# S1 Algorithms

In this appendix, the following notation is used:

| | |
|---|---|
| $\mathrm{N}_{\mathrm{population}}$: | number of individuals in population model (10,000 in this study); |
| $\mathrm{N}_{\mathrm{subgroups}}$: | number of individuals in each population subgroup (5,000 in this study); |
| $\mathrm{N}_{\mathrm{unc}}$: | number of uncertainty iterations (1,000 and 500 for the population model and the subgroups model, respectively); |
| ML: | men of low body weight; |
| MM: | men of medium body weight; |
| MH: | men of high body weight; |
| WL: | women of low body weight; |
| WM: | women of medium body weight; |
| WH: | women of high body weight. |

**Algorithm 1** Population exposure simulation

```
for each individual i ∈ {1, ..., N_population} do
    generate a r.v. s_i for the sex of individual i
    generate a r.v. a_i for the age of individual i
    estimate the weight w_i of individual i
    assign individual i to a weight class c
    generate a r.v. B_i for the barbecuing scenario of individual i
    for each event b ∈ {1, ..., B_i} do
        generate a r.v. t_ib for the total meat consumption, given the class c of the individual i
        generate a r.v. K_ib for the total number of consumed meat types
        for each meat type k ∈ {1, ..., K_ib} do
            generate a r.v. m_ibk for the consumed meat type k
            generate a r.v. v_ibk for the fractions of consumed meat type m_ibk
            calculate the ammount x_ibk of consumed meat type m_ibk, i.e. x_ibk = t_ib · v_ibk
            generate a r.v. c_ibk for the BaP concentration in the consumed meat type m_ibk
        end for
    end for
    calculate the BaP exposure y_i, i.e. y_i = (1/w_i) Σ_{b=1}^{B_i} Σ_{k=1}^{K_ib} x_ikb · c_ibk
end for
```

**Algorithm 2** Population cancer risk simulation

**for** each individual $i \in \{1, \ldots, \mathrm{N}_{\mathrm{population}}\}$ **do**
  generate a uniform r.v. $U_i$
**end for**
**for** each event $n \in \{1, \ldots, \mathrm{N}_{\mathrm{unc}}\}$ **do**
  generate a r.v. $\mathrm{AP}^{(n)}$
  calculate $\mathrm{CF}^{(n)}_{\mathrm{inter,allometric}}$
  generate a r.v. $\mathrm{CF}^{(n)}_{\mathrm{inter,TKTD}}$
  generate a r.v. $\mathrm{GSD}^{(n)}_{\mathrm{CF_{intra}}}$
  generate a bivariate r.v. $(b^{(n)}, c^{(n)})$
  **for** each individual $i \in \{1, \ldots, \mathrm{N}_{\mathrm{population}}\}$ **do**
    calculate $\mathrm{CF}^{(n)}_{\mathrm{intra},i}$ using the inverse transformation method, i.e.

$$\mathrm{CF}^{(n)}_{\mathrm{intra},i} = \exp\left(\ln\left(\mathrm{GM}_{\mathrm{CF_{intra}}}\right) + \ln\left(\mathrm{GSD}_{\mathrm{CF_{intra}}}\right) \cdot \sqrt{21/\mathrm{GSD}^{(n)}_{\mathrm{CF_{intra}}}} \cdot \Phi^{-1}\left(U_i\right)\right)$$

    calculate the animal exposure $\exp^{(n)}_{\mathrm{animal},i}$, i.e.

$$\exp^{(n)}_{\mathrm{animal},i} = y_i \cdot \mathrm{CF}^{(n)}_{\mathrm{intra},i} \cdot \mathrm{CF}^{(n)}_{\mathrm{inter,allometric}} \cdot \mathrm{CF}^{(n)}_{\mathrm{inter,TKTD}}$$

    calculate the extra lifetime risk $\mathrm{ER}^{(n)}_{\mathrm{BaP},i}$, i.e.

$$\mathrm{ER}^{(n)}_{\mathrm{BaP},i} = 1 - \exp\left(\left(\frac{\exp^{(n)}_{\mathrm{animal},i}}{b}\right) - c\left(\frac{\exp^{(n)}_{\mathrm{animal},i}}{b}\right)^2\right)$$

  **end for**
**end for**

**Algorithm 3** Subgroup exposure simulation

```
for each class c ∈ {ML,MM,MH,WL,WM,WH} do
    for each individual i ∈ {1, ..., N_subgroups} do
        for each event b ∈ {1, ..., N_bbq} do
            generate a r.v. t_ib(c) for the total meat consumption
            generate a r.v. K_ib(c) for the total number of consumed meat types
            for each meat type k ∈ {1, ..., K_ib(c)} do
                generate a r.v. m_ibk(c) for the consumed meat type
                generate a r.v. v_ibk(c) for the fractions of consumed meat type m_ibk(c)
                calculate the ammount x_ibk(c) of consumed meat type m_ibk(c), i.e. x_ibk(c) = t_ib(c) · v_ibk(c)
                generate a r.v. c_ibk(c) for the BaP concentration in the consumed meat type m_ibk(c)
            end for
            calculate the BaP intake y_ib(c), i.e. y_ib(c) = Σ_{k=1}^{K_ib(c)} x_ibk(c) · c_ibk(c) at event b
        end for
        for each event B_i(c) ∈ {1, ..., N_bbq} do
            calculate the BaP exposure y_i(c, B), i.e. y_i(c, B) = (1/w(c)) Σ_{b=1}^{B_i(c)} y_ib(c), where w(c) is the
median bodyweight of class c
        end for
    end for
end for
```

**Algorithm 4** Subgroup cancer risk simulation

**for** each class $c \in \{\text{ML,MM,MH,WL,WM,WH}\}$ **do**
  **for** each individual $i \in \{1, \ldots, \mathrm{N}_{\text{subgroups}}\}$ **do**
    generate a uniform r.v. $U_i(c)$
  **end for**
**end for**
**for** each event $n \in \{1, \ldots, \mathrm{N}_{\text{unc}}\}$ **do**
  generate a r.v. $\mathrm{AP}^{(n)}$
  generate a r.v. $\mathrm{CF}^{(n)}_{\text{inter,TKTD}}$
  generate a r.v. $\mathrm{GSD}^{(n)}_{\mathrm{CF}_{\text{intra}}}$
  generate a bivariate r.v. $(b^n, c^n)$
  **for** each class $c \in \{\text{ML,MM,MH,WL,WM,WH}\}$ **do**
    calculate $\mathrm{CF}^{(n)}_{\text{inter,allometric}}(c)$
    **for** each individual $i \in \{1, \ldots, \mathrm{N}_{\text{subgroups}}\}$ **do**
      calculate $\mathrm{CF}^{(n)}_{\text{intra},i}(c)$ using the inverse transformation method, i.e.

$$\mathrm{CF}^{(n)}_{\text{intra},i}(c) = \exp\left(\ln\left(\mathrm{GM}_{\mathrm{CF}_{\text{intra}}}\right) + \ln\left(\mathrm{GSD}_{\mathrm{CF}_{\text{intra}}}\right) \cdot \sqrt{21/\mathrm{GSD}^{(n)}_{\mathrm{CF}_{\text{intra}}}} \cdot \Phi^{-1}\left(U_i(c)\right)\right)$$

      **for** each event $B \in \{1, \ldots, \mathrm{N}_{\text{bbq}}\}$ **do**
        calculate the animal exposure $\exp^{(n)}_{\text{animal},i}(c, B)$, i.e.

$$\exp^{(n)}_{\text{animal},i}(c, B) = y_i(c, B) \cdot \mathrm{CF}^{(n)}_{\text{intra},i}(c) \cdot \mathrm{CF}^{(n)}_{\text{inter,allometric}}(c) \cdot \mathrm{CF}^{(n)}_{\text{inter,TKTD}}$$

        calculate the extra lifetime risk $\mathrm{ER}^{(n)}_{\mathrm{BaP},i}(c, B)$, i.e.

$$\mathrm{ER}^{(n)}_{\mathrm{BaP},i}(c, B) = 1 - \exp\left(\left(\frac{\exp^{(n)}_{\text{animal},i}(c, B)}{b}\right) - c\left(\frac{\exp^{(n)}_{\text{animal},i}(c, B)}{b}\right)^2\right)$$

      **end for**
    **end for**
  **end for**
**end for**