· Derivatives

0 $f(x;\vec{p}) = (p_3 + p_4 x)\arctan\left(\frac{x-p_1}{p_2}\right) + p_5 x + 1$

$$\frac{\partial}{\partial x} f(x) = p_4 \arctan\left(\frac{x-p_1}{p_2}\right) + (p_3 + p_4 x)\frac{1}{1+\left(\frac{x-p_1}{p_2}\right)^2}\left(\frac{1}{p_2}\right) + p_5$$

$$= p_4 \arctan\left(\frac{x-p_1}{p_2}\right) + \frac{p_3 + p_4 x}{\frac{p_2^2 + (x-p_1)^2}{p_2^2}}\,\frac{1}{p_2} + p_5$$

$$= \boxed{p_4 \arctan\left(\frac{x-p_1}{p_2}\right) + \frac{p_2\,(p_3 + p_4 x)}{p_2^2 + (x-p_1)^2} + p_5 .}$$

1 $f_1(x,\vec{p}) = (p_3 + p_4 x)\frac{x-p_1}{\sqrt{p_2 + (x-p_1)^2}} + p_5 x + 1$

$$\frac{\partial}{\partial x} f_1(x,\vec{p}) = p_4 \frac{x-p_1}{\sqrt{p_2 + (x-p_1)^2}} + (p_3 + p_4 x)\left[\frac{\sqrt{p_2 + (x-p_1)^2}\,(1) - (x-p_1)\left(\cancel{\tfrac{1}{2}}\right)\left(p_2 + (x-p_1)^2\right)^{-\frac{1}{2}}\left(\cancel{2}(x-p_1)\right)}{p_2 + (x-p_1)^2}\right] + p_5$$

$$= p_4 \frac{x-p_1}{\sqrt{p_2 + (x-p_1)^2}} + (p_3 + p_4 x)\left[\frac{1}{\sqrt{p_2 + (x-p_1)^2}} - \frac{(x-p_1)^2}{\left(p_2 + (x-p_1)^2\right)^{3/2}}\right] + p_5$$

$$= \boxed{p_4 \frac{x-p_1}{\sqrt{p_2 + (x-p_1)^2}} + \frac{(p_3 + p_4 x)}{\sqrt{p_2 + (x-p_1)^2}}\left[1 - \frac{(x-p_1)^2}{\left(p_2 + (x-p_1)^2\right)}\right] + p_5 .}$$

2 $f_2(x,\vec{p}) = -(p_3 + p_4 x)\left(1 + e^{(x-p_1)/p_2}\right)^{-1} + p_5 x + 1$

$$\frac{\partial}{\partial x} f_2(x,\vec{p}) = -p_4\left(1 + e^{(x-p_1)/p_2}\right)^{-1} + (p_3 + p_4 x)\left(1 + e^{(x-p_1)/p_2}\right)^{-2}\left(e^{\frac{x-p_1}{p_2}} \cdot \frac{1}{p_2}\right) + p_5$$

$$= \boxed{-p_4\left(1 + e^{(x-p_1)/p_2}\right)^{-1} + \frac{(p_3 + p_4 x)}{p_2}\,\frac{e^{\frac{x-p_1}{p_2}}}{\left(1 + e^{(x-p_1)/p_2}\right)^2} + p_5} .$$