Projection model equations

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| **Description** | **Variable or equation** | **Step** |
| Start populations |  | (18.1) |
| Initial populations at risk |  | (18.2) |
| The fertility and nativity model for births |  | (18.3) |
| Mixing: assigning ethnicity to the new-born |  | (18.4) |
| Mortality model: when x <90 |  | (18.5) |
| Mortality model: when x >= 90 |  | (18.6) |
| Subtraction of special population stocks (prisoners and armed forces) |  | (18.7) |
| Emigration option (1) Exogenous projected emigration flows |  | (18.8) |
| Emigration option (2) Emigration (transmission) rates × Populations at Risk |  | (18.9) |
| Emigration option (3) Emigration (admission) rates × Populations at Risk in the Rest of the World |  | (18.10) |
| Internal out-migration option (1) Multi-regional equation with constant or trended transition rates | (t) | (18.11) |
| Internal out-migration option (2) Adjustment of migration flow to destination shares of populations |  | (18.12) |
| Internal out-migration option (3) Gravity model based on origin, destination and impedance factors |  | (18.13) |
| Total internal out-migrations are the sum of projected migration out-flows |  | (18.14) |
| Residual balances |  | (18.15) |
| Total internal in-migrations are the sum of projected migration in-flows |  | (18.16) |
| Immigration option (1)Externally generated projected immigration flows |  | (18.17) |
| Immigration option (2)Immigration (transmission) rates × Population at Risk in Rest of the World |  | (18.18) |
| Immigration option (3)Immigration (admission) rates × Population at Risk |  | (18.19) |
| Addition of prisoners and armed forces |  | (18.20) |
| Final populations |  | (18.21) |
| Populations at risk, convergence test |  | (18.22) |
| Ethnic switching |  | (18.23) |
| Ageing on |  | (24) |

Variable description

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| **Variable** | **Description** |
| *Stocks* | *Counts of people* |
| *PS* | Start Population in a time interval (count) |
| *PF* | Final Population in a time interval (count) |
| *A* | Armed Forces population |
| *C* | Prisoners |
| *Flows* | *Movements from one state to another* |
| *B* | Births |
| *D* | Deaths |
| *E* | Emigrations (international migration from UK to Rest of the World) |
| *M* | Migrations (internal to the country) |
| *Mij* | Migration from LAD i (origin) to LAD j (destination) |
| *Mi+* | Total out-migrations from LAD i = Σj≠iMij |
| *R* | Residual (balances) |
| *M+i* | Total in-migrations to LAD i = Σj≠iMji |
| *I* | Immigrations (international migration to the UK from the Rest of the World) |
| *Intensities* | *Either probabilities or occurrence-exposure rates* |
| *f* | Fertility rates (occurrence exposure rates) for period-ages |
| *d* | Death rates (occurrence-exposure rates) for period-cohorts |
| *m* | Internal migration (transmission) rates |
| *eo* | Emigration (transmission) rates |
| *ea* | Emigration (admission) rates |
| *io* | Immigration (transmission) rates |
| *ia* | Immigration (admission) rates |
| *v* | Sex proportion at birth |
| *b* | Mixing probabilities of the ethnicity of a new-born given the ethnicity of mother |
| *s* | Switching probabilities of a new ethnicity a new ethnicity given ethnicity at a prior census |
| *Indexes* | *Subscripts or superscripts* |
| *x* | Age index (used for period-ages and period-cohorts) |
| *b* | Age index referring |
| *g* | Gender (or sex) index |
| *e* | Ethnic group |
| *n* | Nativity group (birth place) |
| *i* | Zone index for zone of interest (origin) |
| *j* | Zone index for zone of interest (destination) |
| *z* | Zone index for the last zone in the system |
| *u(i)* | Zone index for rest of the UK |
| *w(u)* | Zone index for rest of world or rest of world region |
| *o* | Transmission rate = migration/origin population |
| *a* | Admission rate = migration/destination population |
| *t* | Stocks: a point in time; Flows: an interval in time from t to t+1 |
| *O* | Stocks: indicates removal (out) |
| *I* | Stocks: indicates addition (in) |