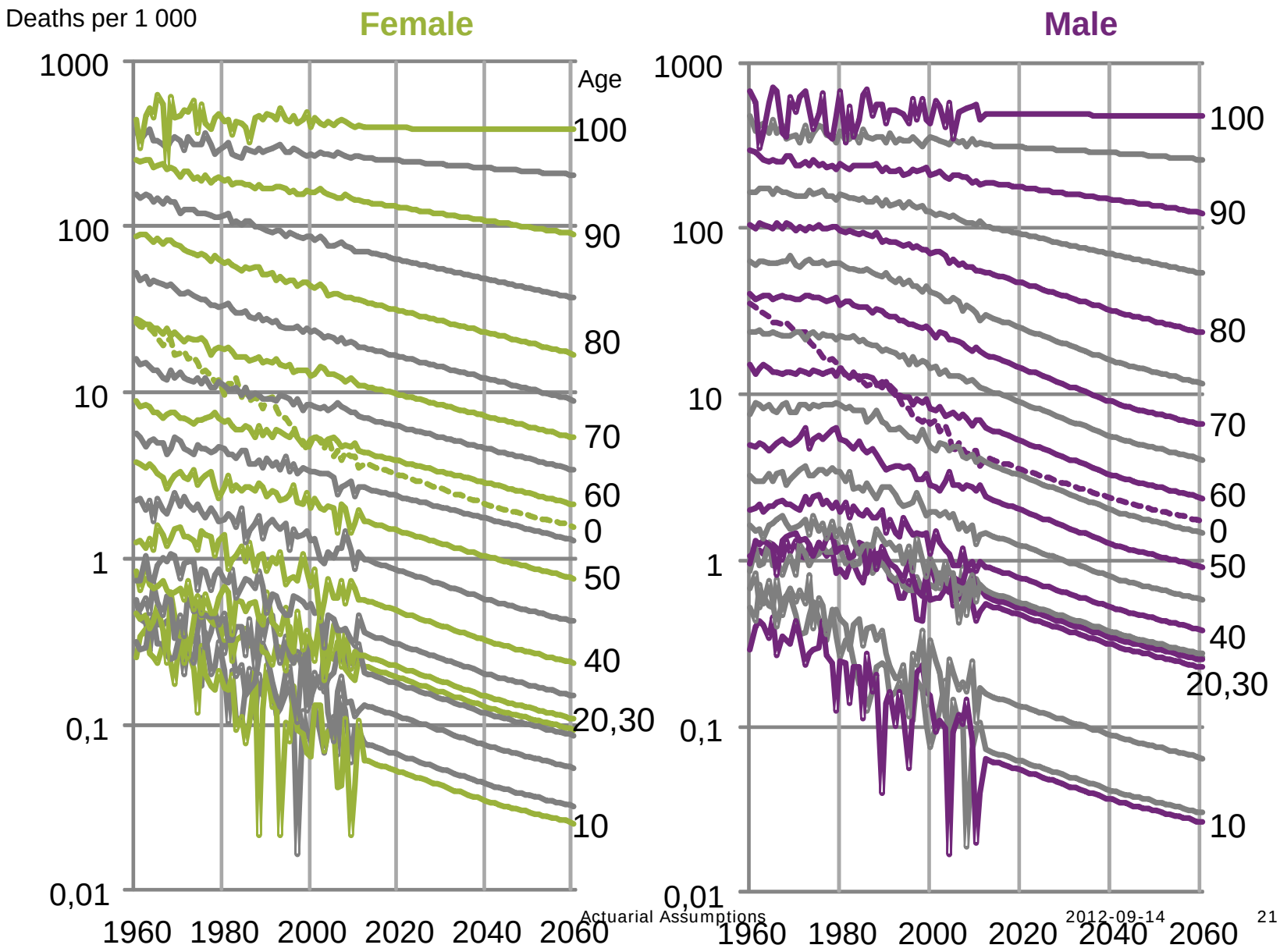


Source: Statistics Sweden

SWEDISH PENSIONS AGENCY

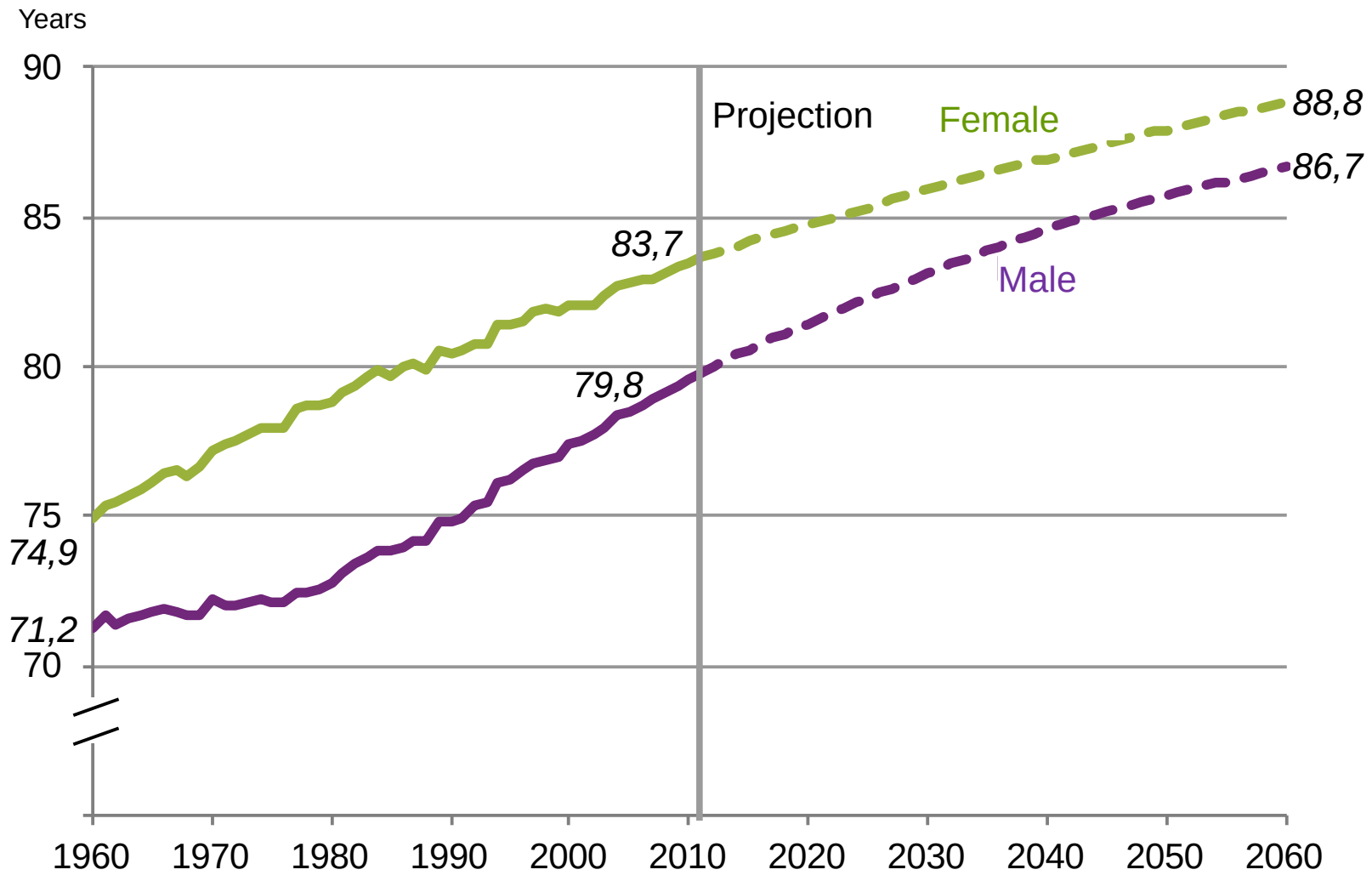
Death rate per gender and age 1960-2011 and projection 2012-2060

Logarithmic scale



Source: Statistics Sweden

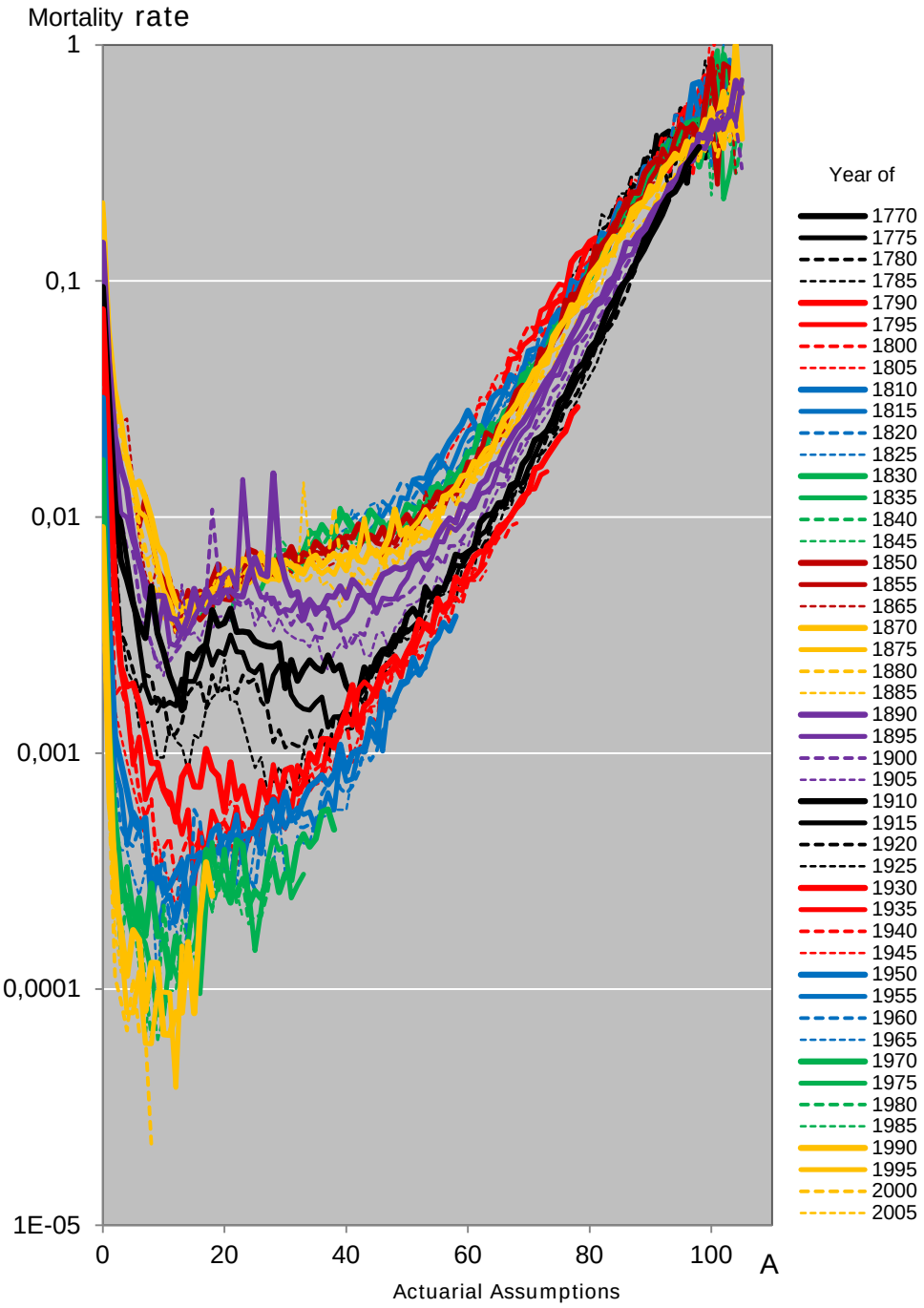
Life expectancy at birth 1960-2011 and projection 2012-2060



Source: Statistics Sweden

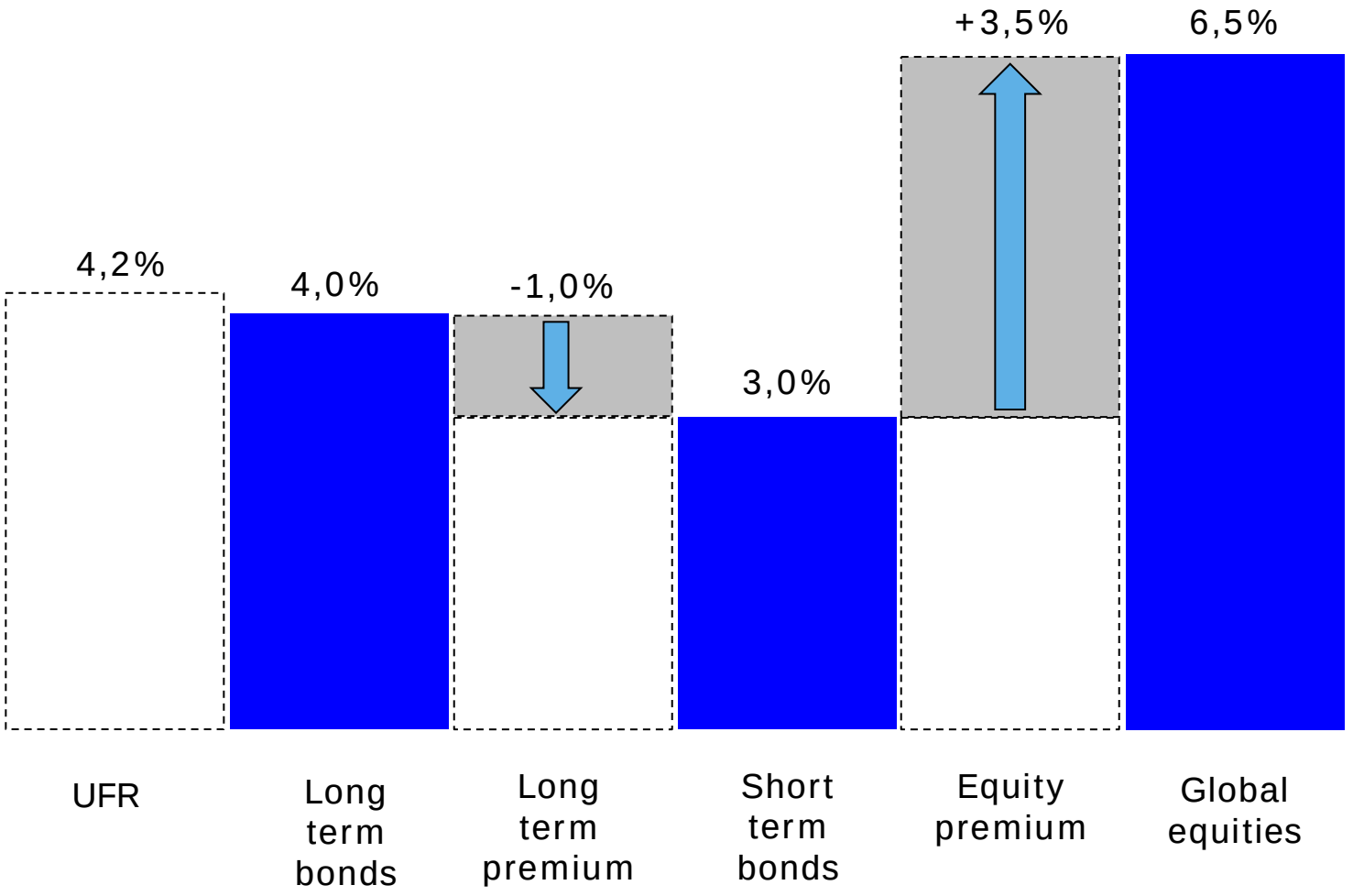
SWEDISH PENSIONS AGENCY

Female mortality. Cohorts 1770-2005.



Source: Statistics Sweden

Expected return on investments



Prognosis of Rate of returns

	Rate		Premium Pension - VA	Premium Pension - WPA
Equities	6,3%		90%	30%
Bonds	3,5%		10%	70%
Inflation	2,0%	Portfolio real return	4,0%	2,3%

Discussion points III

- How do we adapt to all this?

- Future life expectancy:
  - Russia / Sweden / Europe / Japan
  - Trends, death reasons, cohorts, base period
  - Medical cost for living longer

- Future return on investments:
  - Risk vs. return
  - Free choice of assets
  - Default solutions