From Oksendal 2006 (Applied Stoch. Control ...) page 47

```
Exit[]

HessianH[f_, x_List?VectorQ] := Simplify[D[f, {x, 2}]]

h = HessianH[σ[S, t] u q1, {P, S, u}]
```

$$\{\{0,0,0\},\{0,\text{q1}\,u\,\sigma^{(2,0)}[S,t],\text{q1}\,\sigma^{(1,0)}[S,t]\},\{0,\text{q1}\,\sigma^{(1,0)}[S,t],0\}\}$$

```
h // MatrixForm
```

$$\begin{pmatrix} 0 & 0 & 0 \\ 0 & \text{q1}\,u\,\sigma^{(2,0)}[S,t] & \text{q1}\,\sigma^{(1,0)}[S,t] \\ 0 & \text{q1}\,\sigma^{(1,0)}[S,t] & 0 \end{pmatrix}$$

```
Simplify[Det[h]]
```

0

```
Simplify[Eigenvalues[h]]
```

$$\left\{0,\frac{1}{2}\left(\text{q1}\,u\,\sigma^{(2,0)}[S,t]-\text{q1}\sqrt{4\,\sigma^{(1,0)}[S,t]^2+u^2\,\sigma^{(2,0)}[S,t]^2}\right),\frac{1}{2}\,\text{q1}\left(u\,\sigma^{(2,0)}[S,t]+\sqrt{4\,\sigma^{(1,0)}[S,t]^2+u^2\,\sigma^{(2,0)}[S,t]^2}\right)\right\}$$

```
Simplify[Det[h]]
```

$$-\text{q1}^2\,u^2\,\sigma^{(1,0)}[S,t]^2$$

```
g[P_] := -HeavisideTheta[Exp[P] - m] * (Exp[P] - m)

D[-g[Log[p]], p]
```

(−m + p) DiracDelta[−m + p] + HeavisideTheta[−m + p]

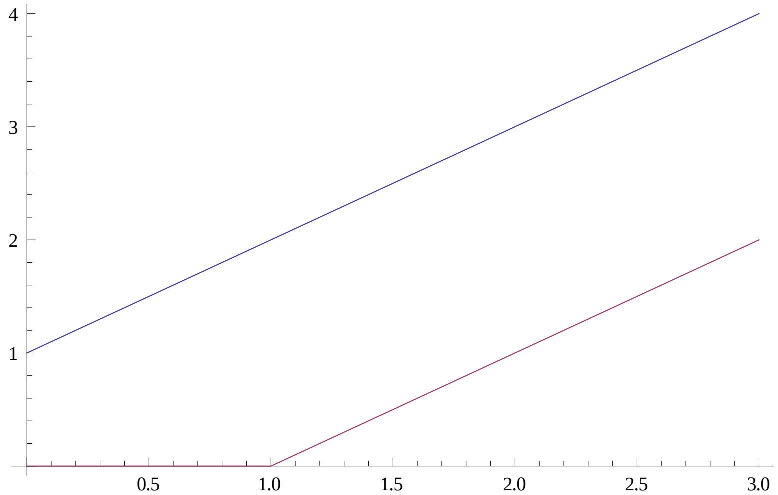
```
D[g[P], P]
```

$-e^P\,(e^P-m)$ DiracDelta$[e^P-m]-e^P$ HeavisideTheta$[e^P-m]$

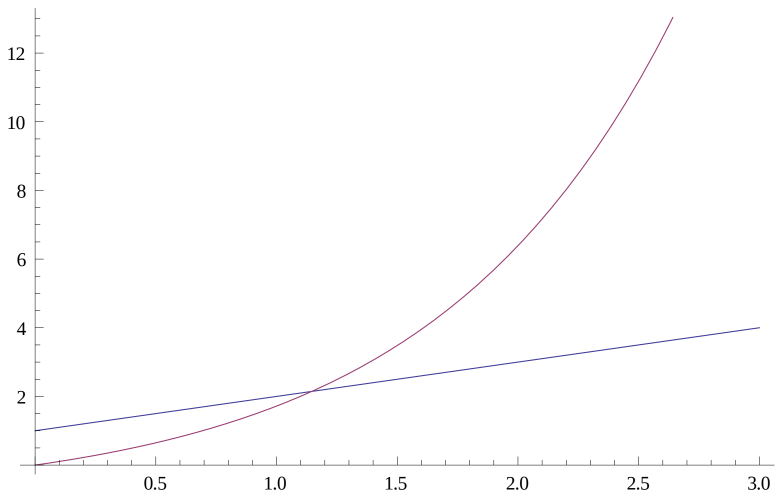
```
D[g[P], P] /. m → 1
```

$-e^P\,(-1+e^P)$ DiracDelta$[-1+e^P]-e^P$ HeavisideTheta$[-1+e^P]$

```
Plot[{1 (P + 1), -g[Log[P]] /. m → 1}, {P, 0, 3}]
```



```
Plot[{1 (P + 1), -g[P] /. m → 1}, {P, 0, 3}]
```



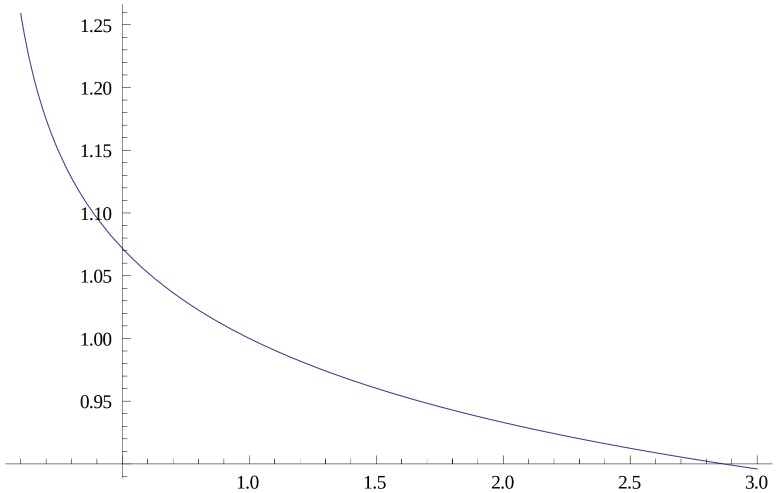
```
h = HessianH[ σ[S, t] u q1, {P, S}]
```

$\{\{0, 0\}, \{0, q1\ u\ \sigma^{(2,0)}[S, t]\}\}$

```
Eigenvalues[h]
```

$\{0, q1\ u\ \sigma^{(2,0)}[S, t]\}$

```
Plot[S^(0.9 - 1), {S, 0.1, 3}]
```




```
Simplify[D[S^(b - 1), S, S] / S^(-3+b)]
```

$(-2 + b)\ (-1 + b)$

```
Plot[(-2 + b) (-1 + b), {b, 0, 1}]
```