### Methods and Formulas

Let $x_i, i = 1, \ldots, k$, denote the variables over which $\alpha$ is to be calculated. If no weights are specified, calculations are done as described in [R] $\alpha$. If weights are specified, the average correlation $\bar{r}$, average covariance $\bar{c}$, and average variance $\bar{v}$ are calculated as

\[
\bar{r} = \frac{\sum_{i=2}^{k} \sum_{j=1}^{i-1} s_is_j W_{ij} r_{ij}}{\sum_{i=2}^{k} \sum_{j=1}^{i-1} W_{ij}}, \quad \bar{c} = \frac{\sum_{i=2}^{k} \sum_{j=1}^{i-1} s_is_j W_{ij} c_{ij}}{\sum_{i=2}^{k} \sum_{j=1}^{i-1} W_{ij}}, \quad \text{and} \quad \bar{v} = \frac{\sum_{i=1}^{k} W_{ii} c_{ii}}{\sum_{i=1}^{k} W_{ii}}
\]

where $r_{ij}$ and $c_{ij}$ are the correlation and covariance between $x_i$ and $x_j$, $c_{ii}$ is the variance of $x_i$, $s_i$ is the sign with which $x_i$ enters the scale, and $W_{ij}$ and $W_{ii}$ are the sum of weights over the observations used to calculate $r_{ij}$ and $c_{ij}$ (the difference to the standard formulas is the usage of the sum of weights $W$ instead of the number of observations $n$; note: if option casewise is specified then $W_{ij} = W_{ii}$ for all $i, j$).

Additionally, the calculation of $r_{ij}$, $c_{ij}$, and $c_{ii}$ is different from the standard case. Let $l = 1, \ldots, n$ be an indicator for the observations of $x_i$ and $w_l$ be the weights. In the case of frequency weights (fweights) the variance $c_{ii}$ and covariance $c_{ij}$ are calculated as

\[
c_{ii} = \frac{1}{W_{ii} - n_{ii}} \sum_{l=1}^{n_{ii}} w_l (x_{il} - \bar{x}_i)^2 \quad \text{and} \quad c_{ij} = \frac{1}{W_{ij} - n_{ij}} \sum_{l=1}^{n_{ij}} w_l (x_{il} - \bar{x}_i)(x_{jl} - \bar{x}_j)
\]

and in the case of analytical weights (aweights) as

\[
c_{ii} = \frac{1}{W_{ii} - n_{ii}} \sum_{l=1}^{n_{ii}} w_l (x_{il} - \bar{x}_i)^2 \quad \text{and} \quad c_{ij} = \frac{1}{W_{ij} - n_{ij}} \sum_{l=1}^{n_{ij}} w_l (x_{il} - \bar{x}_i)(x_{jl} - \bar{x}_j)
\]

where $\bar{x}_i$ is the weighted mean of $x_i$, i.e. $\bar{x}_i = \frac{1}{W_{ii}} \sum_{l=1}^{n_{ii}} w_l x_{il}$ in the case of the variance and $\bar{x}_i = \frac{1}{W_{ij}} \sum_{l=1}^{n_{ij}} w_l x_{il}$ in the case of the covariance. The calculation of $r_{ij}$ is

\[
r_{ij} = \frac{\sum_{l=1}^{n_{ij}} w_l (x_{il} - \bar{x}_i)(x_{jl} - \bar{x}_j)}{\sqrt{\sum_{l=1}^{n_{ij}} w_l (x_{il} - \bar{x}_i)^2 \sum_{l=1}^{n_{ij}} w_l (x_{jl} - \bar{x}_j)^2}}
\]