$$f(z) = P_0 + P_1 * \int_{-\infty}^{x} e^{-\left(\frac{z^2}{2}\right)} dz$$

$$z = \frac{\sqrt{x} - \sqrt{\mu}}{2\sigma} \; ; \; z^2 = \frac{x+\mu-2\sqrt{\mu}\sqrt{x}}{4\sigma^2}$$

$$\frac{z^2}{2} = \frac{x+\mu-2\sqrt{\mu}\sqrt{x}}{8\sigma^2} .$$

$$\frac{\partial f}{\partial \mu} = P_1 * \left[ \frac{\partial}{\partial \mu} \left\{ \int_{-\infty}^{x'} e^{-\frac{x}{8\sigma^2}} e^{-\frac{\mu}{8\sigma^2}} e^{\frac{\sqrt{\mu}\sqrt{x}}{4\sigma^2}} \right\} dz \right]$$

$$\frac{\partial f}{\partial \mu} = P_1 * \left[ \int_{-\infty}^{x'} -\frac{1}{8\sigma^2} e^{-\left(\frac{z^2}{2}\right)} dz + \int_{-\infty}^{x'} \frac{1}{8\sigma^2} \frac{\sqrt{x}}{\sqrt{\mu}} e^{-\left(\frac{z^2}{2}\right)} dz \right]$$

In the code: $freq(x) = \int_{-\infty}^{x'} e^{-\left(\frac{z^2}{2}\right)} dz$

$$\frac{\partial f}{\partial \mu} = -\frac{P_1}{8\sigma^2} * freq(x) + \frac{P_1}{8\sqrt{\mu}\sigma^2} \int_{-\infty}^{x'} \sqrt{x}\, e^{-\left(\frac{z^2}{2}\right)} dz$$

Lets remember: $z = \frac{\sqrt{x} - \sqrt{\mu}}{2\sigma}$

$$\sqrt{x'} = 2\sigma z + \sqrt{r}$$

$$\int_{-\infty}^{x'} \sqrt{x'}\, e^{-\left(\frac{z^2}{2}\right)} dz = \int_{-\infty}^{x'} 2\sigma z\, e^{-\left(\frac{z^2}{2}\right)} dz + \sqrt{r}\,\underbrace{\int_{-\infty}^{x'} e^{-\left(\frac{z^2}{2}\right)} dz}_{freq(x)}$$

$$\frac{\partial f}{\partial r} = -\frac{P_1}{8\sigma^2} * freq(x) + \frac{P_1}{8\sqrt{r}\,\sigma^2}\int_{-\infty}^{x} \sqrt{x'}\, e^{-\left(\frac{z^2}{2}\right)} dz$$

$$\frac{\partial f}{\partial r} = \cancel{-\frac{P_1}{8\sigma^2} freq(x)} + \cancel{\frac{P_1}{8\sigma^2} freq(x)} +$$

$$\frac{P_1}{\sigma^2 8\sqrt{r}}\int_{-\infty}^{x'} 2\sigma z\, e^{-\left(\frac{z^2}{2}\right)} dz$$ $\to$ need to integrate

$$\int_{-\infty}^{x'} z\, e^{-\left(\frac{z^2}{2}\right)} dz = e^{-\left(\frac{z^2}{2}\right)} \Big|_{-\infty}^{x'}$$

in our case $-\infty \to 0$ and $x' = 200$

So $$\int_0^{200} z e^{\left(-\frac{z^2}{2}\right)} dz = 1$$

Therefore: $$\frac{\partial f}{\partial \mu} = \frac{P_1}{4\sqrt{\mu}\,\sigma}$$

OK, we need to check but it looks reasonable. Now, lets work on $\frac{\partial f}{\partial \sigma}$ ....

$$\frac{\partial f}{\partial \sigma} = P_1 * \left[\frac{\partial}{\partial \sigma}\left\{\int_{-\infty}^{x'} e^{-\frac{x}{8\sigma^2}} e^{-\frac{\mu}{8\sigma^2}} e^{\frac{\sqrt{\mu}\sqrt{x}}{4\sigma^2}}\right\} dz\right]$$

$$\frac{\partial f}{\partial \sigma} = P_1 * \left[\frac{\partial}{\partial \sigma}\left\{\int_0^{200} e^{-\frac{1}{8\sigma^2}\left(x+\mu-2\sqrt{\mu}\sqrt{x}\right)} dz\right.\right]$$

$$\beta = \frac{1}{\sigma^2} \quad \therefore \quad \frac{d\beta}{d\sigma} = -\frac{1}{2}\frac{1}{\sigma^3}$$

$$\frac{\partial f}{\partial \sigma} = P_1 * \frac{\partial \beta}{\partial \sigma}\frac{\partial}{\partial \beta}\left\{\int_0^{200} e^{-\frac{1}{8}\beta\left(x+\mu-2\sqrt{\mu}\sqrt{x}\right)} dz\right\}$$

$$\frac{\partial f}{\partial \sigma} = P_1 * \left(-\frac{1}{2\sigma^3}\right)\left\{-\frac{1}{8}\int_0^{200}\left(x+\mu-2\sqrt{\mu}\sqrt{x}\right)e^{-\frac{1}{8}\beta(\ )}\,dz\right\}$$

Remember: $\frac{z^2}{2} = \frac{x+\mu-2\sqrt{\mu}\sqrt{x}}{8\sigma^2}$

$$\frac{\partial f}{\partial \sigma} = \frac{P_1}{2\sigma} * \left\{\int_0^{200}\frac{z^2}{2}\,e^{-\left(\frac{z^2}{2}\right)}\,dz\right\}$$