Predict *Prostate* Mathematics

Summary

• Predict takes the form of a competing risk Cox survival model, with fractional polynomial baseline cumulative hazards.
• Approximate intervals for the benefits of treatment can be obtained from the treatment-effects uncertainties.

The form of the Predict Prostate V1.1 algorithm

The estimated baseline cumulative hazard for prostate cancer mortality H_{pc} at t days post-diagnosis has the form:

$$H_{pc}(t) = \exp[a_c' f(t)]$$

where a_c is a vector of estimated coefficients, and f a (column) vector of fractional polynomial functions of time post-diagnosis.

In Predict Prostate 1.1,

$$H_{pc}(t) = \exp[-16.40532 + 1.653947*(\log(t)) + (1.89x(10^{(-12)}))*(t^3))]$$

The estimated survival function for prostate cancer mortality S_{pc} given prostate cancer risk factors χ_{RP} and the i treatment option χ_i is given by

$$S_{pc}^{i}(t) = \exp[-H_{pc}(t)] \exp[b' \chi_{RP} + c' \chi_i]$$

where b and c vectors of estimated coefficients. This is the chance of living beyond t days after diagnosis, assuming only prostate cancer mortality.

The estimated baseline cumulative hazard for other-cause mortality H_o has the form

$$H_o(t) = \exp[a_o' g(t)]$$

where a_o is a vector of estimated coefficients, and g a vector of fractional polynomial functions of time post diagnosis. This is the chance of living beyond t days after diagnosis, assuming only other-cause mortality.

The estimated survival function for non-prostate cancer (other) mortality S_o, is given by

$$S_o(t) = \exp[-H_o(t) \exp[b_o' \chi_{Ro}]]$$

where b_o is a vector of estimated coefficients, and other cause risk factors is given by χ_{Ro}

In Predict Prostate 1.1, the parameters given by

$$H_o(t) = \exp[-12.4841 + 1.32274*(\log(t)) + 2.90x(10^{(-12)}))* (t^3))]$$

$S_o(t)$ is the yellow 'dashed' line in the graphs - the survival of men who are assumed not to die of prostate cancer, essentially who are 'cured'.

The overall estimated survival function $S(t)$, assuming independent competing risks and treatment regime i is given by

$$S^i(t) = S_o(t)S_{pc}{}^i(t)$$

which is the estimated chance of living beyond time t. This is a competing risk Cox survival model.

Overall survival with conservative management or 'no treatment' ($i = 0$) is then

$$S^0(t) = S_o(t)S_{pc}{}^0(t)$$

The overall survival benefit of radical treatment ($i = 1$) at time t is then given by

$$S^1(t) - S^0(t) = S_o(t)(S_{pc}{}^1(t) - S_{pc}{}^0(t))$$

which is the benefit in prostate cancer specific survival $S_{pc}{}^1(t) - S_{pc}{}^0(t)$, scaled by the probability of surviving other risks $S_o(t)$.