Smoothing Model Reboot: Revisiting Kannisto for Old Age Mortality Smoothing in the HMD

Introduction

Plateau vs. No Plateau Debate

- Mortality at very old ages is hard to study - small numers of people make it to these ages making patterns of mortality difficult to capture
- Overview/history of models used to capture old age mortality, starting with Gompertz
- Discovery of a possible mortality rate plateau, found in multiple countries (and the explosion of models designed to capture this slowing of mortality at very high ages) - Logistic, Log-Quadratic, Kannisto, Beard
- However, there has also been evidence that there is not a mortality plateau and that the Gompertz model fits best into the oldest ages (Gavrilov and Gavrilova) - good transition to my results

Kannisto and HMD

- The Human Mortality Database (HMD) has chosen to use the Kannisto model to smooth old age mortality rates (for ages 80+) for XYZ reason
- Short description of implementation (reference methods protocol)
- But research has shown that the Kannisto model may not perform as well as some other models (Dang & Oulette, Feehan)
- Literature suggests reevaluation of the Kannisto method on HMD data is needed

Methods

Data

- Extinct cohort data used (cohorts included: 1873-1906)
- Three levels of data used
  - **Level one: Gold** - High quality, large population (French data from ..., a truncated version (at 105+) of this data used as input data to the HMD)
  - **Level two: Silver** - High quality, small population (Scandinavian HMD death counts by Lexis triangle, includes data from Denmark, Finland, Sweden, and Norway - supplemented with validated death counts at ages 110+ from IDL)
  - **Level three: Bronze -** Lower quality, large population (England, Wales, Scotland HMD death counts by Lexis triangle - supplemented with validated death counts at ages 110+ from IDL)

Approach

- Fit 5 most promising models to the data
- Used AIC distributions to compare performance
- Plan to add more here once I add other validation metrics

Results

Sample of Cohort Model Fits for France and Sweden

France Fits

Figure 1 shows data and models for a sample of extinct cohorts between 1873 and 1906. Grey points represent the mortality rates calculated from French vital statistics on deaths and exposures calculated through the extinct cohort method. Models include Beard, Gompertz, Kannisto, Log-Quadratic, and Makeham. All models follow the data and each other closely until ages in the late 90s are reached. From there models diverge quite drastically.

Sweden Fits

Model Performance

Create figure with change in AIC and see if distinctions are more obvious

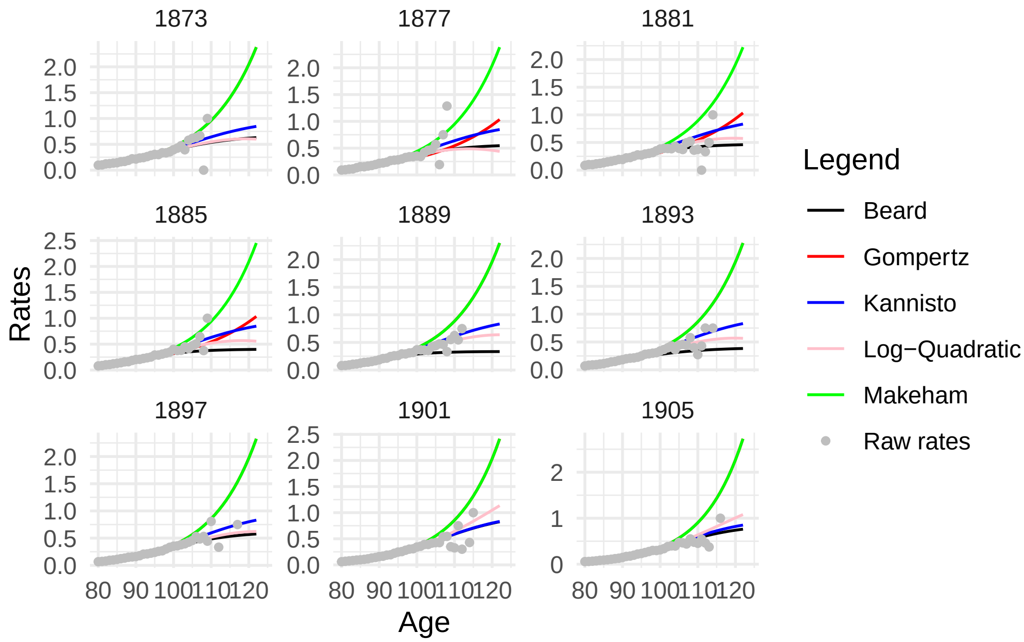


Figure 1: France Mortality Rates Plotted with Model Fits

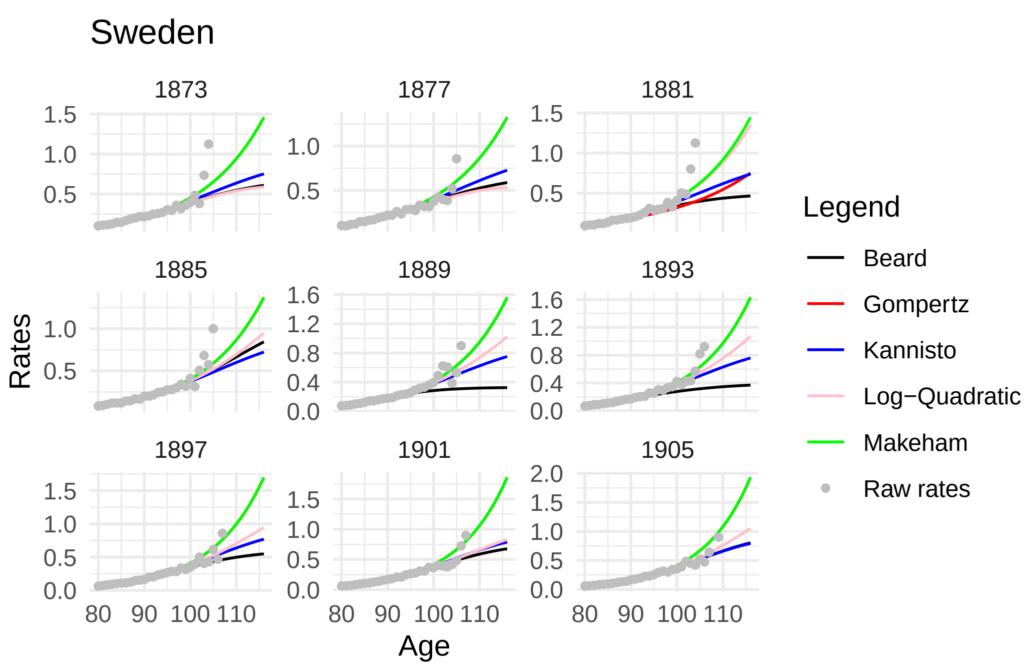


Figure 2: Sweden Mortality Rates Plotted with Model Fits

Sweden AIC Results

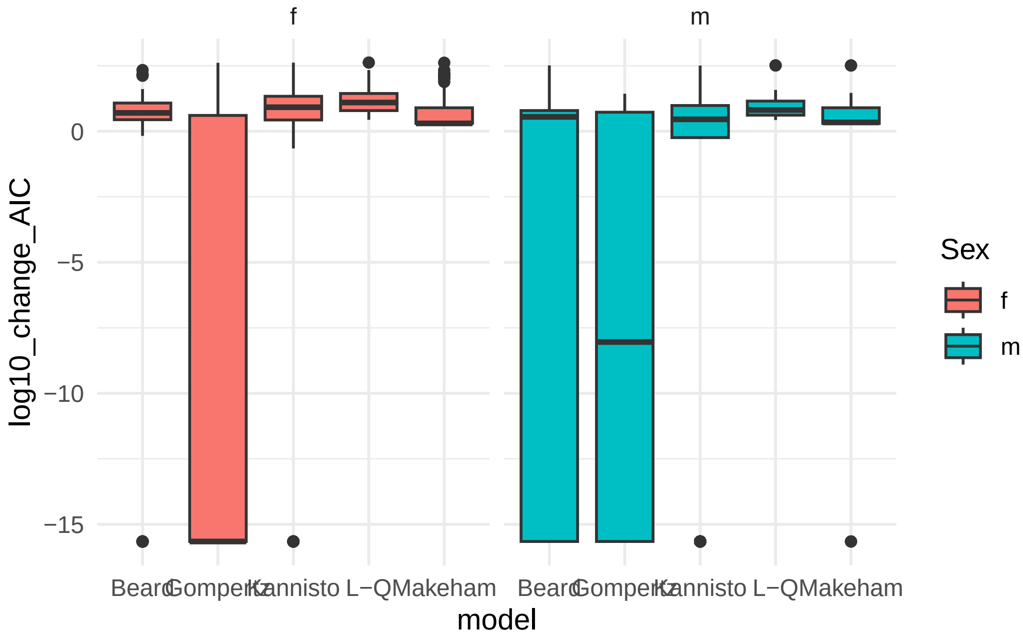
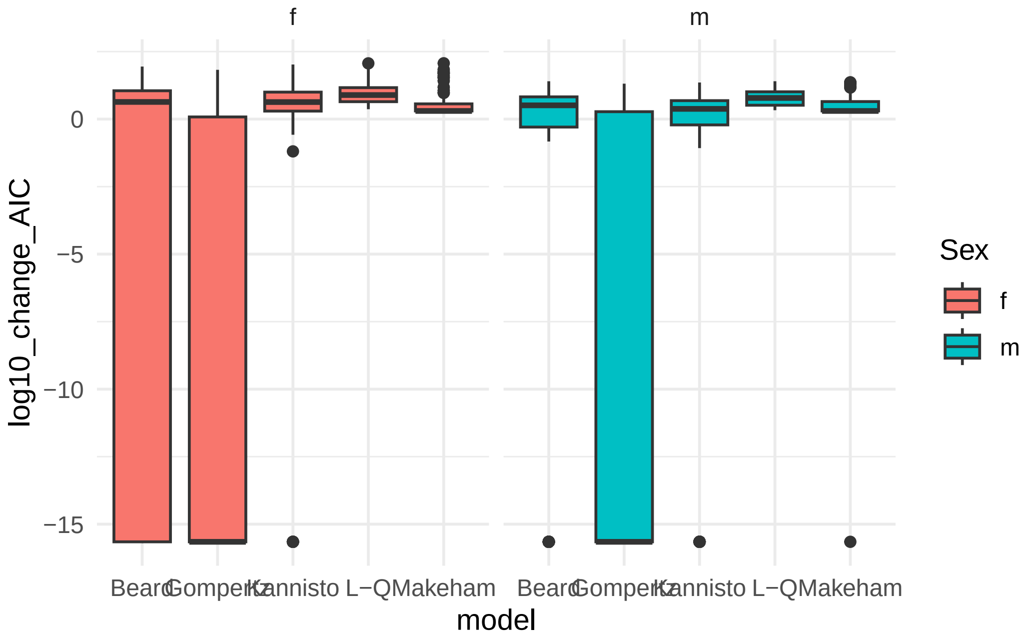
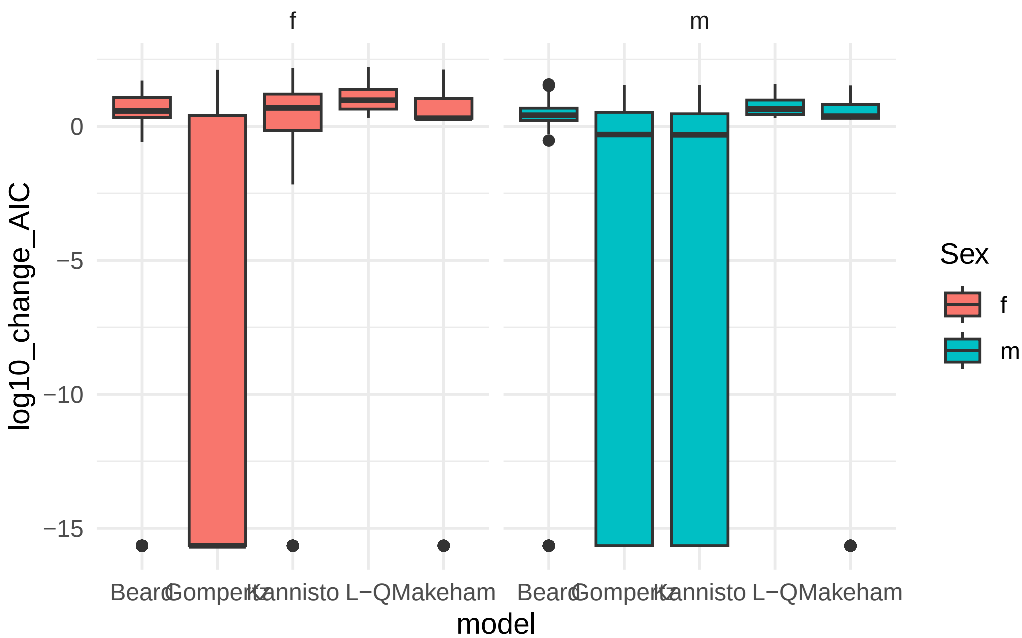


Figure 3: Logarithm of the difference in AIC between the best performing model for each cohort and the model in question for Swedish cohorts. Each model's boxplot represents the distribution of ΔAIC across all Swedish cohorts. Lower values of $log_{10}(\Delta)$AIC imply a better fit.

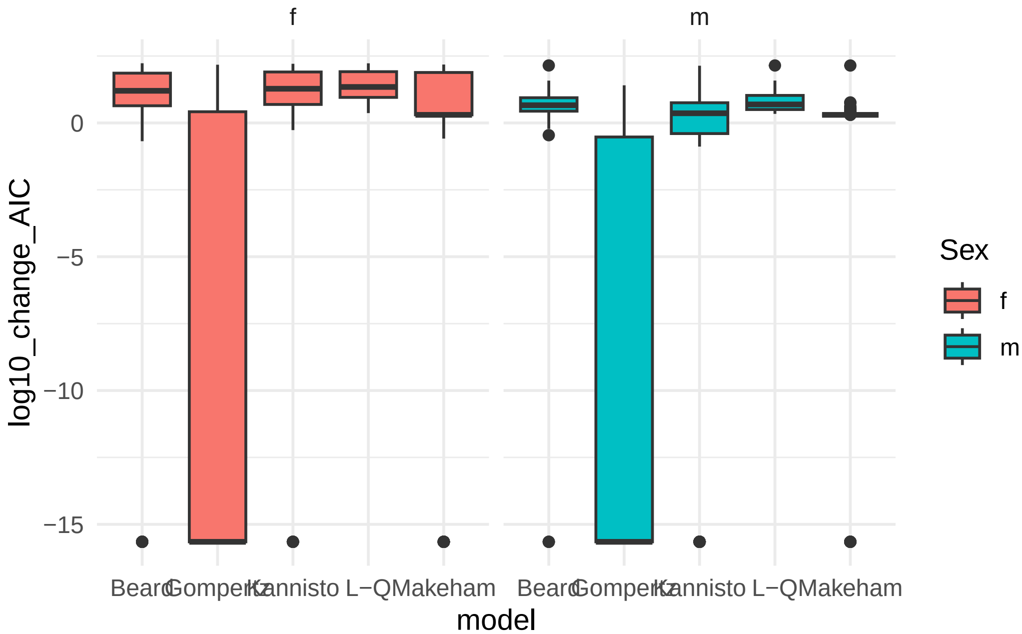
Denmark AIC Results



Finland AIC Results



Norway AIC Results



Pooled Results for Scandinavia

Don't have this yet.

France AIC Results

Discussion and Conclusion

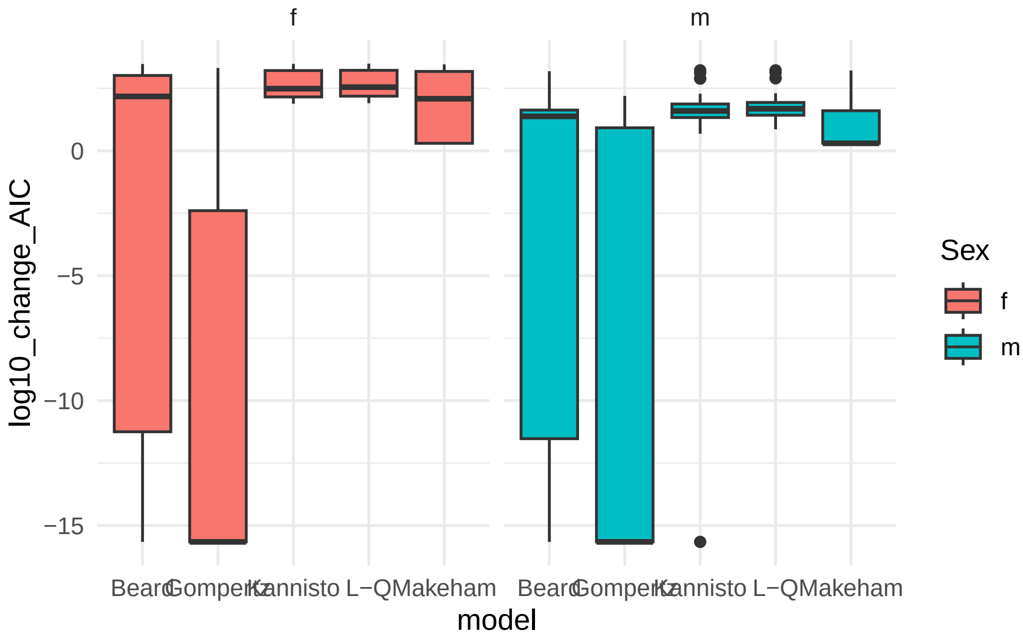


Figure 4: Logarithm of the difference in AIC between the best performing model for each cohort and the model in question for French cohorts. Each model's boxplot represents the distribution of ΔAIC across all French cohorts. Lower values of $log_{10}(\Delta)$AIC imply a better fit.