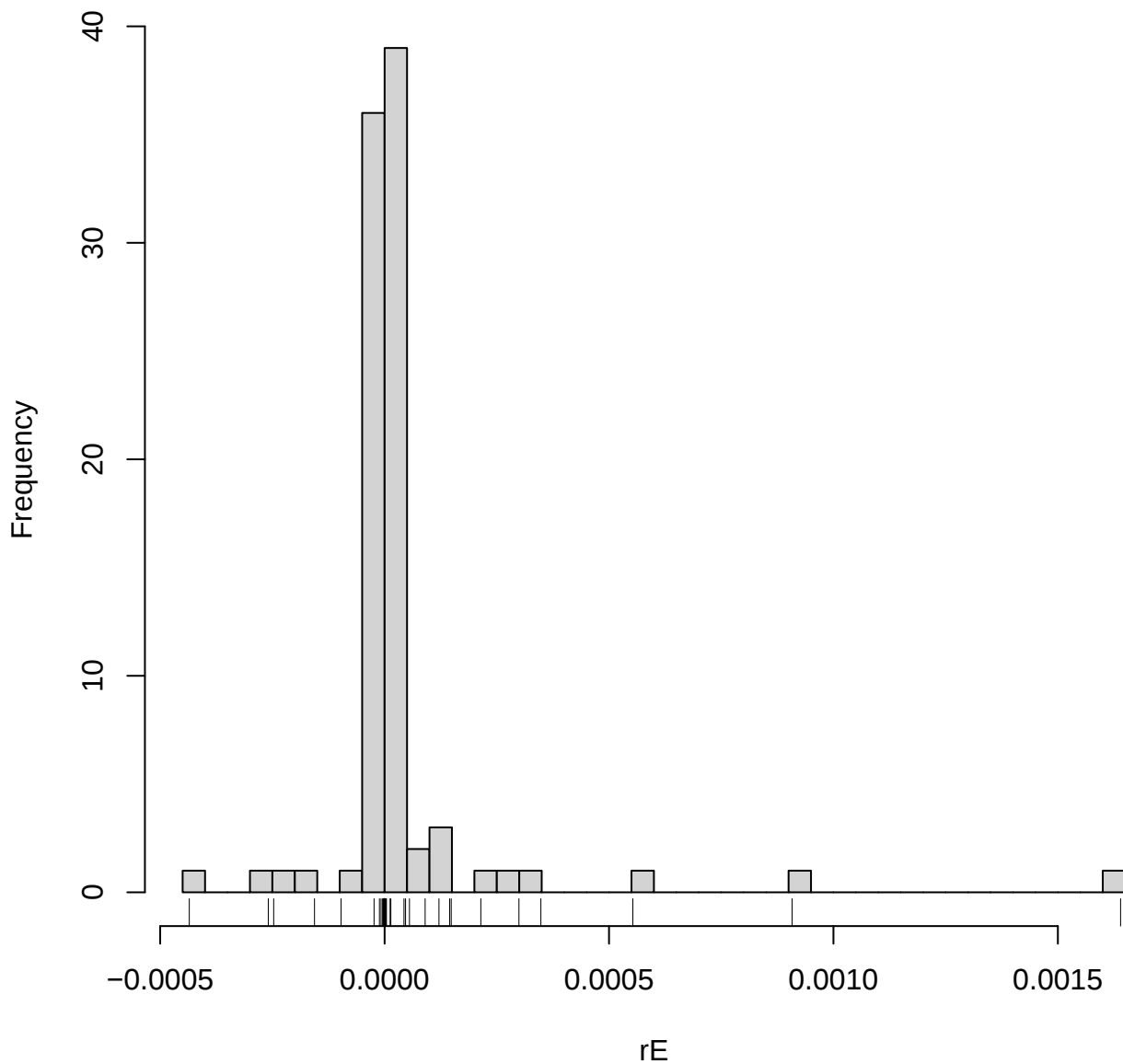
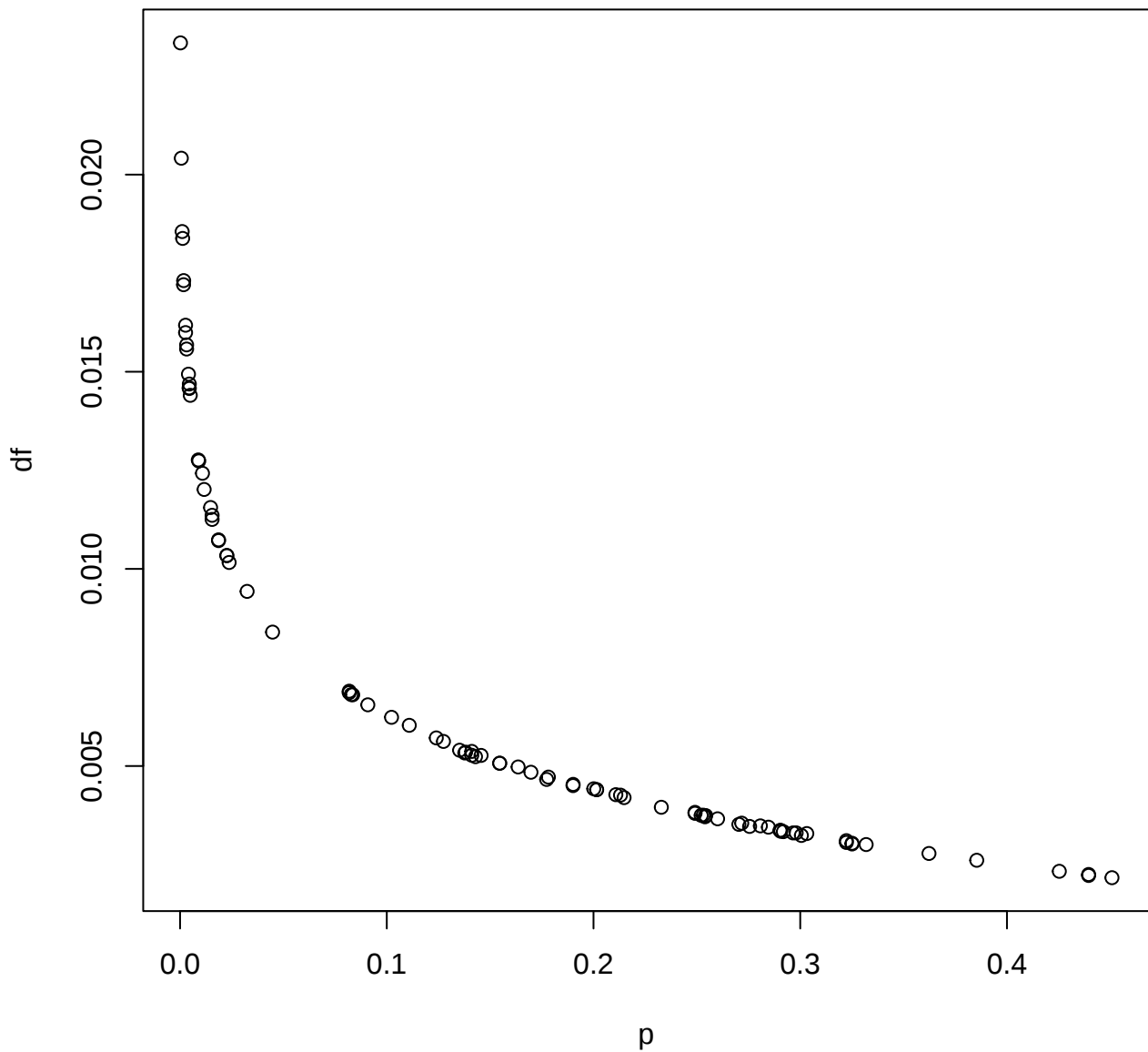
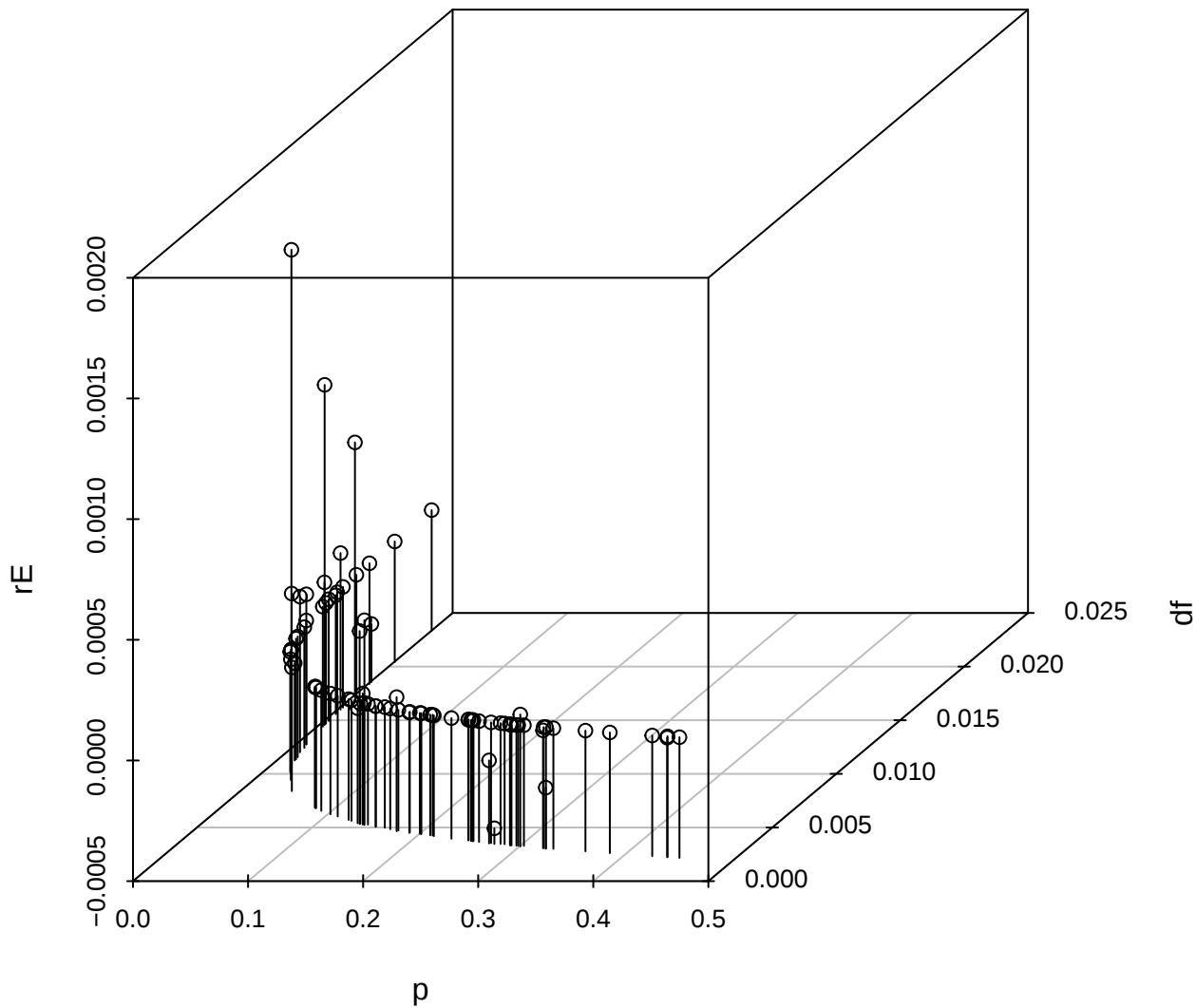
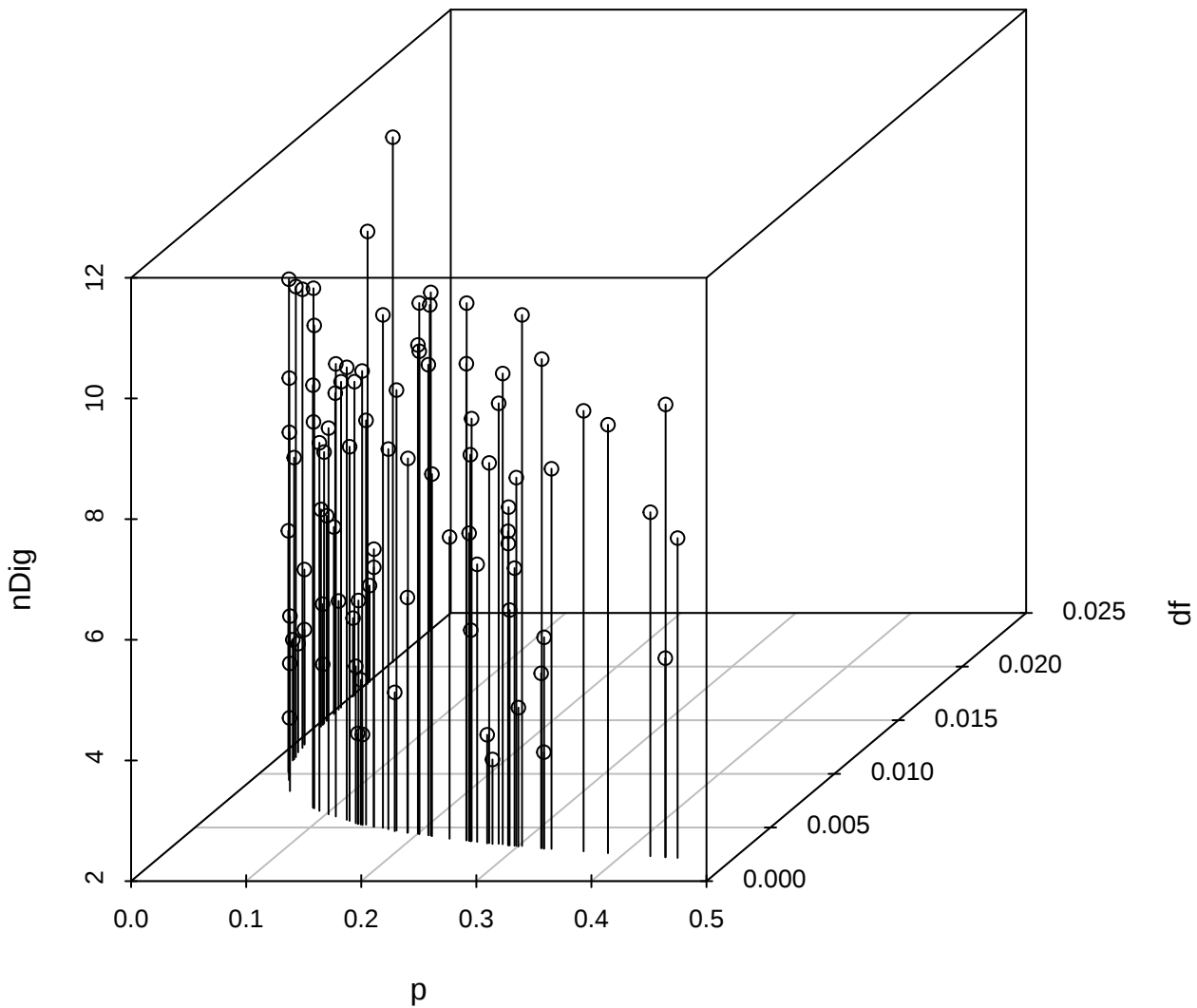


Histogram of rE

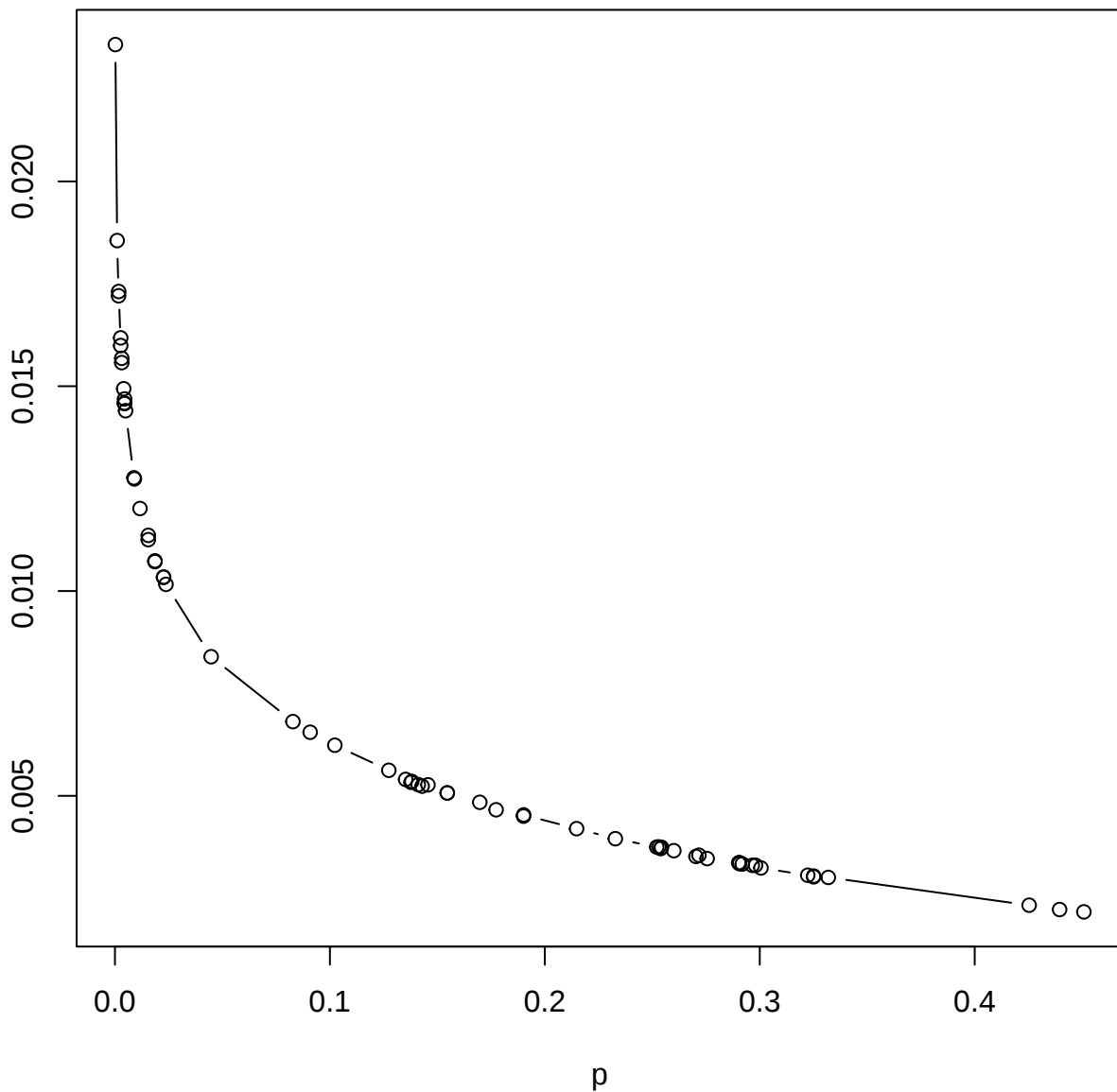




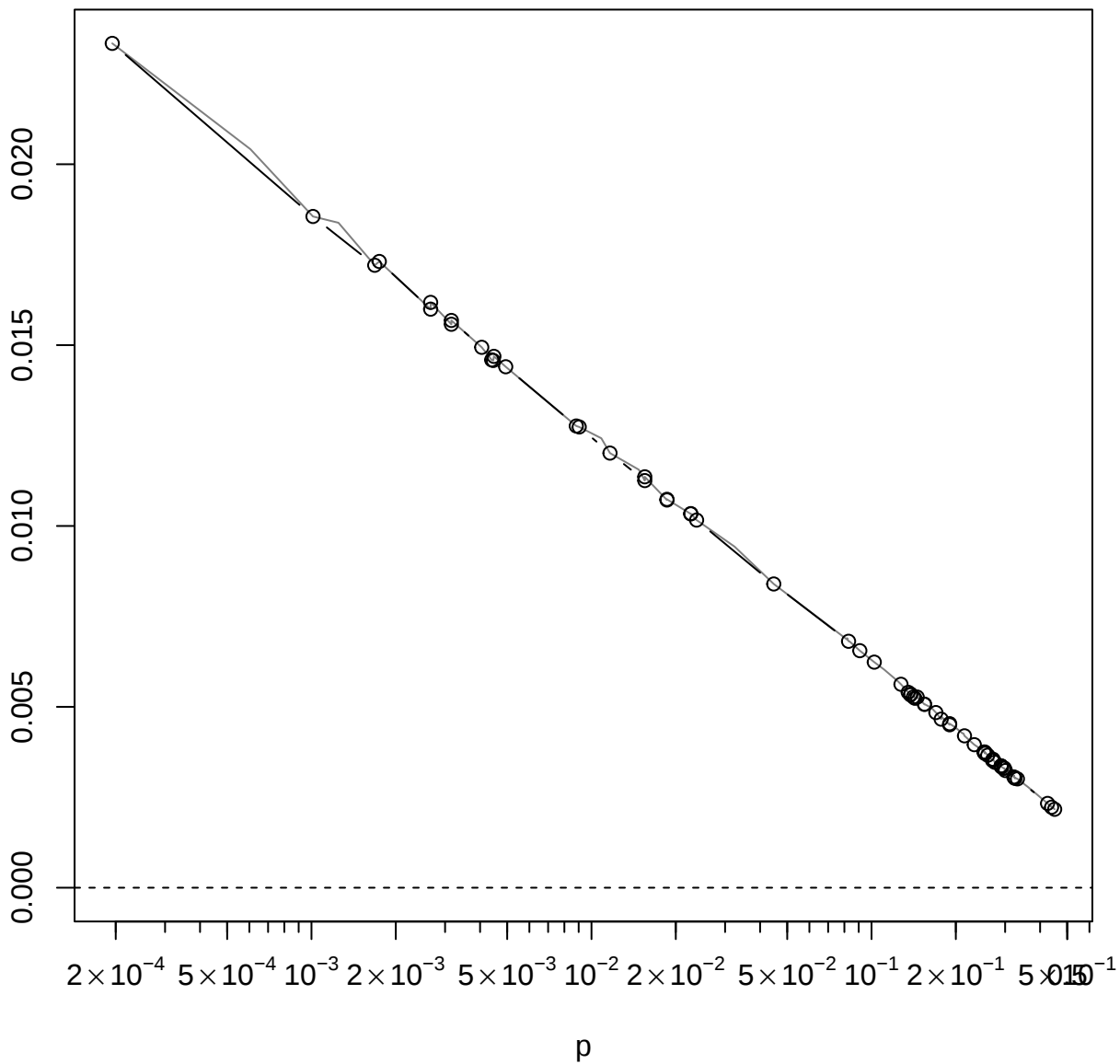


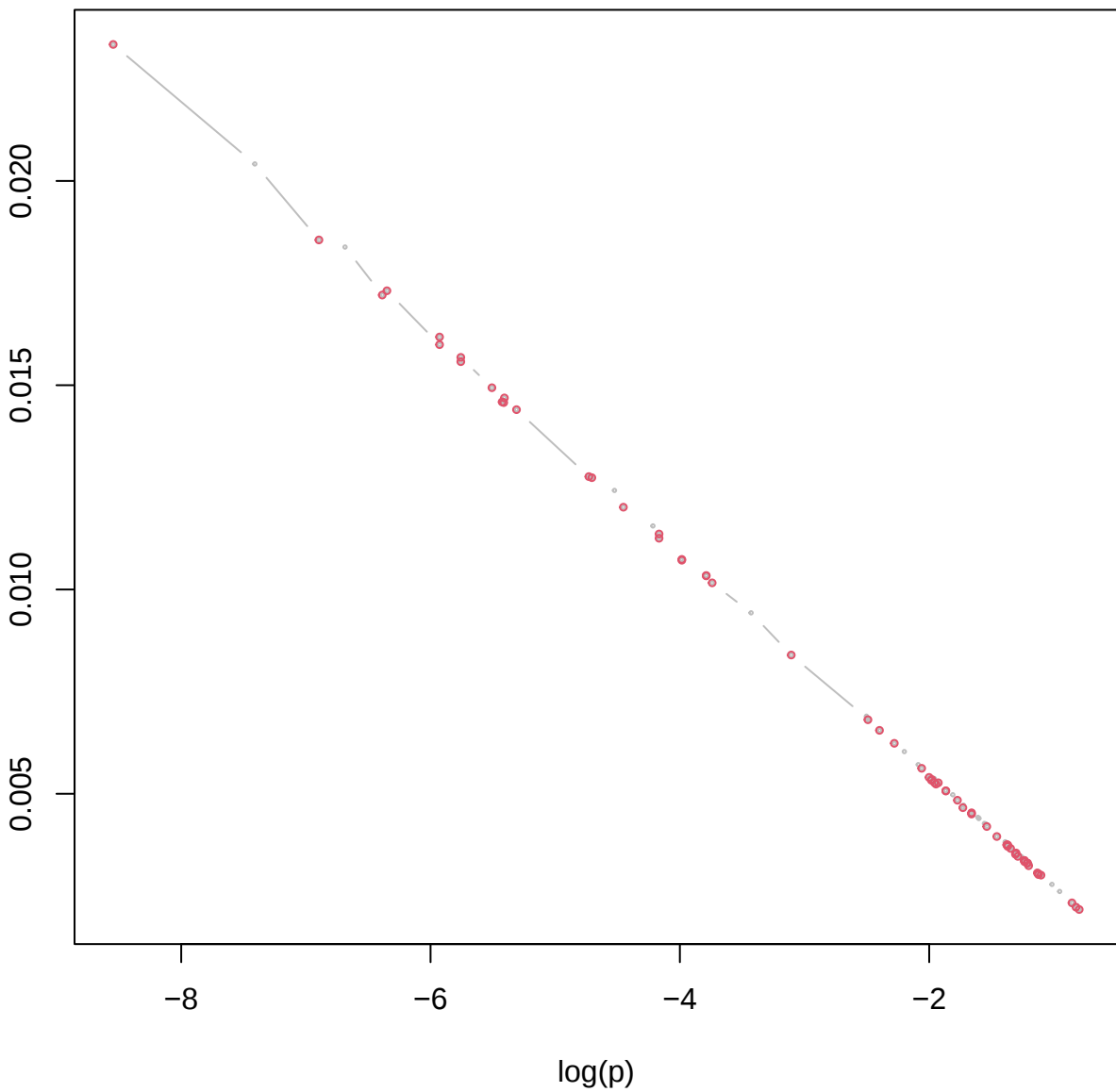


inaccurate pchisq/qchisq pairs

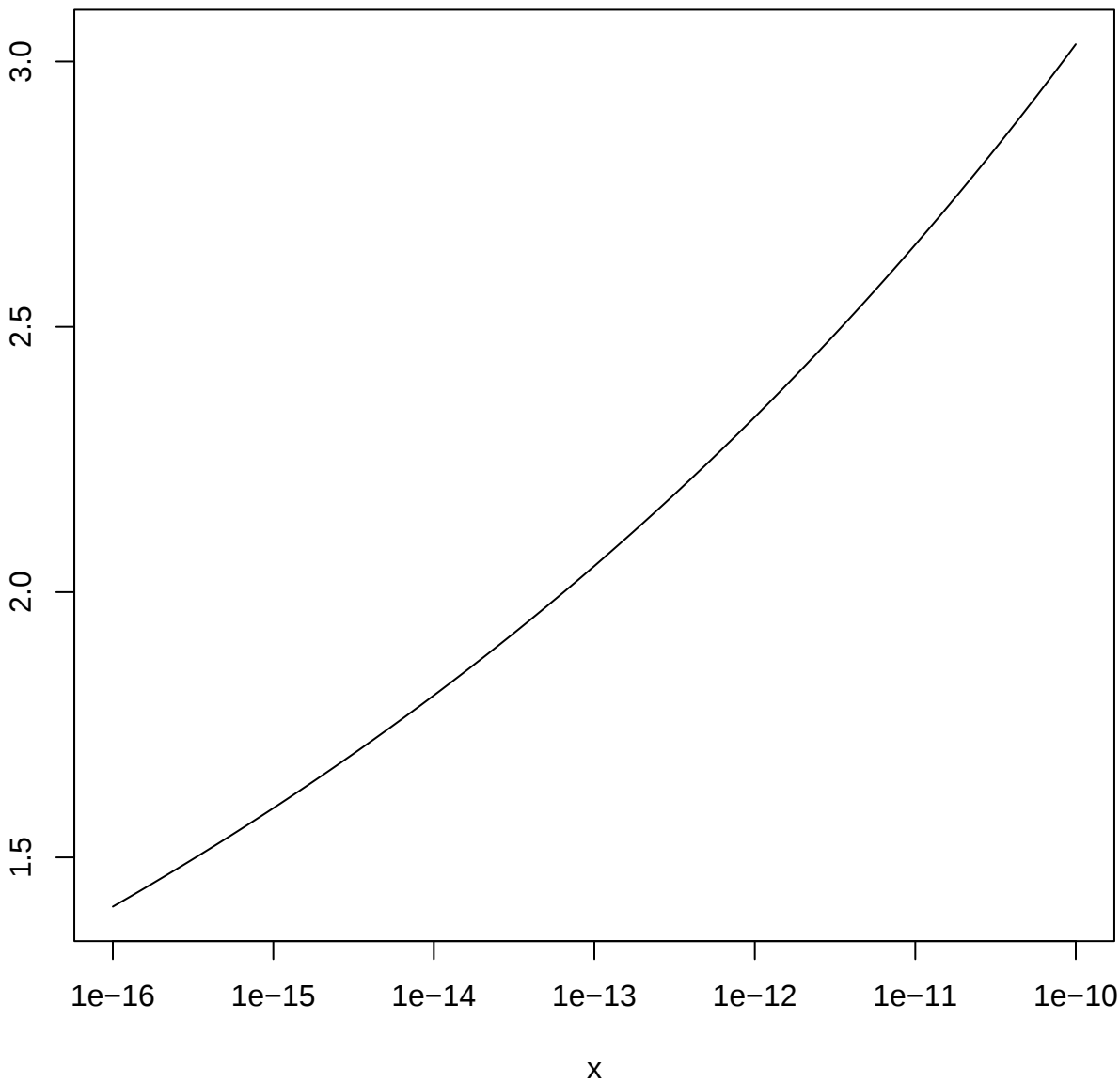


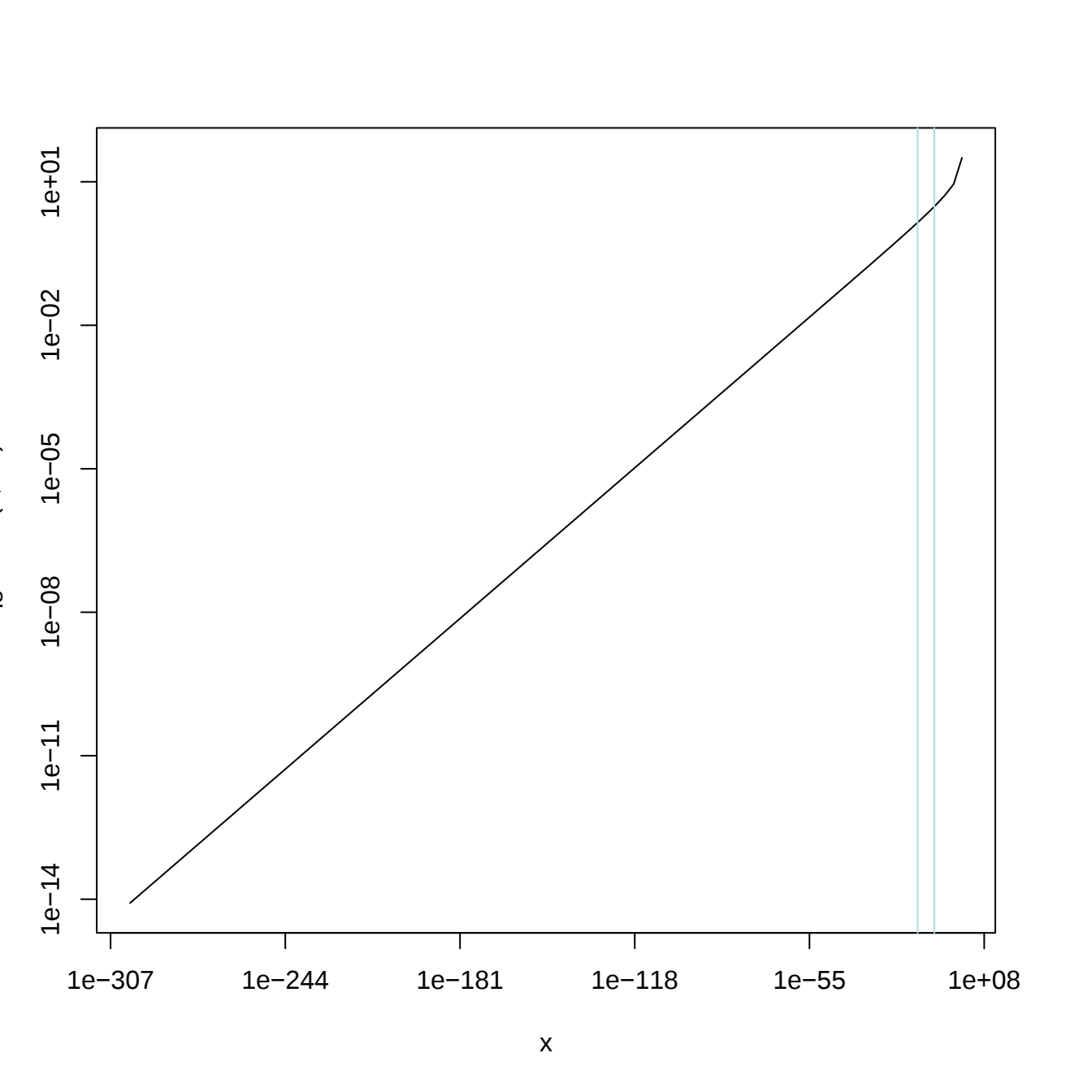
inaccurate pchisq/qchisq pairs

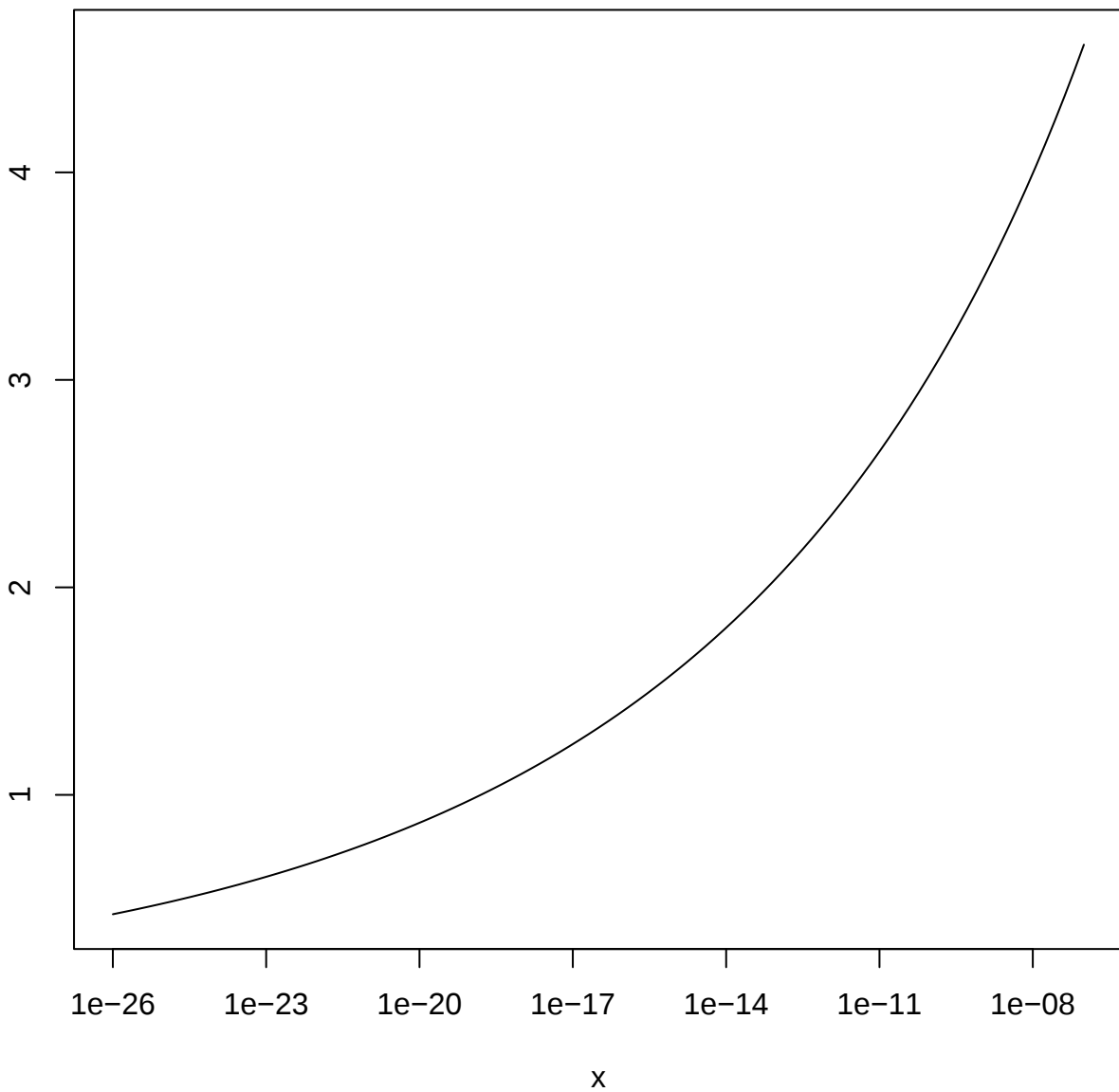


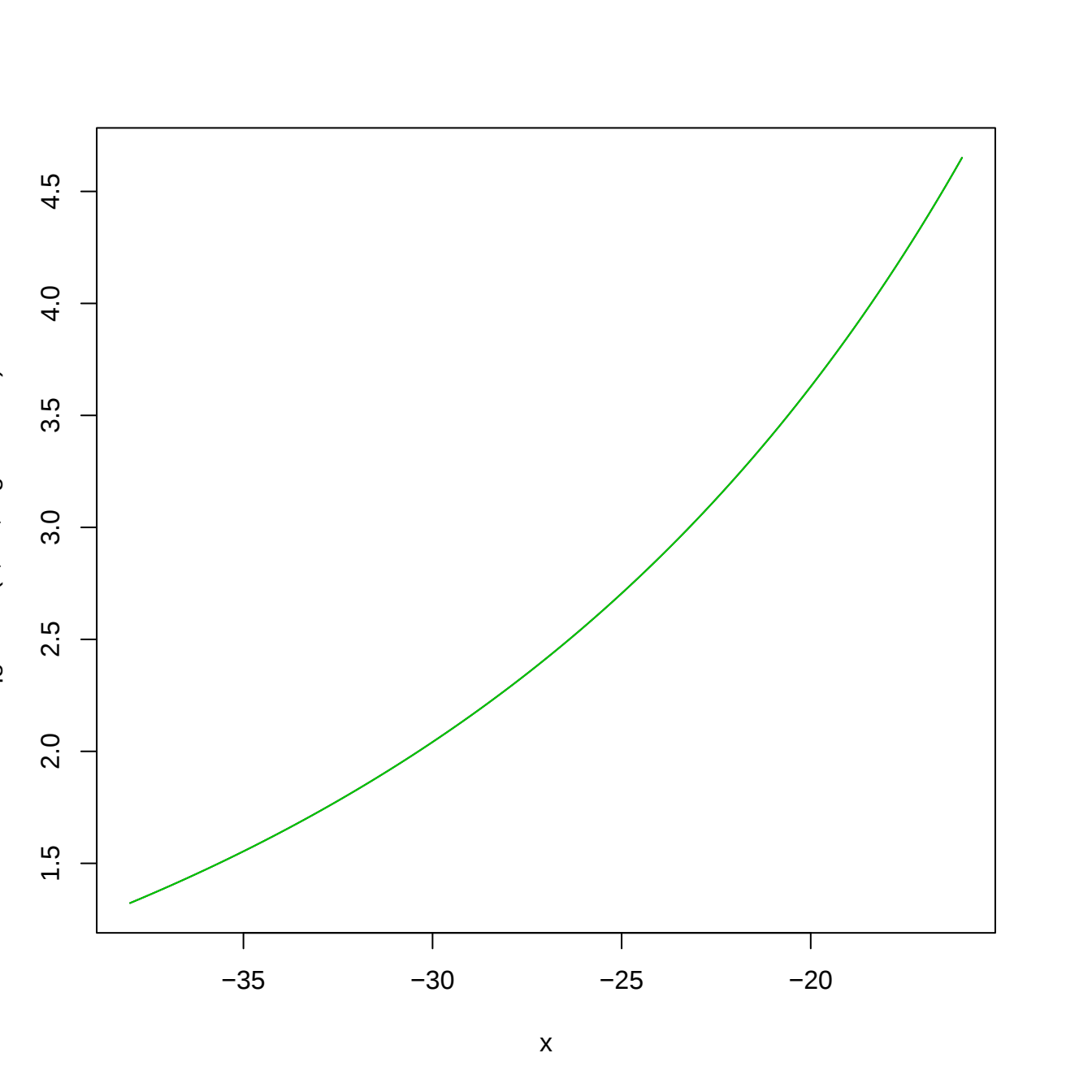


$y = \log_2(x)$

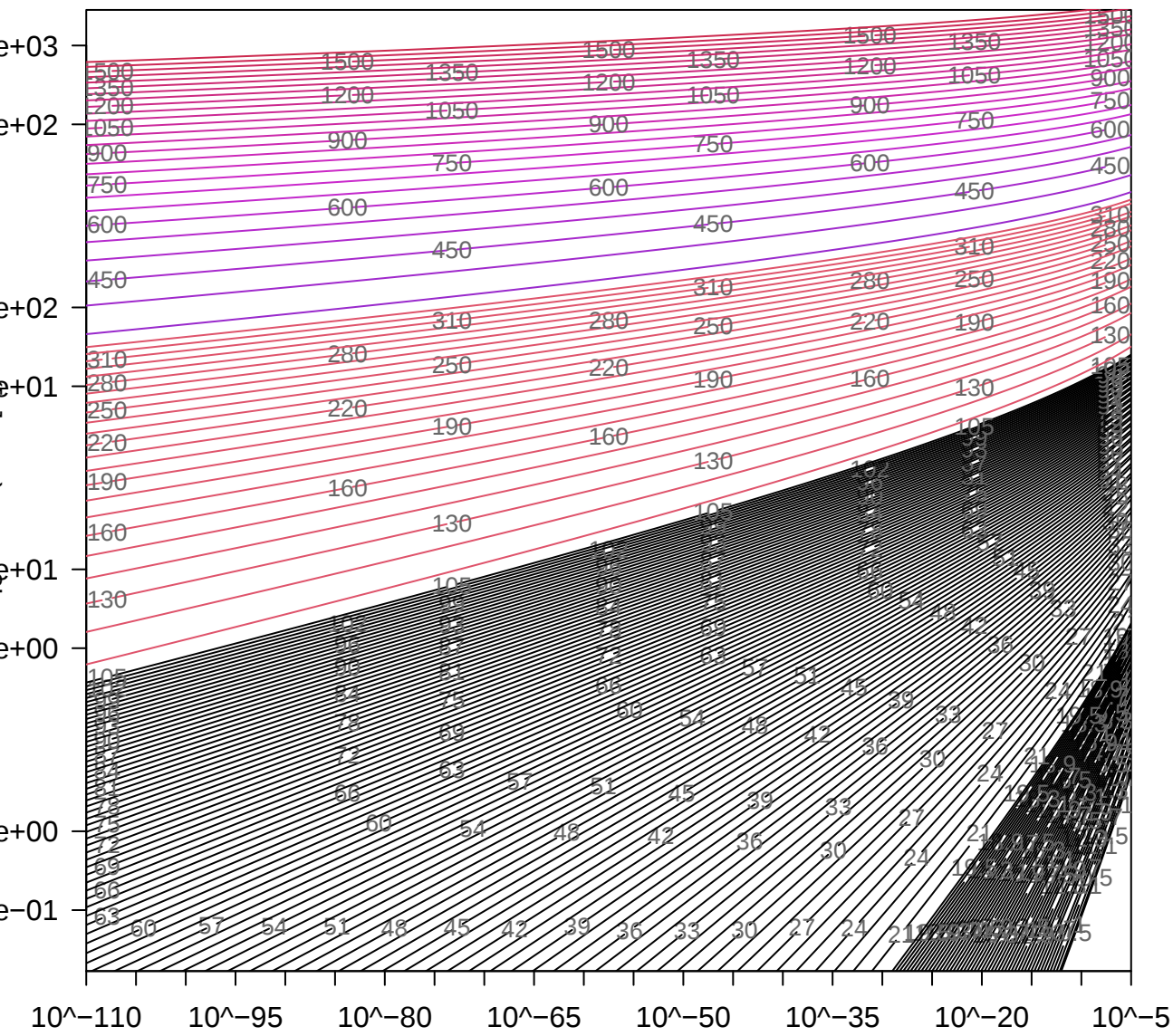




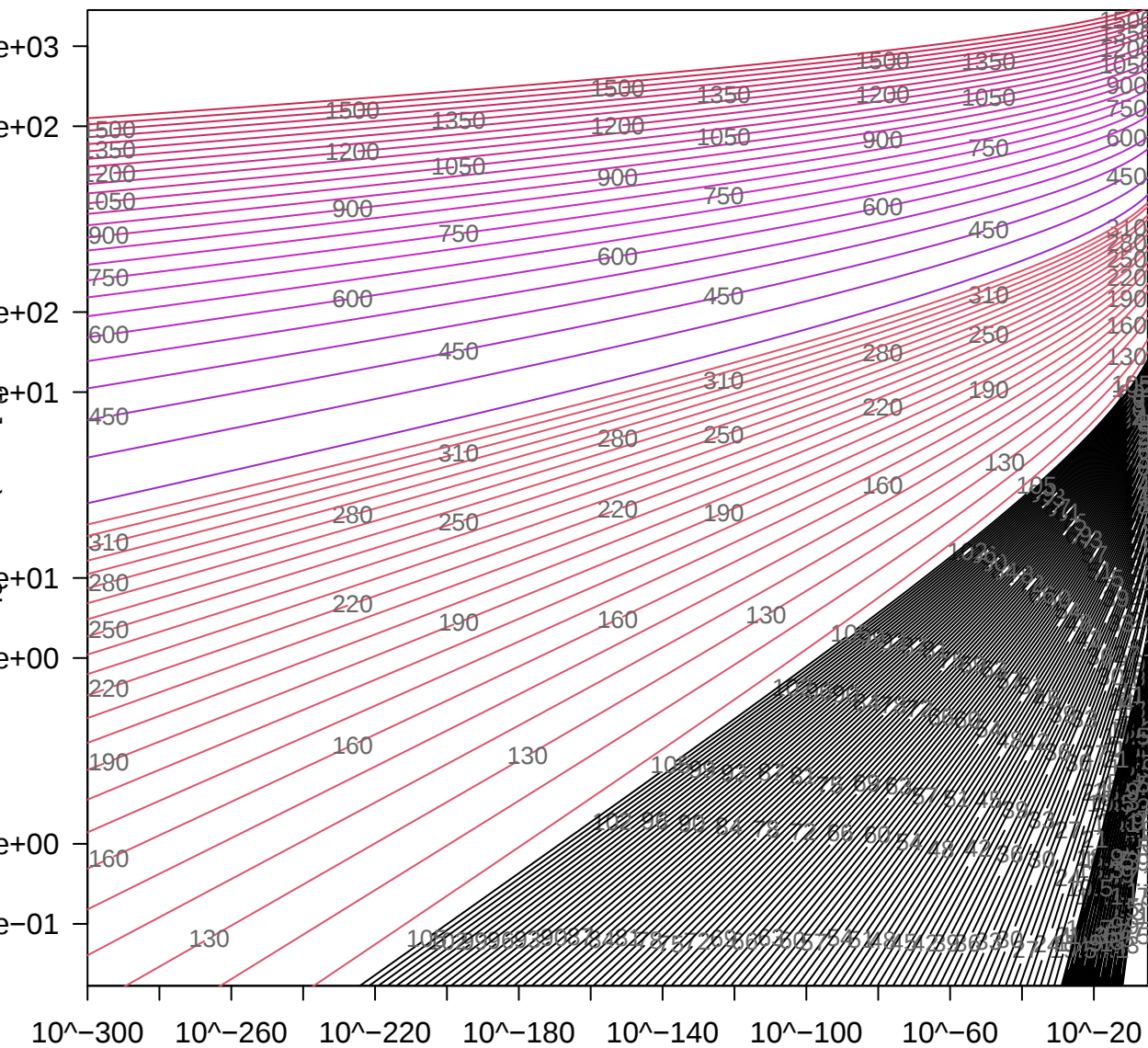




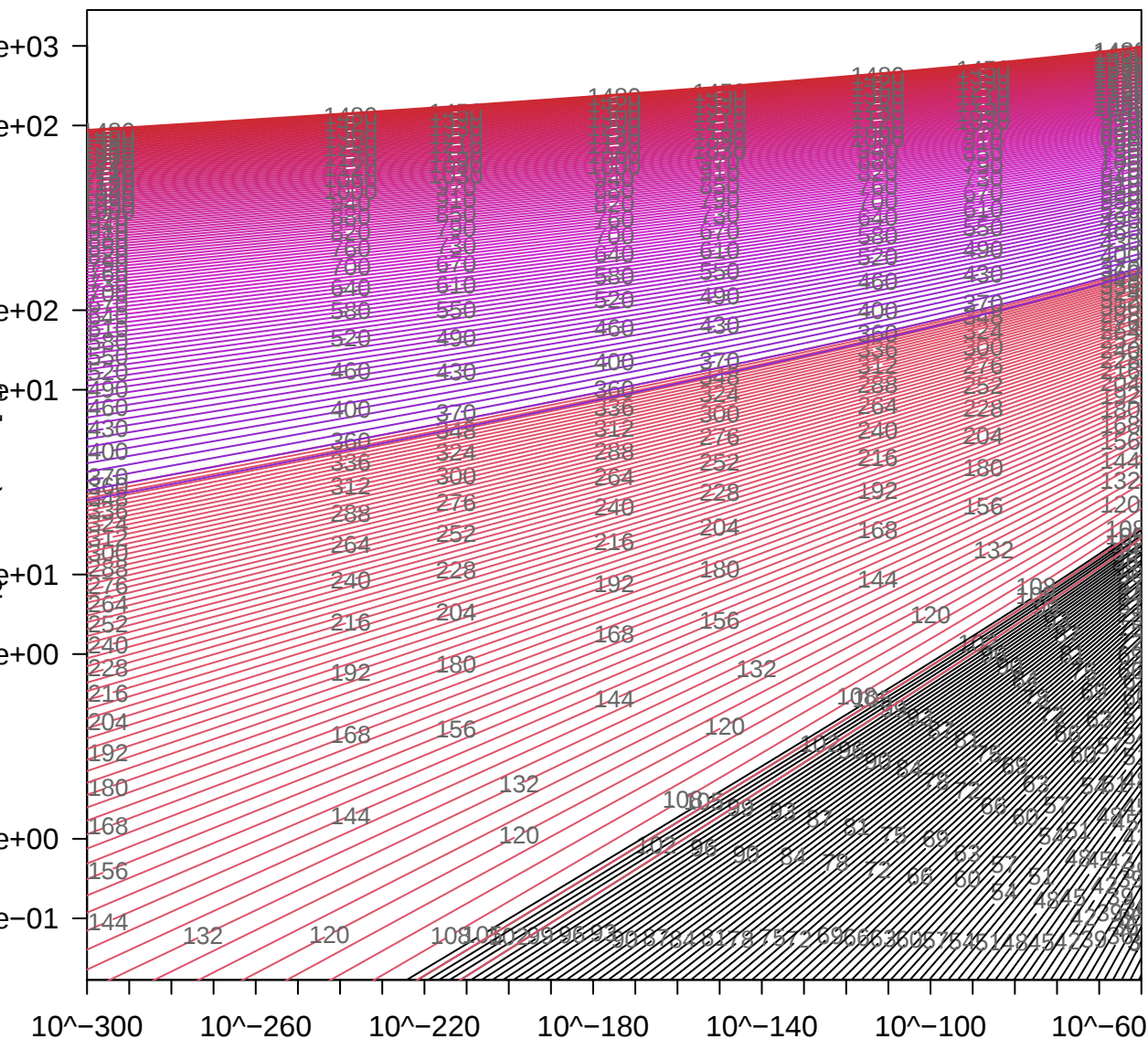
qgamma(x, a) for very small x, a in [10, 1600] – log-log



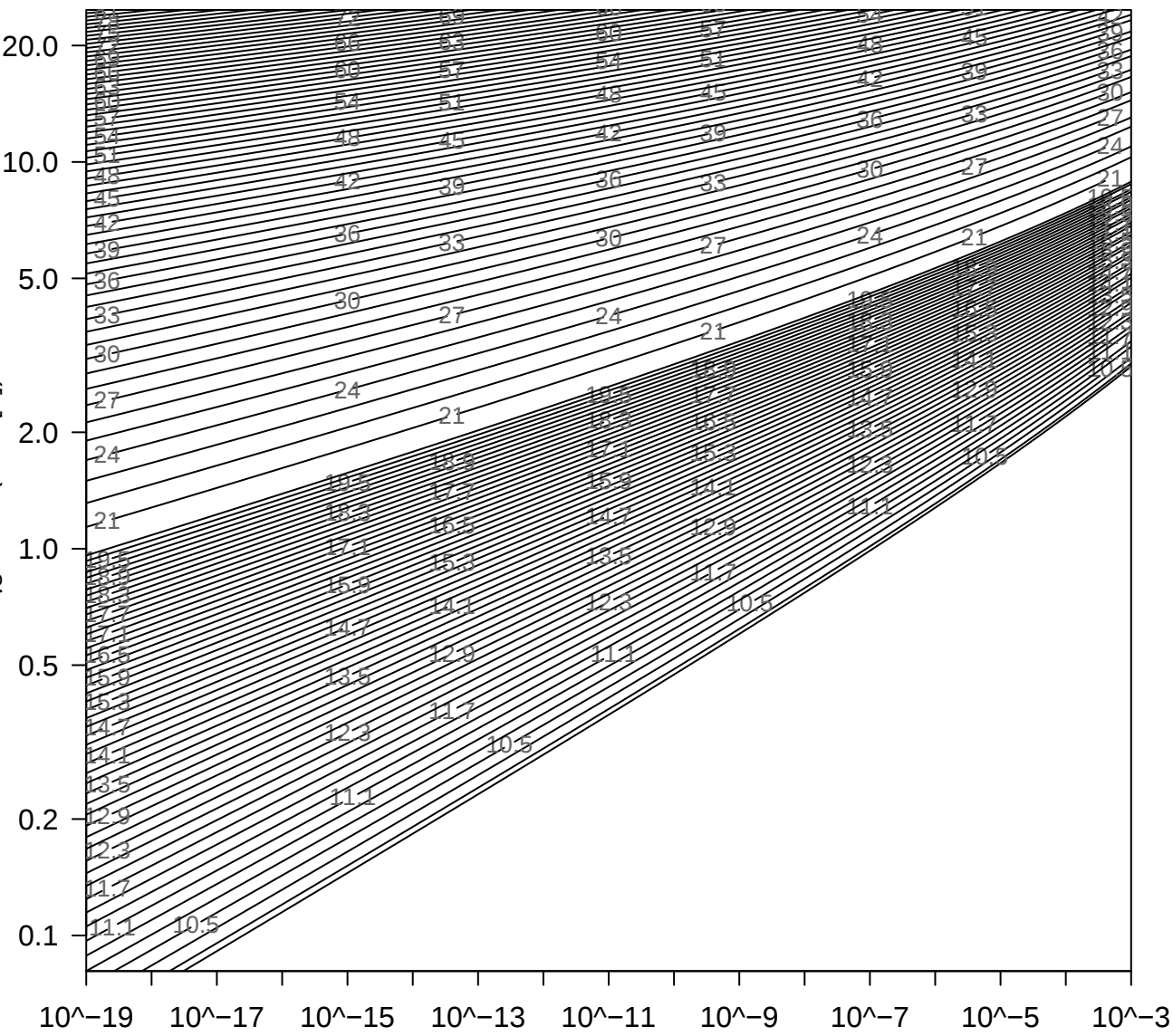
qgamma(x, a) for very small x, a in [10, 1600] – log-log



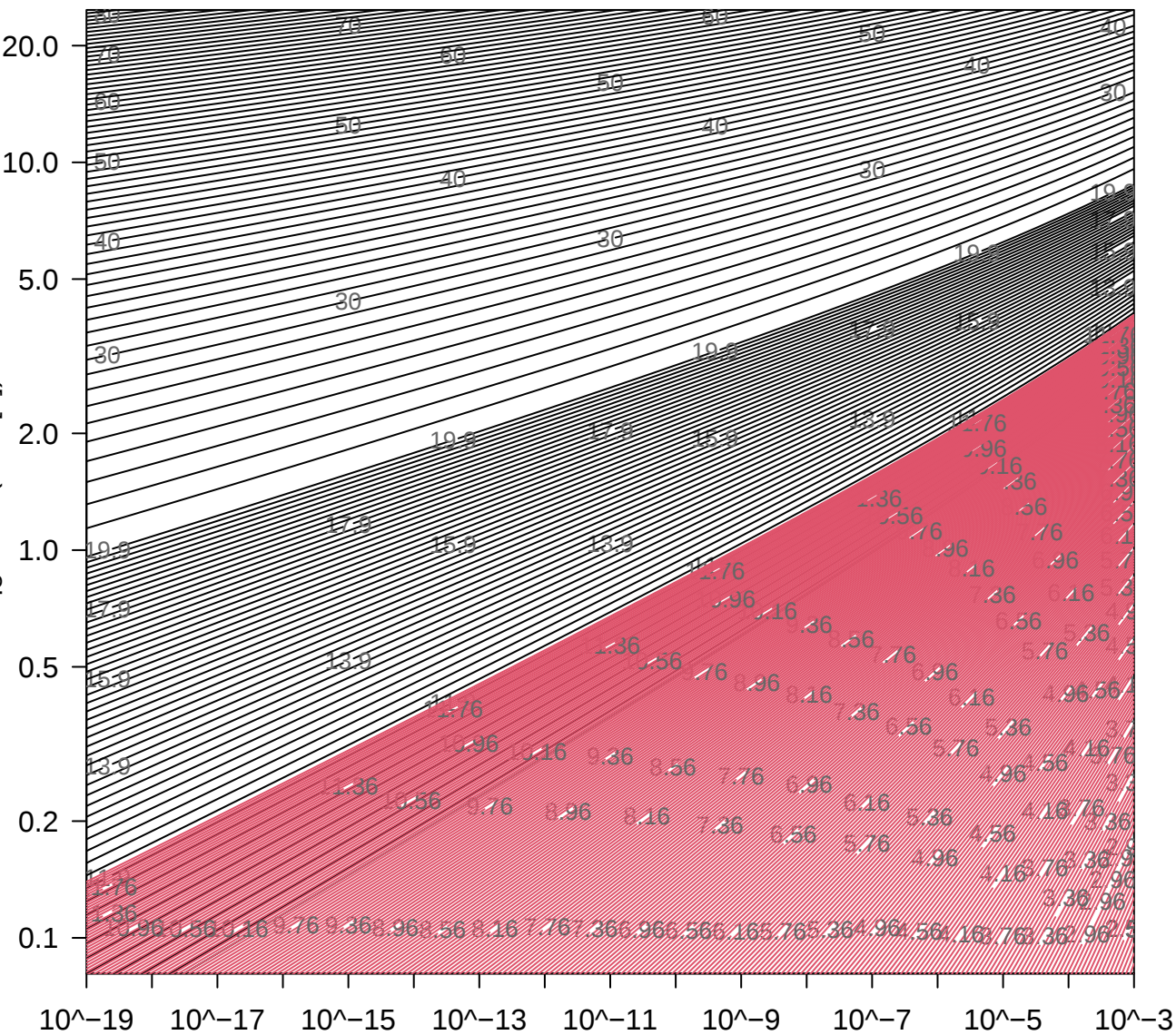
qgamma(x, a) for very small x, a in [10, 1500] – log-log



qgamma(x, a) for very small x, a in [10, 105] – log-log

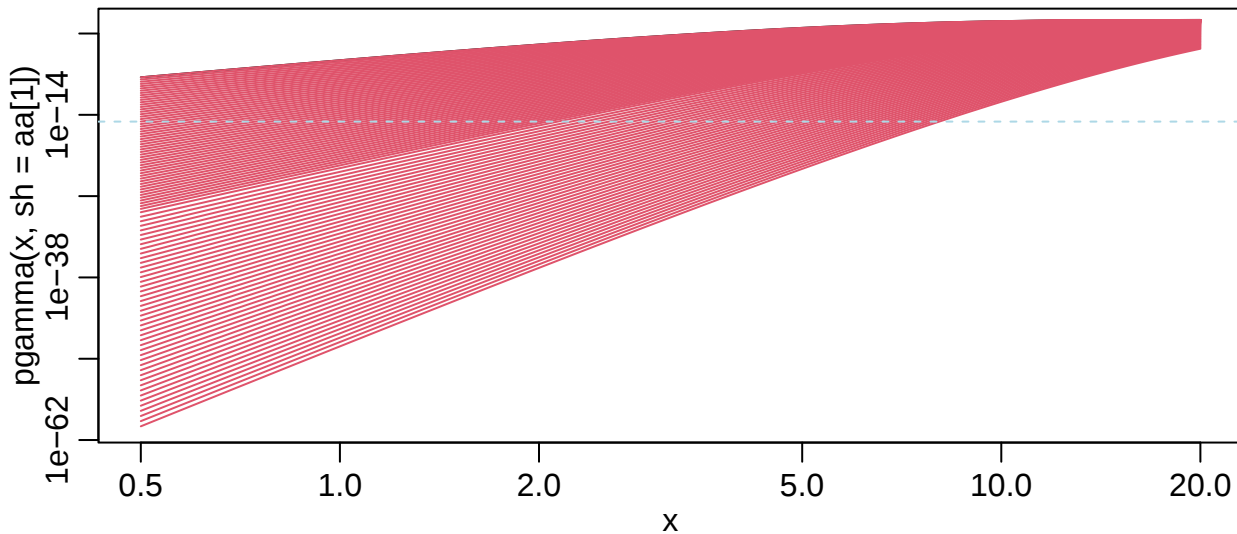


qgamma(x, a) for very small x, a in [10, 105] – log-log

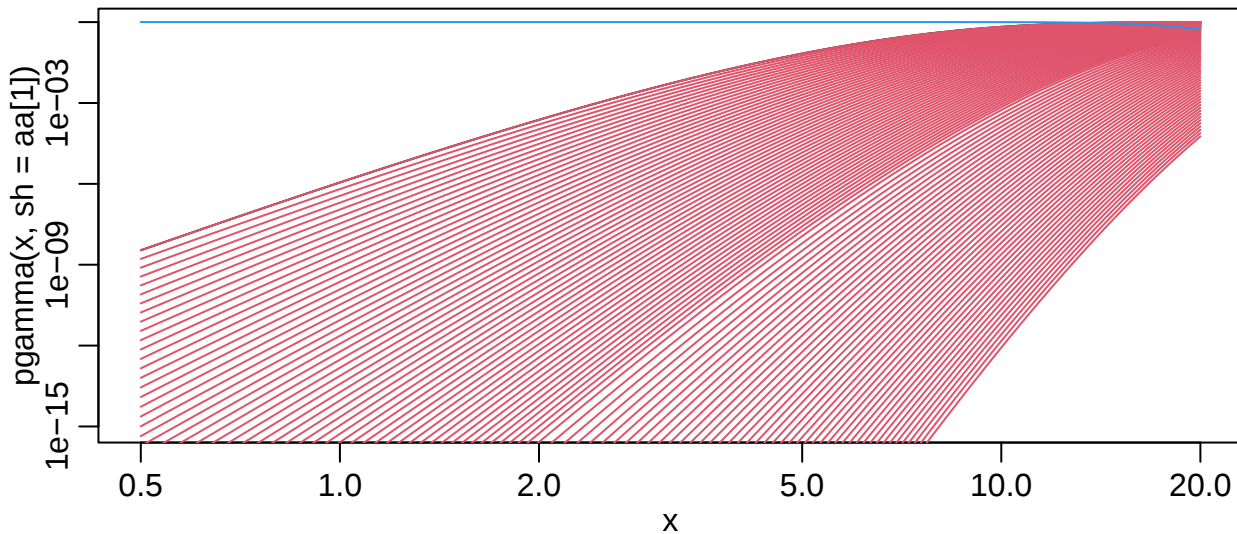


X
R Under development (unstable) (2025-10-10 r88914 ucrt)

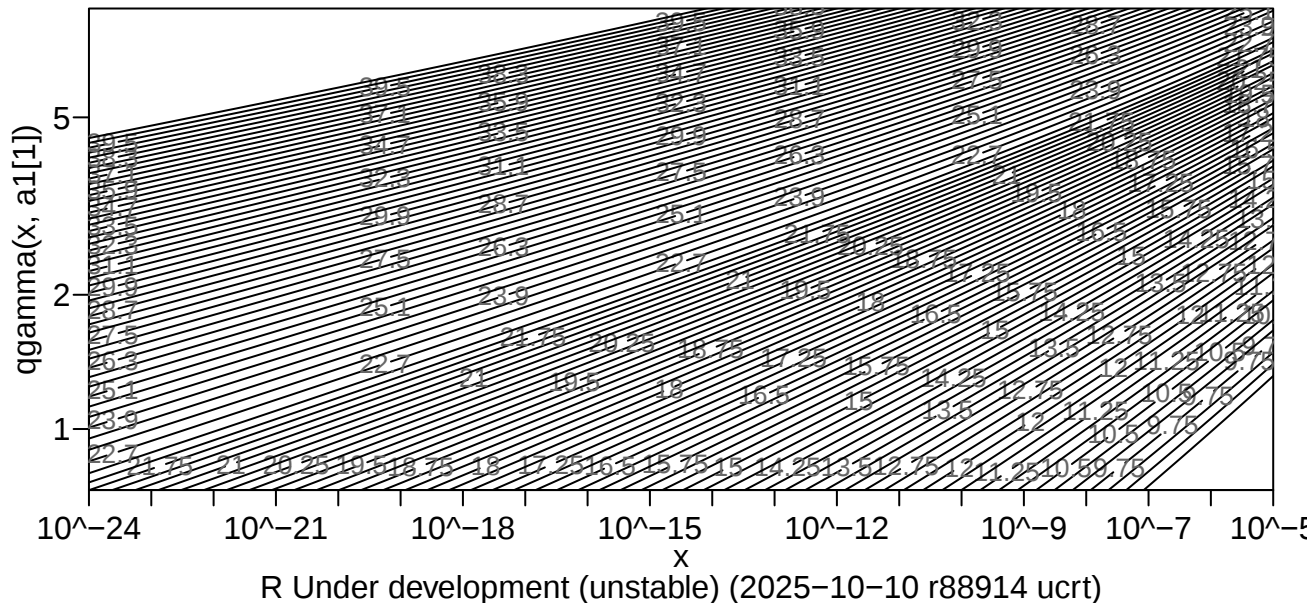
pgamma(x, a) for a in [9,39.9]



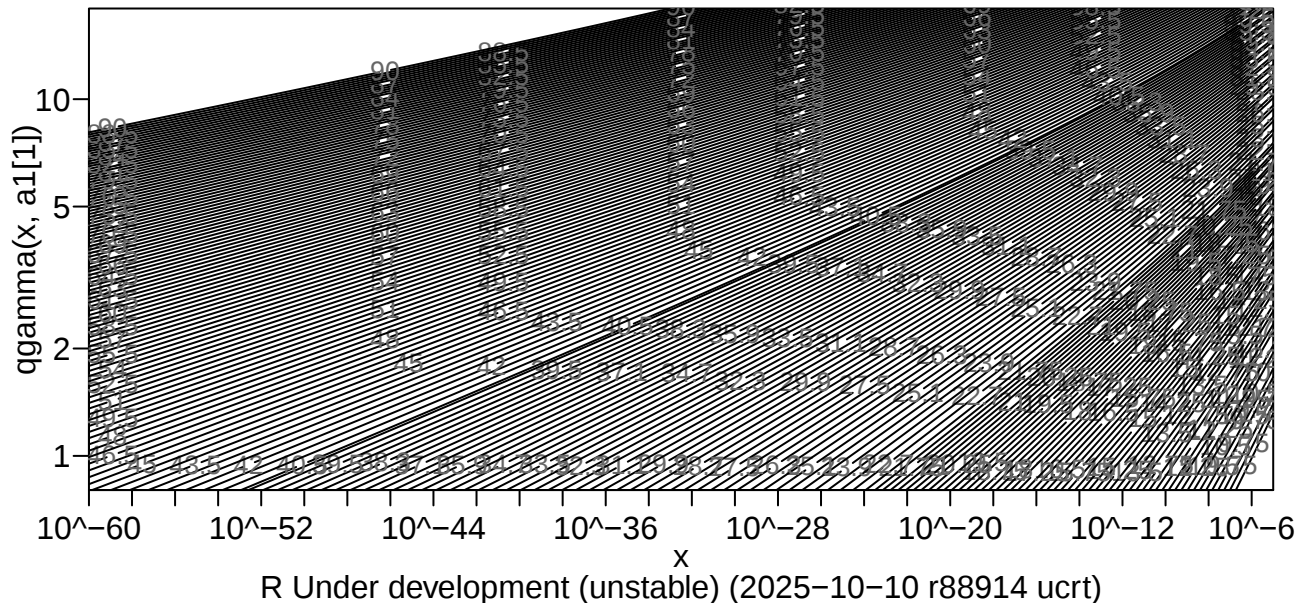
pgamma(x, a) for a in [9,39.9]



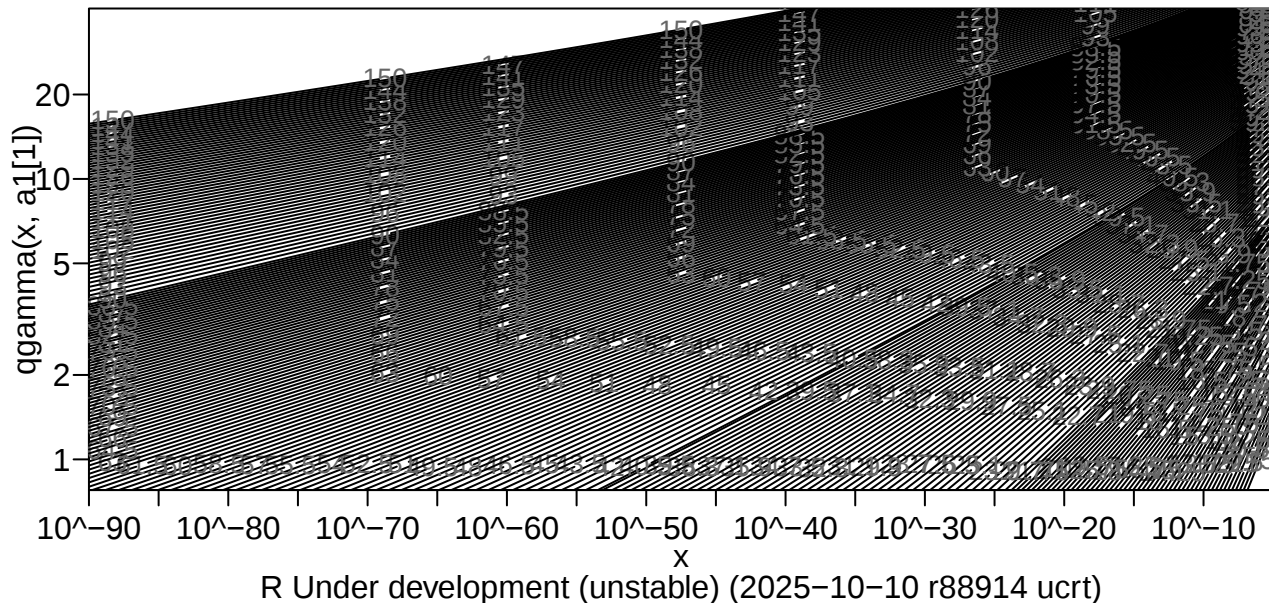
qgamma(x, a) for very small x, a in [9, 40.3] – log-log



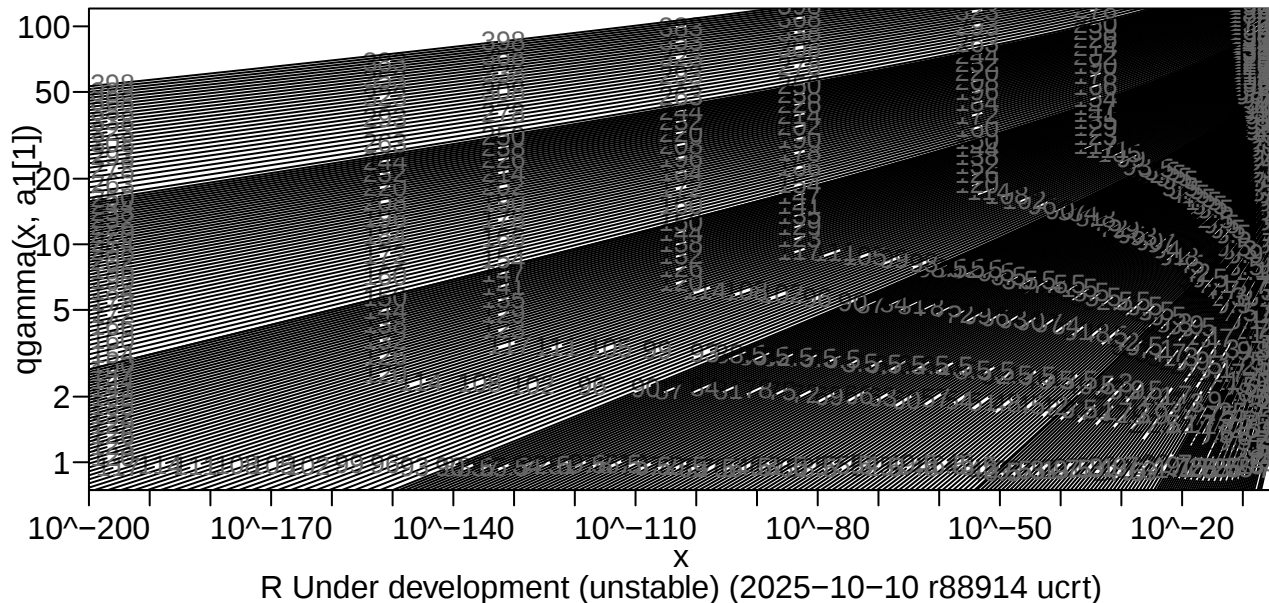
qgamma(x, a) for very small x, a in [9, 90] – log-log



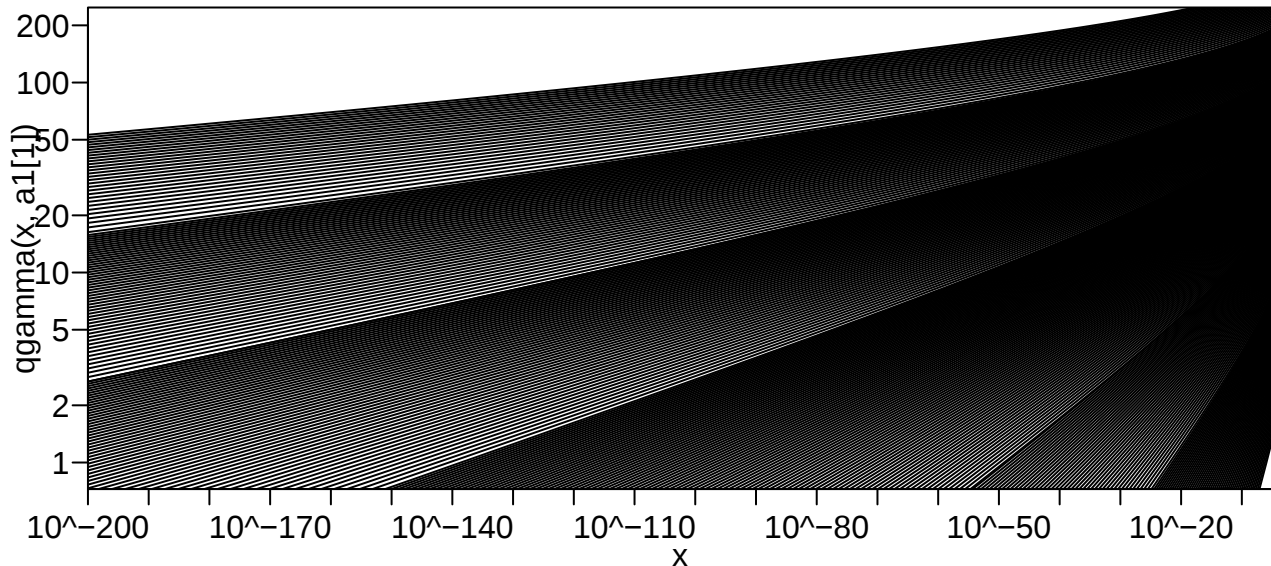
qgamma(x, a) for very small x, a in [9, 150] – log-log



qgamma(x, a) for very small x, a in [9, 398] – log-log

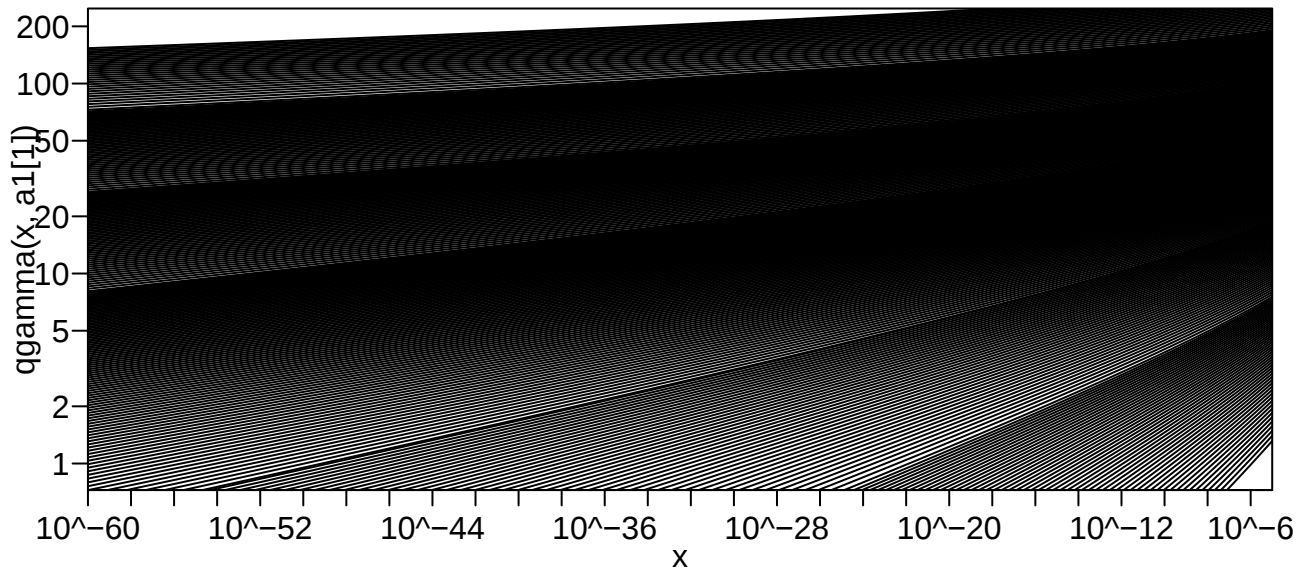


qgamma(x, a) for very small x, a in [9, 398] – log-log

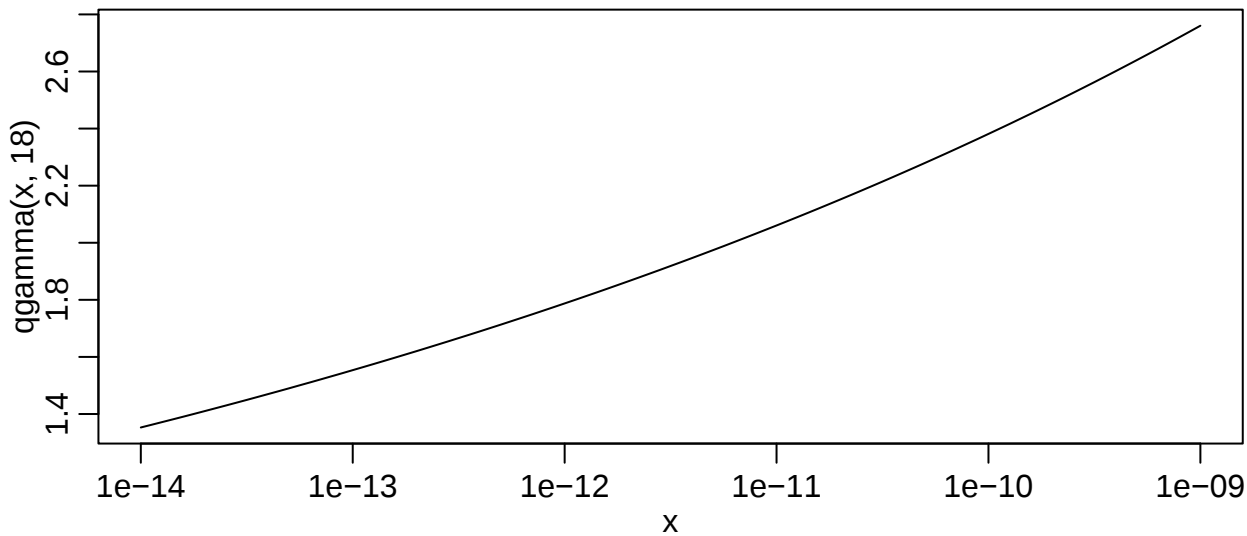
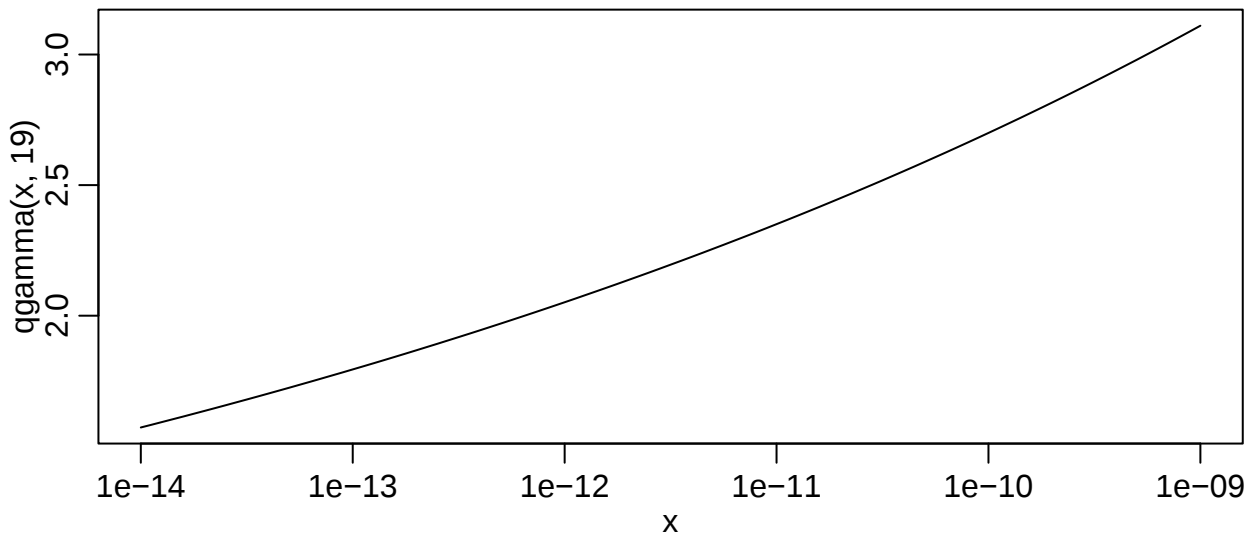


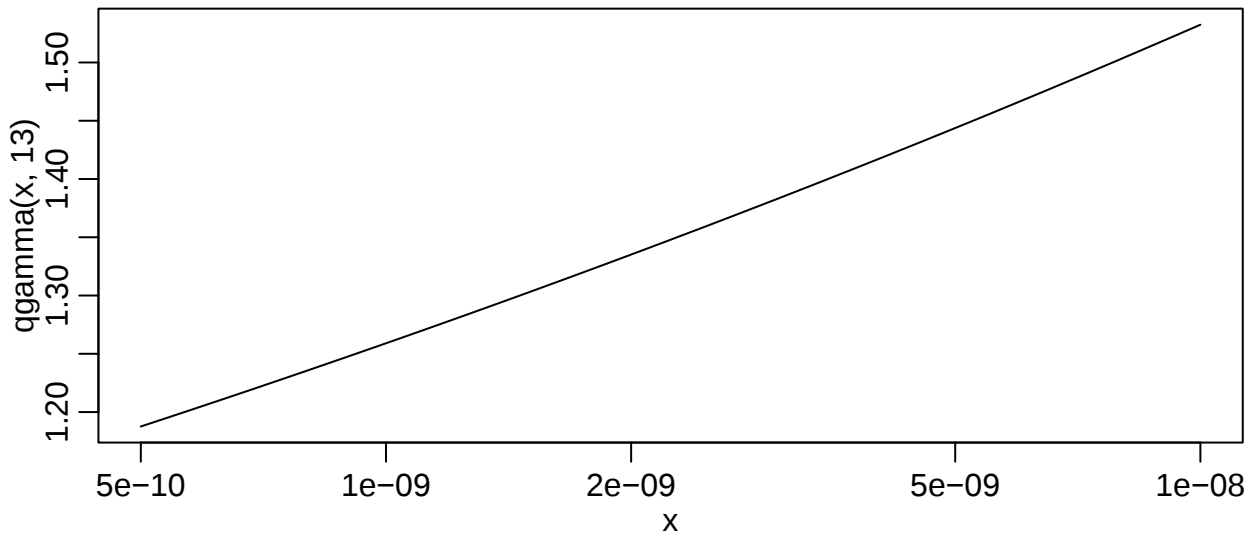
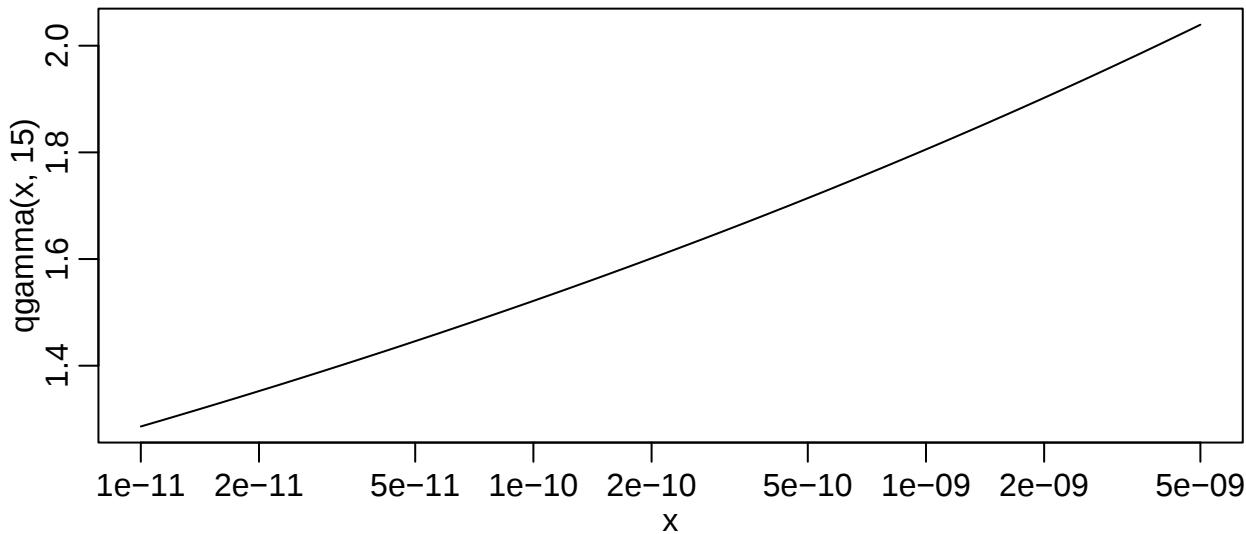
R Under development (unstable) (2025-10-10 r88914 ucrt)

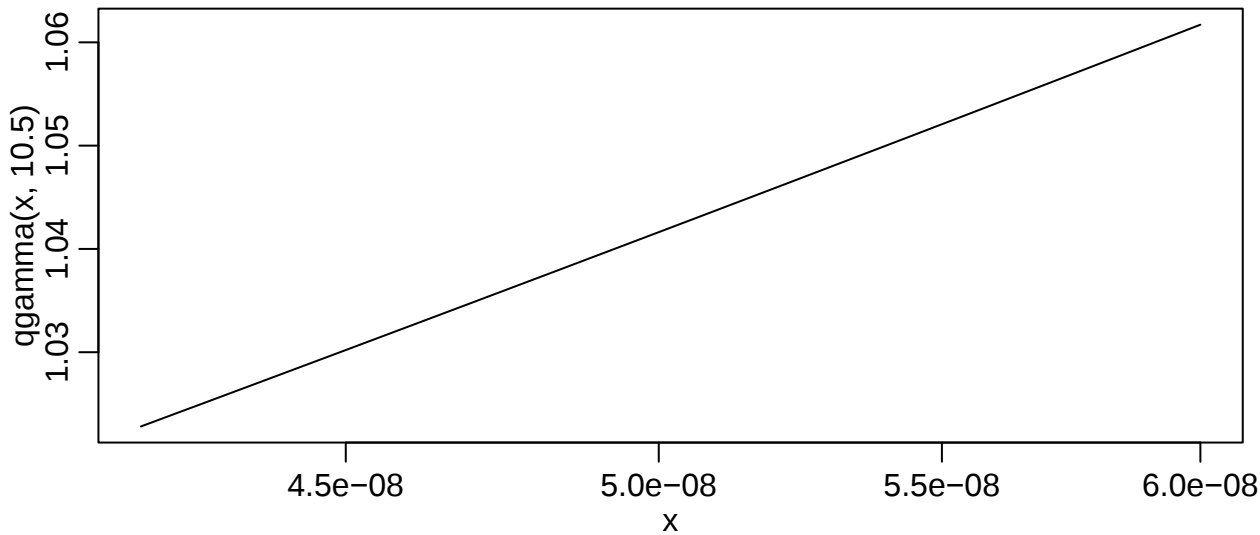
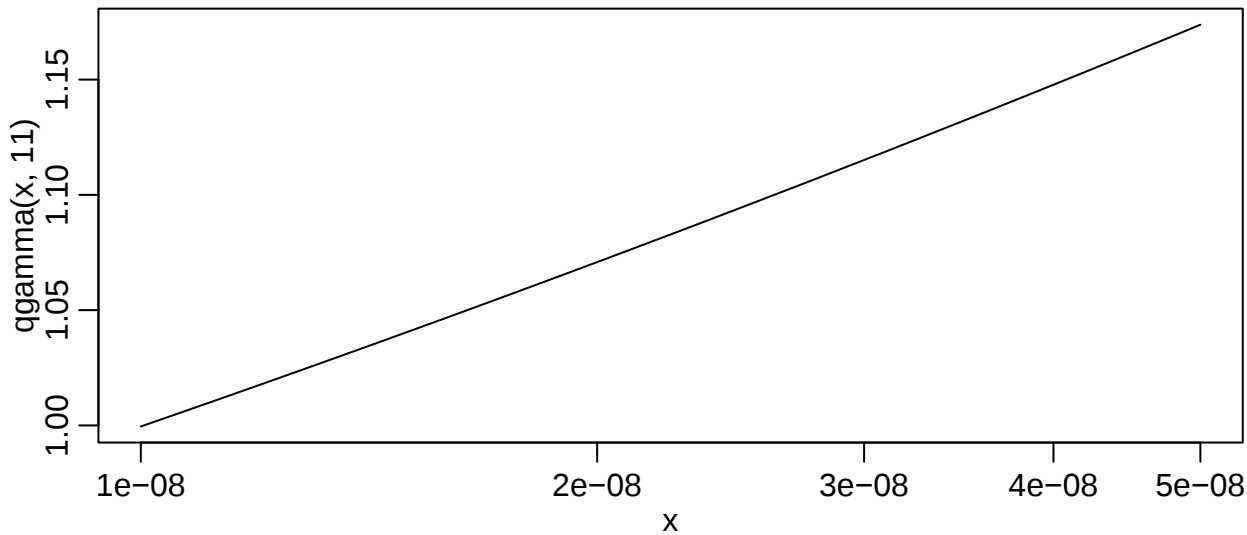
qgamma(x, a) for very small x, a in [9, 398] – log-log

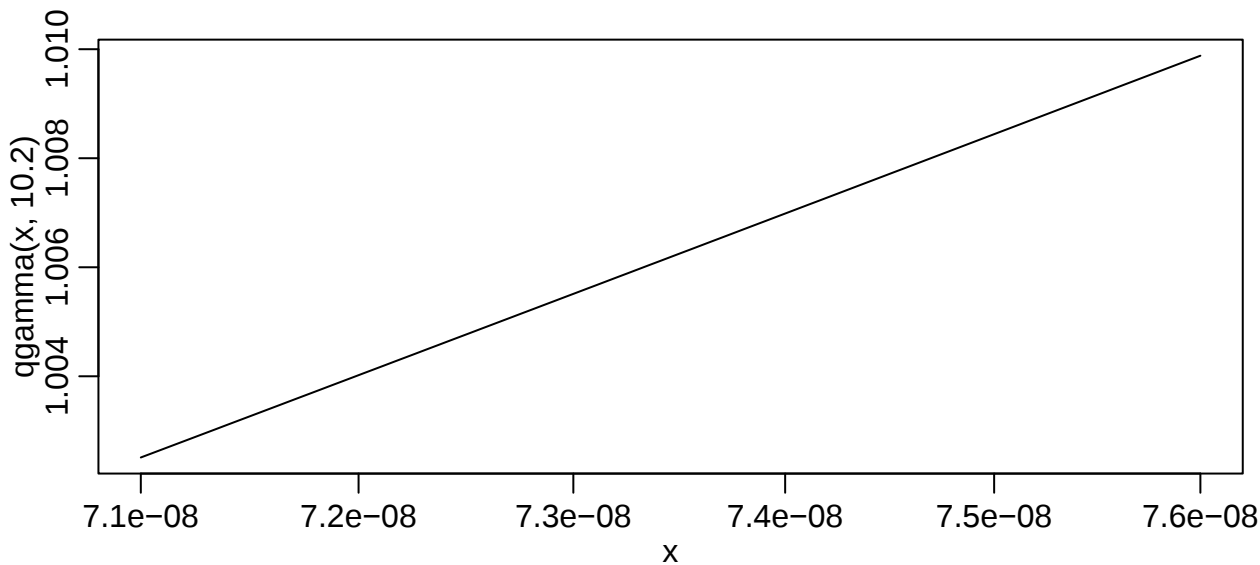
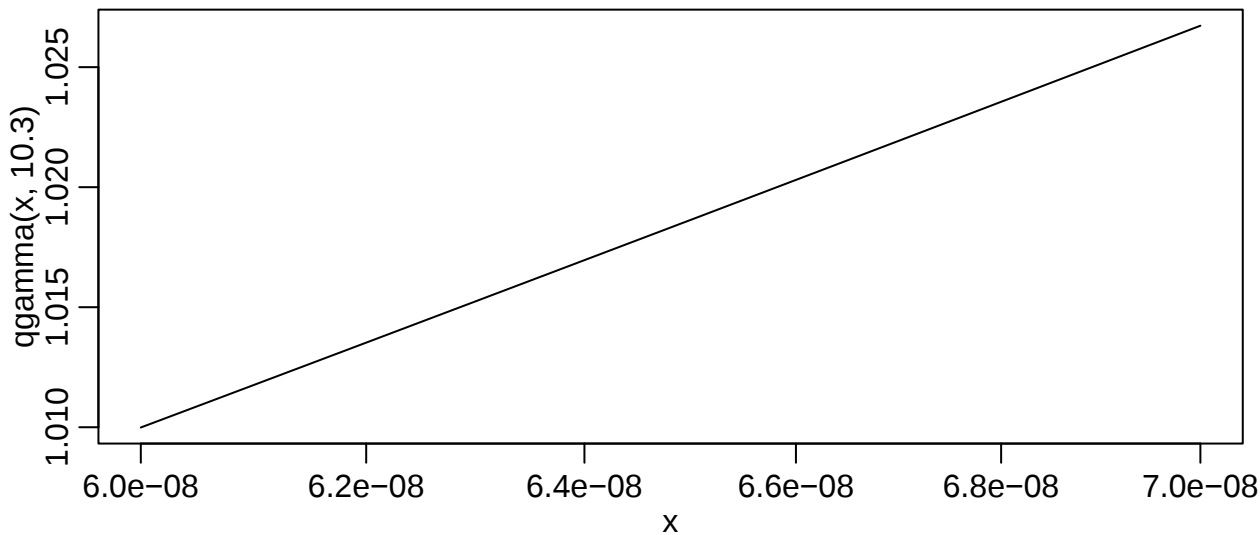


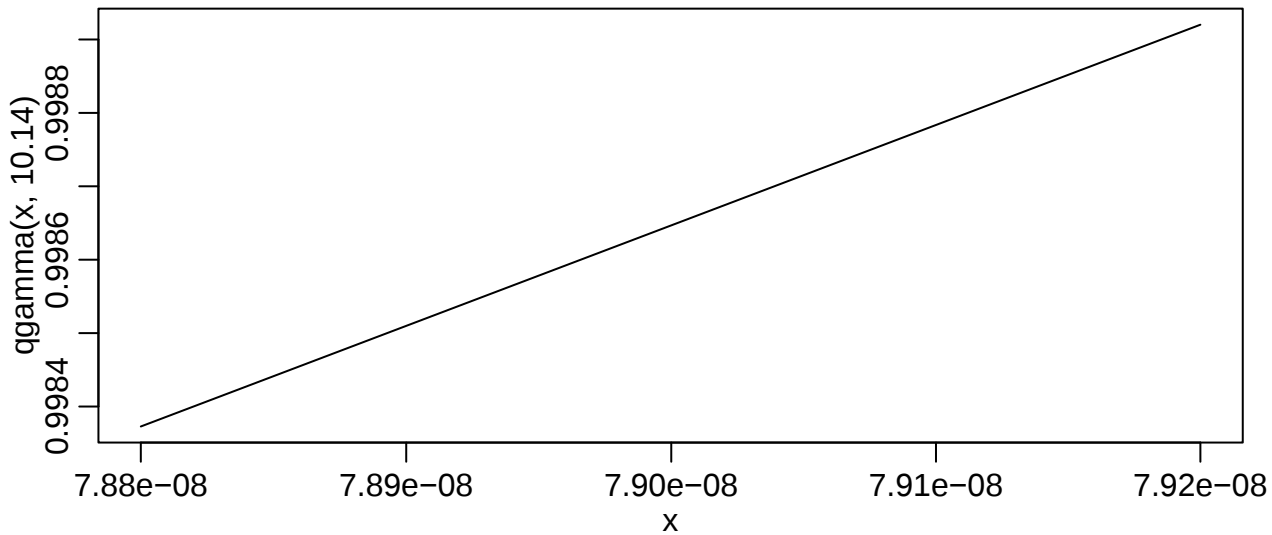
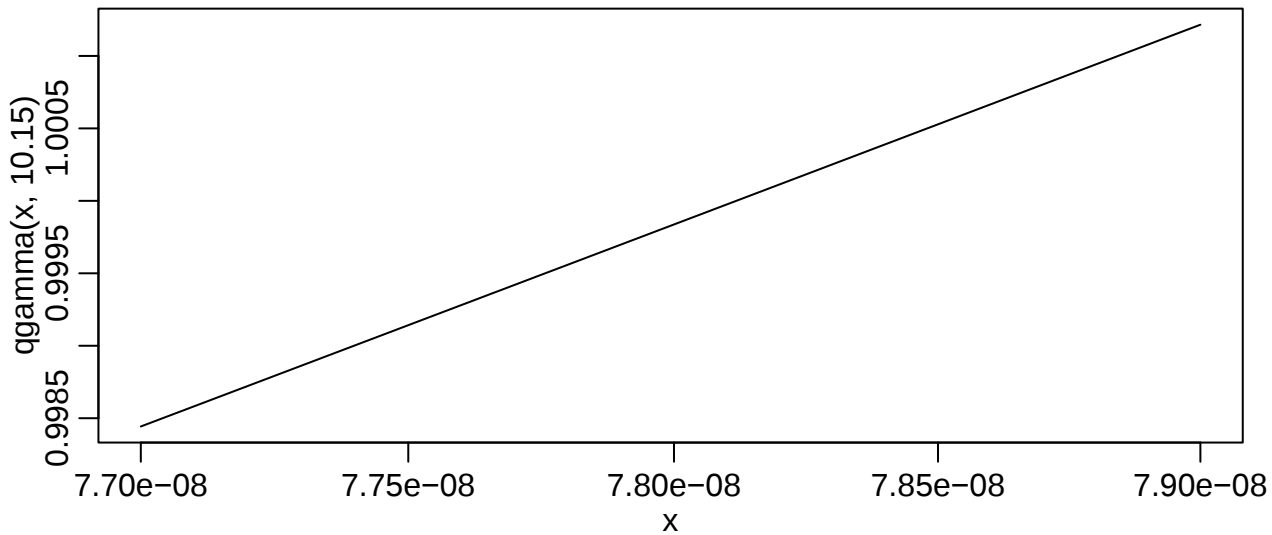
R Under development (unstable) (2025-10-10 r88914 ucrt)

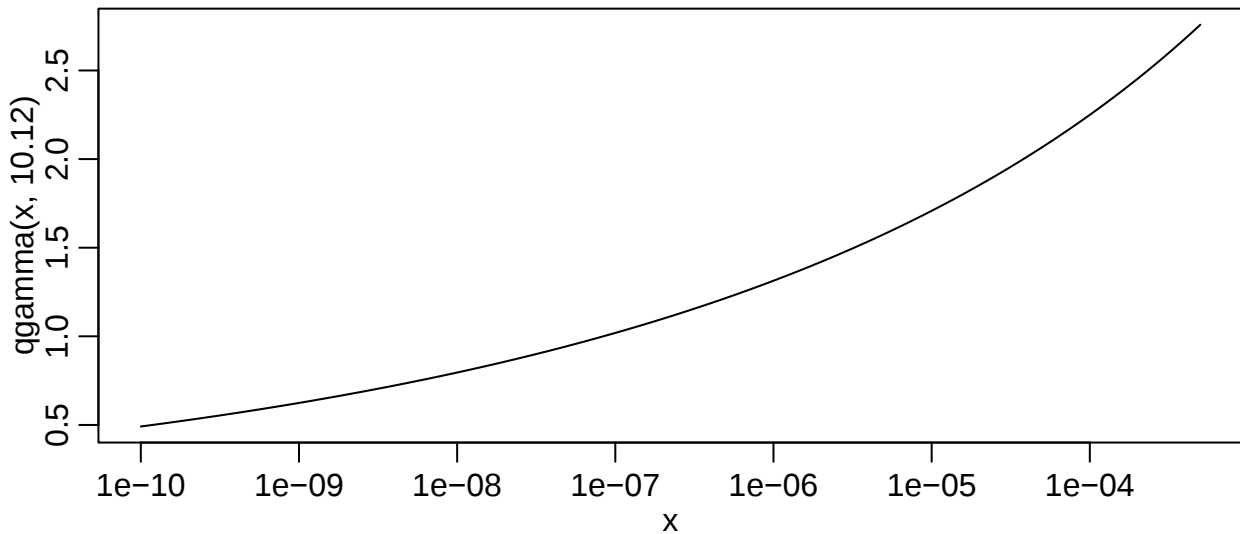
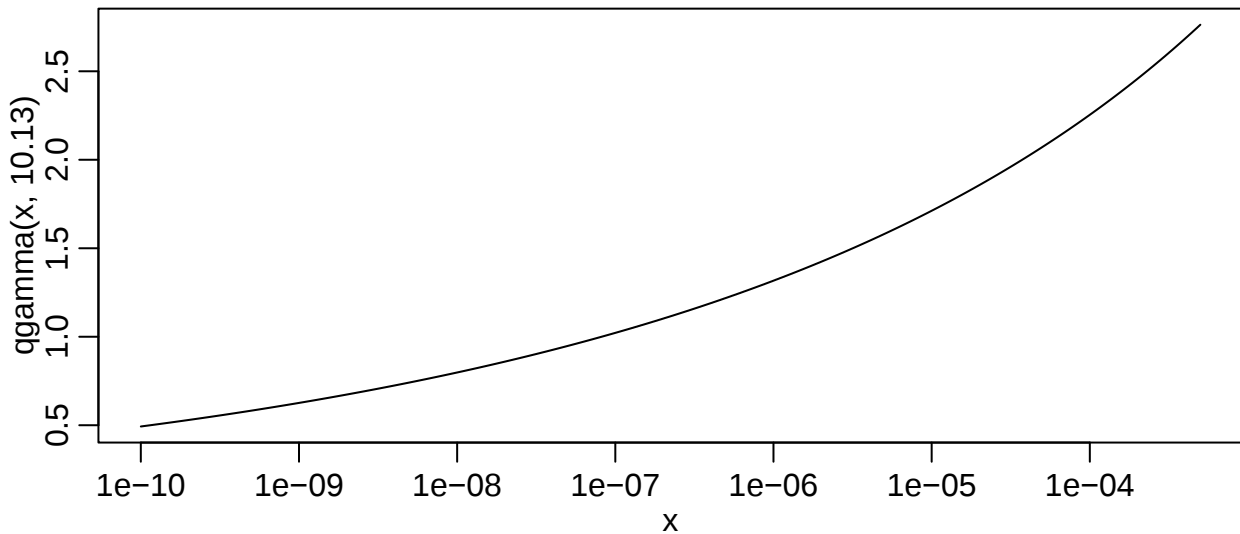


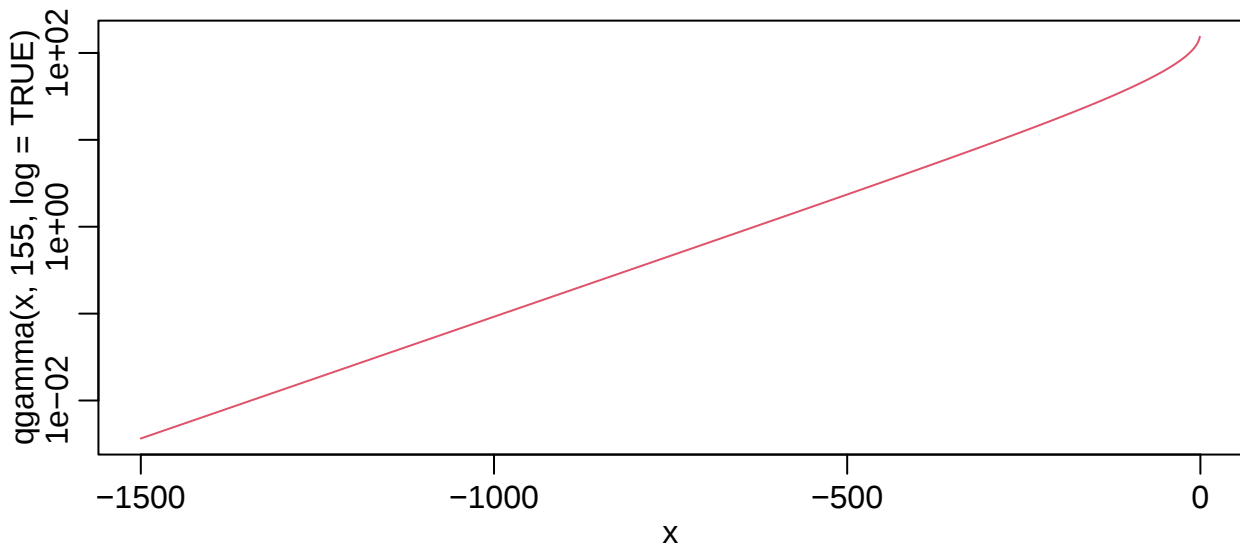
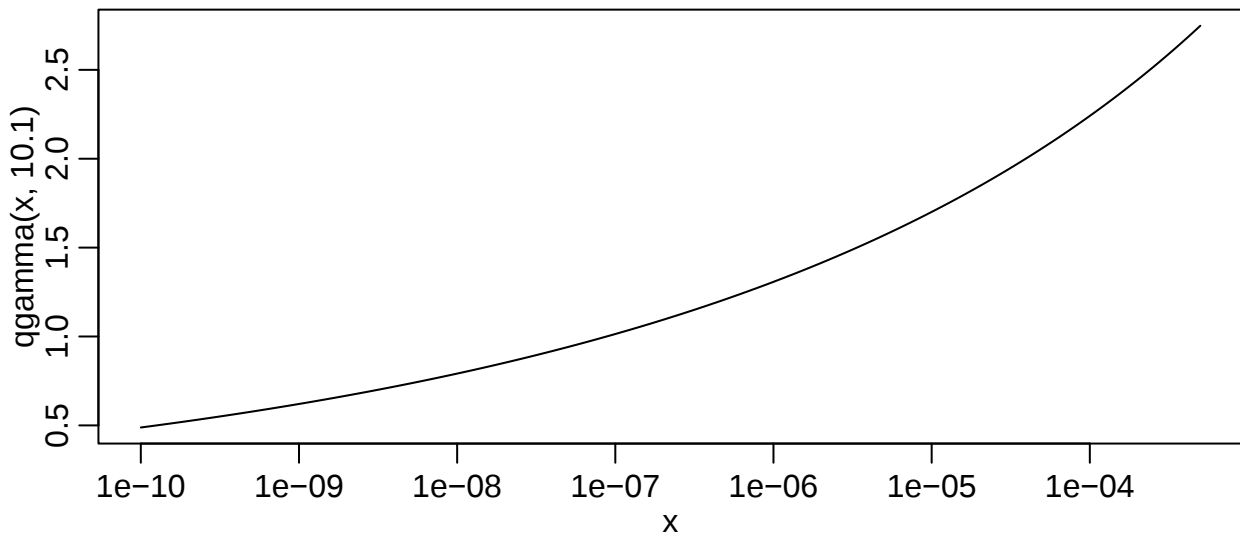


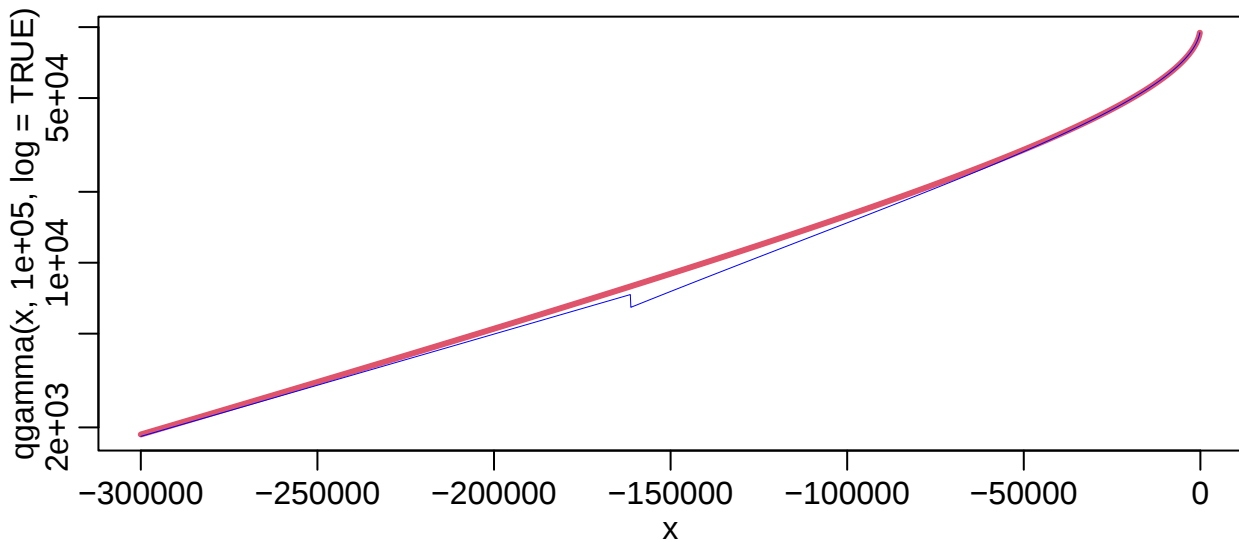
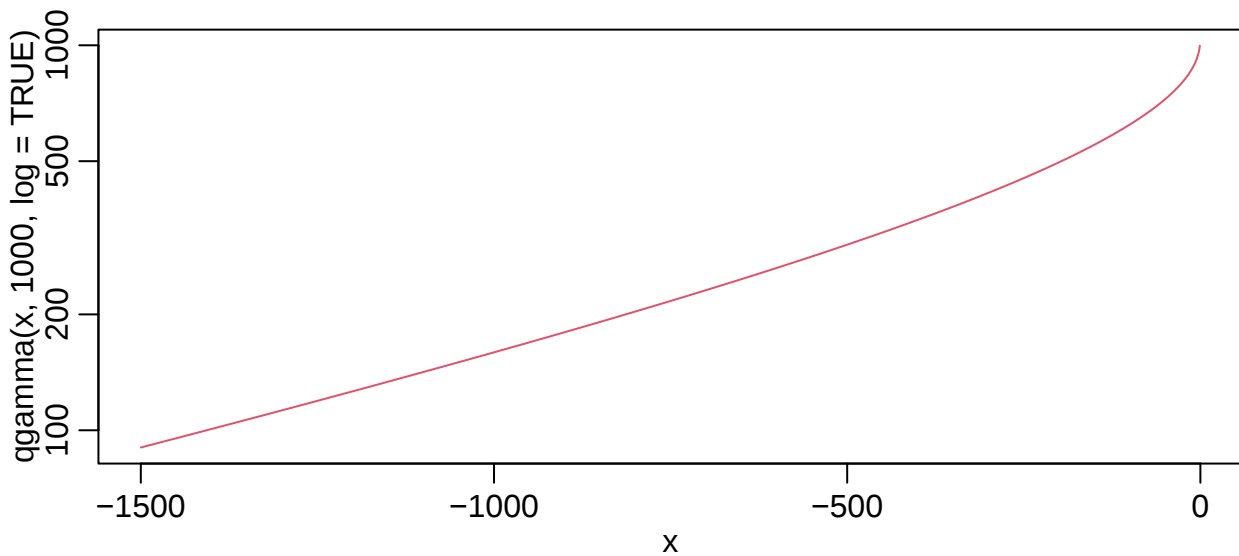


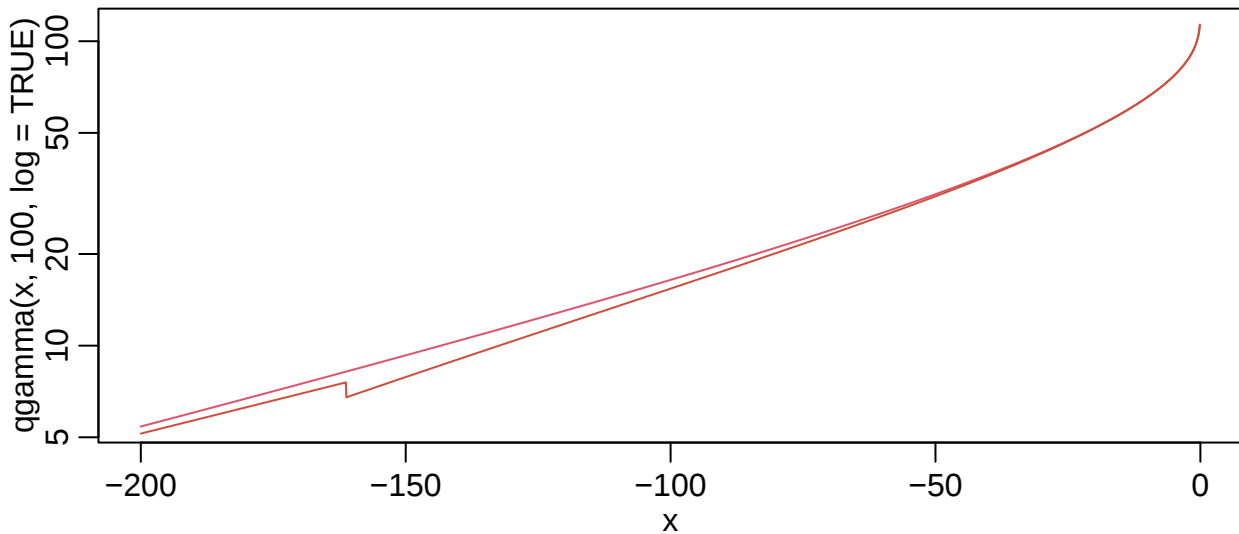
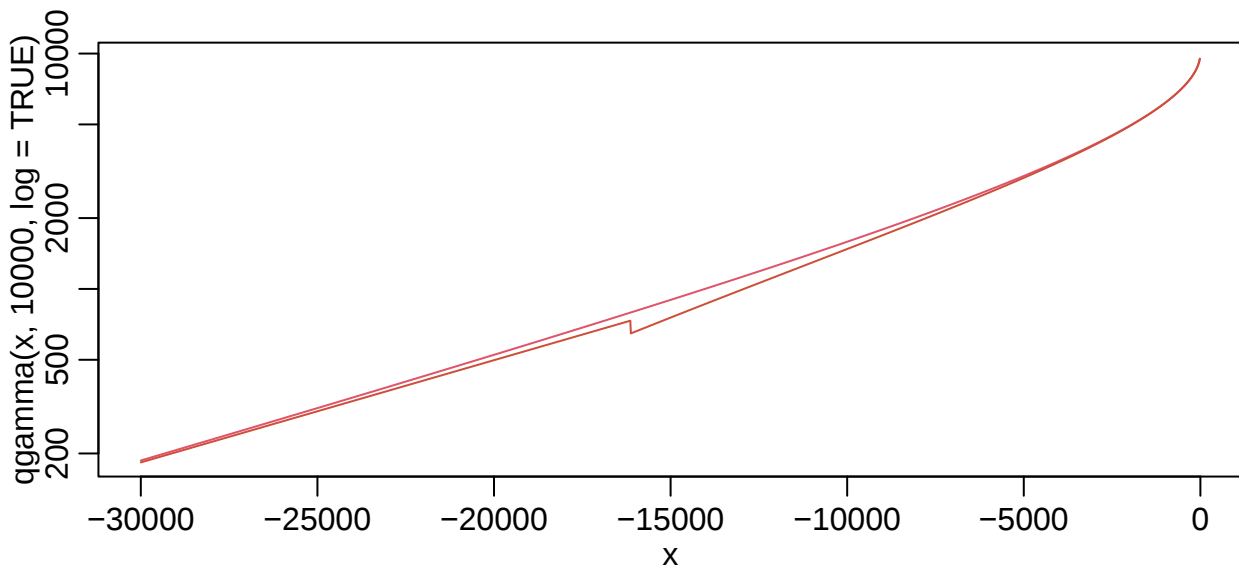


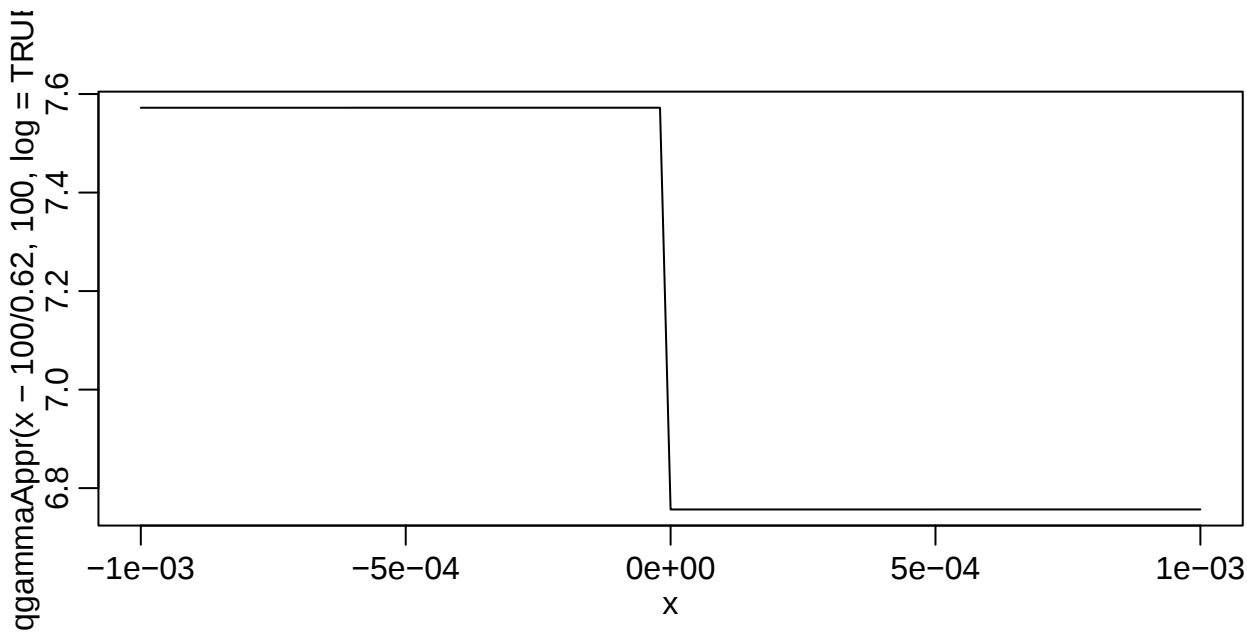
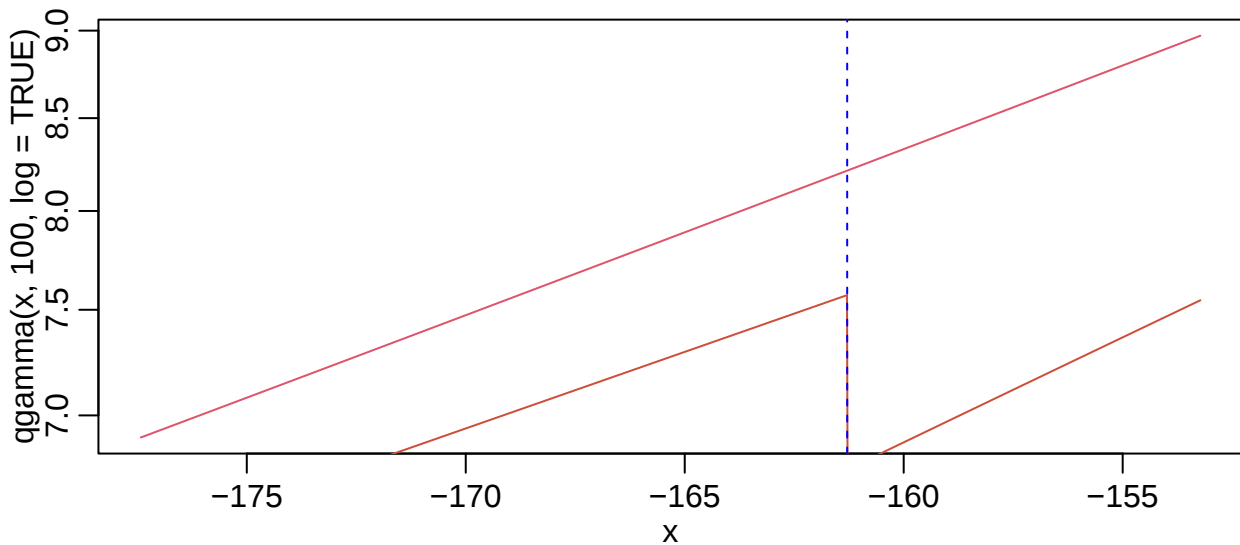




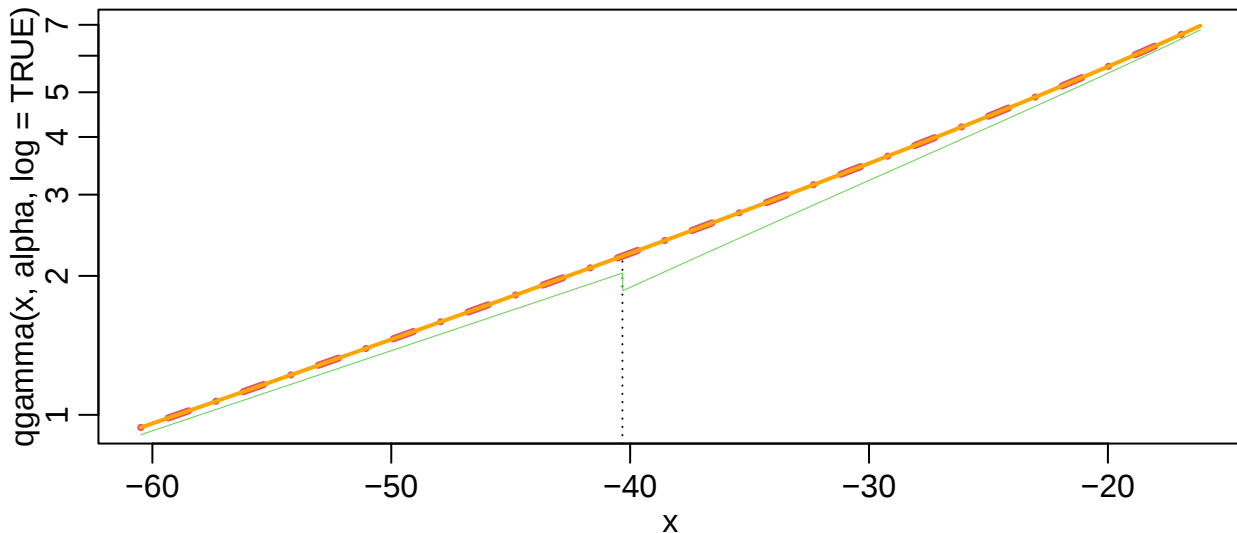




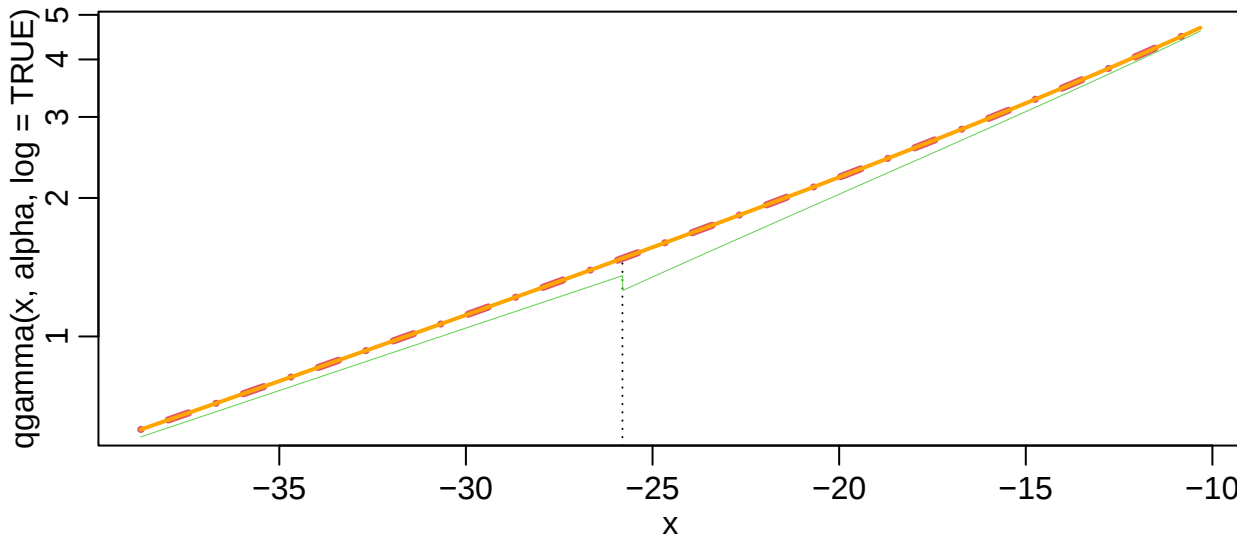




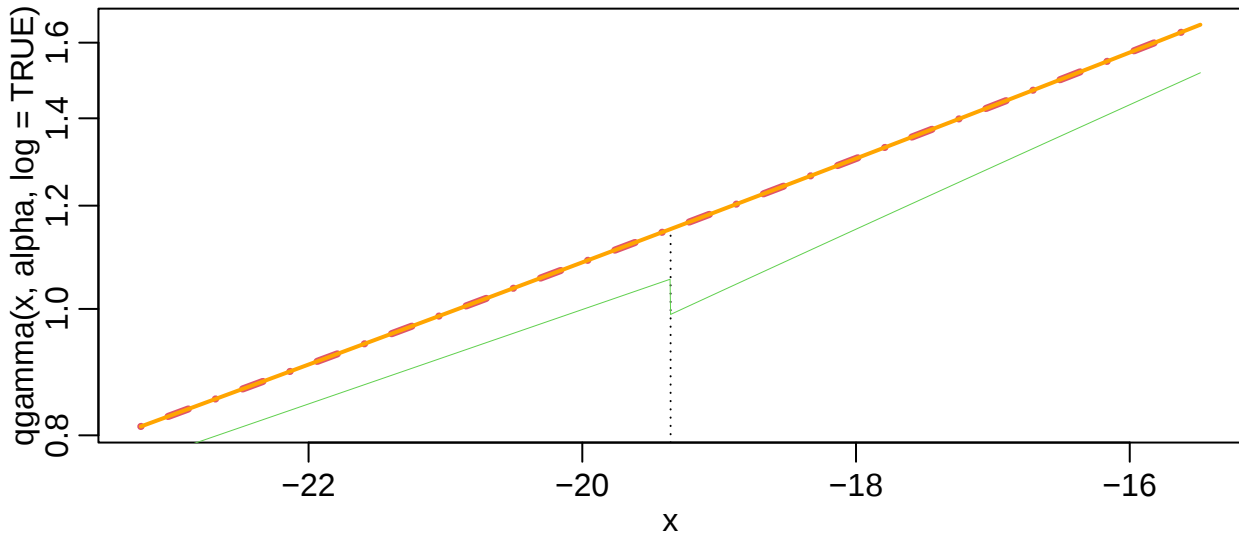
qgamma(x, alpha= 25 , log = TRUE)



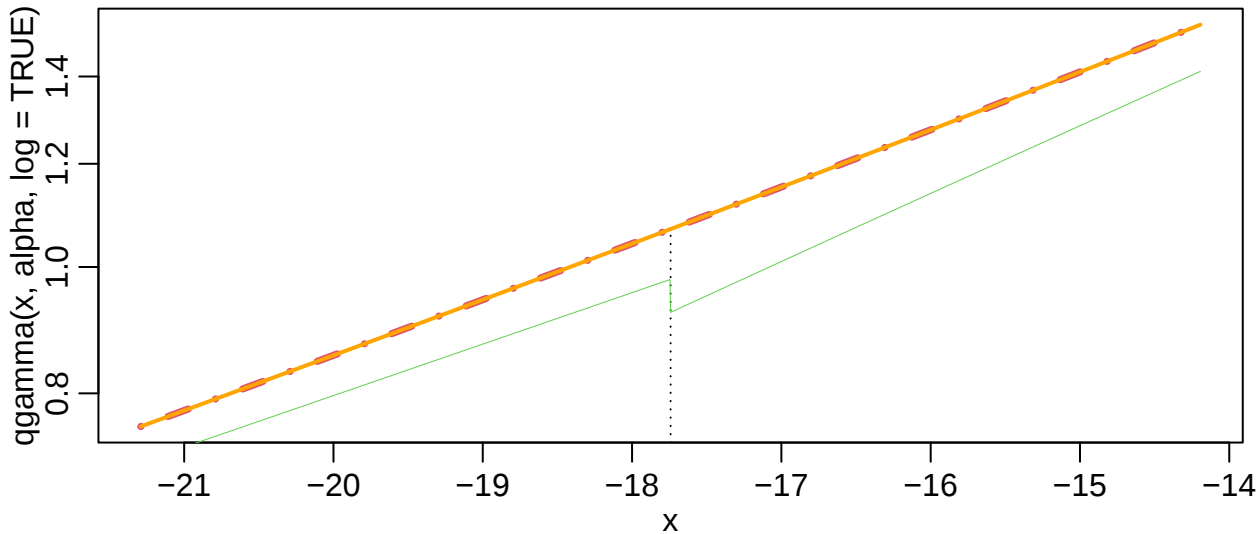
qgamma(x, alpha= 16 , log = TRUE)



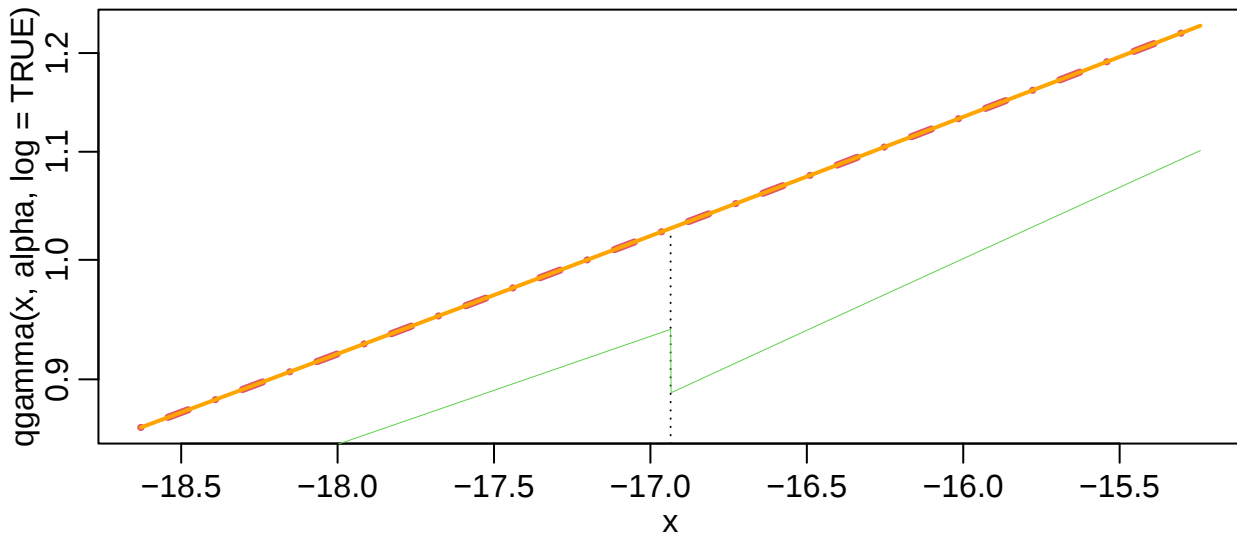
qgamma(x, alpha= 12 , log = TRUE)



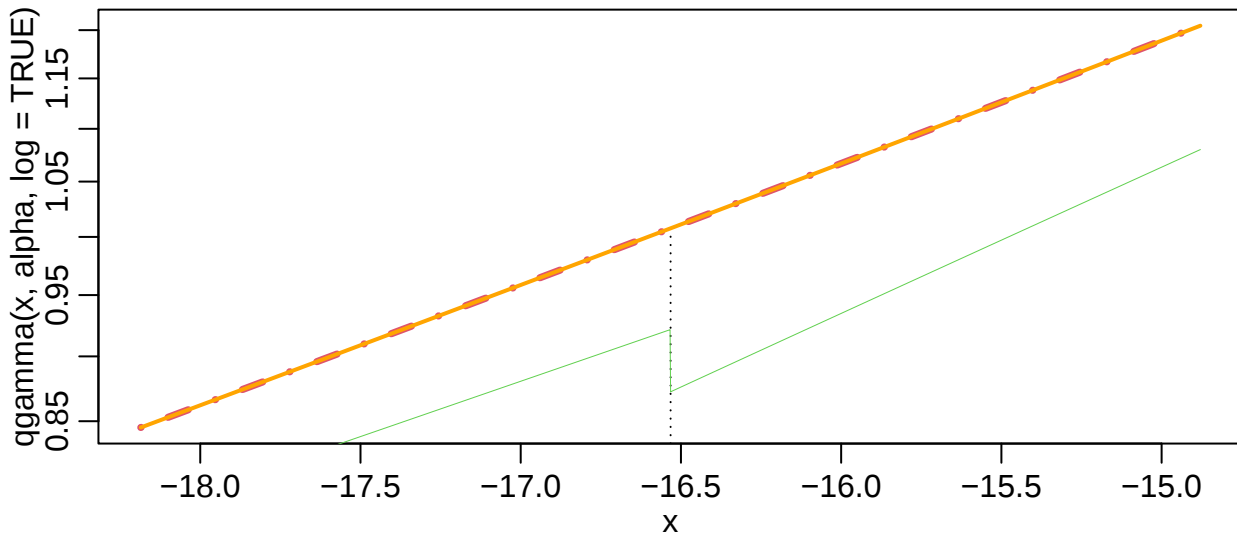
qgamma(x, alpha= 11 , log = TRUE)



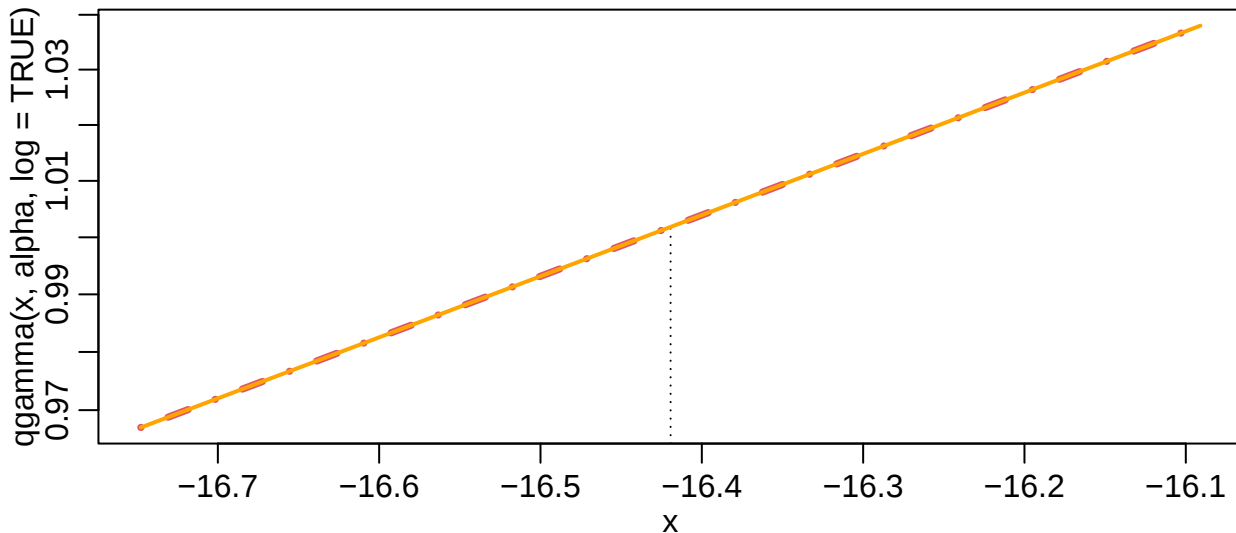
qgamma(x, alpha= 10.5 , log = TRUE)



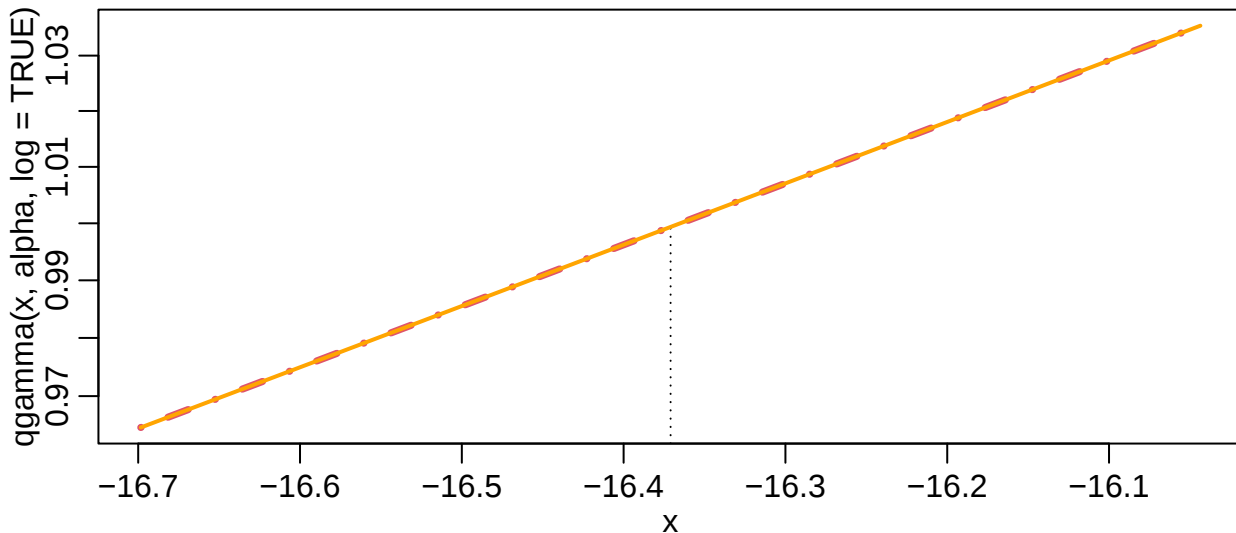
qgamma(x, alpha= 10.25 , log = TRUE)



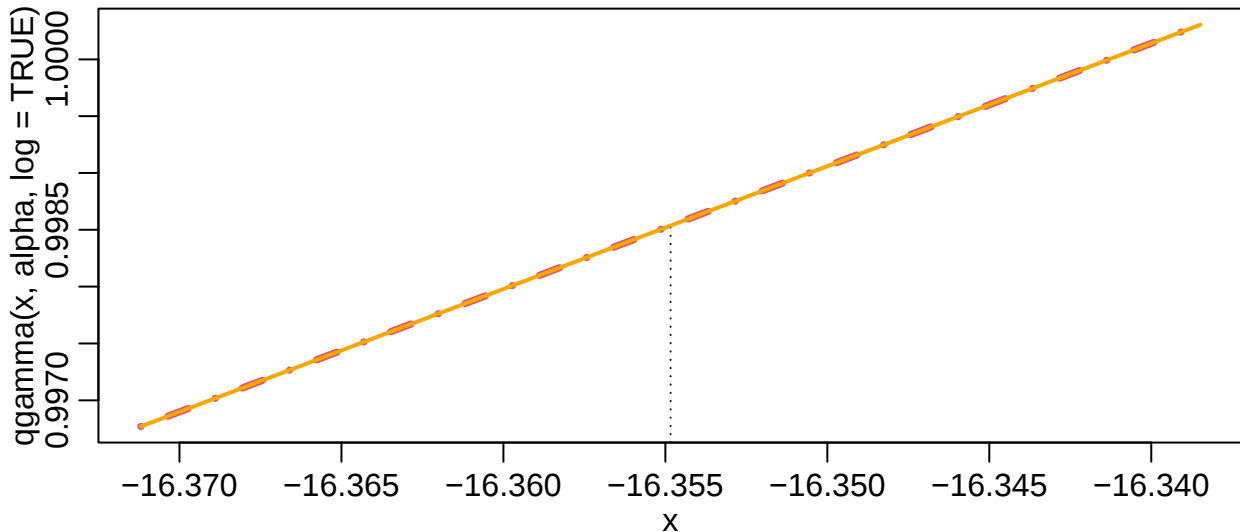
qgamma(x, alpha= 10.18 , log = TRUE)



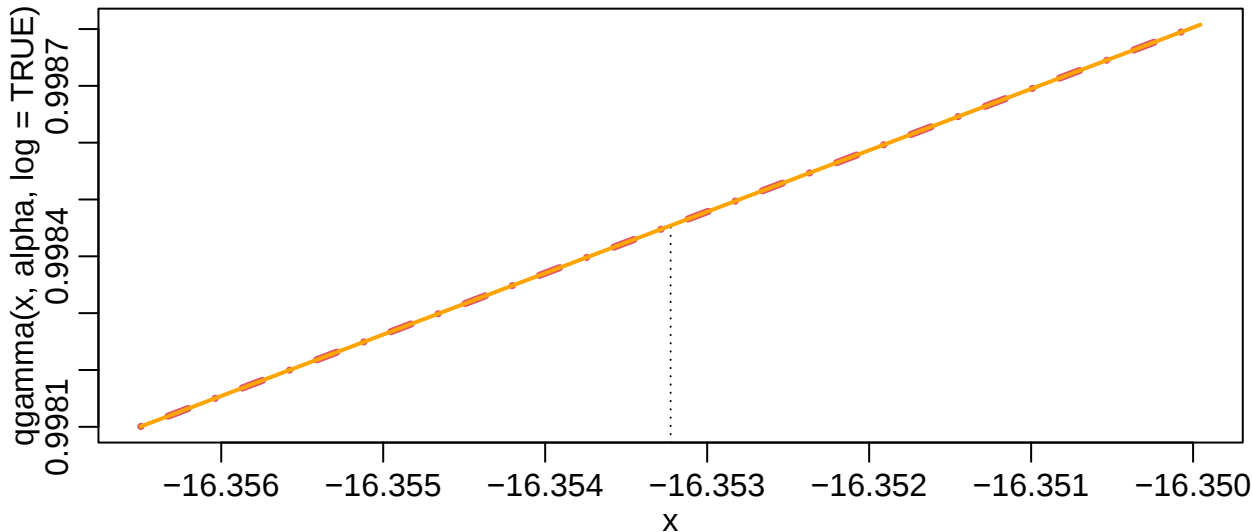
qgamma(x, alpha= 10.15 , log = TRUE)



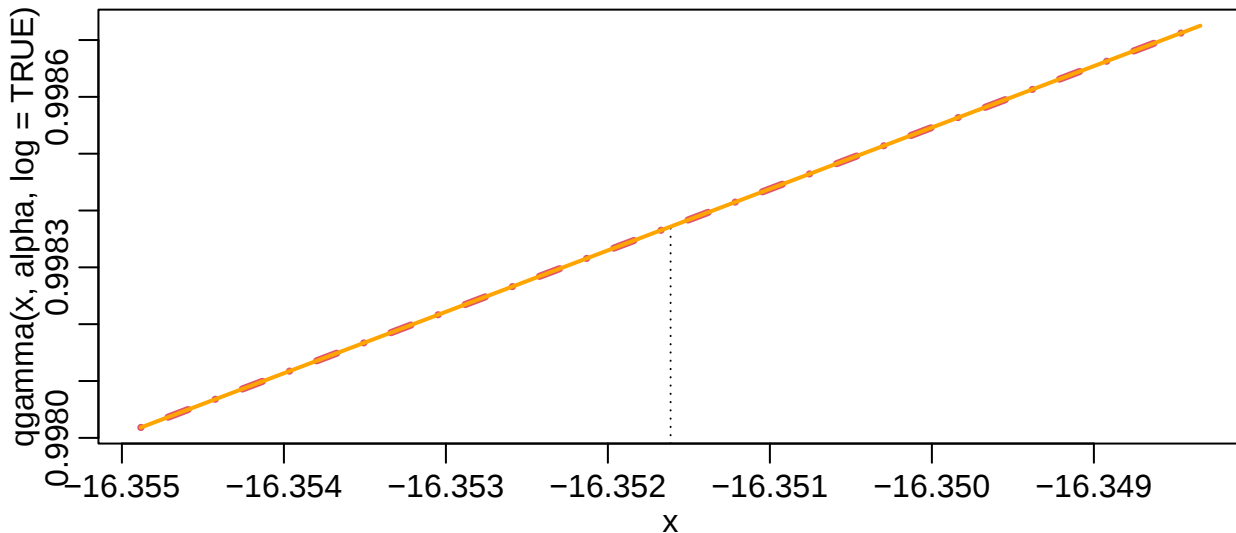
qgamma(x, alpha= 10.14 , log = TRUE)



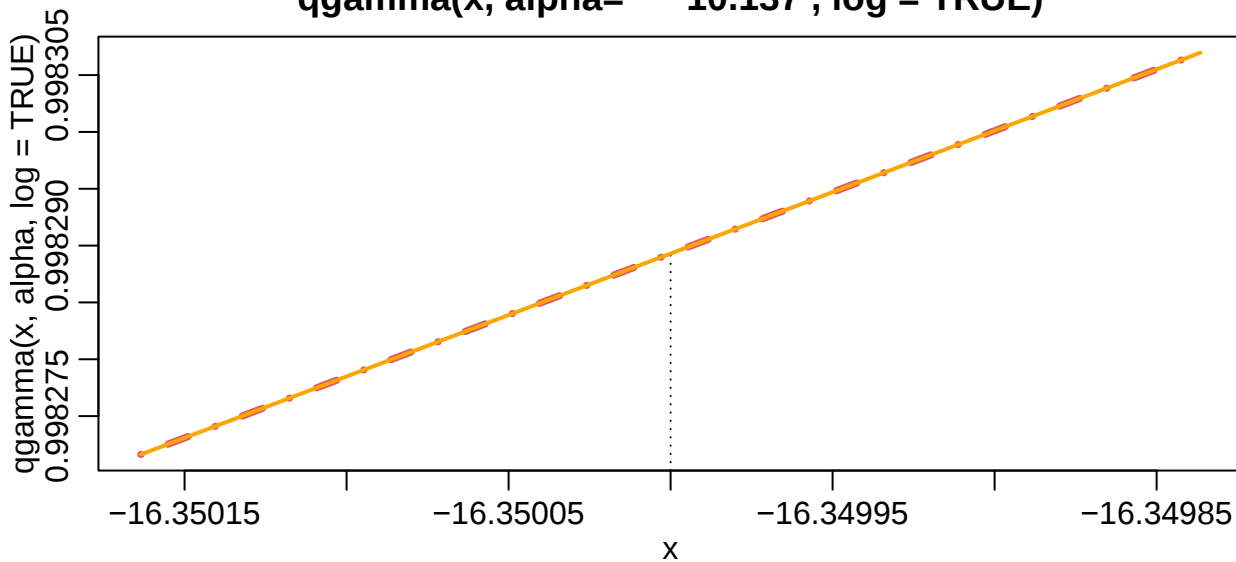
qgamma(x, alpha= 10.139 , log = TRUE)



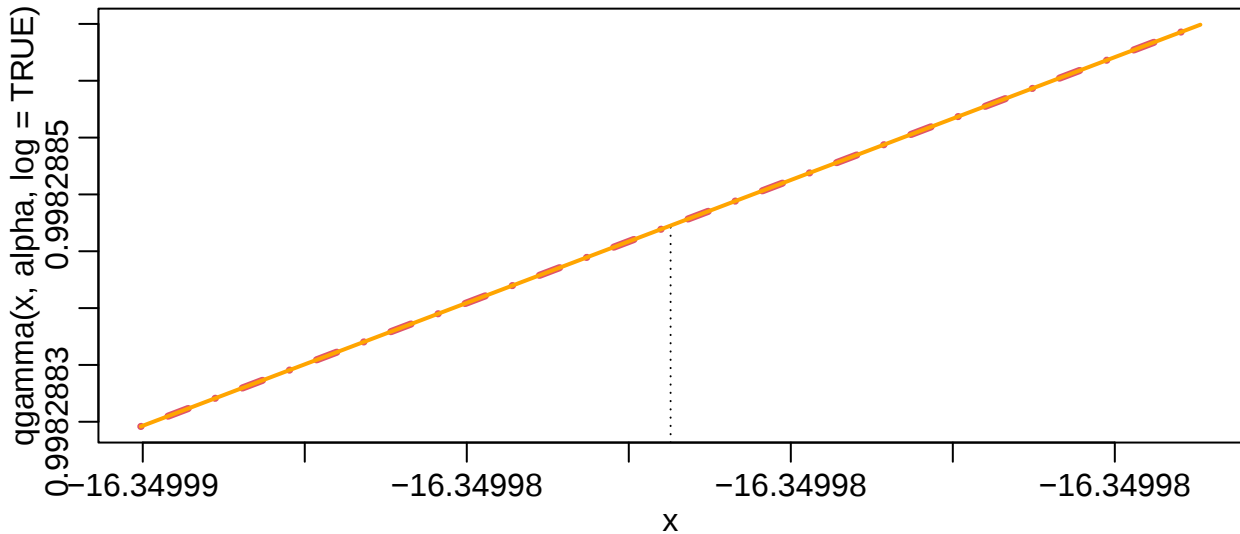
qgamma(x, alpha= 10.138 , log = TRUE)



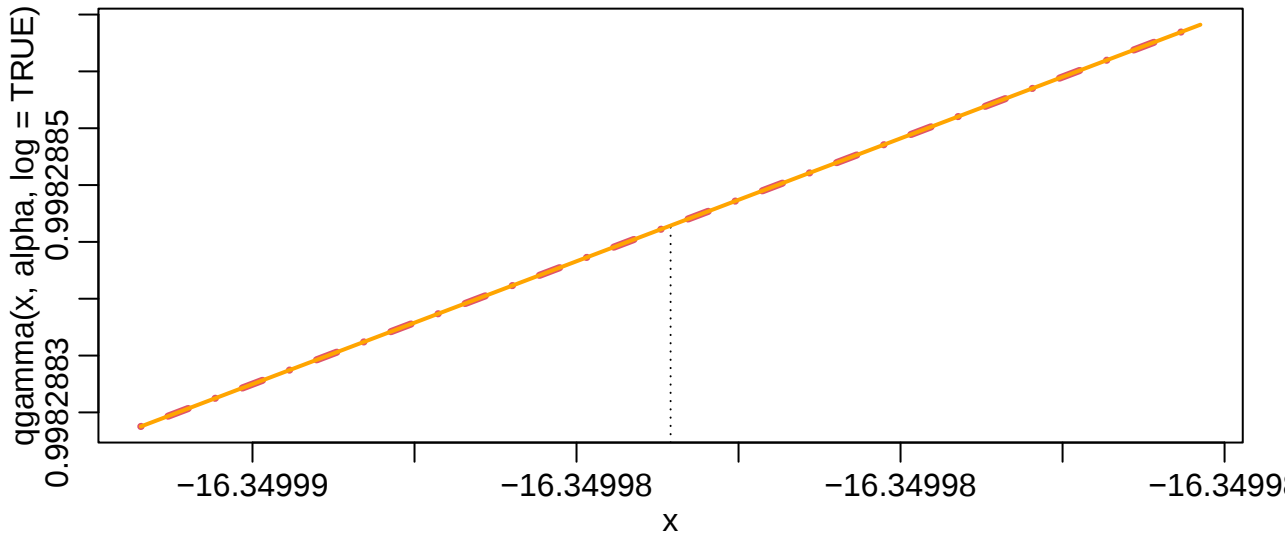
qgamma(x, alpha= 10.137 , log = TRUE)



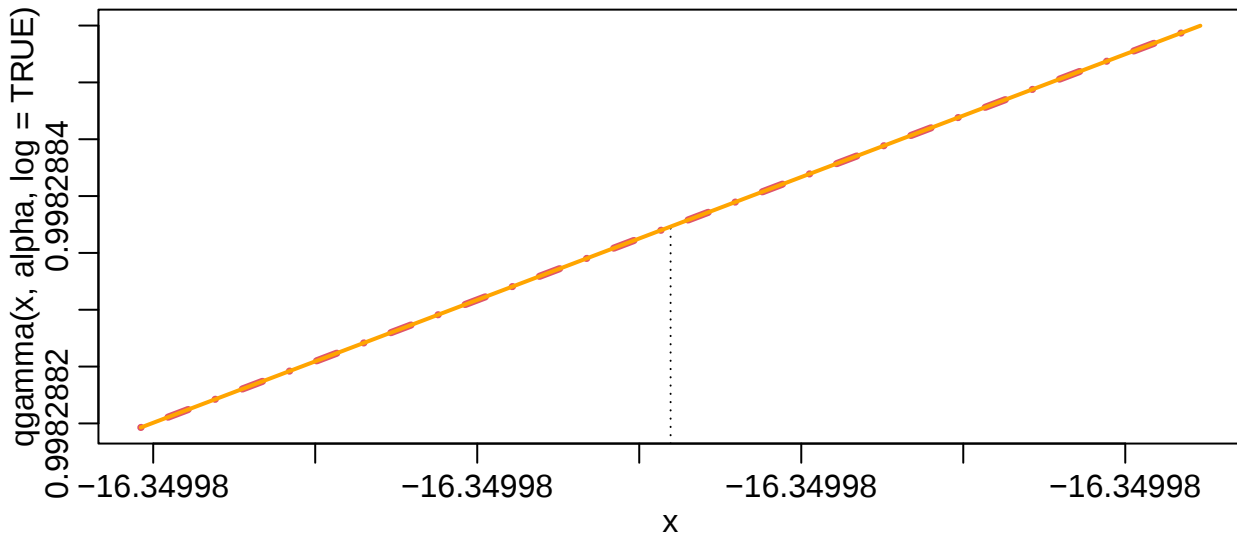
qgamma(x, alpha= 10.13699 , log = TRUE)



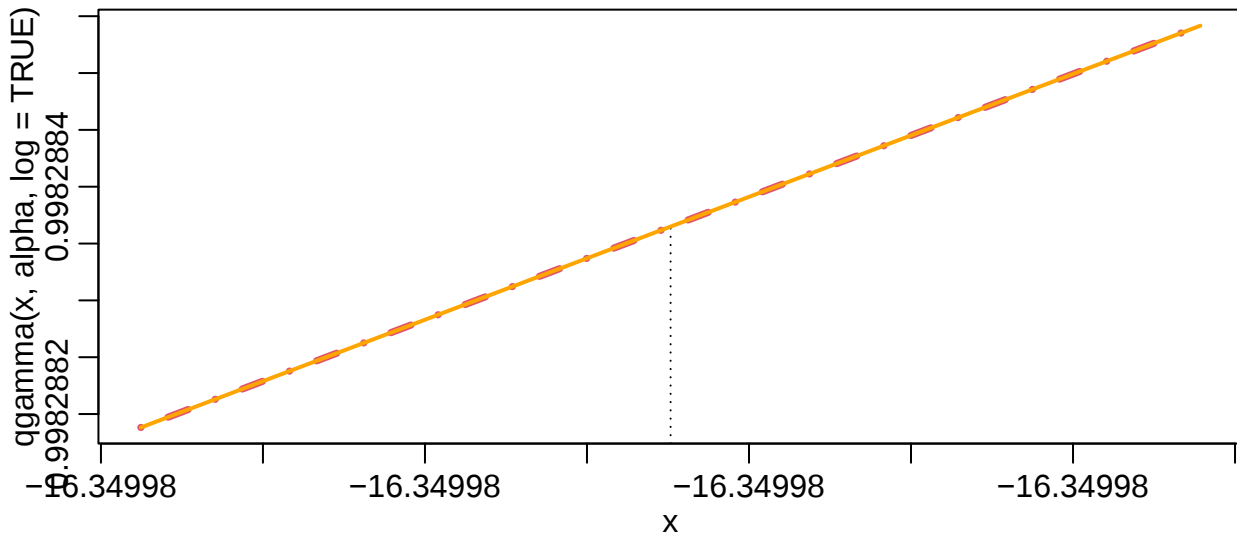
qgamma(x, alpha= 10.1369899 , log = TRUE)



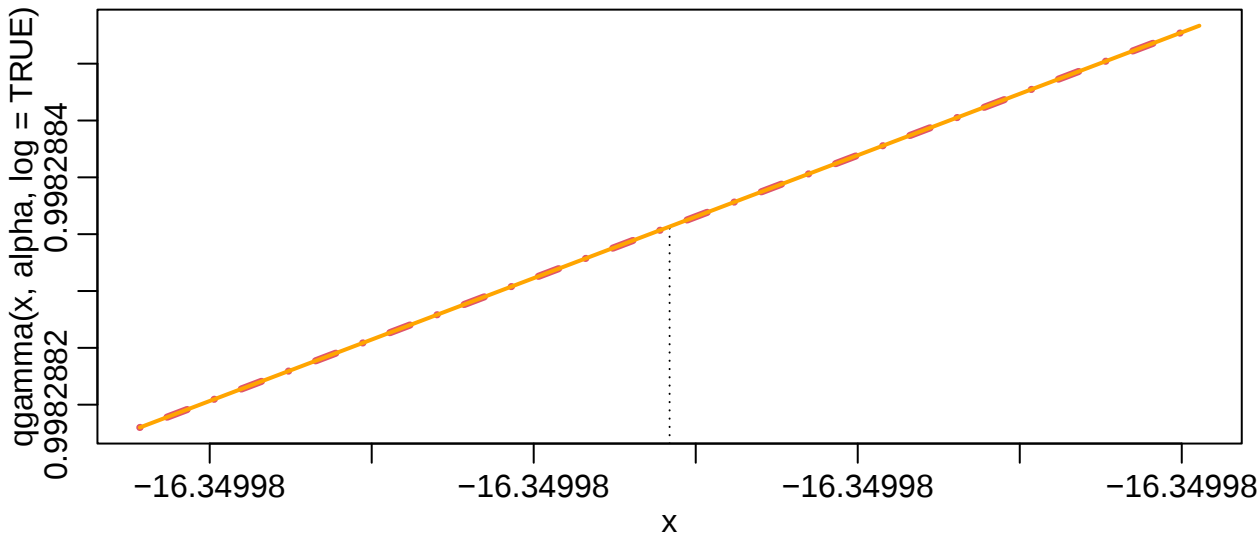
qgamma(x, alpha= 10.1369894 , log = TRUE)



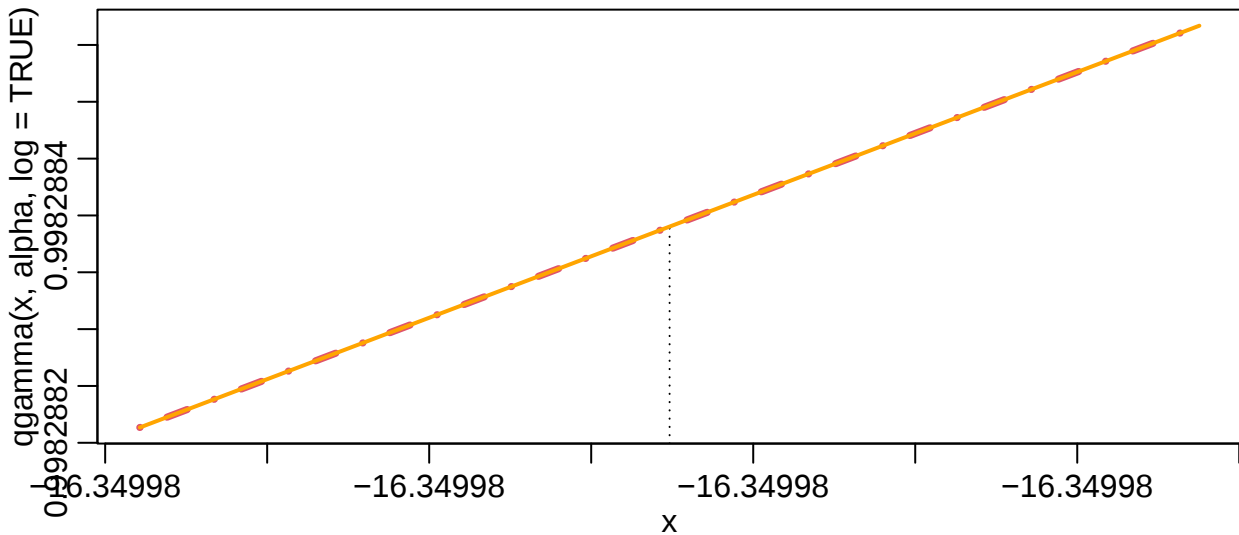
qgamma(x, alpha= 10.1369893 , log = TRUE)



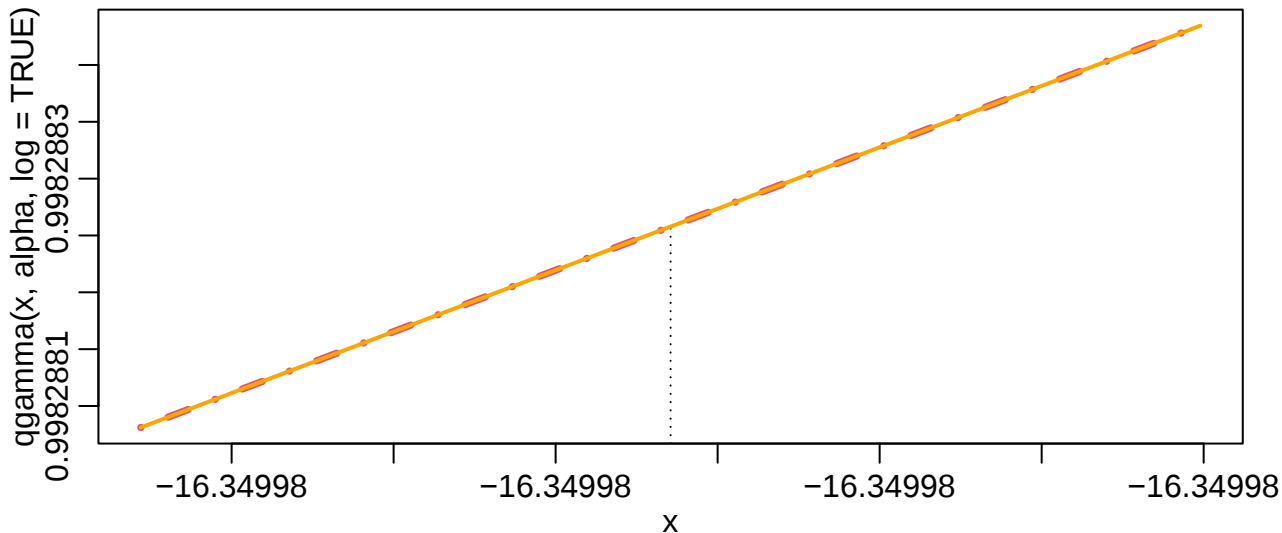
qgamma(x, alpha= 10.1369892 , log = TRUE)



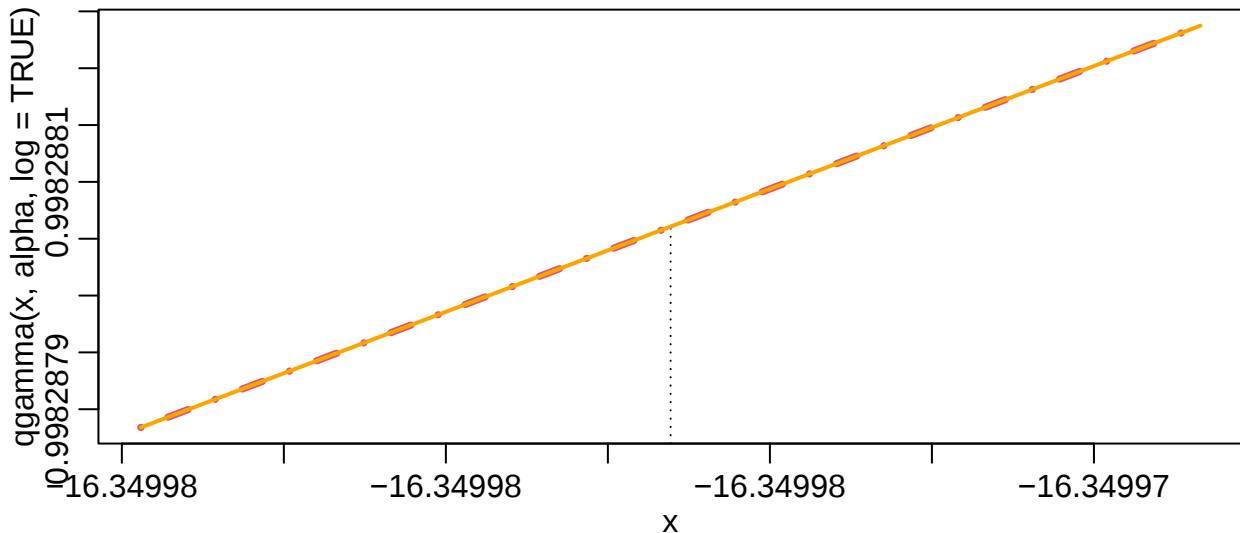
qgamma(x, alpha= 10.136989 , log = TRUE)



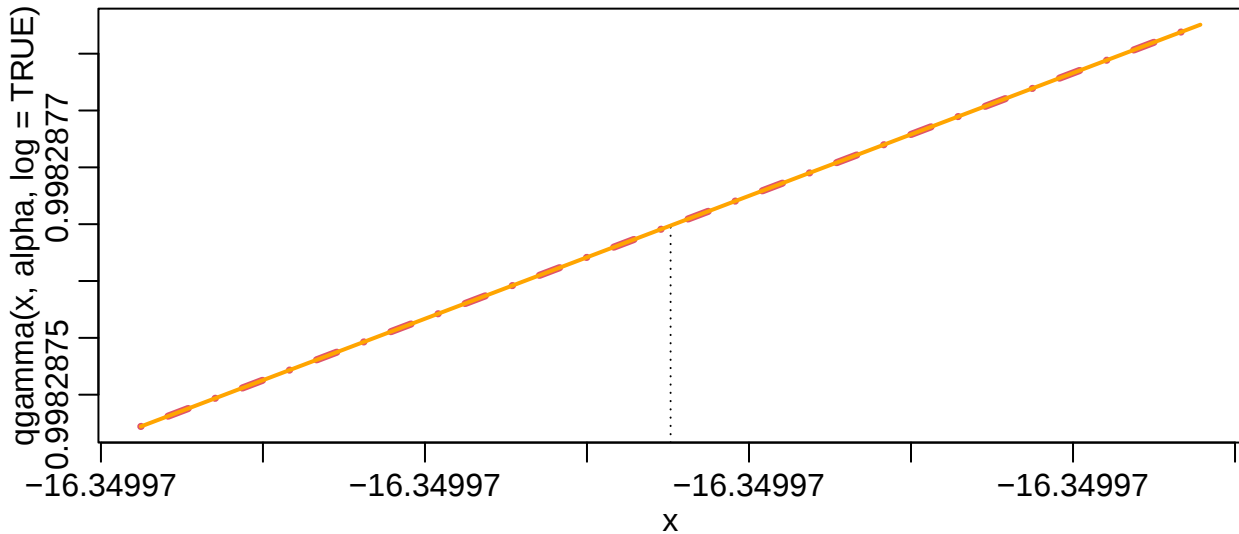
qgamma(x, alpha= 10.136988 , log = TRUE)



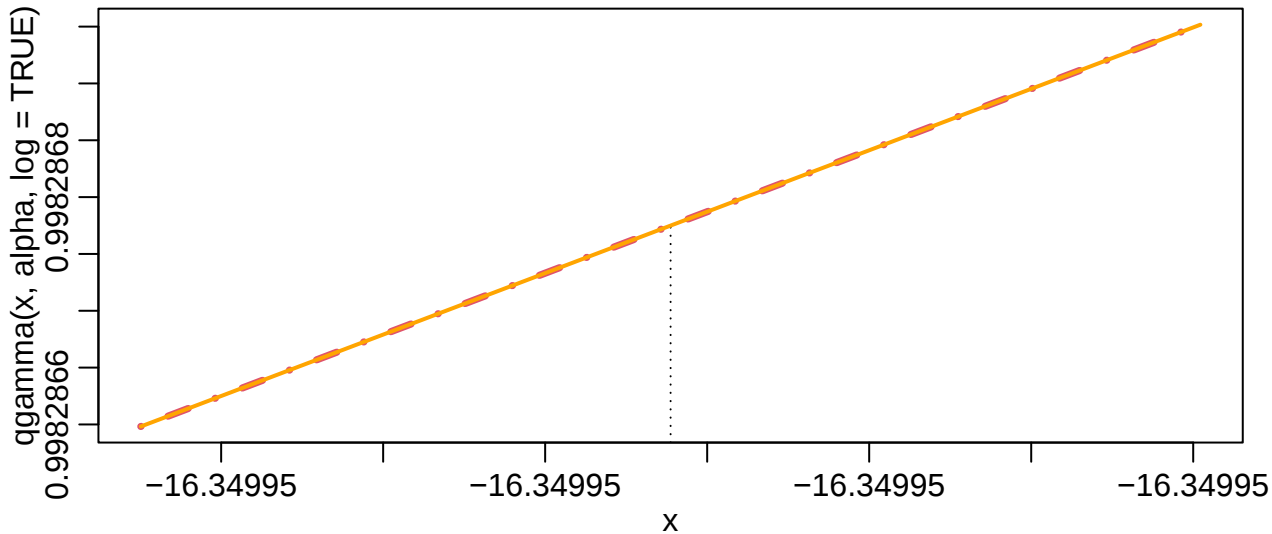
qgamma(x, alpha= 10.136985 , log = TRUE)



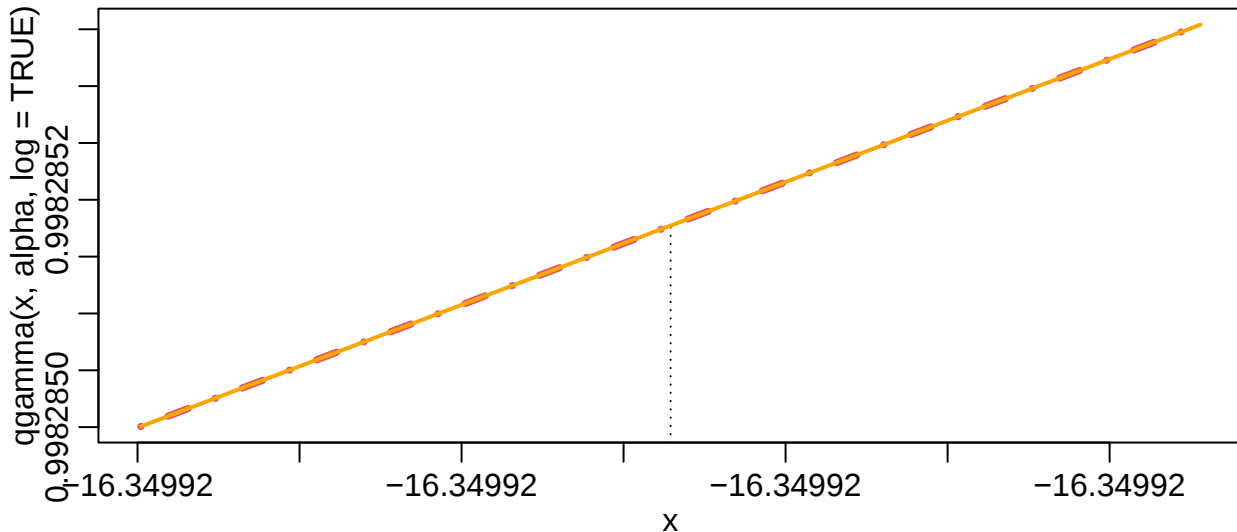
qgamma(x, alpha= 10.13698 , log = TRUE)



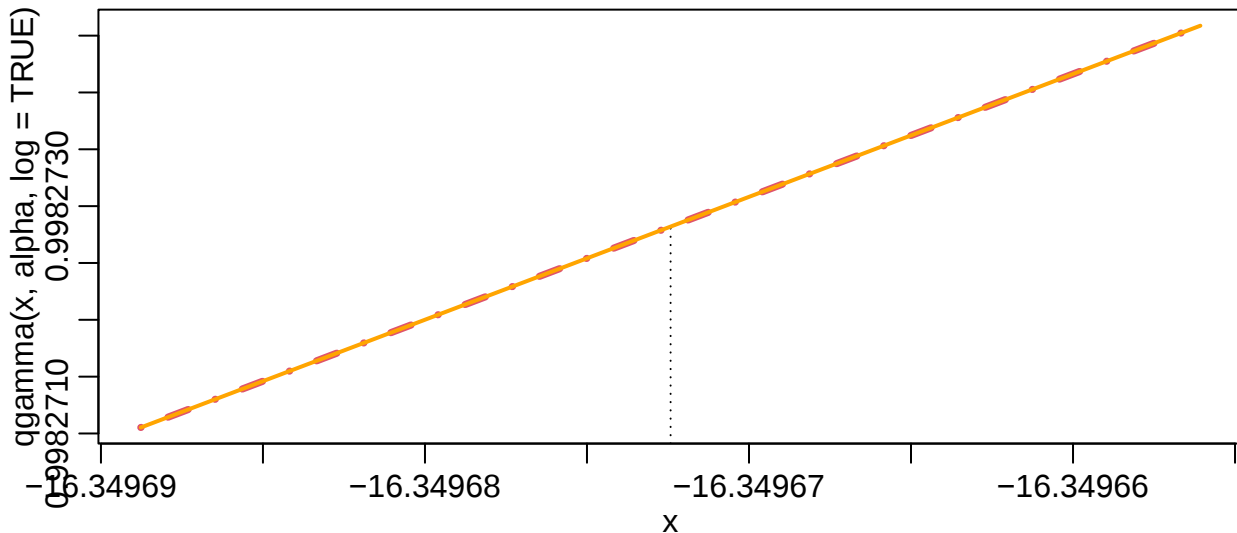
qgamma(x, alpha= 10.13697 , log = TRUE)



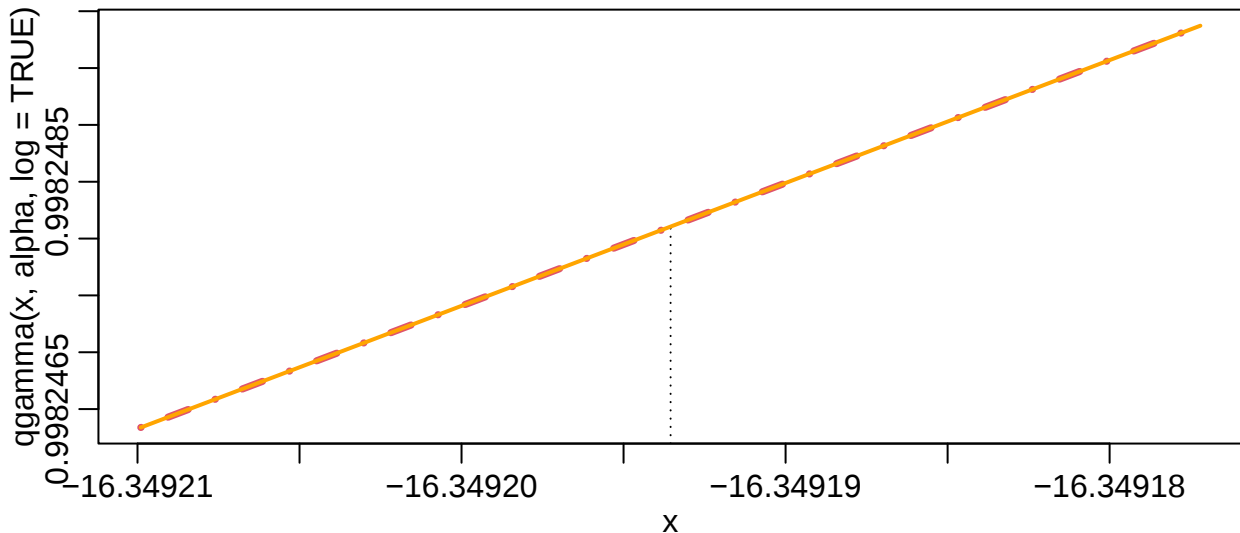
qgamma(x, alpha= 10.13695 , log = TRUE)



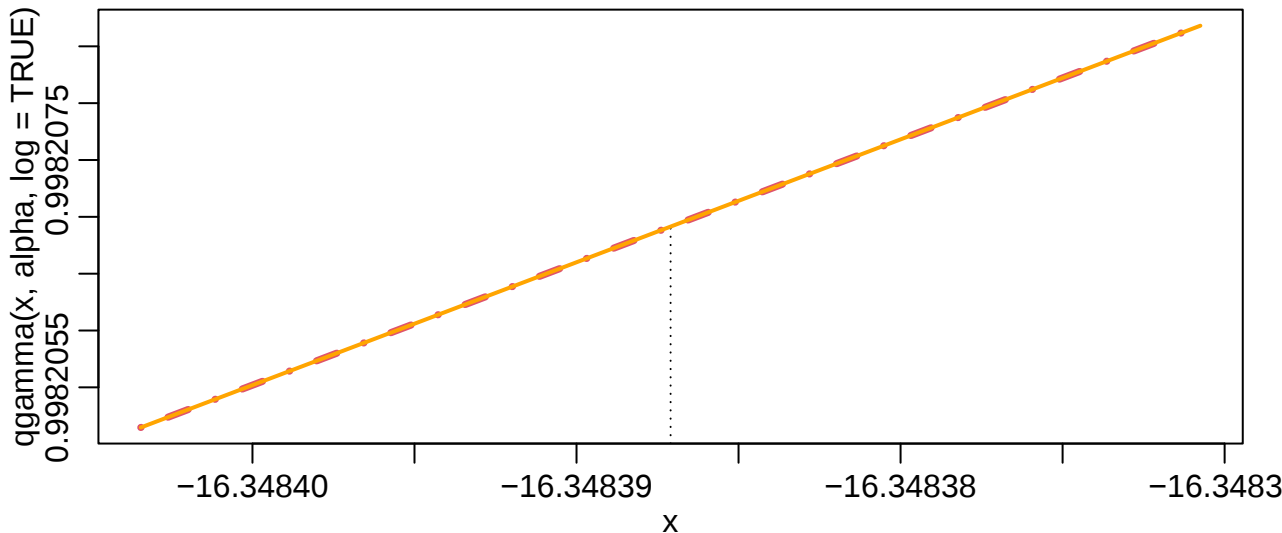
qgamma(x, alpha= 10.1368 , log = TRUE)



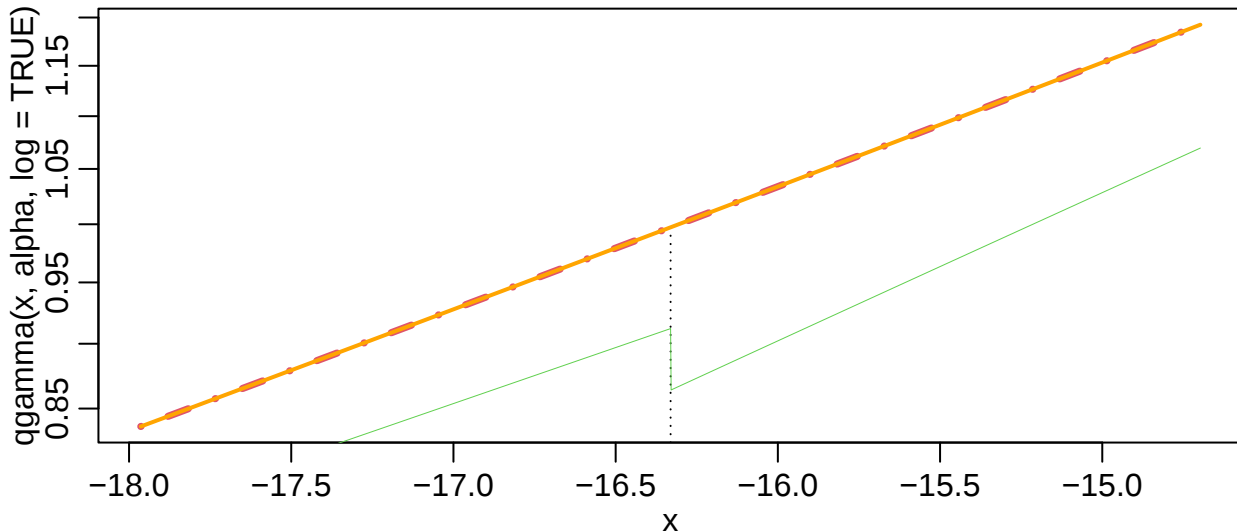
qgamma(x, alpha= 10.1365 , log = TRUE)



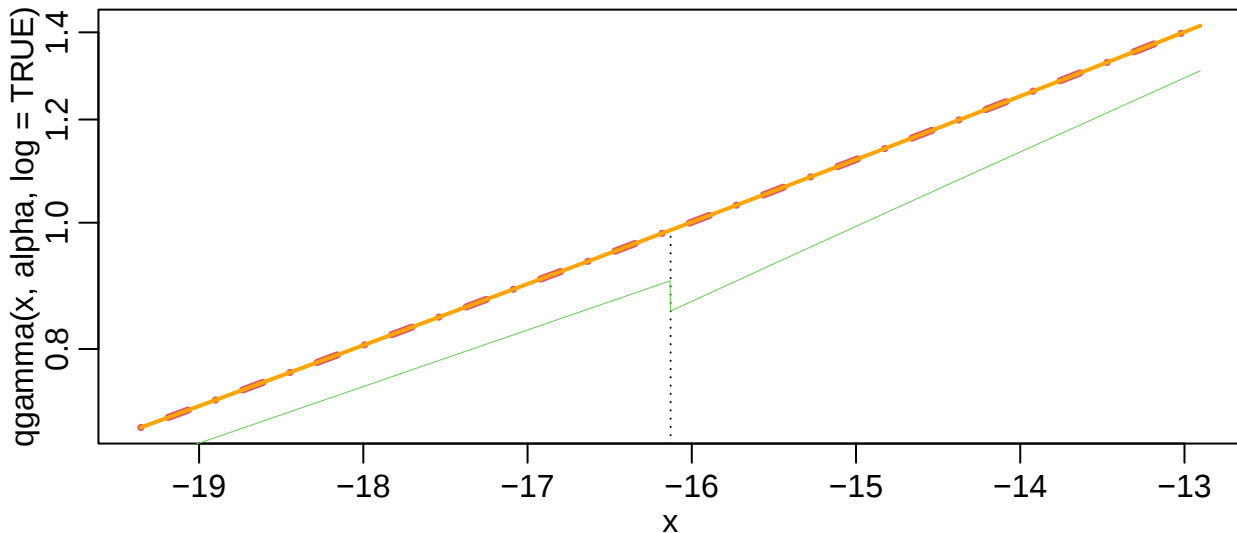
qgamma(x, alpha= 10.136 , log = TRUE)



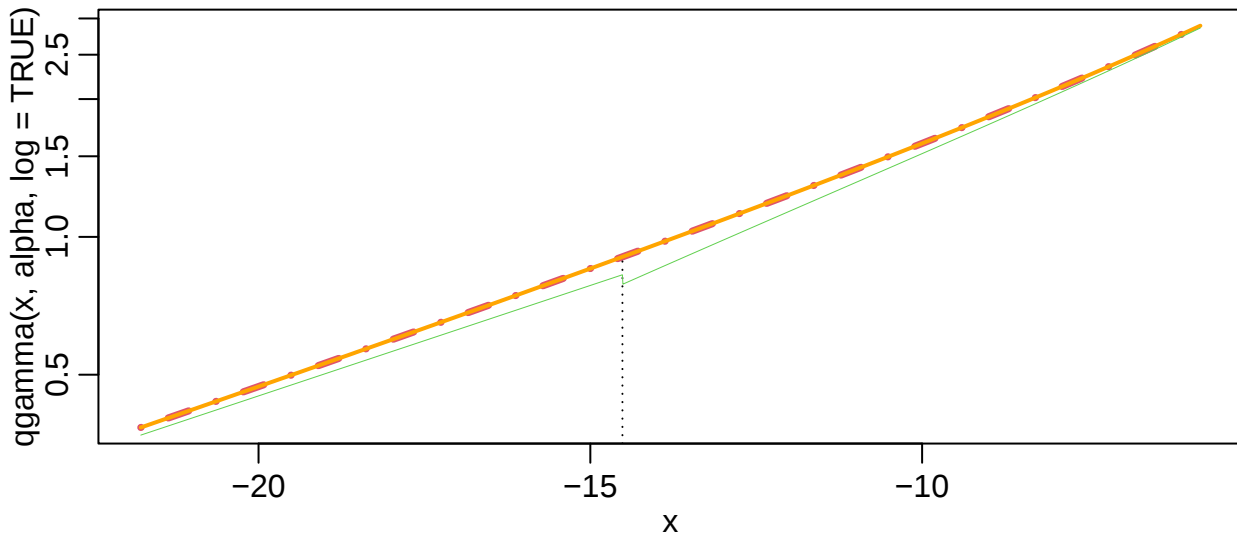
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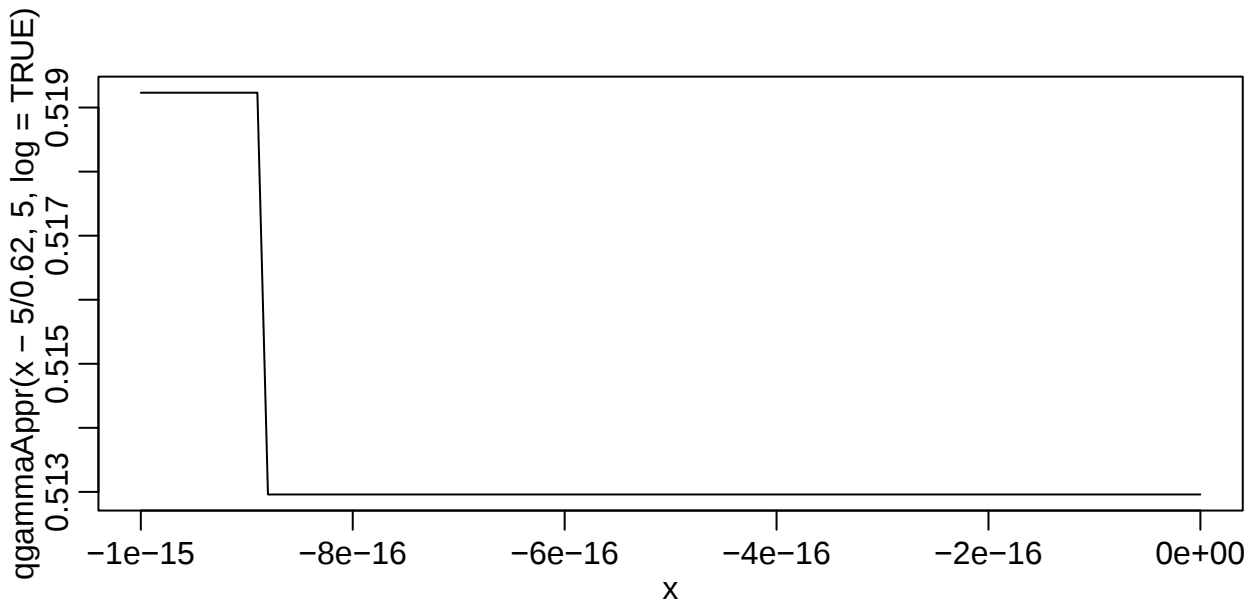
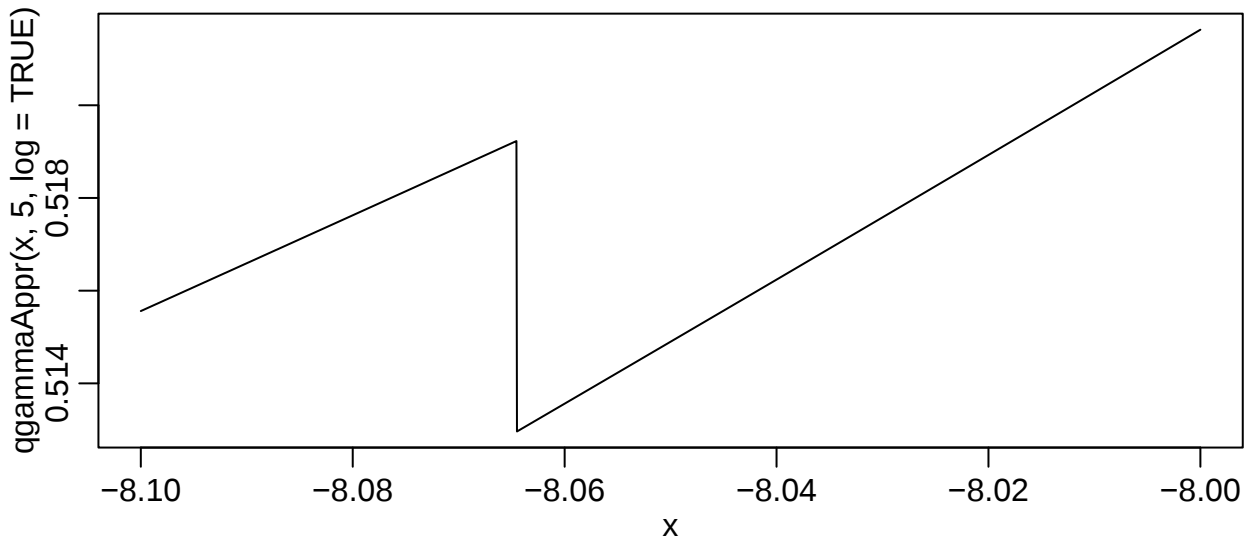


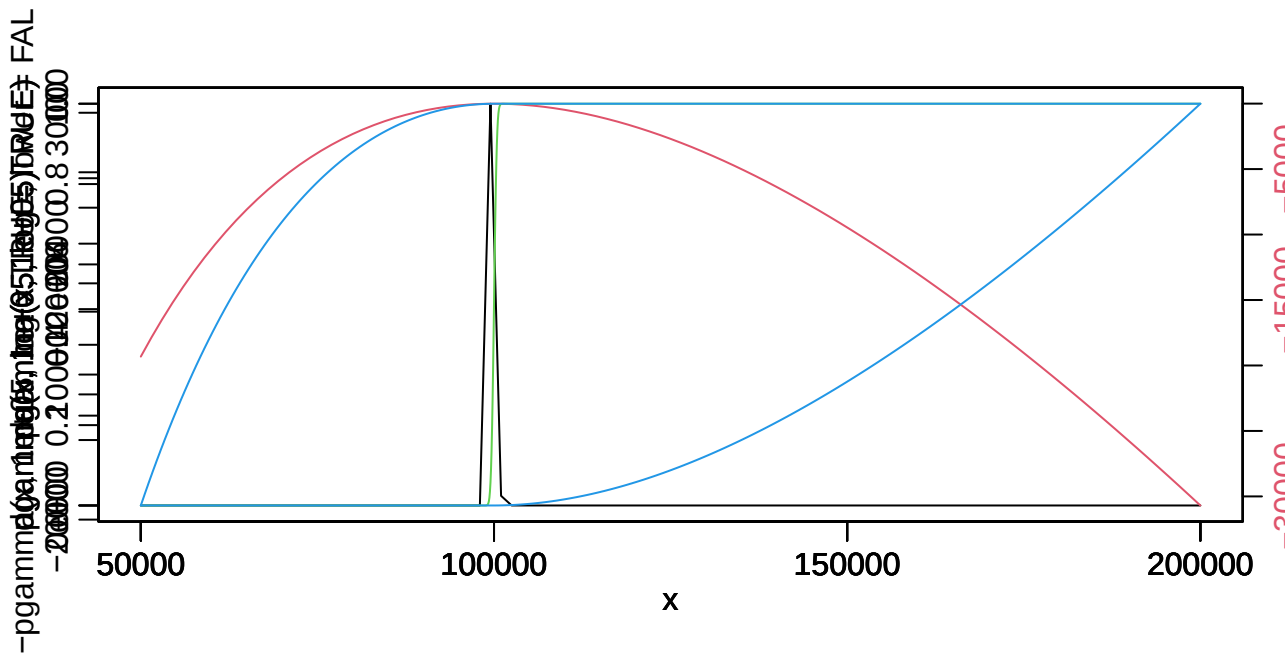
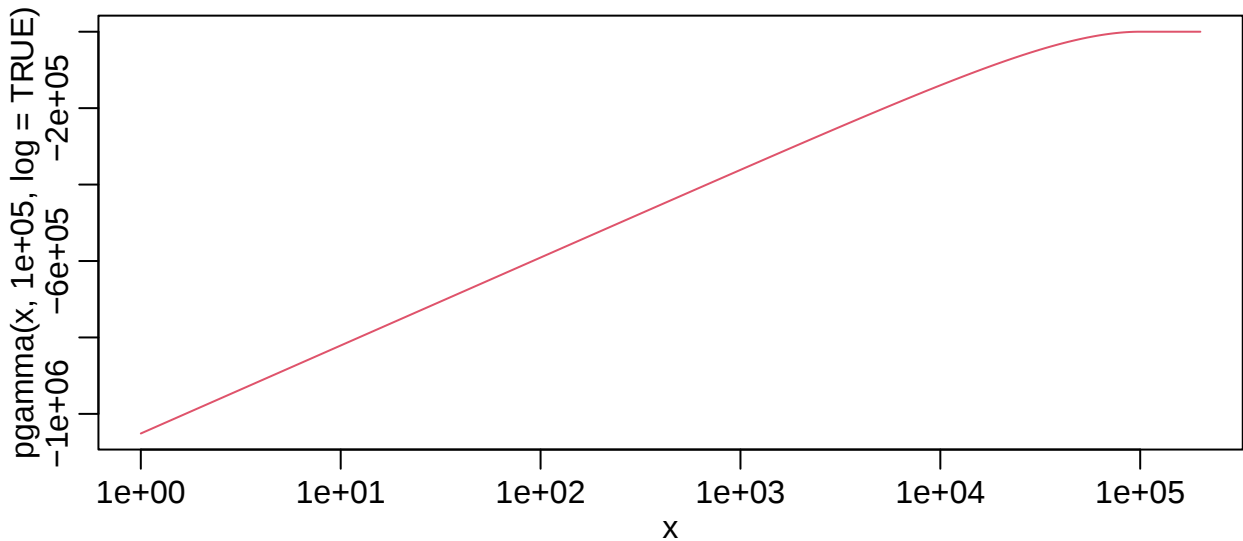
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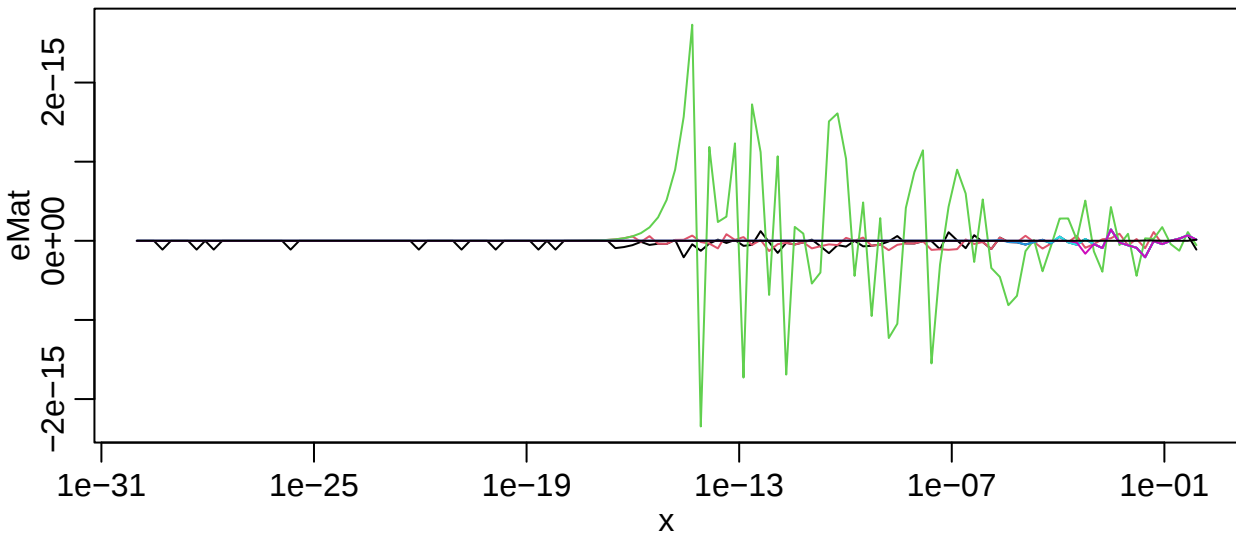
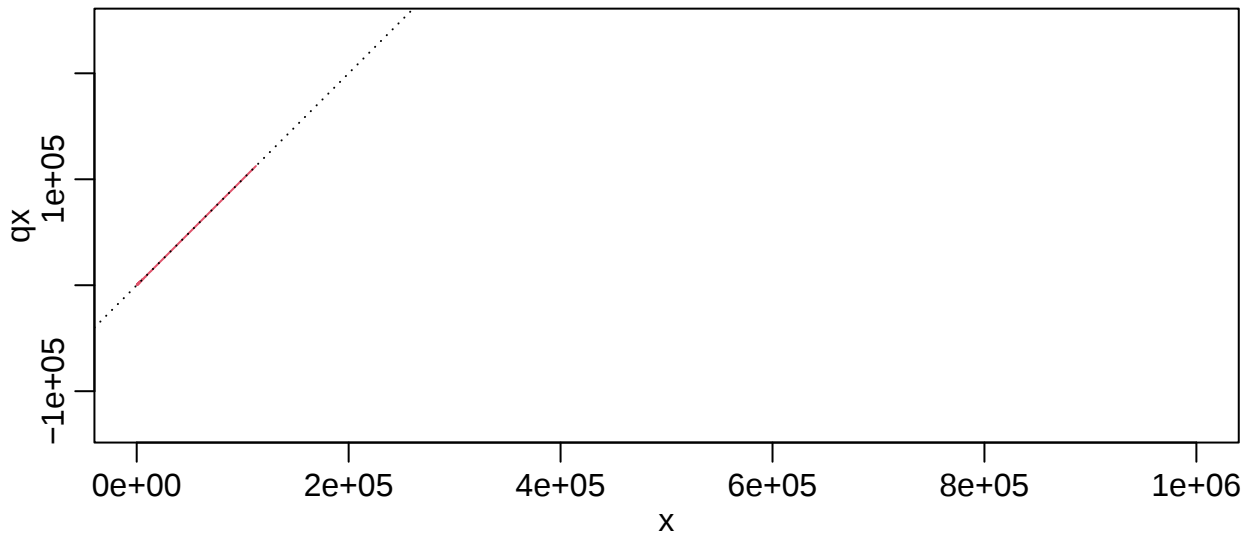


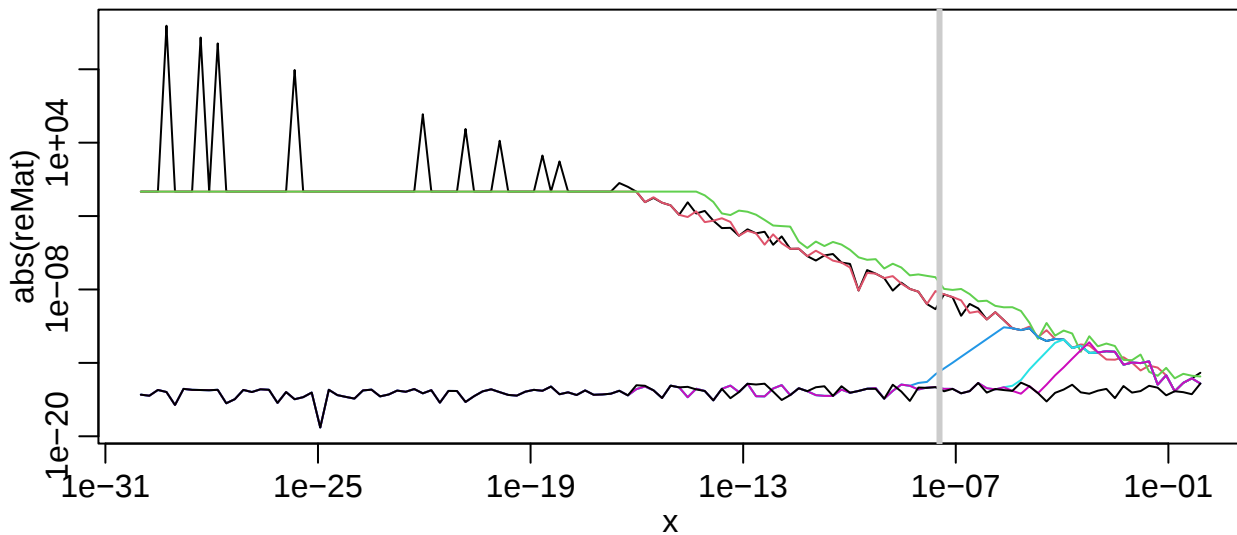
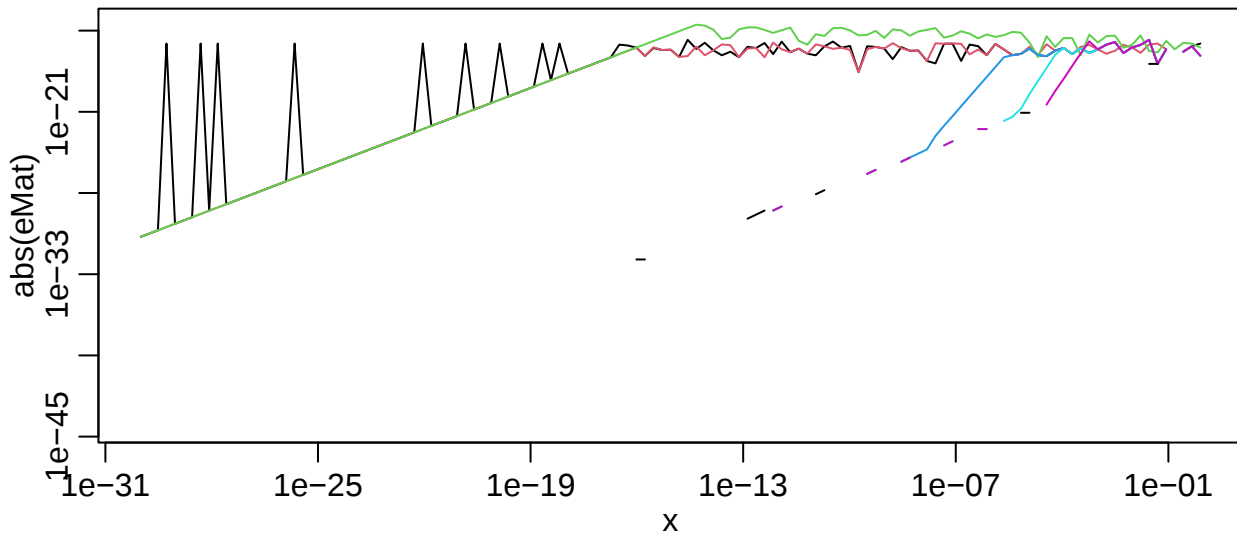
qgamma(x, alpha= 9 , log = TRUE)



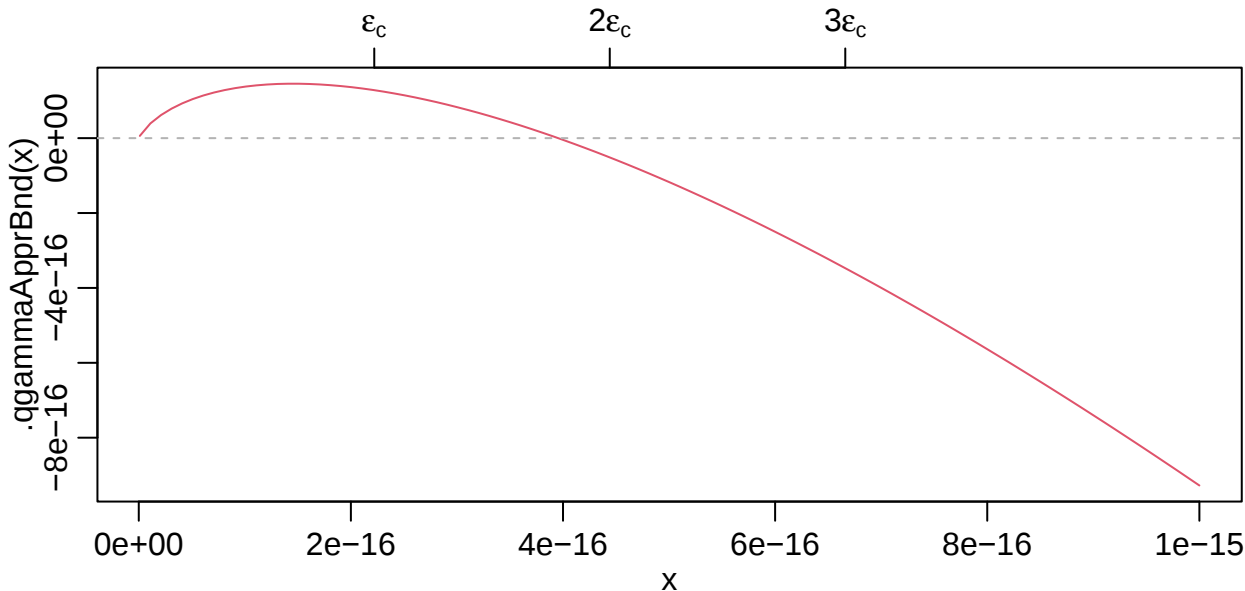
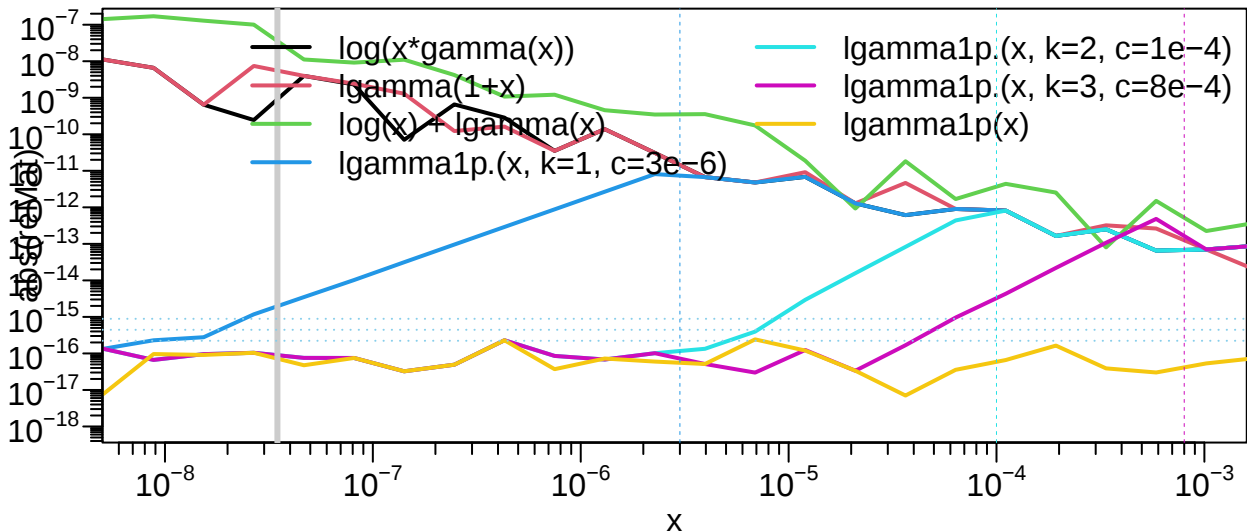


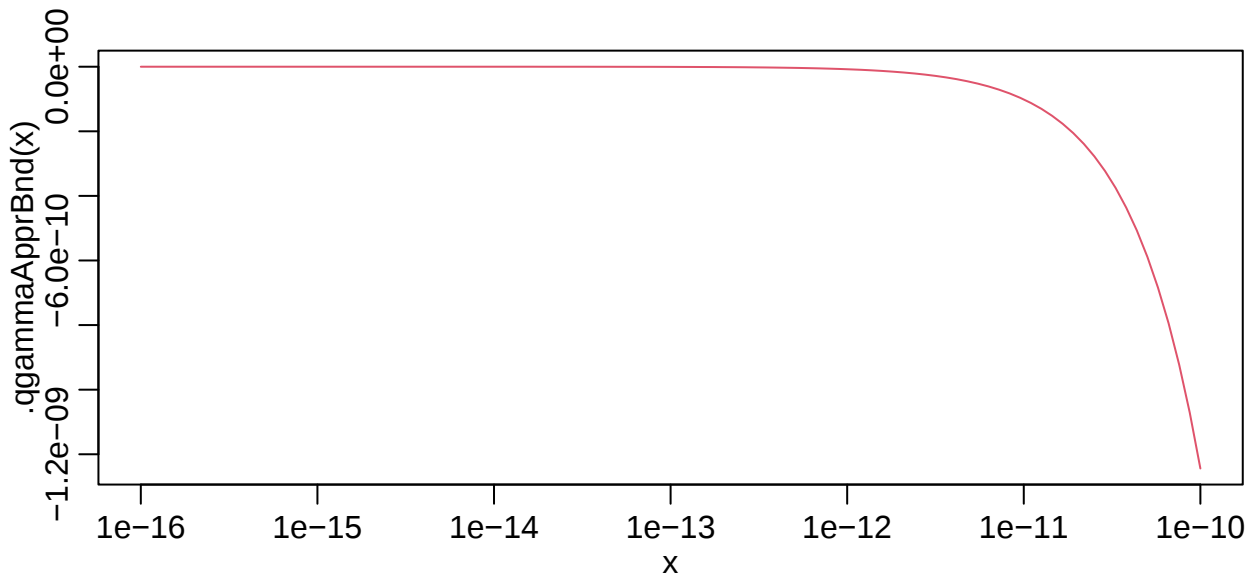




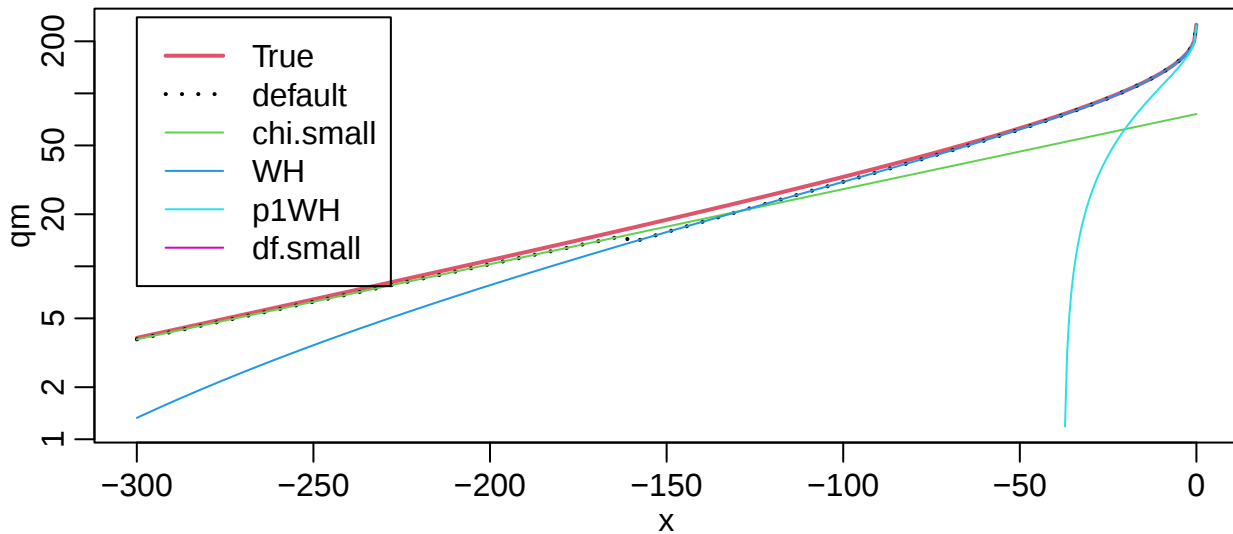


$\lgamma1p(x) = \log(\Gamma(x+1))$ approximations $|\text{rel.Err}(\cdot)|$

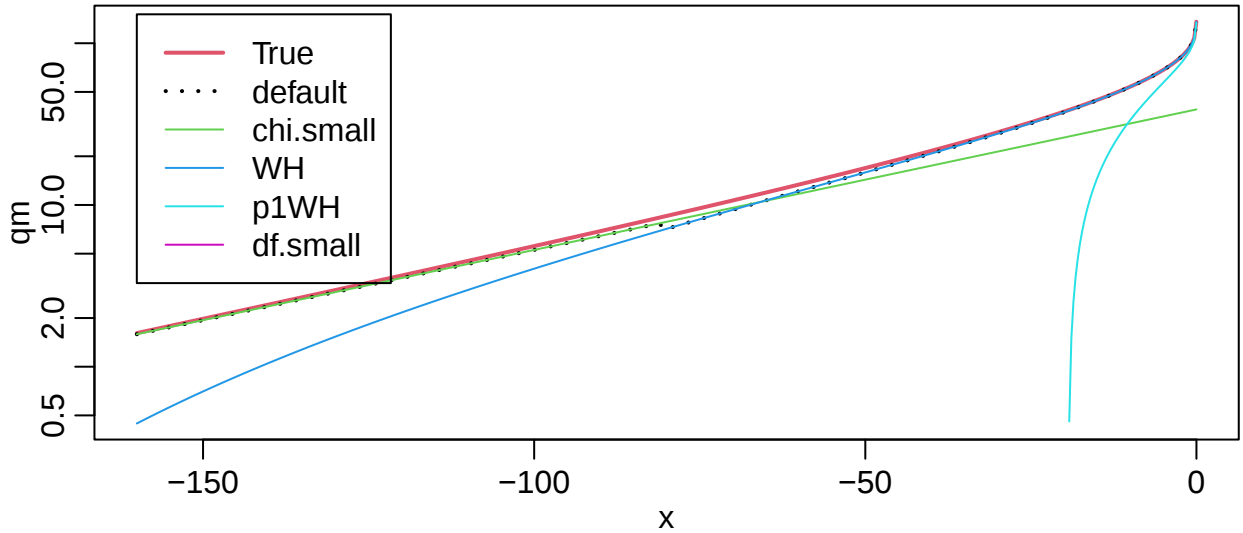




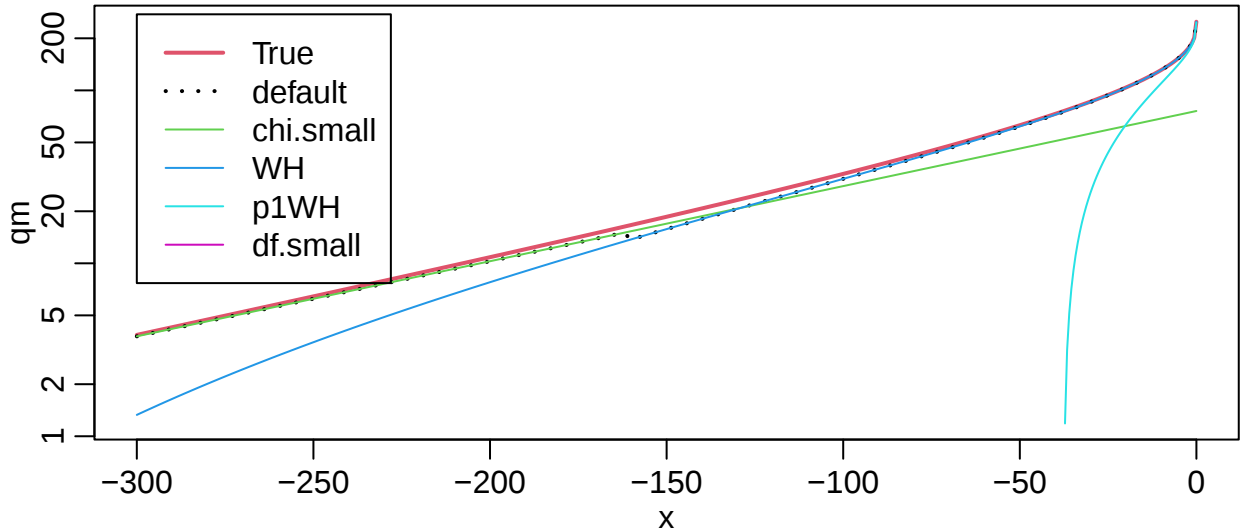
`p.qchi.appr(x = seq(-300, -0.01, length = 501), df = 200)`



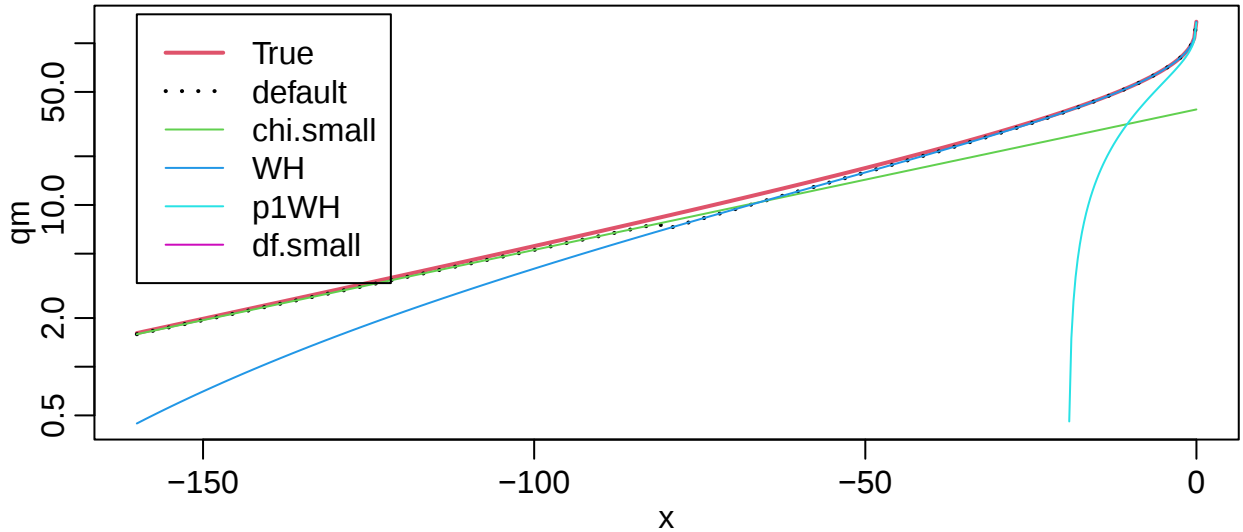
p.qchi.appr(x = seq(-160, -0.01, length = 501), df = 100)



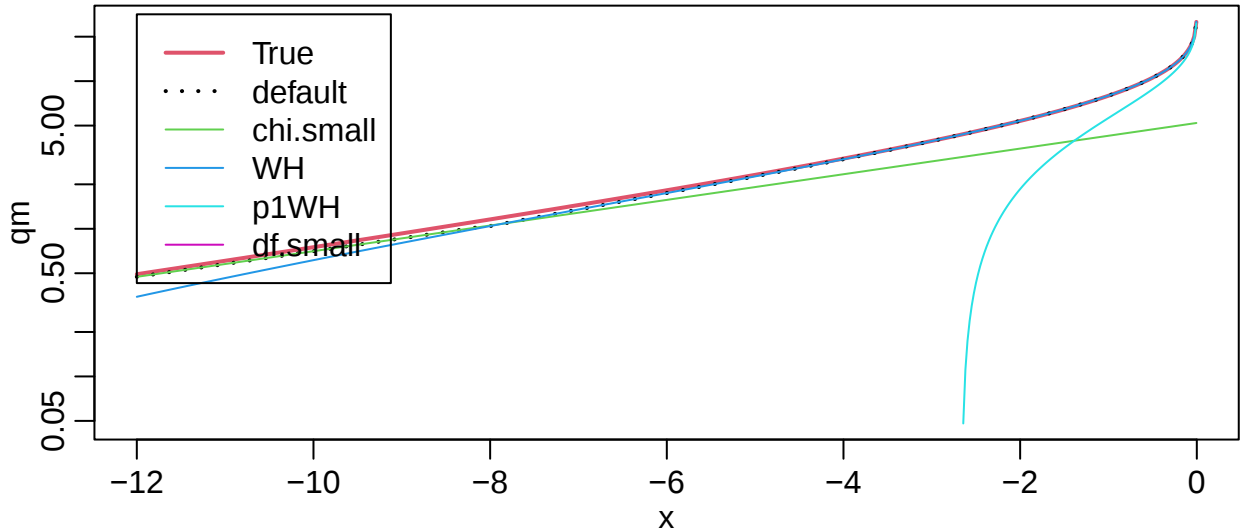
p.qchi.appr(x = seq(-300, -0.01, length = 501), df = 200)



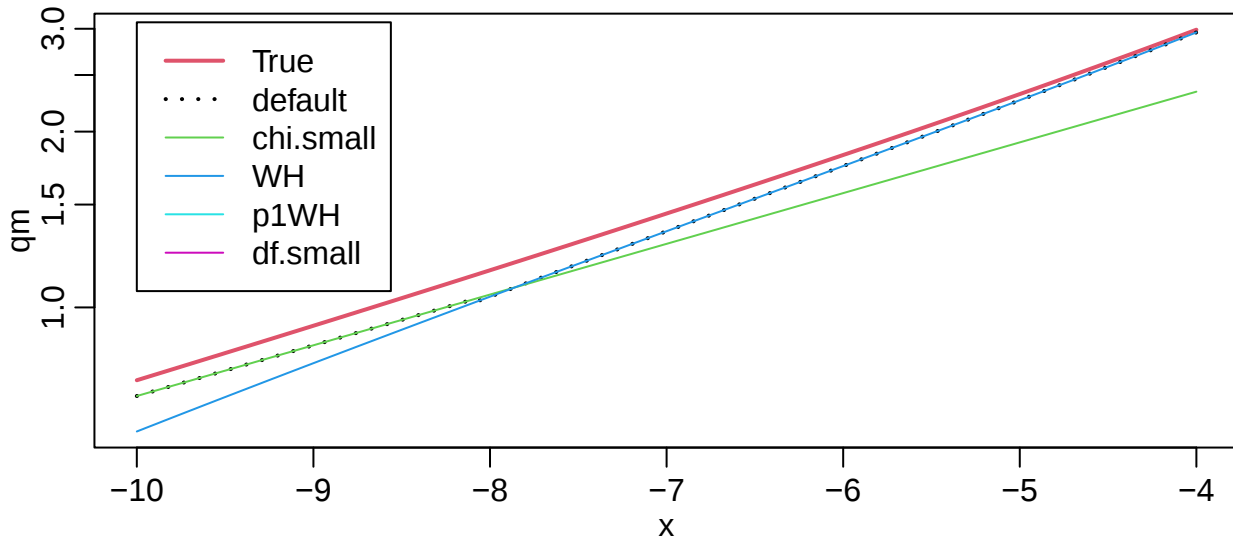
p.qchi.appr(x = seq(-160, -0.01, length = 501), df = 100)



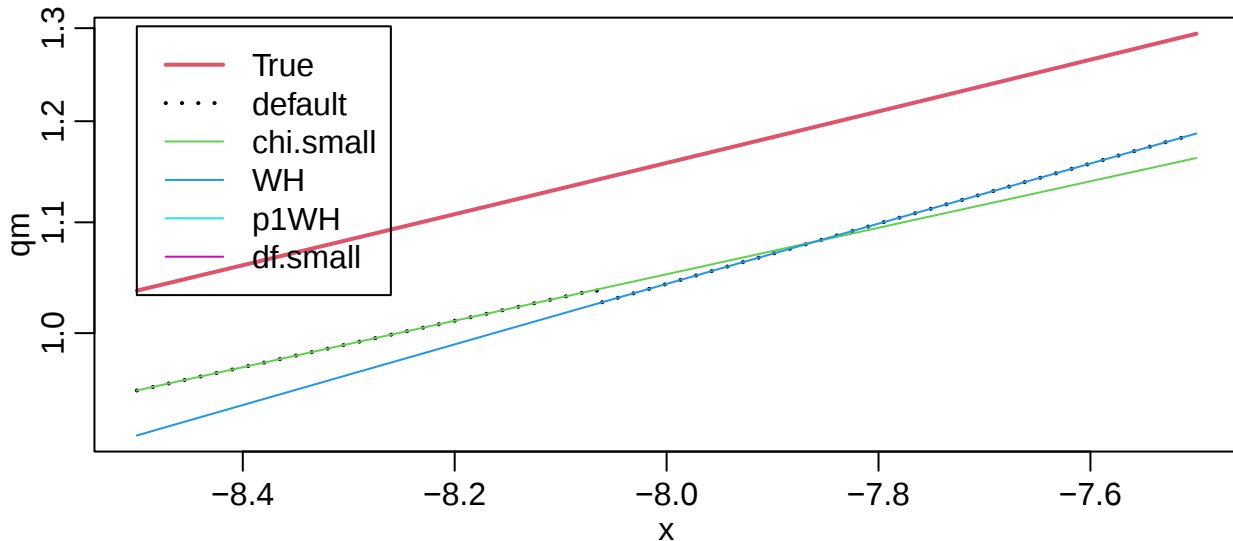
p.qchi.appr(x = seq(-12, -0.005, length = 501), df = 10)



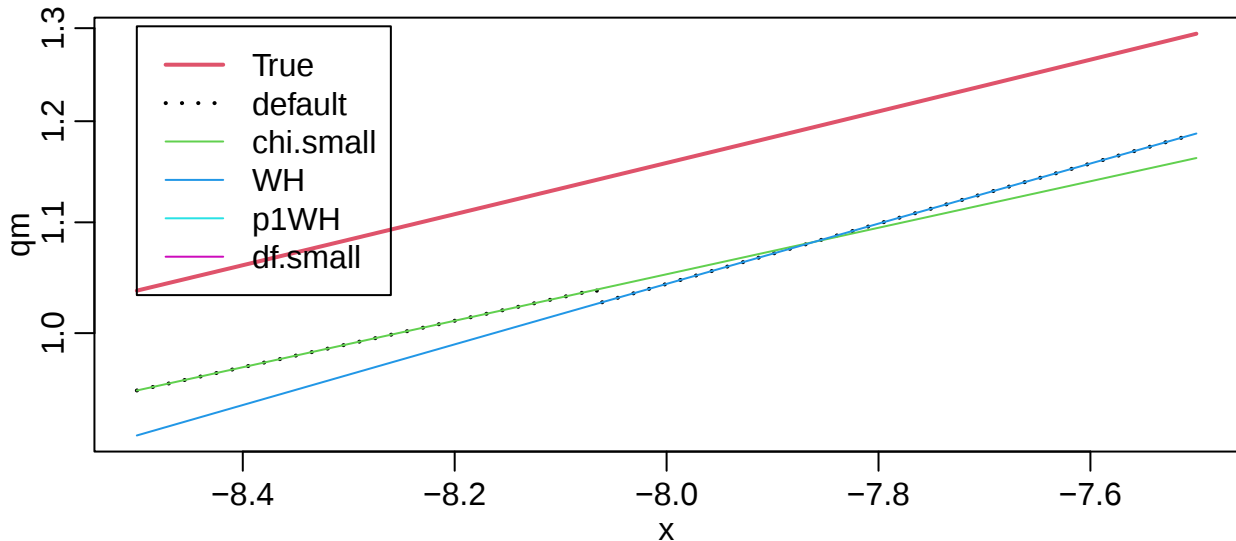
p.qchi.appr(x = seq(-10, -4, length = 501), df = 10)



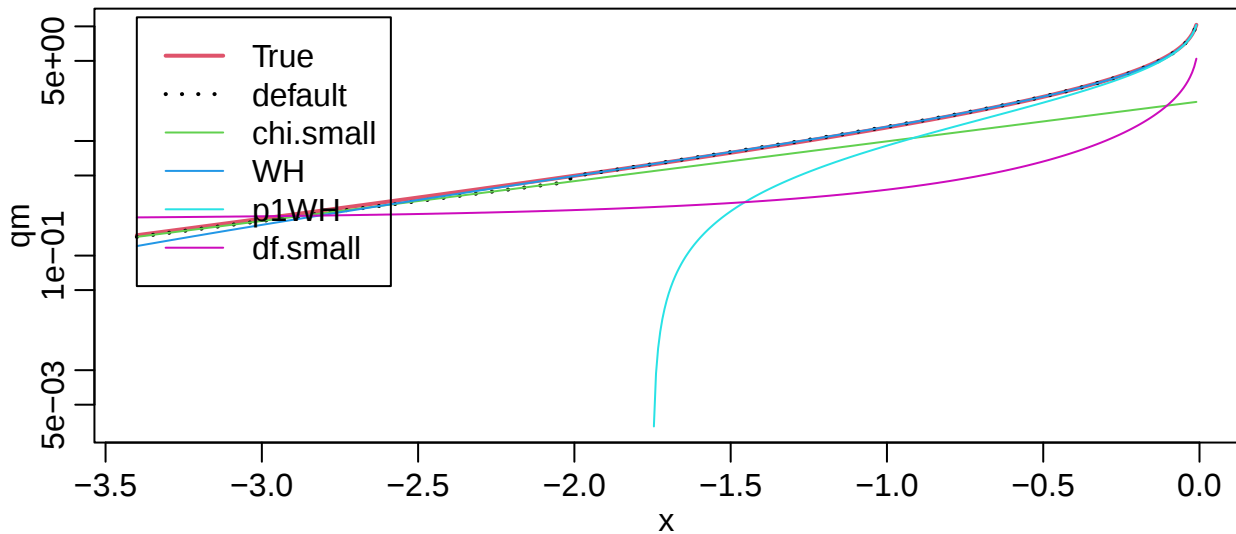
p.qchi.appr(x = seq(-8.5, -7.5, length = 501), df = 10)



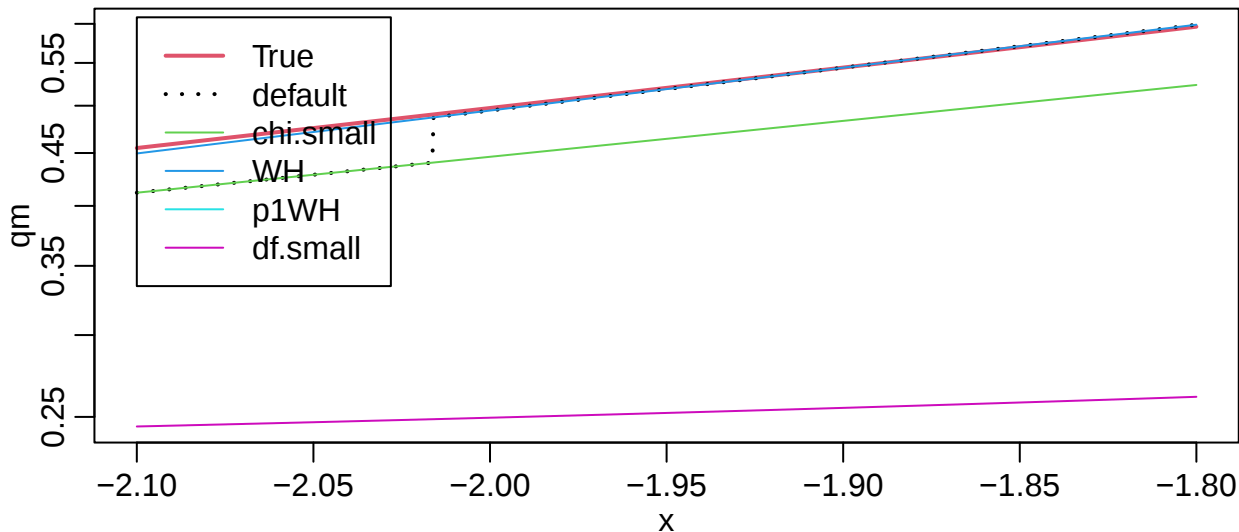
p.qchi.appr(x = seq(-8.5, -7.5, length = 501), df = 10)



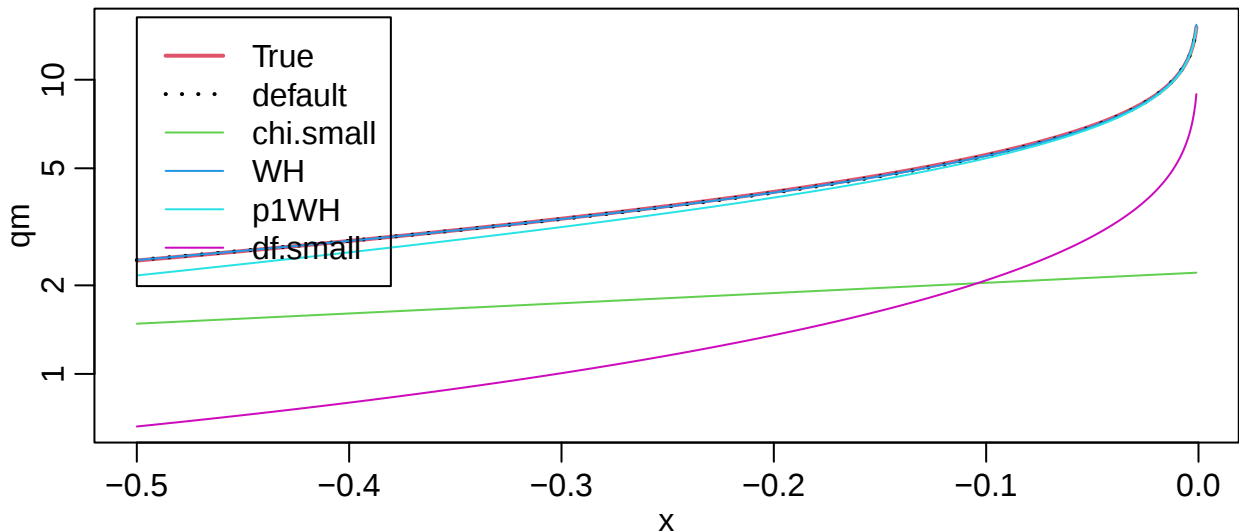
p.qchi.appr(x = seq(-3.4, -0.01, length = 501), df = 2.5)



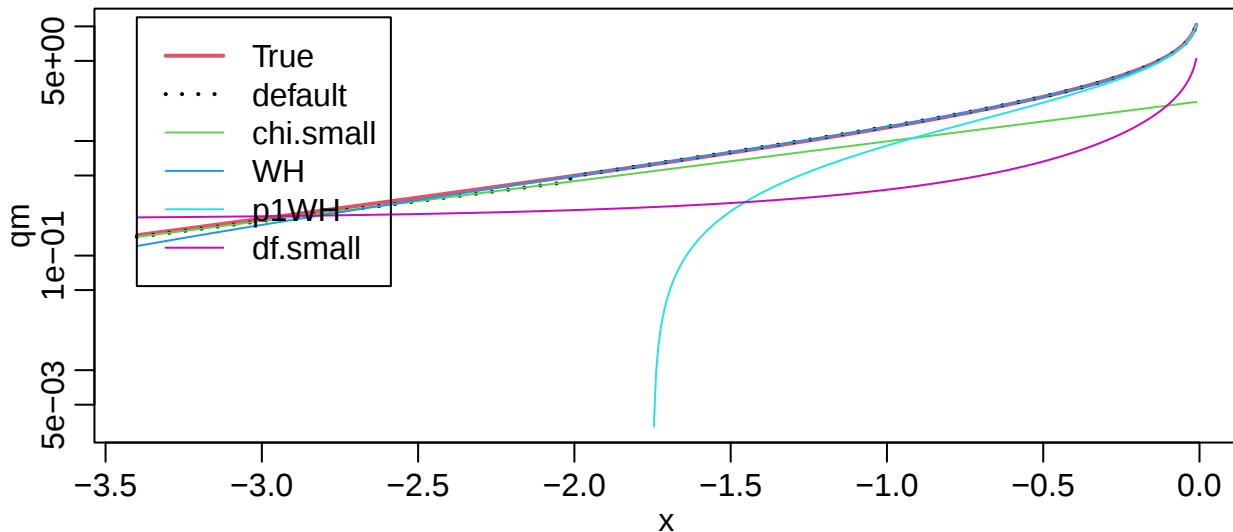
p.qchi.appr(x = seq(-2.1, -1.8, length = 901), df = 2.5)



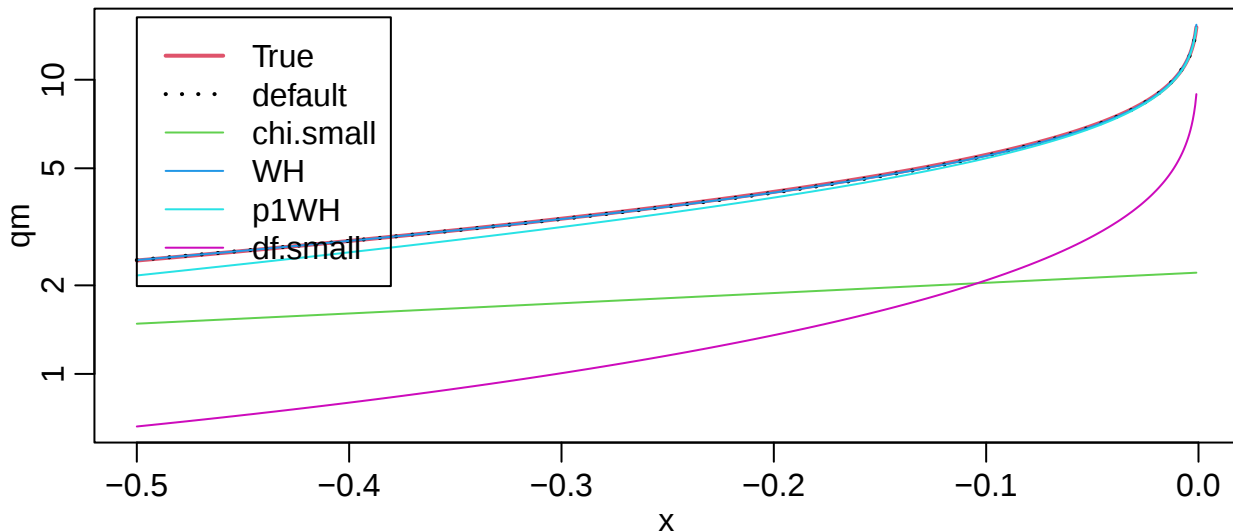
p.qchi.appr(x = seq(-0.5, -0.001, length = 901), df = 2.5)



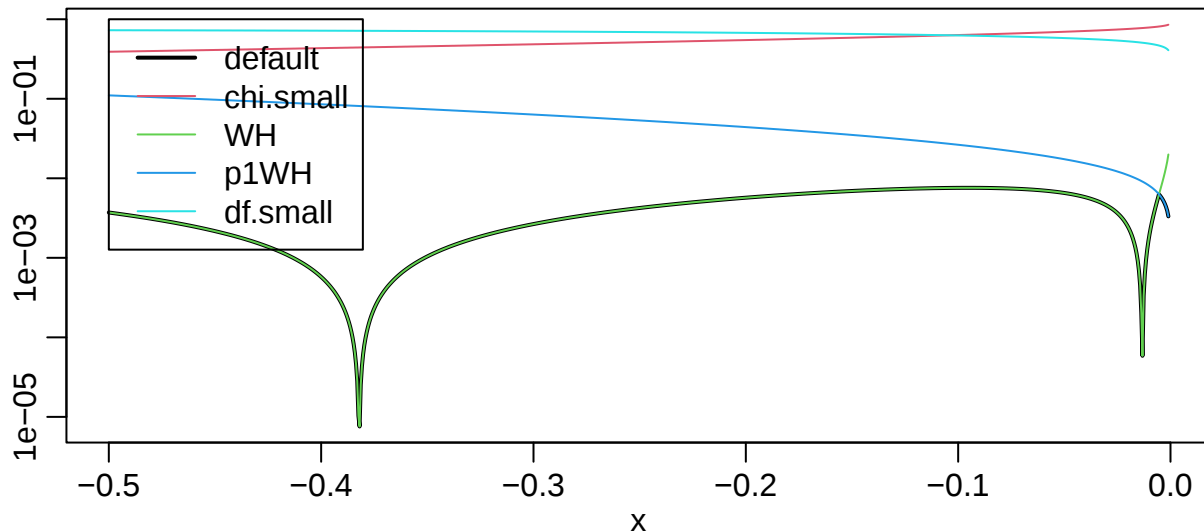
p.qchi.appr(x = seq(-3.4, -0.01, length = 501), df = 2.5)



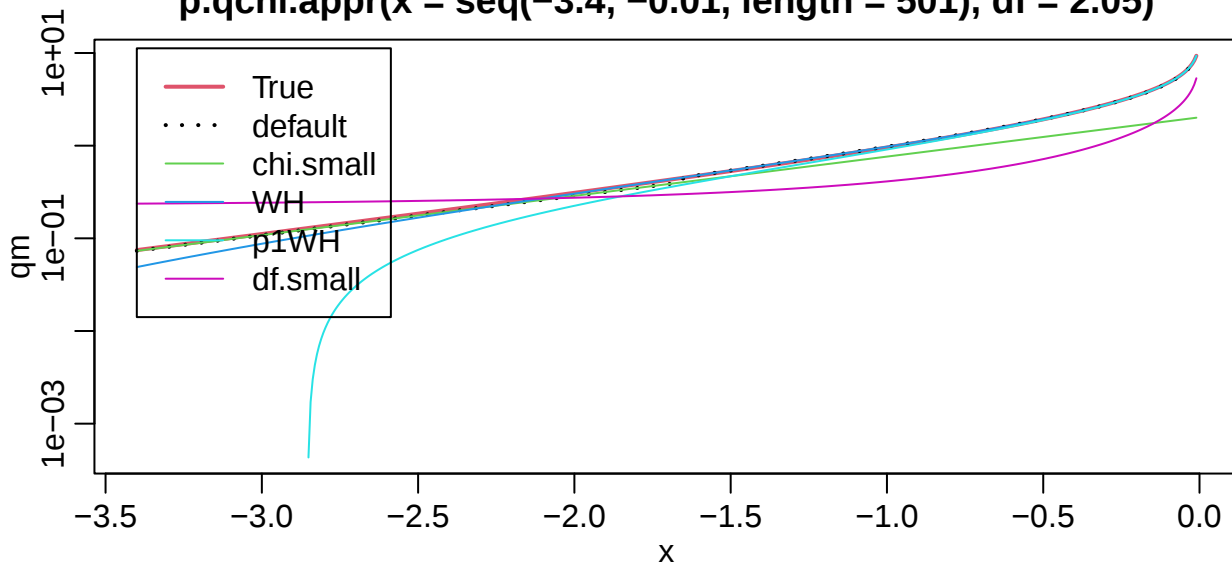
p.qchi.appr(x = seq(-0.5, -0.001, length = 901), df = 2.5)



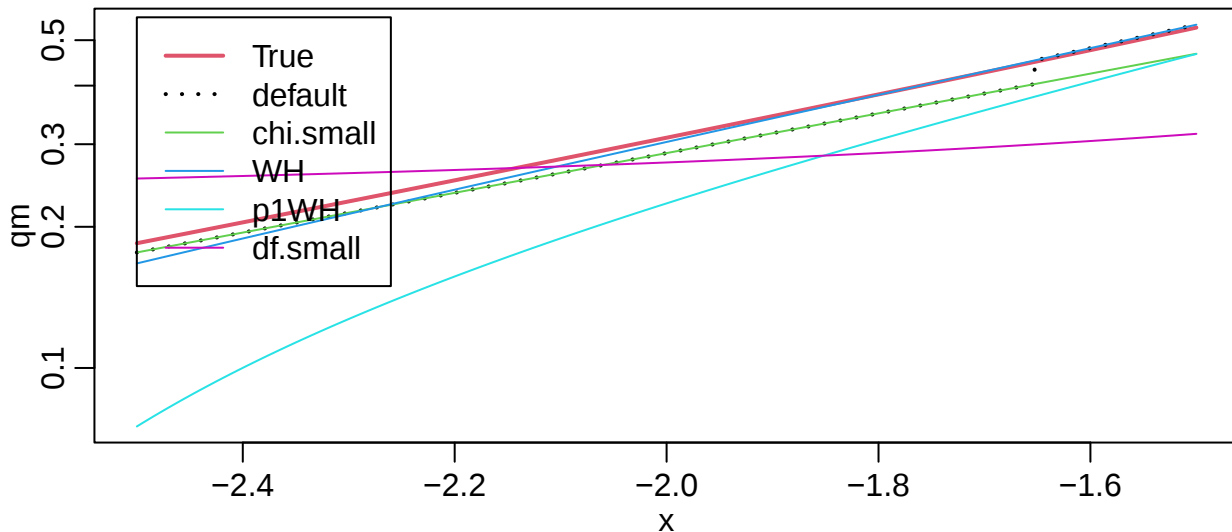
relative Error from `p.qchi.appr(x = seq(-0.5, -0.001, length = 901), df = 2`



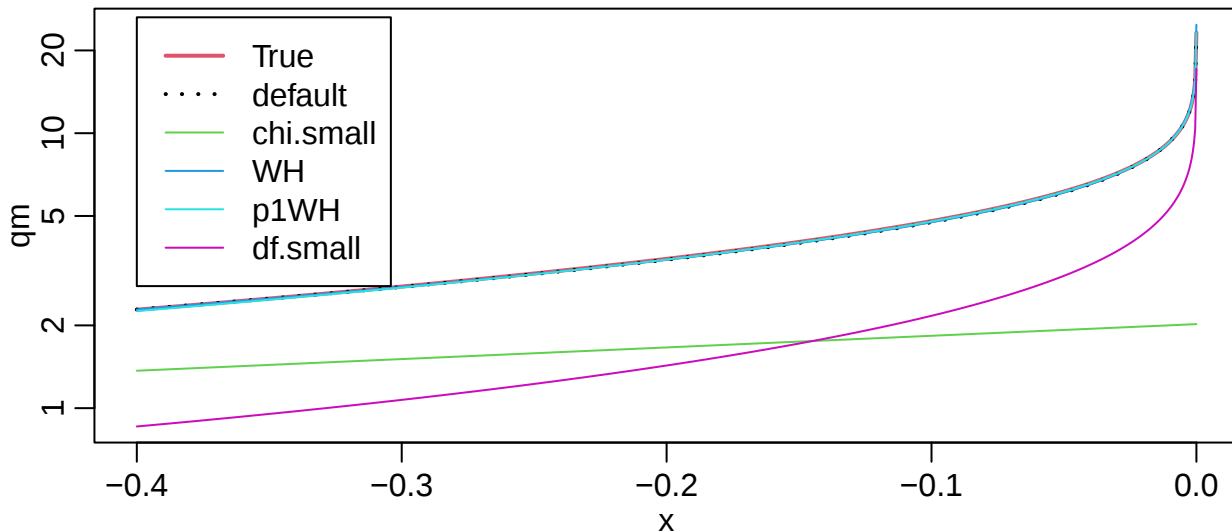
`p.qchi.appr(x = seq(-3.4, -0.01, length = 501), df = 2.05)`



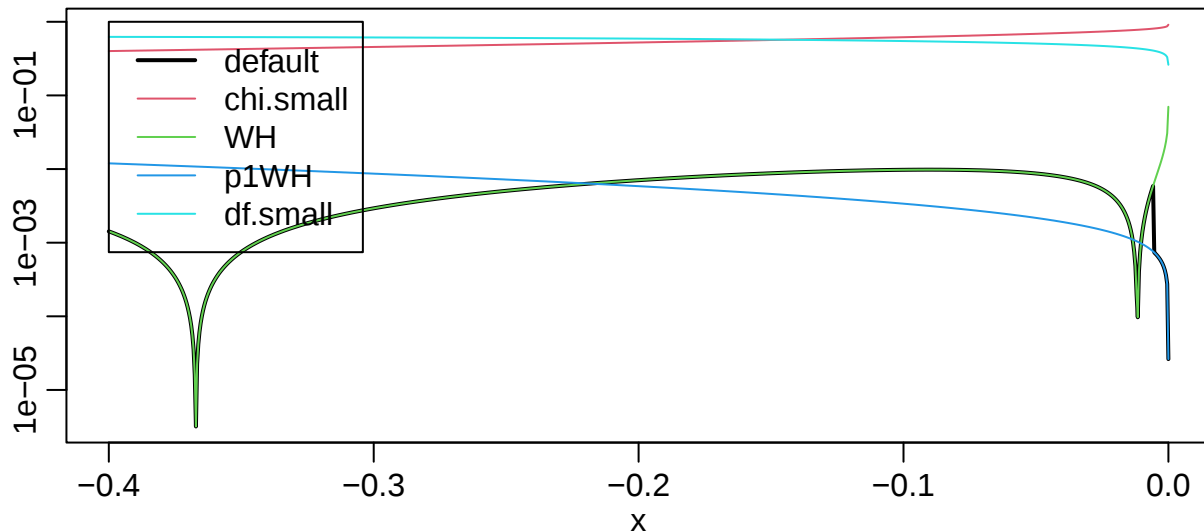
p.qchi.appr(x = seq(-2.5, -1.5, length = 901), df = 2.05)



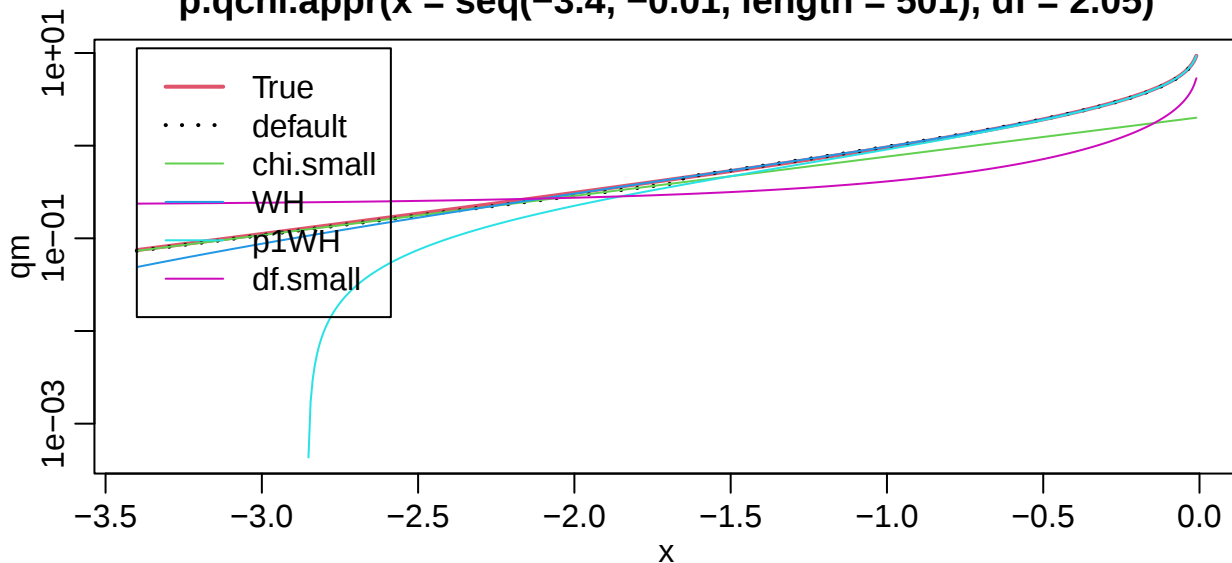
p.qchi.appr(x = seq(-0.4, -1e-05, length = 901), df = 2.05)



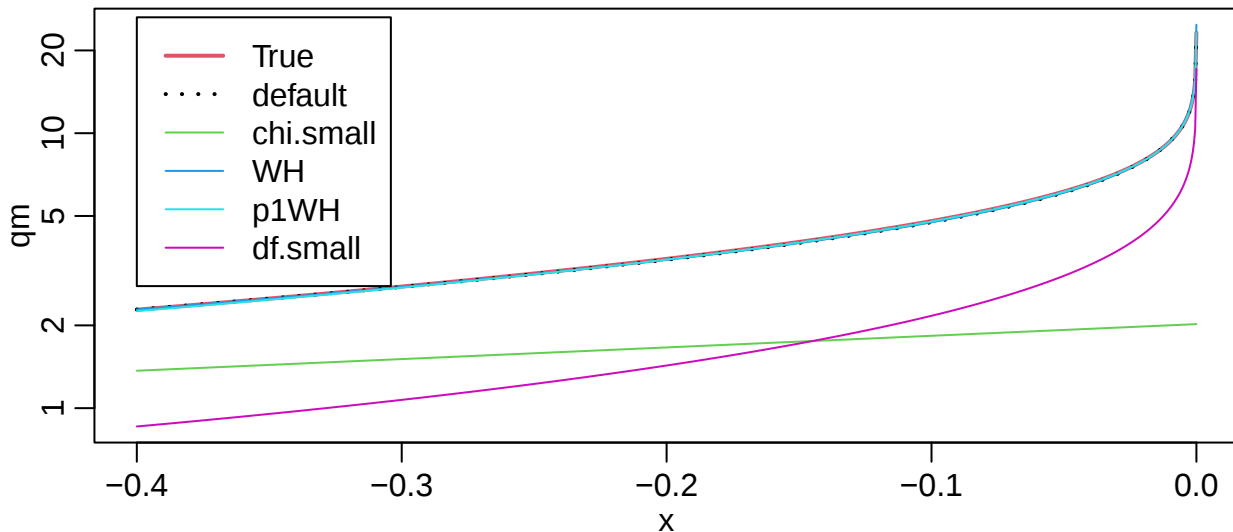
relative Error from `p.qchi.appr(x = seq(-0.4, -1e-05, length = 901), df = 2.05)`



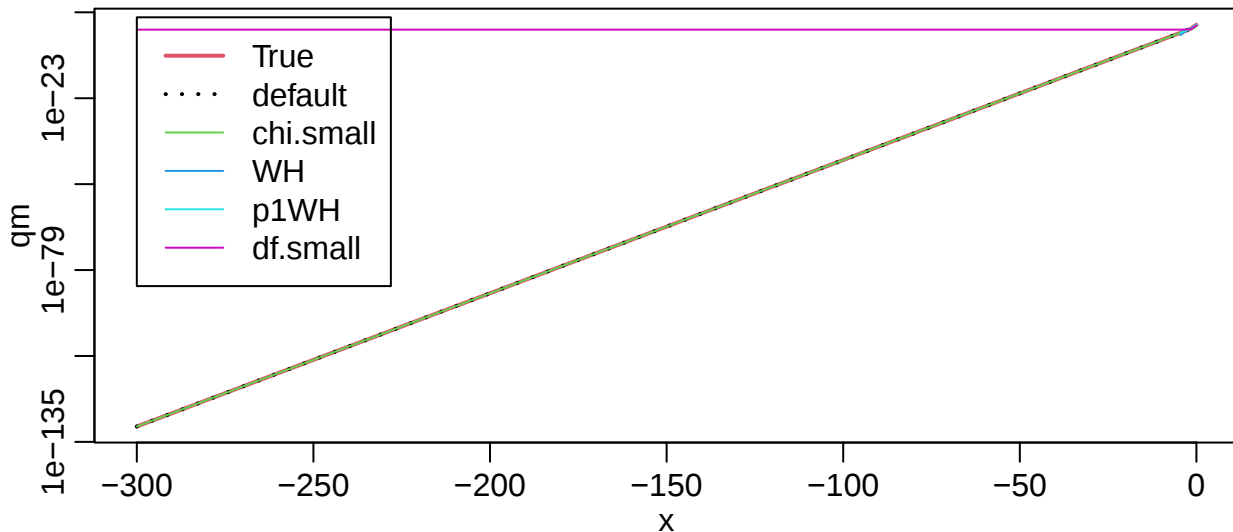
`p.qchi.appr(x = seq(-3.4, -0.01, length = 501), df = 2.05)`



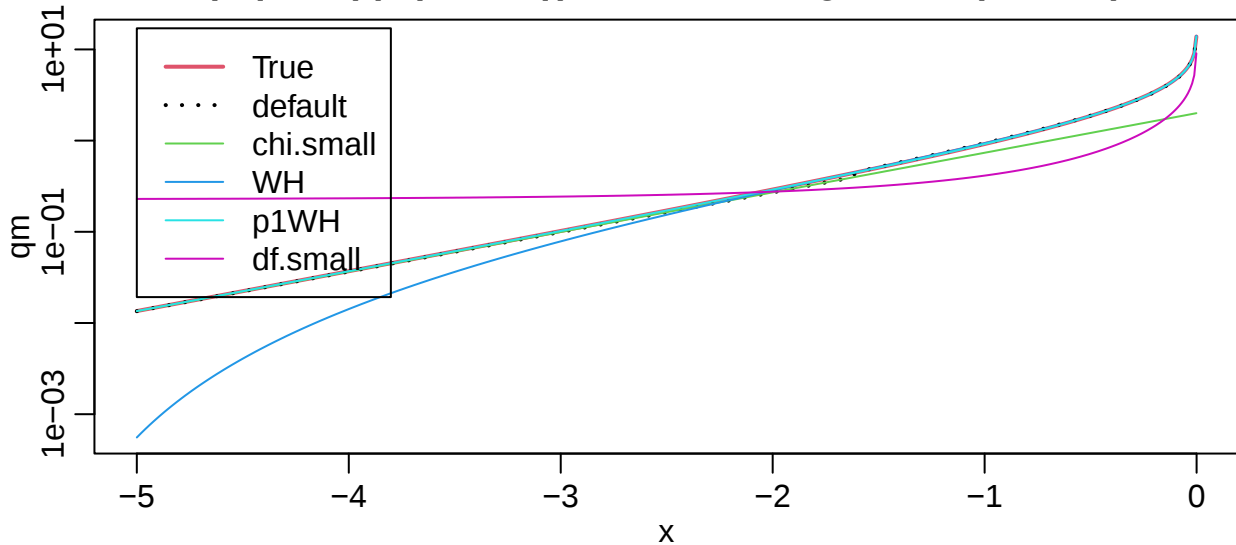
p.qchi.appr(x = seq(-0.4, -1e-05, length = 901), df = 2.05)



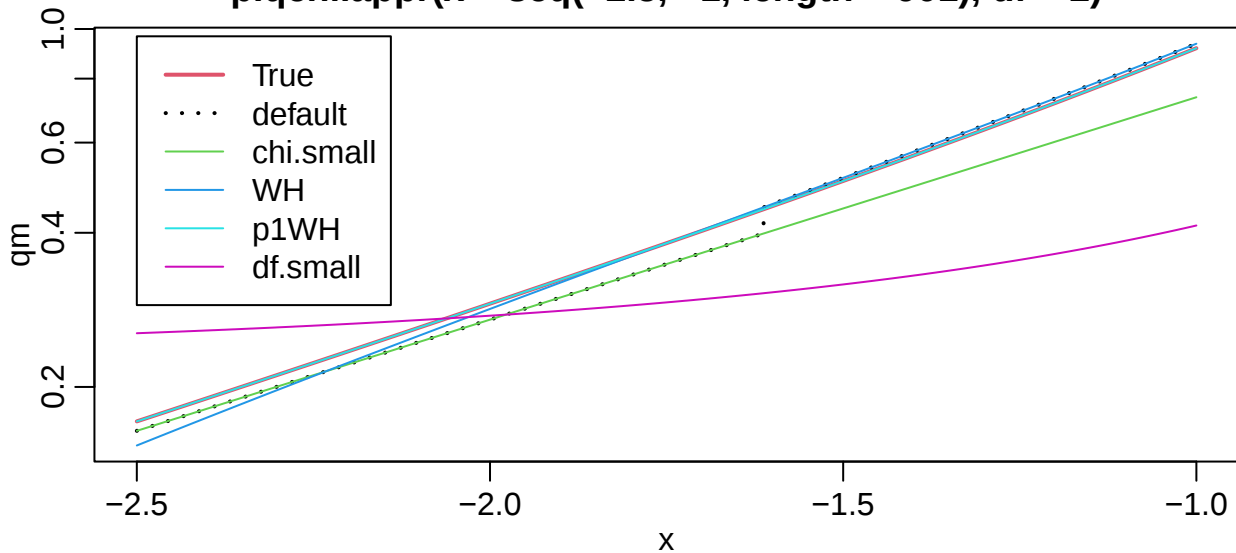
p.qchi.appr(x = seq(-300, -0.01, length = 201), df = 2)



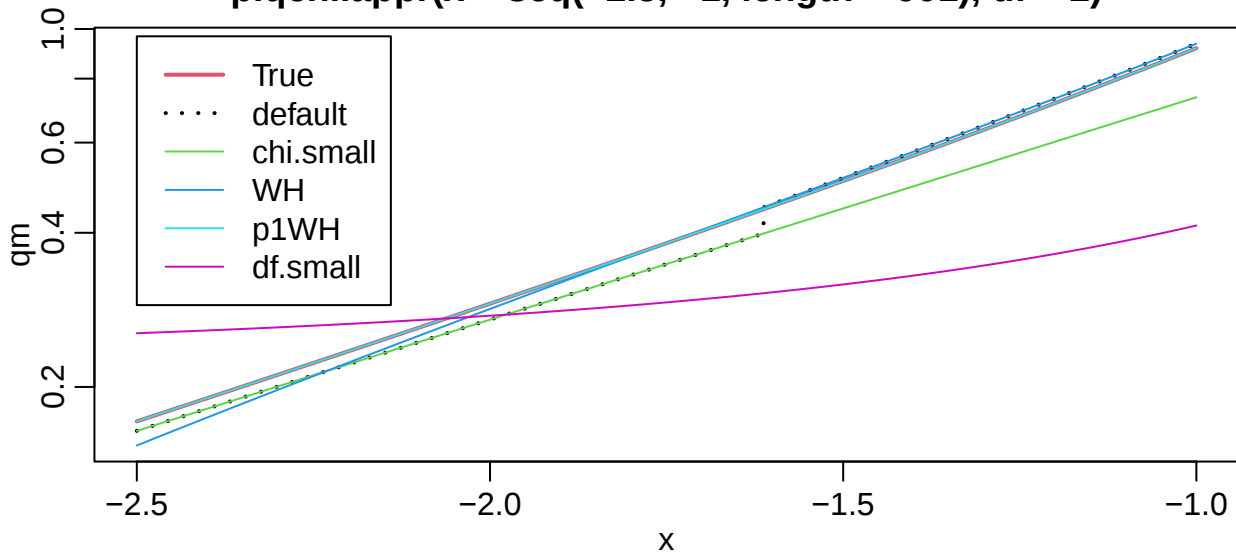
p.qchi.appr(x = seq(-5, -0.001, length = 501), df = 2)



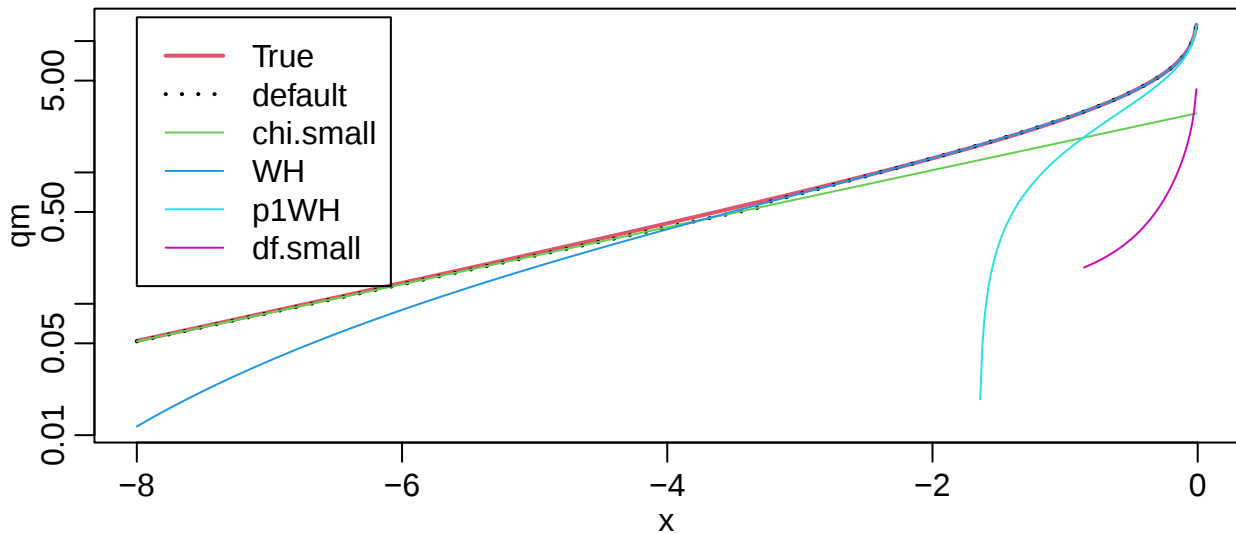
p.qchi.appr(x = seq(-2.5, -1, length = 901), df = 2)



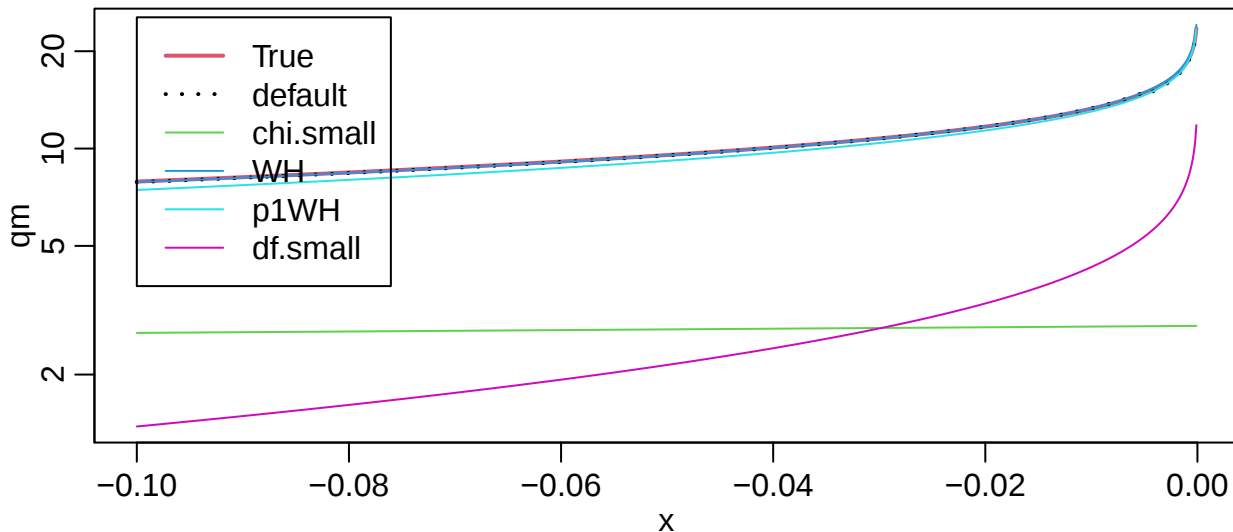
p.qchi.appr(x = seq(-2.5, -1, length = 901), df = 2)



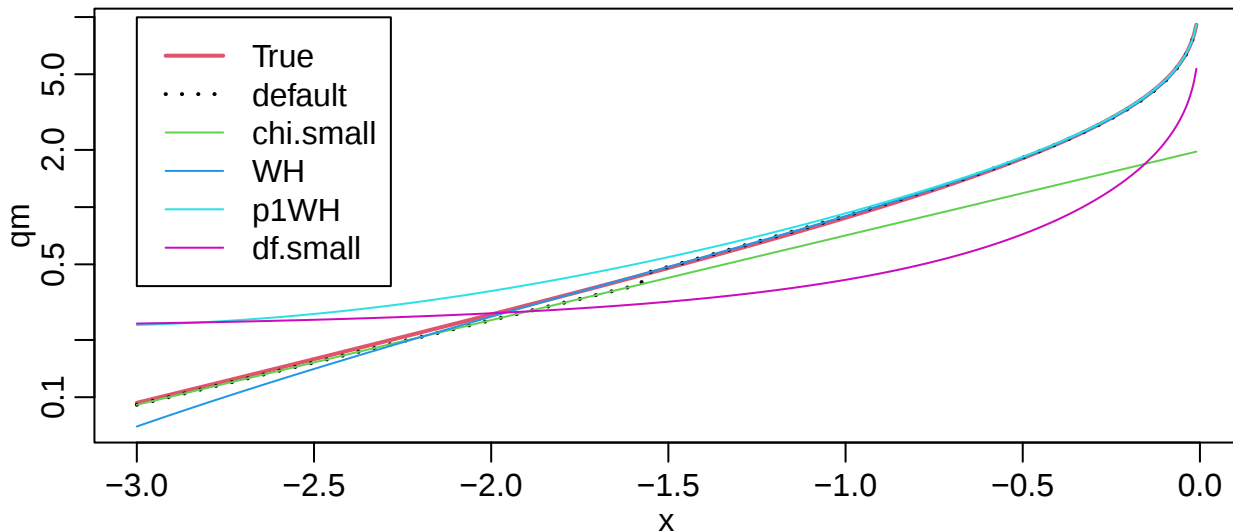
p.qchi.appr(x = seq(-8, -0.01, length = 501), df = 4)



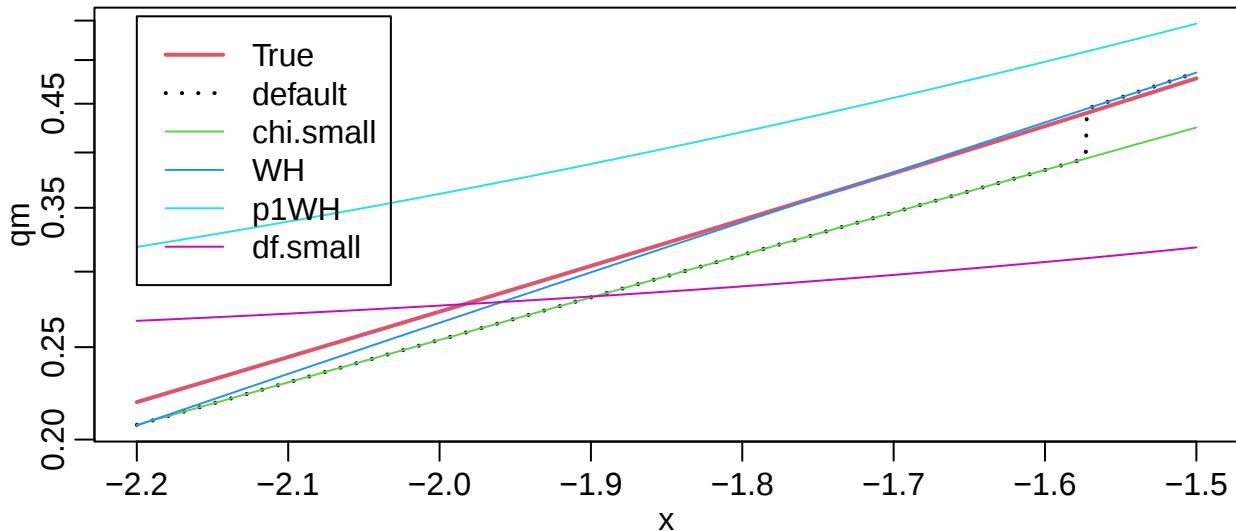
p.qchi.appr(x = seq(-0.1, -1e-04, length = 901), df = 4)



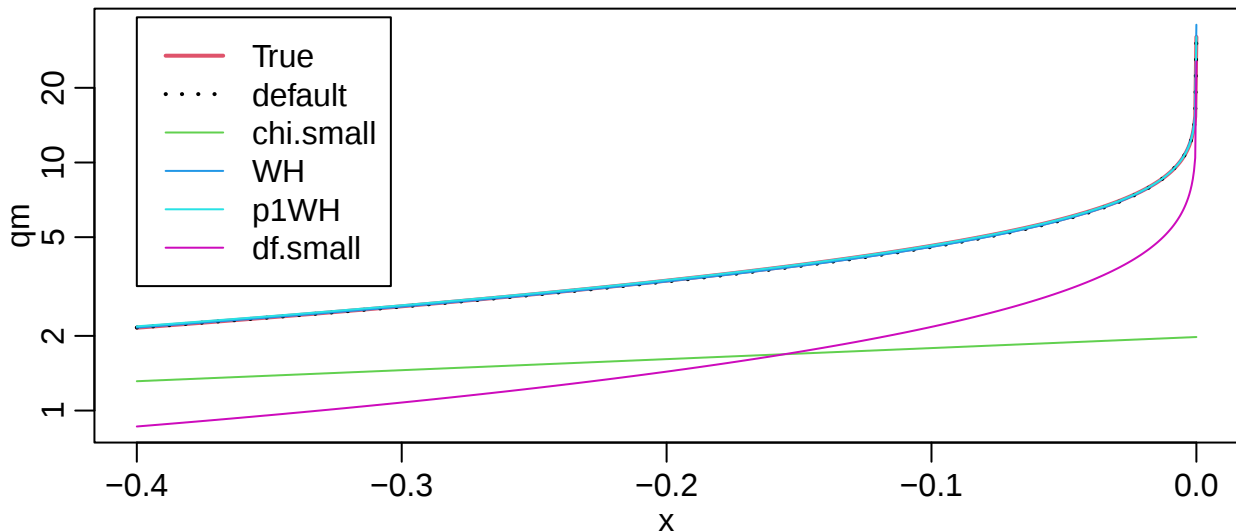
p.qchi.appr(x = seq(-3, -0.01, length = 501), df = 1.95)



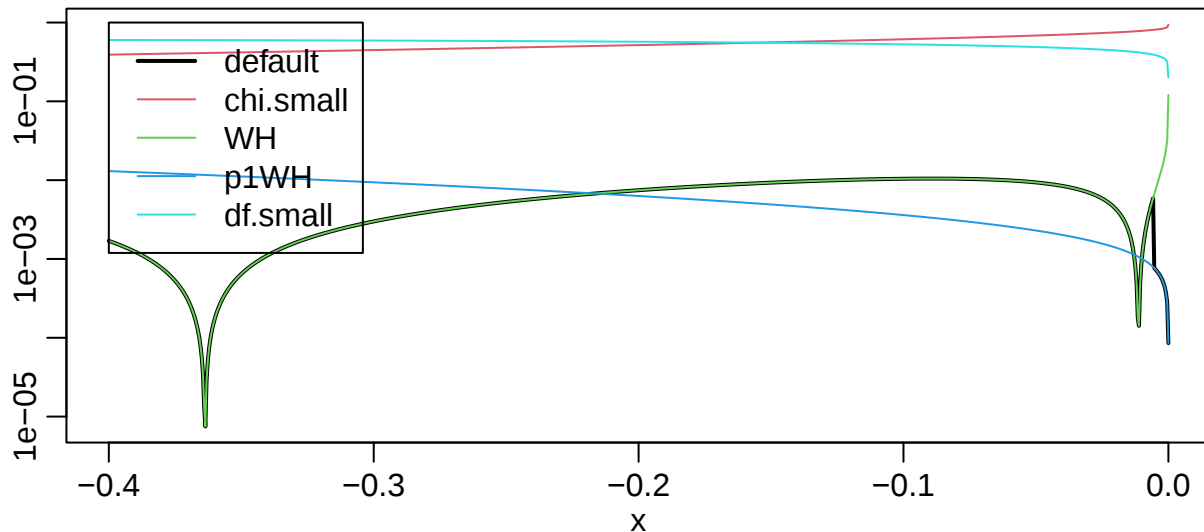
p.qchi.appr(x = seq(-2.2, -1.5, length = 901), df = 1.95)



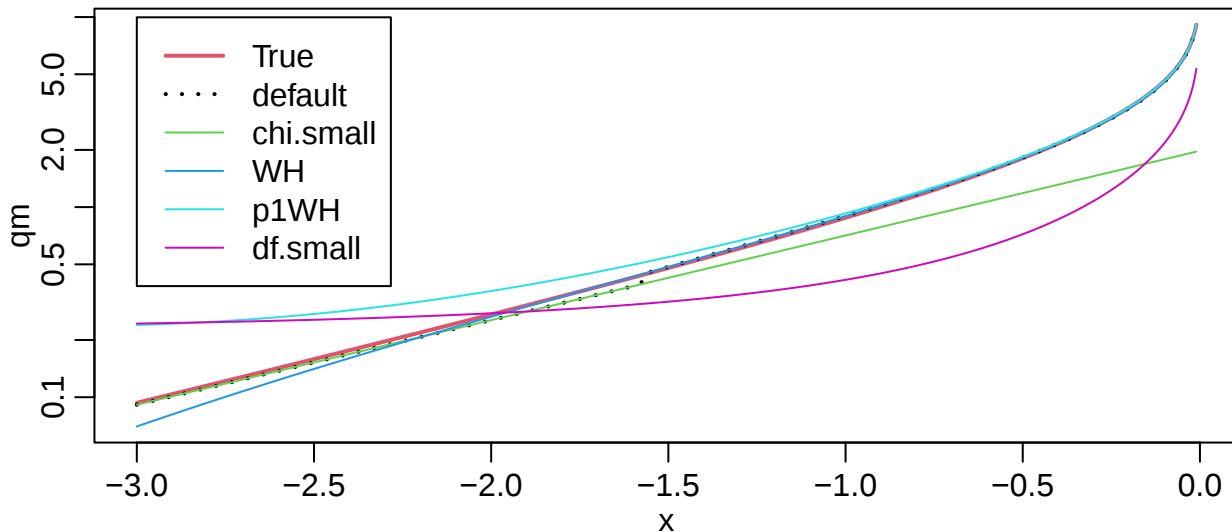
p.qchi.appr(x = seq(-0.4, -1e-07, length = 901), df = 1.95)



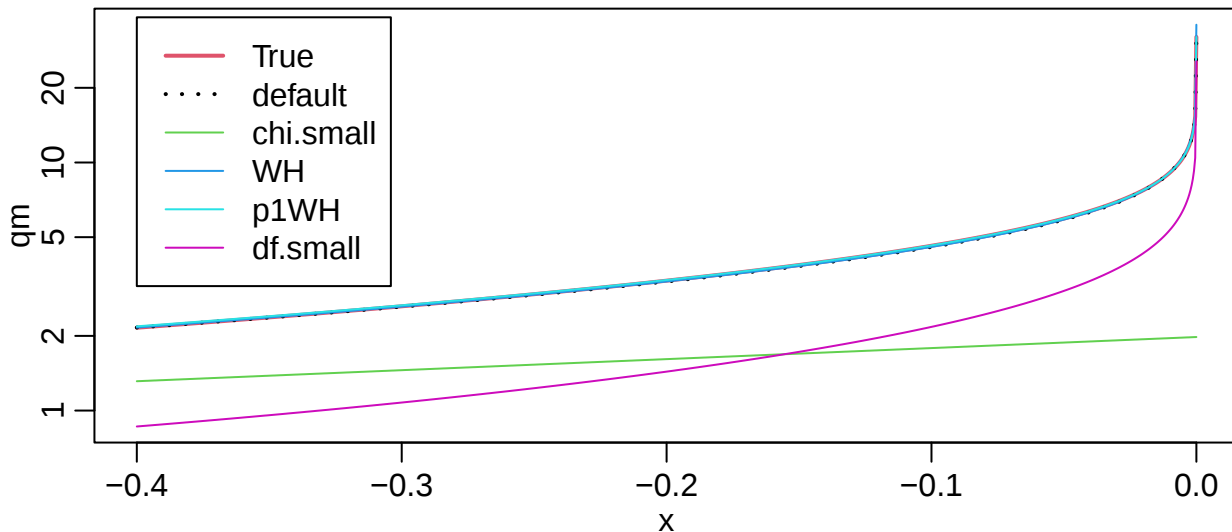
relative Error from `p.qchi.appr(x = seq(-0.4, -1e-07, length = 901), df = 1.95)`



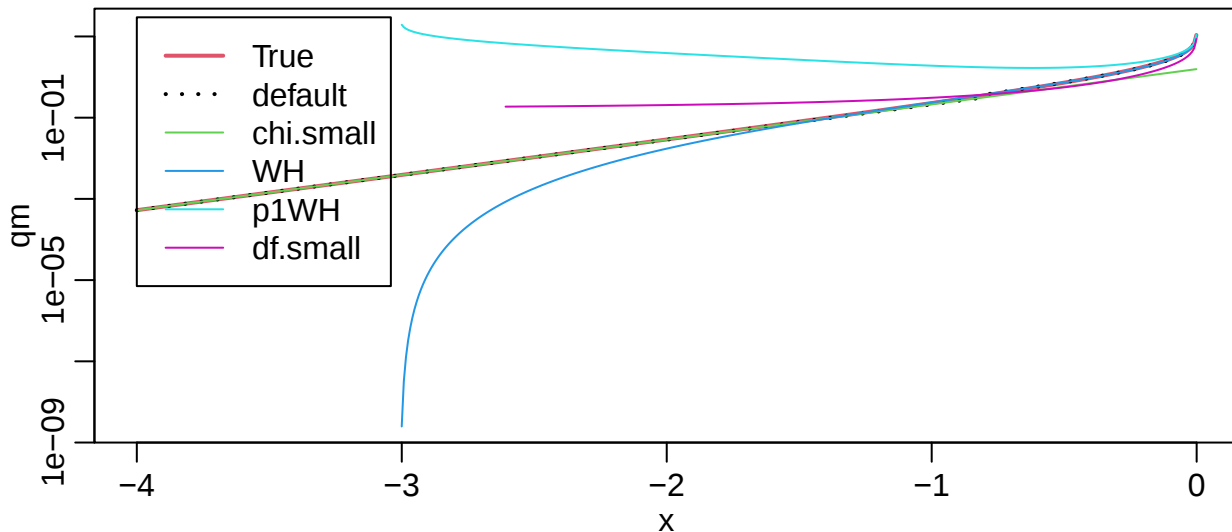
`p.qchi.appr(x = seq(-3, -0.01, length = 501), df = 1.95)`



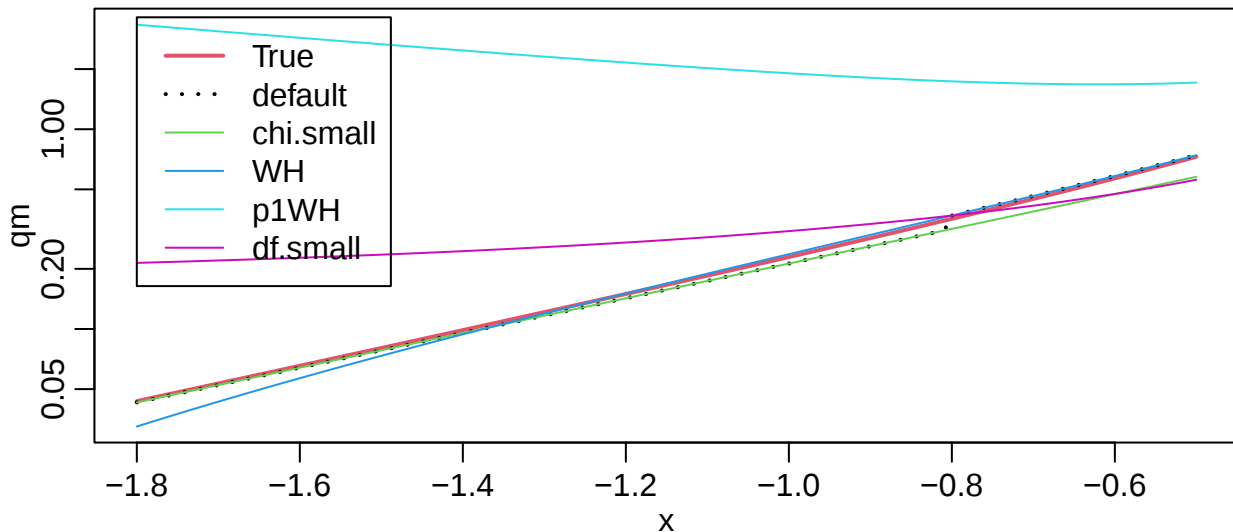
p.qchi.appr(x = seq(-0.4, -1e-07, length = 901), df = 1.95)



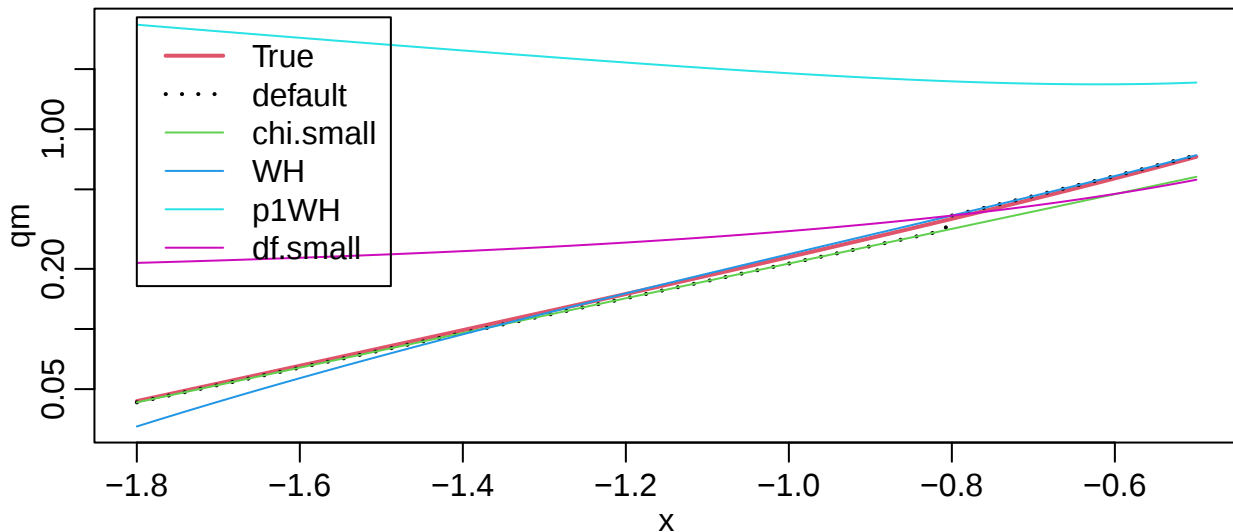
p.qchi.appr(x = seq(-4, -0.001, length = 501), df = 1)



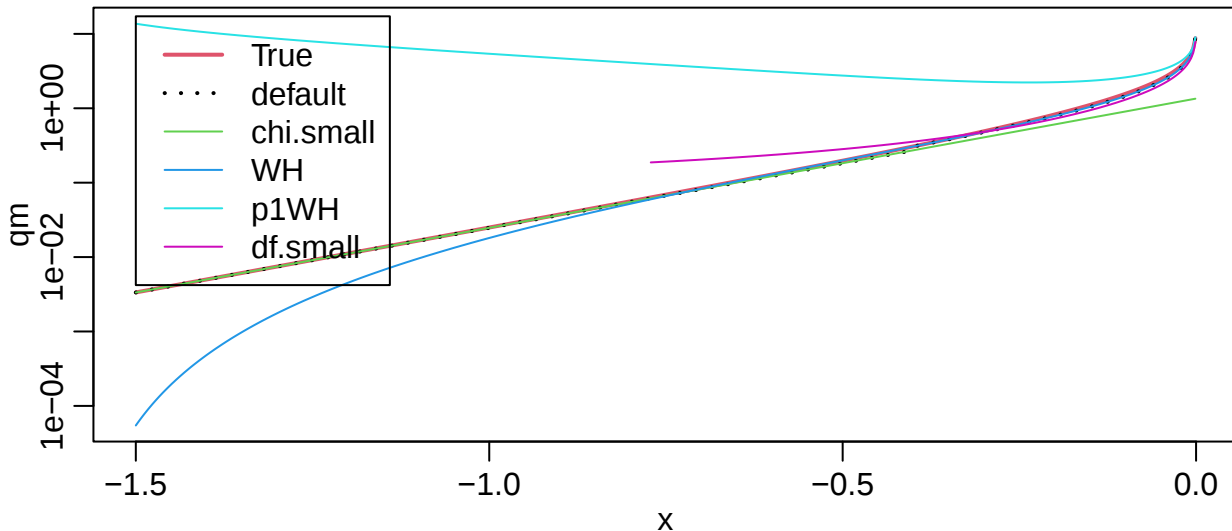
p.qchi.appr(x = seq(-1.8, -0.5, length = 901), df = 1)



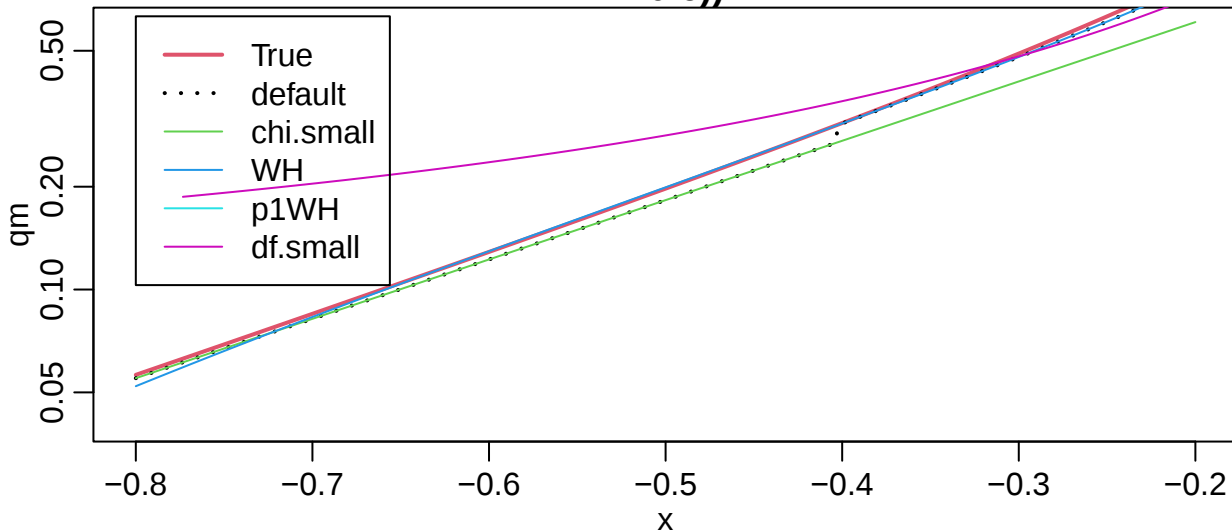
p.qchi.appr(x = seq(-1.8, -0.5, length = 901), df = 1)



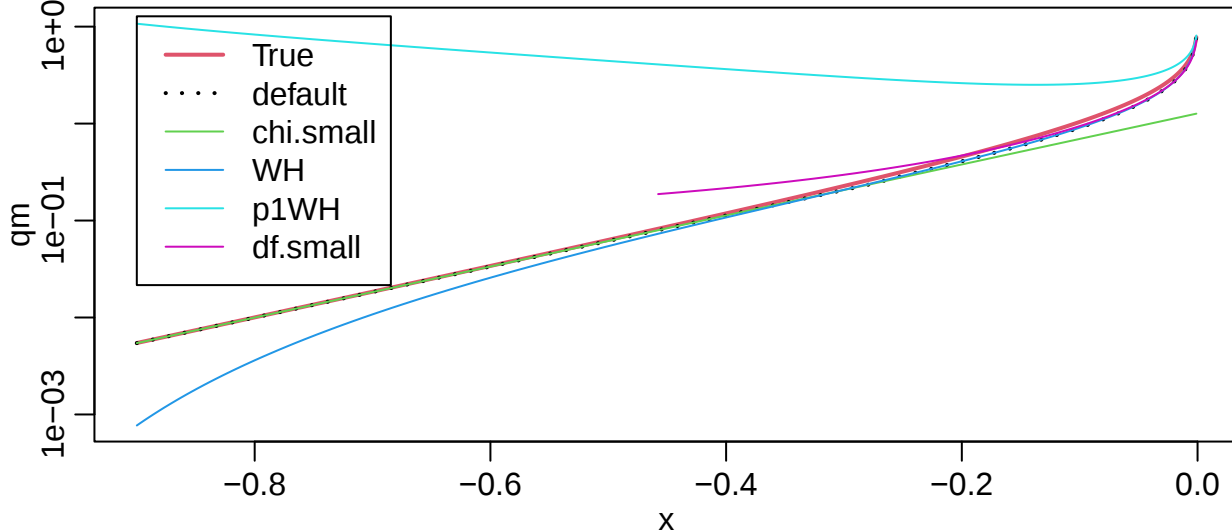
p.qchi.appr(x = seq(-1.5, -0.001, length = 501), df = 0.5)



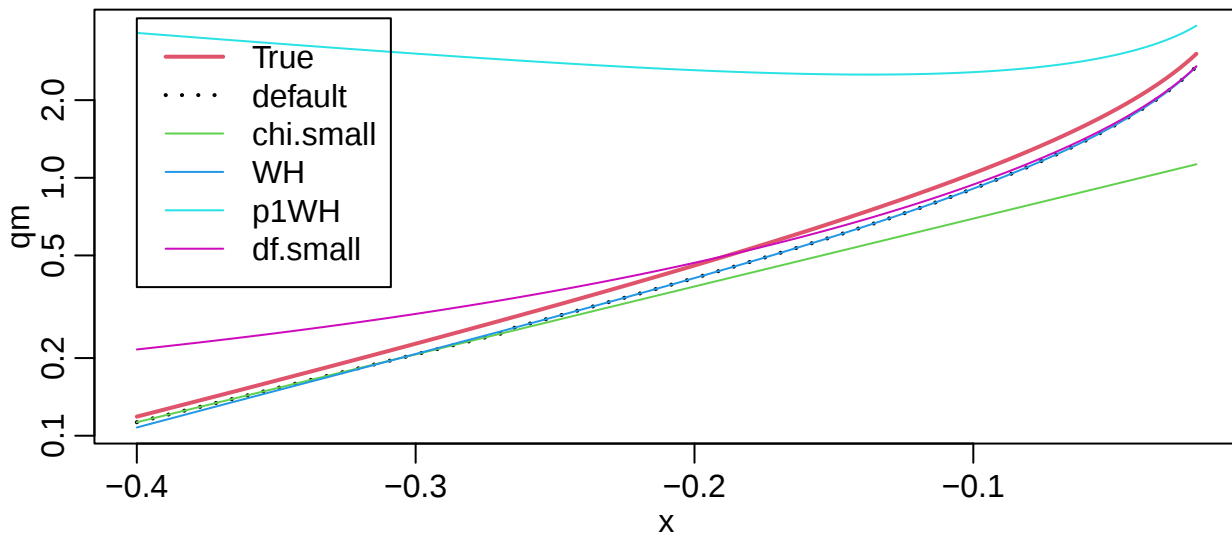
p.qchi.appr(x = seq(-0.8, -0.2, length = 901), df = 0.5, ylim = c(0.04, 0.6))



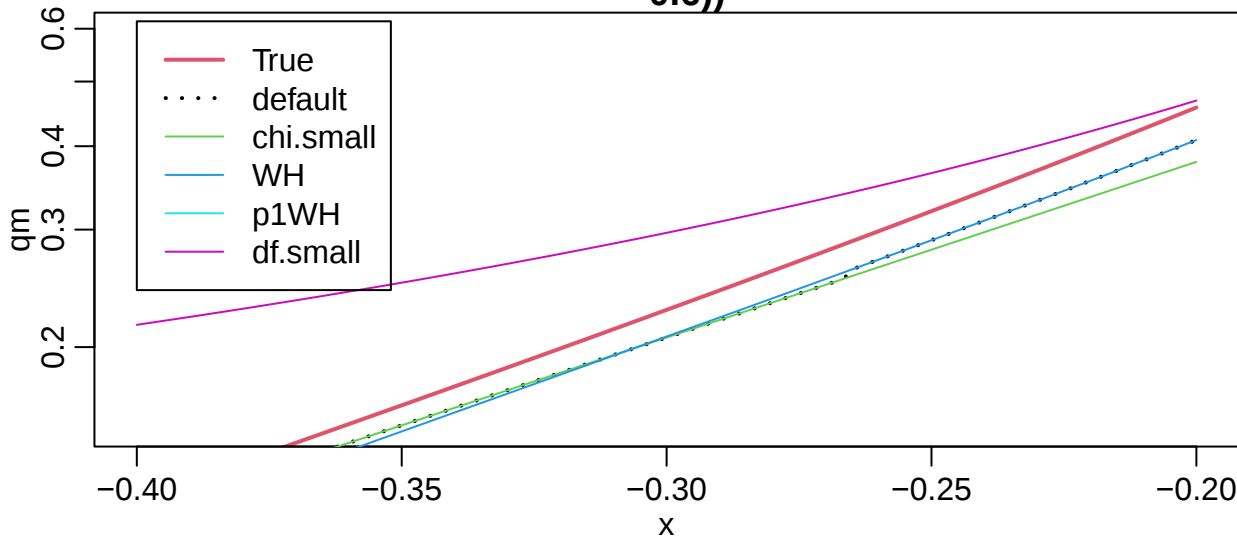
p.qchi.appr(x = seq(-0.9, -0.001, length = 501), df = 0.33)



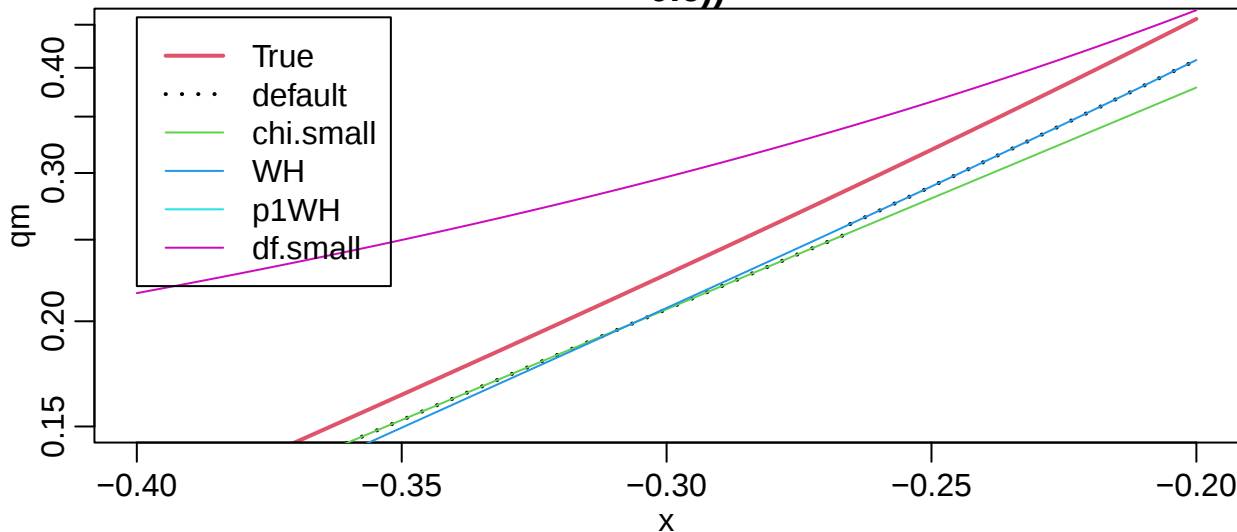
p.qchi.appr(x = seq(-0.4, -0.02, length = 901), df = 0.33)



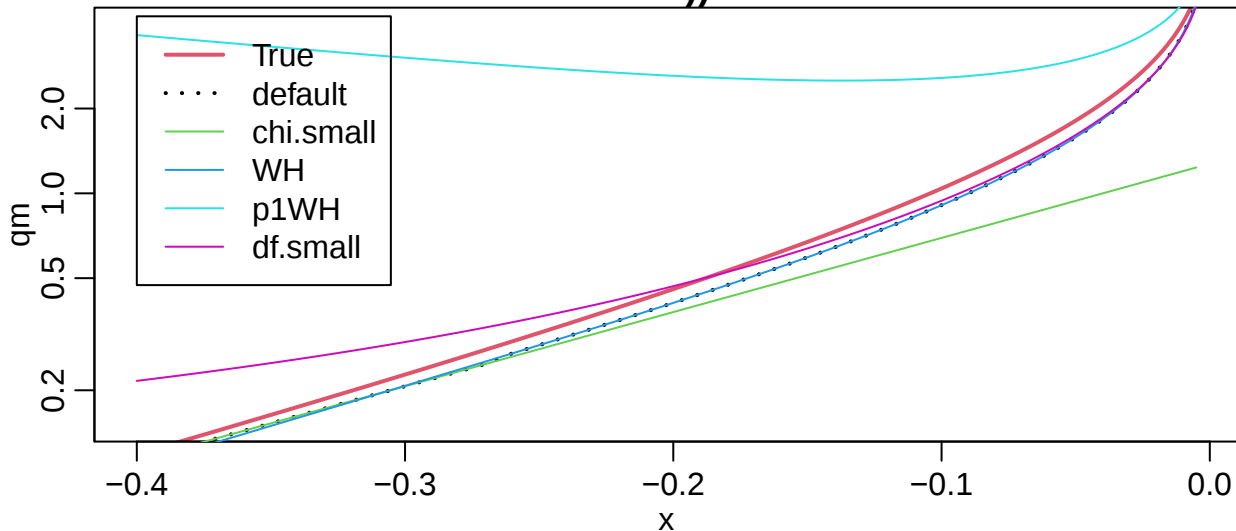
p.qchi.appr(x = seq(-0.4, -0.2, length = 901), df = 0.33, ylim = c(0.15, 0.6))



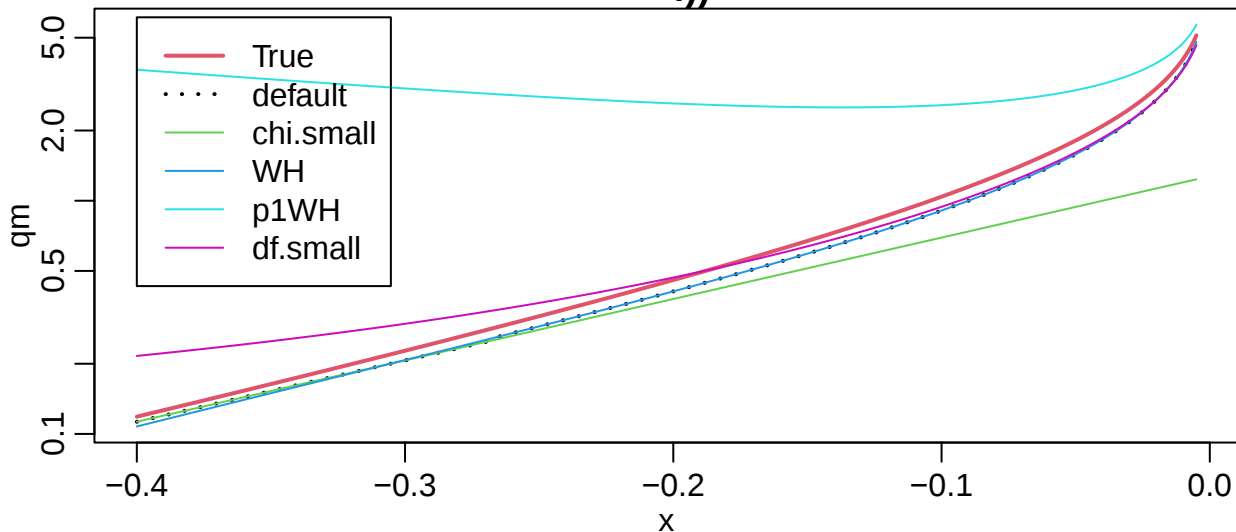
p.qchi.appr(x = seq(-0.4, -0.2, length = 901), df = 0.33, ylim = c(0.15, 0.6))



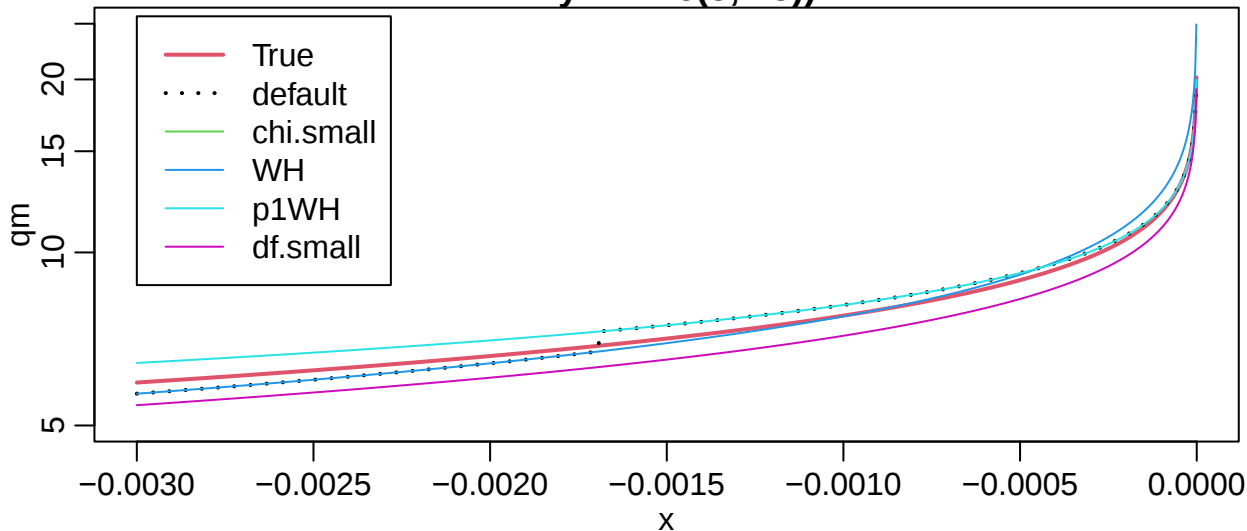
p.qchi.appr(x = seq(-0.4, -0.005, length = 901), df = 0.33, ylim = c(0.15, 4))



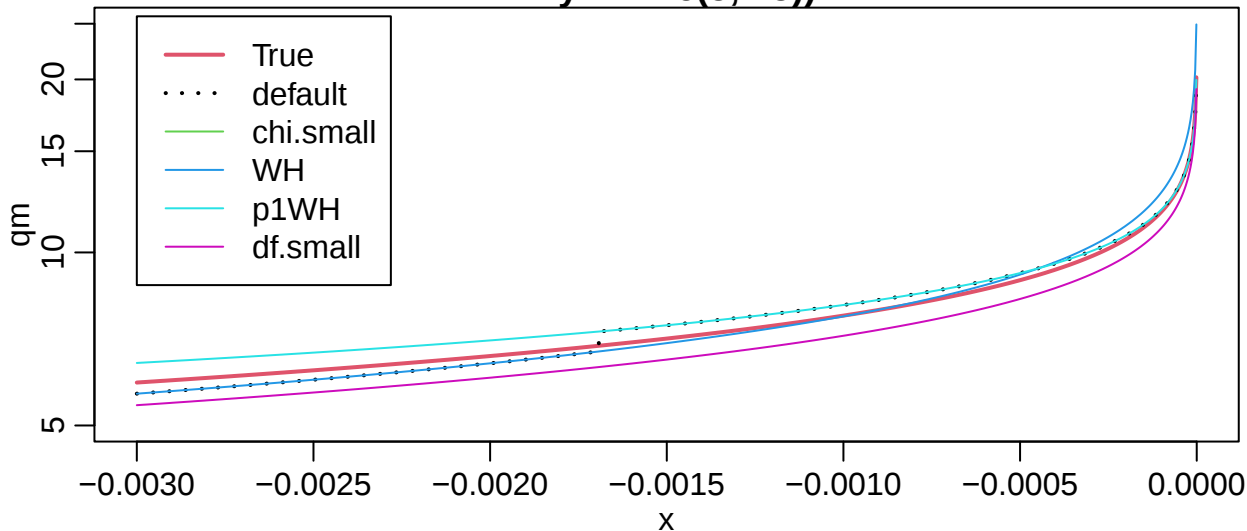
p.qchi.appr(x = seq(-0.4, -0.005, length = 901), df = 0.33, ylim = c(0.15, 4))



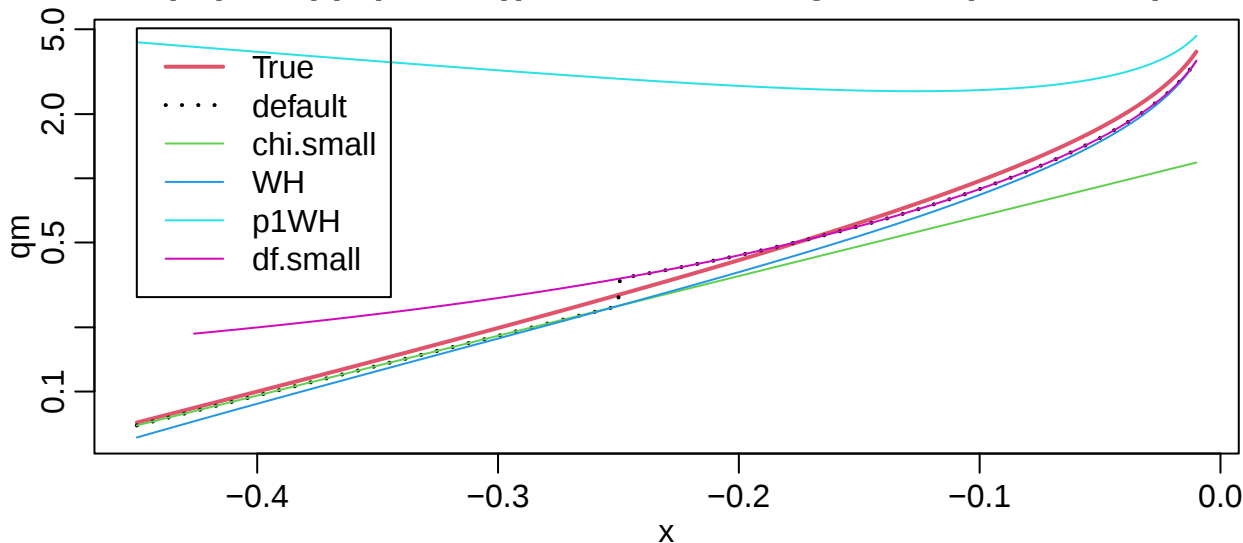
**p.qchi.appr(x = seq(-0.003, -1e-06, length = 901), df = 0.33,
ylim = c(5, 25))**



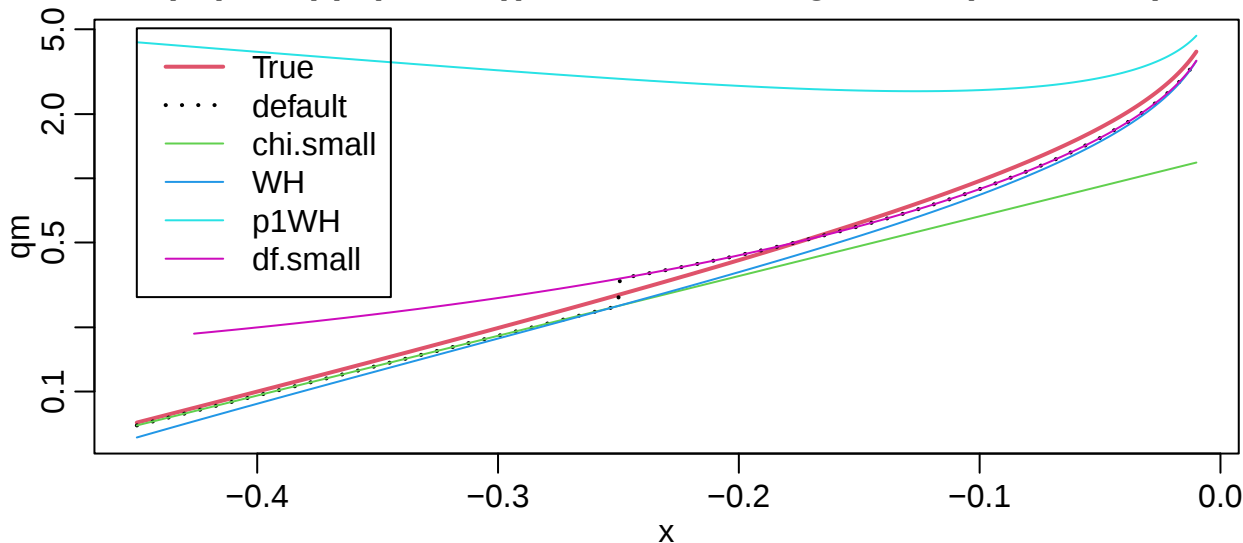
**p.qchi.appr(x = seq(-0.003, -1e-06, length = 901), df = 0.33,
ylim = c(5, 25))**



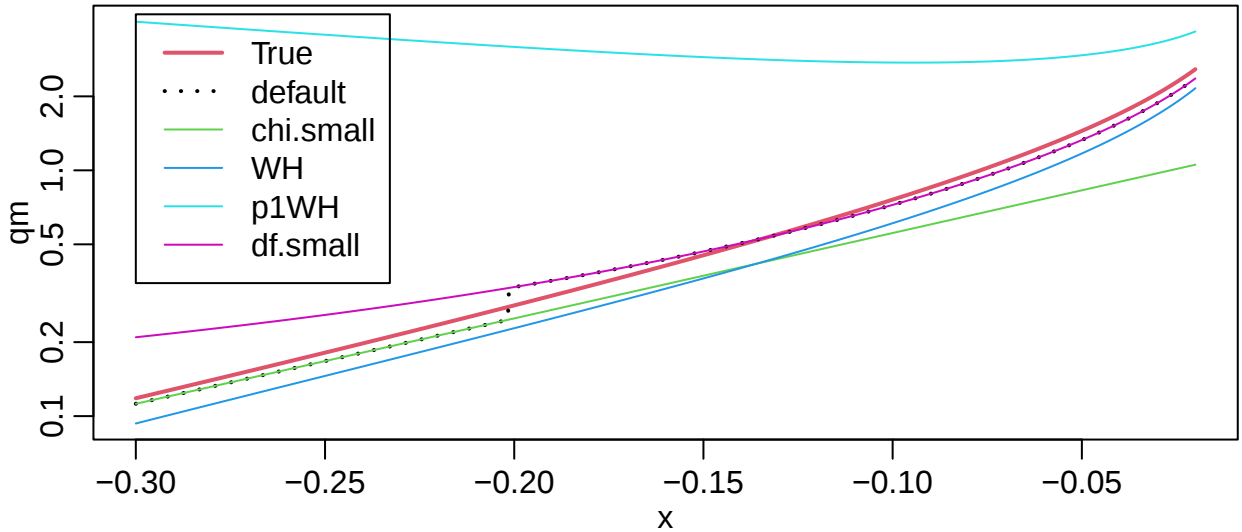
p.qchi.appr(x = seq(-0.45, -0.01, length = 501), df = 0.31)



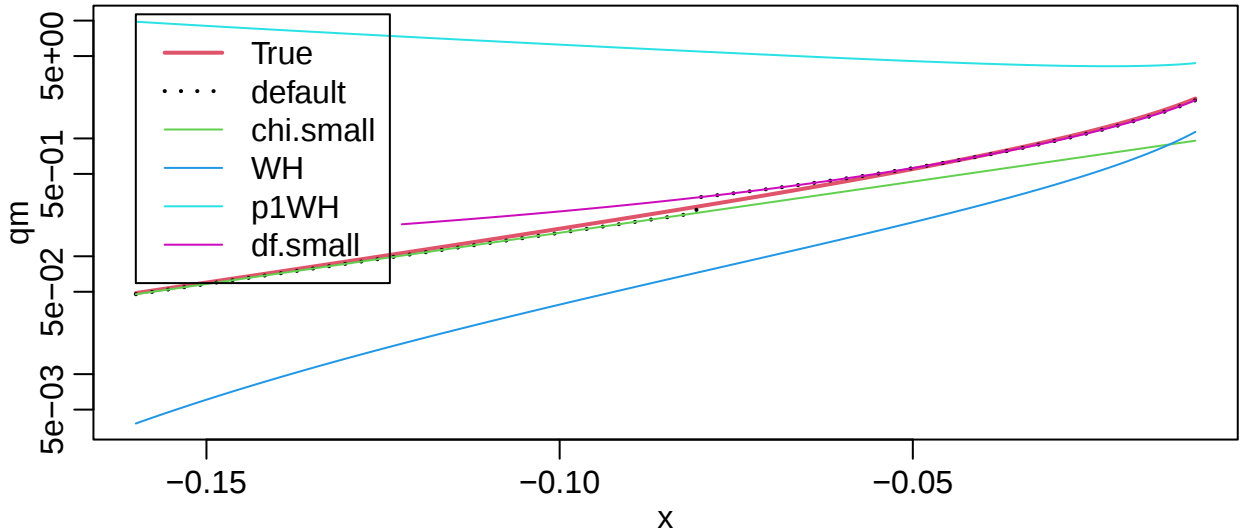
p.qchi.appr(x = seq(-0.45, -0.01, length = 501), df = 0.31)



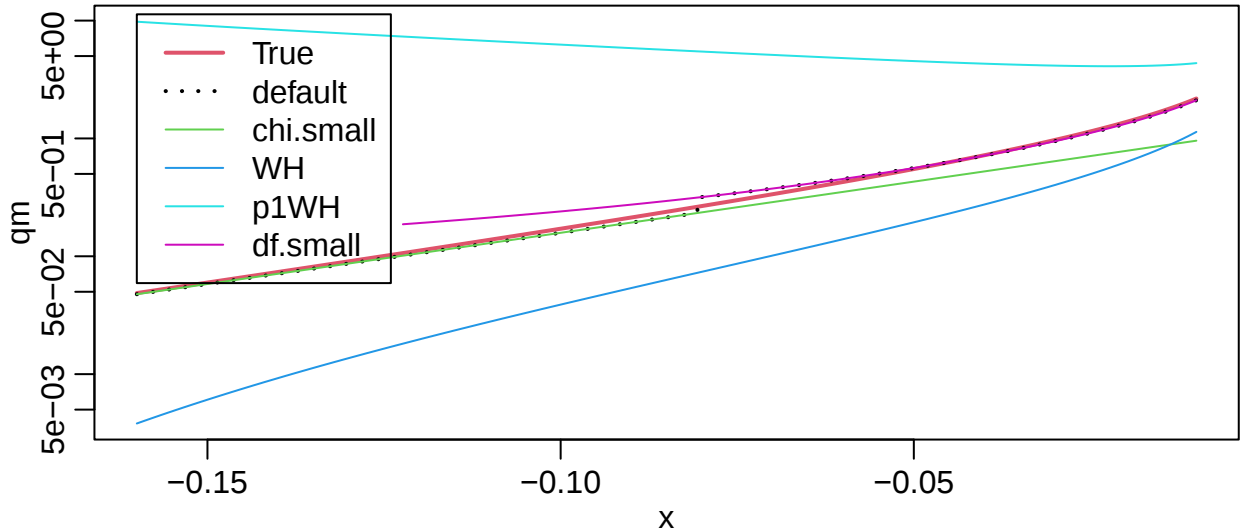
p.qchi.appr(x = seq(-0.3, -0.02, length = 901), df = 0.25)



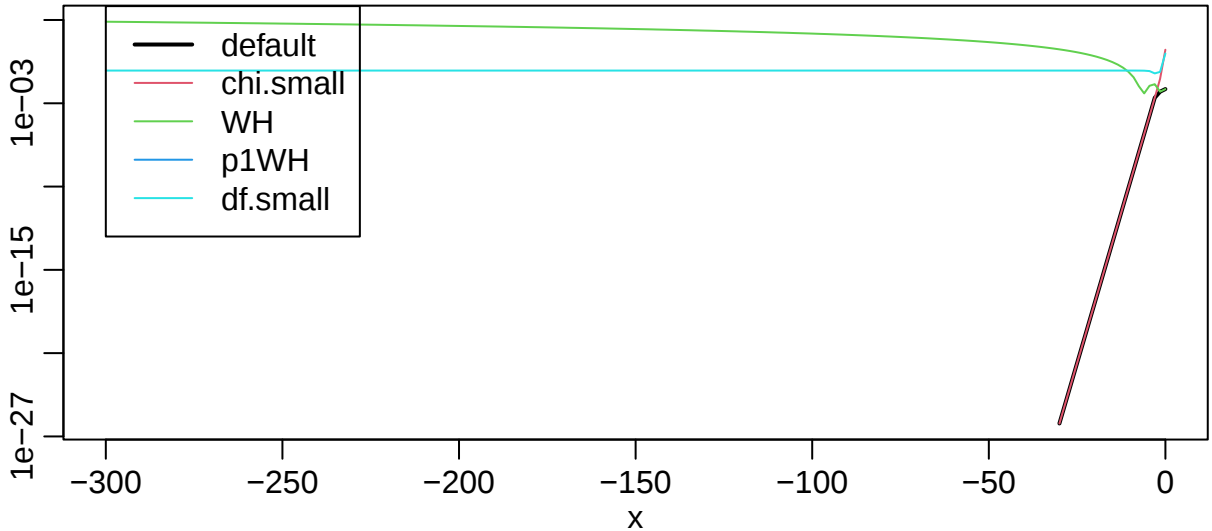
p.qchi.appr(x = seq(-0.16, -0.01, length = 901), df = 0.1)



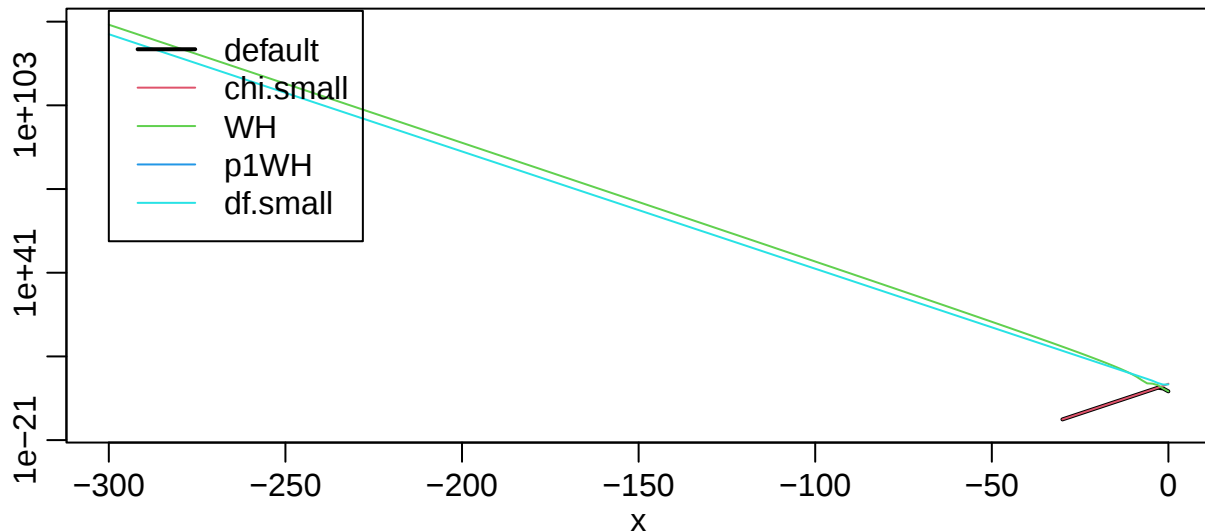
p.qchi.appr(x = seq(-0.16, -0.01, length = 901), df = 0.1)



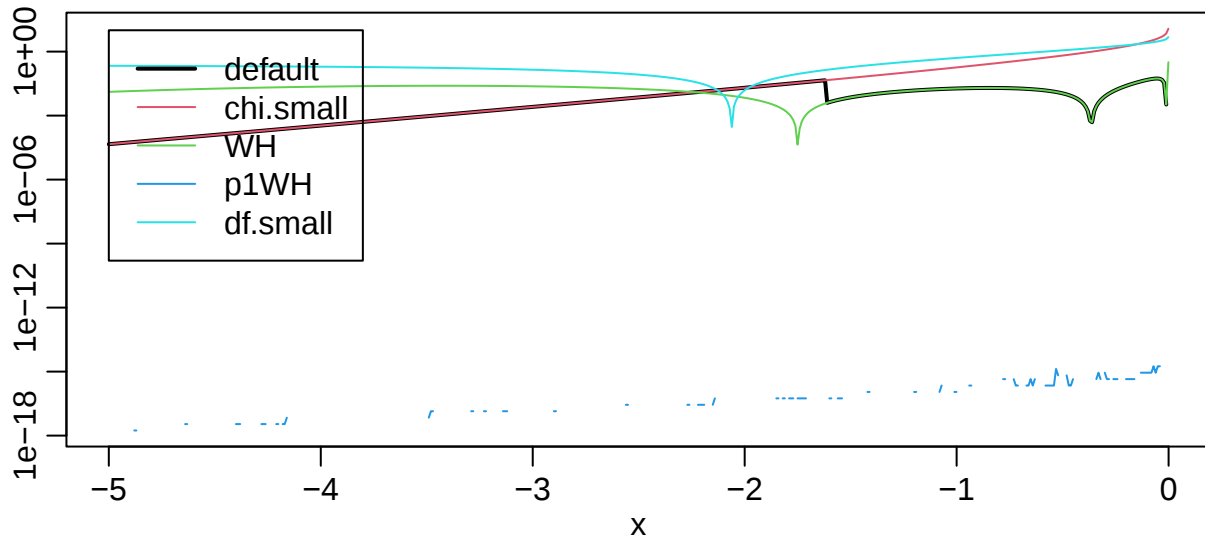
absolute Error from p.qchi.appr(x = seq(-300, -0.01, length = 201), df = 0.1)



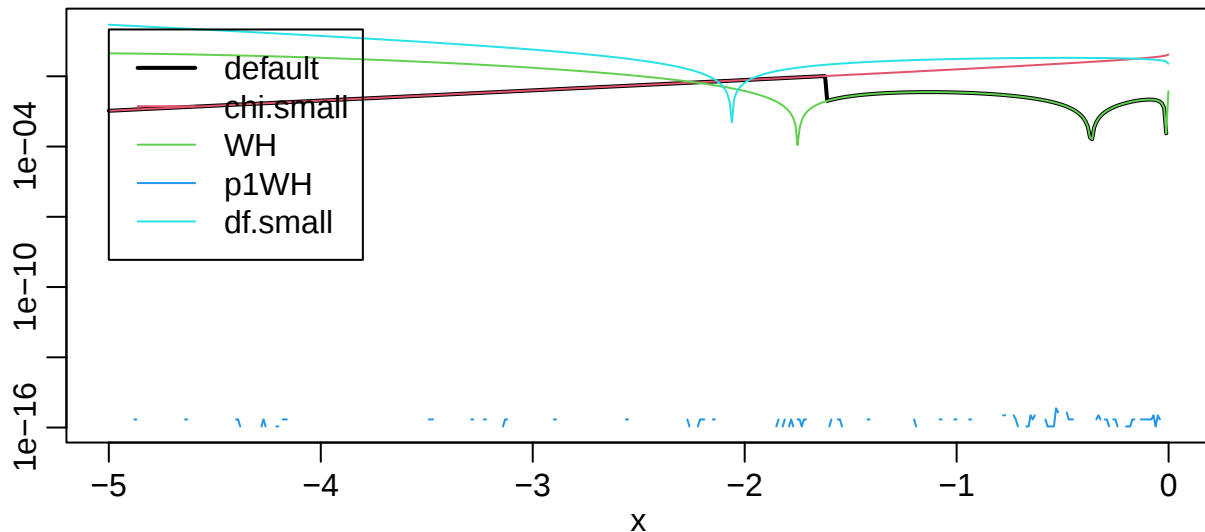
relative Error from `p.qchi.appr(x = seq(-300, -0.01, length = 201), df = 2`



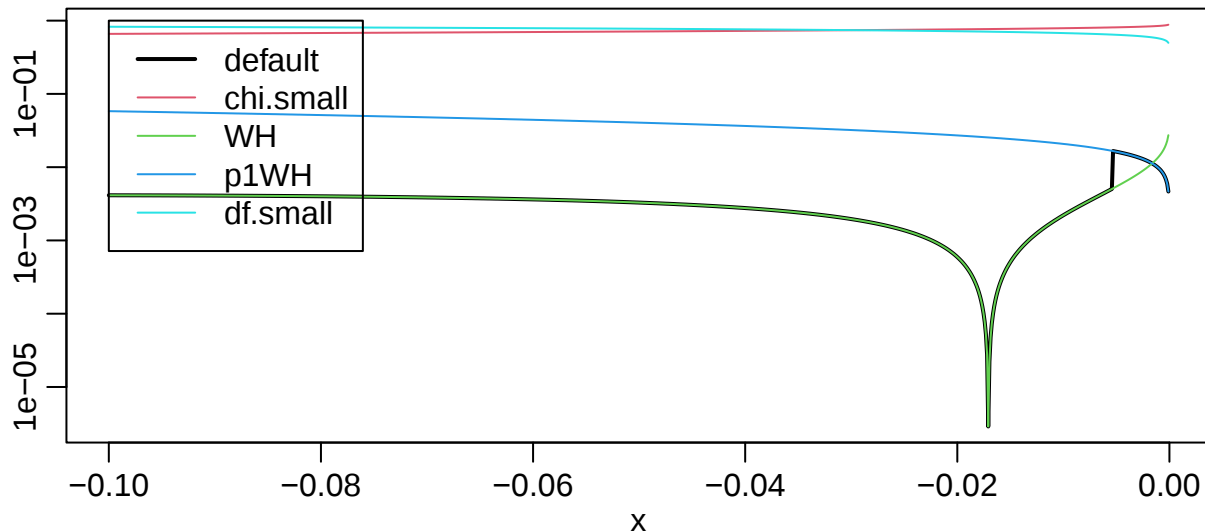
absolute Error from `p.qchi.appr(x = seq(-5, -0.001, length = 501), df = 2`



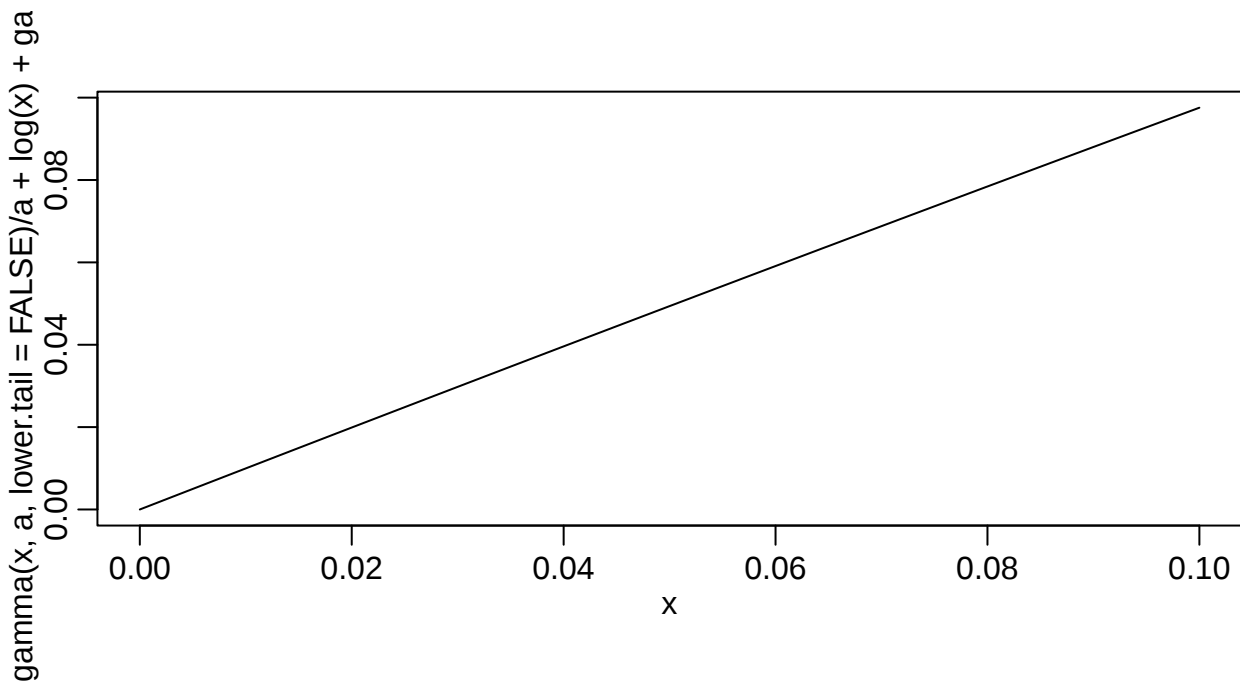
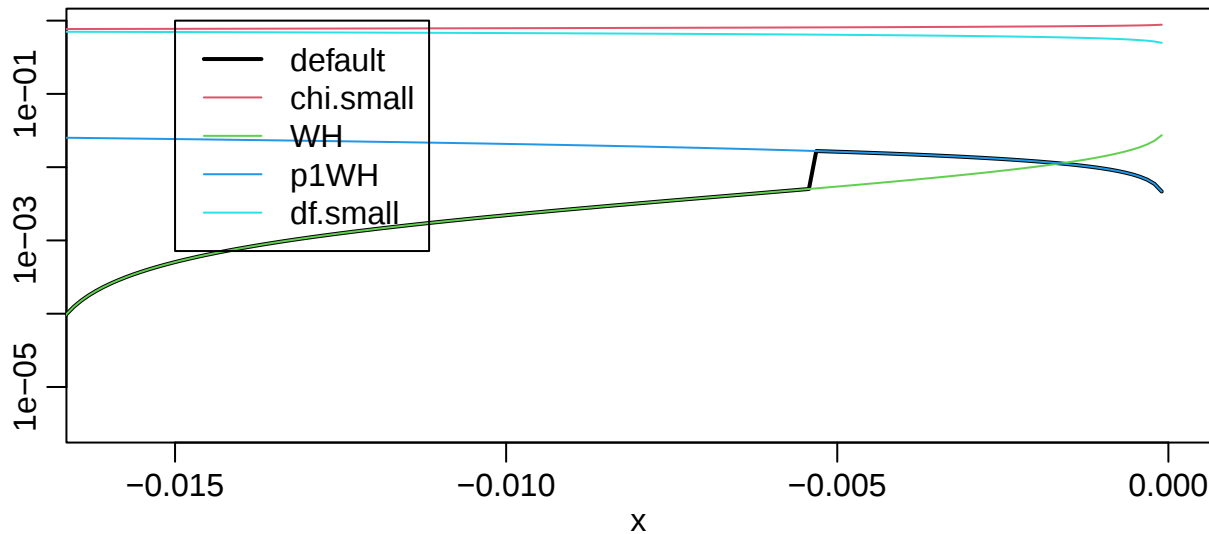
relative Error from `p.qchi.appr(x = seq(-5, -0.001, length = 501), df = 2)`

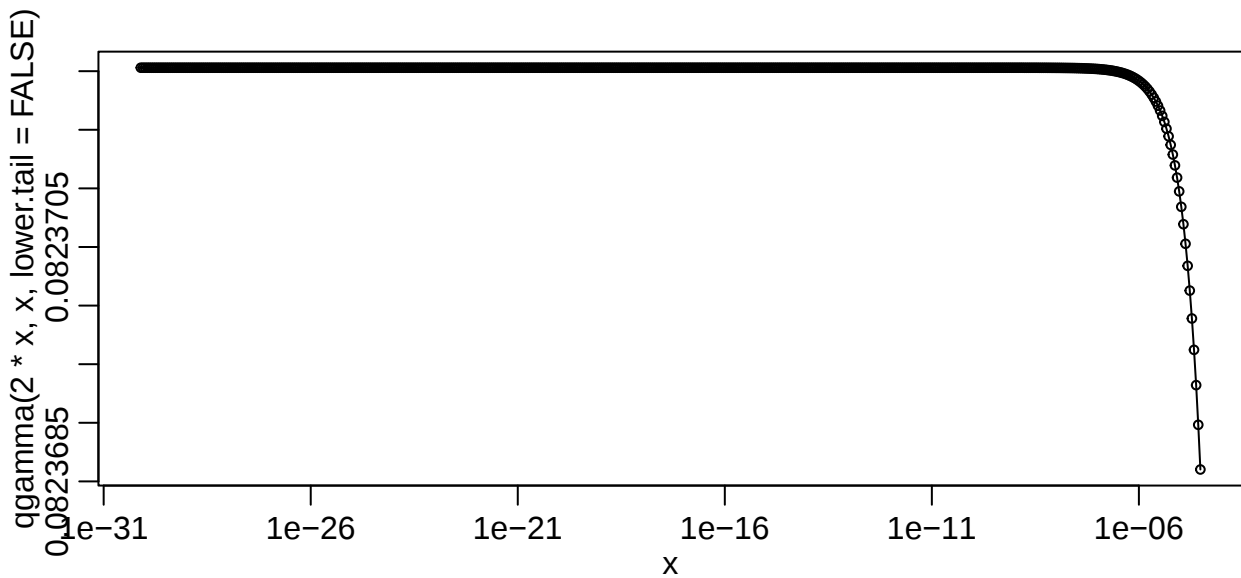
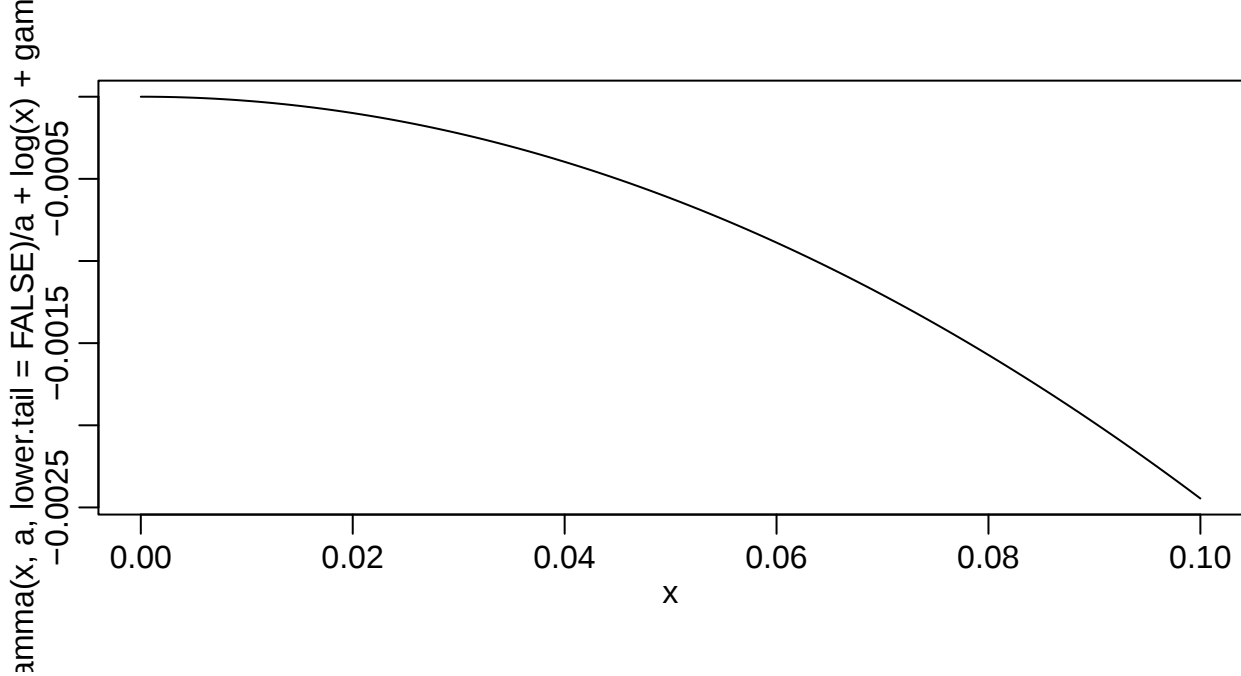


relative Error from `p.qchi.appr(x = seq(-0.1, -1e-04, length = 901), df = 2)`

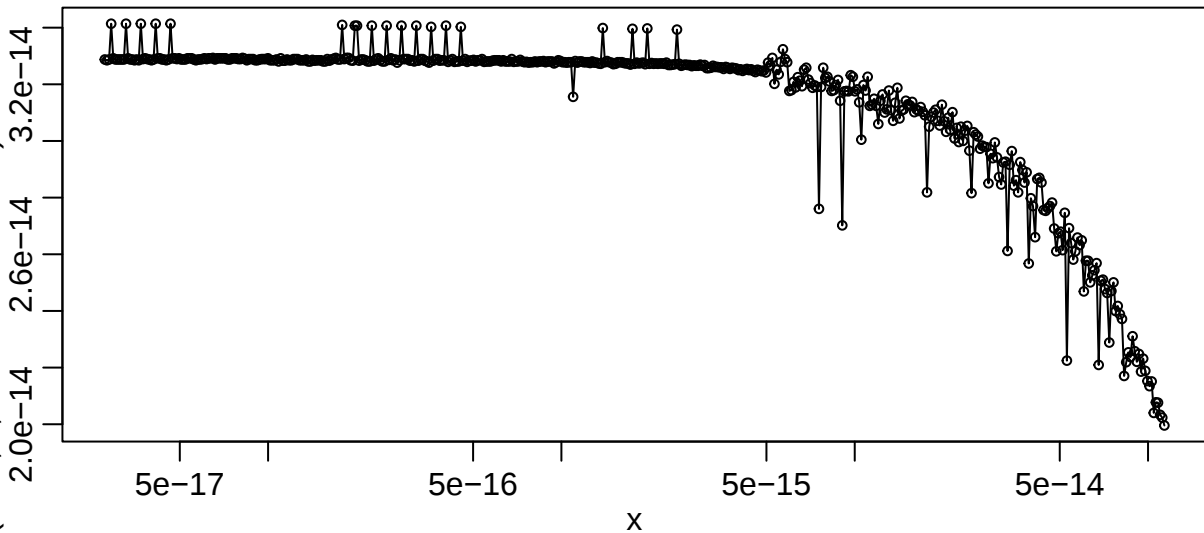


relative Error from `p.qchi.approx(x = seq(-0.1, -1e-04, length = 901), df =`

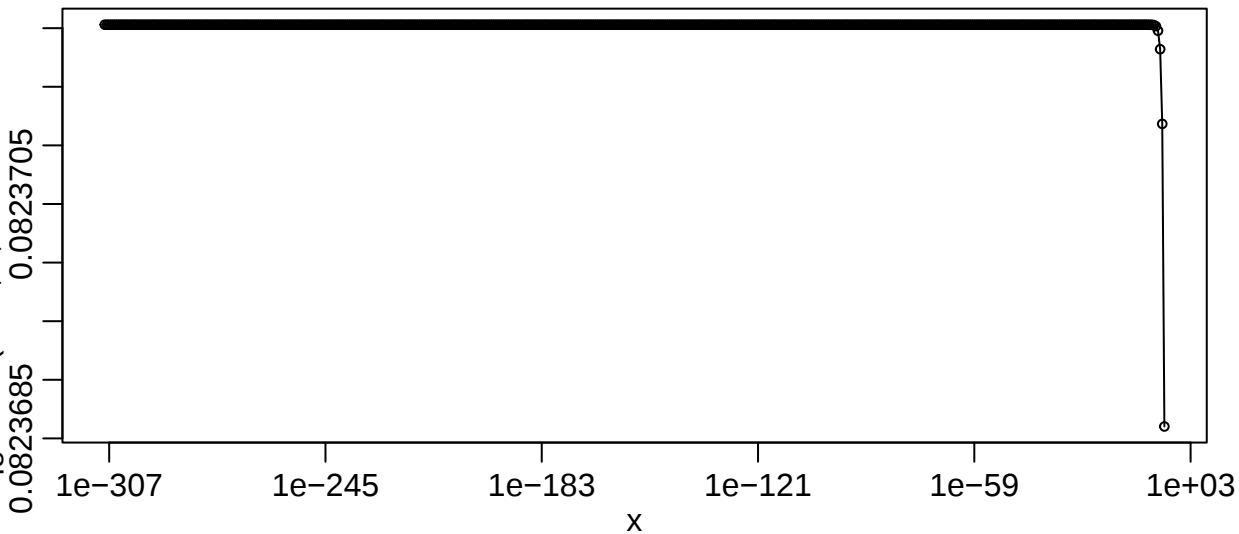


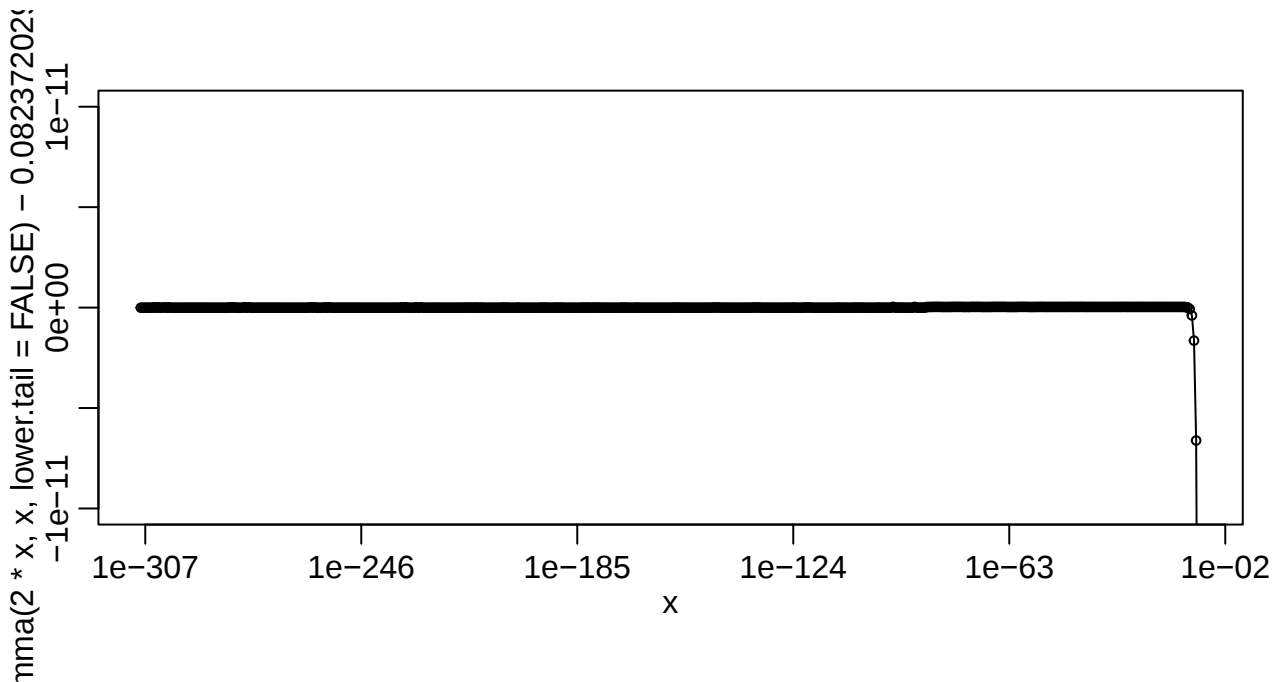
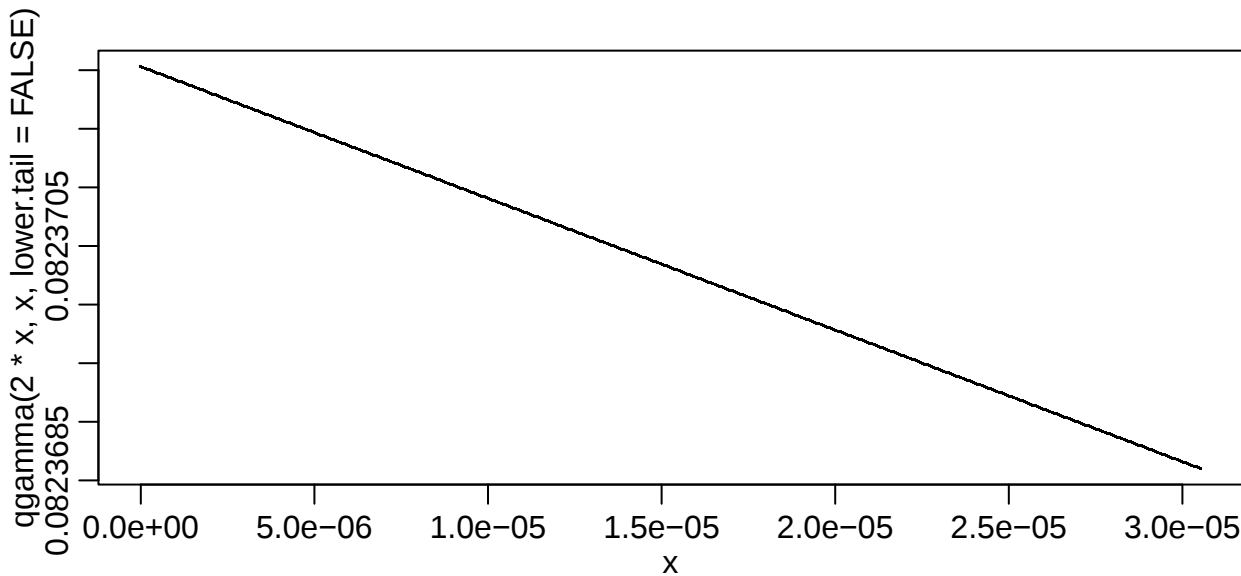


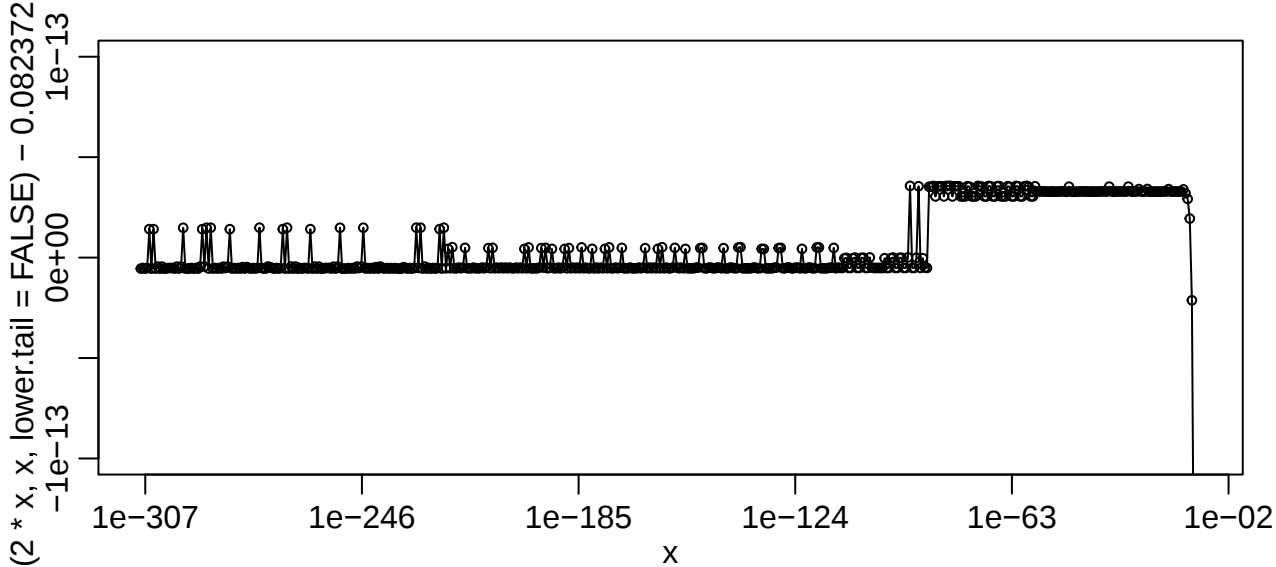
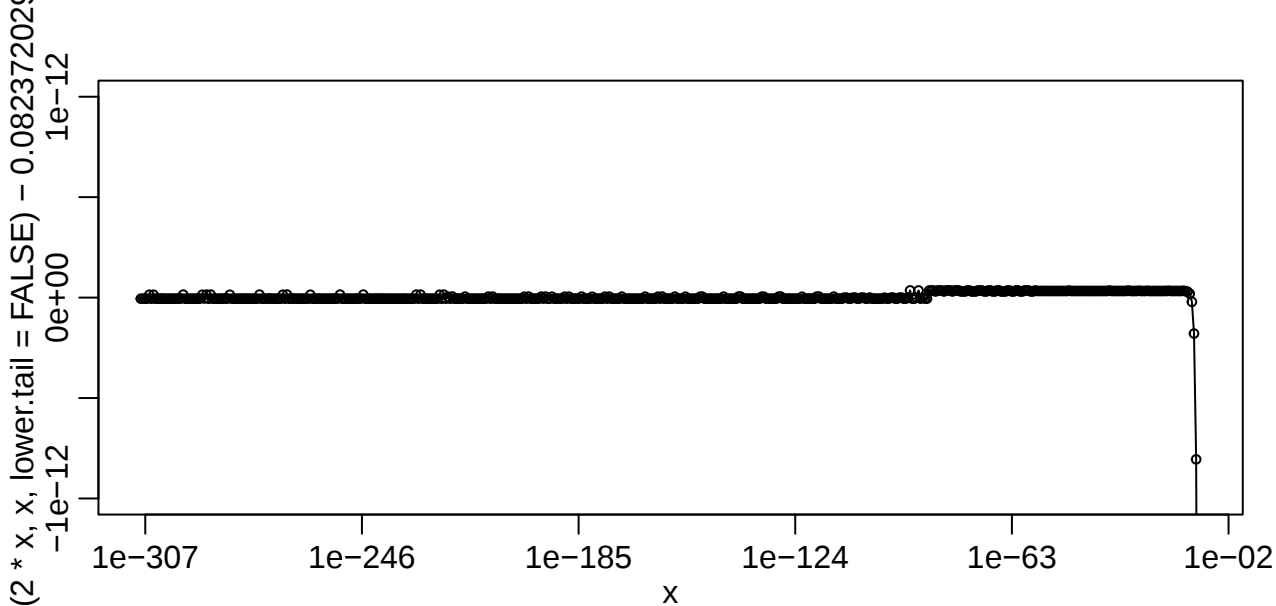
`nma(2 * x, x, lower.tail = FALSE) - 0.08237202`

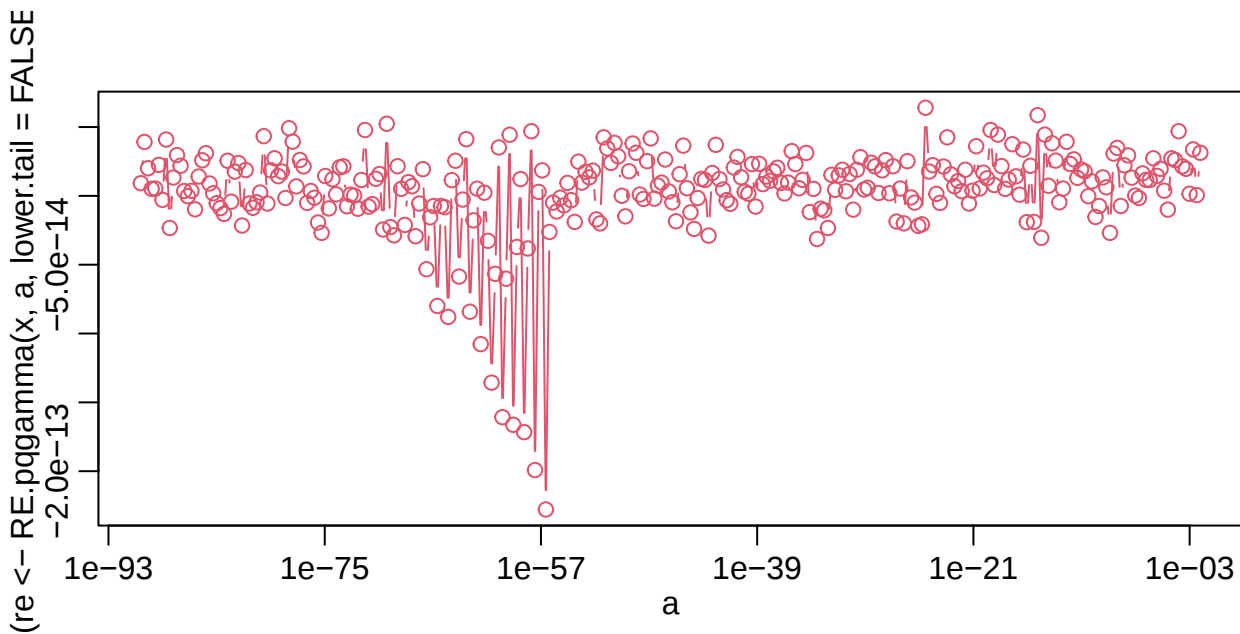
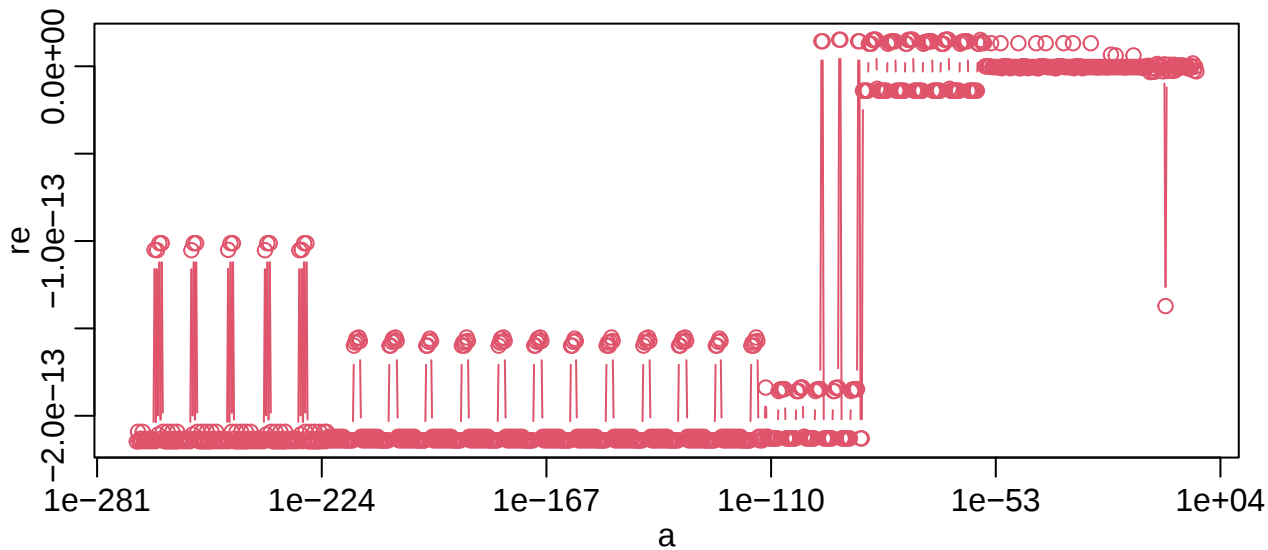


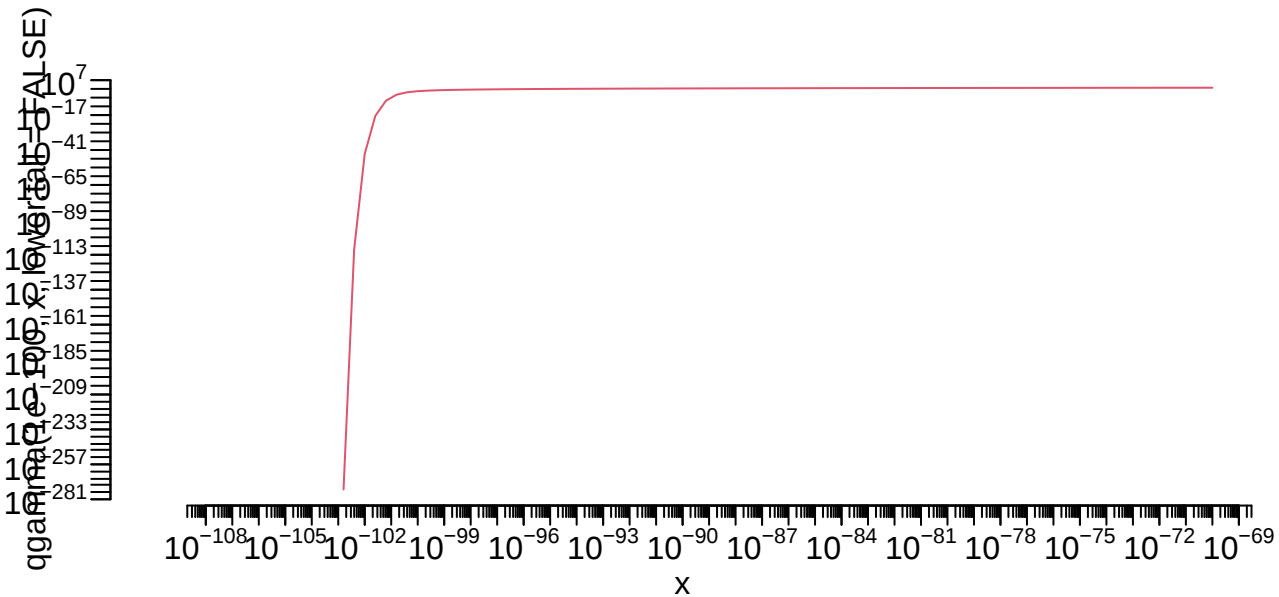
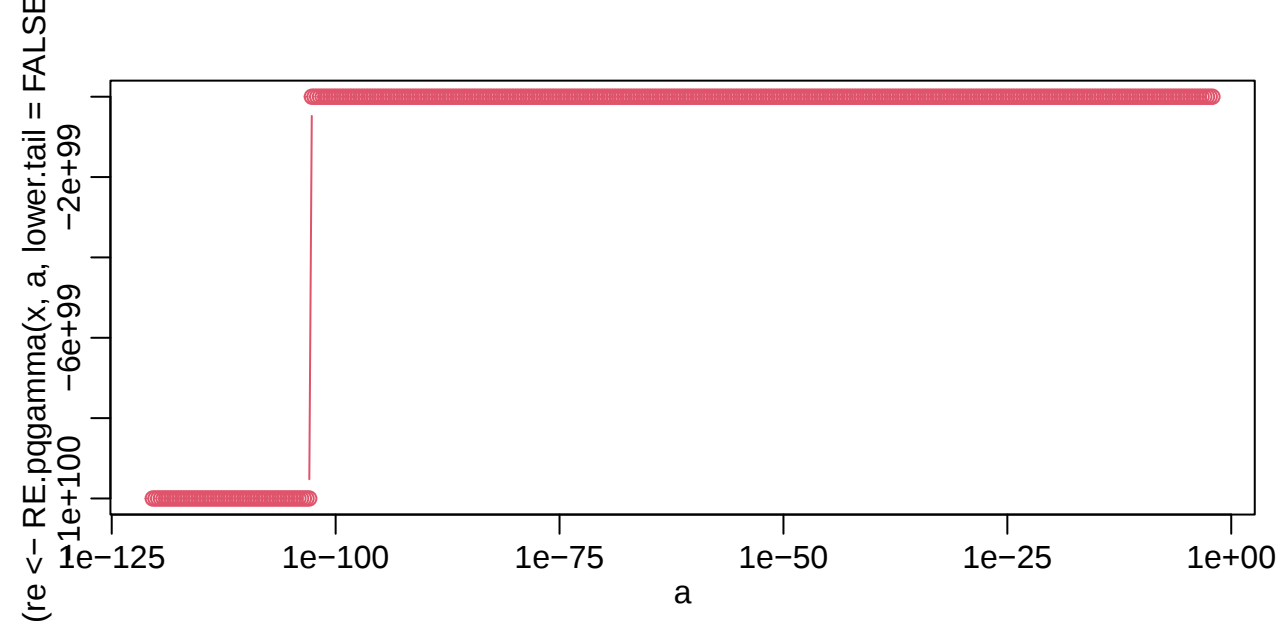
`qgamma(2 * x, x, lower.tail = FALSE)`



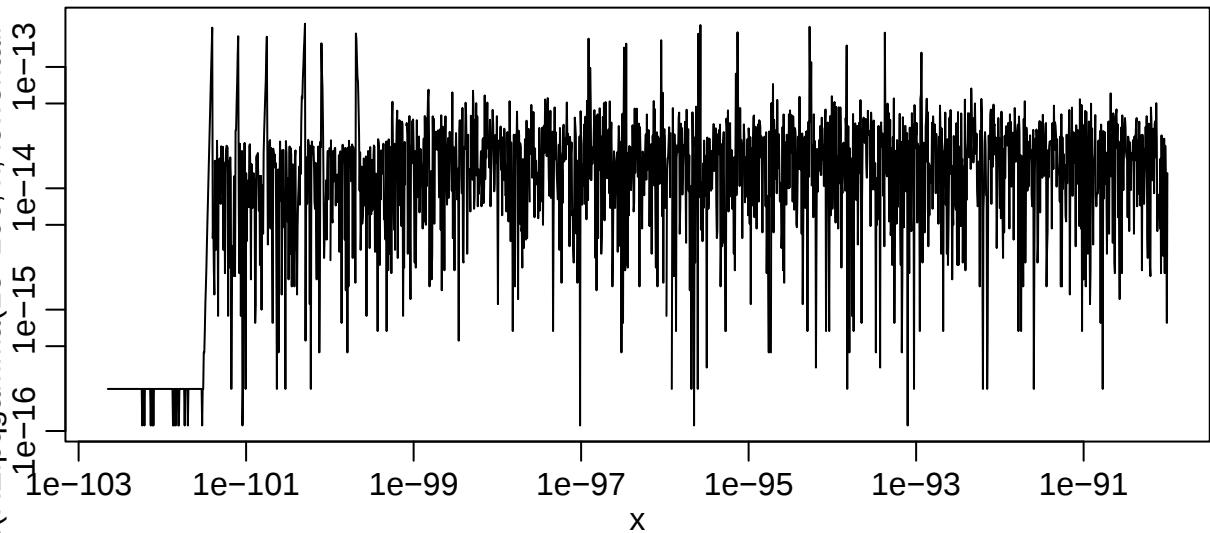




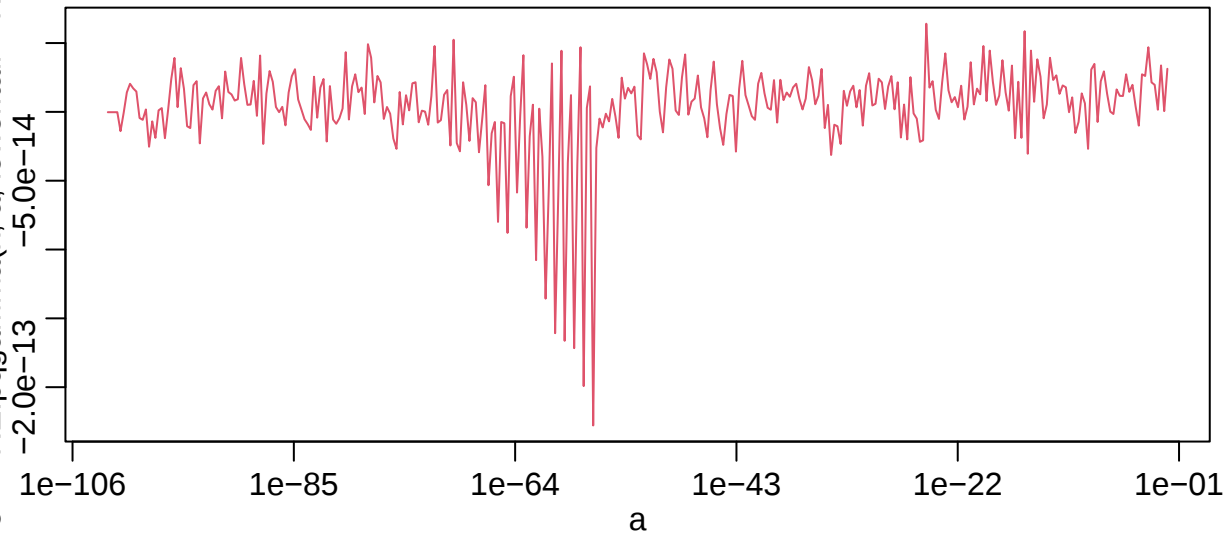




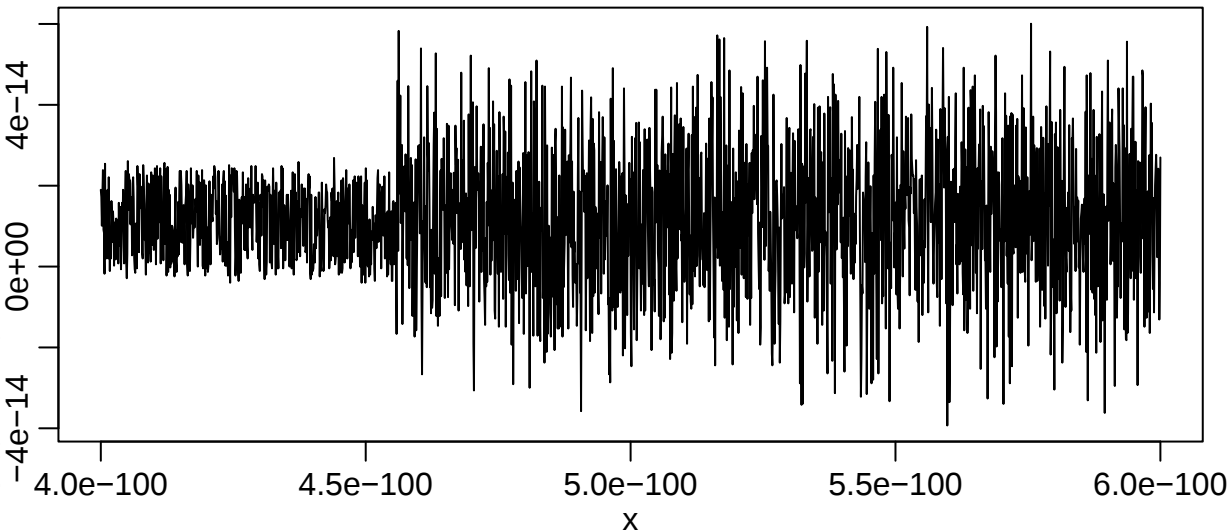
abs(RE.pqgamma(1e-100, x, lower.tail = FALSE



(re <- RE.pqgamma(x, a, lower.tail = FALSE



RE.pqgamma(1e-100, x, lower.tail = FALSE



RE.pqgamma(1e-100, x, lower.tail = FALSE

