The Estimated Annual Percent Change methodology

The Estimated Annual Percent Change (EAPC) of rates during a time period:

The EAPC is calculated using a Generalized Linear Model (GLM) considering a Gaussian distribution for the Age-Standardized Rate (ASR). Under the assumption of linearity on the log scale, which is equivalent to a constant change assumption, the EAPC is calculated (1).

Let us consider:

ASR_t = The Age Standardized Rate for a set of years, where t = 0,1,…n.

The GLM assumes that the expected value of the response is related to the time by a logarithm expression:

$$\log\left(E\left[ASR_t\right]\right) = \gamma + \beta \cdot t + \varepsilon$$

With the estimated parameters it provides that:

$$\log\left(\hat{E}\left[ASR_t\right]\right) = \hat{\gamma} + \hat{\beta} \cdot t \Leftrightarrow \hat{E}\left[ASR_t\right] = e^{\hat{\gamma}+\hat{\beta}\cdot t}$$

So, the EAPC is calculated as:

$$EAPC = \left(\frac{A\hat{S}R_{t+1} - A\hat{S}R_t}{A\hat{S}R_t} \right) \cdot 100 = \left(\frac{A\hat{S}R_{t+1}}{A\hat{S}R_t} - 1 \right) \cdot 100 = \left(\frac{e^{\hat{\gamma}+\hat{\beta}(t+1)}}{e^{\hat{\gamma}+\hat{\beta}(t)}} - 1 \right) \cdot 100 = \left(e^{\hat{\beta}} - 1 \right) \cdot 100$$

$$\downarrow$$

$$\begin{cases} A\hat{S}R_{t+1} = \hat{E}\left[ASR_{t-1}\right] = e^{\hat{\gamma}+\hat{\beta}\cdot(t+1)} \\ A\hat{S}R_t = e^{\hat{\gamma}+\hat{\beta}\cdot t} \end{cases}$$

The Confidence Interval of the EAPC:

The confidence interval of EAPC is calculated as:

$$CI(\alpha\ \%) = \beta \pm \left(Z_{\frac{1-\alpha}{2}} \right) \cdot S_{\hat{\beta}}$$

Where:

α= Confidence level.

$S_{\hat{\beta}}$ = The standard error of $\hat{\beta}$.

It only remains to undo the logarithm.

Reference

(1) Esteve J, Benhamou E, Raymond L. Statistical methods in cancer research. Volume IV. Descriptive epidemiology. *IARC Sci Publ* 1994;(128):1-302.