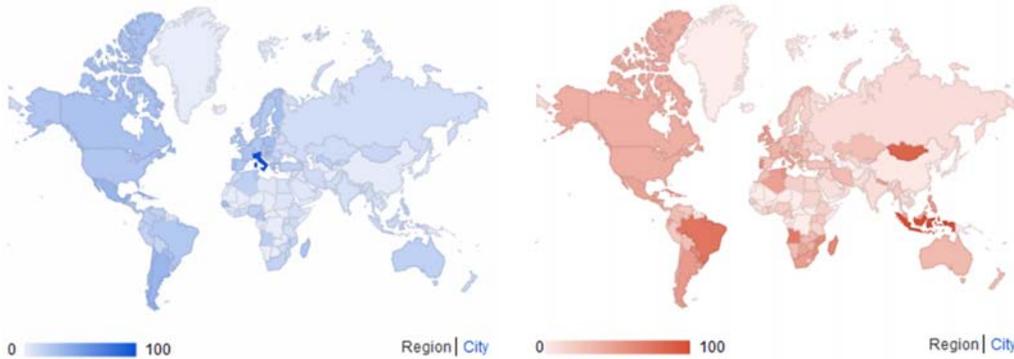
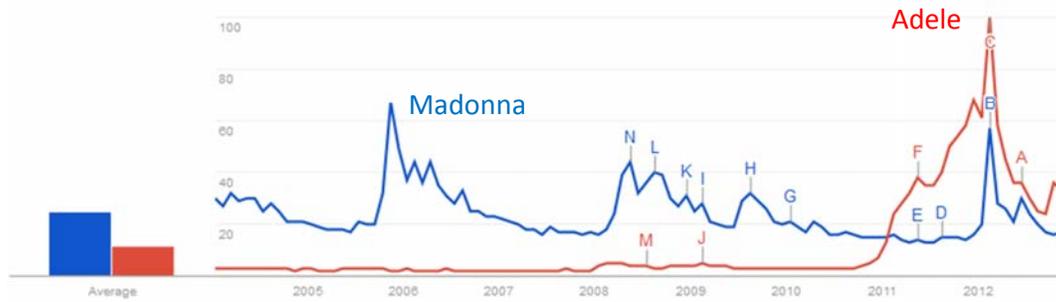


Interest over time ?

The number 100 represents the peak search volume

News headlines Forecast ?



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Information Visualization MOOC

Unit 2 – “When”: Temporal Data

Overview and Terminology

Relevant Research Disciplines:

Mathematics, Statistics, Information Visualization

Temporal Analysis and Visualization Goals

Main goals:

- Understand temporal distribution of a dataset—e.g., first and last time point, any zero or missing values, trends, growth, latency to peak, decay rate.
- Forecasting—i.e., predicting future values of the time-series variable.

Patterns in Time-Series Data

- **Trends:** General tendency such as steadily shifting, stabilizing, or cyclic—e.g., increase in spam email. Frequently, some form of filtering is applied to reduce noise and to make patterns more salient—e.g., averaging using window of a certain width or curve approximation/fitting.
- **Seasonality:** Repetitive and predictable movement around a trend line—e.g., cyclic variations of flu infections, crops harvested, construction workers employed per month, emails received at night/day.
- **Burst Analysis:** Identification of sudden bursts of activity (e.g., right before a deadline) or in response to external events—e.g., disasters.

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Terminology

A time series is a sequence of events/observations which are ordered in one dimension—time.

Time-series data can be *continuous*—i.e., there is an observation at every instant of time—or *discrete*—i.e., observations exist for regularly or irregularly spaced intervals.

Example: Email Data

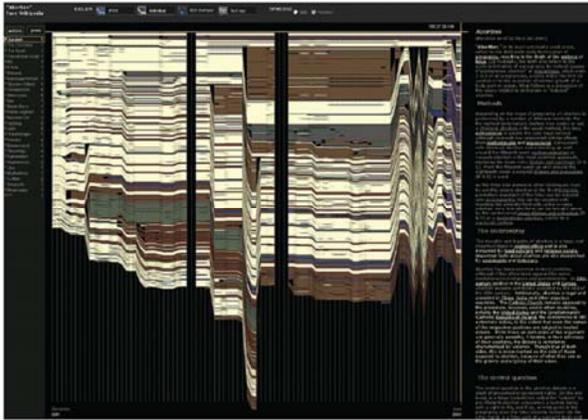
Subject header	Date	Time
Meeting to get key	1/1/2012	2:01 PM
CNS Talk–Meet Speaker?	1/1/2012	2:05 PM
Review paper draft	1/1/2012	3:01 PM
Happy New Year!	1/1/2012	3:01 PM
Action List Reminder	1/1/2012	3:04 PM

Wikipedia editing activity, see next slide.

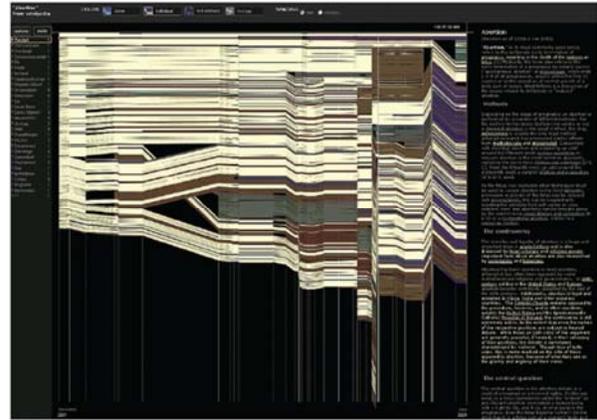
13

History Flow Visualization of the Wikipedia Entry on “Abortion”

Vandalism is detected and corrected rather quickly:



Equal distance spacing

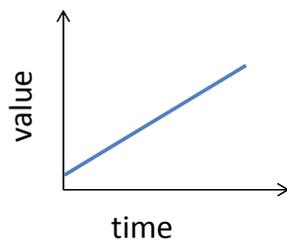


Date spacing

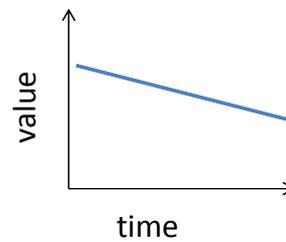
Terminology

Trend: General tendency—e.g.,

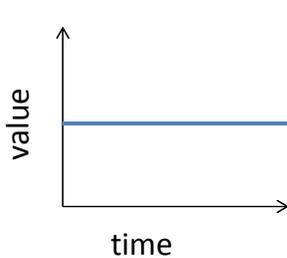
increasing



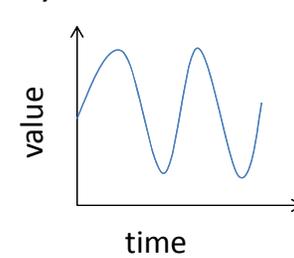
decreasing



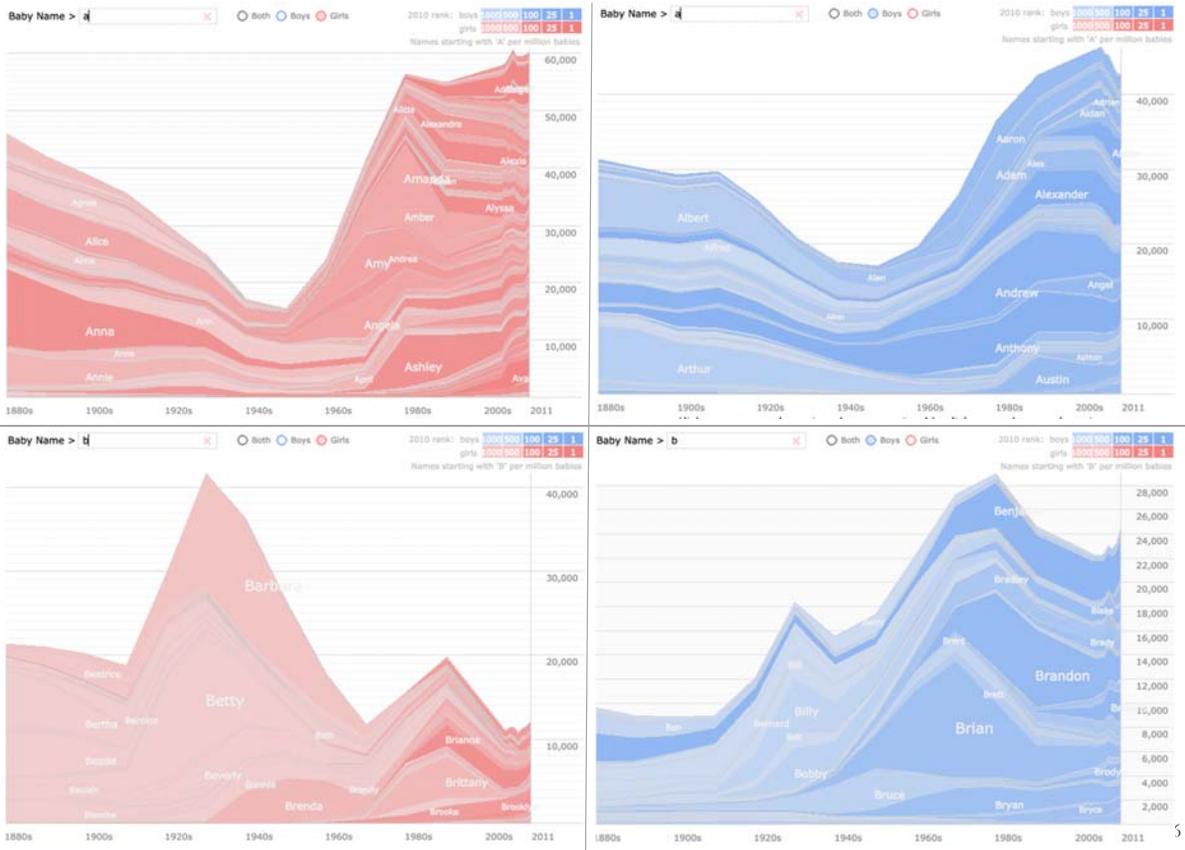
stable



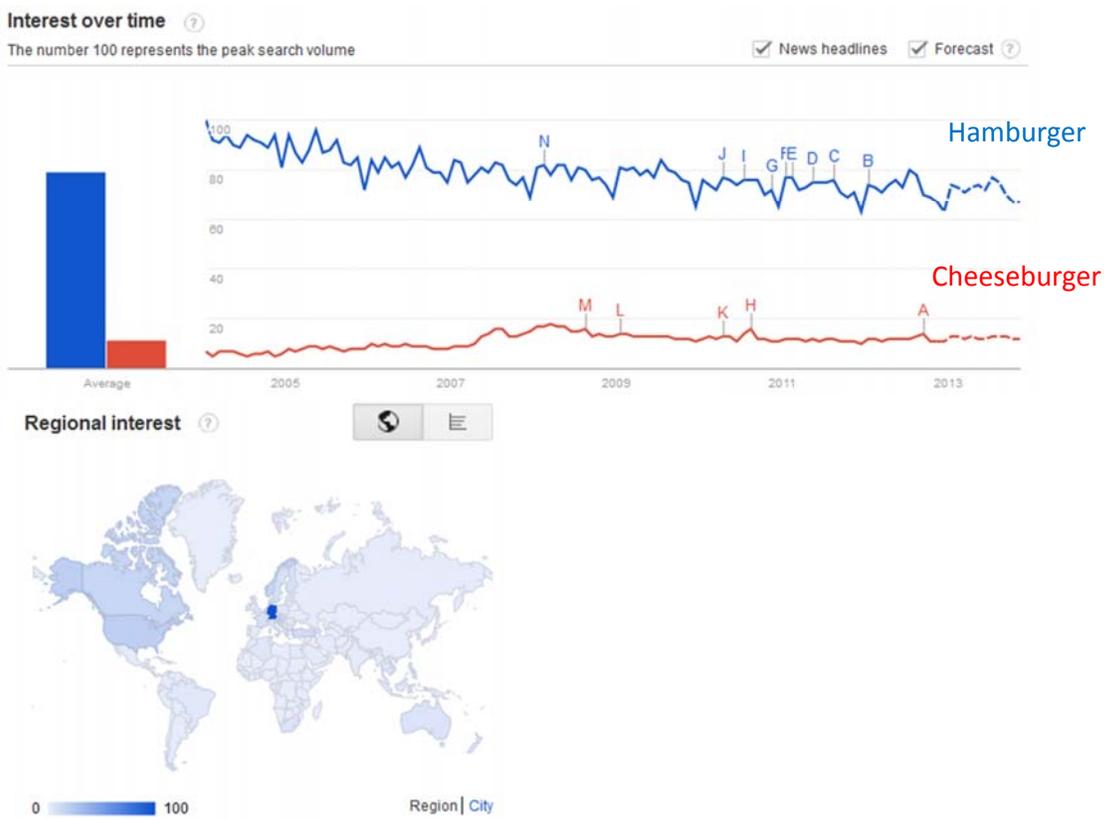
cyclic



Baby name trends: <http://www.babynamewizard.com/voyager#>



Google trends: <http://www.google.com/trends>

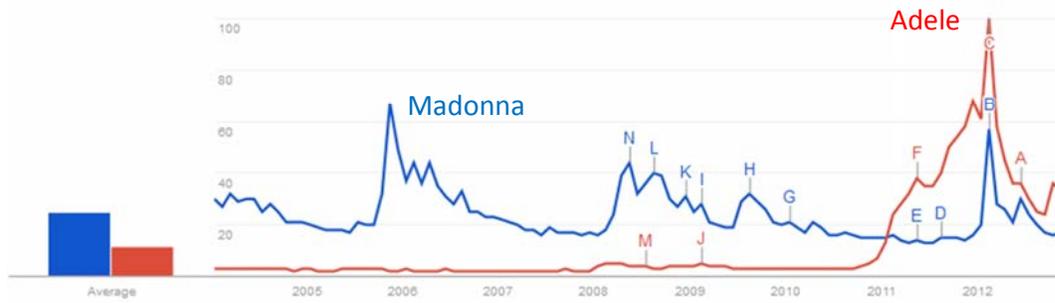


Google trends: <http://www.google.com/trends>

Interest over time

The number 100 represents the peak search volume

News headlines Forecast



Feb 2012:
C: Adele wins 6 Grammys
B: Madonna dazzles Super Bowl

June 2012
A: Adele pregnant with first child

0 100

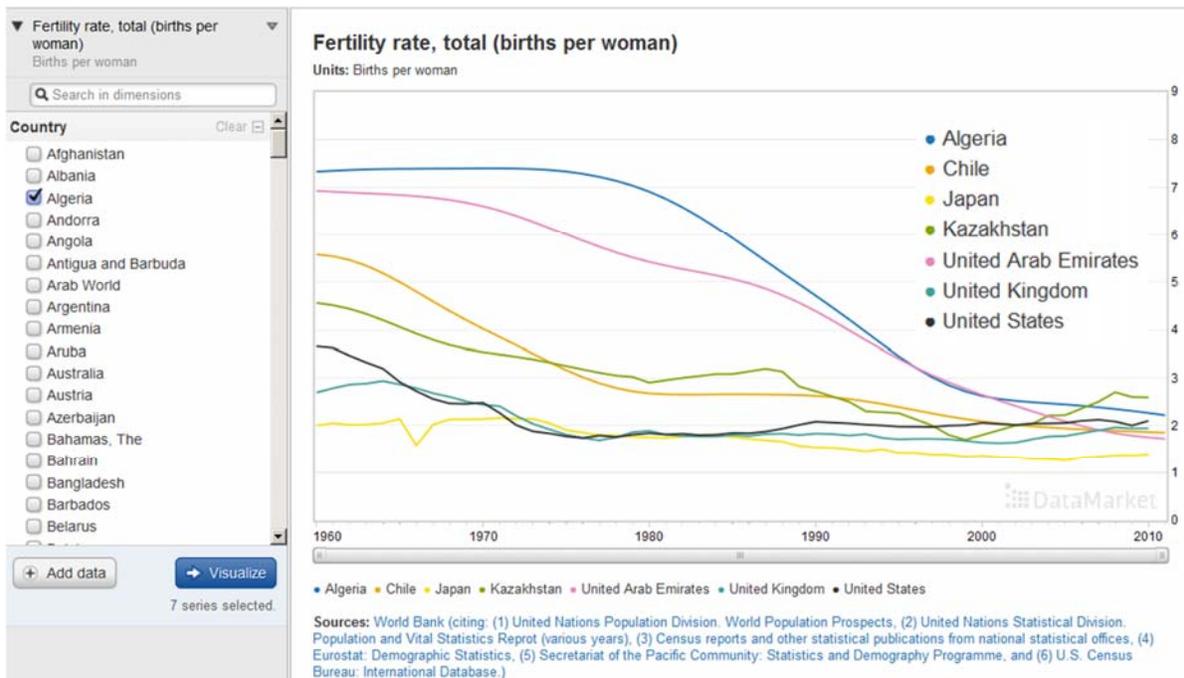
Region | City

0 100

Region | City

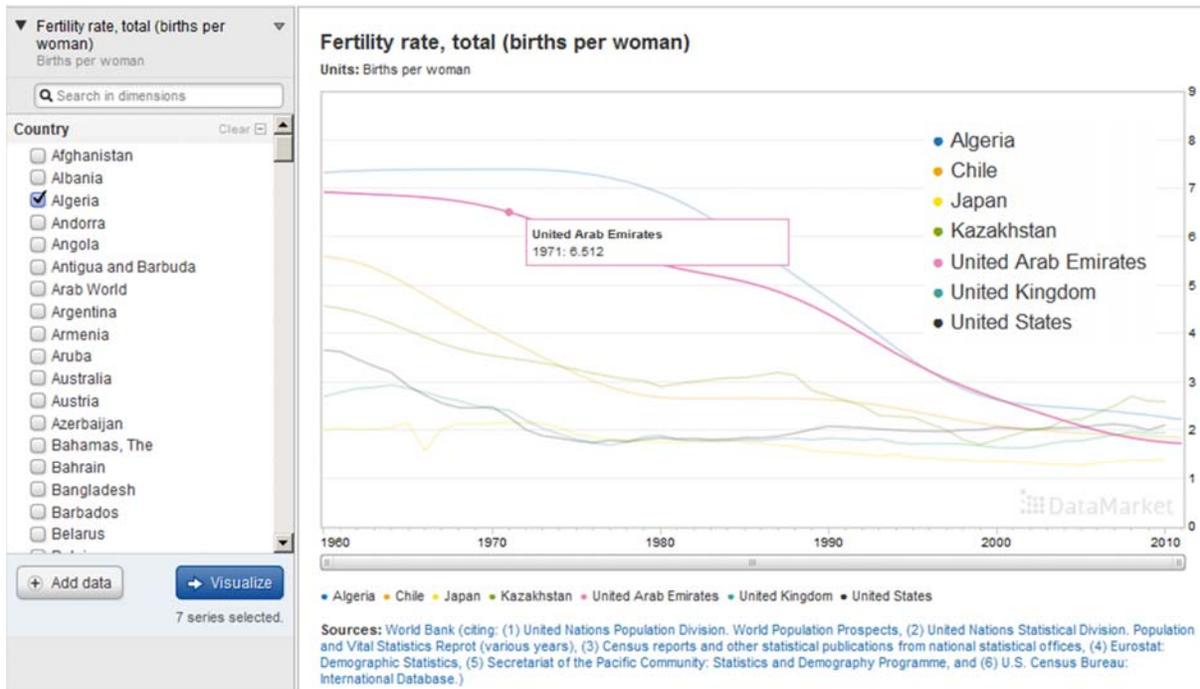
DataMarket: Fertility rate, total (births per woman) 1960-2011

<http://datamarket.com/data/set/15r6/fertility-rate-total-births-per-woman#!display=line&ds=15r6!hrt=1t.19.2g.45.4q.57.m>

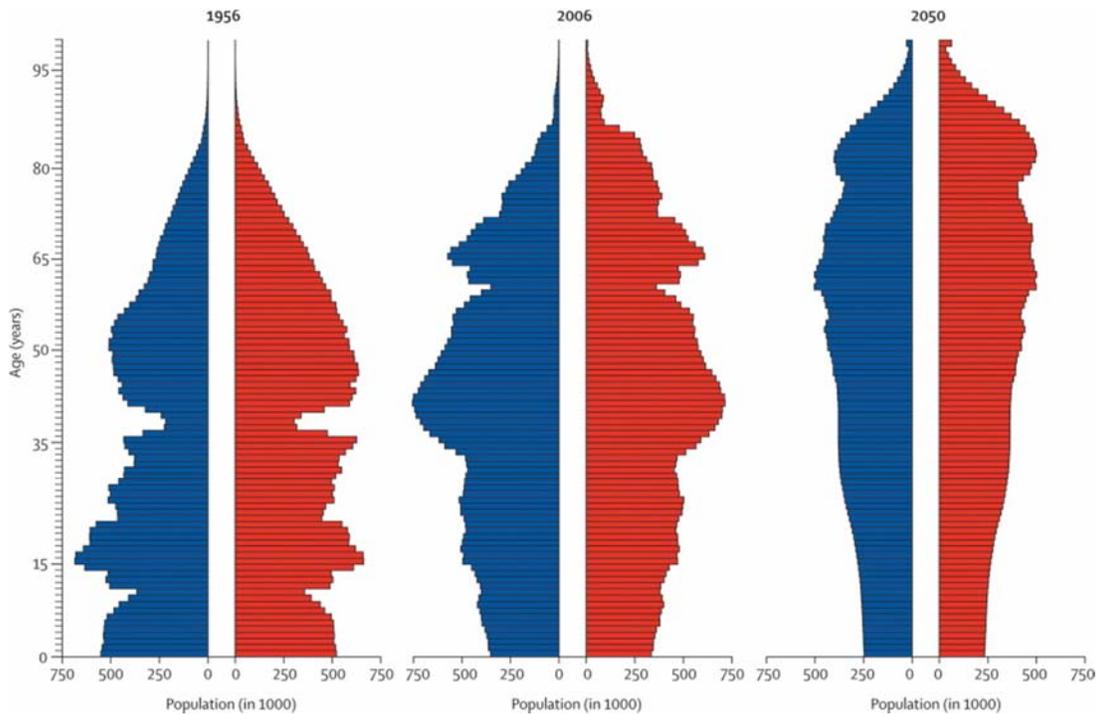


DataMarket: Fertility rate, total (births per woman) 1960-2011

<http://datamarket.com/data/set/15r6/fertility-rate-total-births-per-woman#!display=line&ds=15r6!hrt=1t.19.2g.45.4q.57.m>

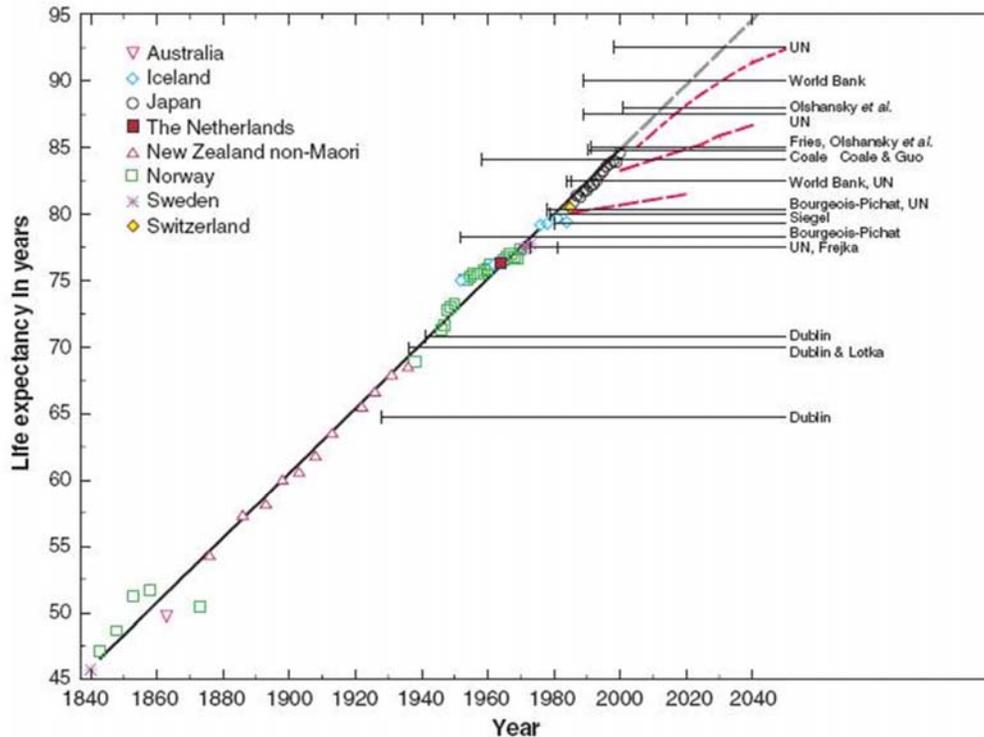


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Christensen, Kaare, Gabriele Doblhammer, Roland Rau, and James W. Vaupel. 2009. "Ageing Populations: The Challenges Ahead." *The Lancet* 374 (9696): 1196–1208.

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Oeppen, Jim, and James W. Vaupel. 2002. "Broken Limits to Life Expectancy." *Science* 296 (5570): 1029–31.

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General Visualization Types

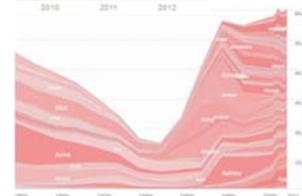
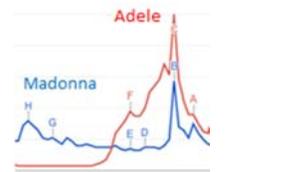
Graphs

- **Line graph:** Show trends over time.
- **Stacked graph:** See individual and total trends.
- **Temporal bar graph:** Show begin, end, and properties of events—see Hands-on session.
- **Scatter plot:** See relationships—e.g., correlations between two data variables.
- **Histogram:** How many observations of a certain value have been made.

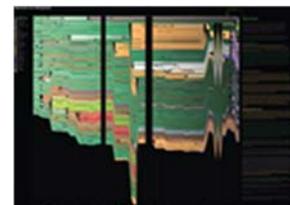
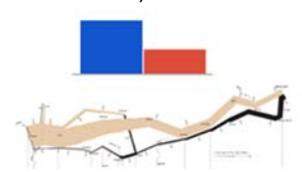
Geomap: Understand change over time in geospatial distribution, see Unit 3.

Topic map: Understand change over time in topical distribution, see Unit 4.

Network Graph: Understand change over time in topical distribution, see Units 5 & 6.



Madonna, Adele



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