$f(y|\alpha,\beta,m,\rho)$ = pdf for min gamma for m iid $Ga(\alpha,\beta)$ racers.

$$f_{min}(x) = \frac{m!}{(1-1)!(m-1)!} f_G(x) \left(F_G(x)\right)^{1-1} \left(1-F_G(x)\right)^{m-1}$$

$$= \frac{m!}{(m-1)!} f_G(x) \left(1-F_G(x)\right)^{m-1}$$

$$= m f_G(x) \left(1-F_G(x)\right)^{m-1}$$

$$\log f_{min}(x) = \log m + \log f_G(x) + (m-1)\log\left(1-F_G(x)\right).$$

$$F_{min}(x) = \sum_{k=1}^{m} \binom{m}{k} \left(F_G(x)\right)^k \left(1 - F_G(x)\right)^{m-k}$$

$$= 1 - \binom{m}{0} \left(F_G(x)\right)^0 \left(1 - F_G(x)\right)^m$$

$$= 1 - \left(1 - F_G(x)\right)^m$$