

# Equations for the rstpm2 package

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## 1 Generalised survival model

```
logexpand:all;
derivsubst:true;
load(pdifff)$
assume(t>0)$
S : S0(t)*G(eta(t,z,theta));
H : -log(S);
h : diff(H,t);
print("H:");
tex(H);
print("h:");
tex(h);

print("diff(H,theta):");
```

```

tex(diff(H,theta));

print("diff(log(h),theta):");
tex(diff(log(h),theta));

print("ll:");
ll : delta*log(h) - H - diff(eta(t,z,beta),t)^2;
tex(ll);
print("diff(ll, beta)");
tex(diff(ll, beta));

```

H:

$$-\log G(\eta(t, z, \vartheta)) - \log S_0(t)$$

h:

$$-\frac{\eta_{(1,0,0)}(t, z, \vartheta) G_{(1)}(\eta(t, z, \vartheta))}{G(\eta(t, z, \vartheta))} - \frac{S_{0(1)}(t)}{S_0(t)}$$

diff(H,theta):

$$-\frac{\eta_{(0,0,1)}(t, z, \vartheta) G_{(1)}(\eta(t, z, \vartheta))}{G(\eta(t, z, \vartheta))}$$

diff(log(h),theta):

$$\frac{-\frac{\eta_{(0,0,1)}(t, z, \vartheta) \eta_{(1,0,0)}(t, z, \vartheta) G_{(2)}(\eta(t, z, \vartheta))}{G(\eta(t, z, \vartheta))} + \frac{\eta_{(0,0,1)}(t, z, \vartheta) \eta_{(1,0,0)}(t, z, \vartheta) G_{(1)}(\eta(t, z, \vartheta))^2}{G(\eta(t, z, \vartheta))^2} - \frac{\eta_{(1,0,1)}(t, z, \vartheta) G_{(1)}(\eta(t, z, \vartheta))}{G(\eta(t, z, \vartheta))}}{-\frac{\eta_{(1,0,0)}(t, z, \vartheta) G_{(1)}(\eta(t, z, \vartheta))}{G(\eta(t, z, \vartheta))} - \frac{S_{0(1)}(t)}{S_0(t)}}$$

ll:

$$\delta \log \left( -\frac{\eta_{(1,0,0)}(t, z, \vartheta) G_{(1)}(\eta(t, z, \vartheta))}{G(\eta(t, z, \vartheta))} - \frac{S_{0(1)}(t)}{S_0(t)} \right) + \log G(\eta(t, z, \vartheta)) + \log S_0(t) - \eta_{(1,0,0)}(t, z, \beta)^2$$

diff(ll, beta)

$$-2 \eta_{(1,0,0)}(t, z, \beta) \eta_{(1,0,1)}(t, z, \beta)$$

## 2 Mixture cure models

```

logexpand:all;
derivsubst:true;
load(pdifff)$
S : S0(t)*(pi(theta)+(1-pi(theta))*exp(-Hu(t,theta)));
H : -log(S);
h : diff(H,t);
h : subst(hu(t,theta), diff(Hu(t,theta),t), h);

```

```

print("H:");
tex(H);
print("h:");
tex(h);

print("diff(H,theta):");
tex(diff(H,theta));

print("diff(log(h),theta):");
tex(diff(log(h),theta));
diff(log(h),theta) - diff(H,theta);

```

H:

$$-\log \left( \pi(\vartheta) + e^{-Hu(t,\vartheta)} (1 - \pi(\vartheta)) \right) - \log S_0(t)$$

h:

$$\frac{e^{-Hu(t,\vartheta)} hu(t,\vartheta) (1 - \pi(\vartheta))}{\pi(\vartheta) + e^{-Hu(t,\vartheta)} (1 - \pi(\vartheta))} - \frac{S_{0(1)}(t)}{S_0(t)}$$

diff(H,theta):

$$-\frac{-e^{-Hu(t,\vartheta)} \pi_{(1)}(\vartheta) + \pi_{(1)}(\vartheta) - e^{-Hu(t,\vartheta)} Hu_{(0,1)}(t,\vartheta) (1 - \pi(\vartheta))}{\pi(\vartheta) + e^{-Hu(t,\vartheta)} (1 - \pi(\vartheta))}$$

diff(log(h),theta):

$$\frac{-\frac{e^{-Hu(t,\vartheta)} hu(t,\vartheta) (1 - \pi(\vartheta)) (-e^{-Hu(t,\vartheta)} \pi_{(1)}(\vartheta) + \pi_{(1)}(\vartheta) - e^{-Hu(t,\vartheta)} Hu_{(0,1)}(t,\vartheta) (1 - \pi(\vartheta)))}{(\pi(\vartheta) + e^{-Hu(t,\vartheta)} (1 - \pi(\vartheta)))^2} - \frac{e^{-Hu(t,\vartheta)} hu(t,\vartheta) \pi_{(1)}(\vartheta)}{\pi(\vartheta) + e^{-Hu(t,\vartheta)} (1 - \pi(\vartheta))} + \frac{e^{-Hu(t,\vartheta)} hu_{(0,1)}(t,\vartheta) (1 - \pi(\vartheta))}{\pi(\vartheta) + e^{-Hu(t,\vartheta)} (1 - \pi(\vartheta))} - \frac{e^{-Hu(t,\vartheta)} Hu_{(0,1)}(t,\vartheta) hu(t,\vartheta) (1 - \pi(\vartheta))}{\pi(\vartheta) + e^{-Hu(t,\vartheta)} (1 - \pi(\vartheta))}}{\frac{e^{-Hu(t,\vartheta)} hu(t,\vartheta) (1 - \pi(\vartheta))}{\pi(\vartheta) + e^{-Hu(t,\vartheta)} (1 - \pi(\vartheta))} - \frac{S_{0(1)}(t)}{S_0(t)}}$$

### 3 Integral equation for AFT models

```

logexpand:all;
derivsubst:true;
load(pdifff)$
assume(t>0)$
S : exp(-exp(B(log(integrate(exp(-x(v)*beta),v,0,t)),gamma)))));
H : -log(S);
h : diff(H,t);
print("H:");
tex(H);
print("h:");
tex(h);

```

```

print("log(h):");
tex(log(h));

print("diff(H,beta):");
tex(diff(H,beta));
print("diff(H,gamma):");
tex(diff(H,gamma));

print("diff(log(h),beta):");
tex(diff(log(h),beta));
print("diff(log(h),gamma):");
tex(diff(log(h),gamma));

print("l1:");
l1 : delta*log(h) - H - (subst(u=log(integrate(exp(-x(v)*beta),v,0,t)), diff(B(u,gamma),u)))^2;
tex(l1);
print("diff(l1, beta)");
tex(diff(l1, beta));
print("diff(l1, gamma)");
tex(diff(l1, gamma));

```

H:

$$e^{B(\log \int_0^t e^{-\beta x(v)} dv, \gamma)}$$

h:

$$\frac{e^{B(\log \int_0^t e^{-\beta x(v)} dv, \gamma) - \beta x(t)} B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma)}{\int_0^t e^{-\beta x(v)} dv}$$

log(h):

$$\log B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma) + B\left(\log \int_0^t e^{-\beta x(v)} dv, \gamma\right) - \log \int_0^t e^{-\beta x(v)} dv - \beta x(t)$$

diff(H,beta):

$$-\frac{\left(\int_0^t e^{-\beta x(v)} x(v) dv\right) e^{B(\log \int_0^t e^{-\beta x(v)} dv, \gamma)} B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma)}{\int_0^t e^{-\beta x(v)} dv}$$

diff(H,gamma):

$$e^{B(\log \int_0^t e^{-\beta x(v)} dv, \gamma)} B_{(0,1)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma)$$

diff(log(h),beta):

$$-\frac{\left(\int_0^t e^{-\beta x(v)} x(v) dv\right) B_{(2,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma)}{\left(\int_0^t e^{-\beta x(v)} dv\right) B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma)} - \frac{\left(\int_0^t e^{-\beta x(v)} x(v) dv\right) B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma)}{\int_0^t e^{-\beta x(v)} dv} + \frac{\int_0^t e^{-\beta x(v)} x(v) dv}{\int_0^t e^{-\beta x(v)} dv} - x(t)$$

diff(log(h),gamma):

$$\frac{B_{(1,1)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma)}{B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma)} + B_{(0,1)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma)$$

ll:

$$\delta \left( \log B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma) + B \left( \log \int_0^t e^{-\beta x(v)} dv, \gamma \right) - \log \int_0^t e^{-\beta x(v)} dv - \beta x(t) \right) - B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma)^2 - e^{B(\log \int_0^t e^{-\beta x(v)} dv, \gamma)}$$

diff(ll, beta)

$$\delta \left( -\frac{\left( \int_0^t e^{-\beta x(v)} x(v) dv \right) B_{(2,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma)}{\left( \int_0^t e^{-\beta x(v)} dv \right) B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma)} - \frac{\left( \int_0^t e^{-\beta x(v)} x(v) dv \right) B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma)}{\int_0^t e^{-\beta x(v)} dv} + \frac{\int_0^t e^{-\beta x(v)} x(v) dv}{\int_0^t e^{-\beta x(v)} dv} - x(t) \right) + \frac{2 \left( \int_0^t e^{-\beta x(v)} x(v) dv \right)}{\int_0^t e^{-\beta x(v)} dv}$$

diff(ll, gamma)

$$\delta \left( \frac{B_{(1,1)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma)}{B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma)} + B_{(0,1)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma) \right) - 2 B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma) B_{(1,1)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma) - e^{B(\log \int_0^t e^{-\beta x(v)} dv, \gamma)} B_{(0,1)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma)$$

## 4 Integral equation for AFT models with functional constraints on gamma

```
logexpand:all;
derivsubst:true;
load(pdifff)$
assume(t>0)$
gamma : gamma0 + exp(alpha);
S : exp(-exp(B(log(integrate(exp(-x(v)*beta),v,0,t)),gamma))));
H : -log(S);
h : diff(H,t);
print("H:");
tex(H);
print("h:");
tex(h);

print("diff(H,beta):");
tex(diff(H,beta));
print("diff(H,alpha):");
tex(diff(H,alpha));
print("diff(H,gamma0):");
tex(diff(H,gamma0));
```

```

print("diff(log(h),beta):");
tex(diff(log(h),beta));
print("diff(log(h),alpha):");
tex(diff(log(h),alpha));
print("diff(log(h),gamma0):");
tex(diff(log(h),gamma0));

```

H:

$$e^{B(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha)}$$

h:

$$\frac{e^{B(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha) - \beta x(t)} B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha)}{\int_0^t e^{-\beta x(v)} dv}$$

diff(H,beta):

$$-\frac{\left(\int_0^t e^{-\beta x(v)} x(v) dv\right) e^{B(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha)} B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha)}{\int_0^t e^{-\beta x(v)} dv}$$

diff(H,alpha):

$$e^{B(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha) + \alpha} B_{(0,1)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha)$$

diff(H,gamma0):

$$e^{B(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha)} B_{(0,1)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha)$$

diff(log(h),beta):

$$-\frac{\left(\int_0^t e^{-\beta x(v)} x(v) dv\right) B_{(2,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha)}{\left(\int_0^t e^{-\beta x(v)} dv\right) B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha)} - \frac{\left(\int_0^t e^{-\beta x(v)} x(v) dv\right) B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha)}{\int_0^t e^{-\beta x(v)} dv} + \frac{\int_0^t e^{-\beta x(v)} x(v) dv}{\int_0^t e^{-\beta x(v)} dv} - x(t)$$

diff(log(h),alpha):

$$\frac{e^\alpha B_{(1,1)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha)}{B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha)} + e^\alpha B_{(0,1)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha)$$

diff(log(h),gamma0):

$$\frac{B_{(1,1)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha)}{B_{(1,0)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha)} + B_{(0,1)}(\log \int_0^t e^{-\beta x(v)} dv, \gamma_0 + e^\alpha)$$

## 5 Non-integral equation for AFT models

```

logexpand:all;
derivsubst:true;
load(pdifff)$
assume(t>0)$
S : exp(-exp(B(log(t*exp(-eta(X,log(t),beta))),gamma)));
H : -log(S);
h : diff(H,t);
print("H:");
tex(H);
print("h:");
tex(h);
print("log(h):");
tex(log(h));

print("diff(H,beta):");
tex(diff(H,beta));
print("diff(H,gamma):");
tex(diff(H,gamma));

print("diff(log(h),beta):");
tex(diff(log(h),beta));
print("diff(log(h),gamma):");
tex(diff(log(h),gamma));

print("ll:");
ll : delta*log(h) - H - (1-subst(u=log(t), diff(eta(X,u,beta),u)))^2 -
subst(u=log(t)-eta(X,log(t),beta), diff(B(u,gamma),u))^2;
tex(ll);
print("diff(ll, beta)");
tex(diff(ll, beta));
print("diff(ll, gamma)");
tex(diff(ll, gamma));

```

H:

$$e^{B(\log t - \eta(X, \log t, \beta), \gamma)}$$

h:

$$\left( \frac{1}{t} - \frac{\eta_{(0,1,0)}(X, \log t, \beta)}{t} \right) e^{B(\log t - \eta(X, \log t, \beta), \gamma)} B_{(1,0)}(\log t - \eta(X, \log t, \beta), \gamma)$$

log(h):

$$\log B_{(1,0)}(\log t - \eta(X, \log t, \beta), \gamma) + B(\log t - \eta(X, \log t, \beta), \gamma) + \log \left( \frac{1}{t} - \frac{\eta_{(0,1,0)}(X, \log t, \beta)}{t} \right)$$

diff(H,beta):

$$-\eta_{(0,0,1)}(X, \log t, \beta) e^{B(\log t - \eta(X, \log t, \beta), \gamma)} B_{(1,0)}(\log t - \eta(X, \log t, \beta), \gamma)$$

diff(H,gamma):

$$e^{B(\log t - \eta(X, \log t, \beta), \gamma)} B_{(0,1)}(\log t - \eta(X, \log t, \beta), \gamma)$$

diff(log(h),beta):

$$-\frac{\eta_{(0,0,1)}(X, \log t, \beta) B_{(2,0)}(\log t - \eta(X, \log t, \beta), \gamma)}{B_{(1,0)}(\log t - \eta(X, \log t, \beta), \gamma)} - \eta_{(0,0,1)}(X, \log t, \beta) B_{(1,0)}(\log t - \eta(X, \log t, \beta), \gamma) - \frac{\eta_{(0,1,1)}(X, \log t, \beta)}{\left( \frac{1}{t} - \frac{\eta_{(0,1,0)}(X, \log t, \beta)}{t} \right) t}$$

diff(log(h),gamma):

$$\frac{B_{(1,1)}(\log t - \eta(X, \log t, \beta), \gamma)}{B_{(1,0)}(\log t - \eta(X, \log t, \beta), \gamma)} + B_{(0,1)}(\log t - \eta(X, \log t, \beta), \gamma)$$

ll:

$$\delta \left( \log B_{(1,0)}(\log t - \eta(X, \log t, \beta), \gamma) + B(\log t - \eta(X, \log t, \beta), \gamma) + \log \left( \frac{1}{t} - \frac{\eta_{(0,1,0)}(X, \log t, \beta)}{t} \right) \right) - B_{(1,0)}(\log t - \eta(X, \log t, \beta), \gamma)^2 - e^{B(\log t - \eta(X, \log t, \beta), \gamma)} - (1 - \eta_{(0,0,1)}(X, \log t, \beta))$$

diff(ll, beta)

$$\delta \left( -\frac{\eta_{(0,0,1)}(X, \log t, \beta) B_{(2,0)}(\log t - \eta(X, \log t, \beta), \gamma)}{B_{(1,0)}(\log t - \eta(X, \log t, \beta), \gamma)} - \eta_{(0,0,1)}(X, \log t, \beta) B_{(1,0)}(\log t - \eta(X, \log t, \beta), \gamma) - \frac{\eta_{(0,1,1)}(X, \log t, \beta)}{\left( \frac{1}{t} - \frac{\eta_{(0,1,0)}(X, \log t, \beta)}{t} \right) t} \right) + 2 \eta_{(0,0,1)}(X, \log t, \beta) B_{(1,0)}(\log t - \eta(X, \log t, \beta), \gamma)$$

diff(ll, gamma)

$$\delta \left( \frac{B_{(1,1)}(\log t - \eta(X, \log t, \beta), \gamma)}{B_{(1,0)}(\log t - \eta(X, \log t, \beta), \gamma)} + B_{(0,1)}(\log t - \eta(X, \log t, \beta), \gamma) \right) - 2 B_{(1,0)}(\log t - \eta(X, \log t, \beta), \gamma) B_{(1,1)}(\log t - \eta(X, \log t, \beta), \gamma) - e^{B(\log t - \eta(X, \log t, \beta), \gamma)} B_{(0,1)}(\log t - \eta(X, \log t, \beta), \gamma)$$

## 6 Non-integral equation for AFT models without time-varying effect

```
logexpand:all;
derivsubst:true;
load(pdifff)$
assume(t>0)$
S : exp(-exp(B(log(t*exp(-eta(X,beta))),gamma)));
H : -log(S);
h : diff(H,t);
```



```

print("H:");
tex(H);
print("h:");
tex(h);
print("log(h):");
tex(log(h));

print("diff(H,beta):");
tex(diff(H,beta));
print("diff(H,gamma):");
tex(diff(H,gamma));

print("diff(log(h),beta):");
tex(diff(log(h),beta));
print("diff(log(h),gamma):");
tex(diff(log(h),gamma));

print("ll:");
ll : delta*log(h) - H - (1-subst(u=log(t), diff(eta(X,u,beta),u)))^2 -
subst(u=log(t)-eta(X,log(t),beta), diff(B(u,gamma),u))^2;
tex(ll);
print("diff(ll, beta)");
tex(diff(ll, beta));
print("diff(ll, gamma)");
tex(diff(ll, gamma));

```

H:

$$e^{B(\log t - \eta(X, \beta), \gamma)}$$

h:

$$\frac{e^{B(\log t - \eta(X, \beta), \gamma)} B_{(1,0)}(\log t - \eta(X, \beta), \gamma)}{t}$$

log(h):

$$\log B_{(1,0)}(\log t - \eta(X, \beta), \gamma) + B(\log t - \eta(X, \beta), \gamma) - \log t$$

diff(H,beta):

$$-\eta_{(0,1)}(X, \beta) e^{B(\log t - \eta(X, \beta), \gamma)} B_{(1,0)}(\log t - \eta(X, \beta), \gamma)$$

diff(H,gamma):

$$e^{B(\log t - \eta(X, \beta), \gamma)} B_{(0,1)}(\log t - \eta(X, \beta), \gamma)$$

diff(log(h),beta):

$$-\frac{\eta_{(0,1)}(X, \beta) B_{(2,0)}(\log t - \eta(X, \beta), \gamma)}{B_{(1,0)}(\log t - \eta(X, \beta), \gamma)} - \eta_{(0,1)}(X, \beta) B_{(1,0)}(\log t - \eta(X, \beta), \gamma)$$

diff(log(h),gamma):

$$\frac{B_{(1,1)}(\log t - \eta(X, \beta), \gamma)}{B_{(1,0)}(\log t - \eta(X, \beta), \gamma)} + B_{(0,1)}(\log t - \eta(X, \beta), \gamma)$$

ll:

$$\delta \left( \log B_{(1,0)}(\log t - \eta(X, \beta), \gamma) + B(\log t - \eta(X, \beta), \gamma) - \log t \right) - B_{(1,0)}(\log t - \eta(X, \log t, \beta), \gamma)^2 - e^{B(\log t - \eta(X, \beta), \gamma)} - (1 - \eta_{(0,1,0)}(X, \log t, \beta))^2$$

diff(ll, beta)

$$2 \eta_{(0,0,1)}(X, \log t, \beta) B_{(1,0)}(\log t - \eta(X, \log t, \beta), \gamma) B_{(2,0)}(\log t - \eta(X, \log t, \beta), \gamma) + \delta \left( -\frac{\eta_{(0,1)}(X, \beta) B_{(2,0)}(\log t - \eta(X, \beta), \gamma)}{B_{(1,0)}(\log t - \eta(X, \beta), \gamma)} - \eta_{(0,1)}(X, \beta) B_{(1,0)}(\log t - \eta(X, \beta), \gamma) \right)$$

diff(ll, gamma)

$$-2 B_{(1,0)}(\log t - \eta(X, \log t, \beta), \gamma) B_{(1,1)}(\log t - \eta(X, \log t, \beta), \gamma) + \delta \left( \frac{B_{(1,1)}(\log t - \eta(X, \beta), \gamma)}{B_{(1,0)}(\log t - \eta(X, \beta), \gamma)} + B_{(0,1)}(\log t - \eta(X, \beta), \gamma) \right) - e^{B(\log t - \eta(X, \beta), \gamma)} B_{(0,1)}(\log t - \eta(X, \beta), \gamma)$$

## 7 Integral equations for AFT models with $H = B(\dots)$

```
logexpand:all;
derivsubst:true;
load(pdifff)$
assume(t>0)$
S : exp(-B(integrate(exp(-x(v)*beta),v,0,t),gamma));
H : -log(S);
h : diff(H,t);
print("H:");
tex(H);
print("h:");
tex(h);

print("diff(H,beta):");
tex(diff(H,beta));
print("diff(H,gamma):");
tex(diff(H,gamma));

print("diff(log(h),beta):");
tex(diff(log(h),beta));
print("diff(log(h),gamma):");
tex(diff(log(h),gamma));
```

H:

$$B\left(\int_0^t e^{-\beta x(v)} dv, \gamma\right)$$

h:

$$e^{-\beta x(t)} B_{(1,0)}\left(\int_0^t e^{-\beta x(v)} dv, \gamma\right)$$

diff(H,beta):

$$-\left(\int_0^t e^{-\beta x(v)} x(v) dv\right) B_{(1,0)}\left(\int_0^t e^{-\beta x(v)} dv, \gamma\right)$$

diff(H,gamma):

$$B_{(0,1)}\left(\int_0^t e^{-\beta x(v)} dv, \gamma\right)$$

diff(log(h),beta):

$$-\frac{\left(\int_0^t e^{-\beta x(v)} x(v) dv\right) B_{(2,0)}\left(\int_0^t e^{-\beta x(v)} dv, \gamma\right)}{B_{(1,0)}\left(\int_0^t e^{-\beta x(v)} dv, \gamma\right)} - x(t)$$

diff(log(h),gamma):

$$\frac{B_{(1,1)}\left(\int_0^t e^{-\beta x(v)} dv, \gamma\right)}{B_{(1,0)}\left(\int_0^t e^{-\beta x(v)} dv, \gamma\right)}$$