1 Poisson noise

Derivation of the cost function

$$\varphi\left(\frac{d-m}{s\sqrt{\eta m+v_0}}\right)$$

η is the ratio to convert the model m to unit in terms in which the variance is given by the Poisson law.

s is a fixed scaling factor

v_0 is the variance of the model at null flux

d is the data

$$X(m)=\frac{d-m}{s\sqrt{\eta m+v_0}}$$

$$\begin{aligned}
\frac{\partial\varphi}{\partial m}X(m) &= \frac{\partial X}{\partial m}(m)\,\varphi'(X(m)) \\
&= \frac{1}{s}\frac{-\sqrt{\eta m+v_0}-\frac{\eta(d-m)}{2\sqrt{\eta m+v_0}}}{\eta m+v_0}\varphi'(X(m)) \\
&= \frac{-2(\eta m+v_0)-\eta(d-m)}{2s(\eta m+v_0)^{3/2}}\varphi'(X(m)) \\
&= -\frac{\eta(m+d)+2v_0}{2s(\eta m+v_0)^{3/2}}\varphi'(X(m))
\end{aligned}$$