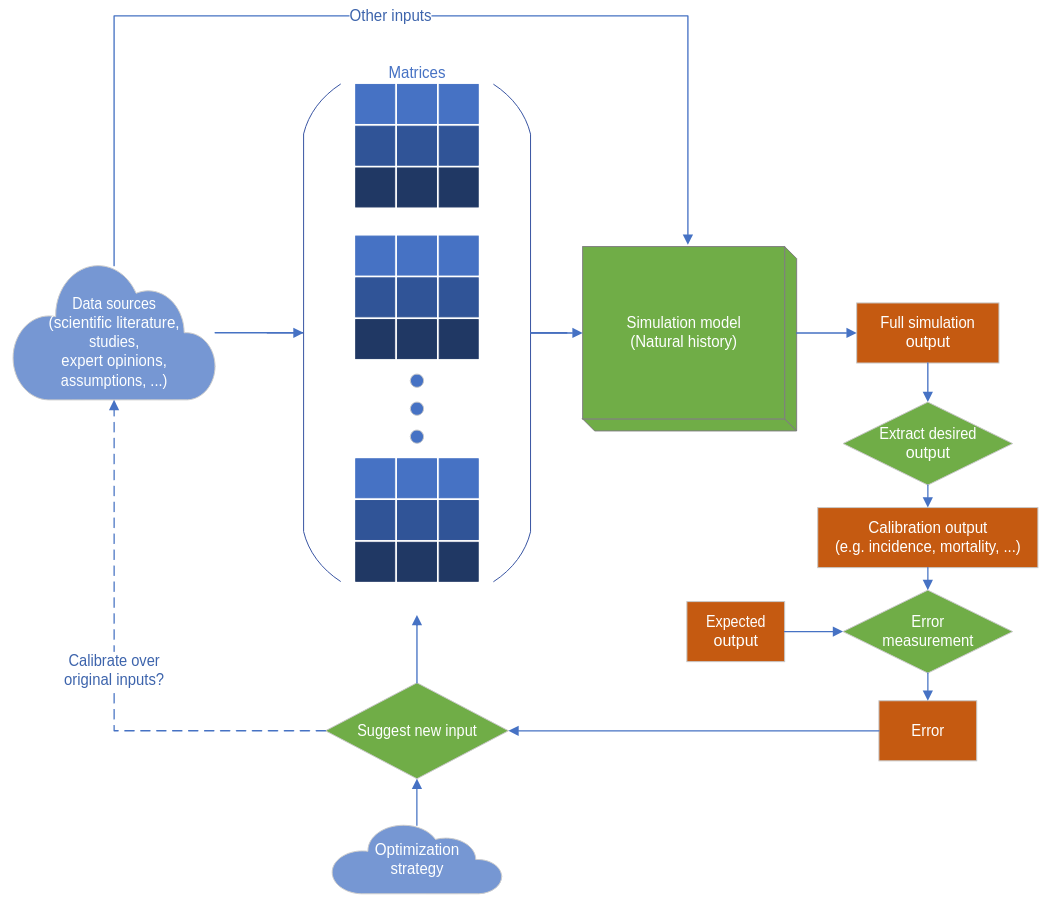
Calibration of cost-effectiveness models

# Overall workflow



# Test model: Lung cancer (LC)

* Total of 9 matrices (one per age group: 35-39, 40-44, …, 75-79).
* 7 health states: healthy, stages I-II, stage IIIa, stage IIIb, LC survival, death from LC, death from other causes → 7x7 matrices. Sometimes the LC survival state is excluded from the calibration resulting in 6x6 matrices.
* Matrices represent monthly steps in the simulation. Since they are applied for 5-year groups, each matrix is used in 5 \* 12 = 60 iterations in the model.
* A **simplified calibration** can be performed without running the model, only the matrices are used. This is a fast approximation since we are not considering some factors of the full model (e.g. prevalence of smoking):
* LC survival state is excluded → 6x6 matrices
* From the 6x6=36 probabilities per matrix, only 11 probabilities are allowed to change. The rest are either constant (zeroes, ones) or one minus the sum of the rest of the row.
* The error measurement is a weighted sum of the absolute differences of the LC incidence, LC mortality and mortality from other causes. The weights are 0.45, 0.45 and 0.10 respectively.

## Test #1: Simplified lung model calibration using only first matrix

* Source file: *models/lung/calibration\_wrapper.R* (N\_MATRICES set to 1)
* Only the first age group is being calibrated (35-39): 1x11 = **11 parameters**.
* Results:

|  |  |  |
| --- | --- | --- |
| **Algorithm** | **Nelder-Mead** | **Bayesian Optimization** |
| **Best solution** | [1.11792560e-06  4.40025000e-05  2.85500424e-02  5.58688151e-01  2.33054382e-02  2.56198878e-06  6.26189872e-02  2.35346590e-02  1.89438555e-06  2.33023545e-02  1.84300020e-06] | [1.11743209e-06  4.40025000e-05  3.49317322e-02  3.52614061e-01  2.33019105e-02  2.16691398e-06  9.78486120e-02  2.33015791e-02  2.81935900e-06  2.33023544e-02  1.69119083e-06] |
| **Error** | 0.6633085653748201 | 0.6629851533965986 |
| **Time (s)** | 0.7594297569958144 | 114.89221513200027 |
| **Model evaluations** | 252 | 21 |

## Test #2: Simplified lung model calibration using first and second matrices

* Source file: *models/lung/calibration\_wrapper.R* (N\_MATRICES set to 2)
* The first and second age groups are being calibrated (35-39 and 40-44): 2x11 = **22 parameters**.
* Results:

|  |  |  |
| --- | --- | --- |
| **Algorithm** | **Nelder-Mead** | **Bayesian Optimization** |
| **Best solution** | [1.11772134e-06  4.42306248e-05  2.85017410e-02  3.45979312e-01  2.33460108e-02  2.57661105e-06  1.02035604e-01  3.28843601e-02  2.83664387e-06  2.33070955e-02  1.44304635e-06  7.87229723e-06  7.22628698e-05  1.36209733e-02  3.68460579e-01  2.95497778e-02  1.71769333e-06  6.01628601e-02  3.01599686e-02  2.48081674e-06  2.36671750e-02  1.08325532e-06] | [1.11743209e-06  4.40025000e-05  3.29773169e-02  5.01644723e-01  2.33019105e-02  2.37534043e-06  1.04074200e-01  2.33015791e-02  2.95611906e-06  2.33023544e-02  1.77700528e-06  7.86577500e-06  7.22100000e-05  1.76876690e-02  4.21488733e-01  3.07201770e-02  1.69078343e-06  6.25333450e-02  3.88364300e-02  1.95655409e-06  2.33027557e-02  8.71881206e-07] |
| **Error** | 0.7333381543348456 | 0.7287116136105645 |
| **Time (s)** | 4.444447371002752 | 421.6934125780026 |
| **Model evaluations** | 2092 | 70 |

## Test #3: Simplified lung model calibration using all matrices

* Source file: *models/lung/calibration\_wrapper.R* (N\_MATRICES set to 9)
* All age groups are being calibrated: 9x11 = **99 parameters**.
* Standard bayesian optimization takes too much time and the process was aborted before completion. Other strategies could be attempted: calibrate matrices sequentially, restrict number of parameters, optimize gaussian process regression (see phd\_proposal.docx), ...
* Results:

|  |  |  |
| --- | --- | --- |
| **Algorithm** | **Nelder-Mead** | **Bayesian Optimization** |
| **Best solution** | \* | <Aborted due to excessive computation time> |
| **Error** | 4.021066119701601 | - |
| **Time (s)** | 57.58928211599414 | - |
| **Model evaluations** | 19800 | - |