- For child and old age component, spline coefficients are given the usual 2nd order penalties + shrinkage towards 0 around the LQ derived priors

- For the hump component, as discussed last week, want:

  - want smooth trends defined by 2nd order differences

  - does not want the linear trend to continue in periods without sufficient data

  - want extrapolation of the parameters into periods without data to converge approximately at the current levels

  - did not use an AR process in the end, but an ARIMA(1,1,0), below is my thought process

  $\hookrightarrow$ the 2nd order smoothness penalty implies

  $$\begin{aligned} \beta_{t+1} &= 2\beta_t - \beta_{t-1} + \varepsilon_{t+1} \\ &= \beta_t + \underbrace{(\beta_t - \beta_{t-1})}_{\text{continuation of the trend}} + \varepsilon_{t+1} \end{aligned}$$

  introduce $\rho \in (0,1)$ such that $\beta_{t+1} = \beta_t + \rho(\beta_t - \beta_{t-1}) + \varepsilon_{t+1}$, i.e. the next beta does not continue the current trend entirely

    - when $\rho \to 0$, a RW1 is obtained, so future coefficients maintain the current level (flat line)
    - when $\rho \to 1$, a RW2 is obtained, so future coefficients maintain the current trend (linear line)
    - varying $\rho \in (0,1)$ maintains a trade of between smoothness in the linear trend sense and staying approximately at the current level
    - I think this is equivalent to having $\lambda_1(\boldsymbol{D_1' D_1}) + \lambda_2(\boldsymbol{D_2' D_2})$ as penalty, where $\boldsymbol{D_i}$ is the i-th order difference matrix, based on previous work on the ICAR representation of the spline coefficients
    - this suggests using an ARIMA(1,1,0) on the coefficients with ρ restricted to be in (0,1), but in practice I used $\rho \in (-1, 1)$ to be consistent with time-series, might not be logical in the smoothing penalty sense? Should I restrict them to be in $(0, 1)$?

  - will change smoothness priors on gx to be 2nd order diff

  - flatter priors on smoothness penalties?

  - male B under-smoothed

  - will set males and females lambda to be the same

  - investigating how to set informative priors on the smoothness penalties, as these are difficult to elicit due to the dependency on knot spacing, number of basis, design matrix etc.

  - converged for most countries, except for Gambia (outder mgc exploding), Lesotho (only converged when ρ restricted to (0,1)), etc.