constant cancel

So the leading term is

$$\frac{\int_{u=v+w}^{\infty} u^{p} p_{u|\nu D}(u|0)\, du}{\int_{u=v}^{\infty} u^{p} p_{u|\nu D}(u|0)\, du}$$

Add

$$= \frac{\int_{v+w}^{\infty} u^{\frac{n-2}{2}} e^{-u/2\sigma}\, du}{\int_{v}^{\infty} u^{n-2/2} e^{-u/2\sigma}\, du}$$

$e^{-u/2\sigma}$

$$= \mathbb{P}(\chi_n^2 > v+w) \Big/ \mathbb{P}(\chi_n^2 > v)$$

~~need the cdf of a χ^2 distn!!~~

$u = u^k \quad v = 2\sigma e^{-u/2\sigma}$

$du = k u^{k-1} \quad dv = -e^{-u/2\sigma}$

$\cancel{\int u^k e^{2u/}}$ $\int u^k e^{-u/2\sigma} du$

$$= 2\sigma\left[-u^k e^{-u/2\sigma}\right]_v^{\infty} + \int k u^{k-1} e^{-u}\, du$$

The 2σ factor cancels