



SOCIETY OF ACTUARIES

**A World of Mortality Issues and Insights Seminar
May 23, 2012**

Session 3 – Impact of Seasonality on Mortality

Presenter

Timothy L. Rozar, FSA, CERA, MAAA



Mortality Seasonality

A World of Mortality Issues and Insights



Tim Rozar FSA, CERA, MAAA
Vice President and Head of Global Research and Development
RGA Reinsurance Company



Mortality Seasonality



Seasonality:

The tendency for deaths to be correlated with seasonal weather patterns.

- § Mortality shows clear seasonal trends, which may significantly affect the distribution of deaths within a calendar year
- § The magnitude of seasonal influences varies by a number of factors including age, cause of death, geography, and socio-economic status
- § Some of the results may surprise you...

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Seasonality Myths



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Seasonality Myths



Myth: There are more heat-related deaths than cold-related deaths

Reality:

- § Mortality rates are generally 10-20% higher in the winter months than in the summer months in developed countries.

Grain of Truth:

- § Ancient periods often experienced more summer deaths.
- § Younger ages and accidental causes of death often have higher mortality rates during the summer.
- § Tropical or monsoon climates will have elevated mortality during wet seasons
- § Some researchers have theorized that global warming will lead to elevated mortality due to increased cases of heatstroke

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Seasonality Myths

Myth: Excess deaths in the winter are only attributable to influenza

Reality:

- § Most causes of deaths experience seasonal variations.
- § Circulatory and respiratory causes of death are also a major contributor to adverse winter mortality.

Grain of Truth:

- § Influenza is one of the most seasonal causes of death.
- § Flu seasons that exceed the epidemic threshold will cause the magnitude of winter seasonality to be more severe than average.
- § Influenza leads to compromised immune systems and often contributes to more serious conditions.

Seasonality Myths

Myth: Higher suicide rates around the holidays also play a role

Reality:

- § Suicides only make up 1-2% of total deaths and actually peak during the spring and fall months.
- § Research from the Mayo clinic showed no elevated risk of suicide over a 35 year period immediately before, during, or after Thanksgiving, Christmas, or New Year's Day.
- § Research from the Annenberg Public Policy Center shows that the media perpetuates this myth.

Grain of Truth:

- § One specific form of depression, seasonal affective disorder, is strongly correlated with winter.



Seasonality Myths

Myth: Winter seasonality must mean people are “freezing to death”

Reality:

- § “Freezing to death” is more a colloquial turn of phrase than a significant medical epidemic.
- § There are only about 300 hypothermia deaths reported per year.

Grain of Truth:

- § There is technically a correlation between “freezing” weather ($< 0^{\circ}\text{C}$) and elevated mortality.



Seasonality Myths

Myth: Colder climates experience worse winter mortality

Reality:

- § Warmer climates have more seasonal variations in mortality than cold climates.

Grain of Truth:

- § None.

Evidence of Seasonality

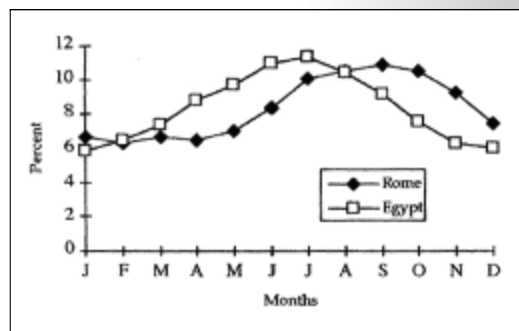


Ancient Seasonality



- § Mortality in Ancient Rome, Egypt, and other warm regions peaked in the summer
- § Younger ages were more susceptible to seasonal trends.
- § One of the primary causes of death was malaria, which peaks during summer months

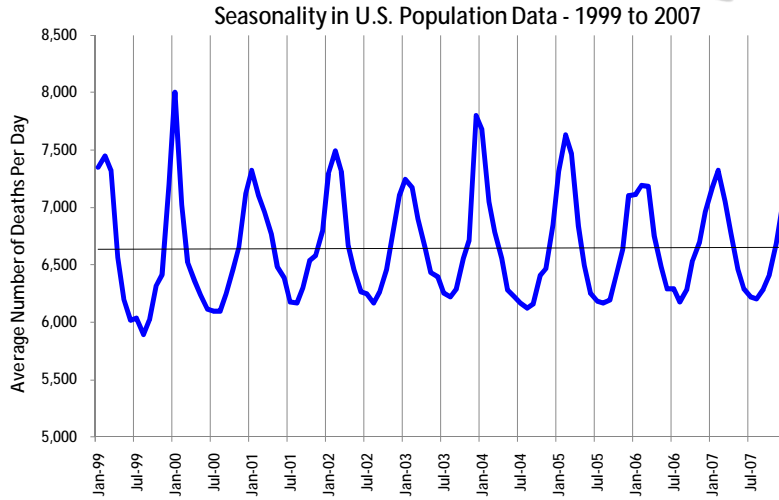
**Seasonal Distribution of Deaths:
Ancient Rome & Egypt**



Scheidel, Walter. *Measuring Sex, Age and Death in the Roman Empire*. *Journal of Roman Archaeology*, Supplementary Series Number 21:1-184, 1996



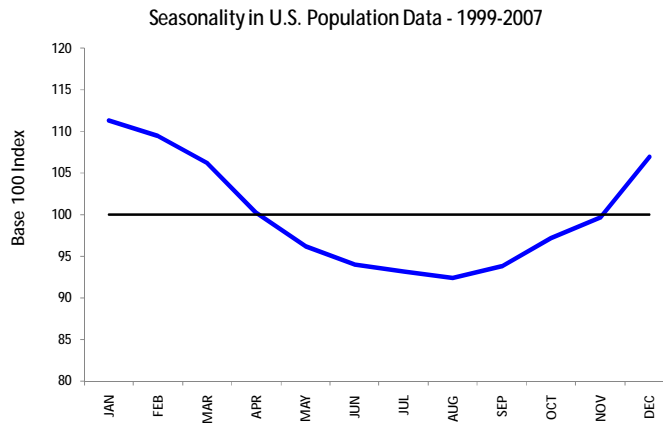
Seasonality in Modern US Population



Source: National Center for Health Statistics Multiple Cause-of-Death Files. Data compiled by RGA ¹¹

Seasonality in US Population

- § Mortality Indexed to average level
- § Winter months 10-15% higher than average
- § Summer months approximately 10% lower than average

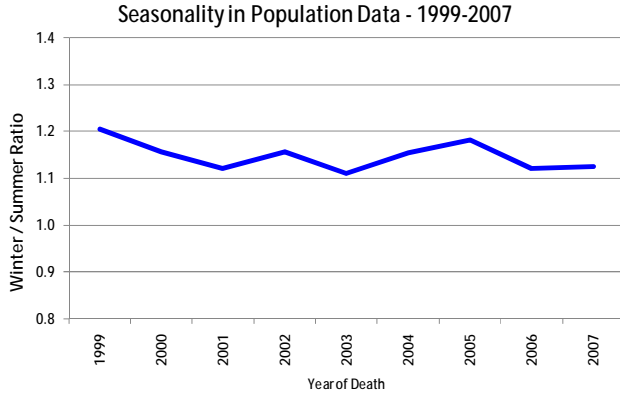


Source: National Center for Health Statistics Multiple Cause-of-Death Files. Data compiled by RGA ¹²

Seasonality in US Population

Winter / Summer Ratio =
 (Total deaths in Jan, Feb & Mar) / (Total deaths in July, Aug & Sept)

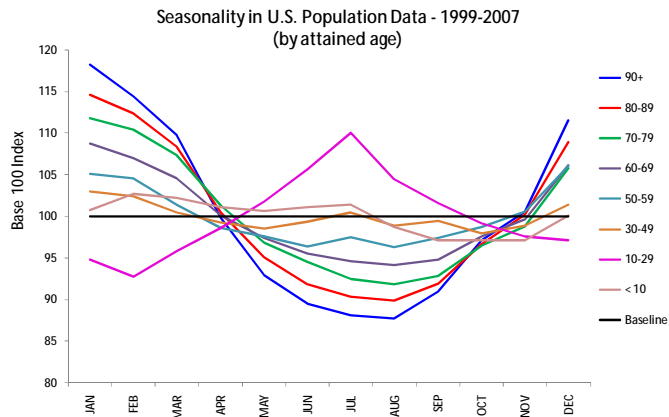
- § W/S Ratio provides simple metric to study seasonality as one number for entire period.
- § Ratio of 1.2 means winter mortality is 20% higher than summer mortality.



Source: National Center for Health Statistics Multiple Cause-of-Death Files. Data compiled by RGA 13

Seasonality in US Population: by Age

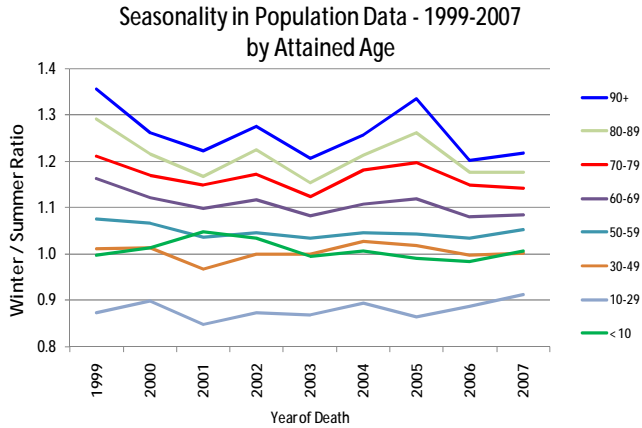
- § Impact of winter seasonality increases by increasing age.
- § Younger ages have excess mortality in summer.



Source: National Center for Health Statistics Multiple Cause-of-Death Files. Data compiled by RGA 14

Seasonality in US Population: by Age

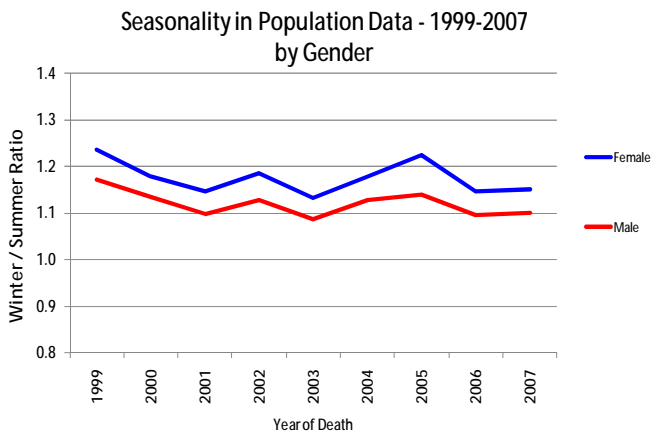
- § Impact of winter seasonality increases by increasing age.
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Source: National Center for Health Statistics Multiple Cause-of-Death Files. Data compiled by RGA 15

Seasonality in US Population: by Gender

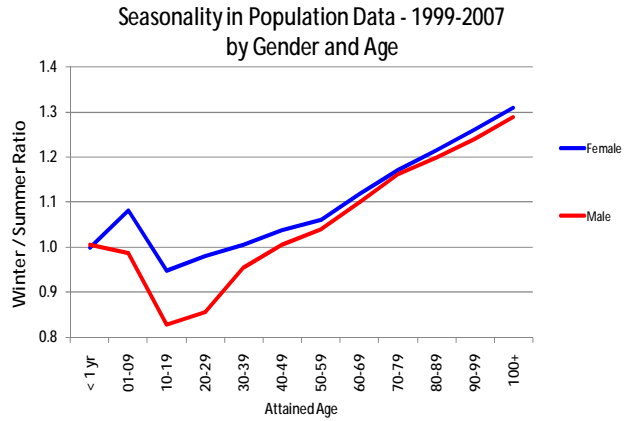
- § At first glance, females appear more susceptible to seasonality.



Source: National Center for Health Statistics Multiple Cause-of-Death Files. Data compiled by RGA 16

Seasonality in US Population: by Gender

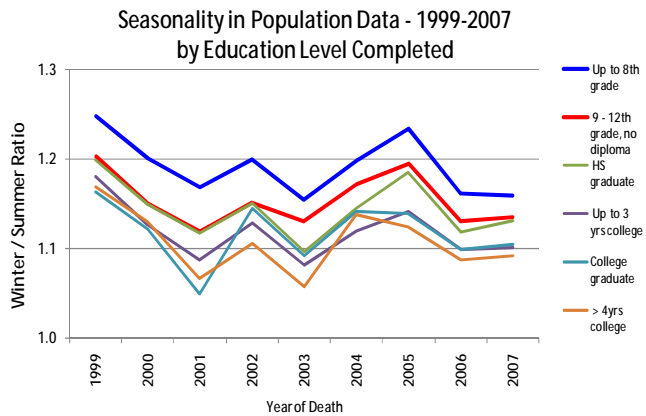
- § Less differential by gender after controlling for age.
- § Younger men have worse summer mortality



Source: National Center for Health Statistics Multiple Cause-of-Death Files. Data compiled by RGA 17

Seasonality in US Population: Education Level

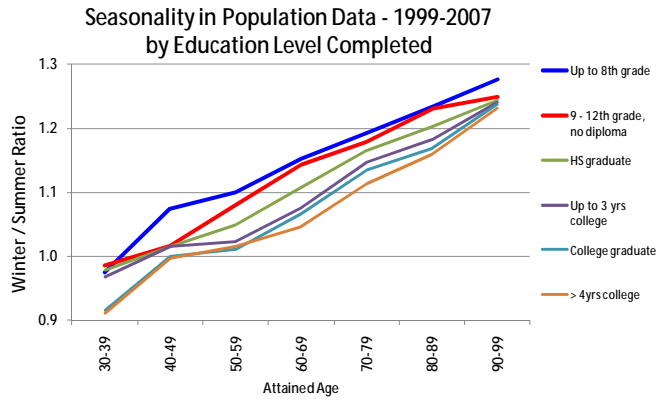
- § Socio-economic factors influence susceptibility to seasonality.



Source: National Center for Health Statistics Multiple Cause-of-Death Files. Data compiled by RGA 18

Seasonality in US Population: Education Level

§ Socio-economic factors influence susceptibility to seasonality.

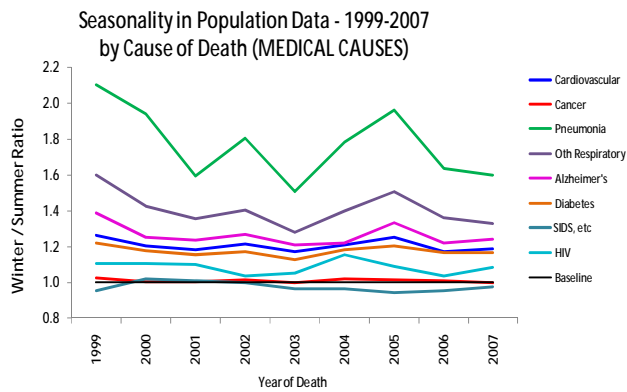


Source: National Center for Health Statistics Multiple Cause-of-Death Files. Data compiled by RGA 19

Seasonality in US Population: Medical Causes of Death

§ Seasonality varies significantly by cause of death.

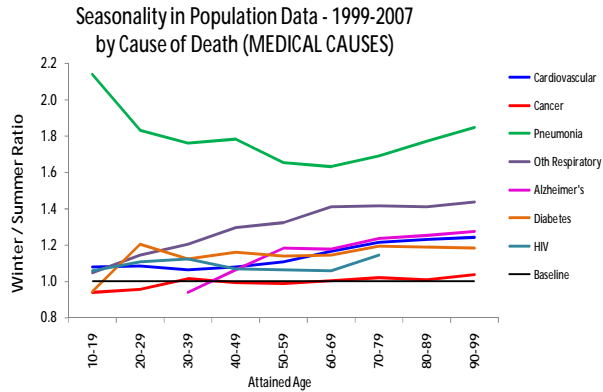
§ Most causes other than cancer show some seasonality.



Source: National Center for Health Statistics Multiple Cause-of-Death Files. Data compiled by RGA 20

Seasonality in US Population: Medical Causes of Death

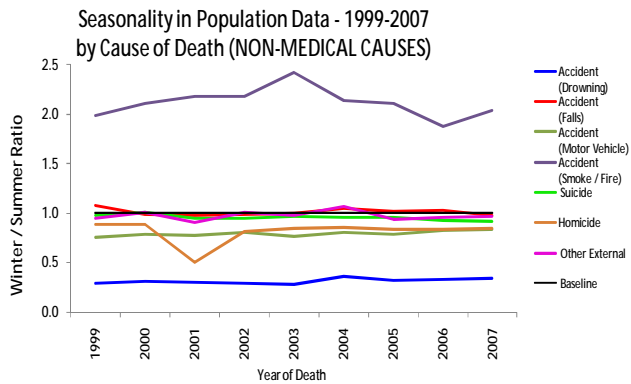
- § Seasonality varies significantly by cause of death.
- § Most causes other than cancer show some seasonality.
- § Seasonality is more pronounced at older ages.



Source: National Center for Health Statistics Multiple Cause-of-Death Files. Data compiled by RGA 21

Seasonality in US Population: Non-Med Causes of Death

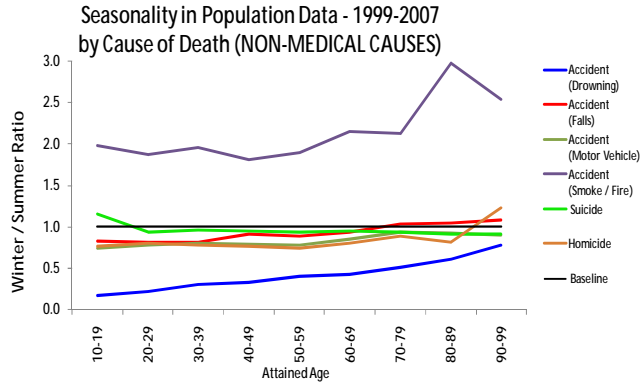
- § Most non-medical causes of death have less seasonal influences.
- § Obvious exceptions:
 - § smoke/fire accidents (winter)
 - § drowning (summer)



Source: National Center for Health Statistics Multiple Cause-of-Death Files. Data compiled by RGA 22

Seasonality in US Population: Non-Med Causes of Death

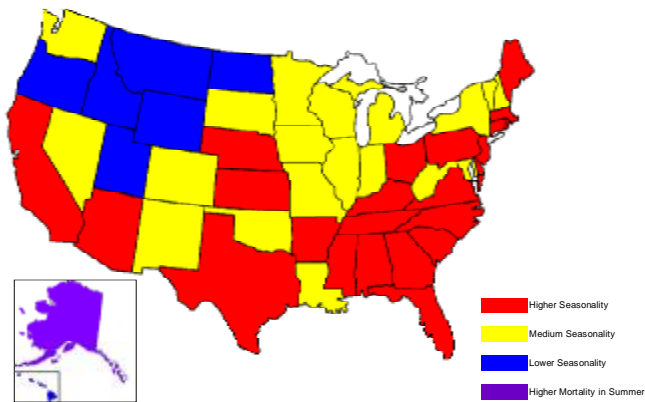
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Source: National Center for Health Statistics Multiple Cause-of-Death Files. Data compiled by RGA 23

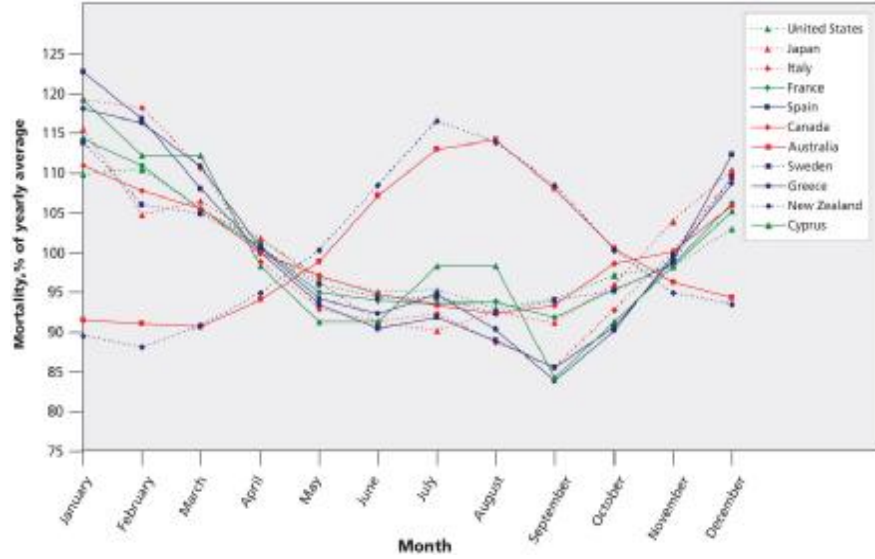
Seasonality in US Population: Geography

- § Warmer states generally have more winter month seasonality.



Source: National Center for Health Statistics Multiple Cause-of-Death Files. Data compiled by RGA 24

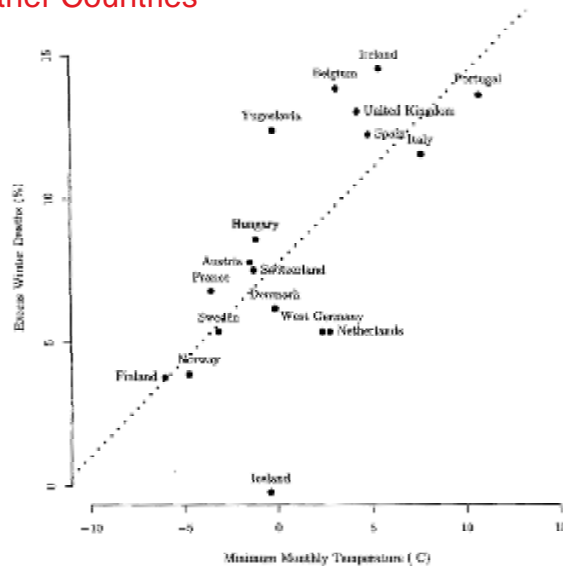
Seasonality in Other Countries



Source: Falagas M E et al. CMAJ 2009;181:484-486 ²⁵
<http://www.cmaj.ca/content/181/8/484.full>

Seasonality in Other Countries

§ Warmer countries generally have more winter seasonality than colder countries.



Source: Rau, Roland. Seasonality in Human Mortality: A Demographic Approach. Springer, 2006. ²⁶

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Explanations for Seasonality



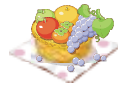
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Explanations for Seasonality



§ Biomedical Factors



§ External Factors



§ Behavioral Factors

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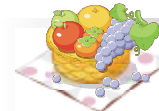


Explanations for Seasonality

Biomedical Factors

- § Cold temperatures **allow bacteria to survive longer**, which has adverse effects on immune system's resistance against respiratory infections.
- § **Social crowding** facilitates the rapid spread of infectious diseases.
- § Cold air leads to **coronary vasospasm**, a condition where blood vessels spasm causing them to narrow.
- § Cold air also affects the **composition of blood**. Reduced levels of plasma cause the blood to be thicker.

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Explanations for Seasonality

External Factors

- § **Internal air pollution** is more present during the winter due to central heating (smoke, sulfur dioxide, and carbon monoxide)
 - § Respiratory diseases (small particles getting into the sensitive parts of the lungs)
 - § Cardiovascular diseases (aggravating existing heart disease)
- § **Access to nutrition** is reduced during the winter.
 - § Fresh fruits and vegetables provide good sources for vitamin C
 - § UV radiation of the sun provides a synthesizable source of vitamin D.
 - § Both have positive effects on cardiovascular disease, renal function, autoimmune disorders and infections (including the flu).
- § **Air conditioning** has reduced the susceptibility to summer seasonality.
- § **Influenza vaccinations** have reduced the effects of winter over time.

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Explanations for Seasonality



Behavioral Factors

- § Individuals with known CAD could be **over-exerting** themselves with winter activities such as shoveling snow.
- § Normal exercise routines and eating **habits may be altered** during the winter.
- § Some **individuals may not properly prepare** for the cold weather.

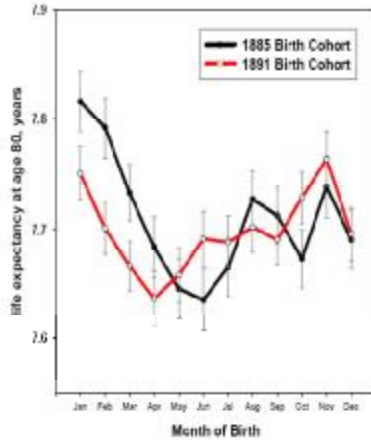
And just for fun...



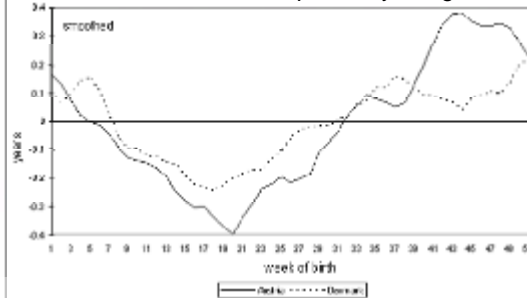
Seasonality by Month of Birth

§ Research supports the notion that life expectancies are also dependent on the season (or month) of birth.

Mean Life Expectancy at Age 80



Deviation in Life Expectancy at Age 50



*Search for Predictors of Exceptional Human Longevity" by Gavrilova / Gavrilov

"Longevity and month of birth: Evidence from Austria and Denmark" by Gabriele Doblhammer, Demographic Research, Vol 1, Aug 1999.

Explanations for Seasonality by Month of Birth

- § There may be **critical periods early in human life** sensitive to seasonal variations.
- § **"Selective survival"** for infants who survive during more difficult months.
- § Nutrition of the mother or other **pre-natal** influences.
- § **Social factors** that are closely related to a child's birthday, such as the age that they enter school.

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