??
Y_t
$\Delta Y(t)$
$W(t)$
$S(t)$
O_i i
$F_i(t)$ i
$N_j(t)$ i
$N'_i(t)$ i
$Q_i(t)$ i
R
Why do we build the population growth model?
Why do we divide each language into different country?
Why do we divide each language into two parts(L1 country, L2 country)?

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{n} \alpha_i \Delta Y_{i-1} + \mu_i$$

α_0
α_i
μ_i

$$Y_t = Y_{t-1} + \Delta Y_t \tag{1}$$

Y_t
ΔY_{t-1}
$\{\Delta Y_t\}$
$Y = (1-\beta-\lambda)Y_t$

β
λ
n

$$\begin{cases} F_1 = a_{11}X_1 + a_{12}X_2 + a_{13}X_3 + a_{14}X_4 \\ F_2 = a_{21}X_1 + a_{22}X_2 + a_{23}X_3 + a_{24}X_4 \\ F_3 = a_{31}X_1 + a_{32}X_2 + a_{33}X_3 + a_{34}X_4 \\ F_4 = a_{41}X_1 + a_{42}X_2 + a_{43}X_3 + a_{44}X_4 \\ F_5 = a_{51}X_1 + a_{52}X_2 + a_{53}X_3 + a_{54}X_4 \end{cases}$$

$$S(t) = Y(t) + W(t)$$

??
??
??
β
λ
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Input C++