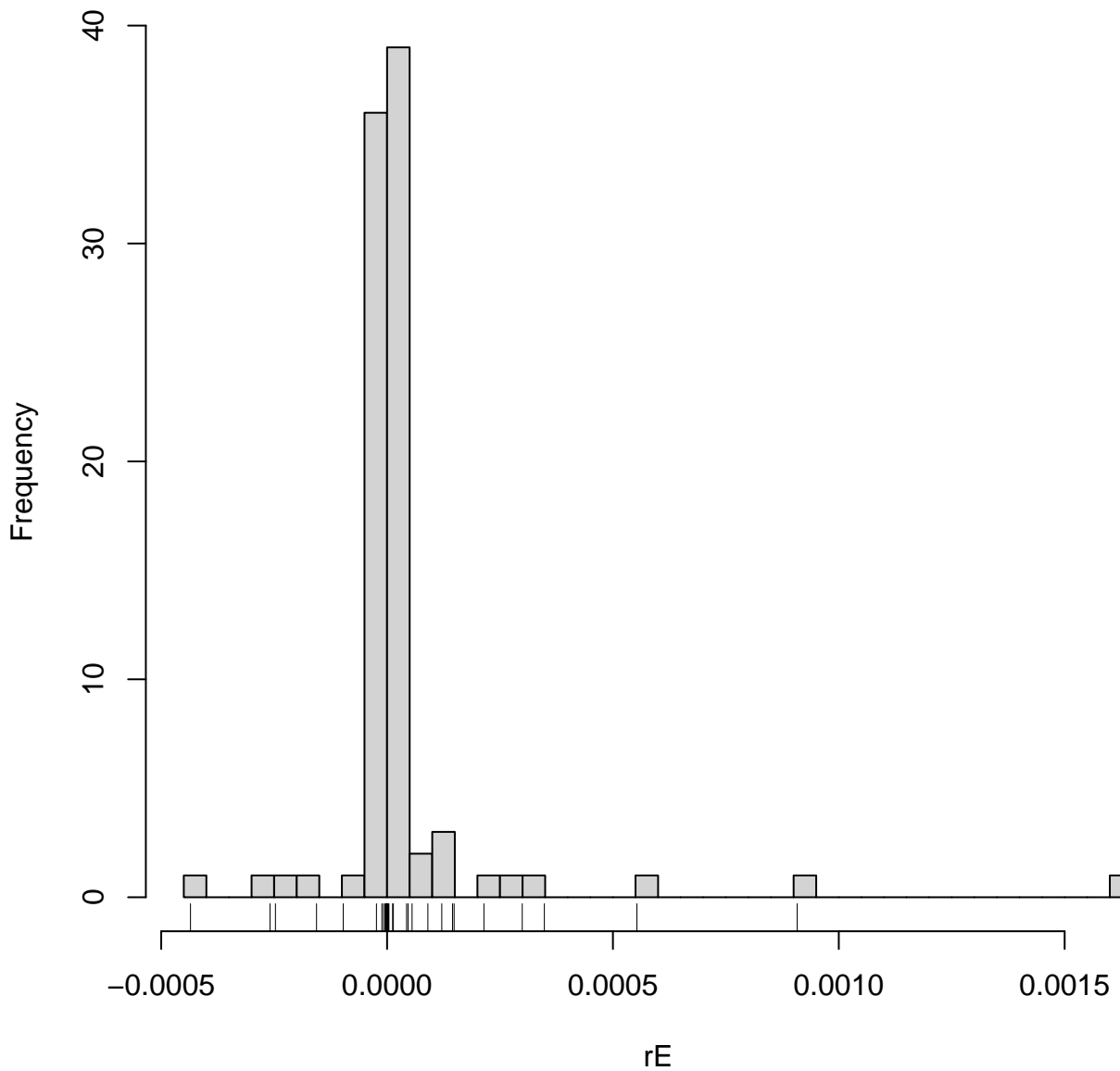
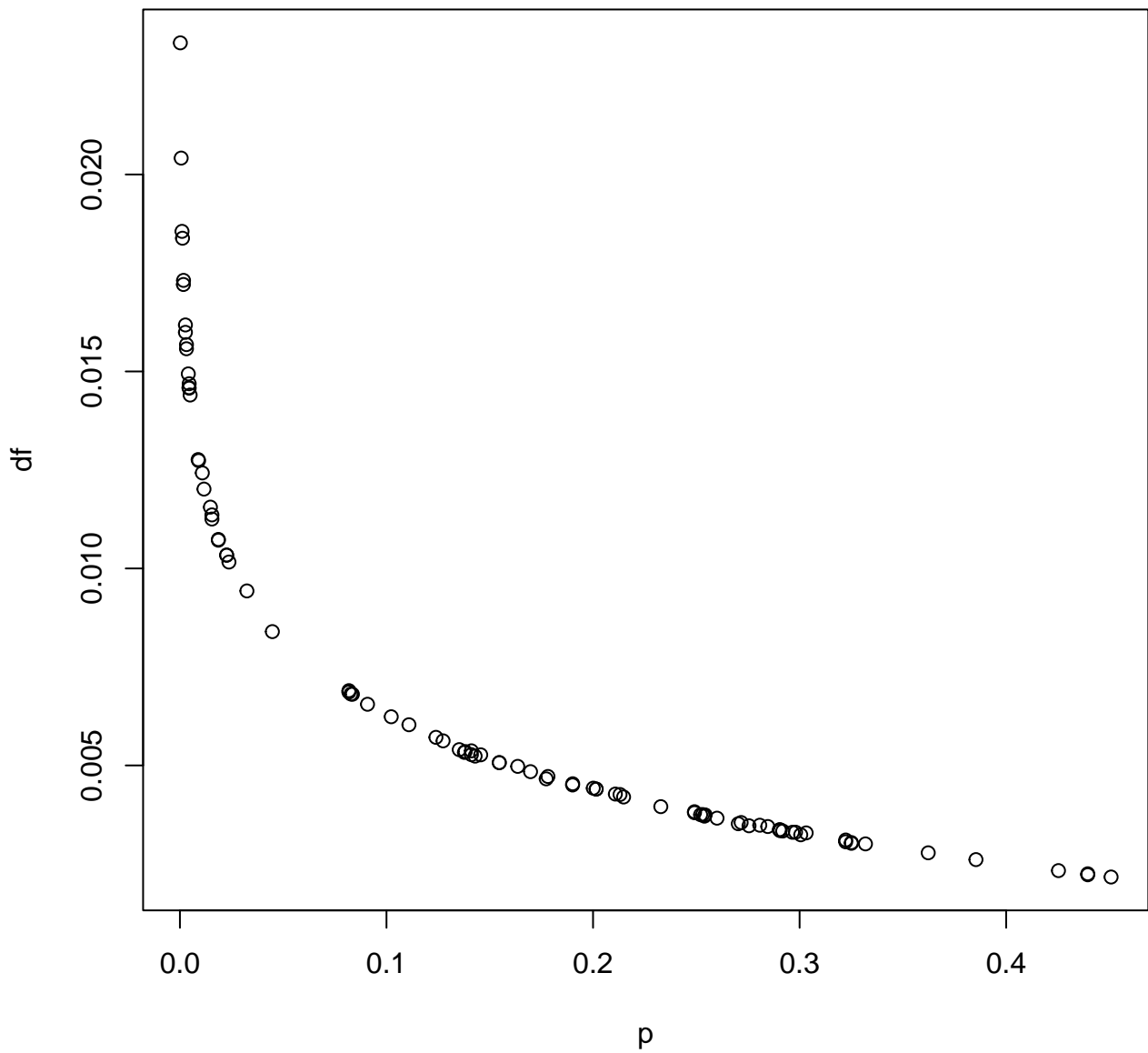
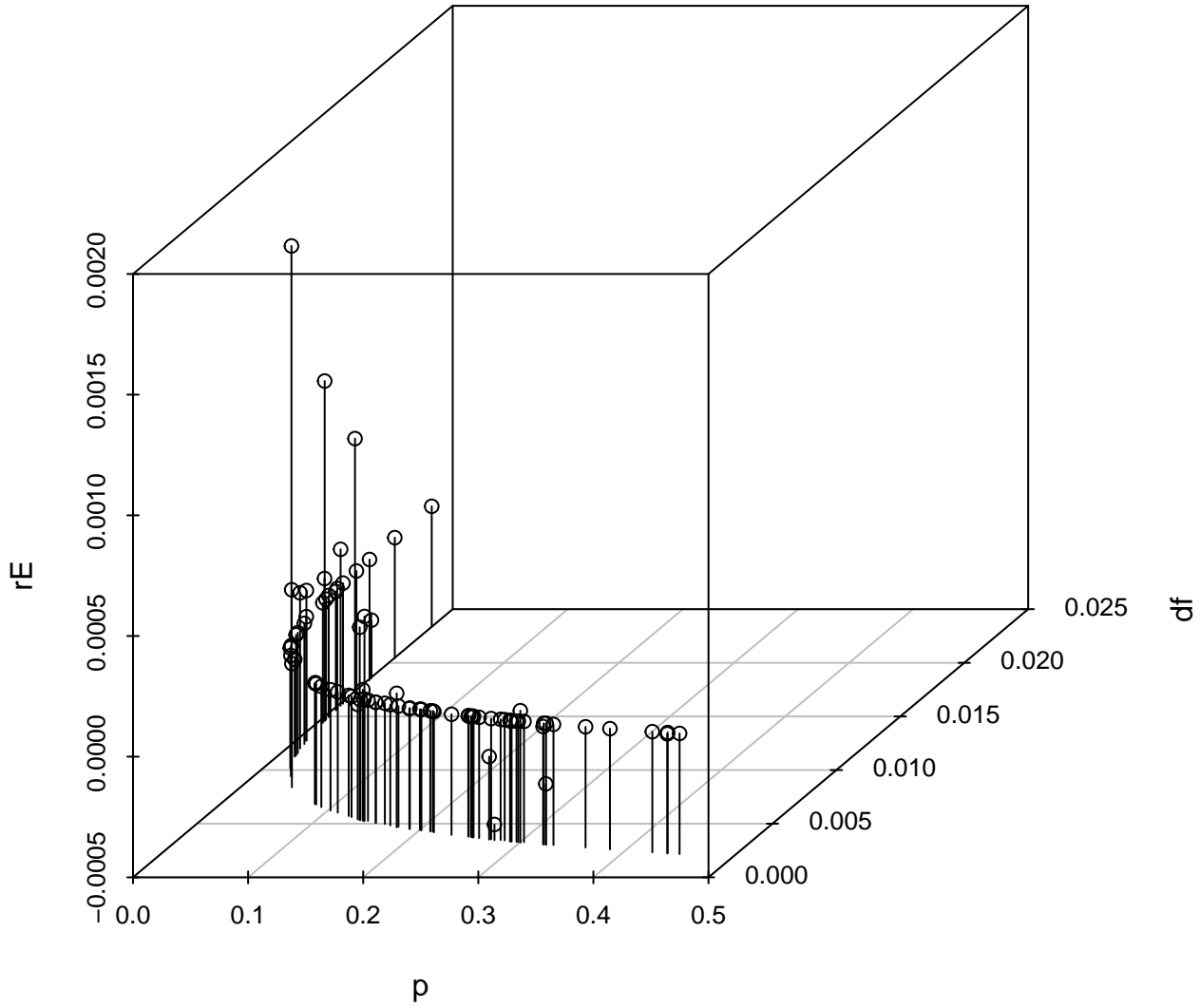
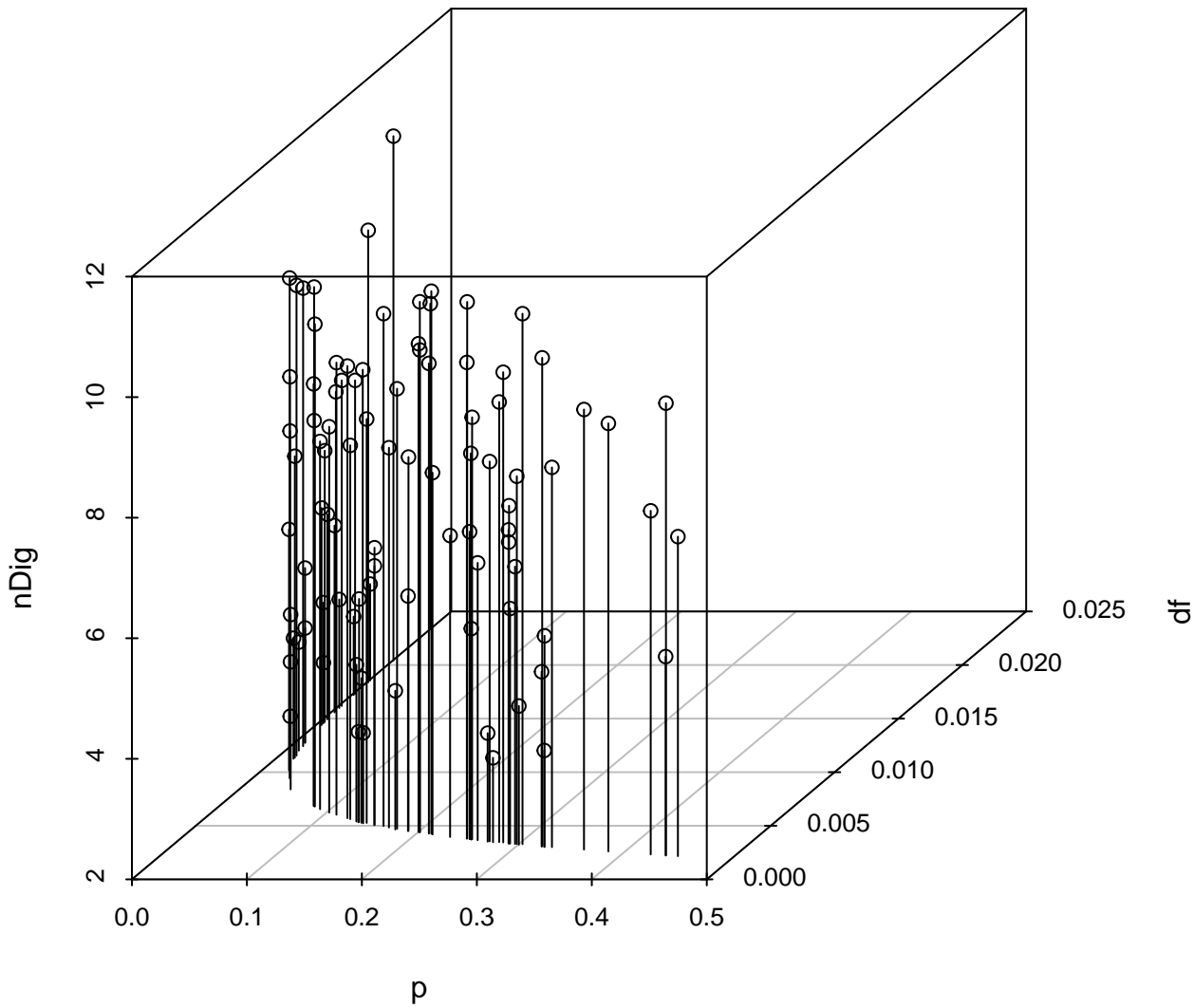


# Histogram of rE



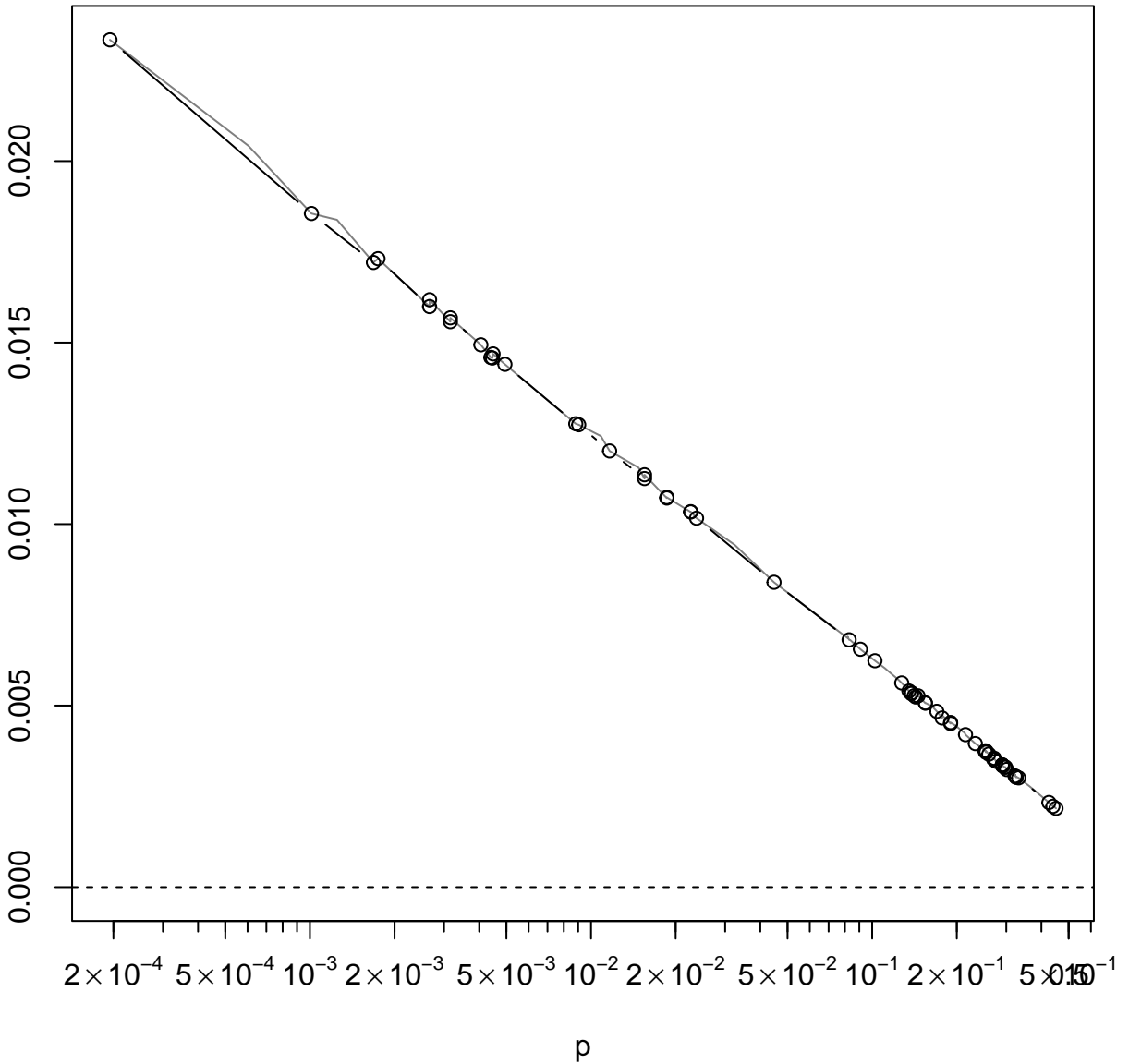


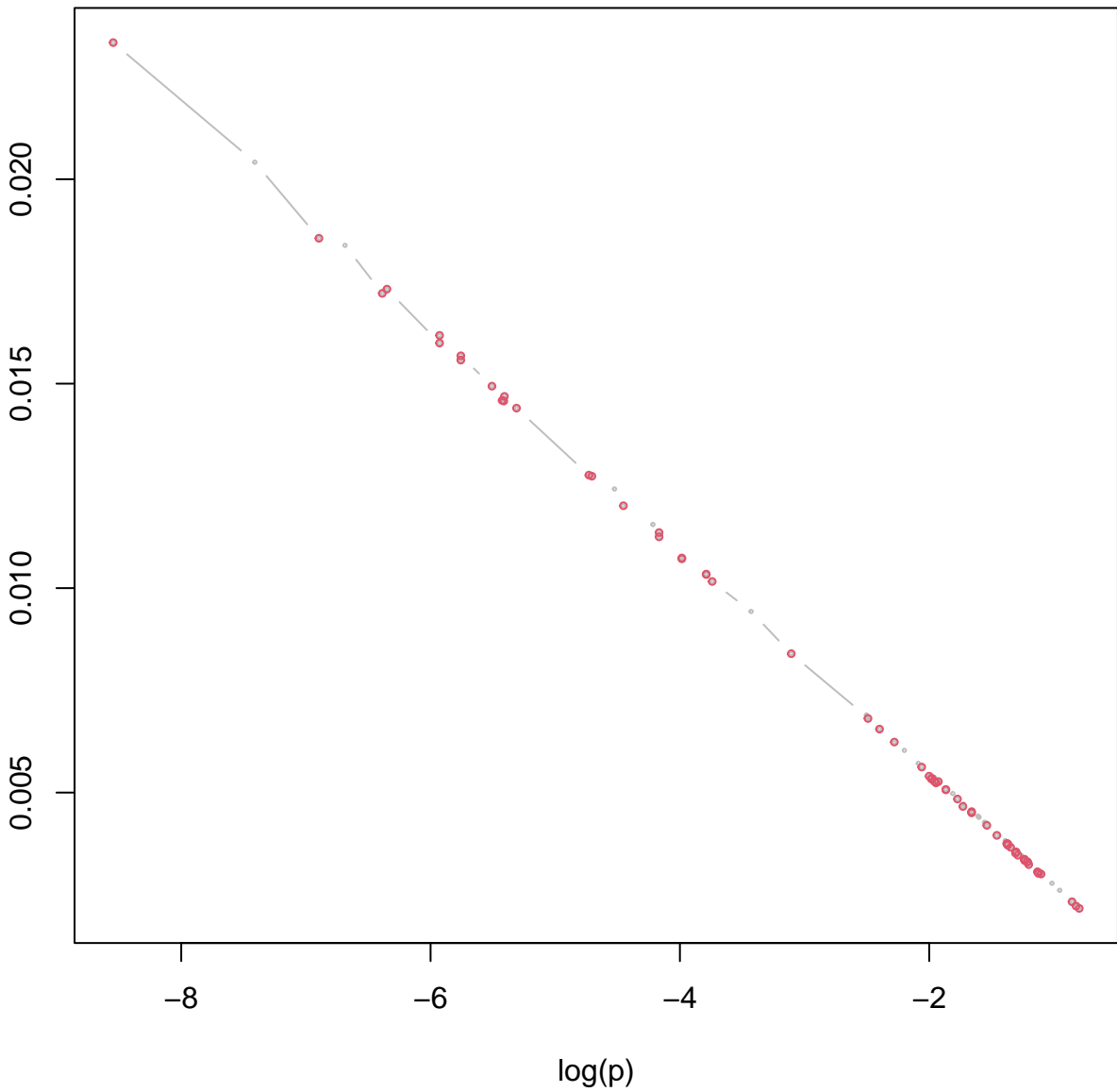


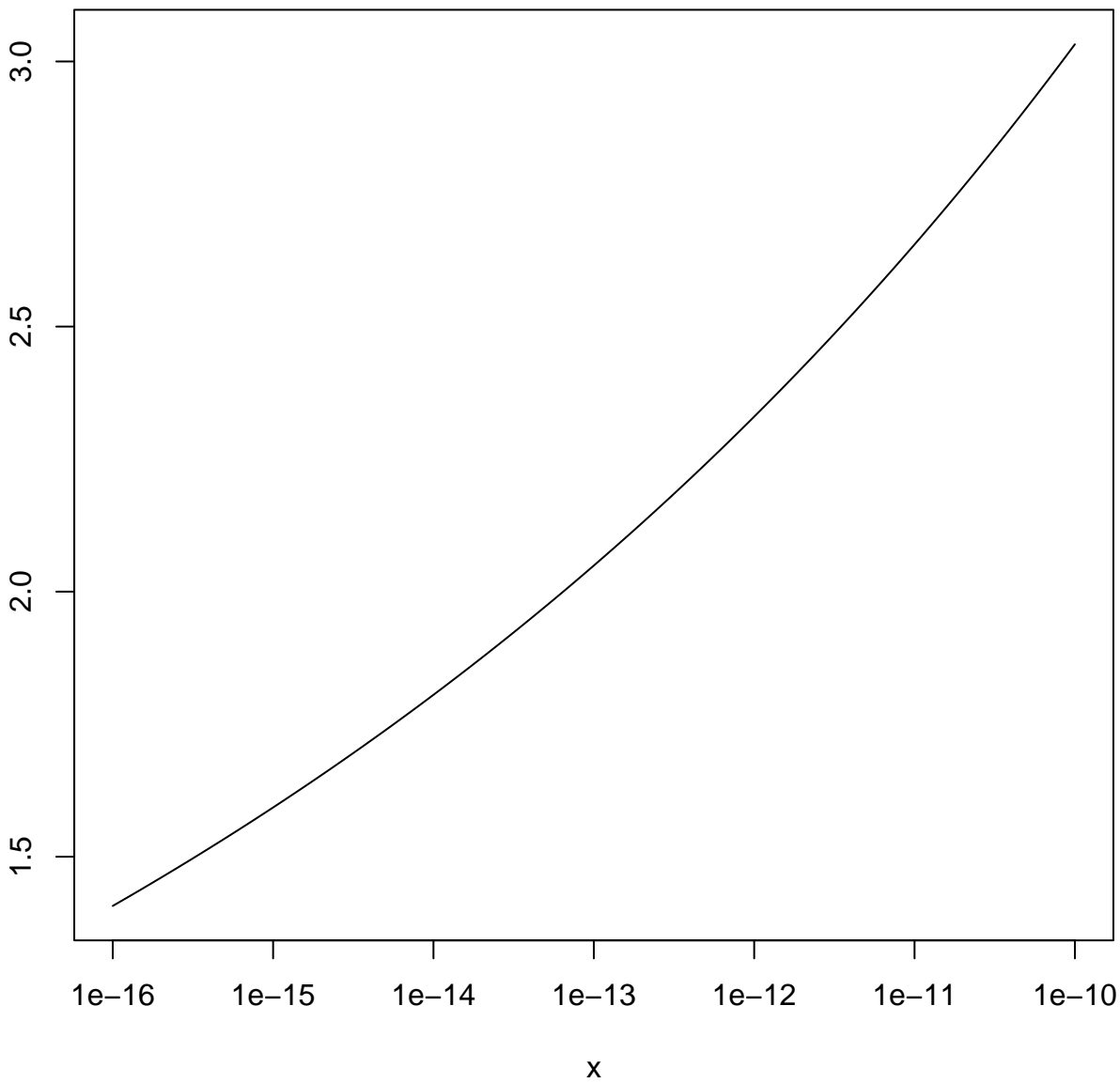




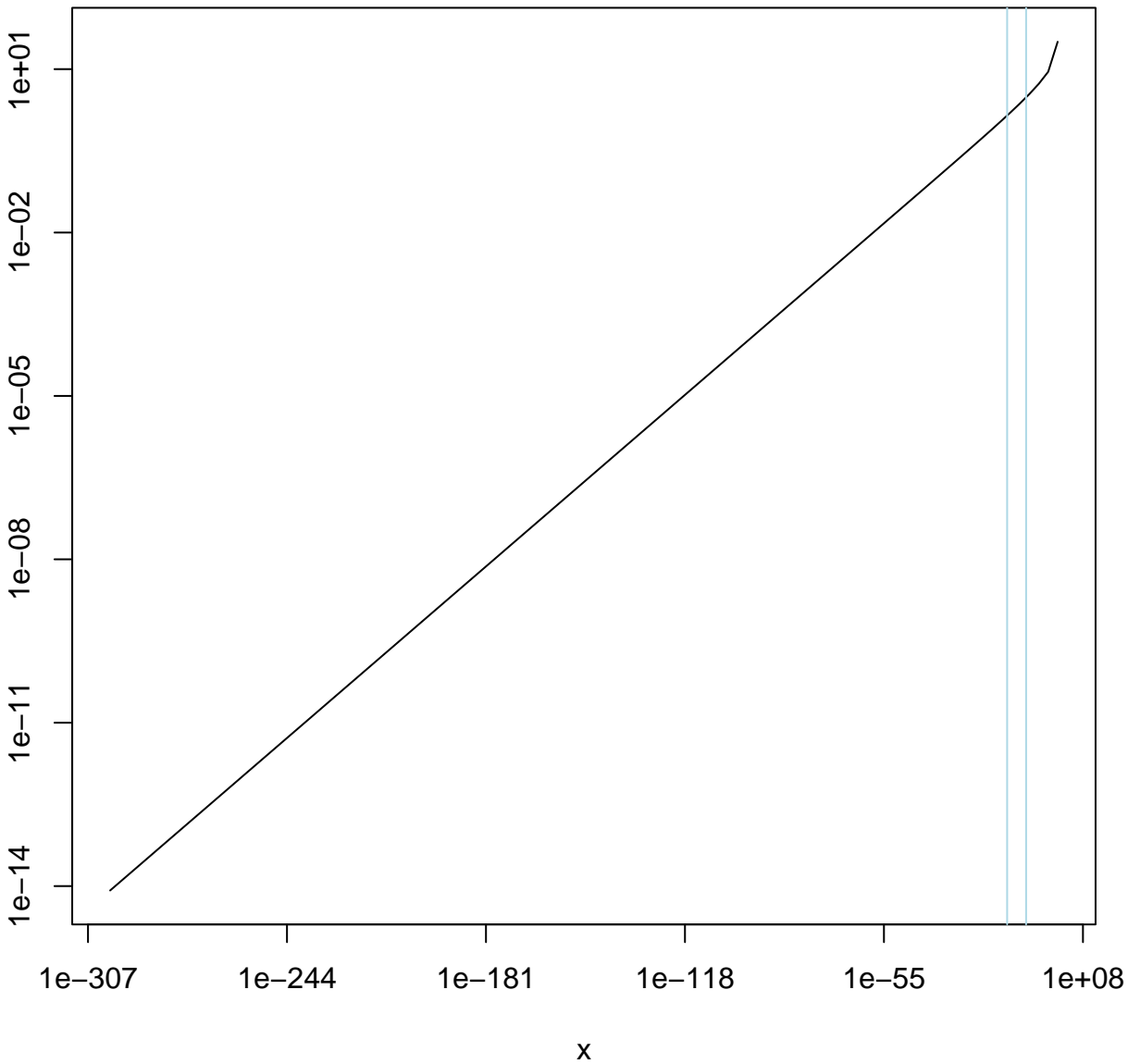
# inaccurate pchisq/qchisq pairs

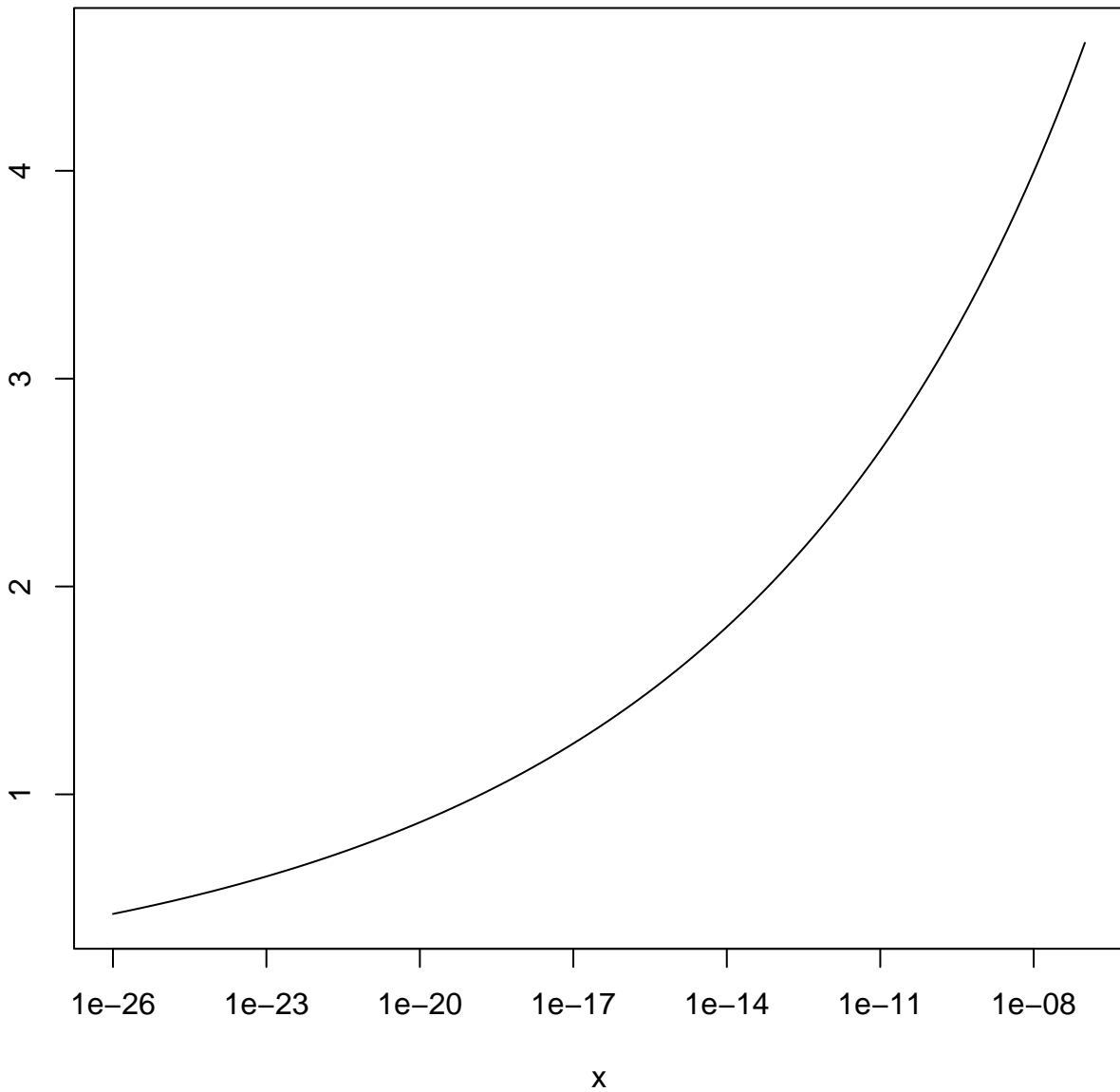


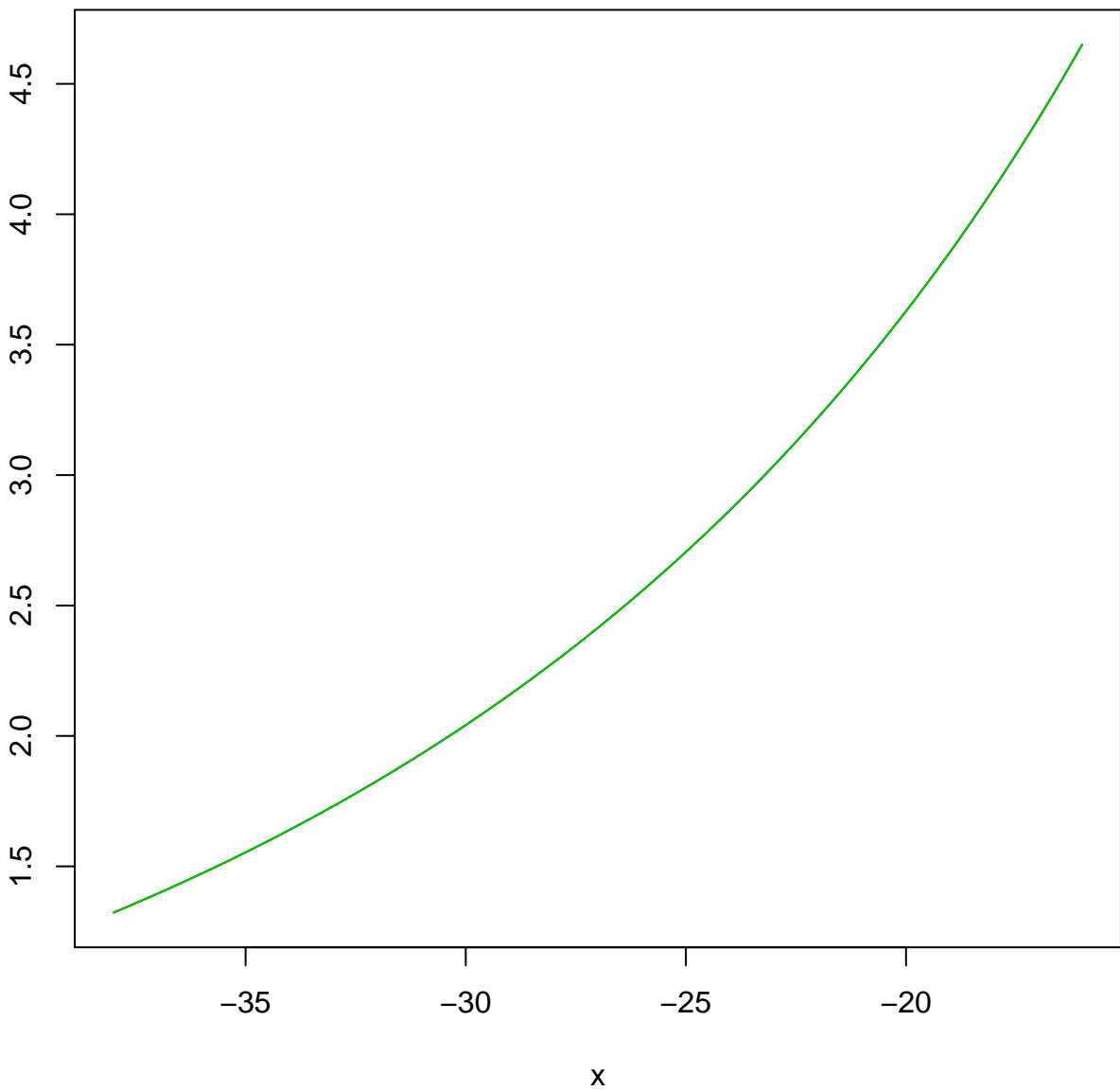




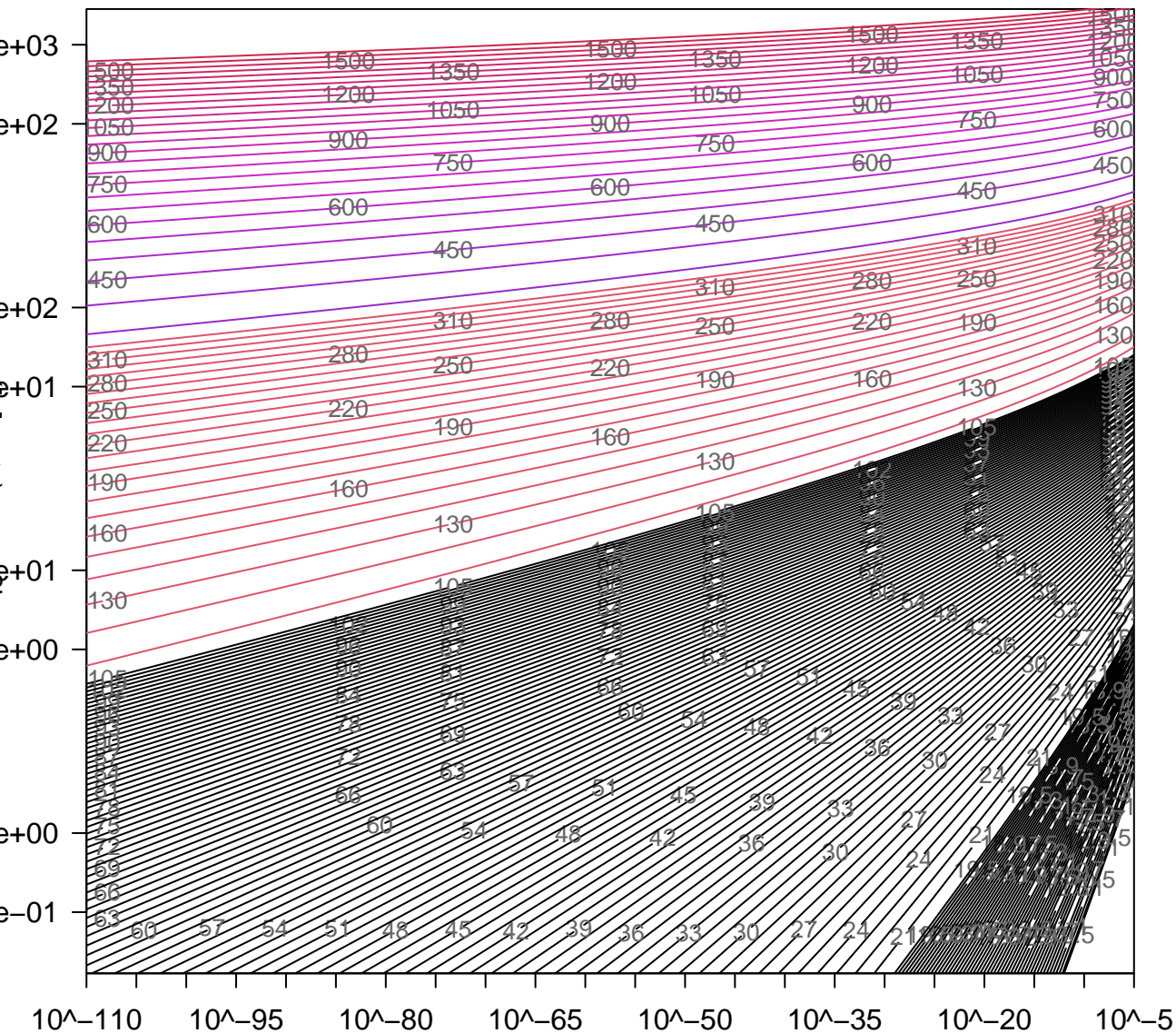




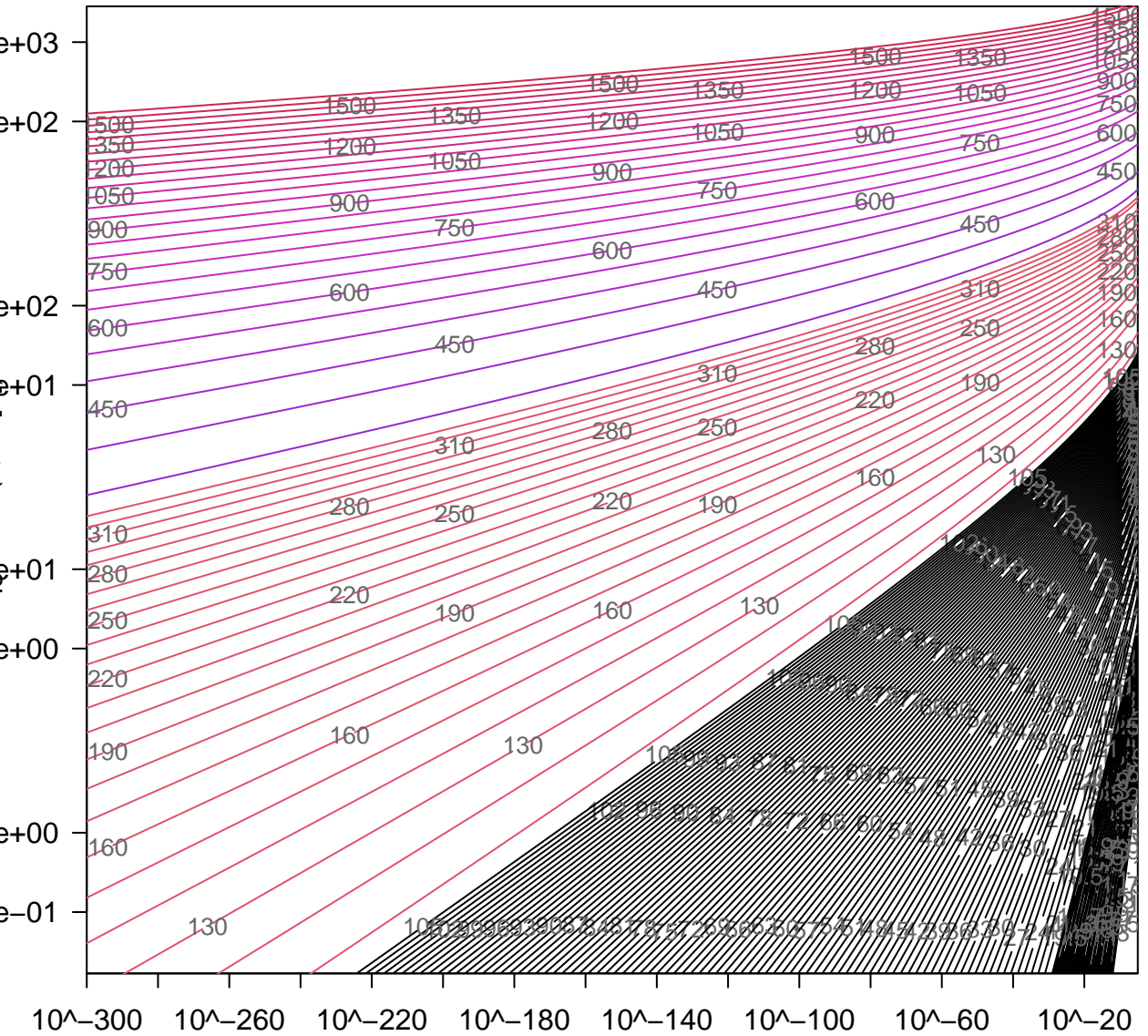




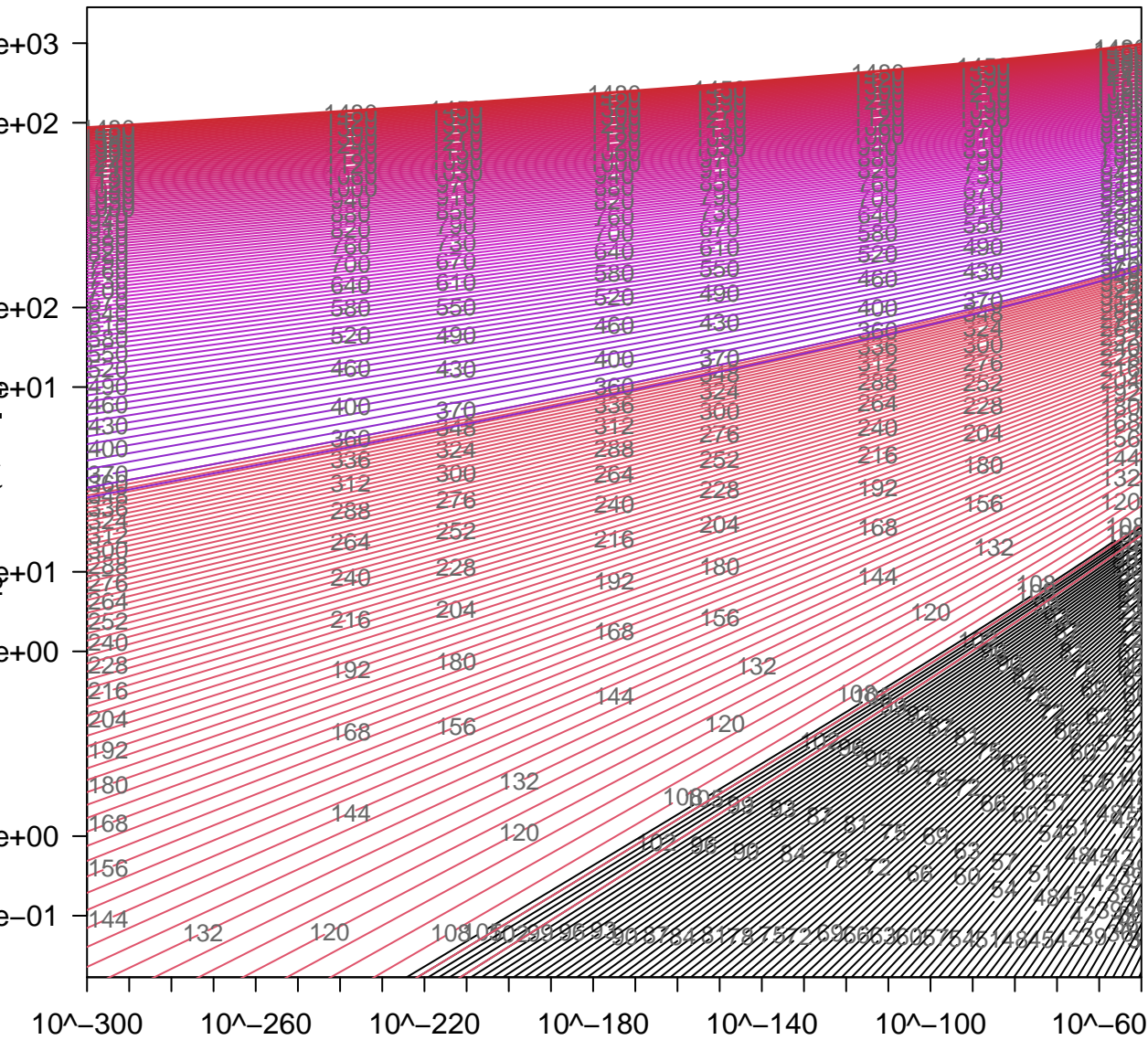
# qgamma(x, a) for very small x, a in [10, 1600] – log-log



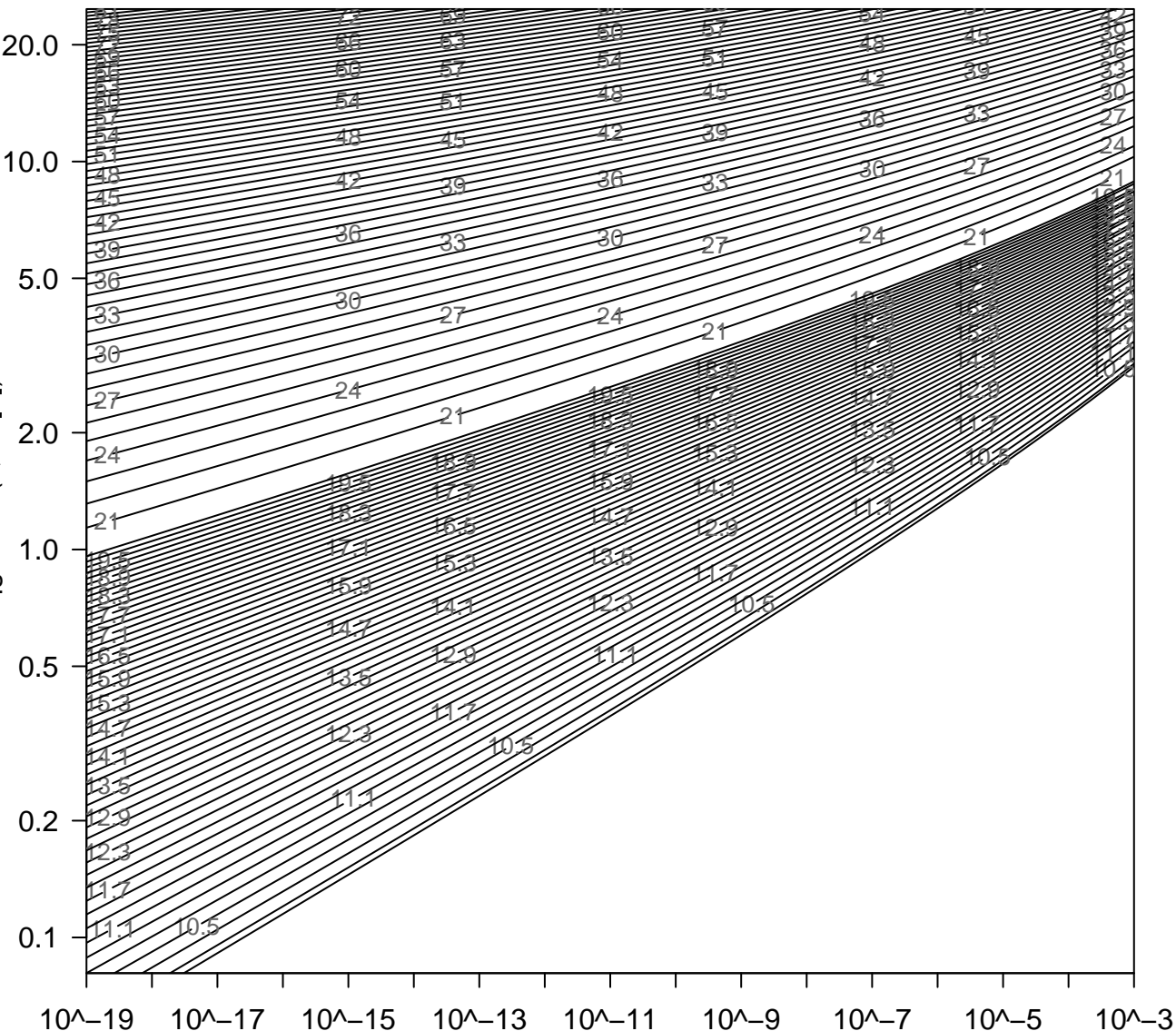
# qgamma(x, a) for very small x, a in [10, 1600] – log-log



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



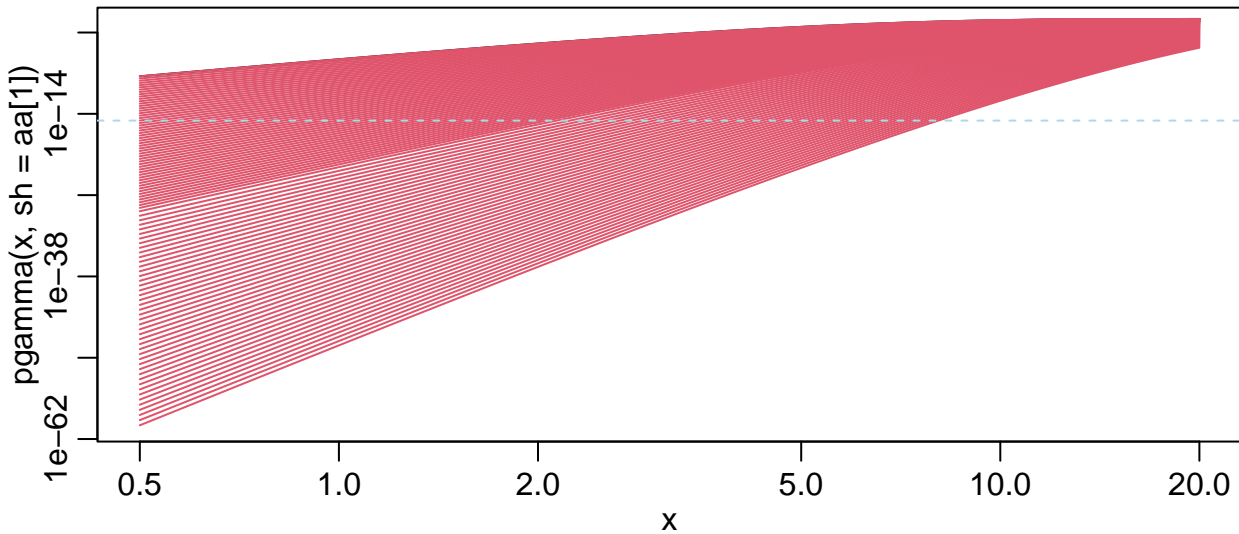
# qgamma(x, a) for very small x, a in [10, 105] – log-log



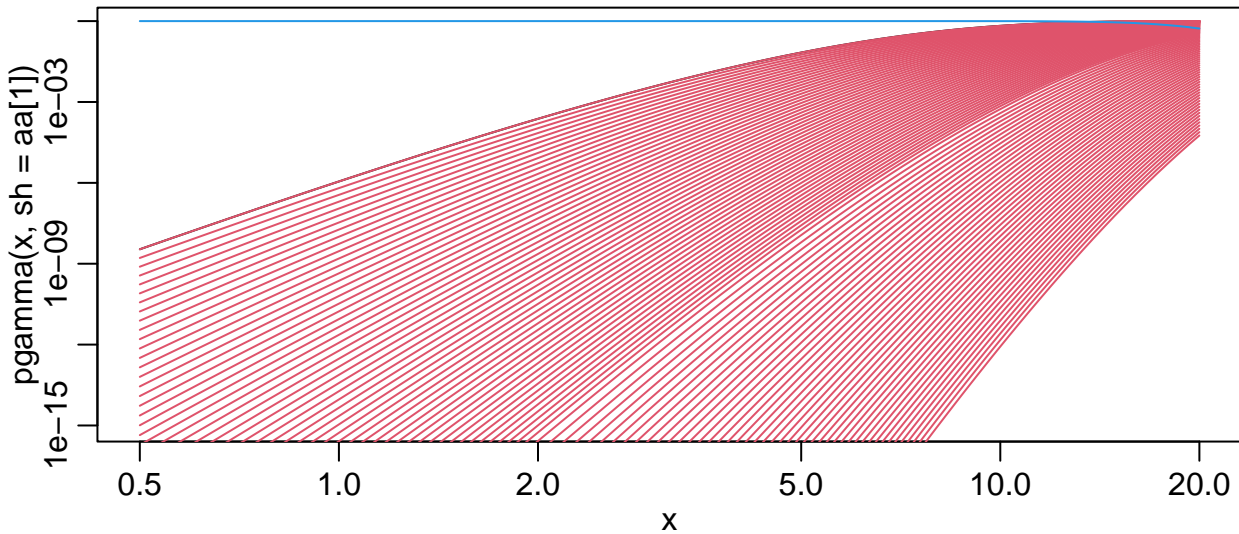




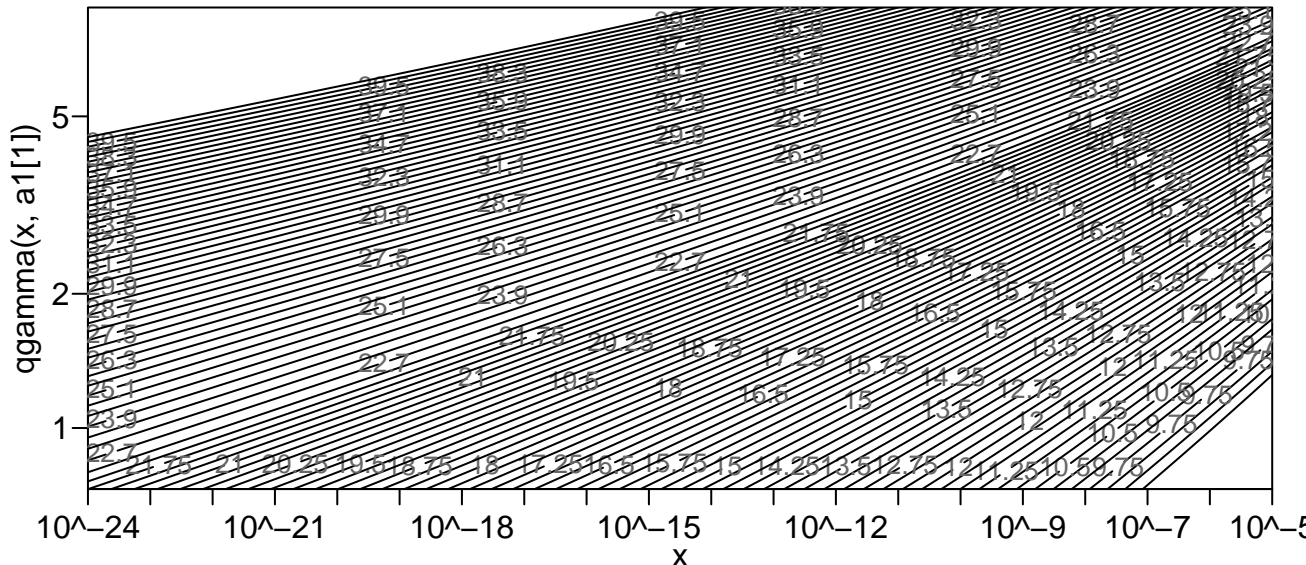
**pgamma(x, a) for a in [9,39.9]**



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

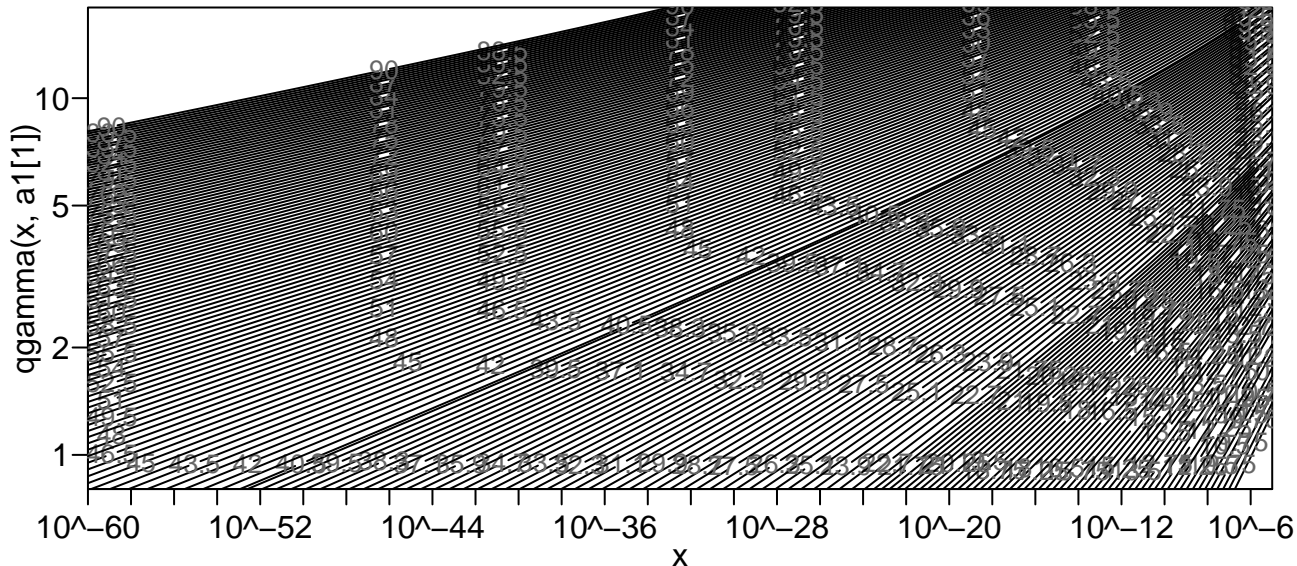


**qgamma(x, a) for very small x, a in [9, 40.3] – log–log**



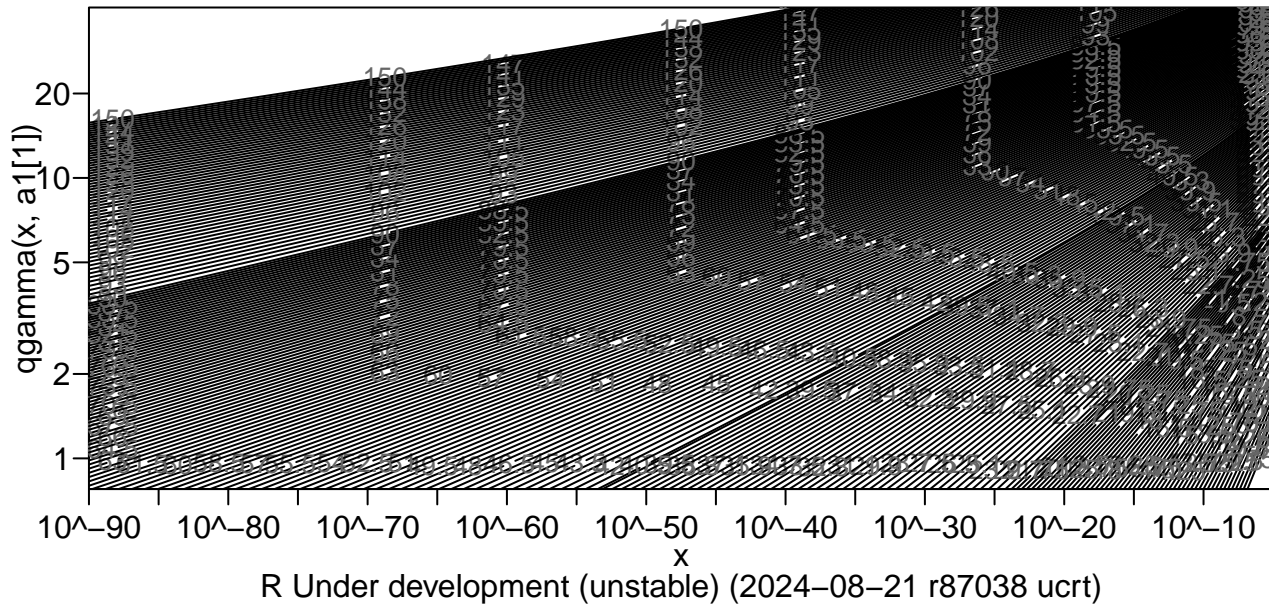
R Under development (unstable) (2024-08-21 r87038 ucrt)

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

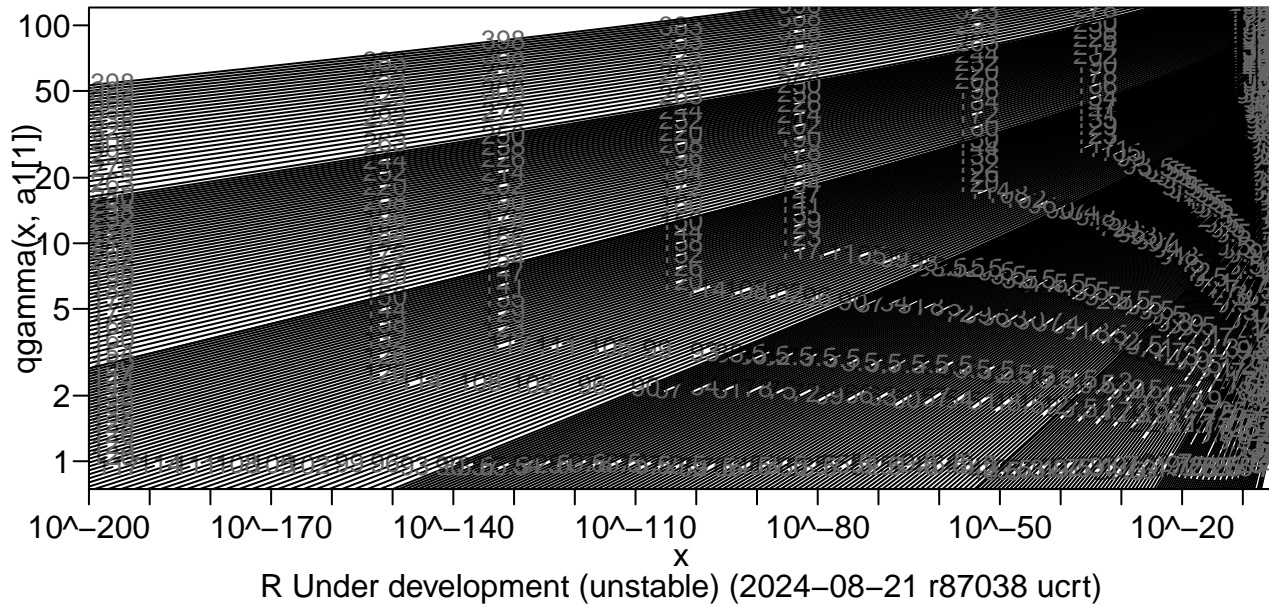


R Under development (unstable) (2024-08-21 r87038 ucrt)

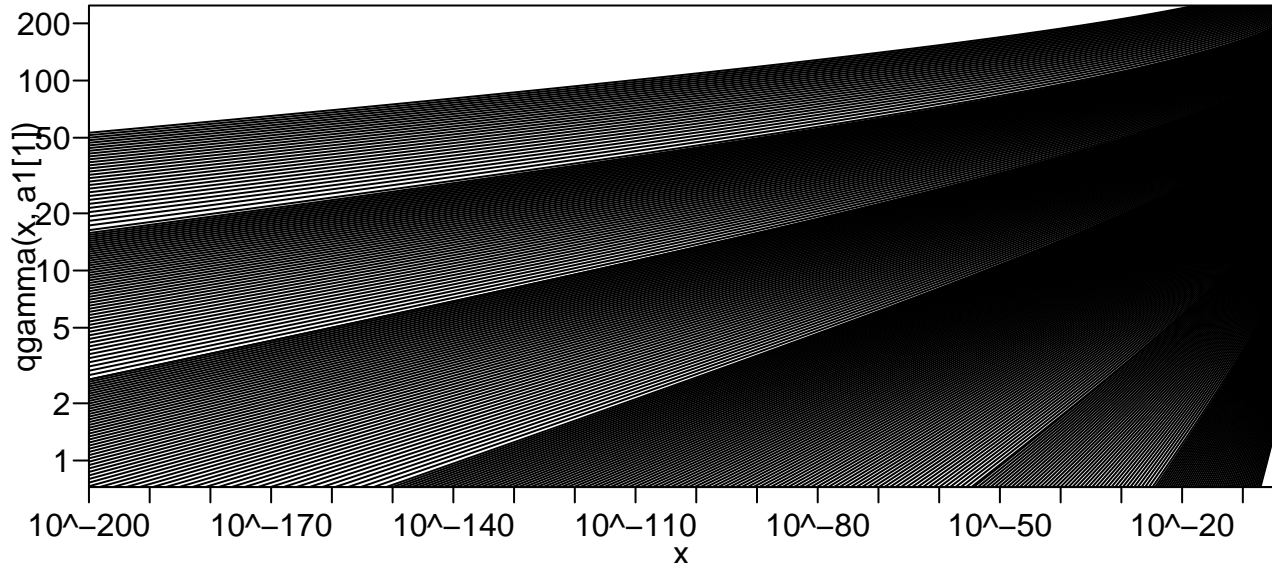
**qgamma(x, a) for very small x, a in [9, 150] – log-log**



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

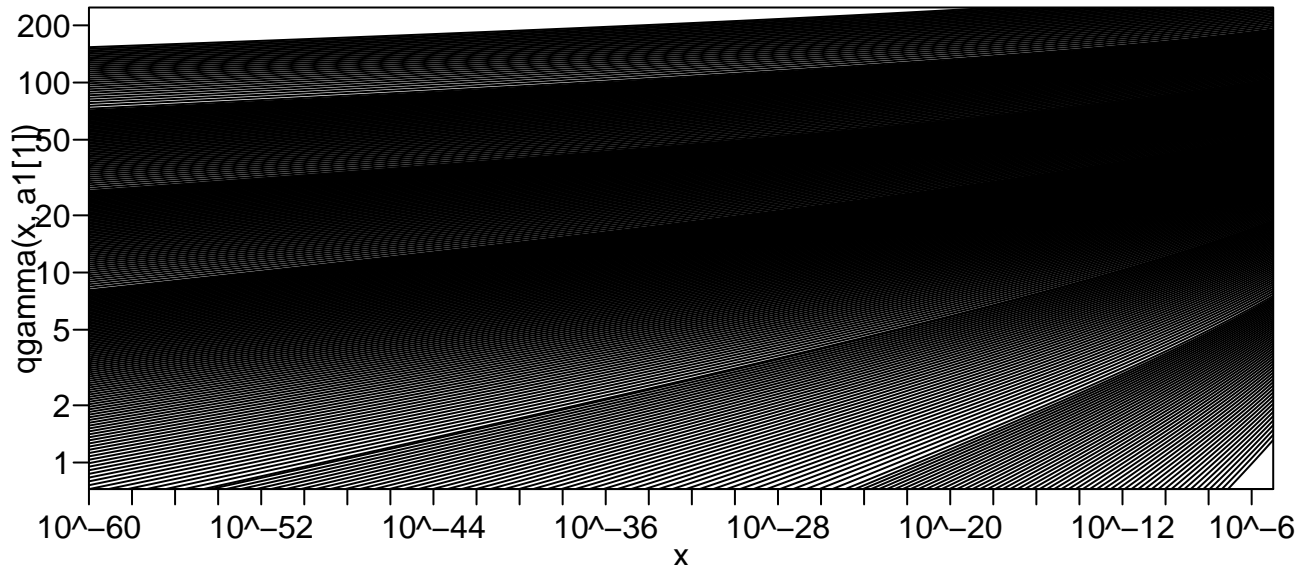


**qgamma(x, a) for very small x, a in [9, 398] – log-log**

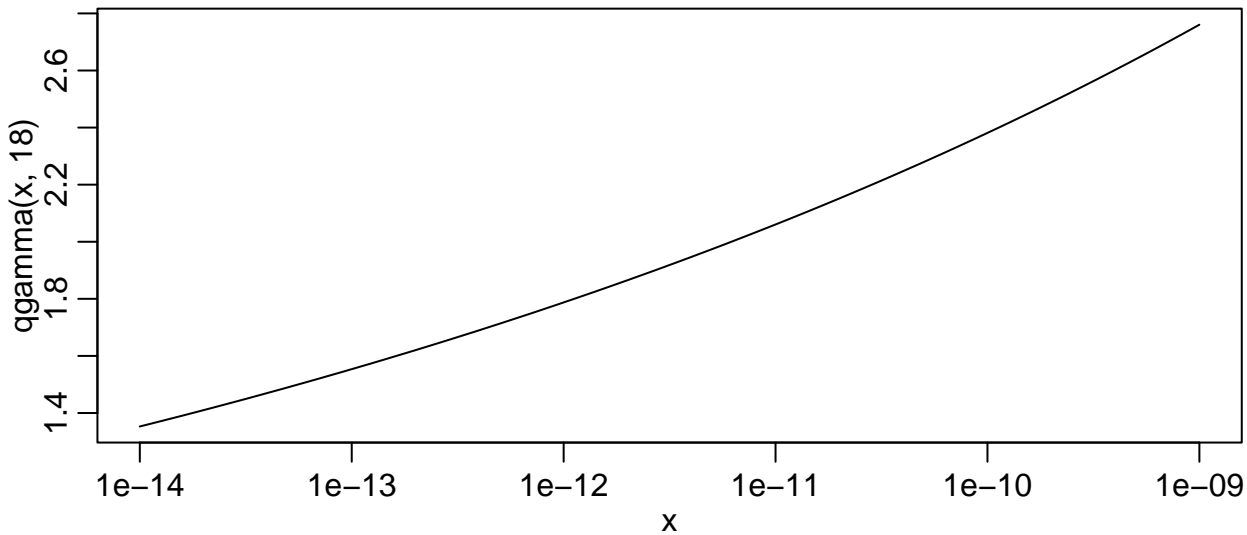
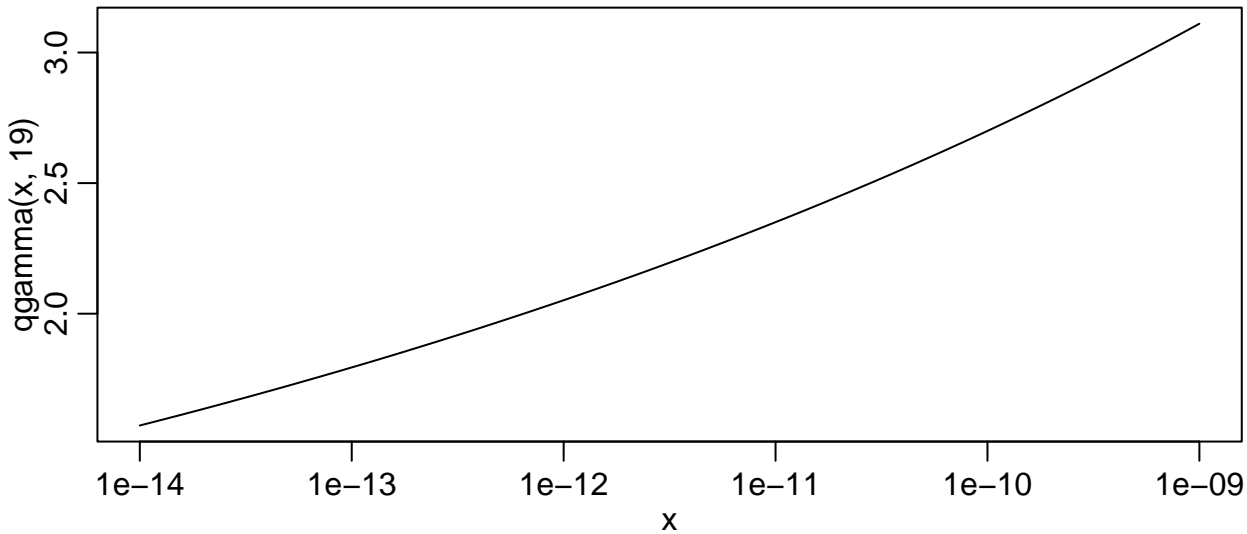


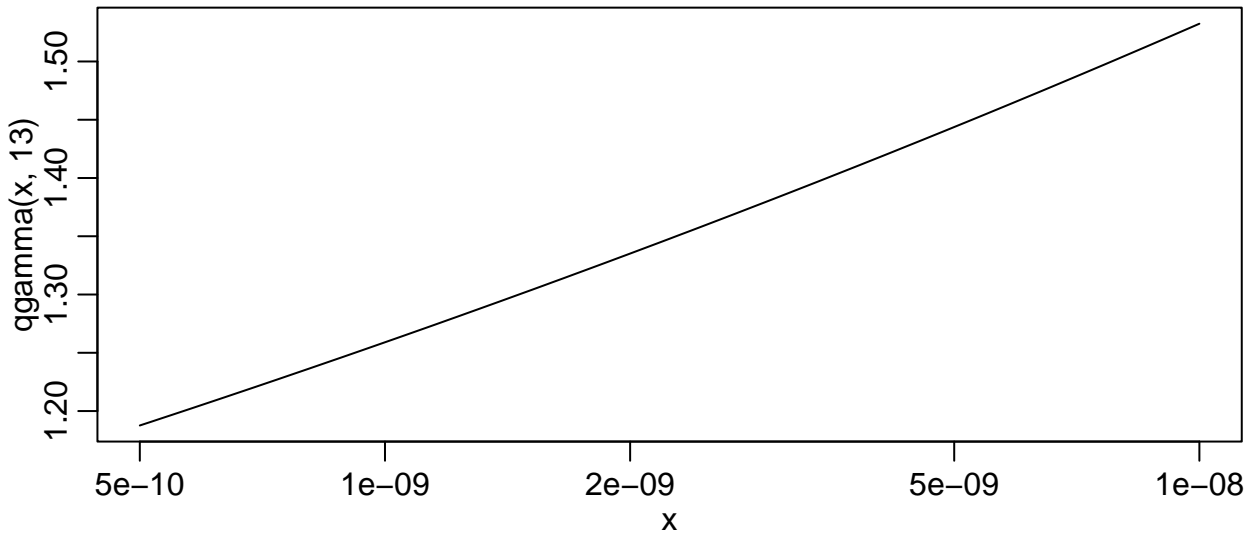
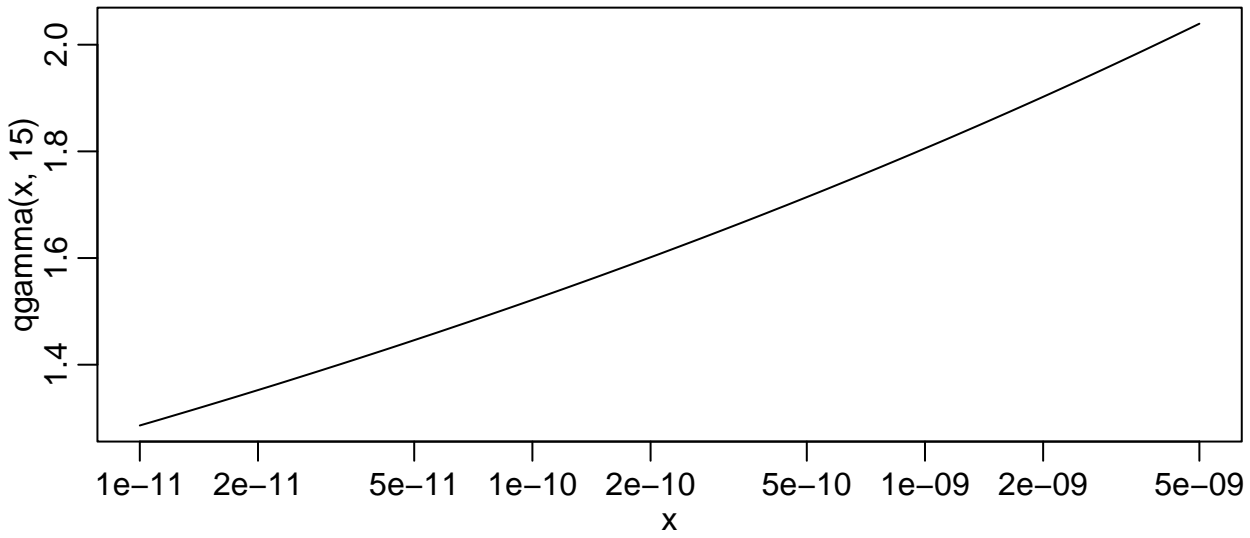
R Under development (unstable) (2024-08-21 r87038 ucrt)

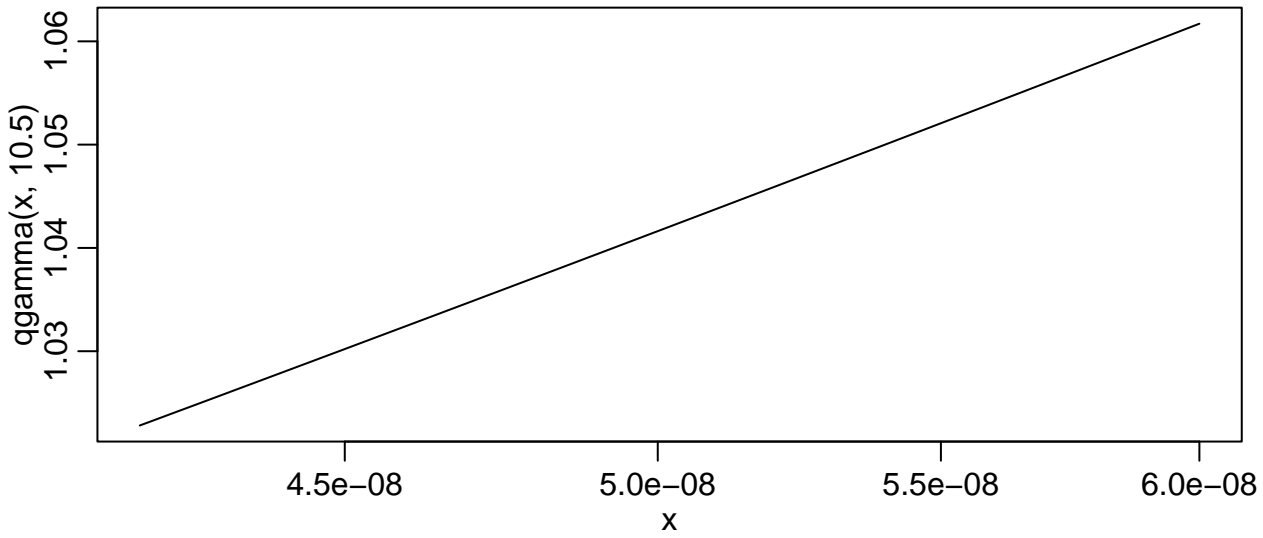
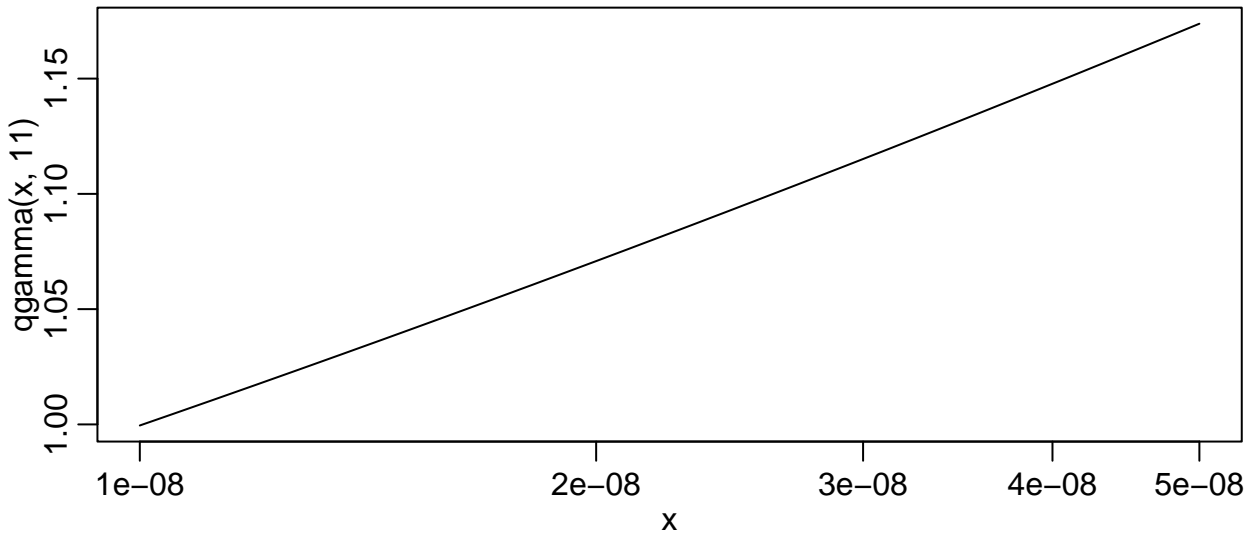
**qgamma(x, a) for very small x, a in [9, 398] – log-log**

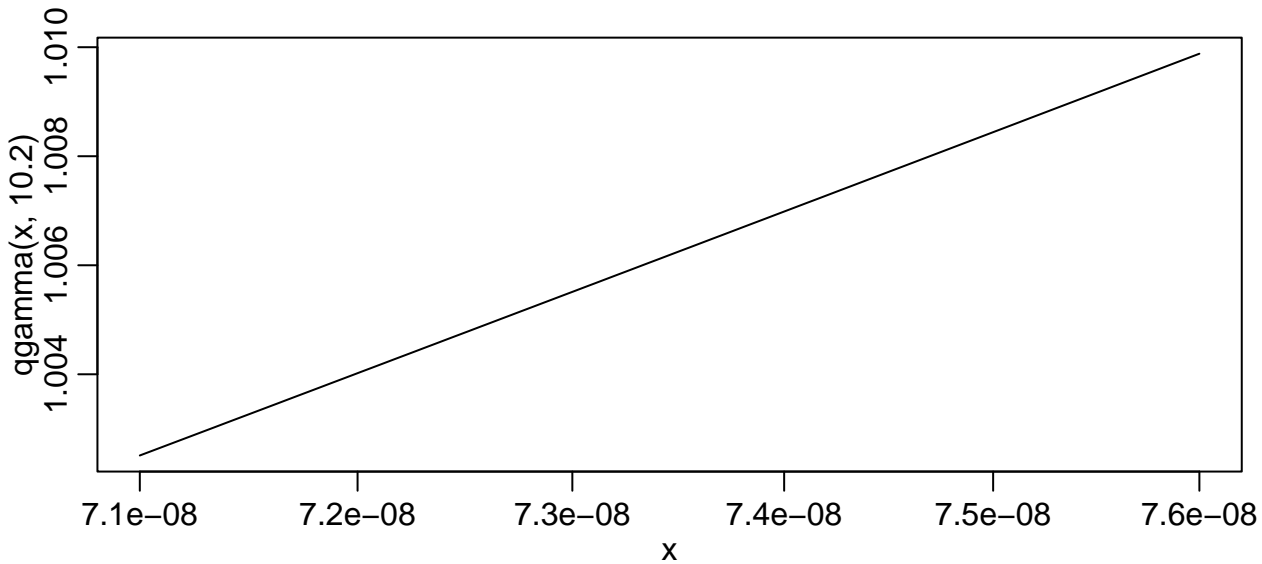
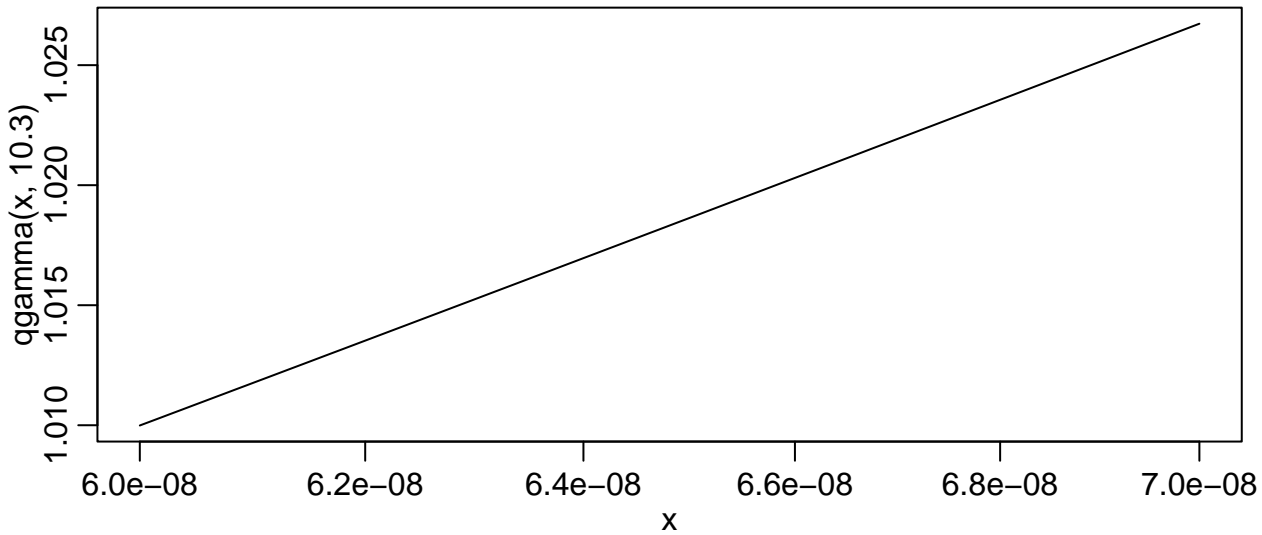


R Under development (unstable) (2024-08-21 r87038 ucrt)

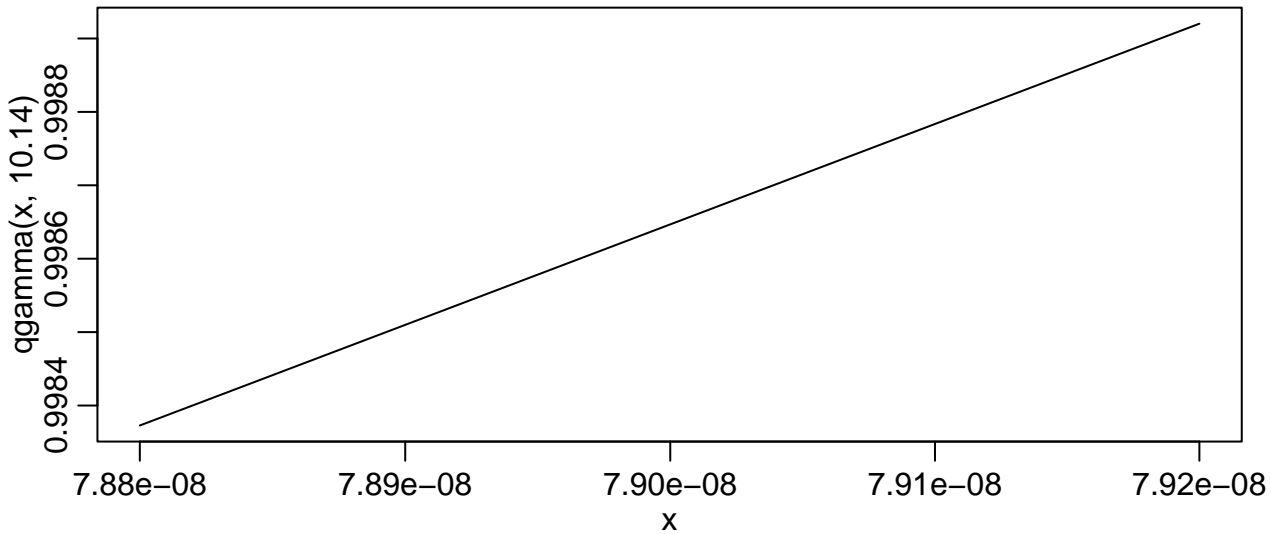
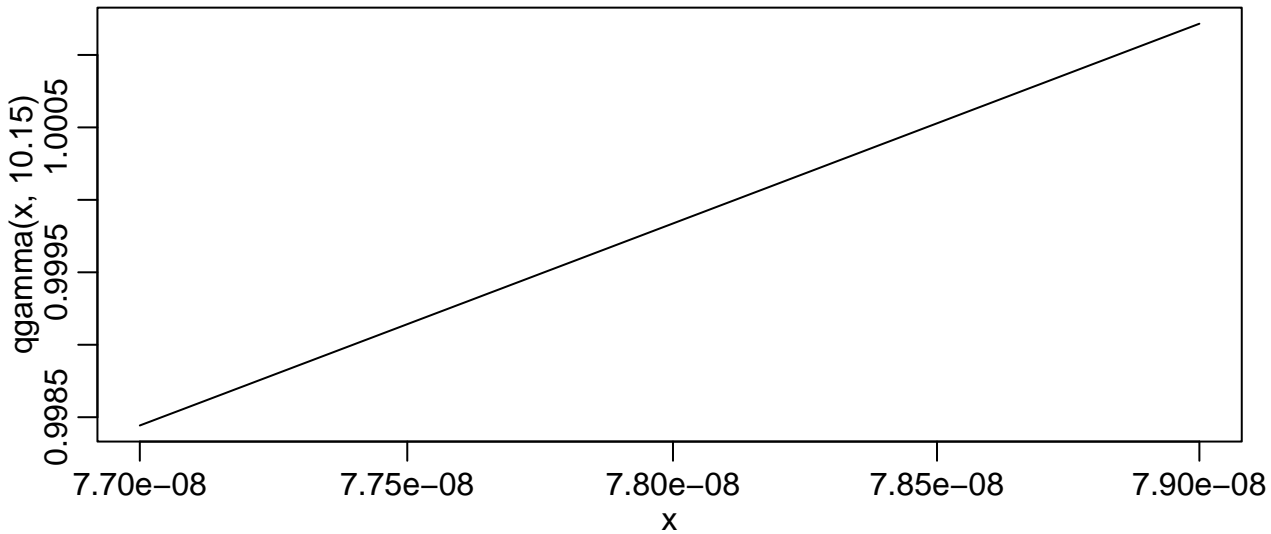


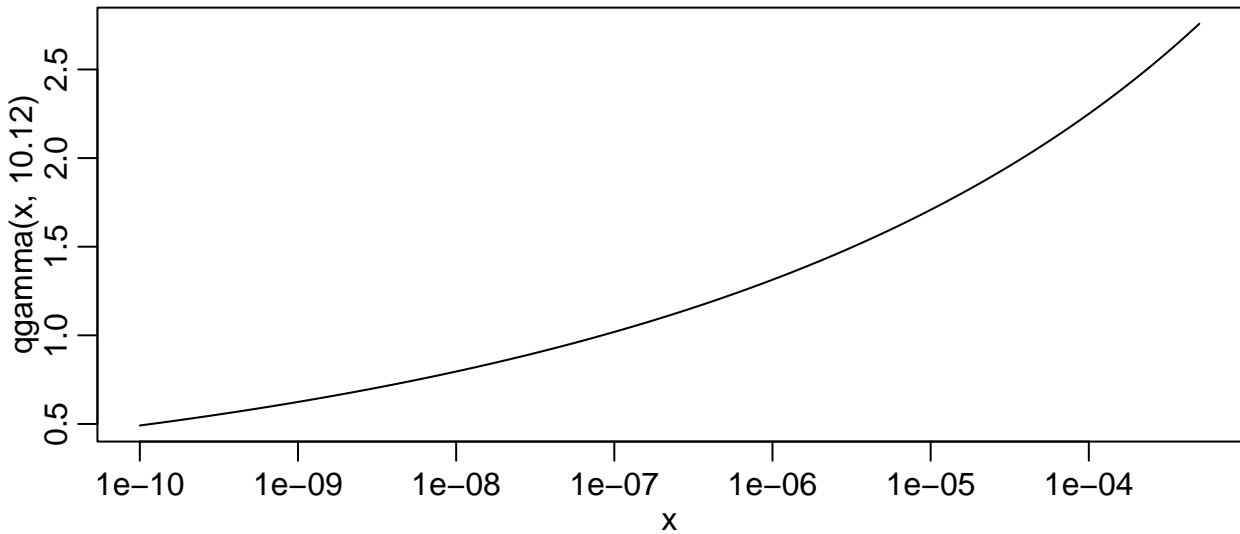
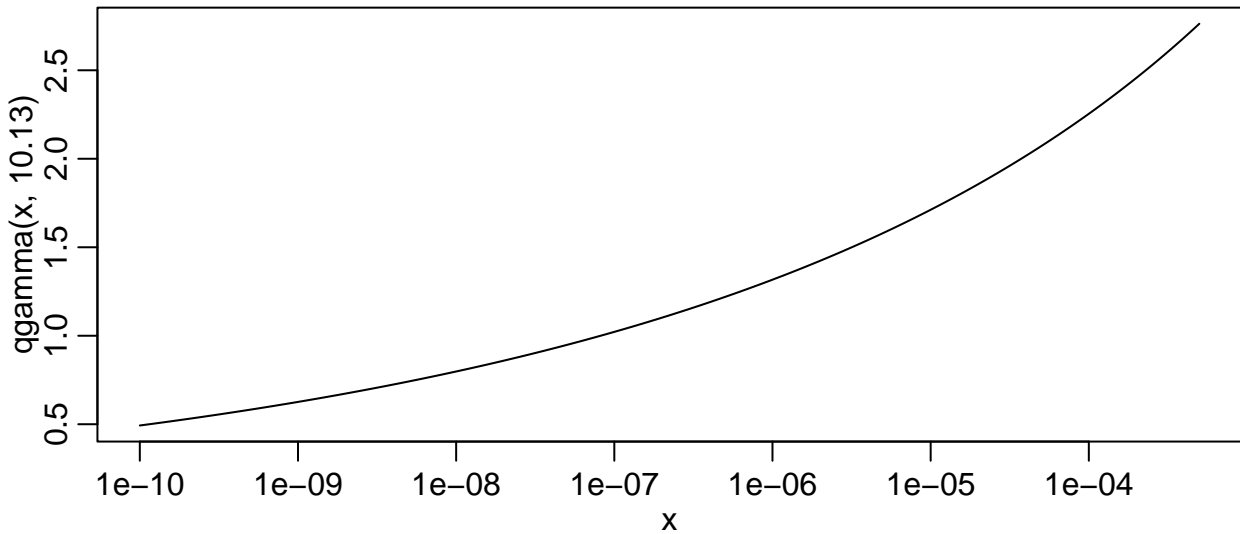


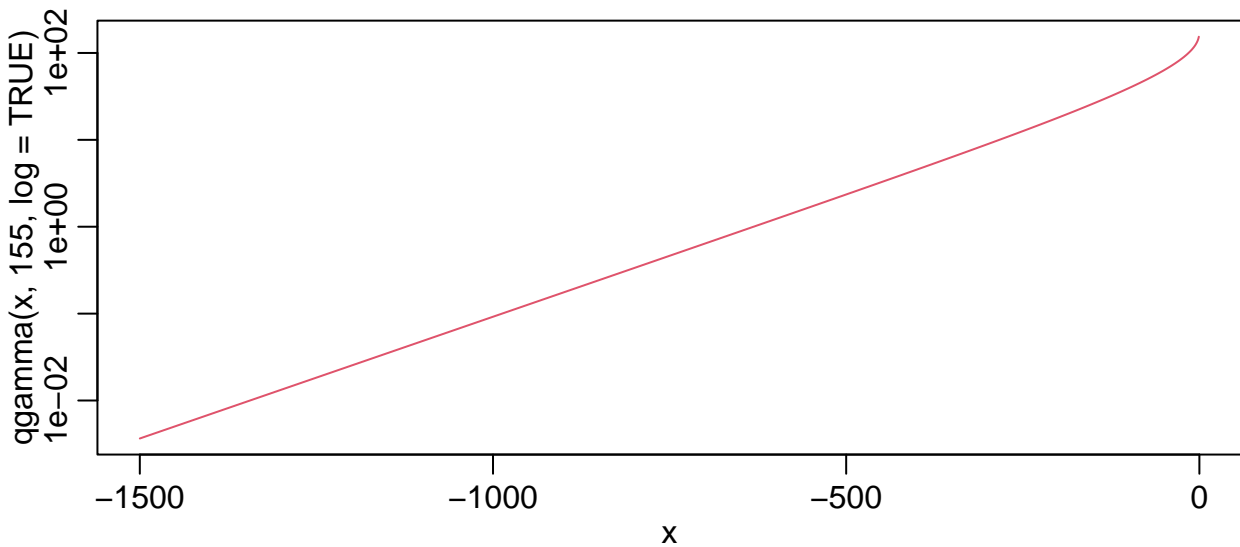
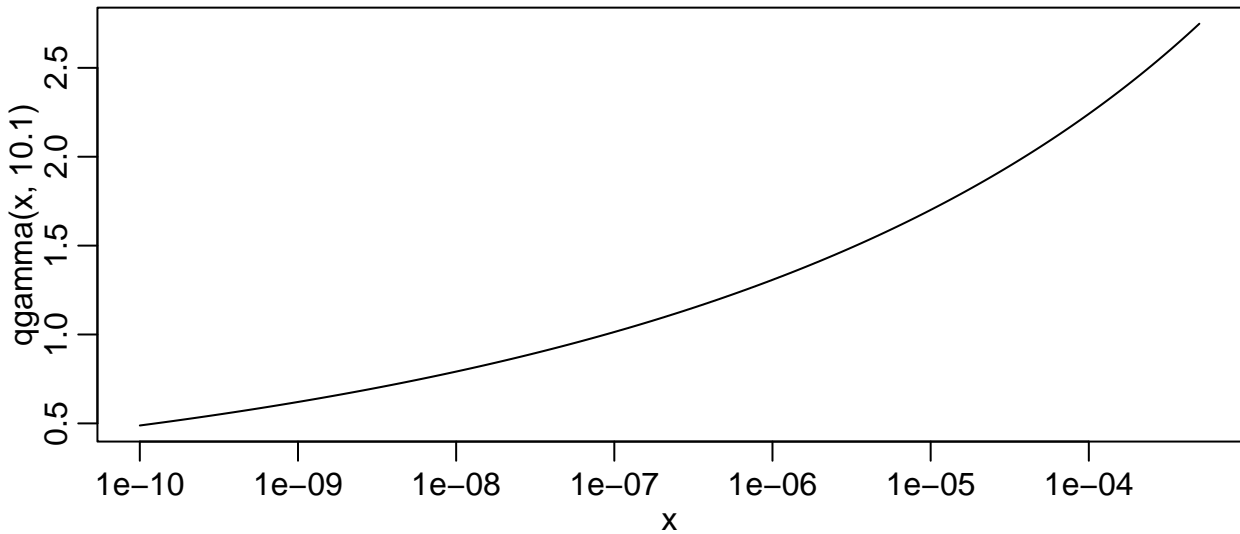


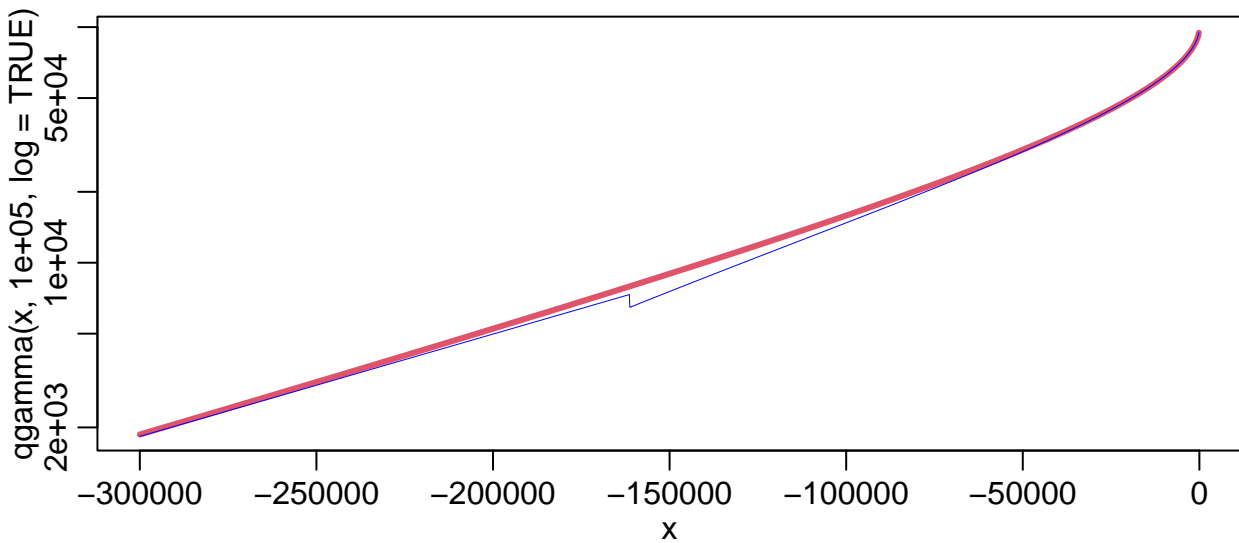
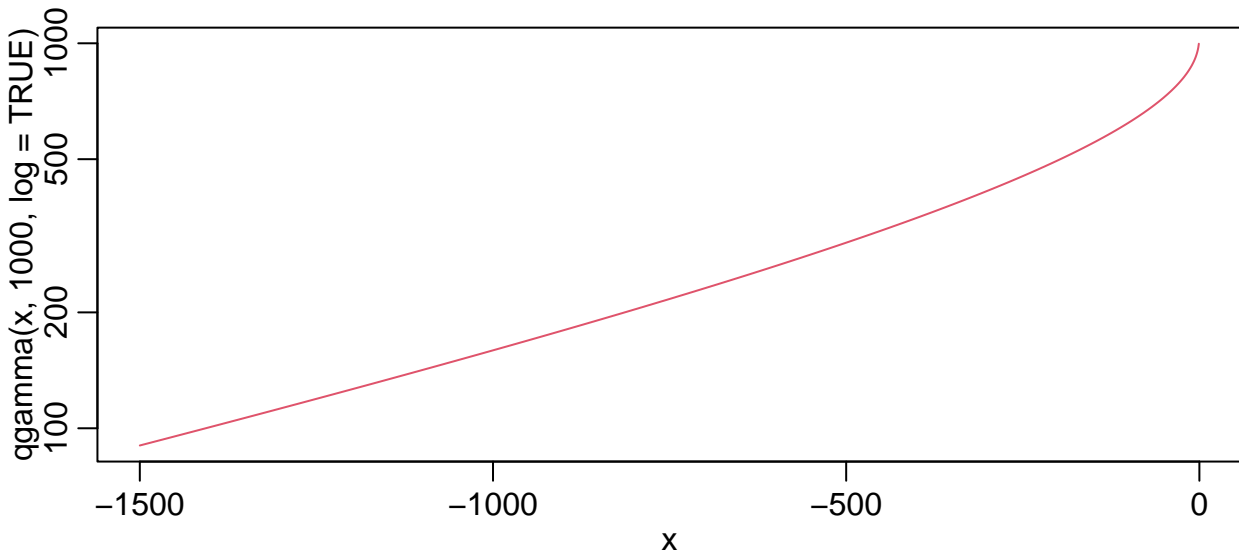


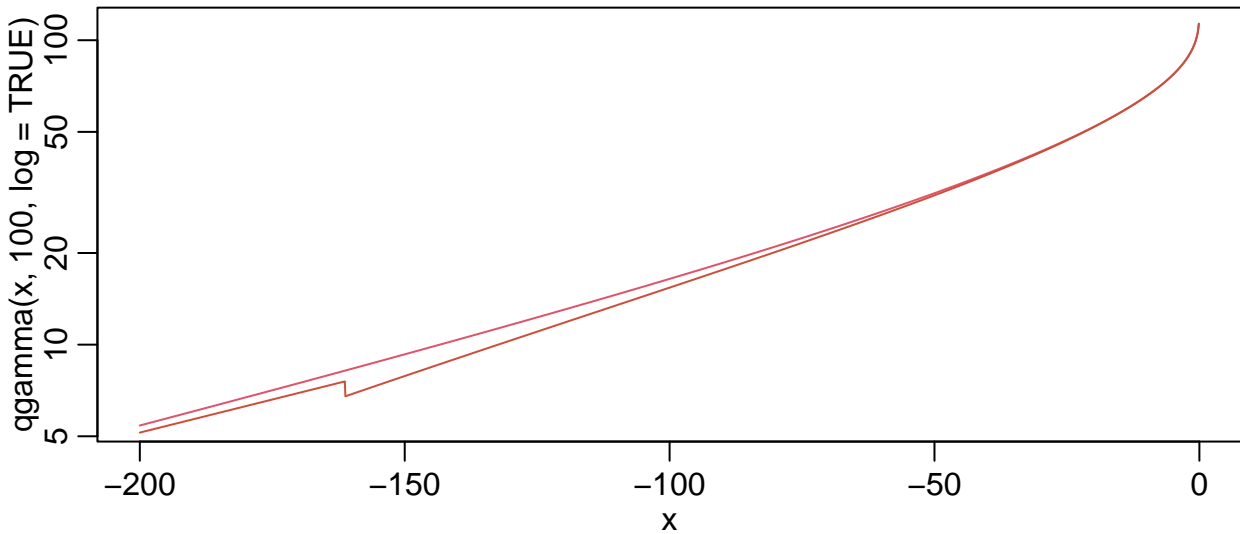
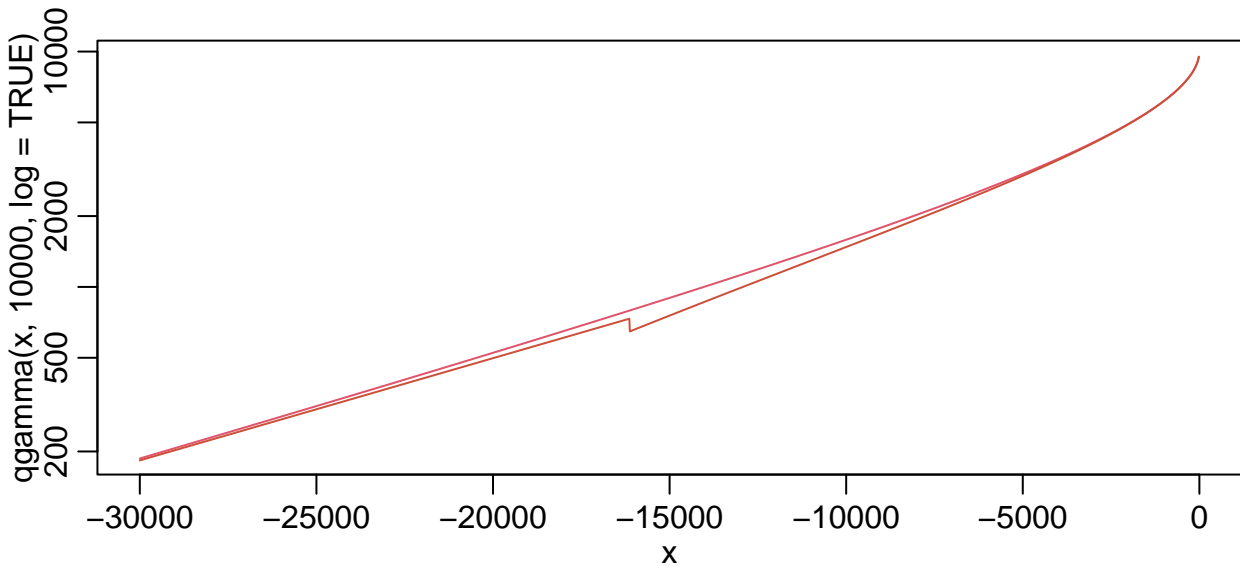


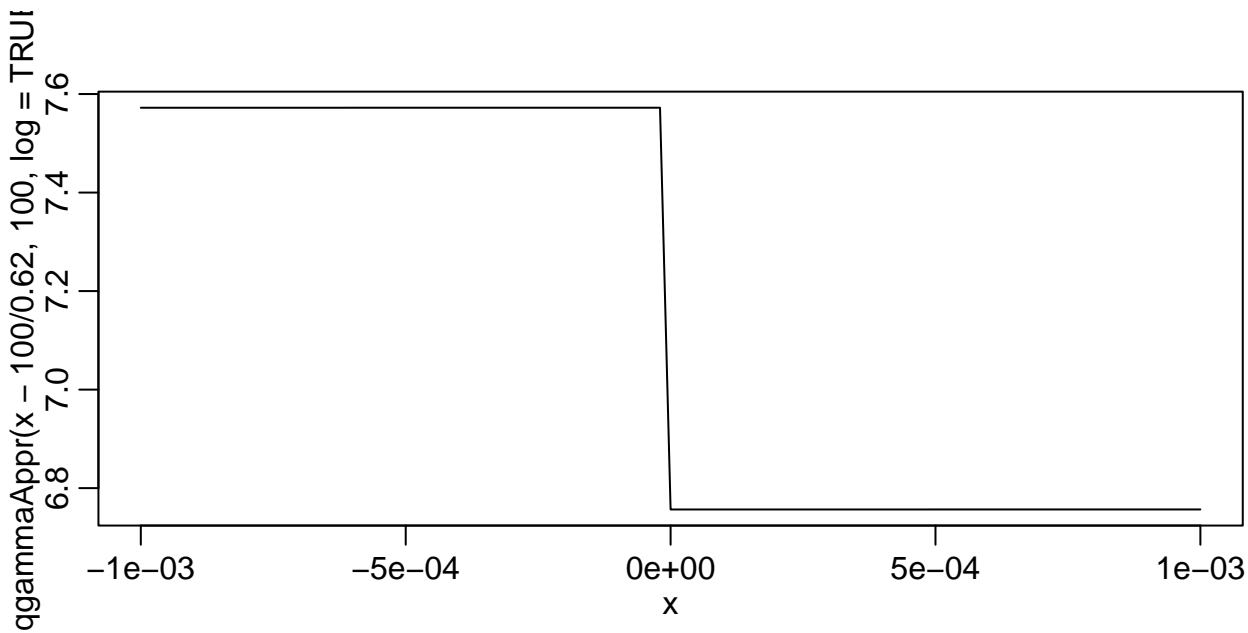
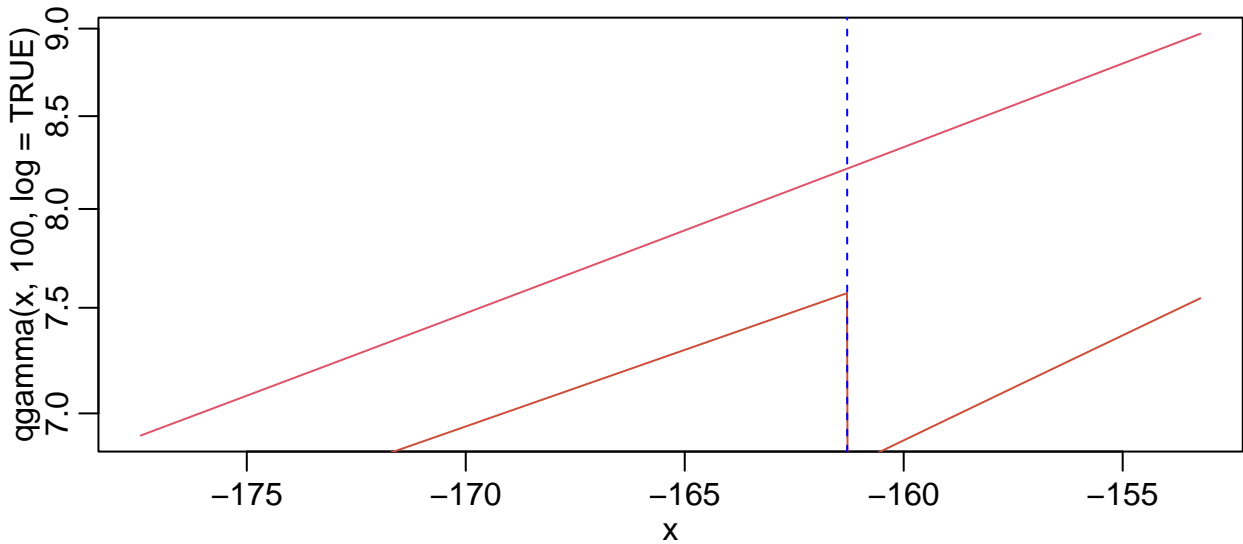




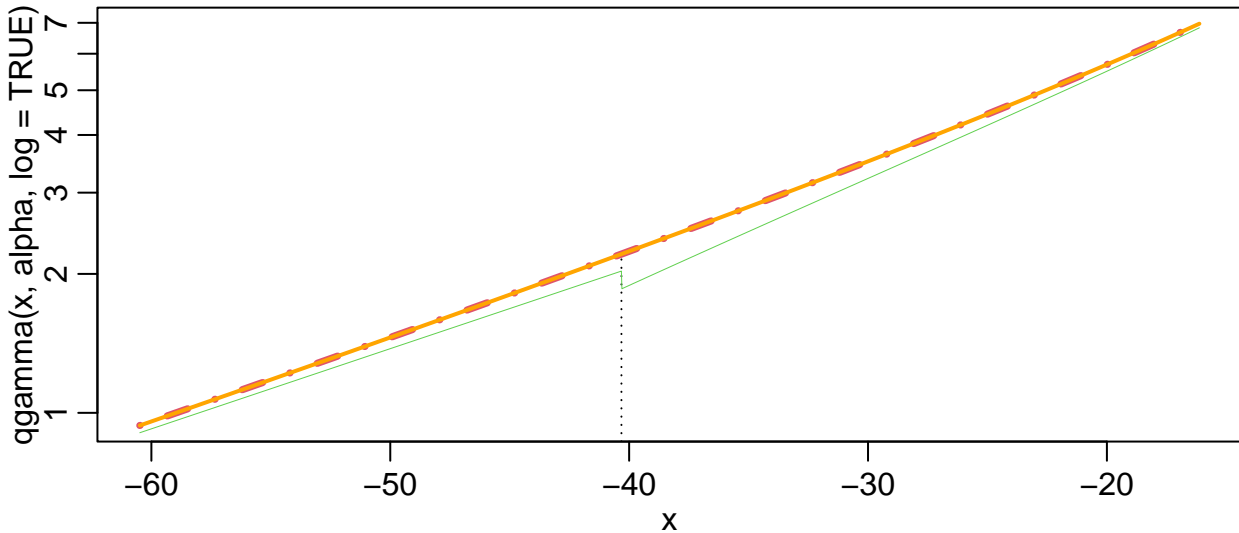




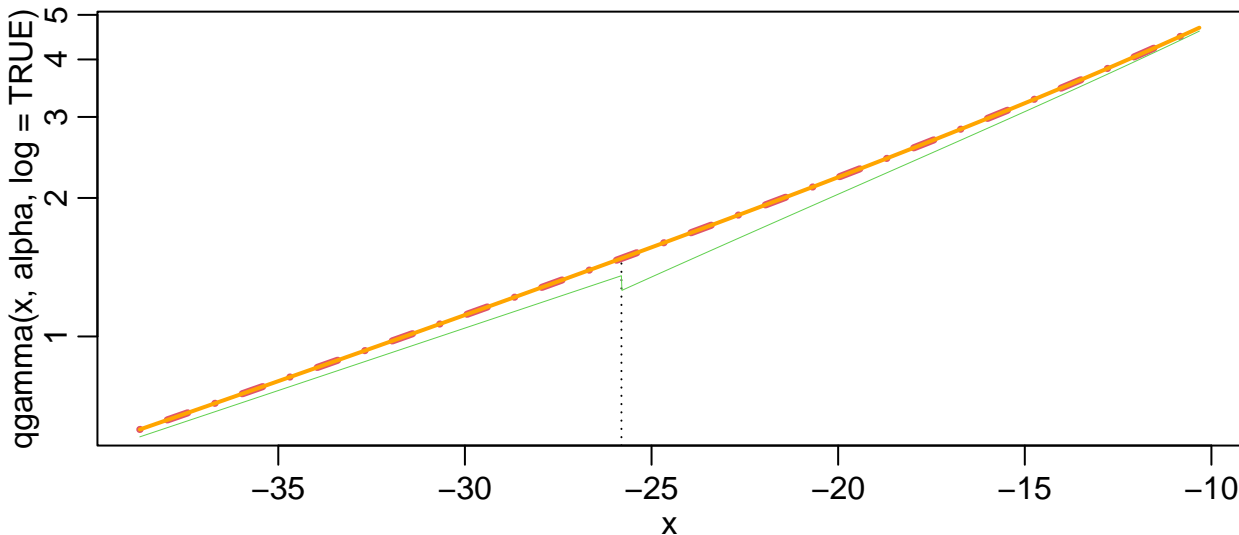




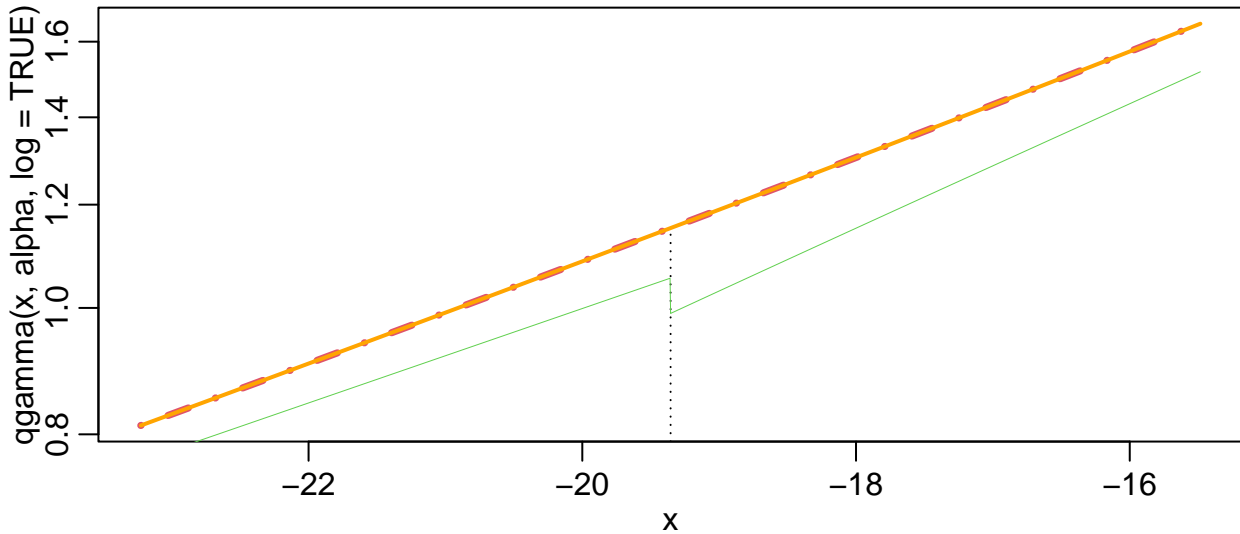
**qgamma(x, alpha= 25 , log = TRUE)**



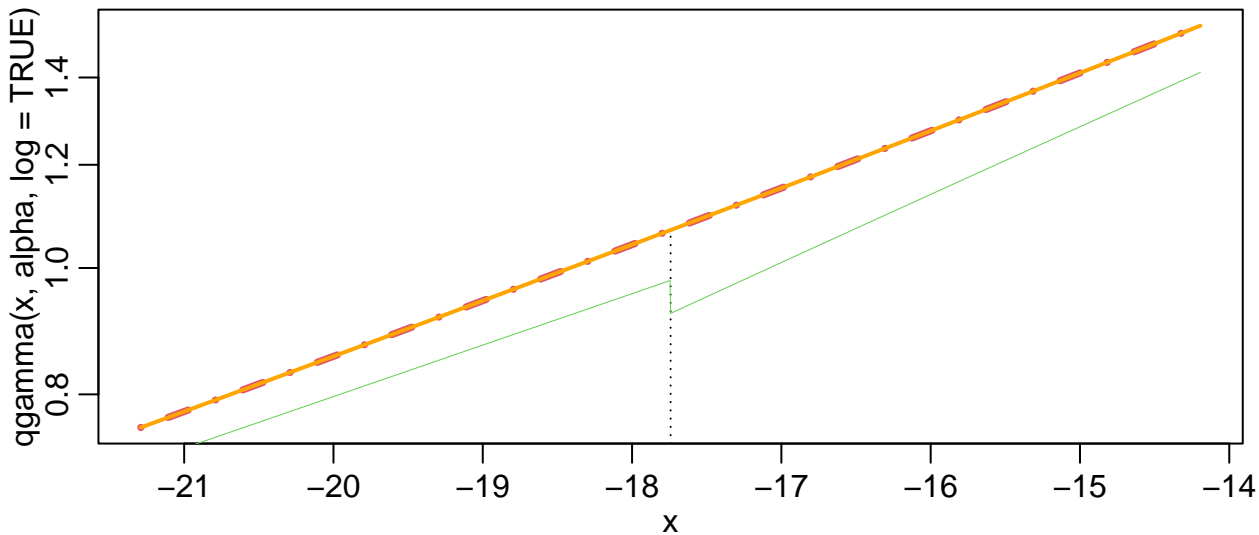
**qgamma(x, alpha= 16 , log = TRUE)**



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

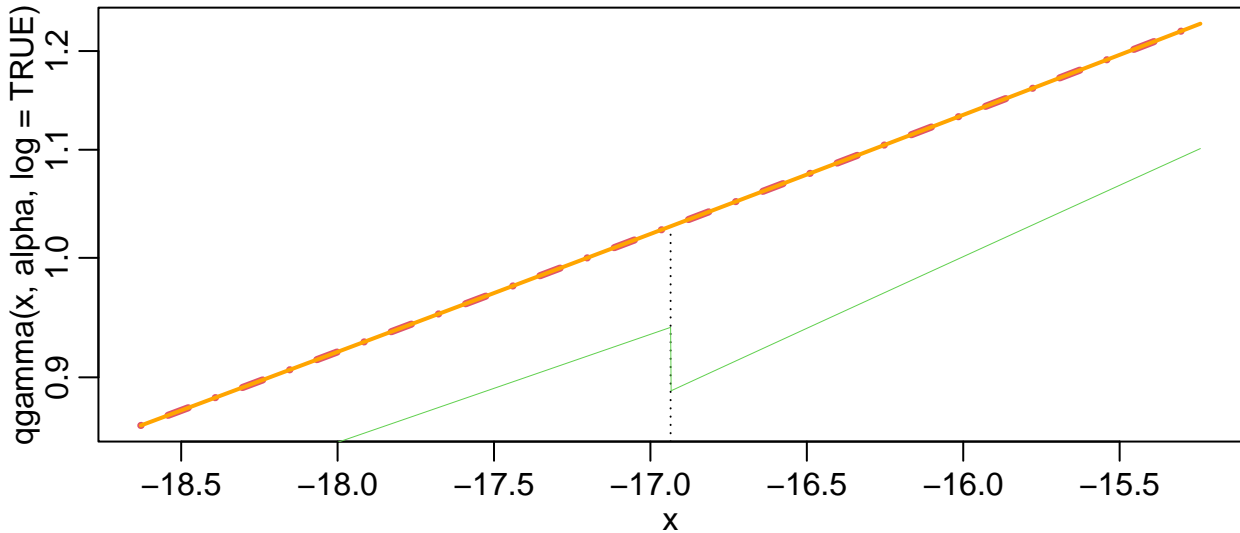


**qgamma(x, alpha= 11 , log = TRUE)**

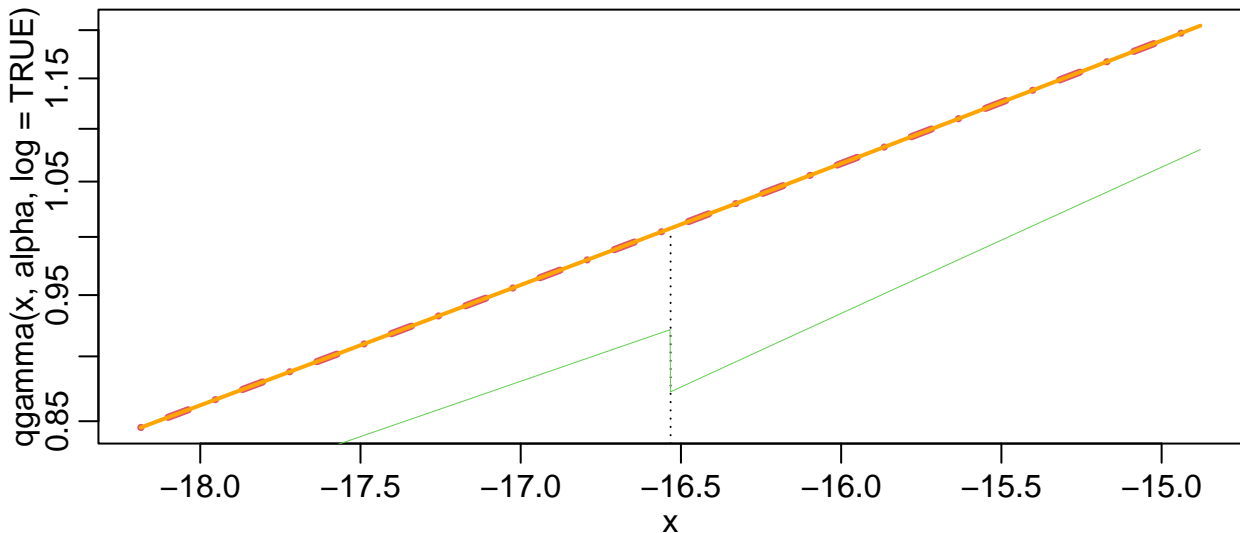




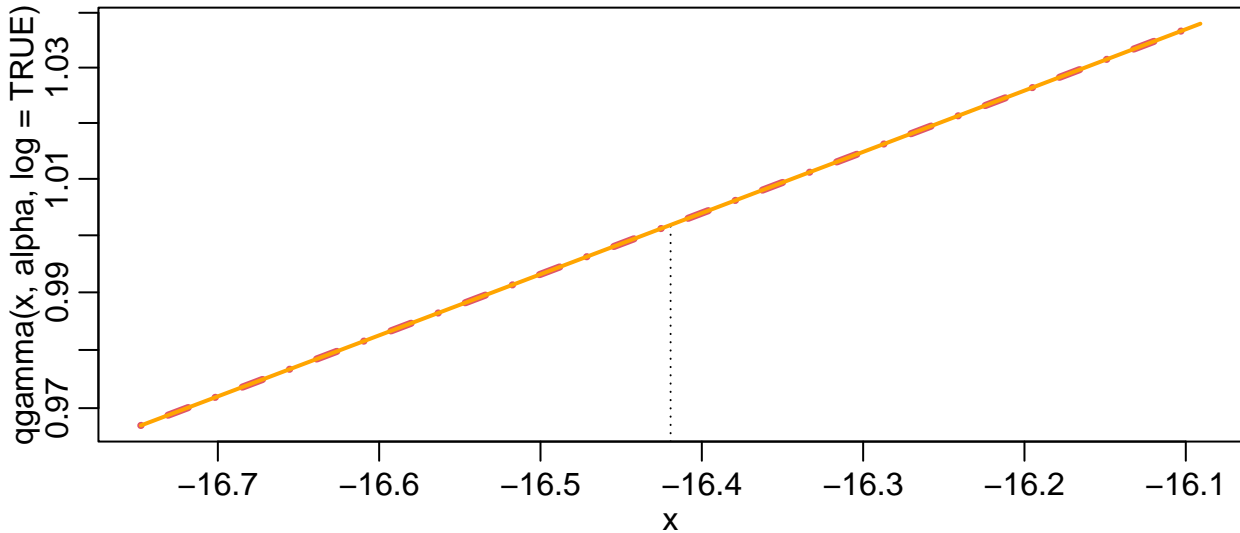
**qgamma(x, alpha= 10.5 , log = TRUE)**



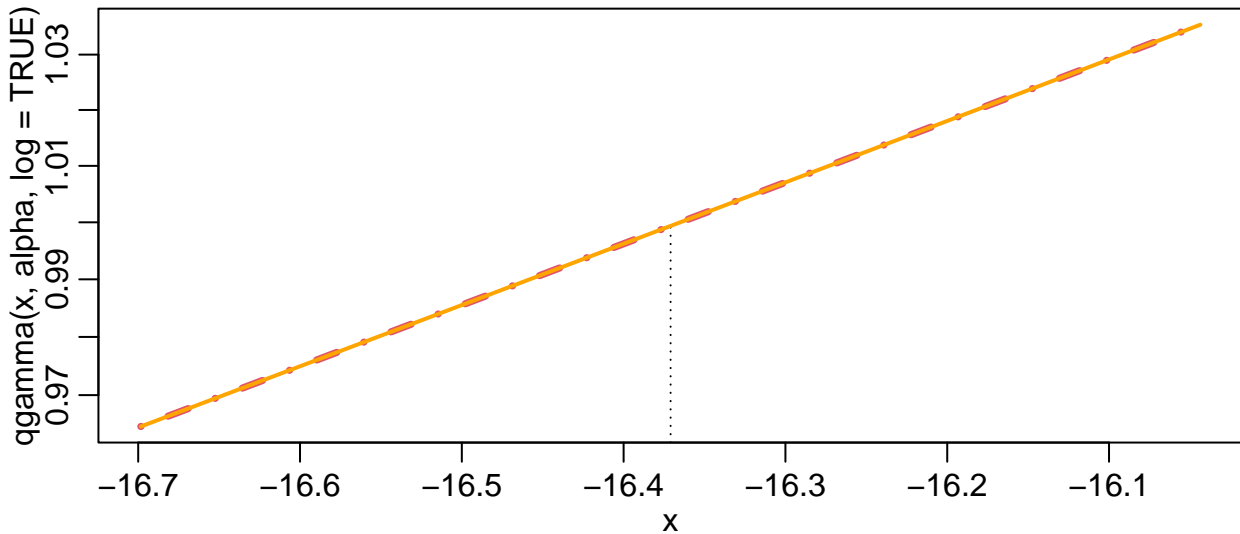
**qgamma(x, alpha= 10.25 , log = TRUE)**



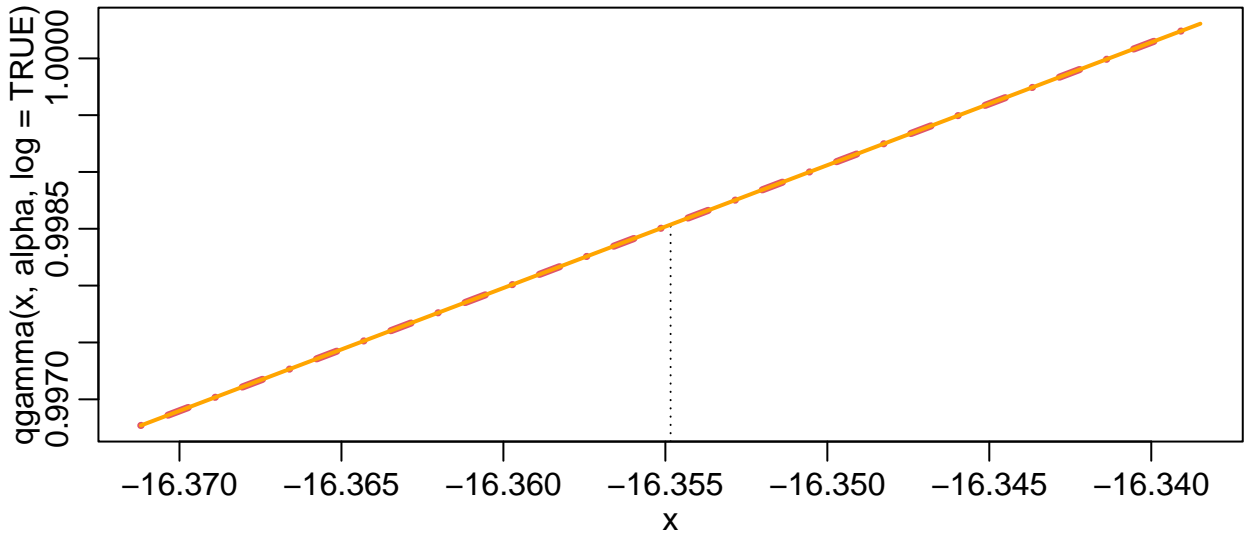
**qgamma(x, alpha= 10.18 , log = TRUE)**



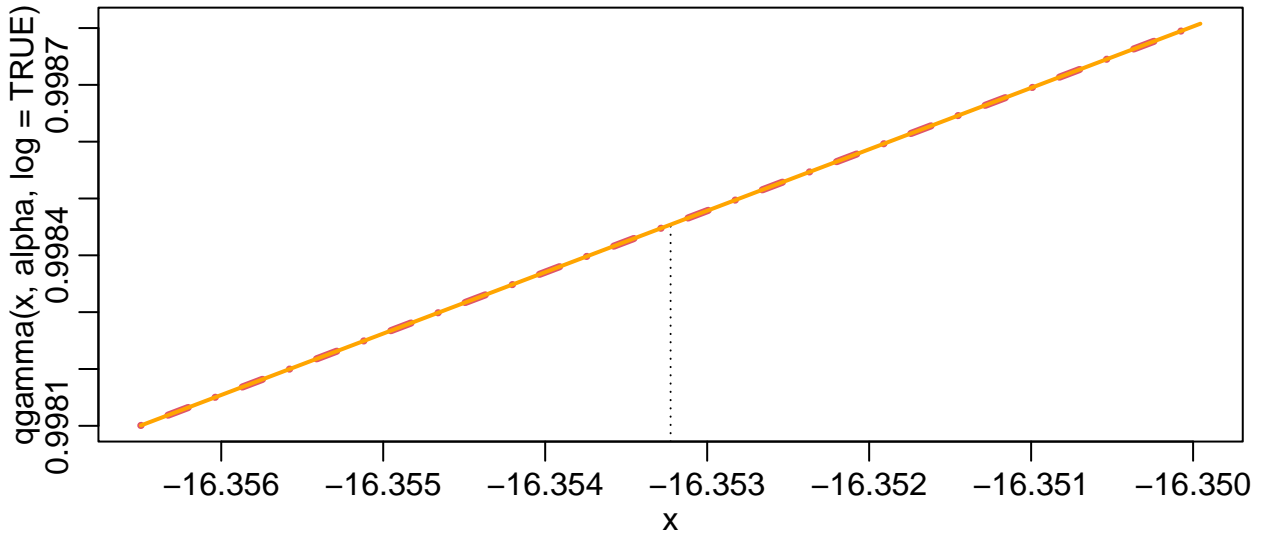
**qgamma(x, alpha= 10.15 , log = TRUE)**



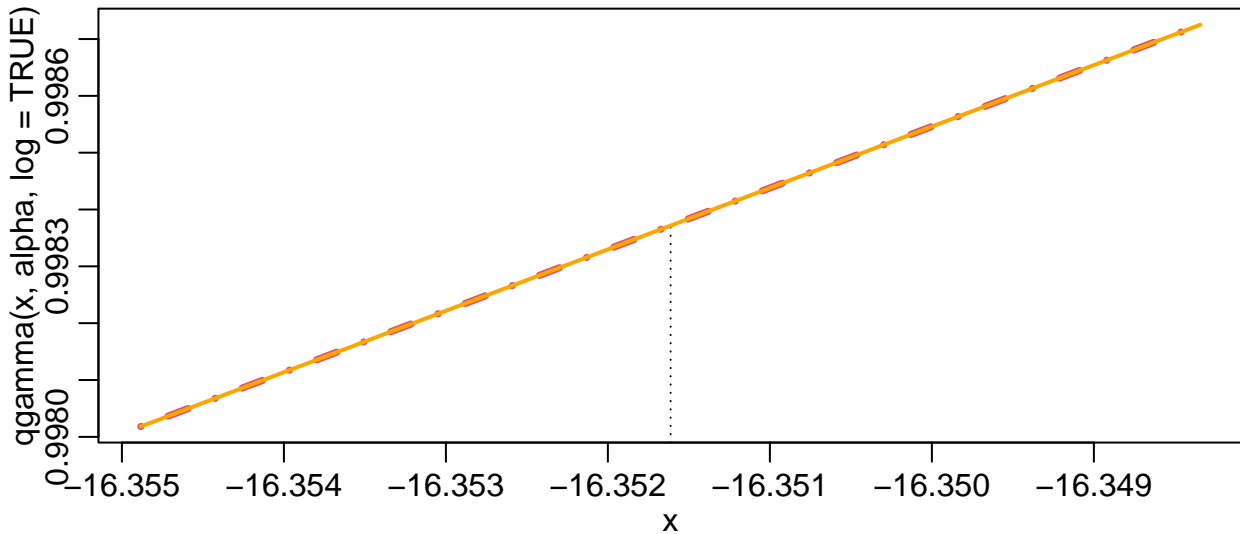
**qgamma(x, alpha= 10.14 , log = TRUE)**



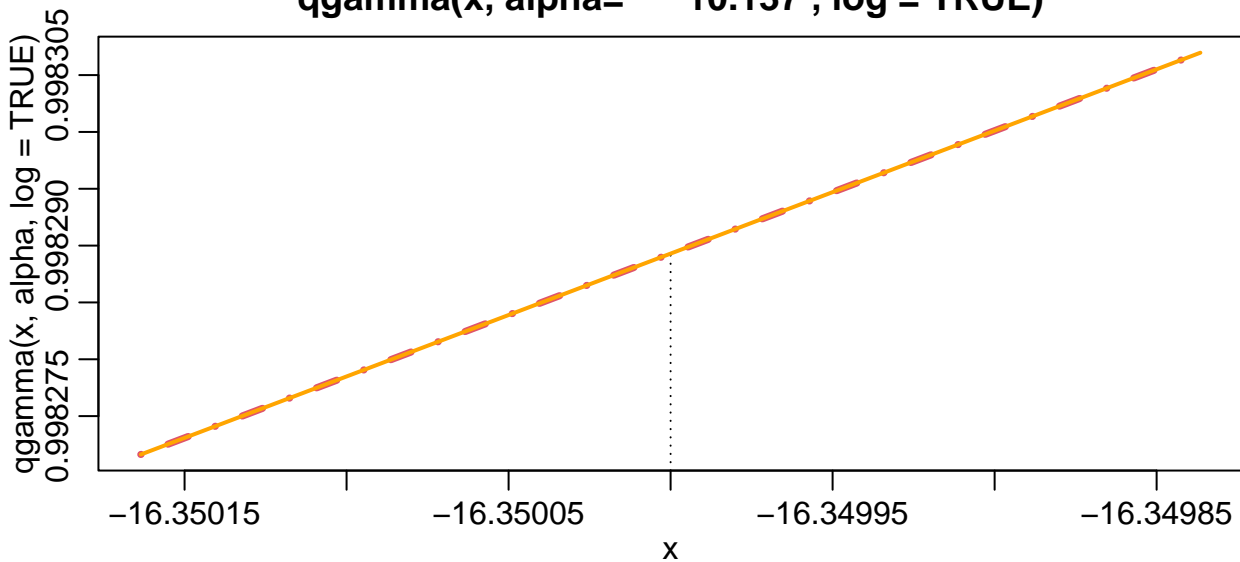
**qgamma(x, alpha= 10.139 , log = TRUE)**



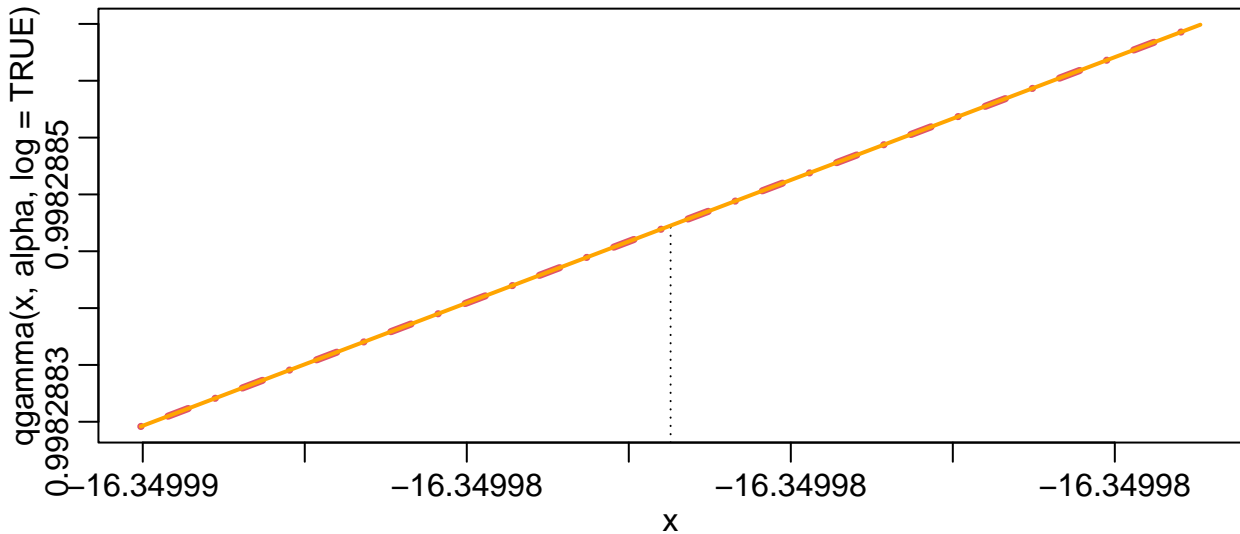
**qgamma(x, alpha= 10.138 , log = TRUE)**



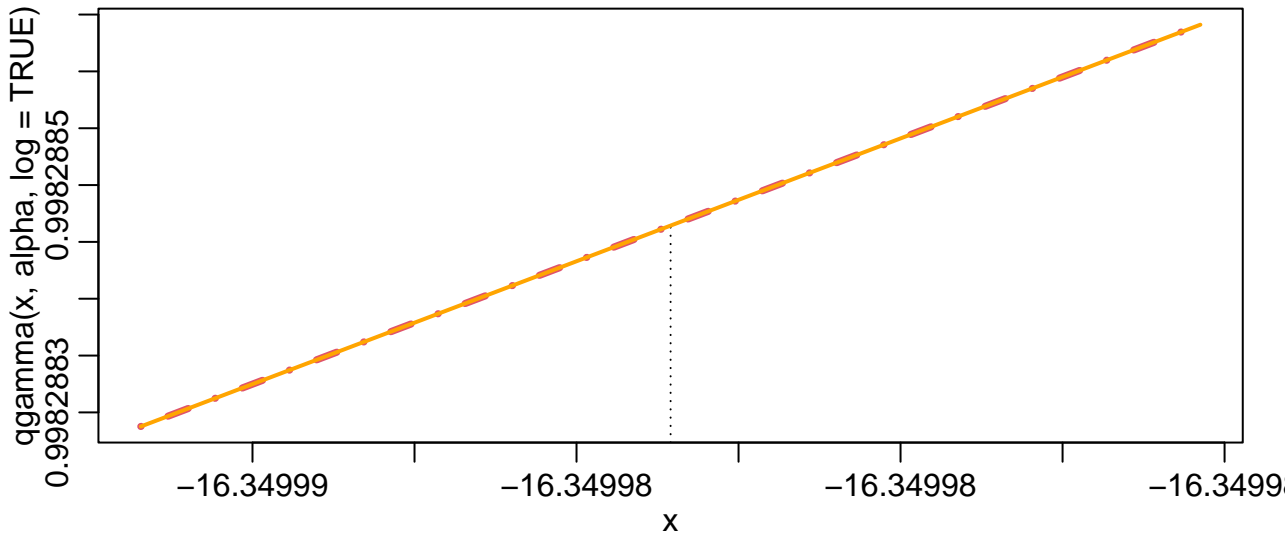
**qgamma(x, alpha= 10.137 , log = TRUE)**



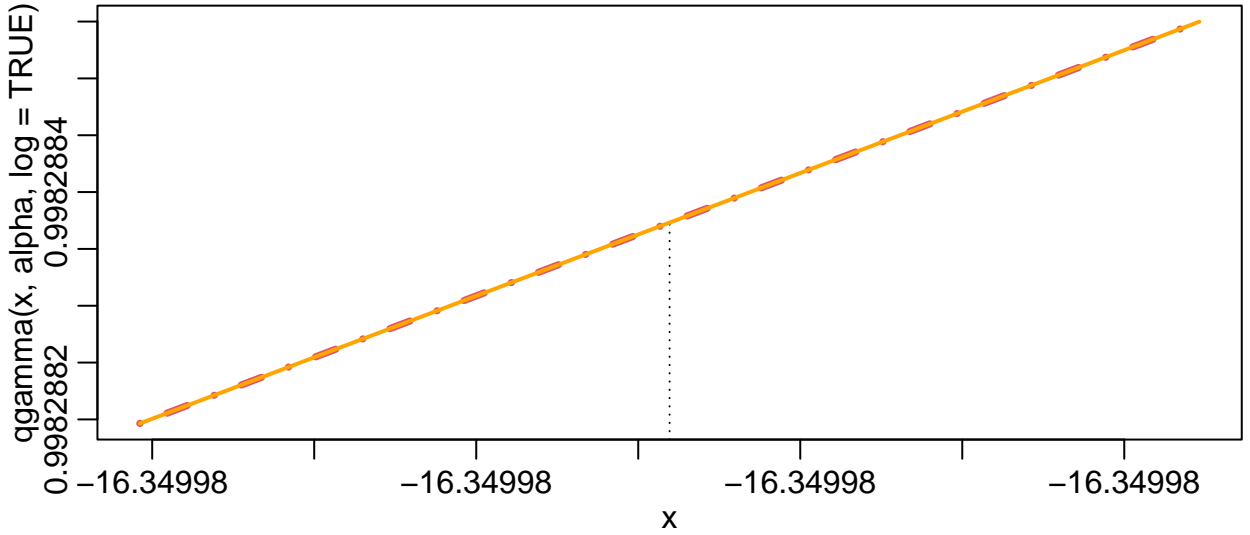
**qgamma(x, alpha= 10.13699 , log = TRUE)**



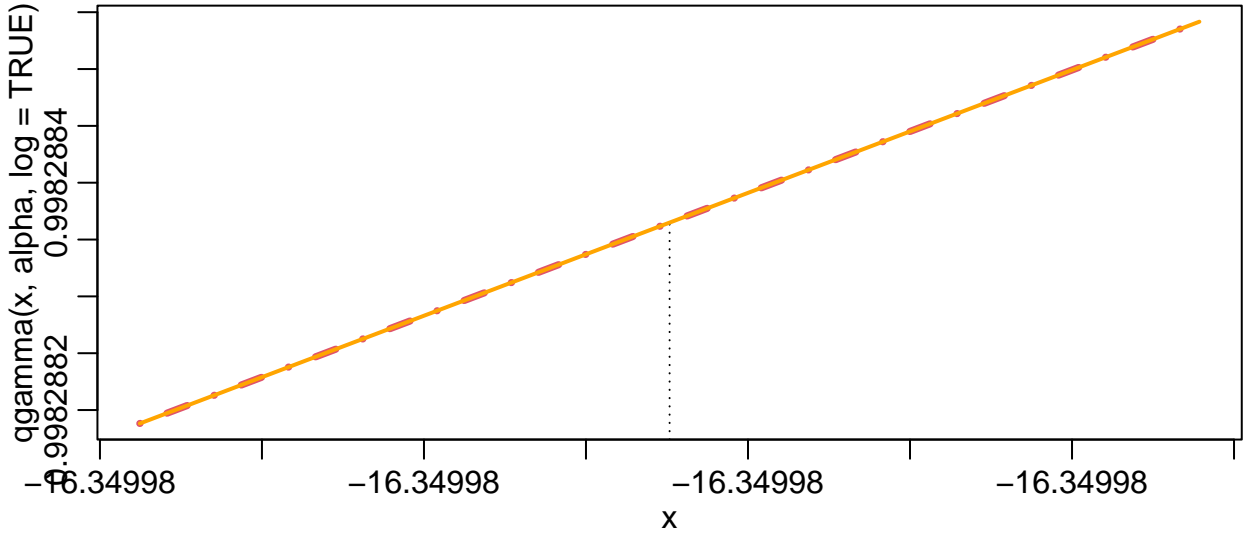
**qgamma(x, alpha= 10.1369899 , log = TRUE)**



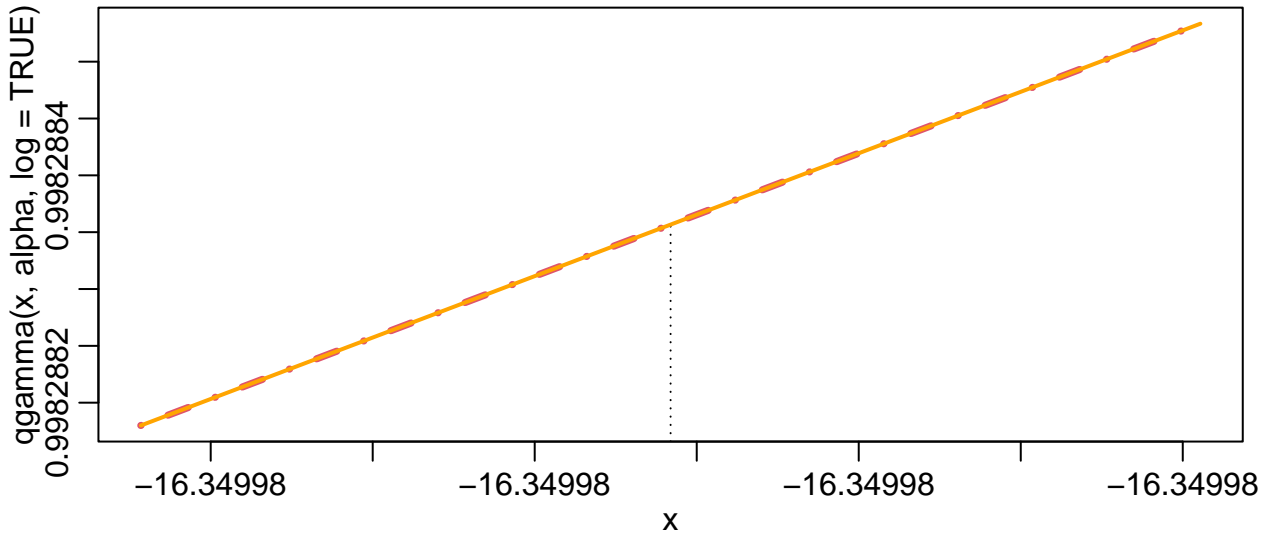
**qgamma(x, alpha= 10.1369894 , log = TRUE)**



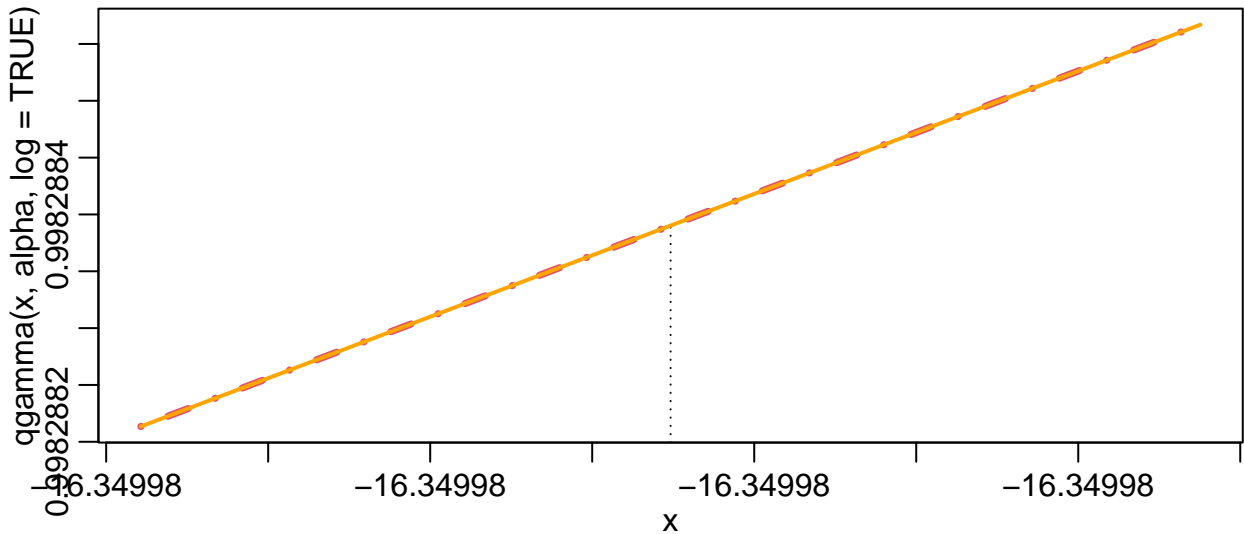
**qgamma(x, alpha= 10.1369893 , log = TRUE)**



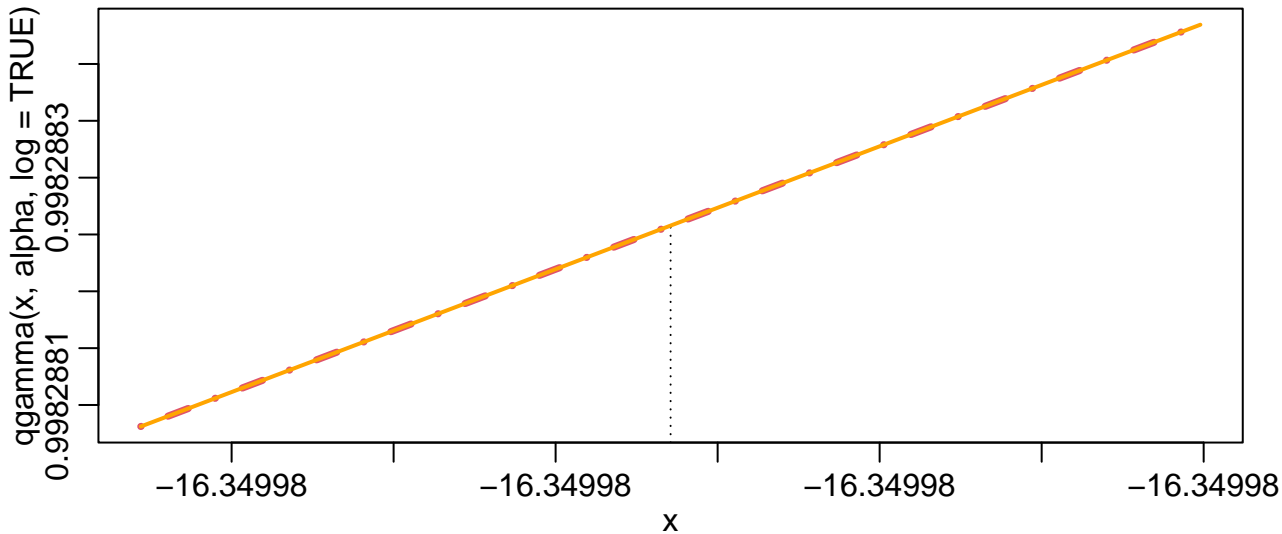
**qgamma(x, alpha= 10.1369892 , log = TRUE)**



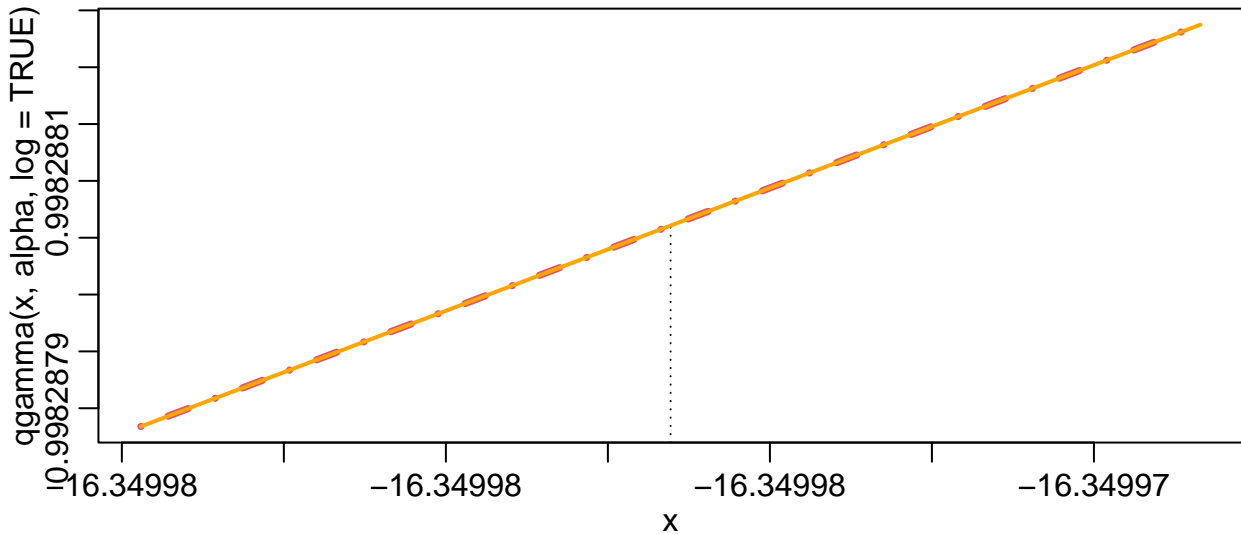
**qgamma(x, alpha= 10.136989 , log = TRUE)**



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

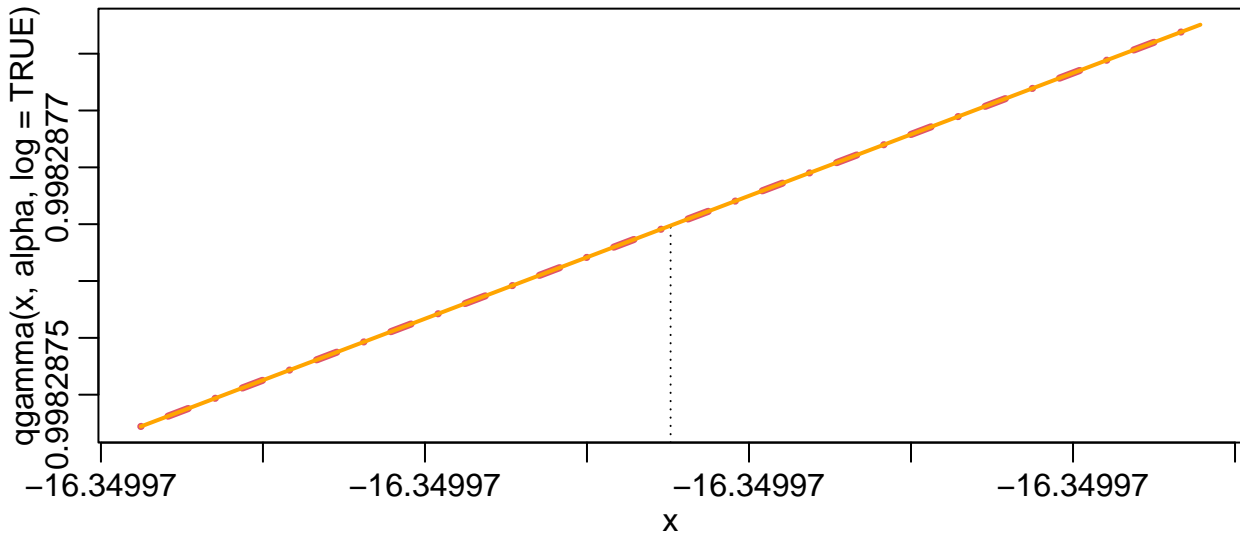


**qgamma(x, alpha= 10.136985 , log = TRUE)**

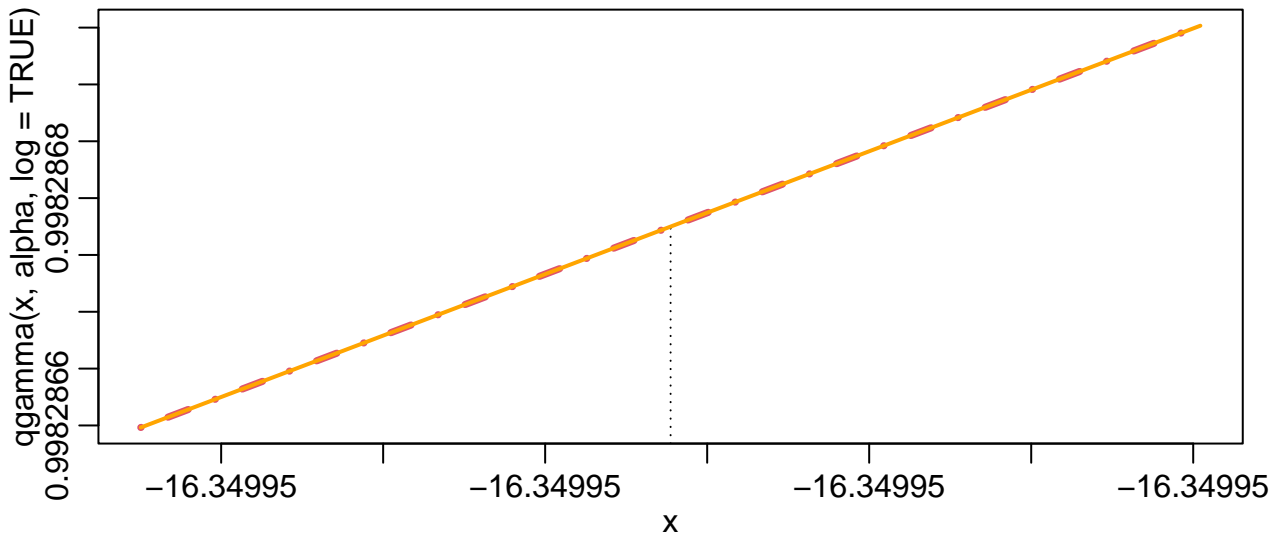




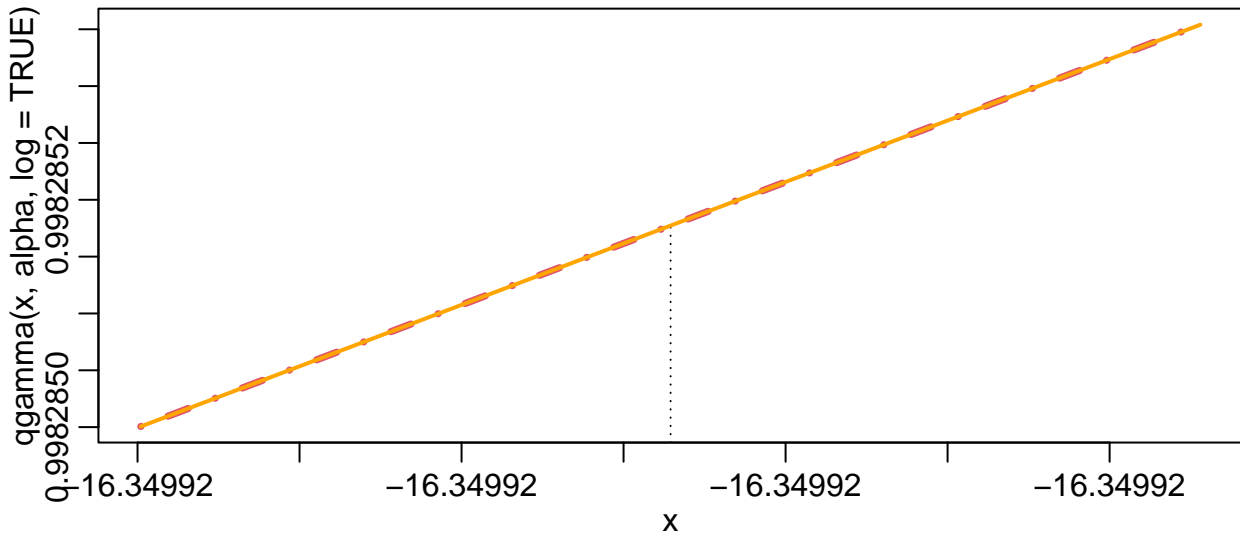
**qgamma(x, alpha= 10.13698 , log = TRUE)**



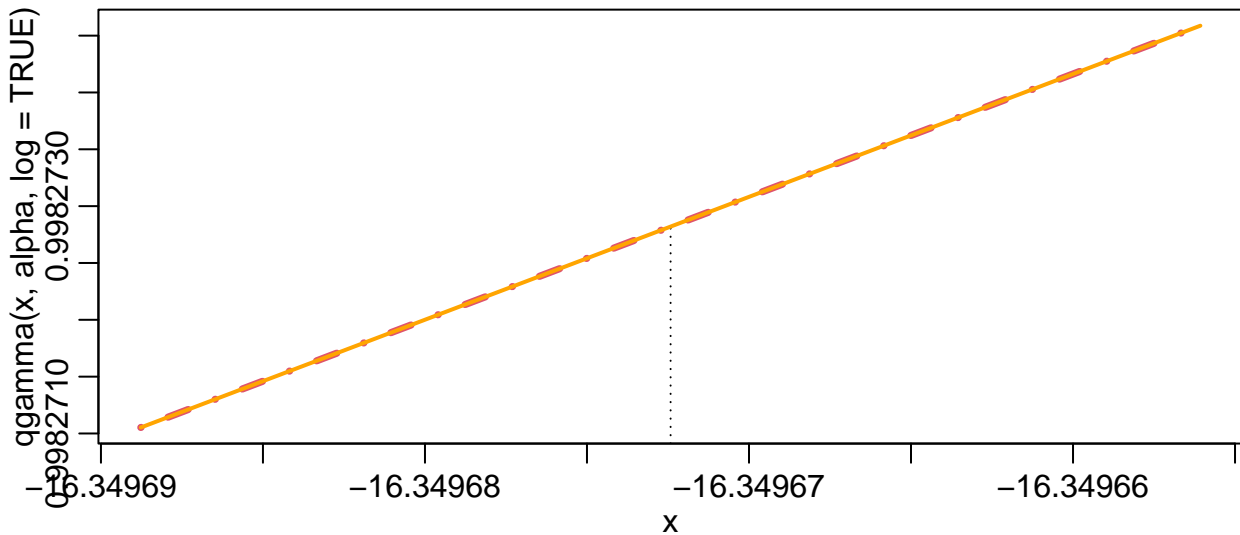
**qgamma(x, alpha= 10.13697 , log = TRUE)**



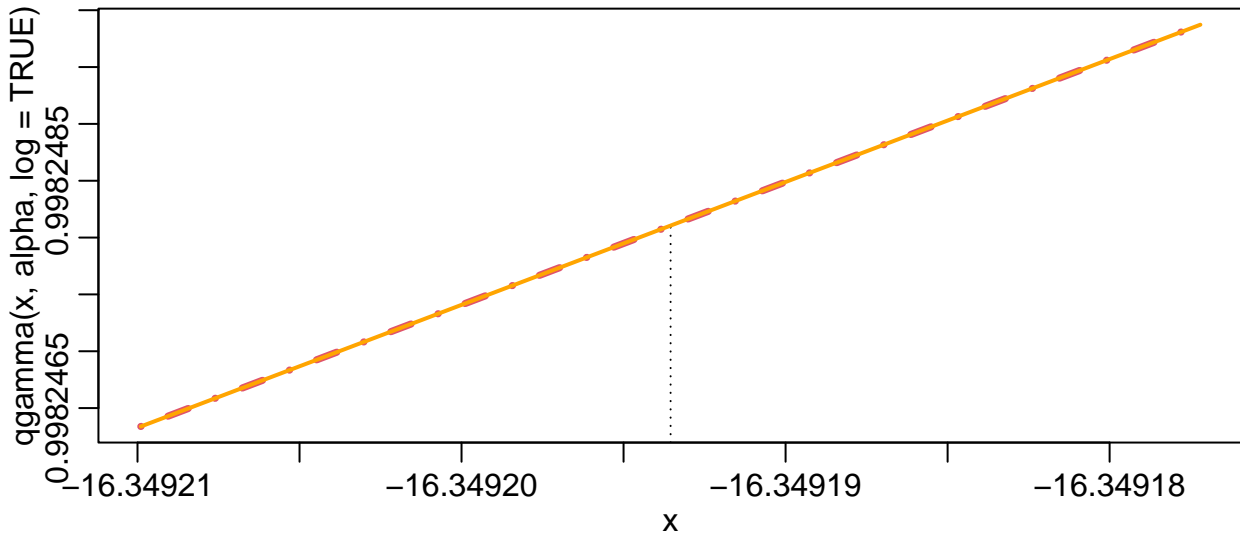
**qgamma(x, alpha= 10.13695 , log = TRUE)**



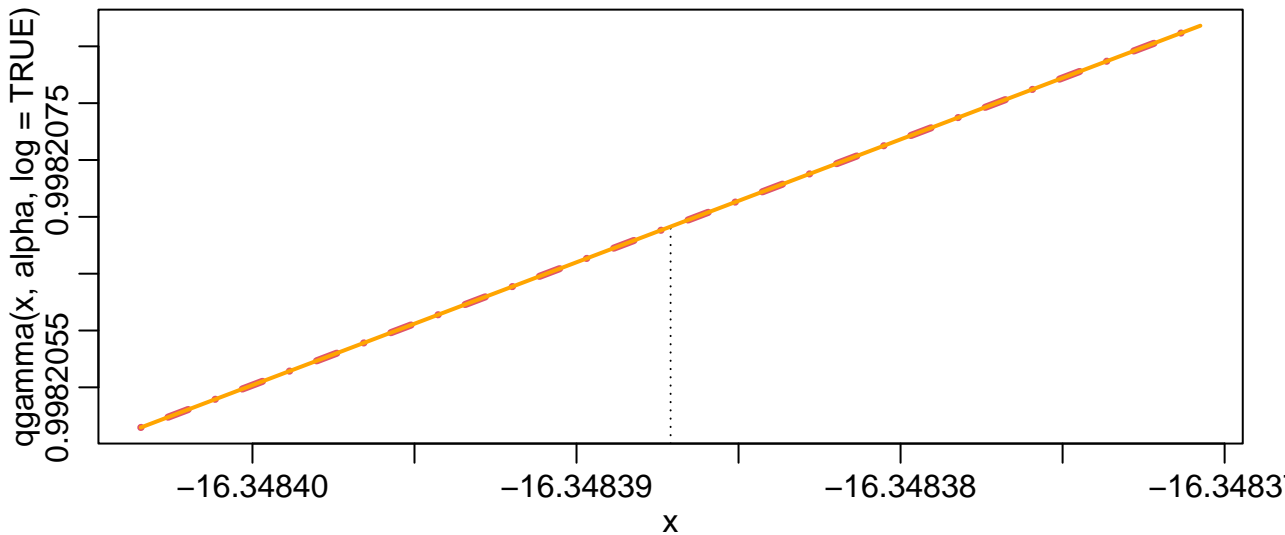
**qgamma(x, alpha= 10.1368 , log = TRUE)**



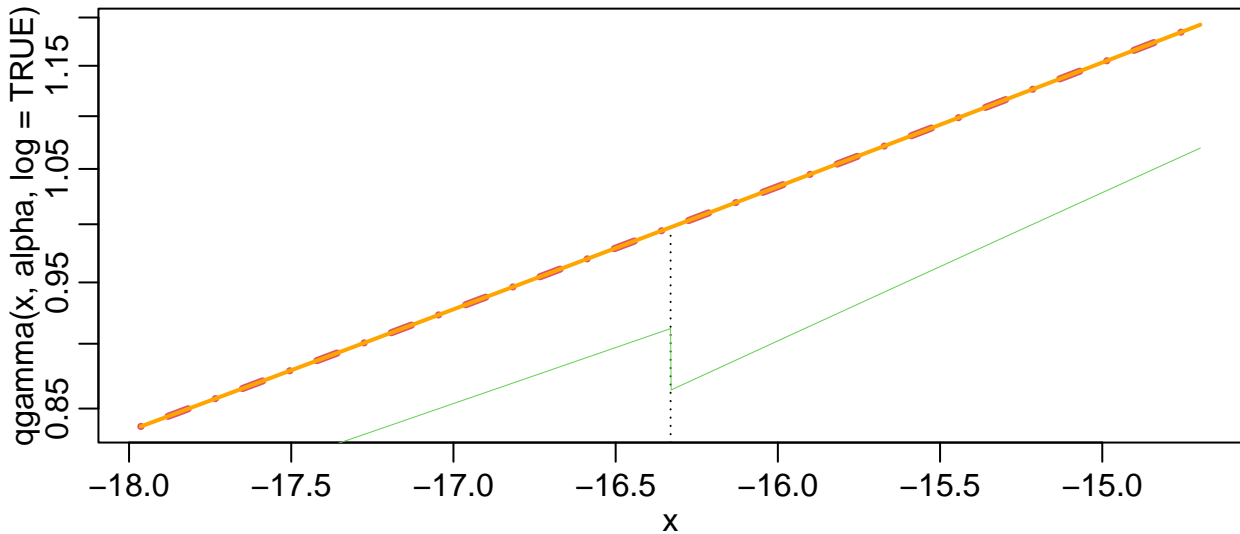
**qgamma(x, alpha= 10.1365 , log = TRUE)**



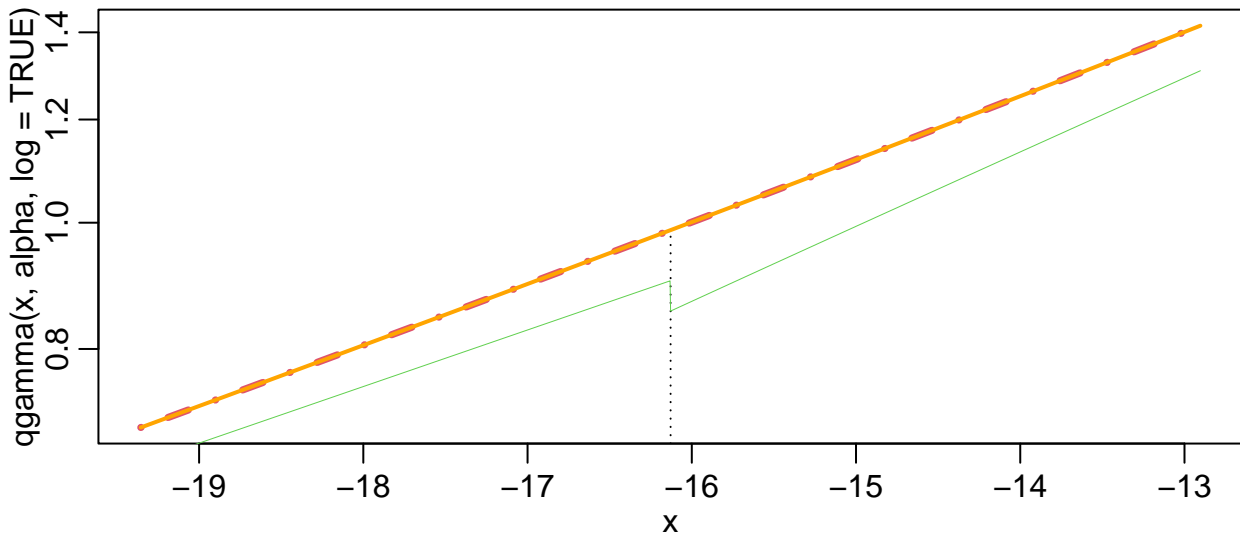
**qgamma(x, alpha= 10.136 , log = TRUE)**



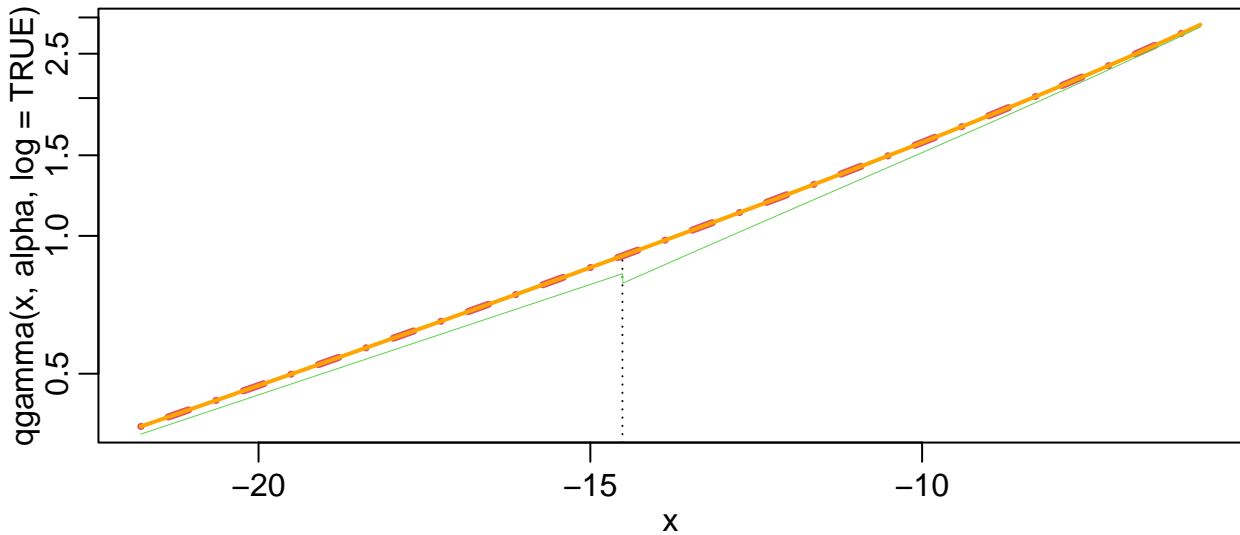
**qgamma(x, alpha= 10.125 , log = TRUE)**

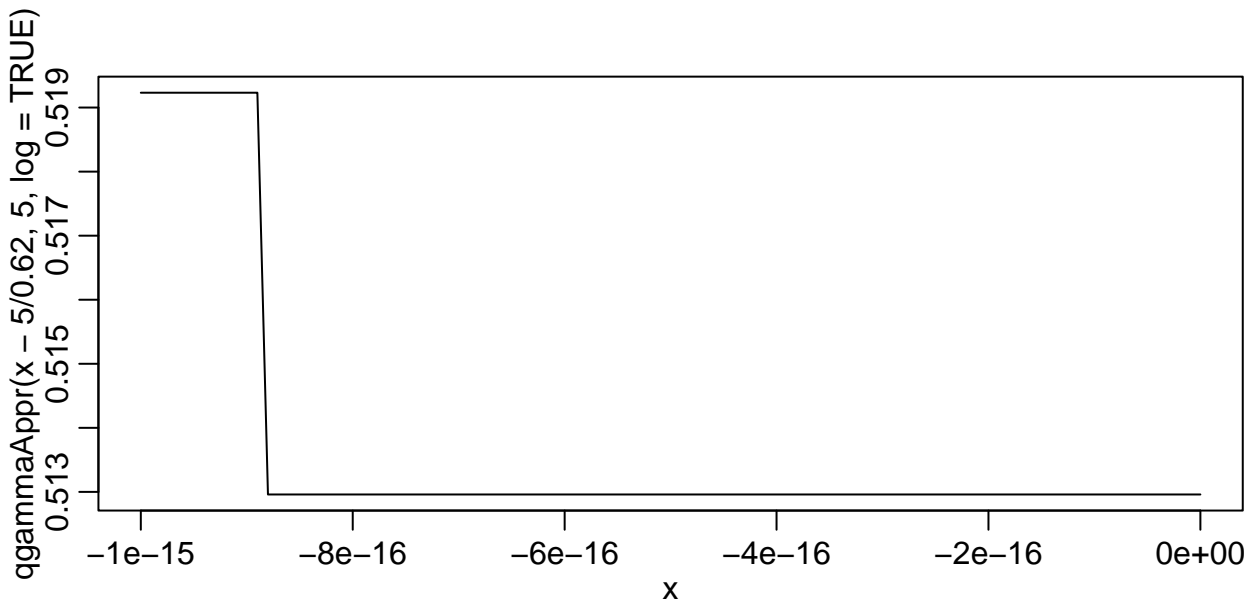
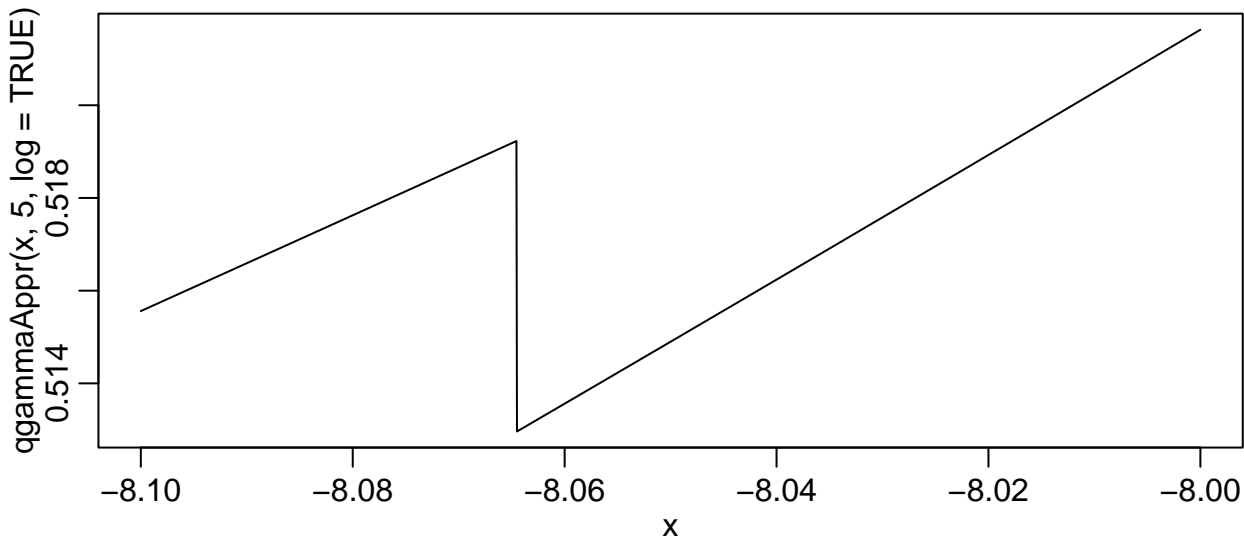


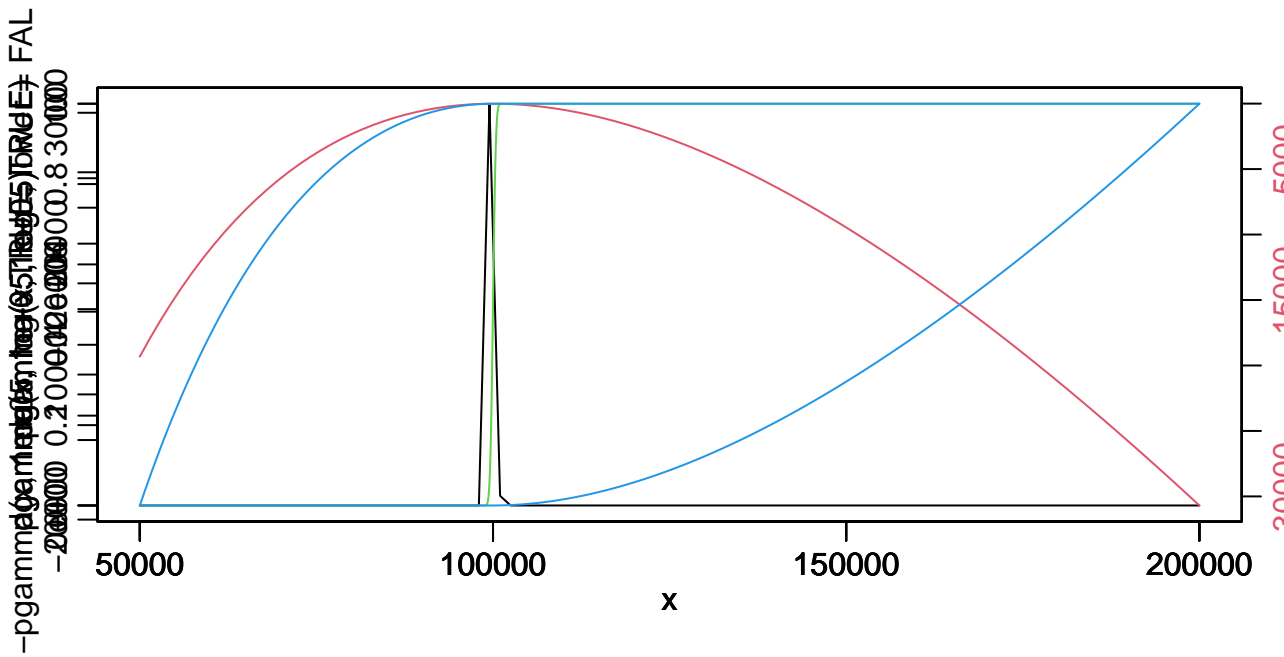
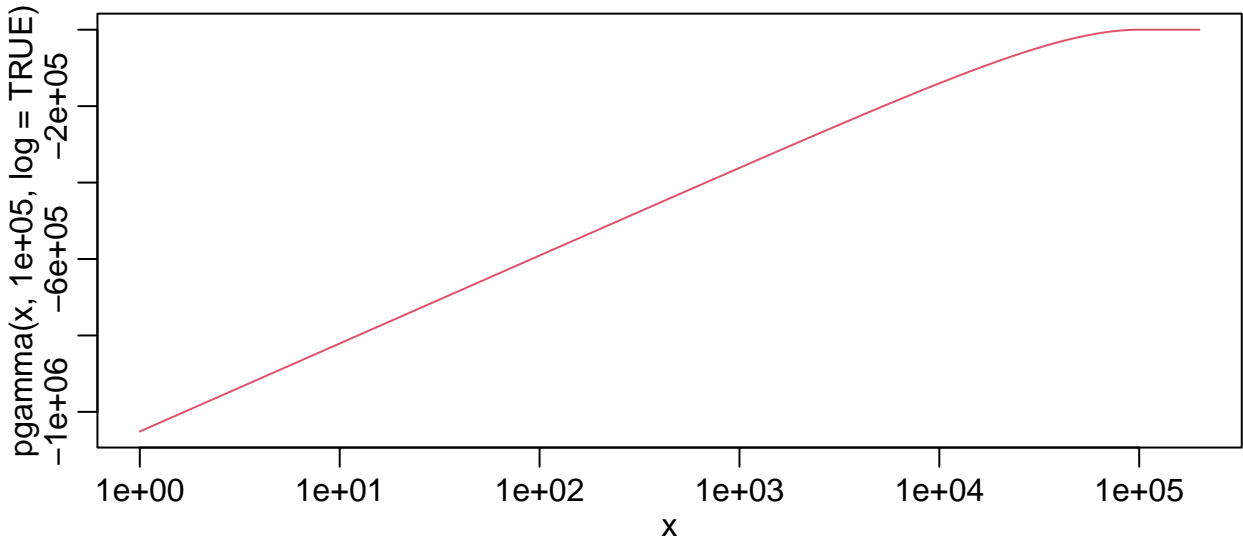
**qgamma(x, alpha= 10 , log = TRUE)**

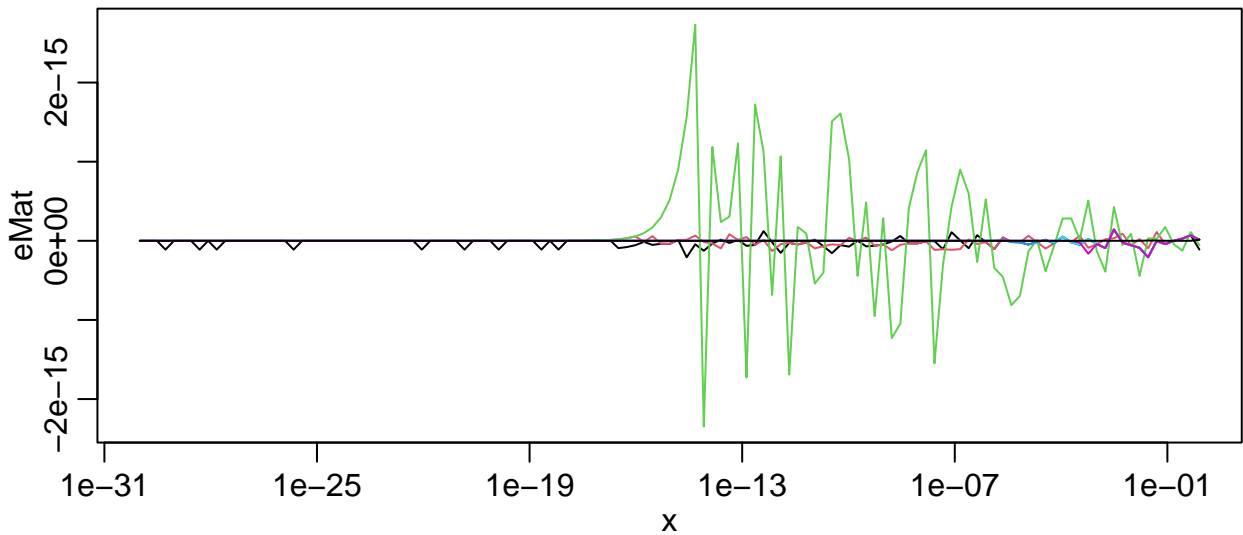
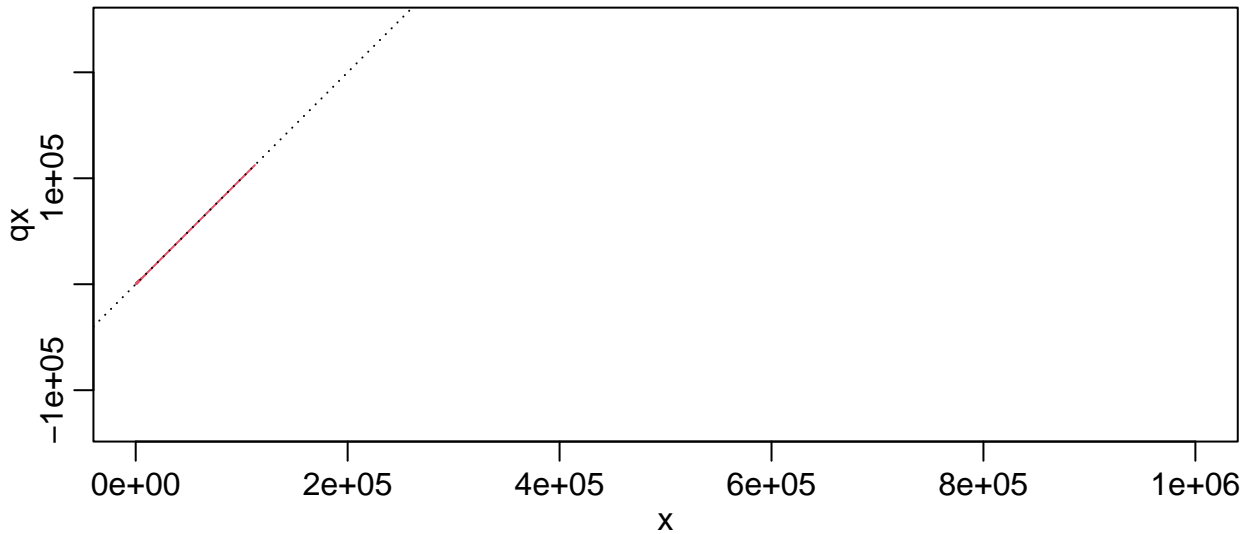


qgamma(x, alpha= 9 , log = TRUE)

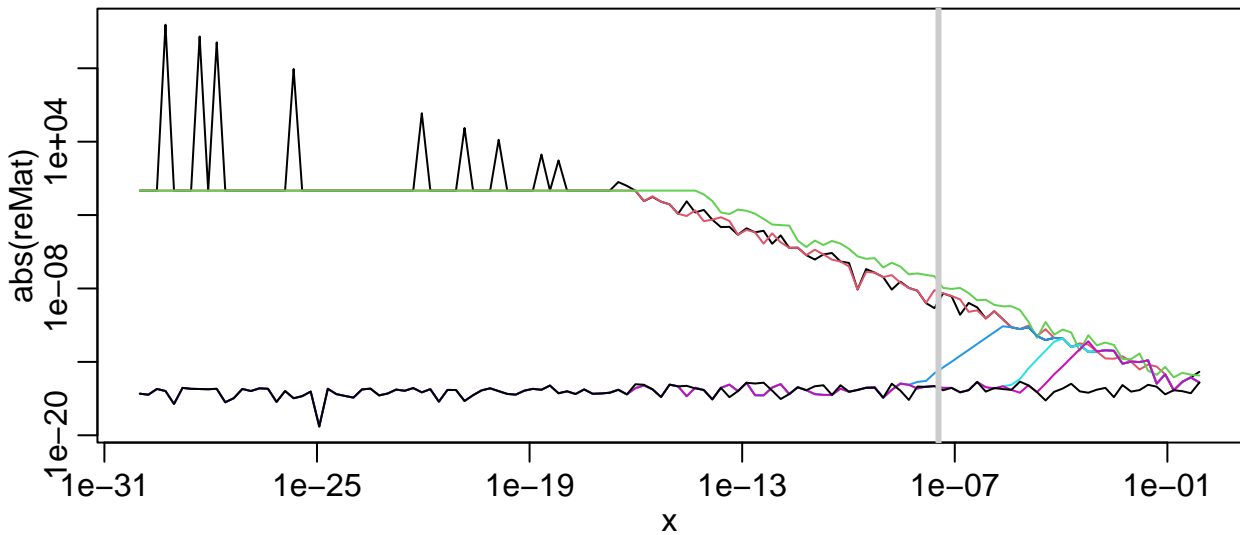
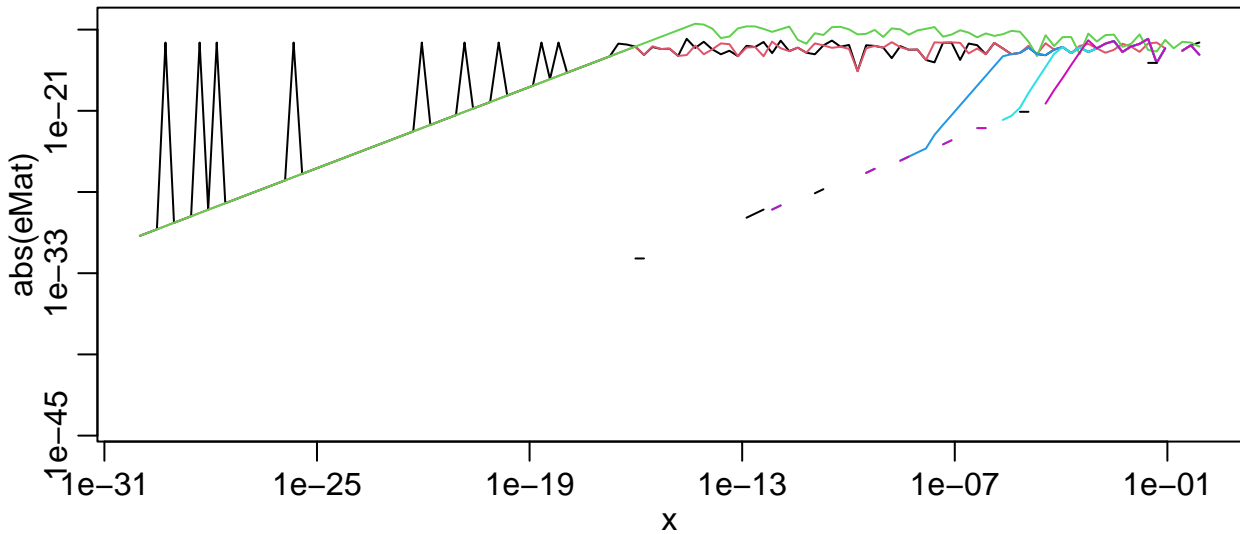




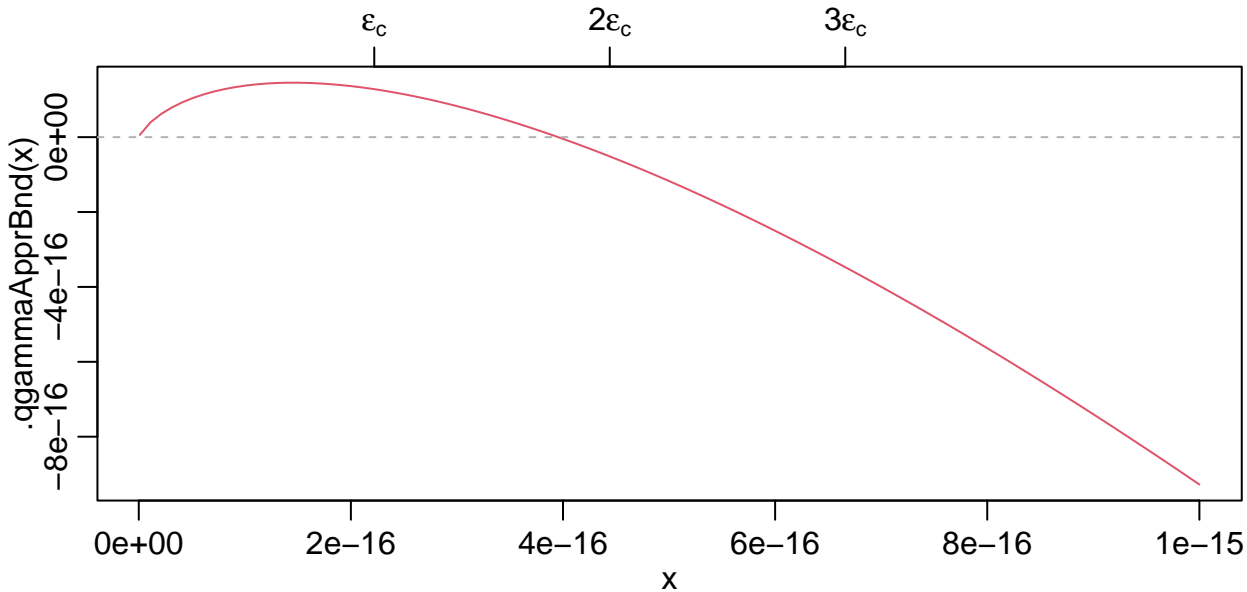
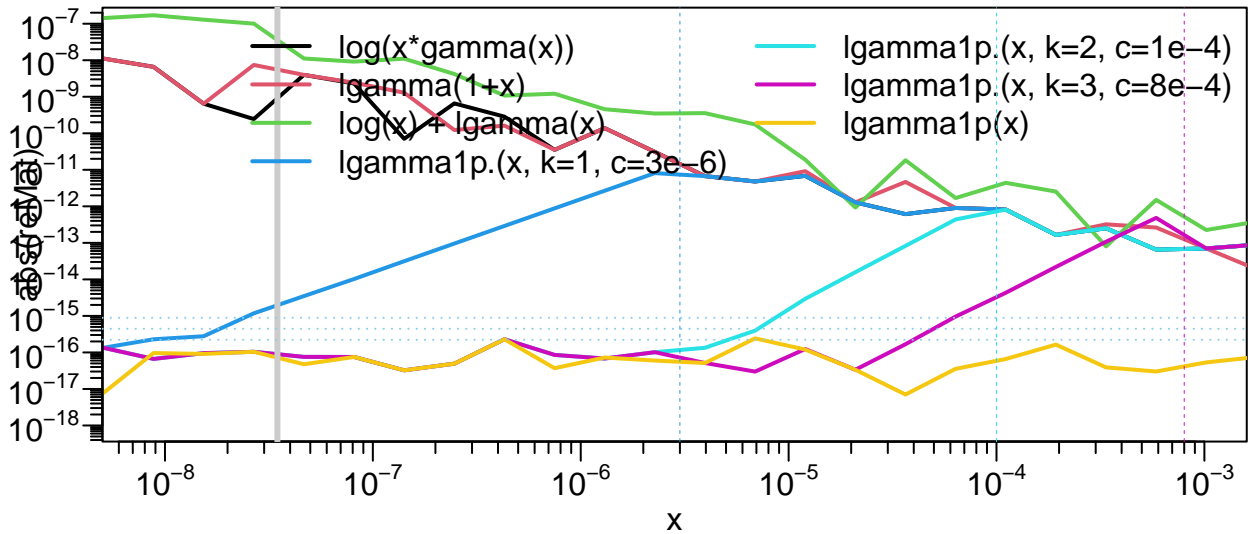


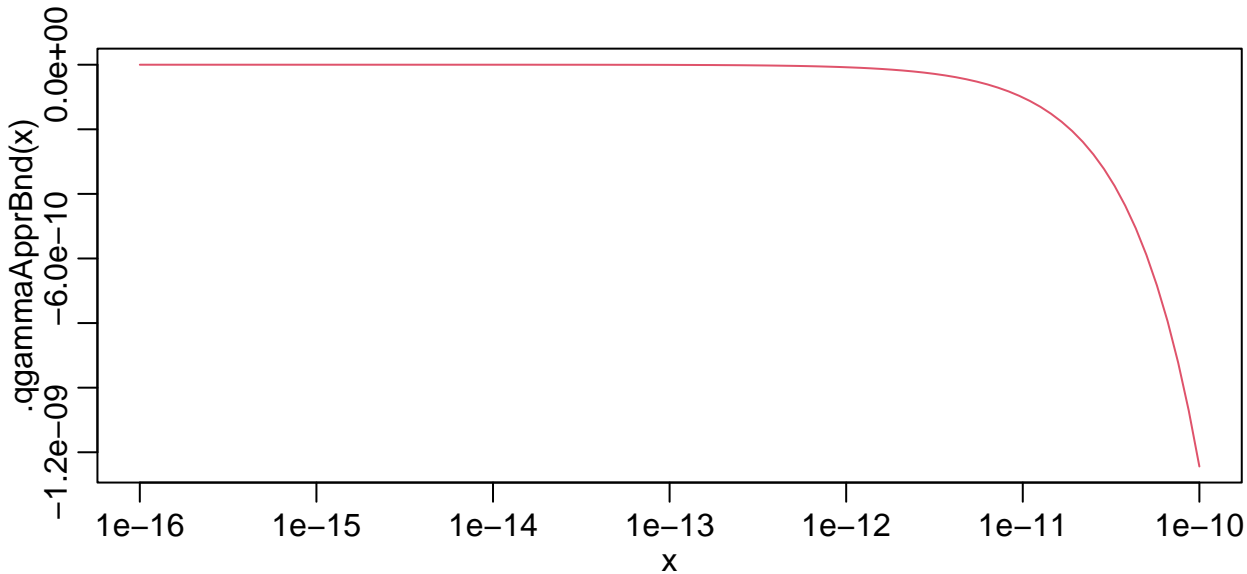




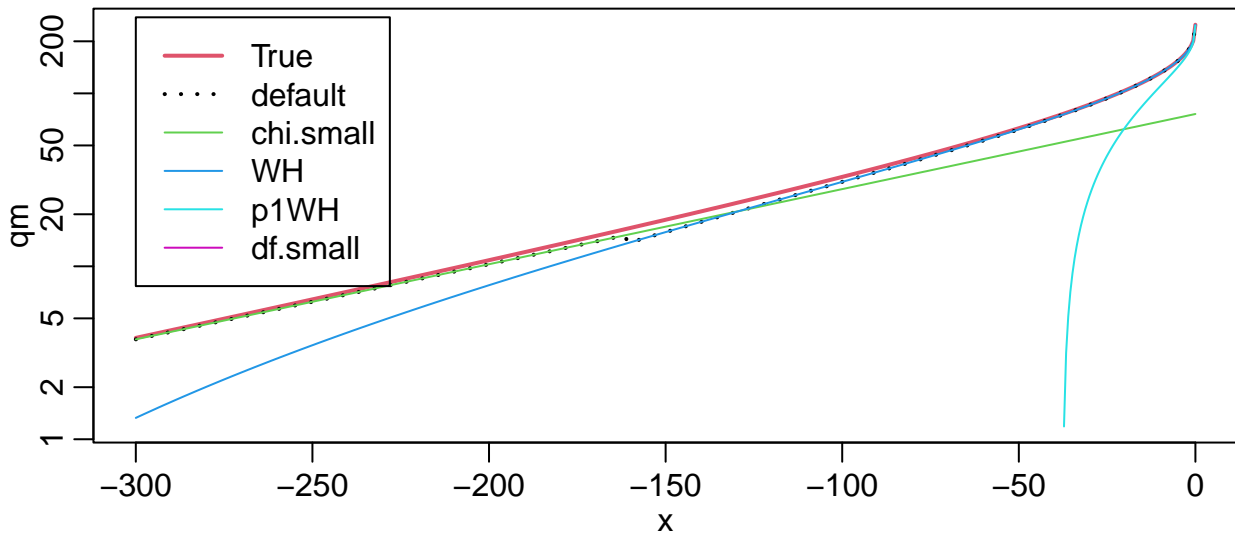


$\lgamma1p(x) = \log(\Gamma(x+1))$  approximations  $|\text{rel.Err}(\cdot)|$

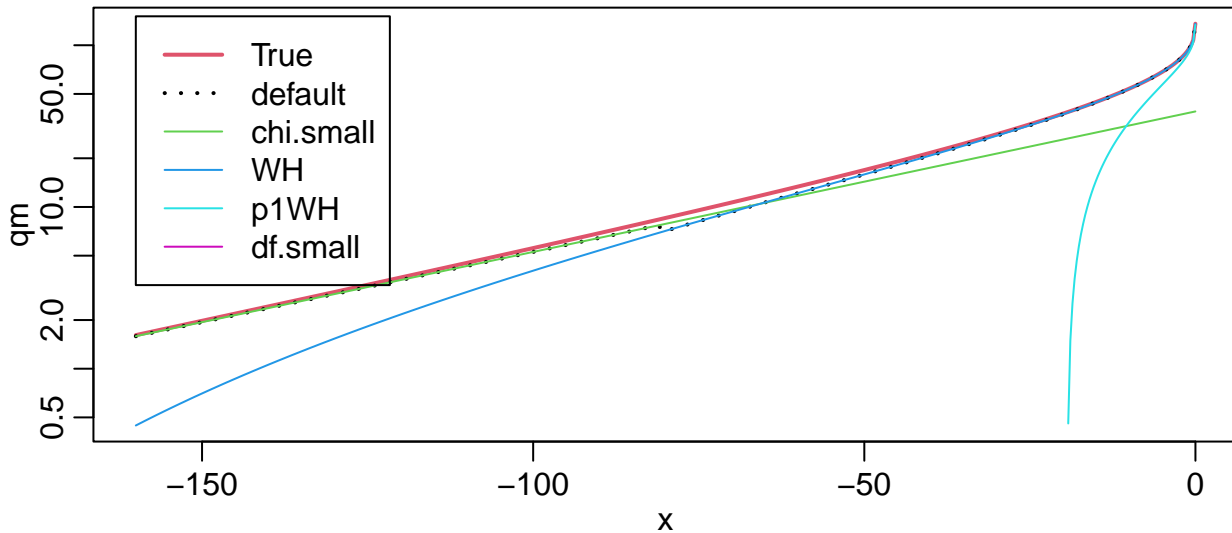




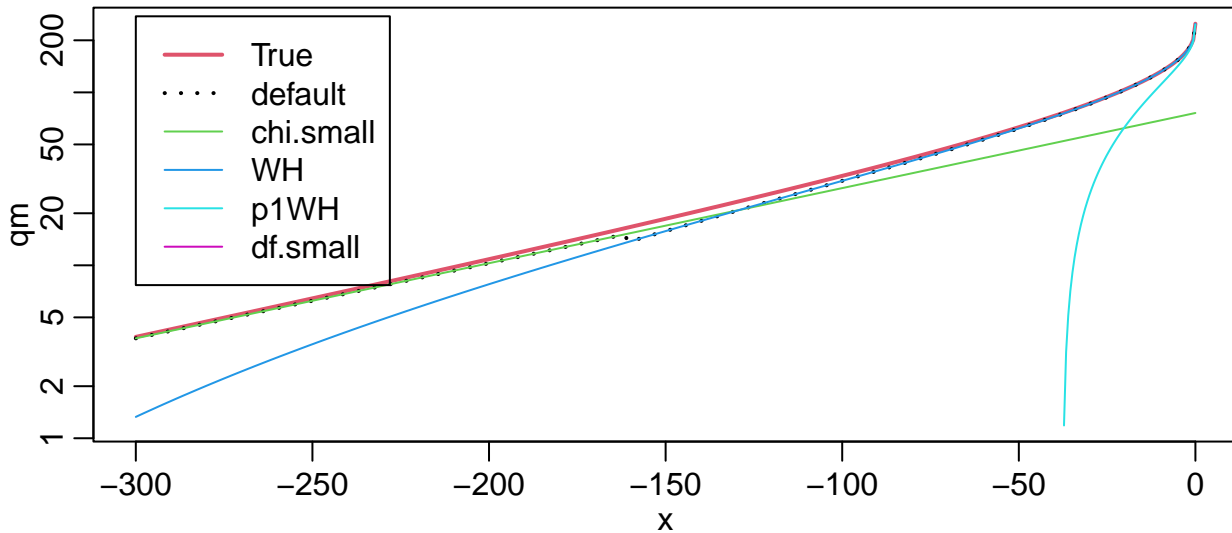
**p.qchi.appr(x = seq(-300, -0.01, length = 501), df = 200)**



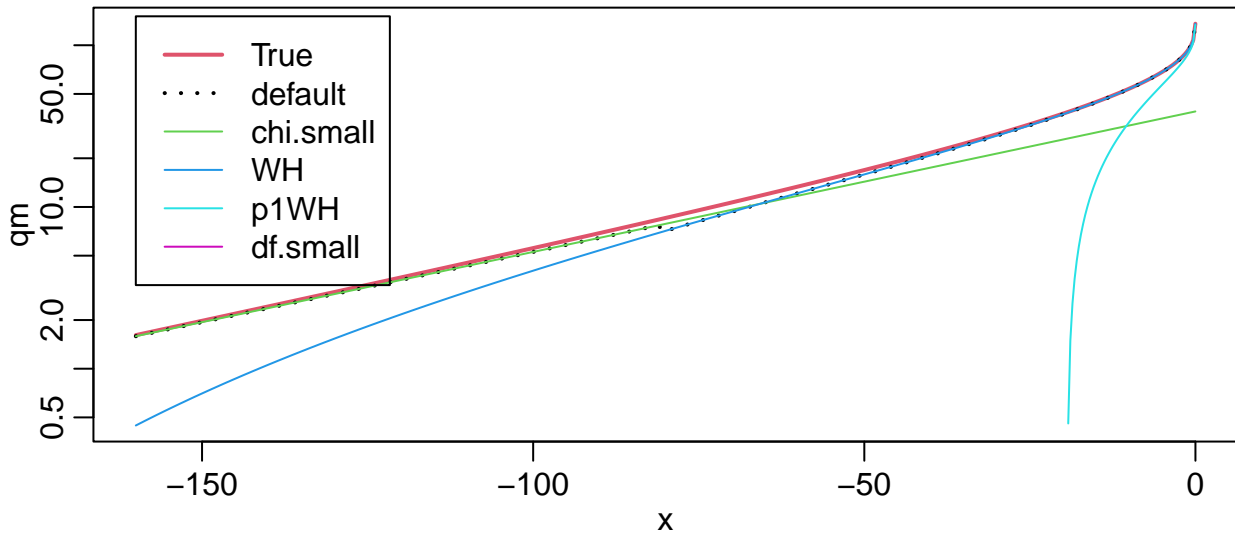
**p.qchi.appr(x = seq(-160, -0.01, length = 501), df = 100)**



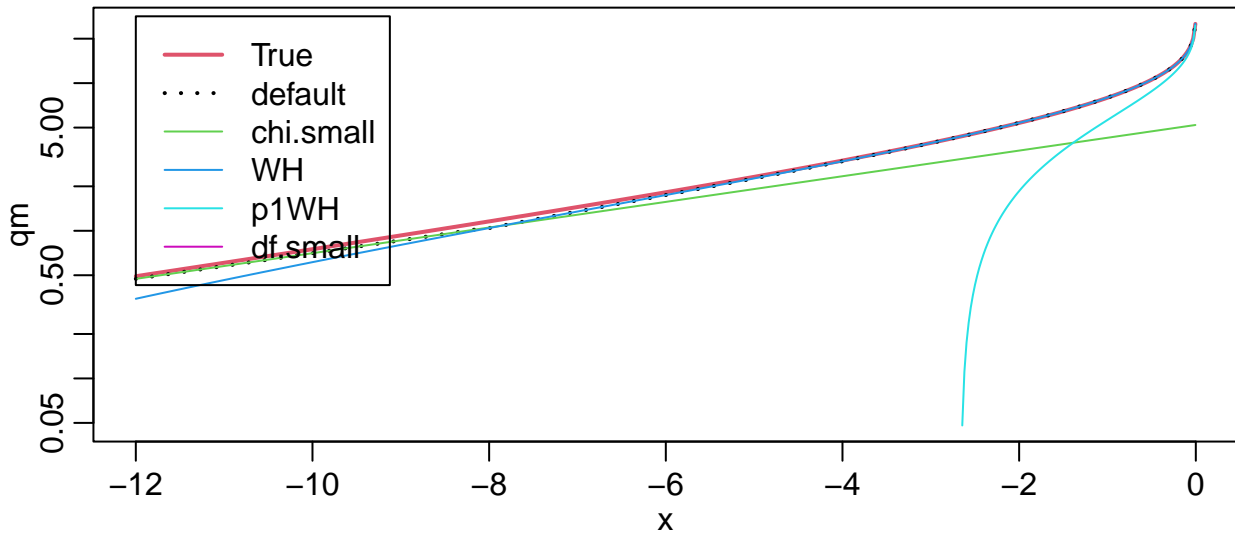
**p.qchi.appr(x = seq(-300, -0.01, length = 501), df = 200)**



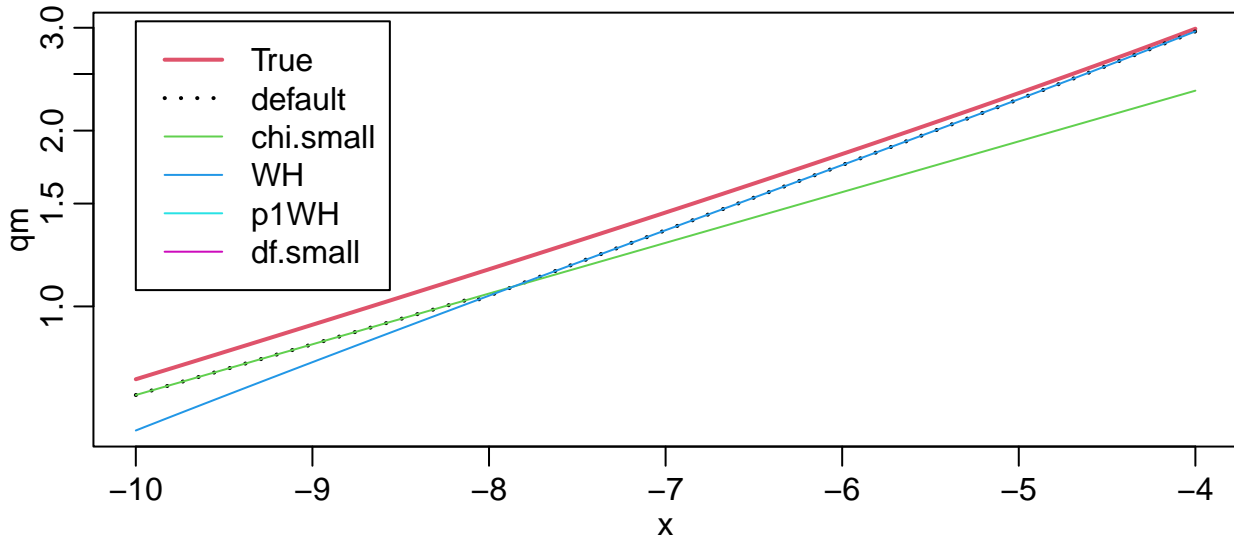
**p.qchi.appr(x = seq(-160, -0.01, length = 501), df = 100)**



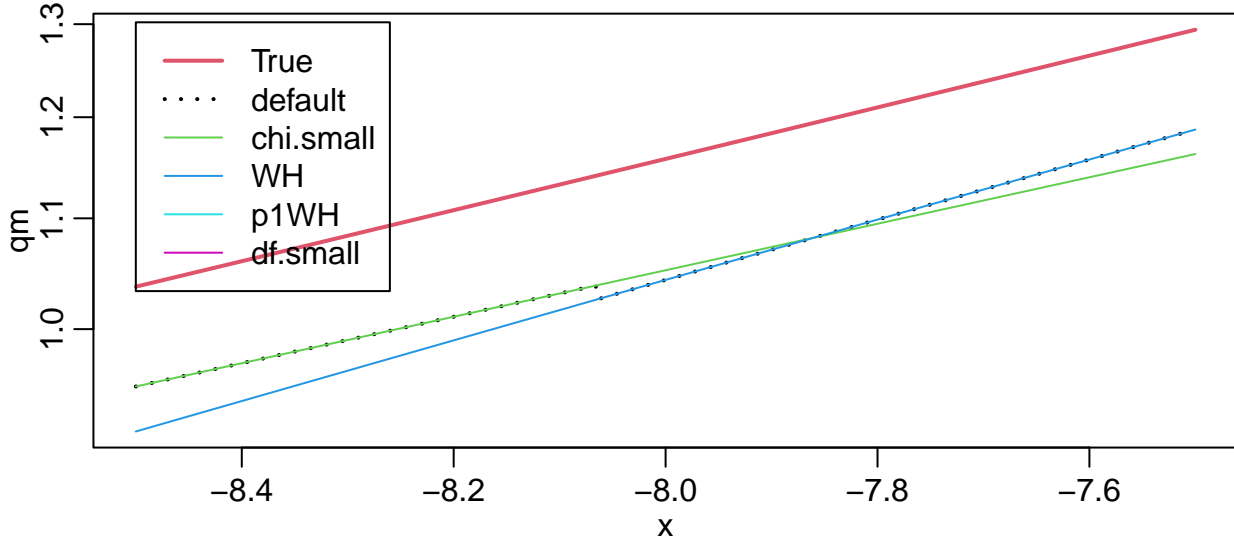
**p.qchi.appr(x = seq(-12, -0.005, length = 501), df = 10)**



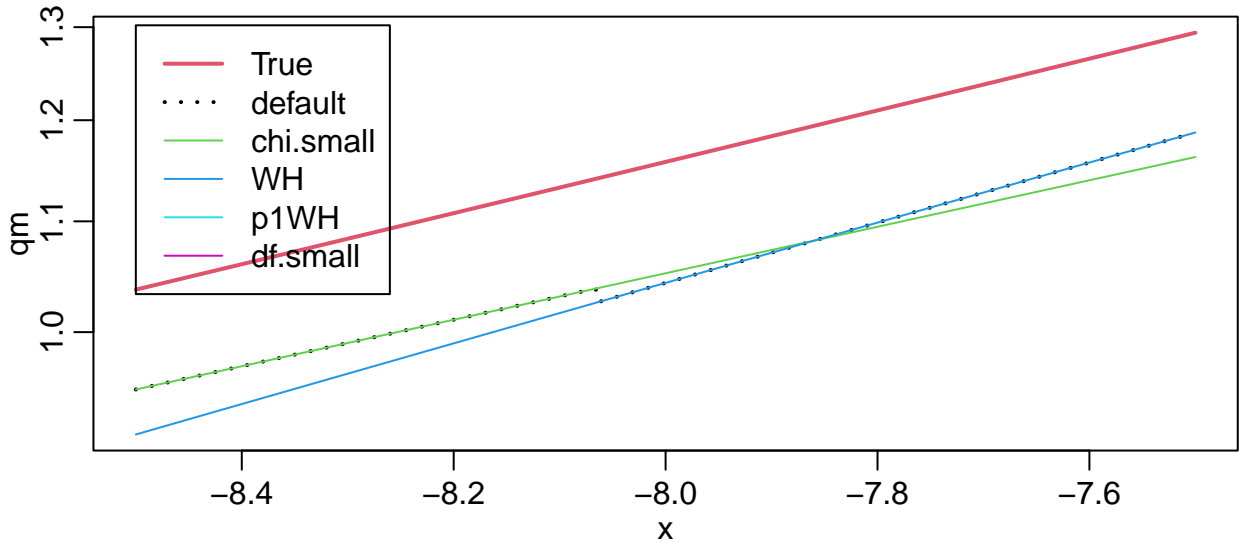
**p.qchi.appr(x = seq(-10, -4, length = 501), df = 10)**



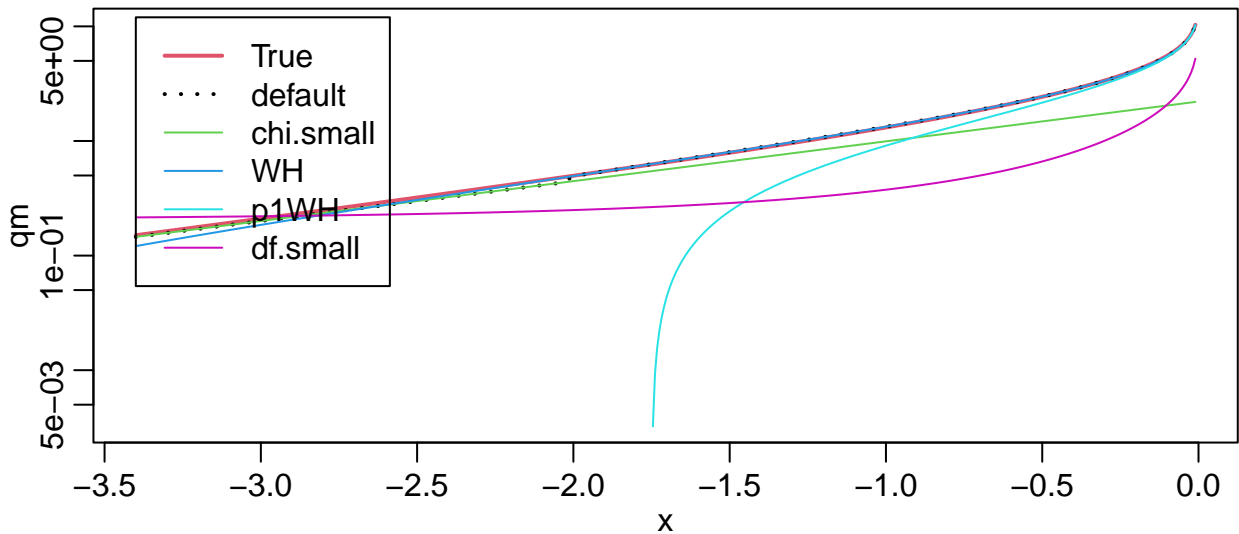
**p.qchi.appr(x = seq(-8.5, -7.5, length = 501), df = 10)**



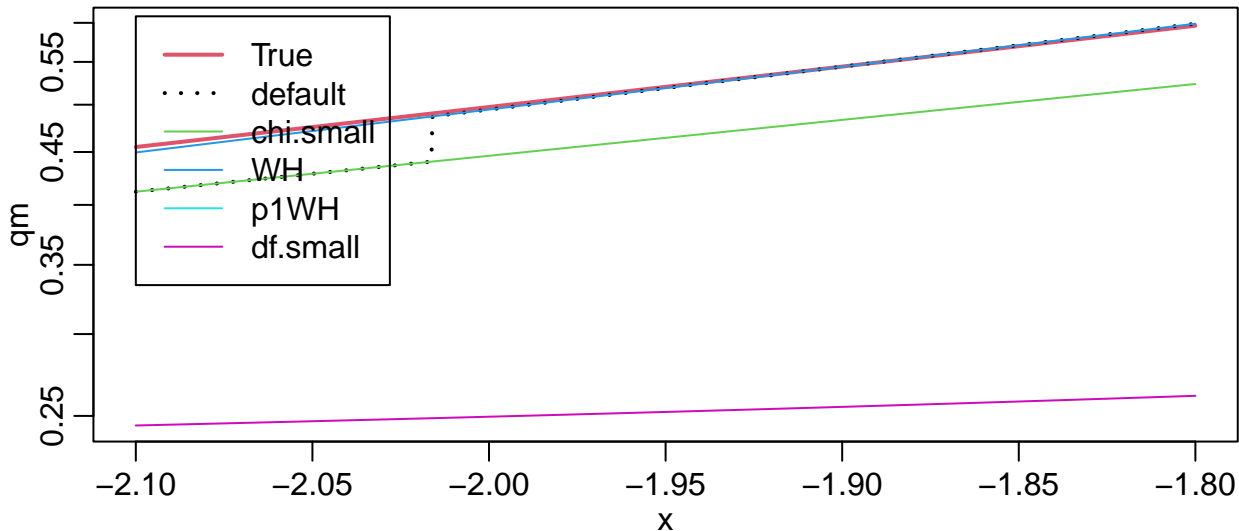
**p.qchi.appr(x = seq(-8.5, -7.5, length = 501), df = 10)**



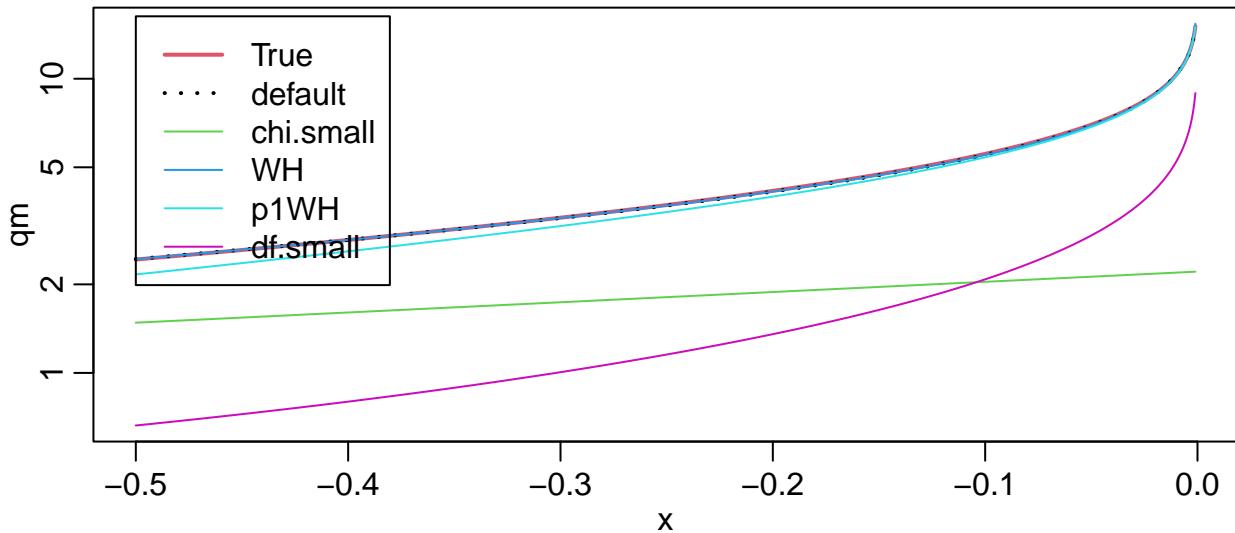
**p.qchi.appr(x = seq(-3.4, -0.01, length = 501), df = 2.5)**



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

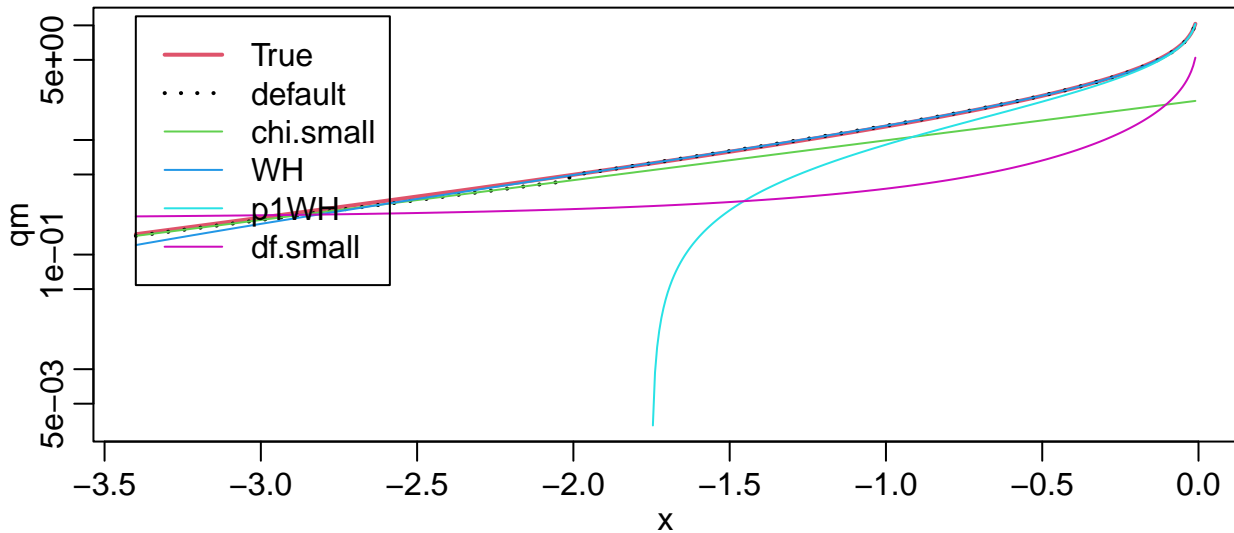


**p.qchi.appr(x = seq(-0.5, -0.001, length = 901), df = 2.5)**

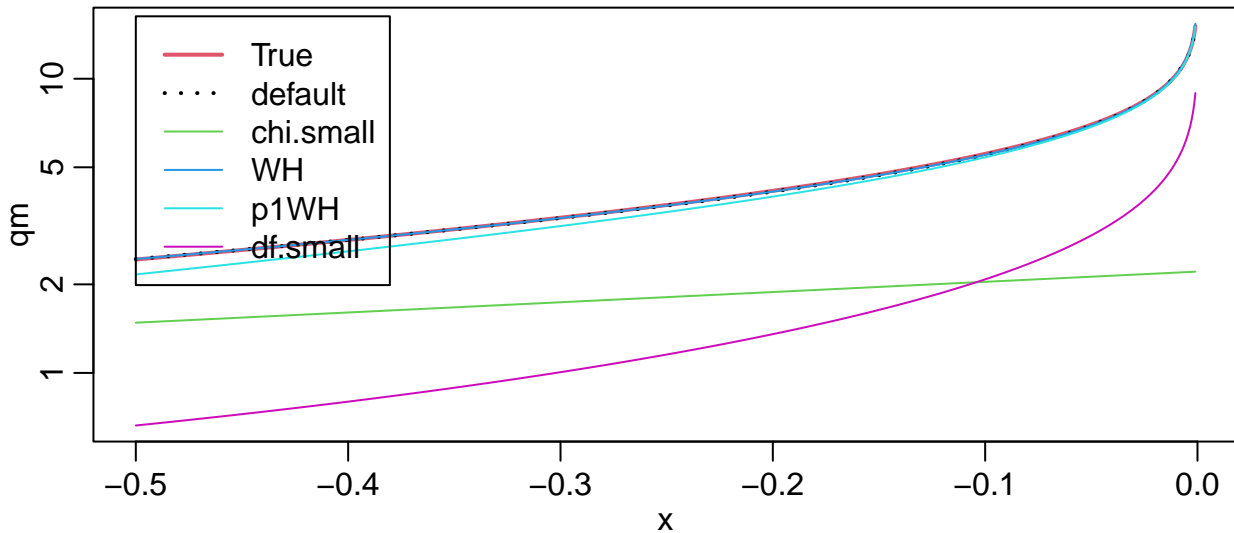




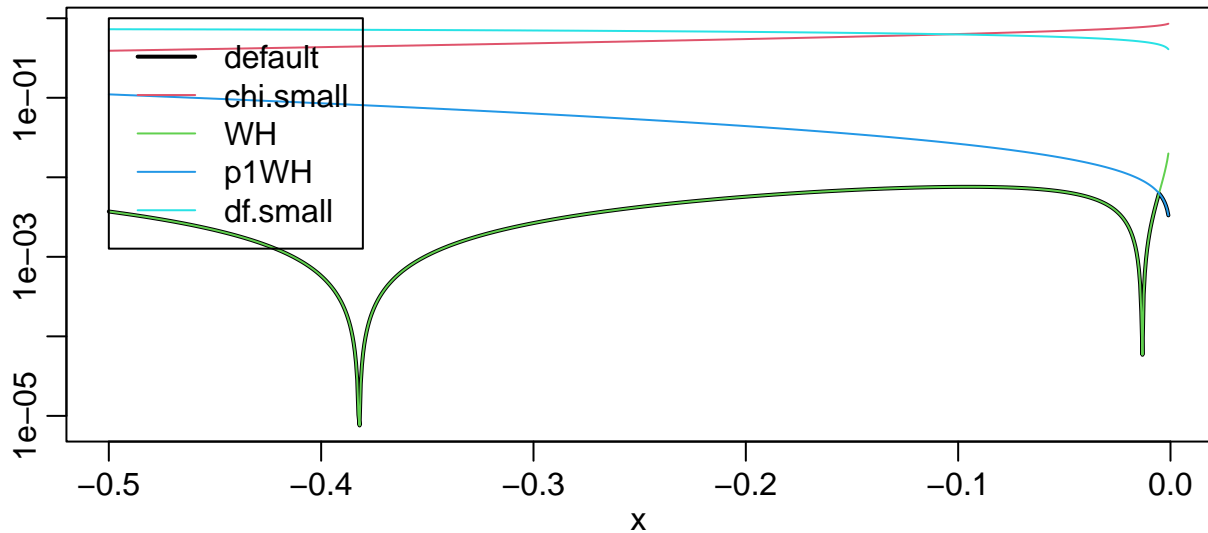
**p.qchi.appr(x = seq(-3.4, -0.01, length = 501), df = 2.5)**



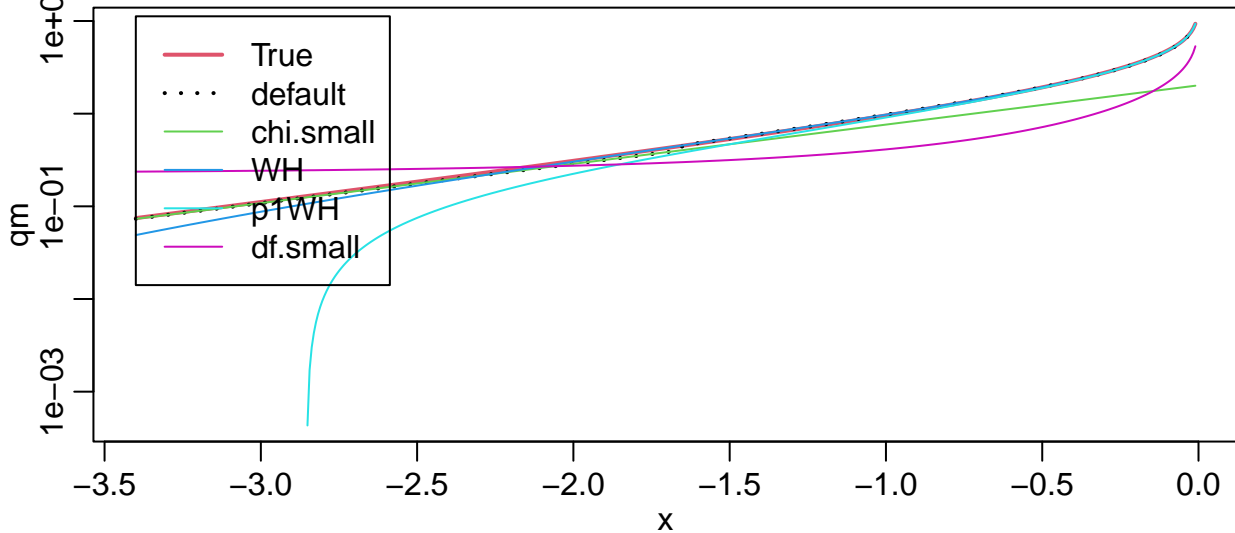
**p.qchi.appr(x = seq(-0.5, -0.001, length = 901), df = 2.5)**



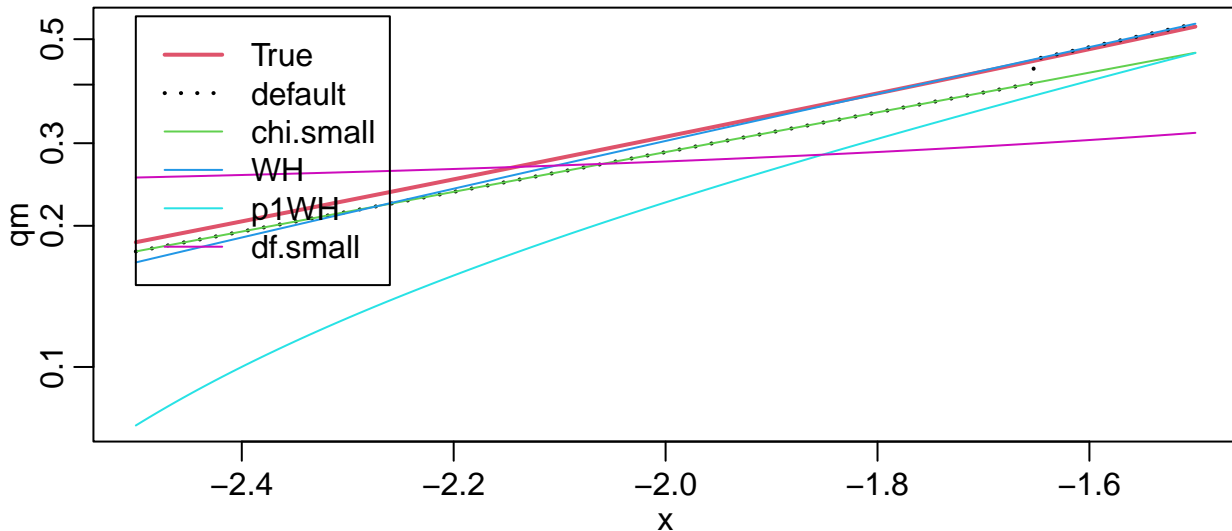
relative Error from  $p.qchi.appr(x = seq(-0.5, -0.001, length = 901), df = 2)$



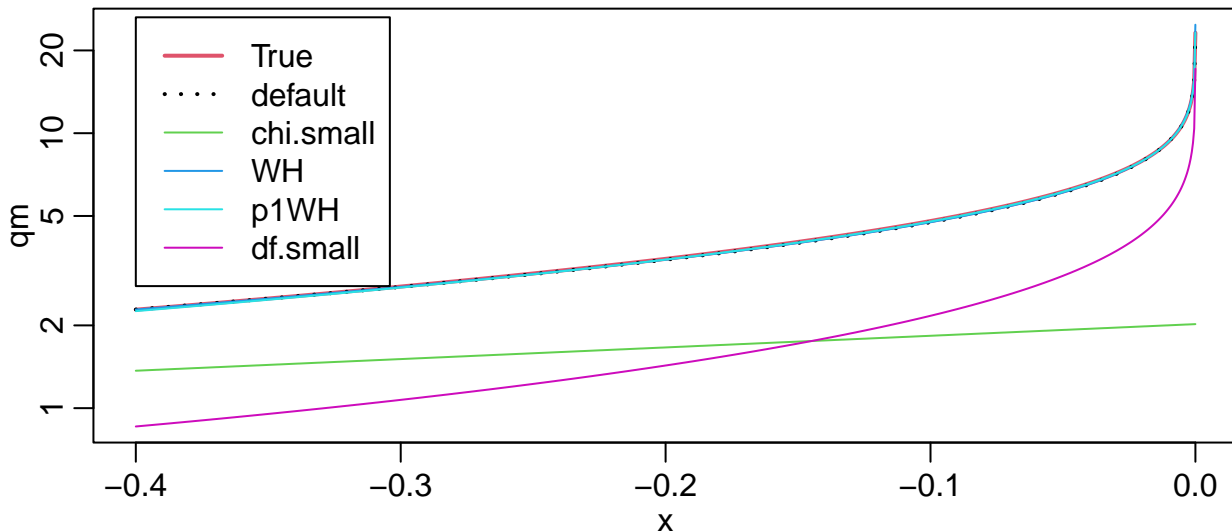
$p.qchi.appr(x = seq(-3.4, -0.01, length = 501), df = 2.05)$



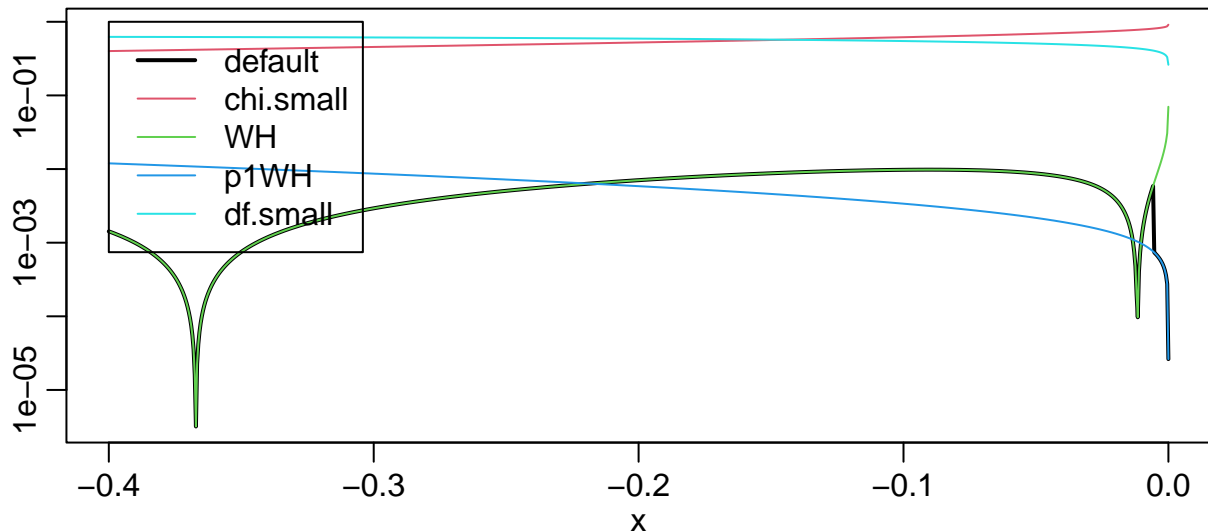
**p.qchi.appr(x = seq(-2.5, -1.5, length = 901), df = 2.05)**



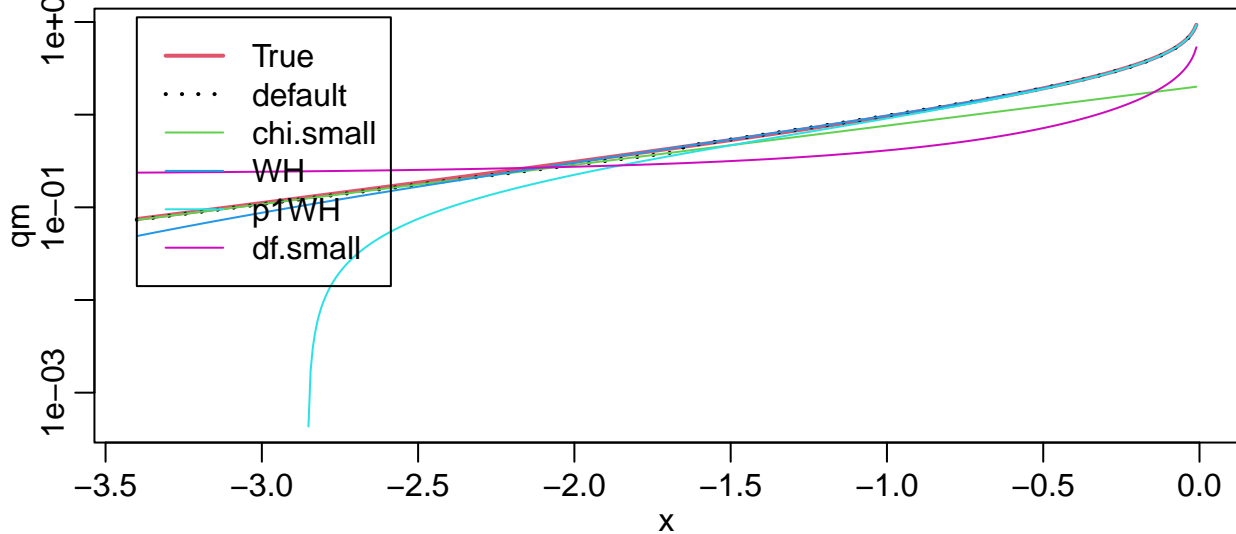
**p.qchi.appr(x = seq(-0.4, -1e-05, length = 901), df = 2.05)**



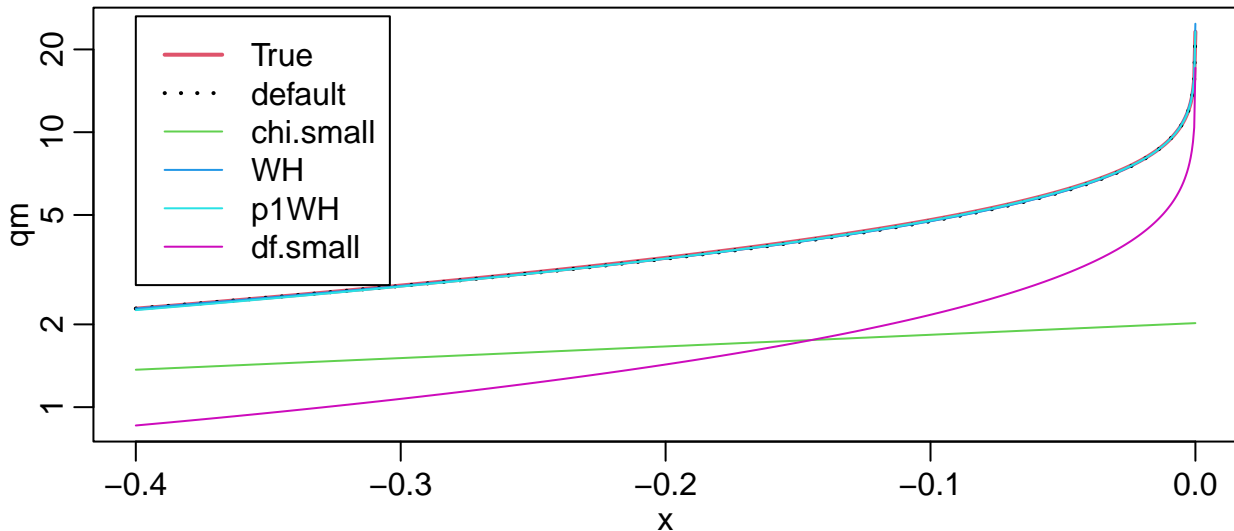
relative Error from `p.qchi.appr(x = seq(-0.4, -1e-05, length = 901), df = 2.05)`



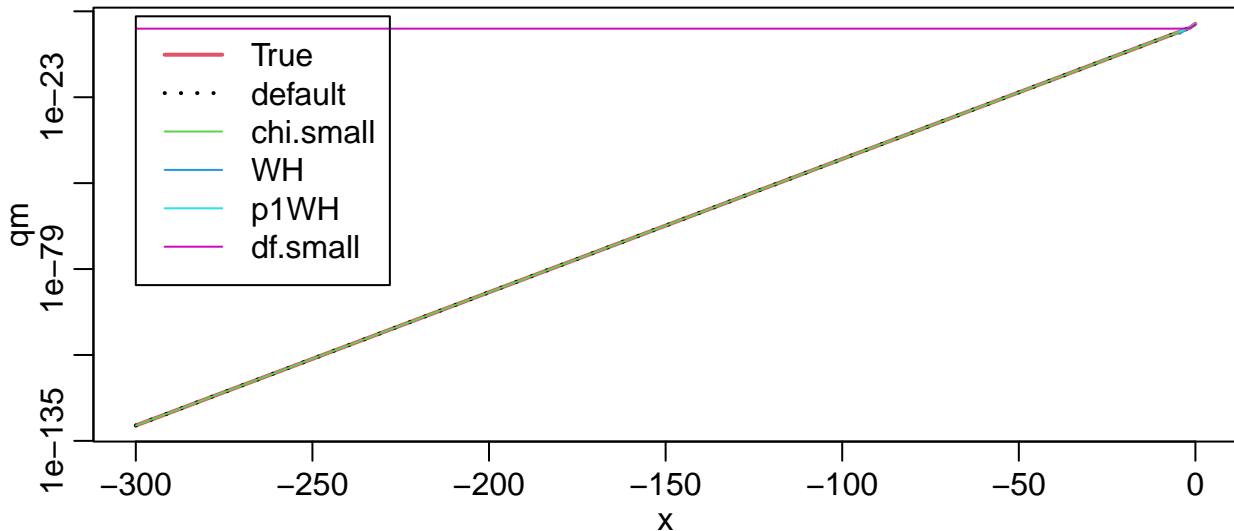
`p.qchi.appr(x = seq(-3.4, -0.01, length = 501), df = 2.05)`



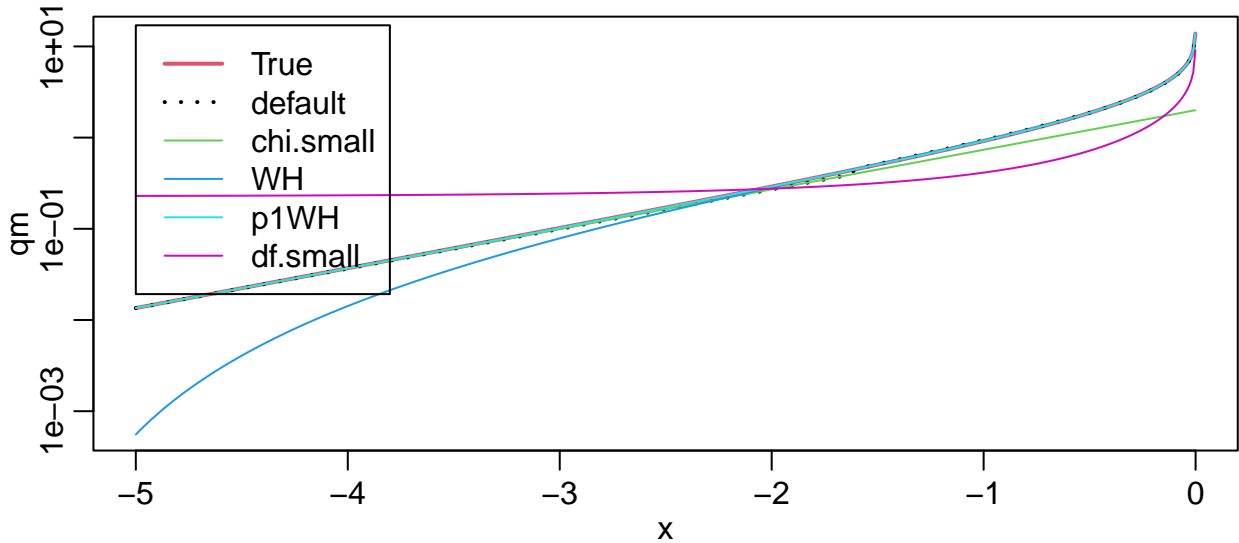
**p.qchi.appr(x = seq(-0.4, -1e-05, length = 901), df = 2.05)**



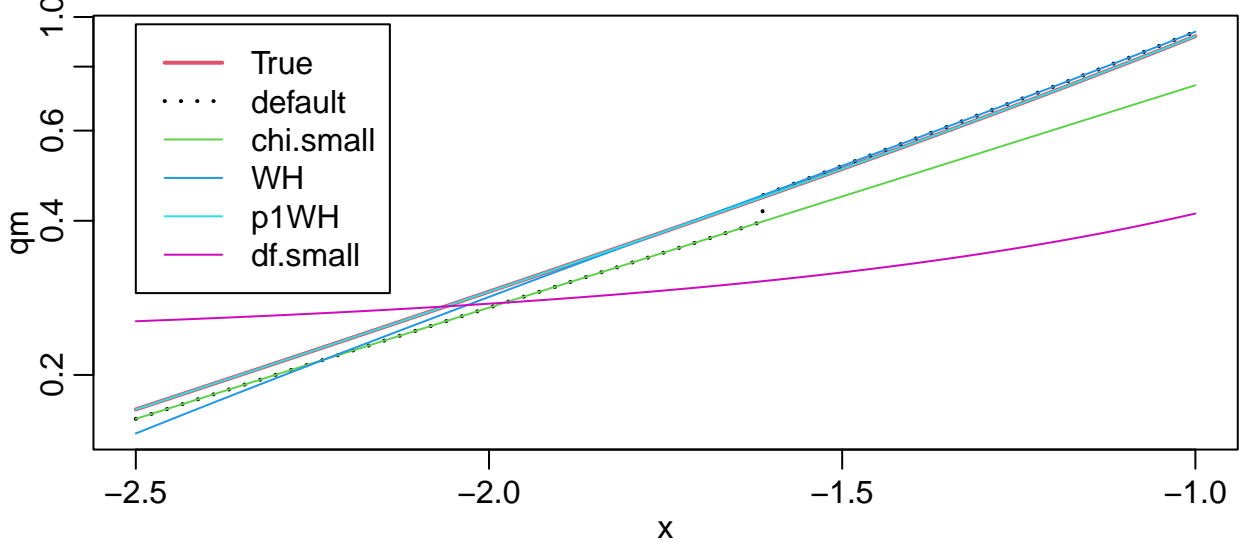
**p.qchi.appr(x = seq(-300, -0.01, length = 201), df = 2)**



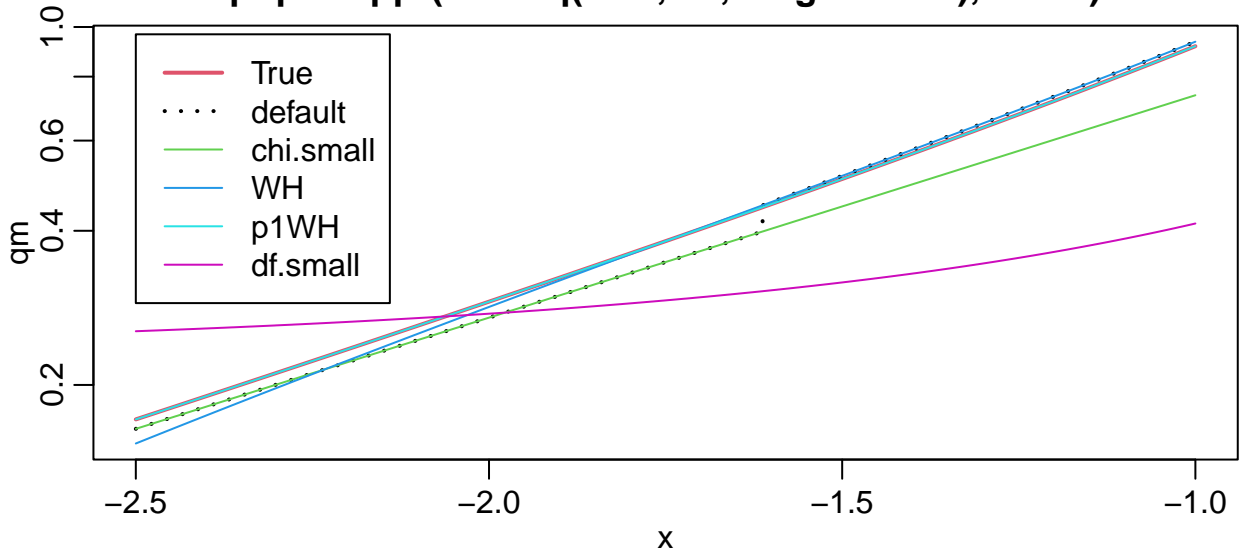
**p.qchi.appr(x = seq(-5, -0.001, length = 501), df = 2)**



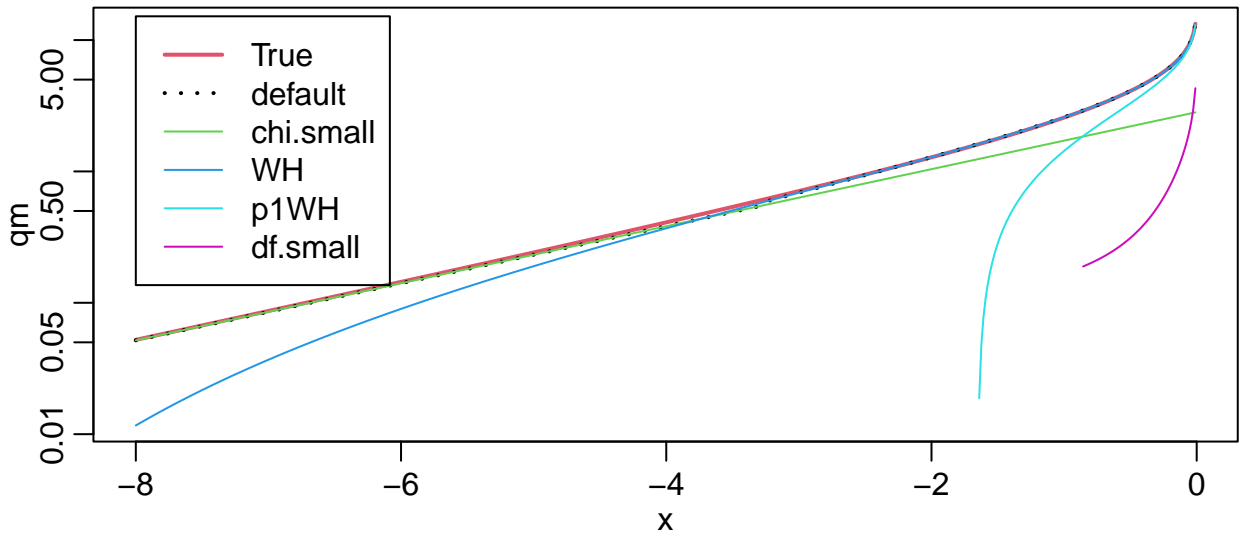
**p.qchi.appr(x = seq(-2.5, -1, length = 901), df = 2)**



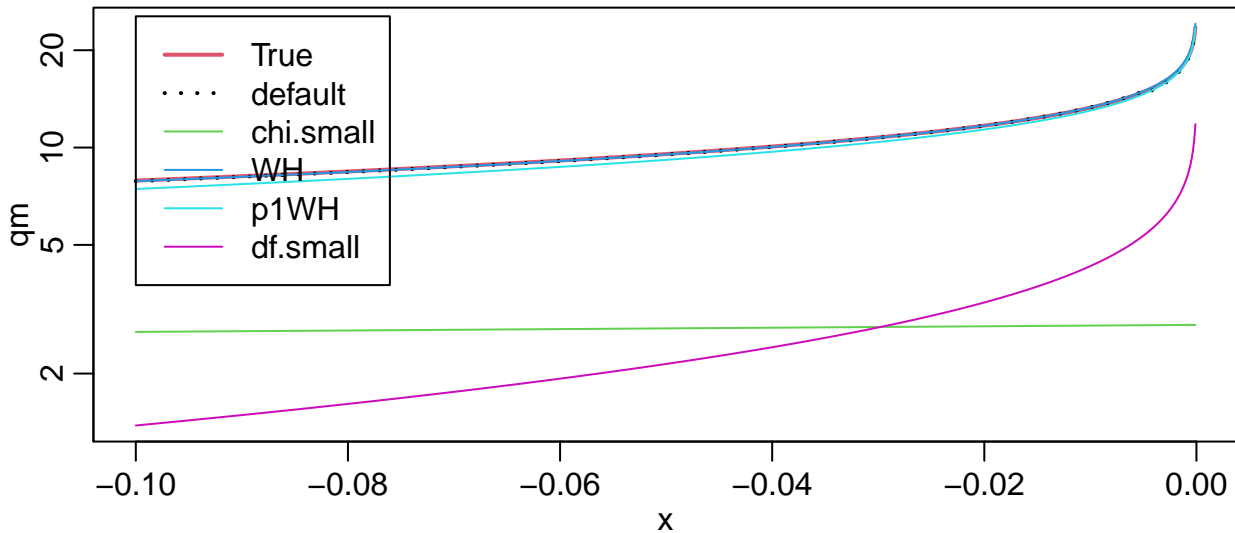
**p.qchi.appr(x = seq(-2.5, -1, length = 901), df = 2)**



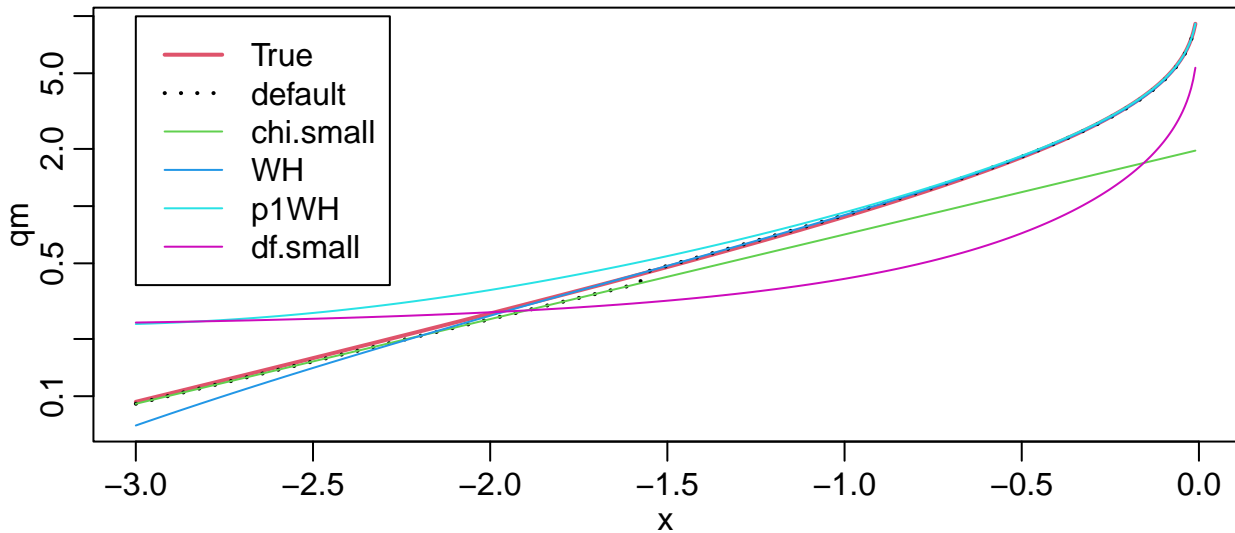
**p.qchi.appr(x = seq(-8, -0.01, length = 501), df = 4)**



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

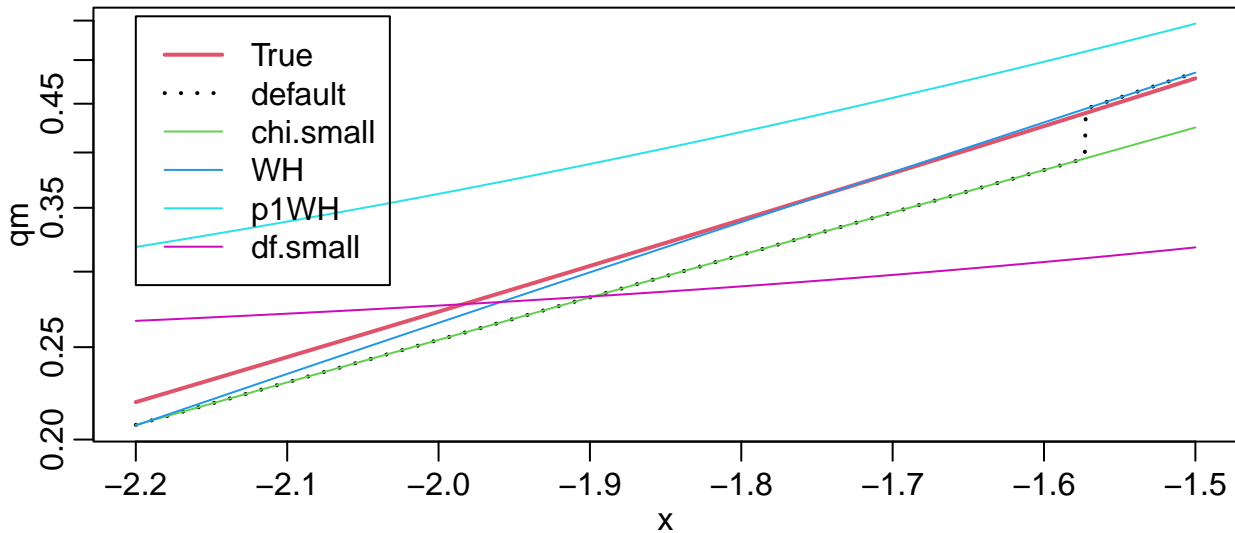


**p.qchi.appr(x = seq(-3, -0.01, length = 501), df = 1.95)**

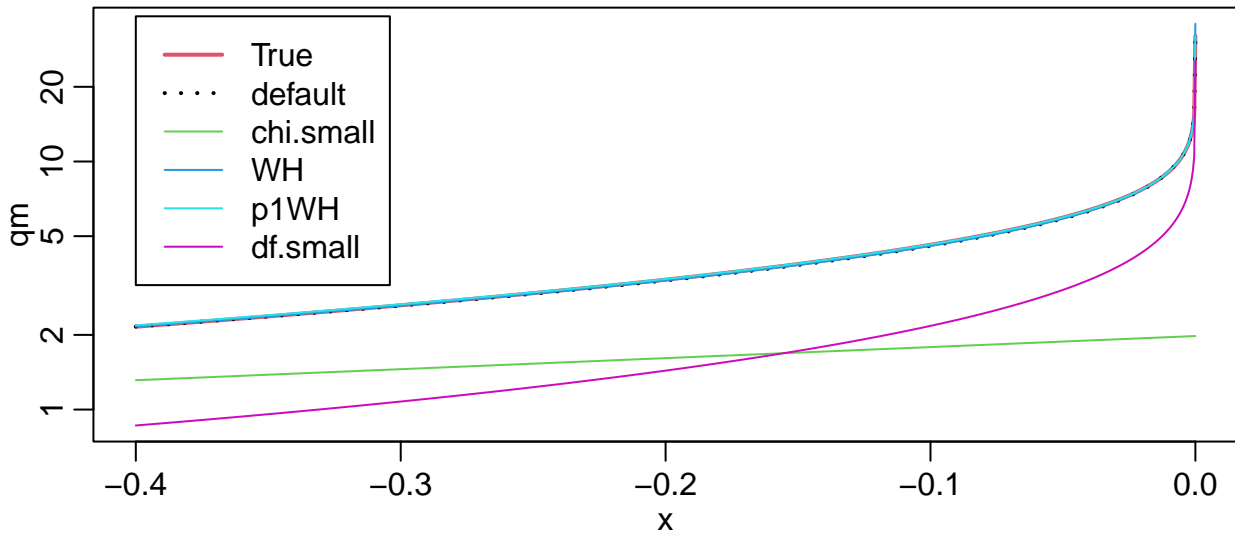




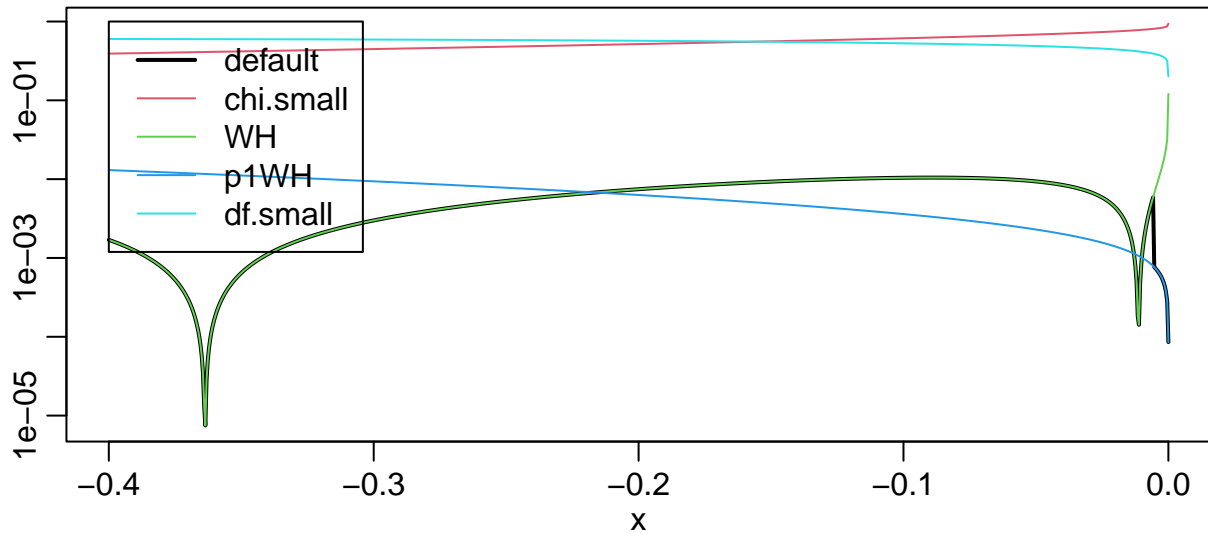
**p.qchi.appr(x = seq(-2.2, -1.5, length = 901), df = 1.95)**



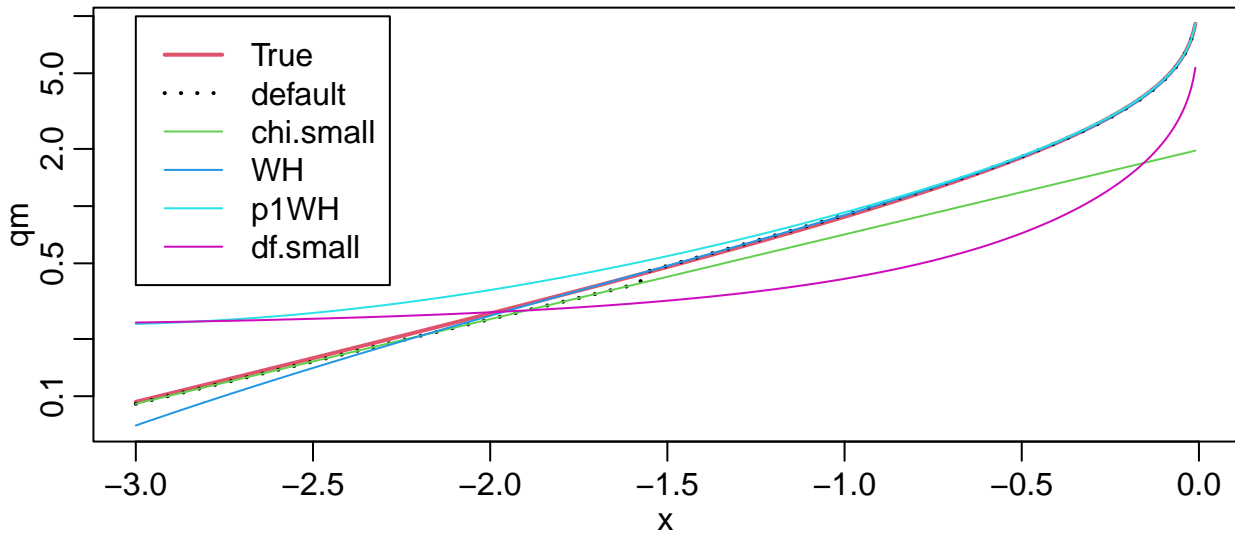
**p.qchi.appr(x = seq(-0.4, -1e-07, length = 901), df = 1.95)**



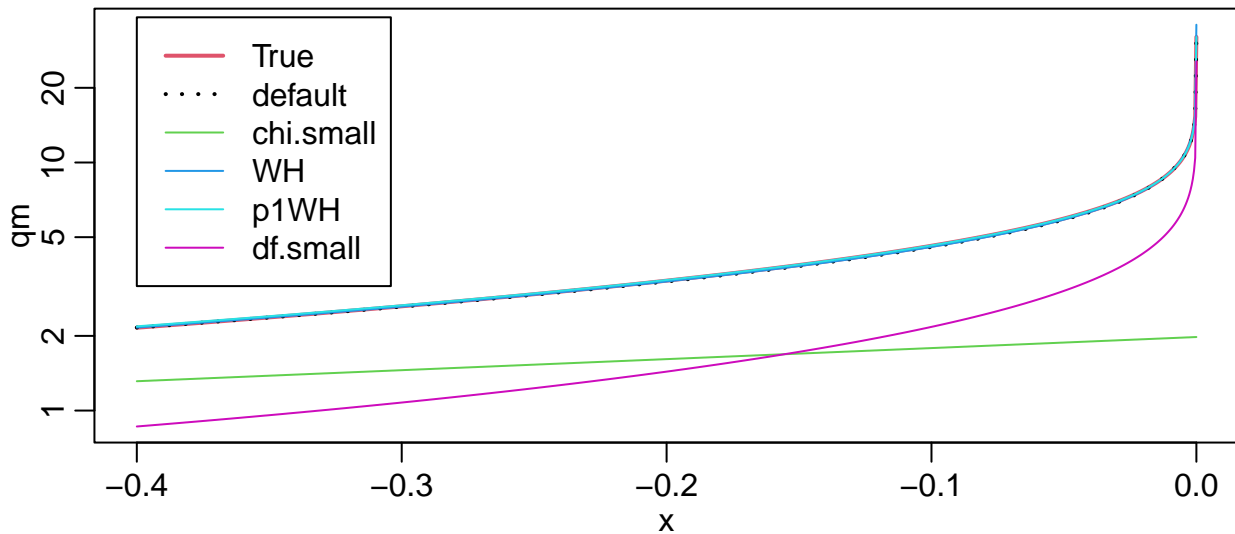
**relative Error from  $p.qchi.appr(x = seq(-0.4, -1e-07, length = 901), df = 1)$**



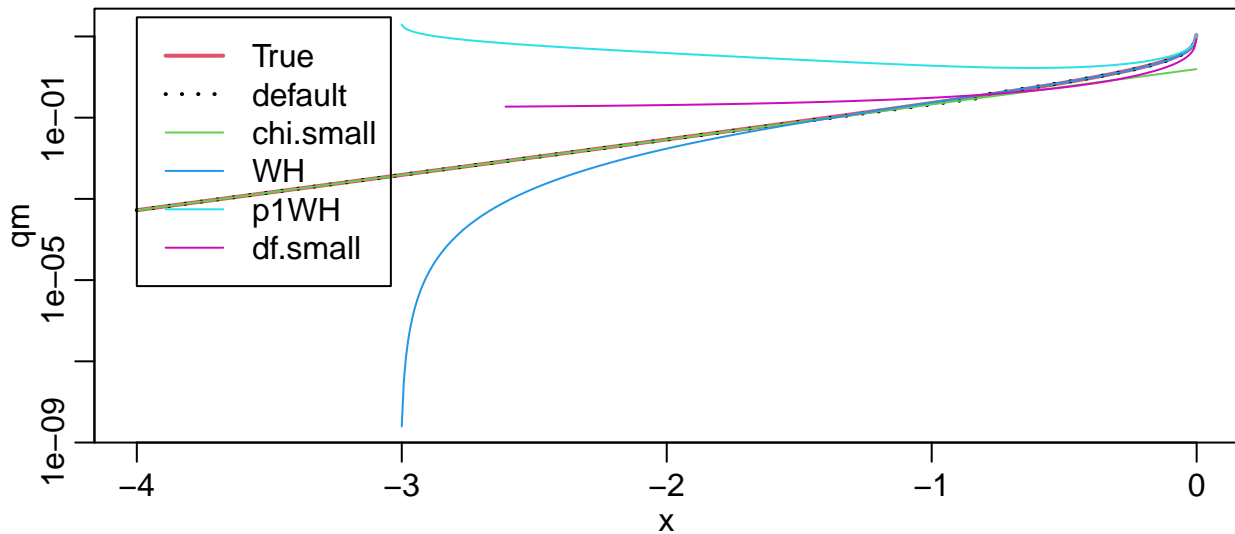
**$p.qchi.appr(x = seq(-3, -0.01, length = 501), df = 1.95)$**



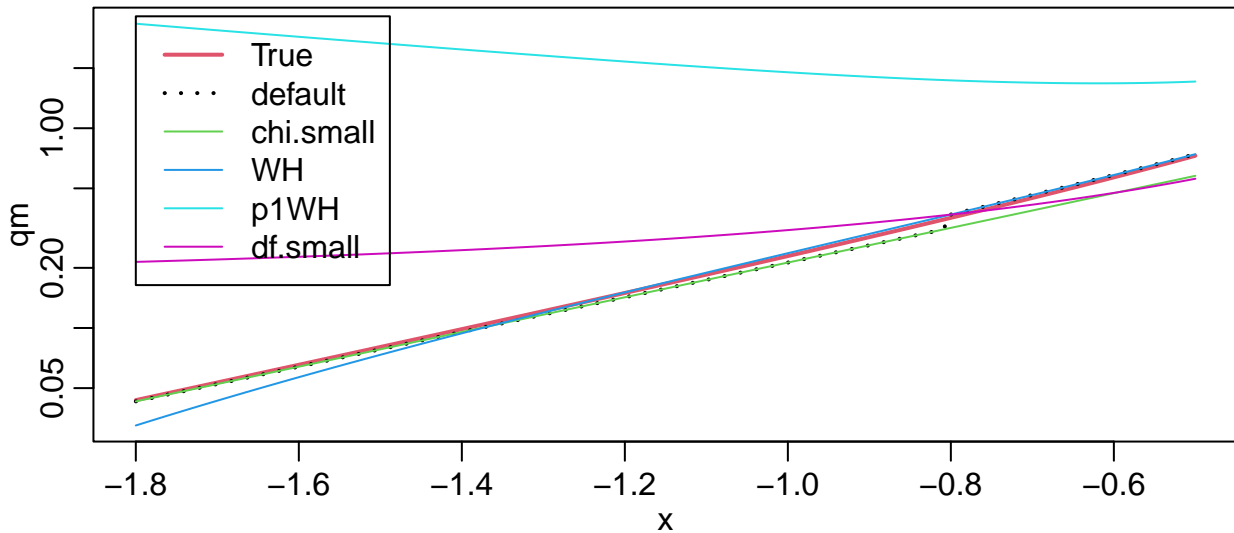
**p.qchi.appr(x = seq(-0.4, -1e-07, length = 901), df = 1.95)**



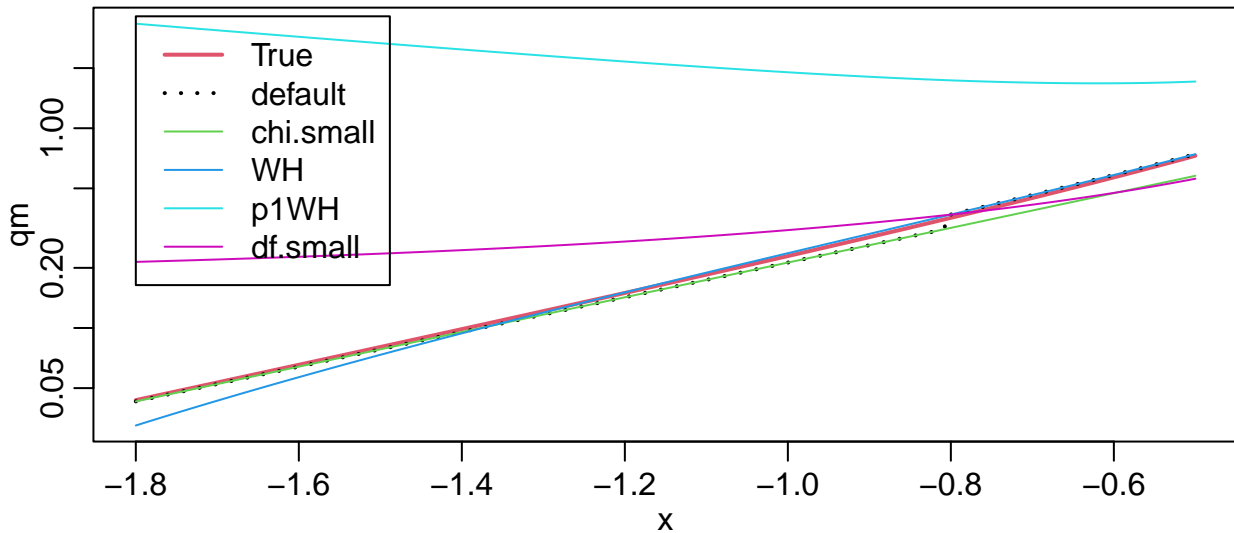
**p.qchi.appr(x = seq(-4, -0.001, length = 501), df = 1)**



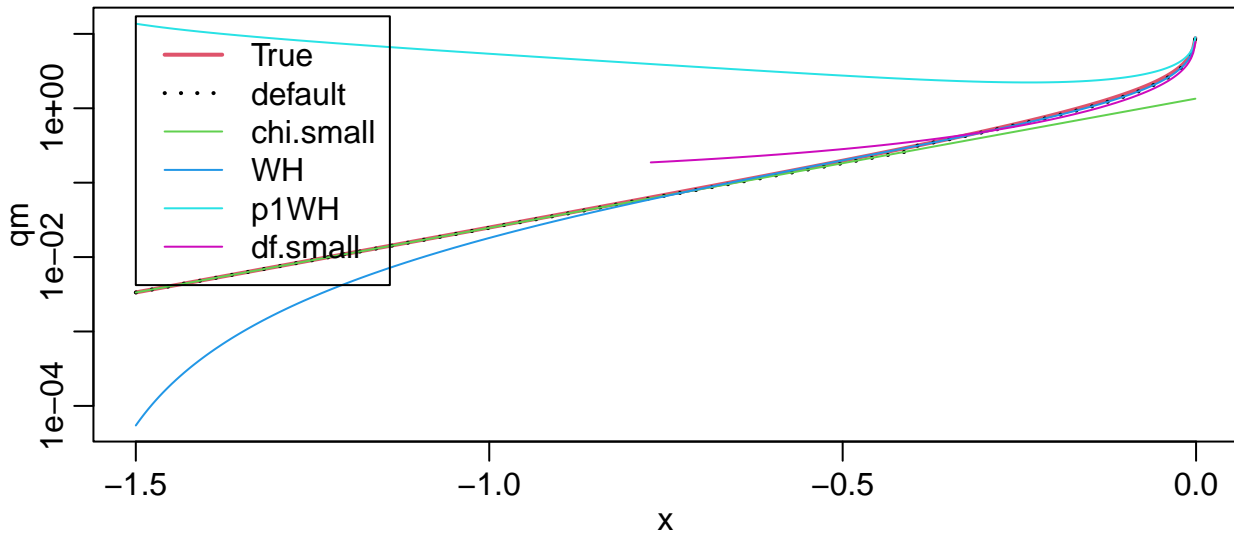
**p.qchi.appr(x = seq(-1.8, -0.5, length = 901), df = 1)**



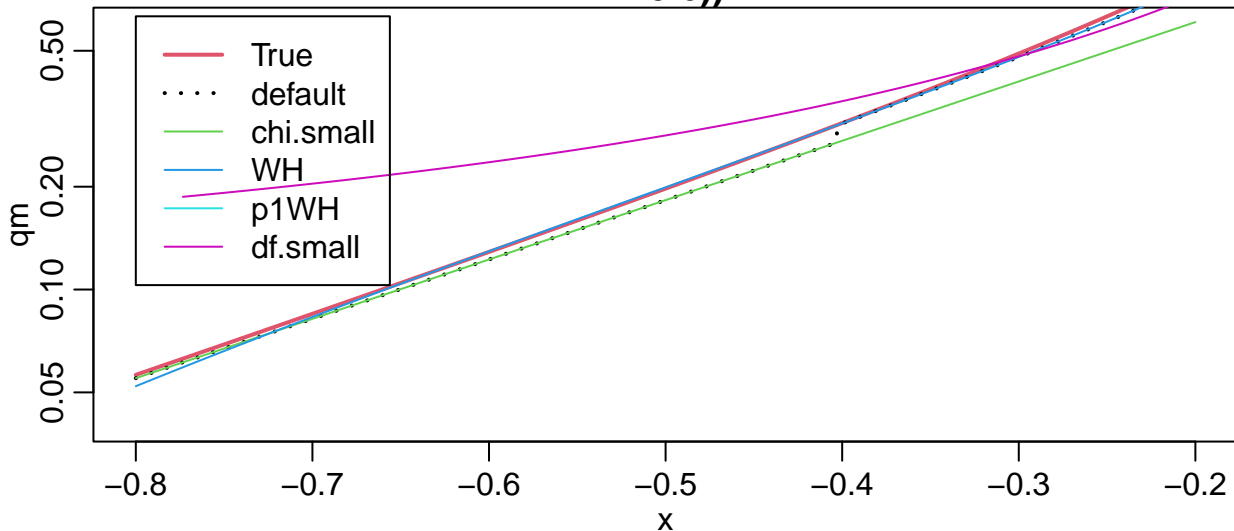
**p.qchi.appr(x = seq(-1.8, -0.5, length = 901), df = 1)**



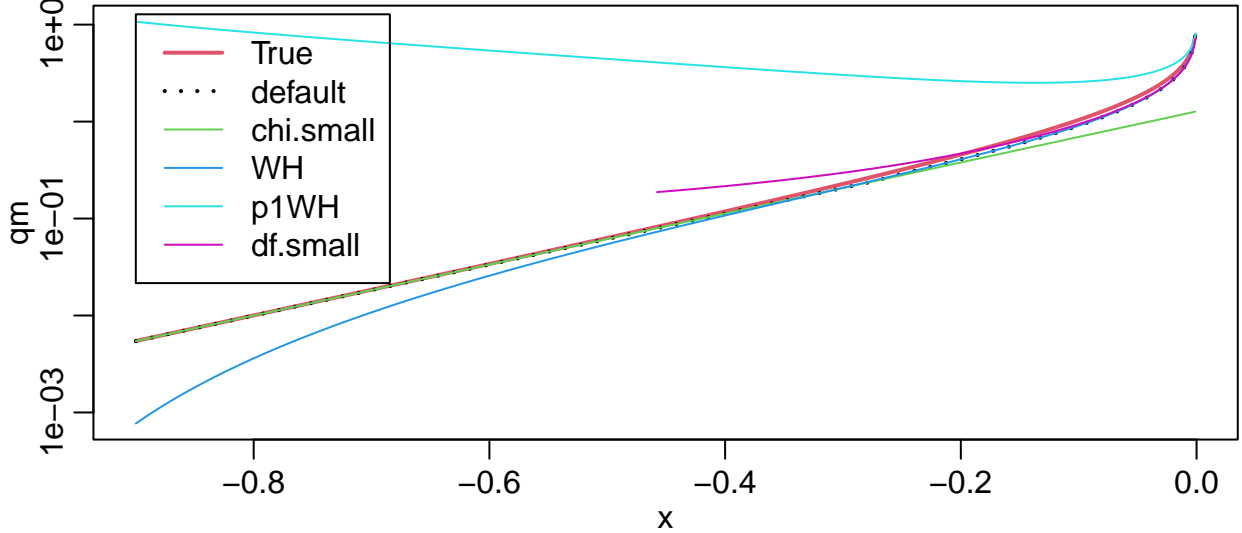
**p.qchi.appr(x = seq(-1.5, -0.001, length = 501), df = 0.5)**



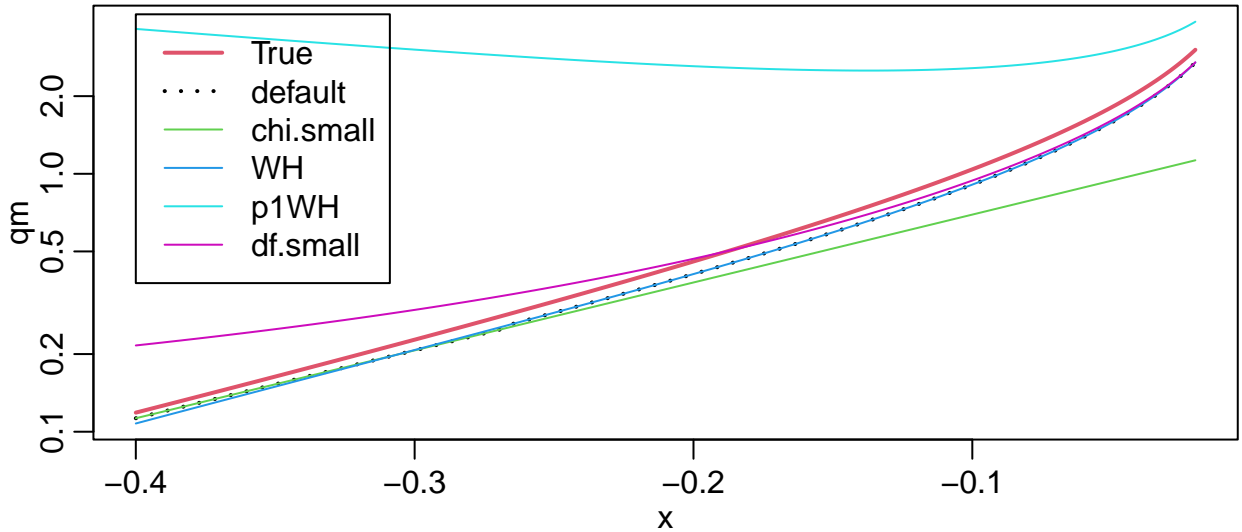
**p.qchi.appr(x = seq(-0.8, -0.2, length = 901), df = 0.5, ylim = c(0.04, 0.6))**



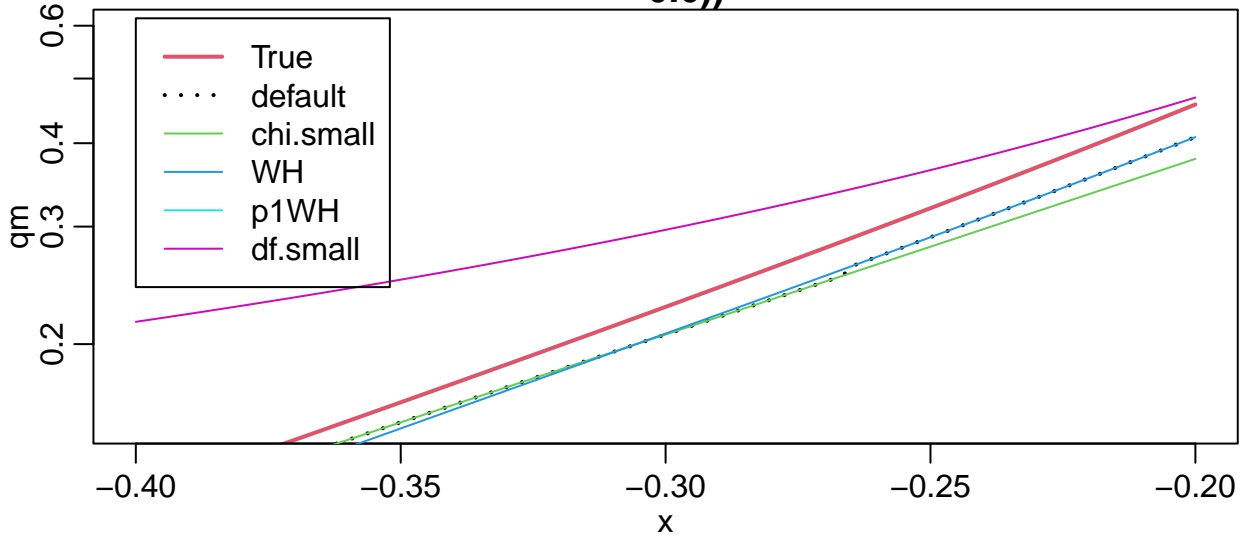
**p.qchi.appr(x = seq(-0.9, -0.001, length = 501), df = 0.33)**



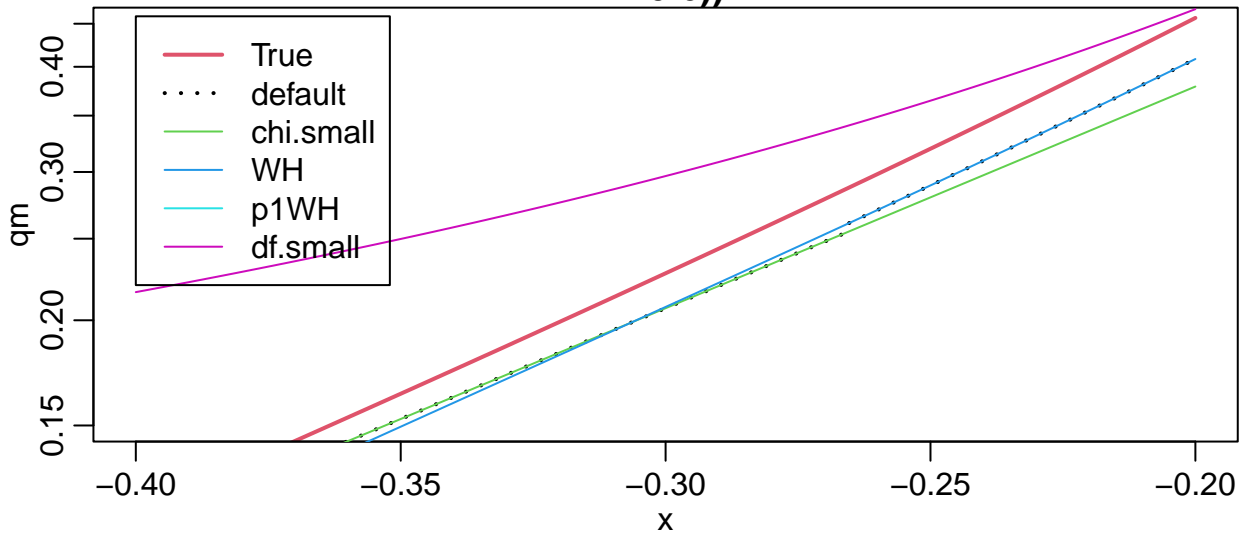
**p.qchi.appr(x = seq(-0.4, -0.02, length = 901), df = 0.33)**



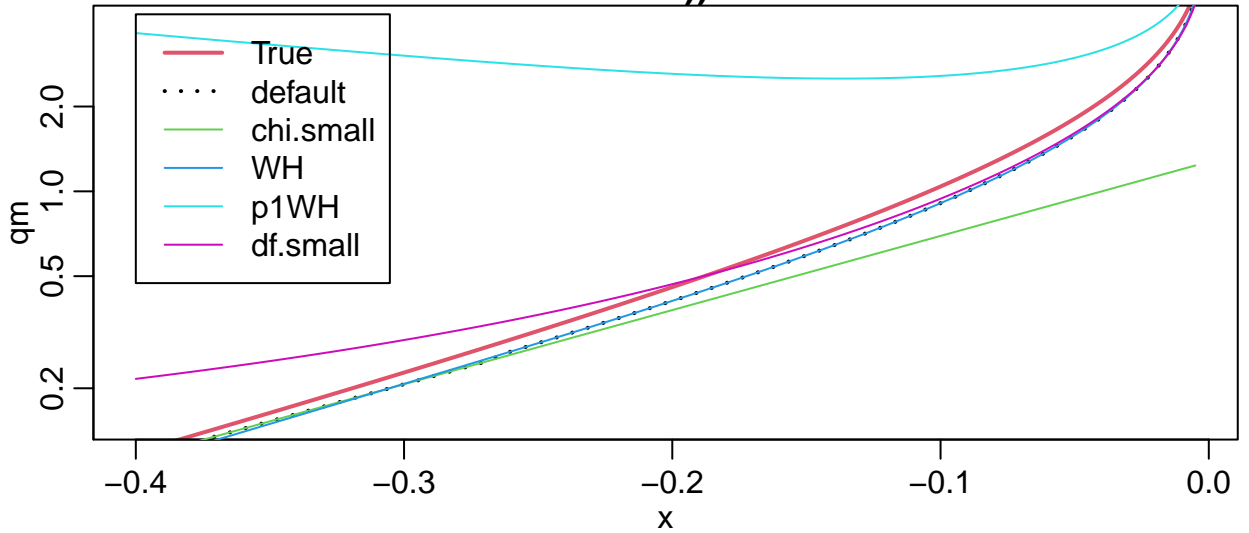
**p.qchi.appr(x = seq(-0.4, -0.2, length = 901), df = 0.33, ylim = c(0.15, 0.6))**



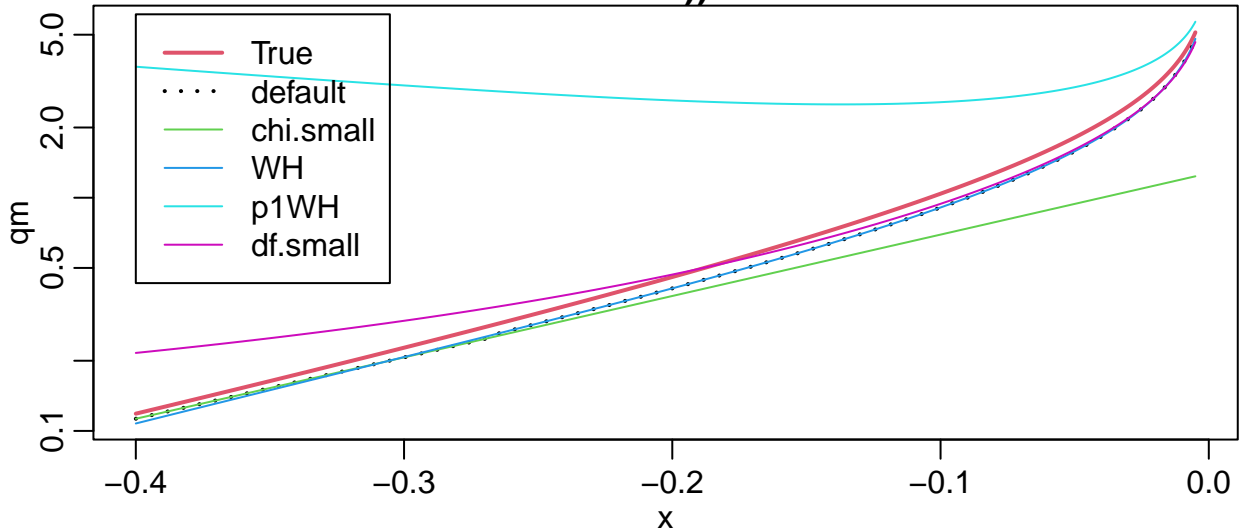
**p.qchi.appr(x = seq(-0.4, -0.2, length = 901), df = 0.33, ylim = c(0.15, 0.6))**



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

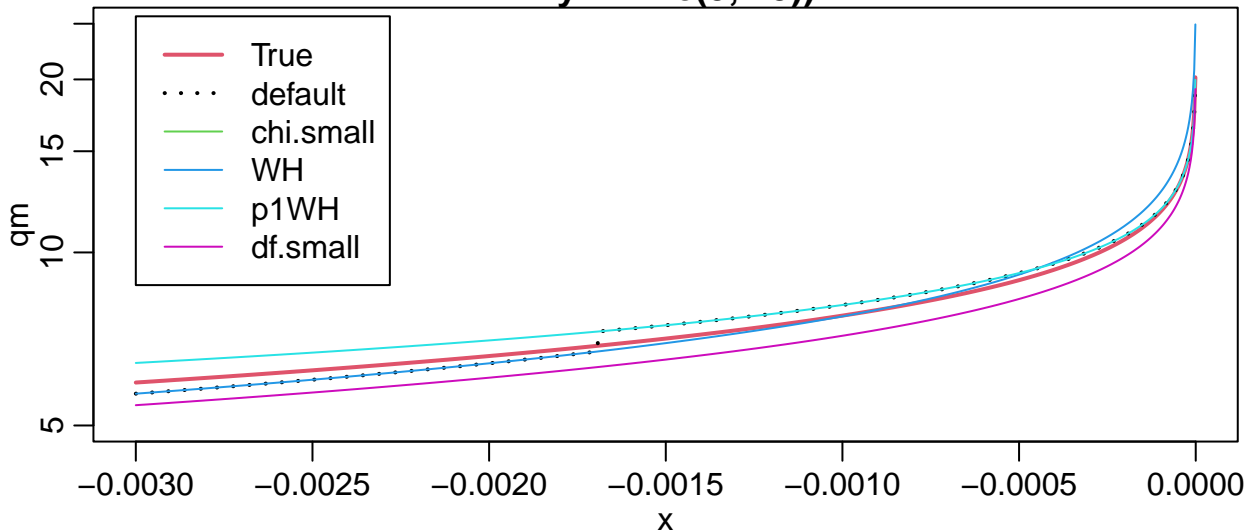


**p.qchi.appr(x = seq(-0.4, -0.005, length = 901), df = 0.33, ylim = c(0.15, 4))**

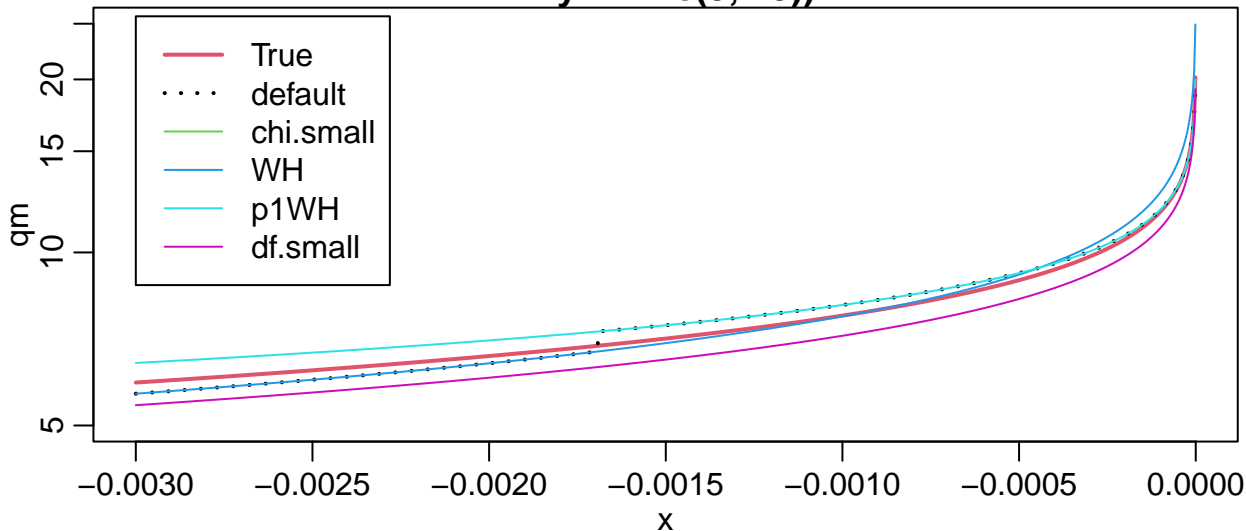




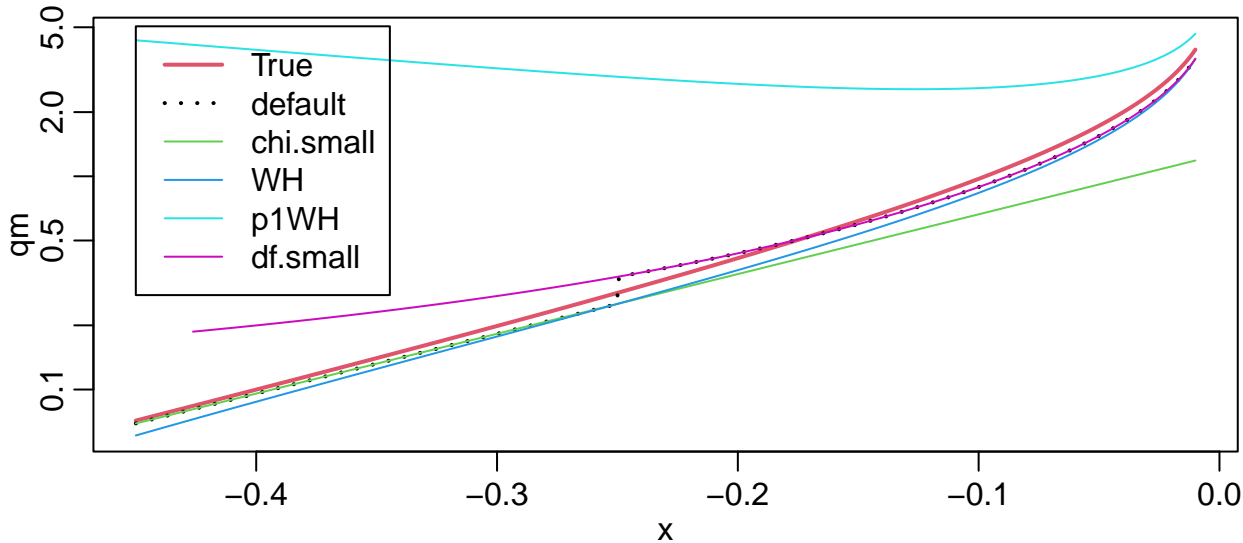
**p.qchi.appr(x = seq(-0.003, -1e-06, length = 901), df = 0.33,  
ylim = c(5, 25))**



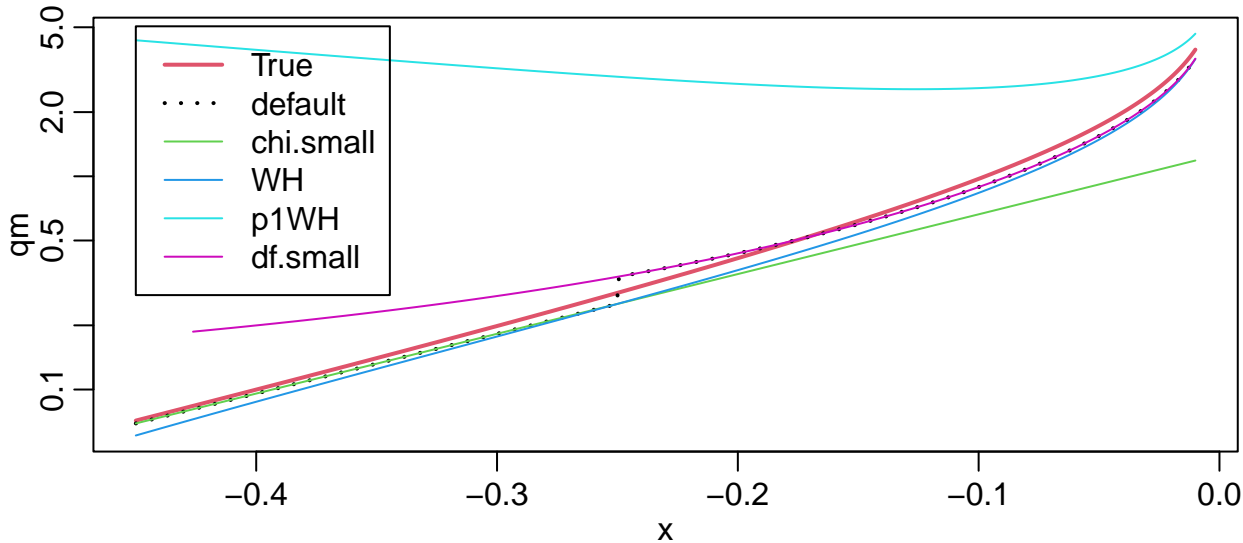
**p.qchi.appr(x = seq(-0.003, -1e-06, length = 901), df = 0.33,  
ylim = c(5, 25))**



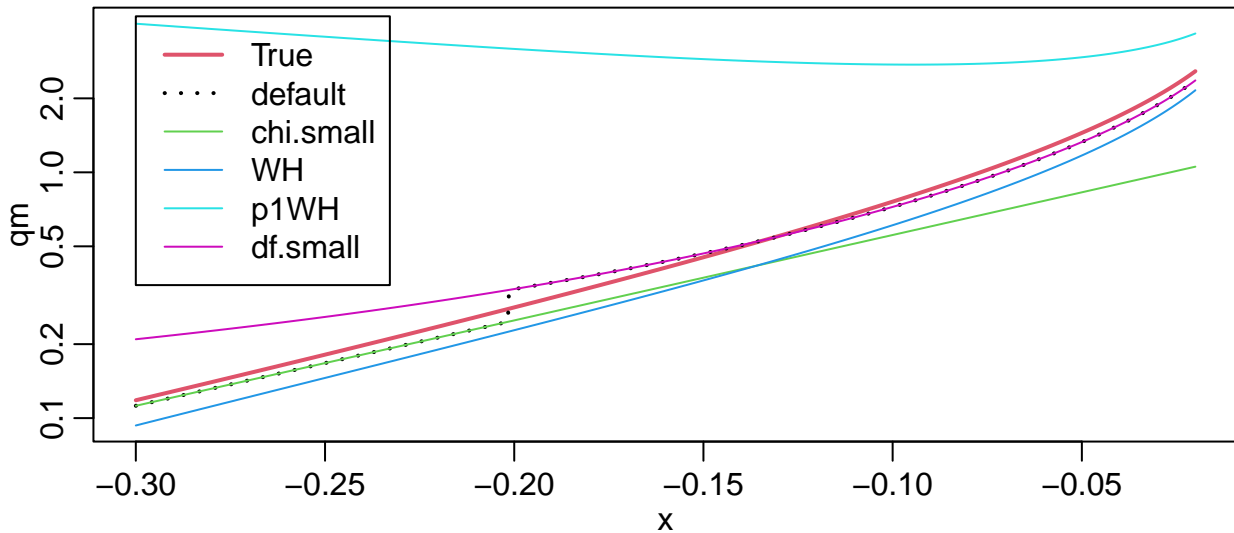
**p.qchi.appr(x = seq(-0.45, -0.01, length = 501), df = 0.31)**



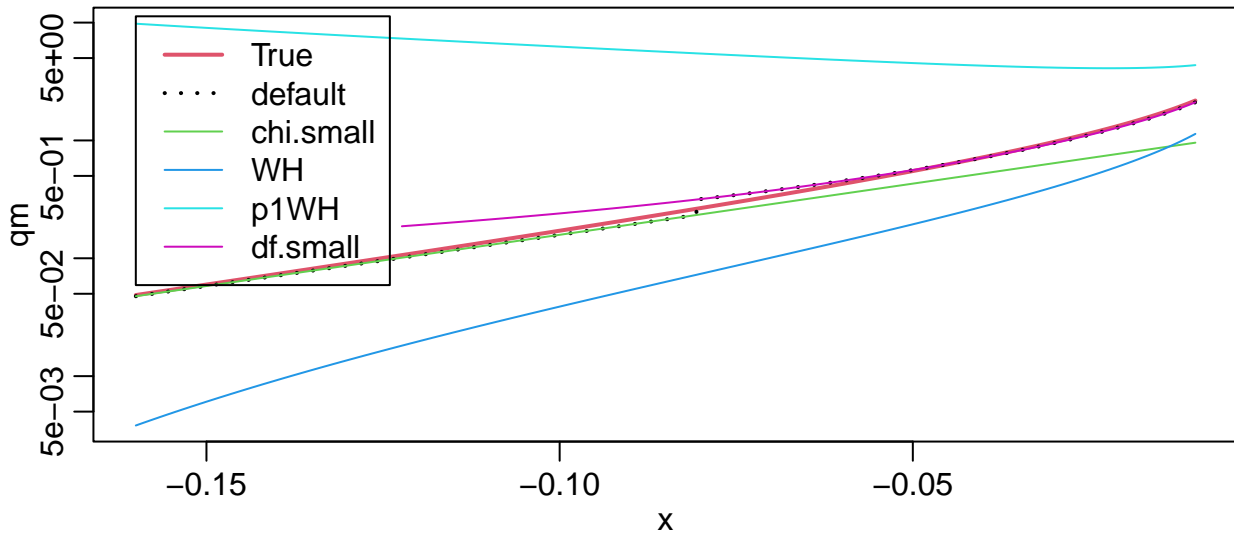
**p.qchi.appr(x = seq(-0.45, -0.01, length = 501), df = 0.31)**



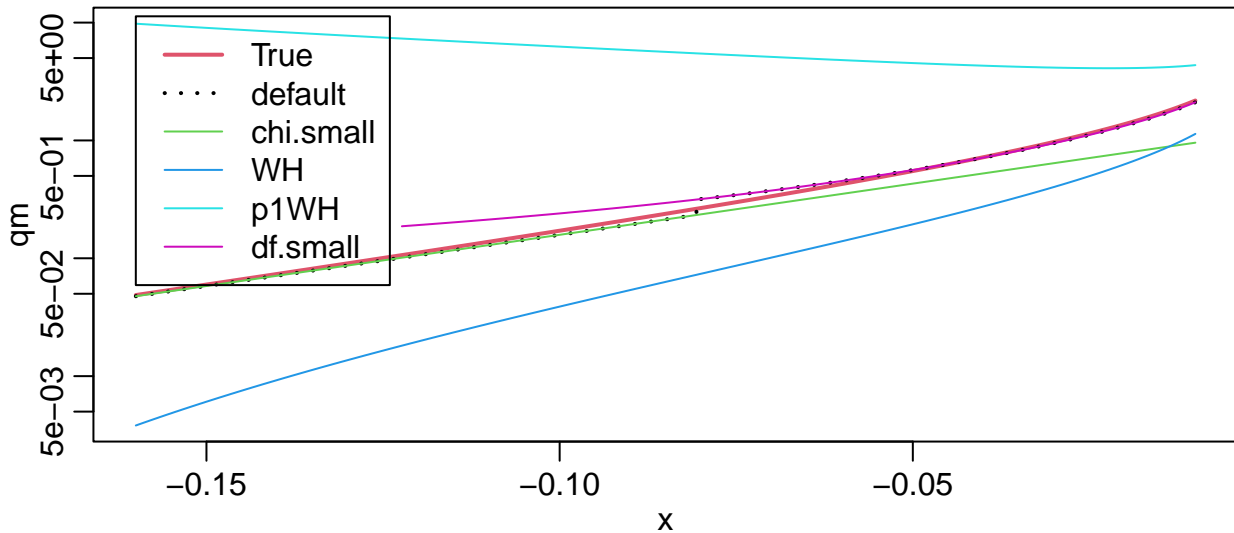
**p.qchi.appr(x = seq(-0.3, -0.02, length = 901), df = 0.25)**



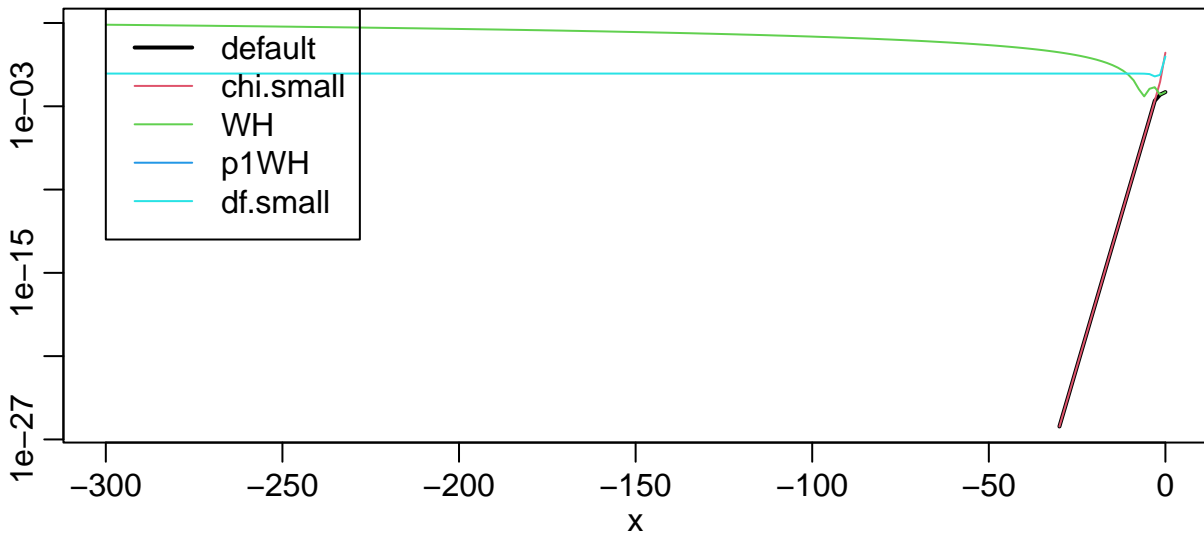
**p.qchi.appr(x = seq(-0.16, -0.01, length = 901), df = 0.1)**



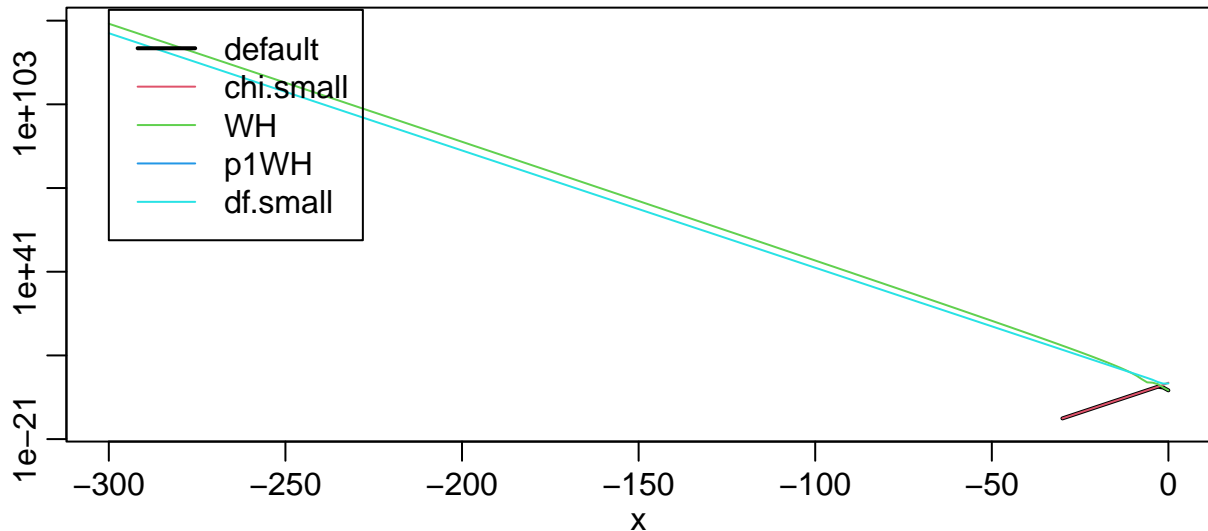
**p.qchi.appr(x = seq(-0.16, -0.01, length = 901), df = 0.1)**



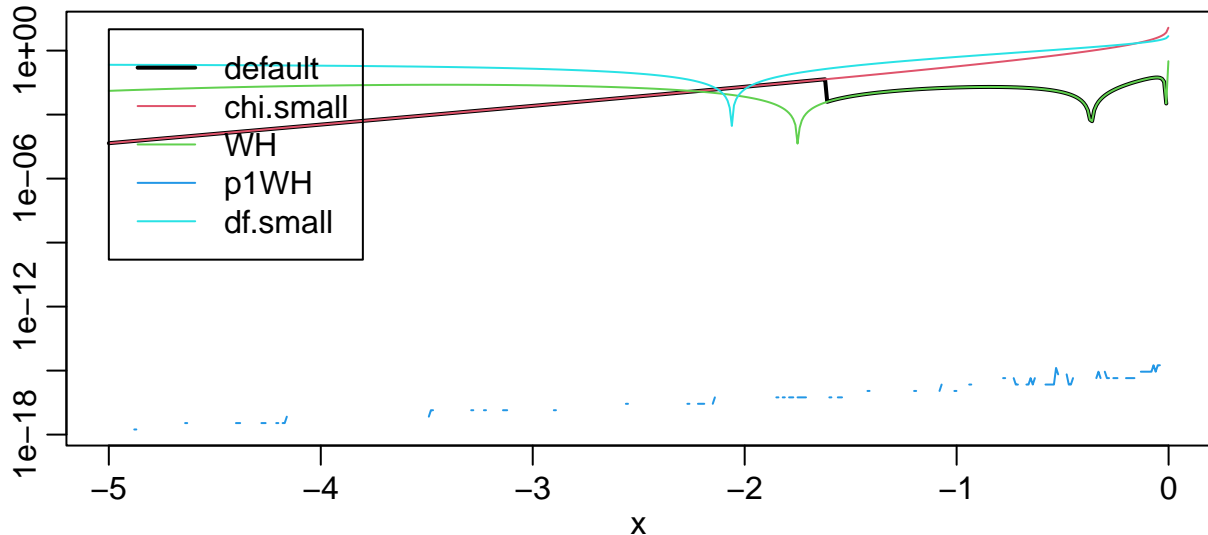
**absolute Error from p.qchi.appr(x = seq(-300, -0.01, length = 201), df = 0.1)**



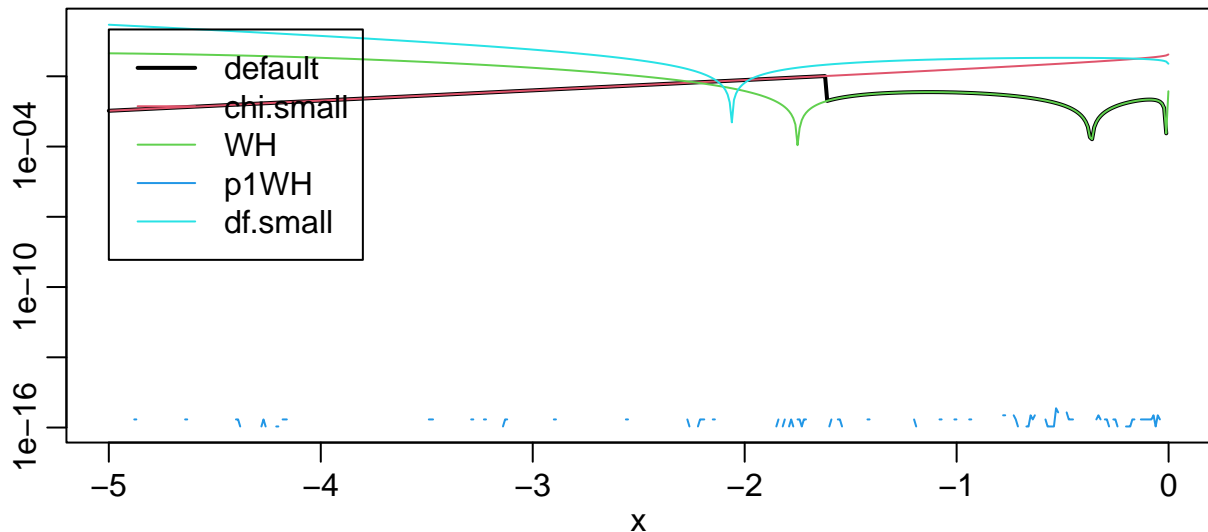
relative Error from  $p.qchi.appr(x = seq(-300, -0.01, length = 201), df = 2)$



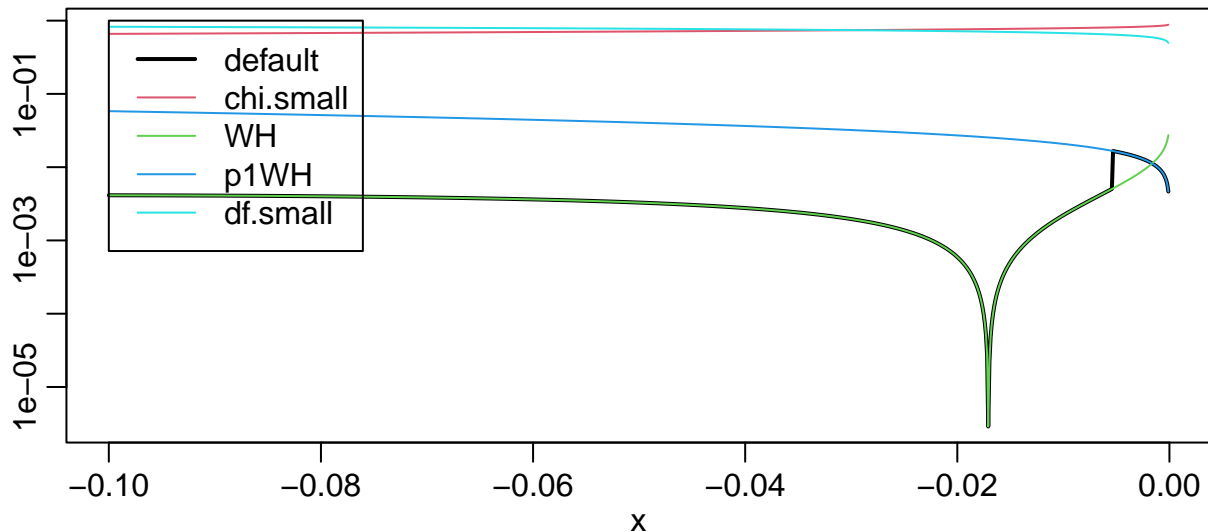
absolute Error from  $p.qchi.appr(x = seq(-5, -0.001, length = 501), df = 2)$



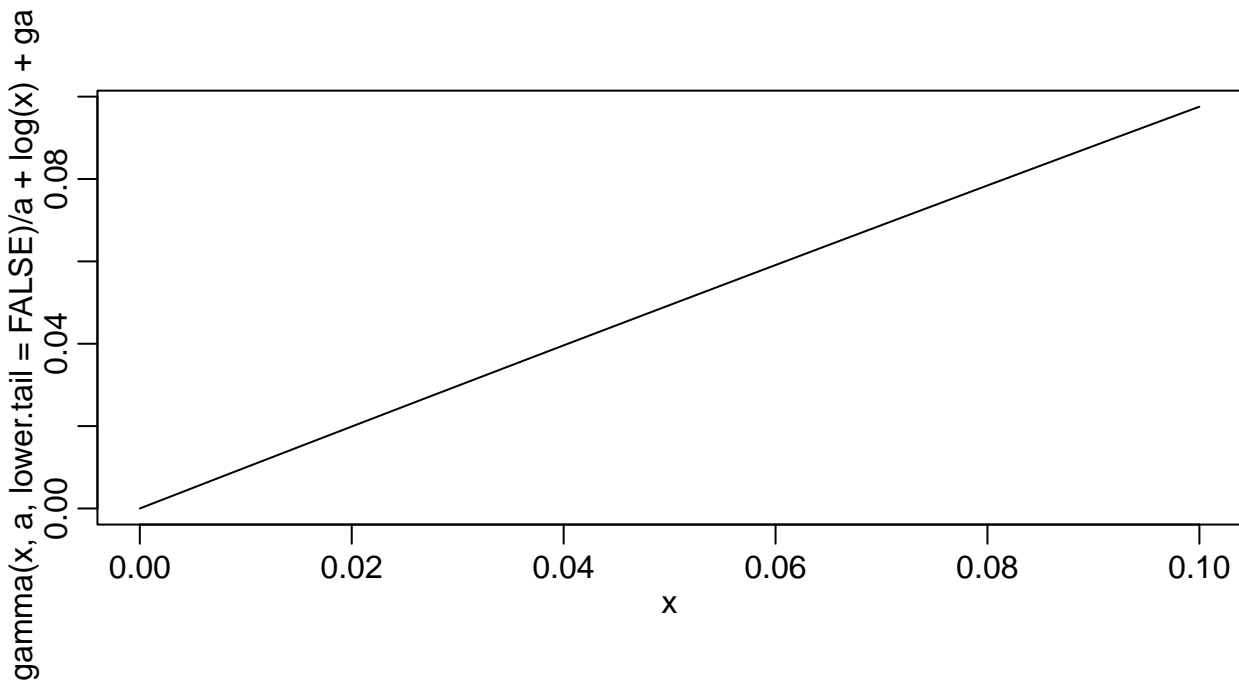
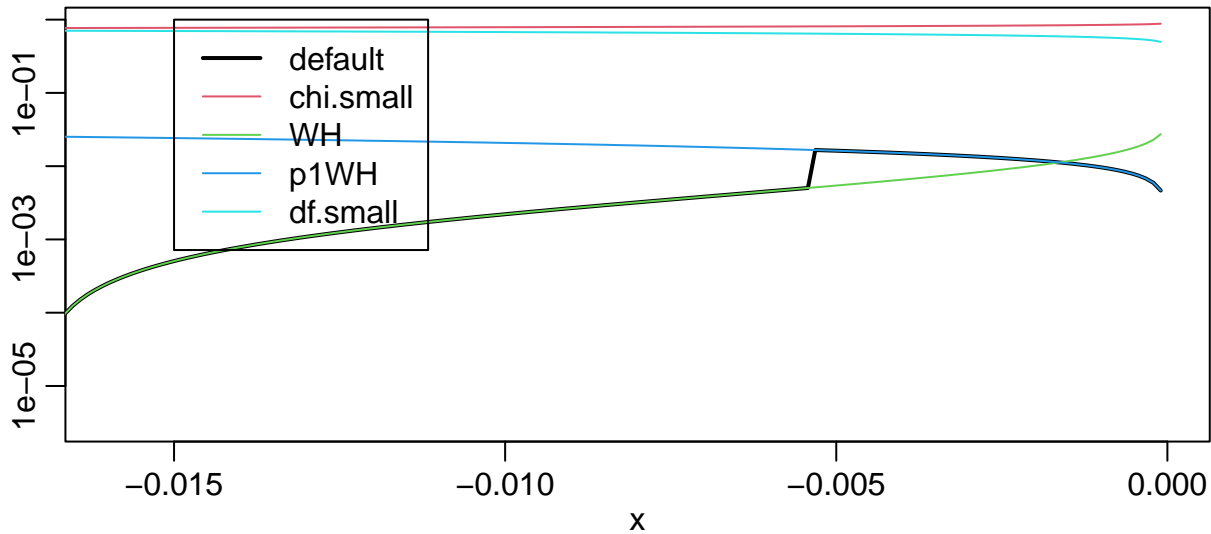
relative Error from  $p.qchi.appr(x = seq(-5, -0.001, length = 501), df = 2)$

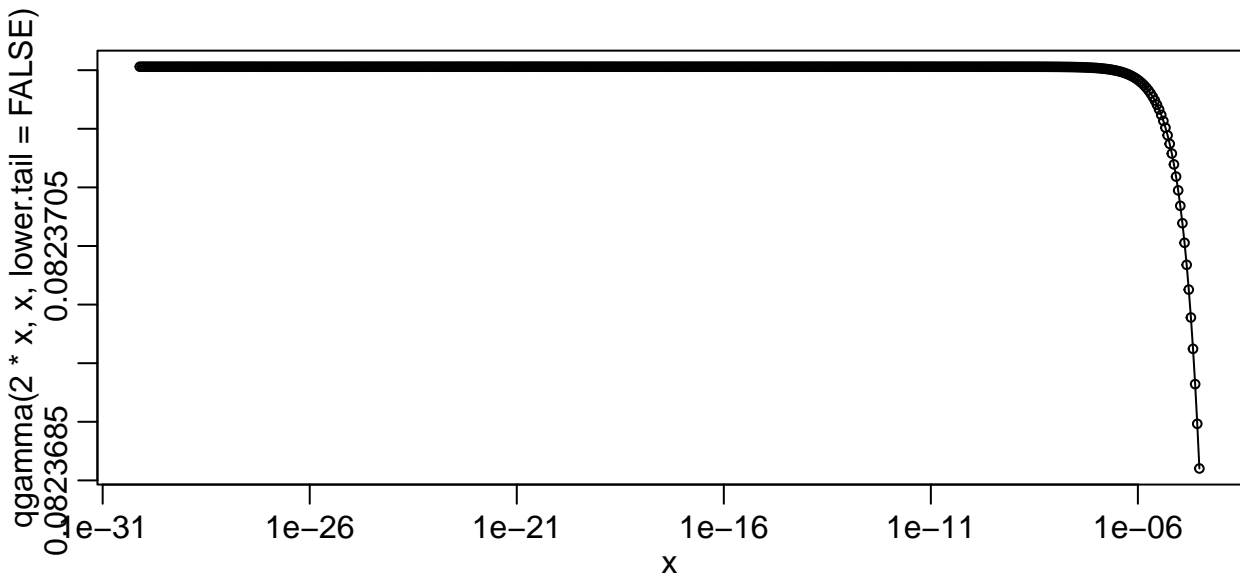
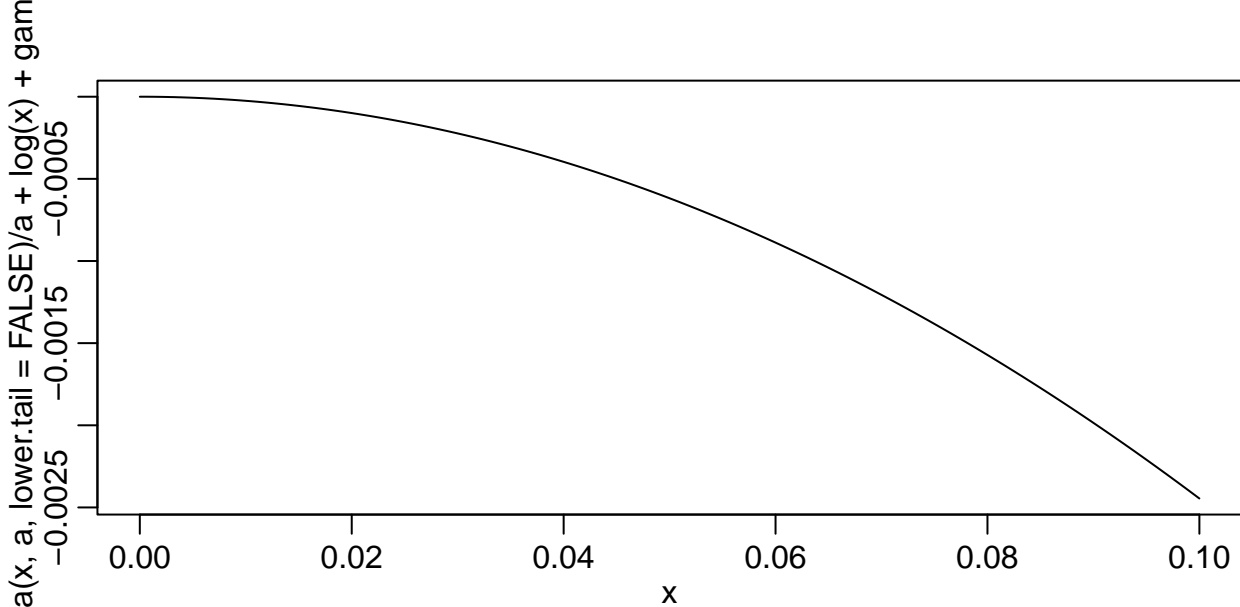


relative Error from  $p.qchi.appr(x = seq(-0.1, -1e-04, length = 901), df = 2)$



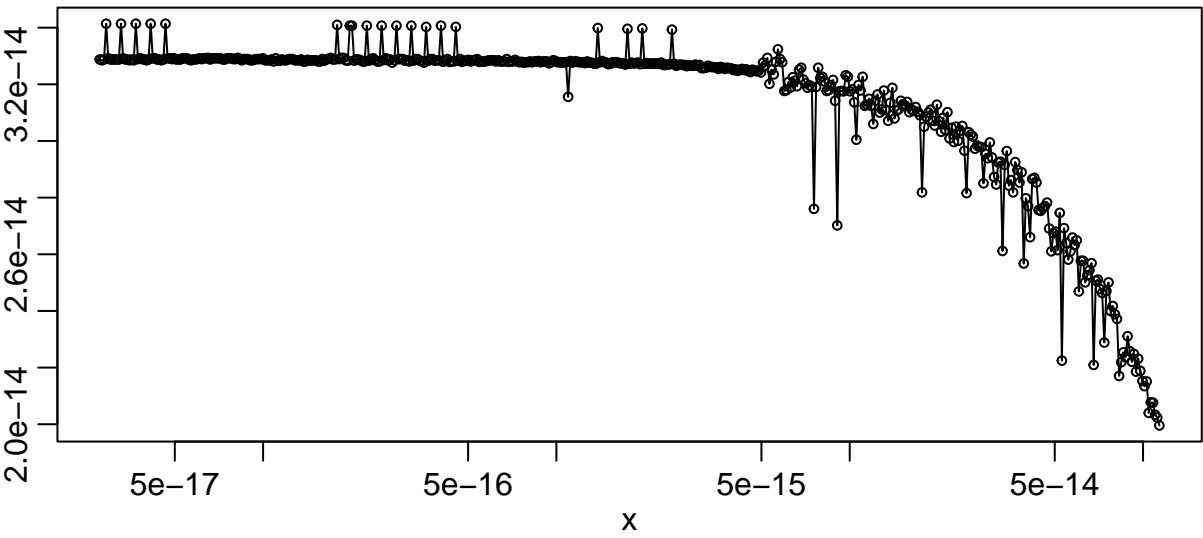
relative Error from `p.qchi.appr(x = seq(-0.1, -1e-04, length = 901), df =`



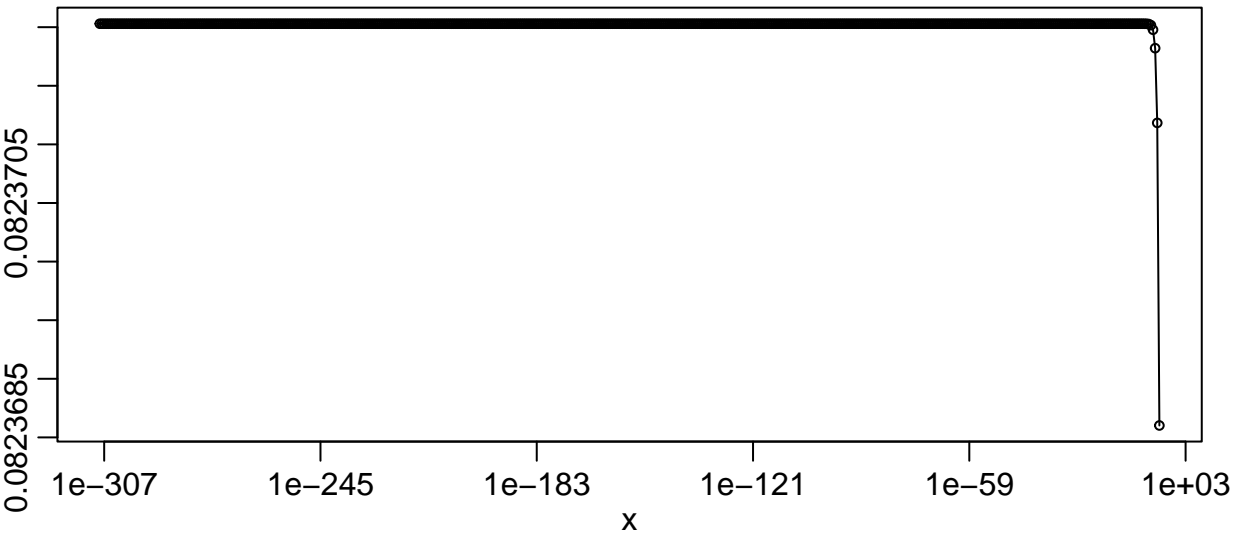


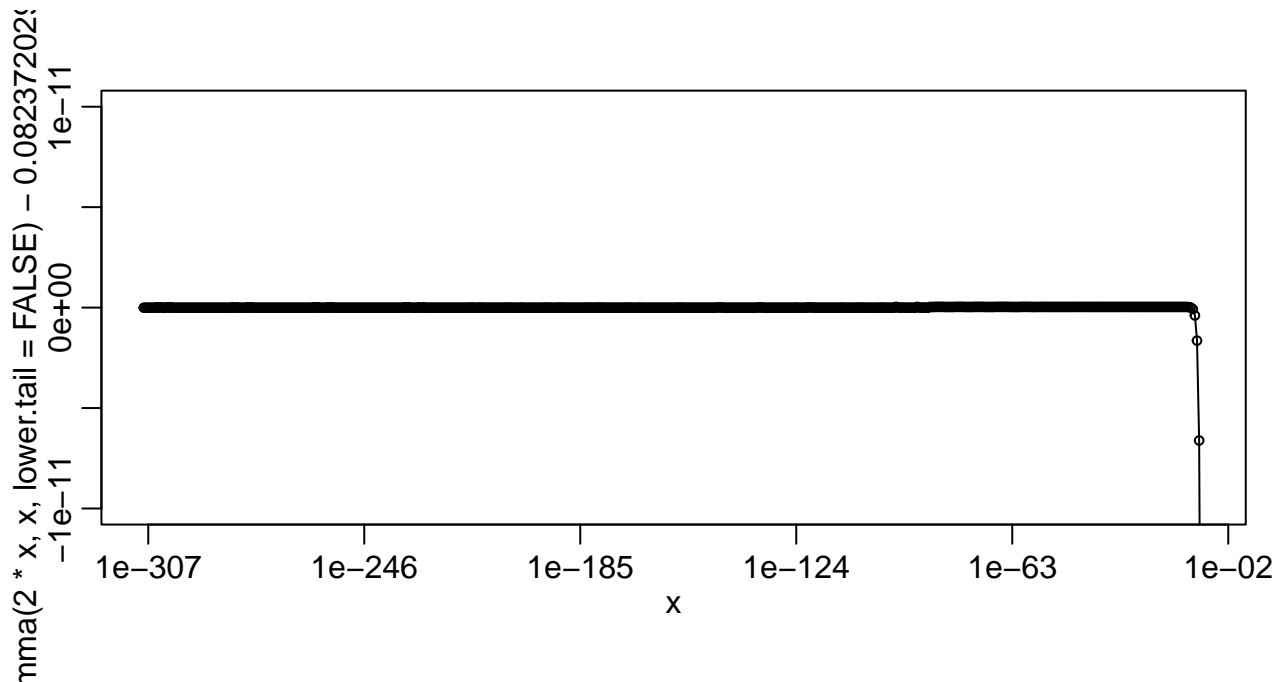
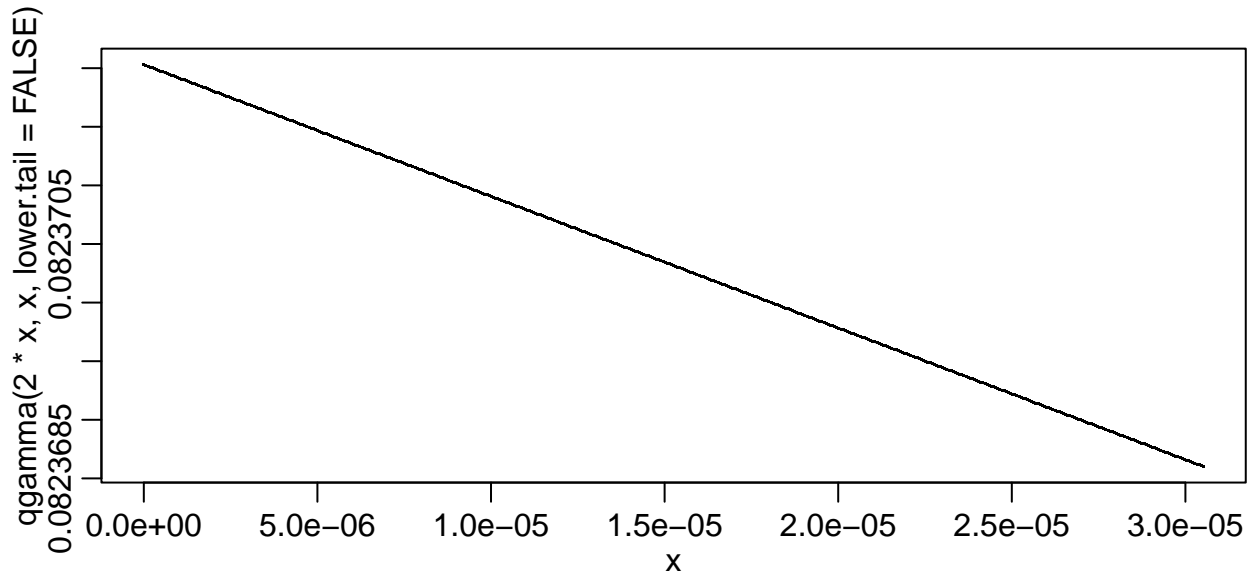


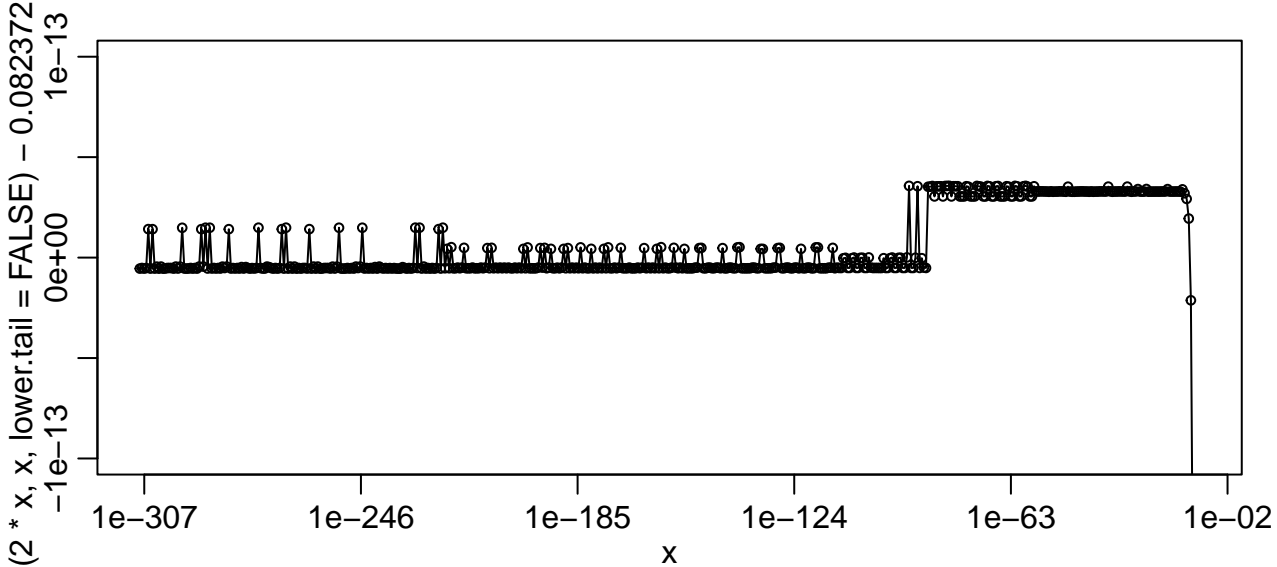
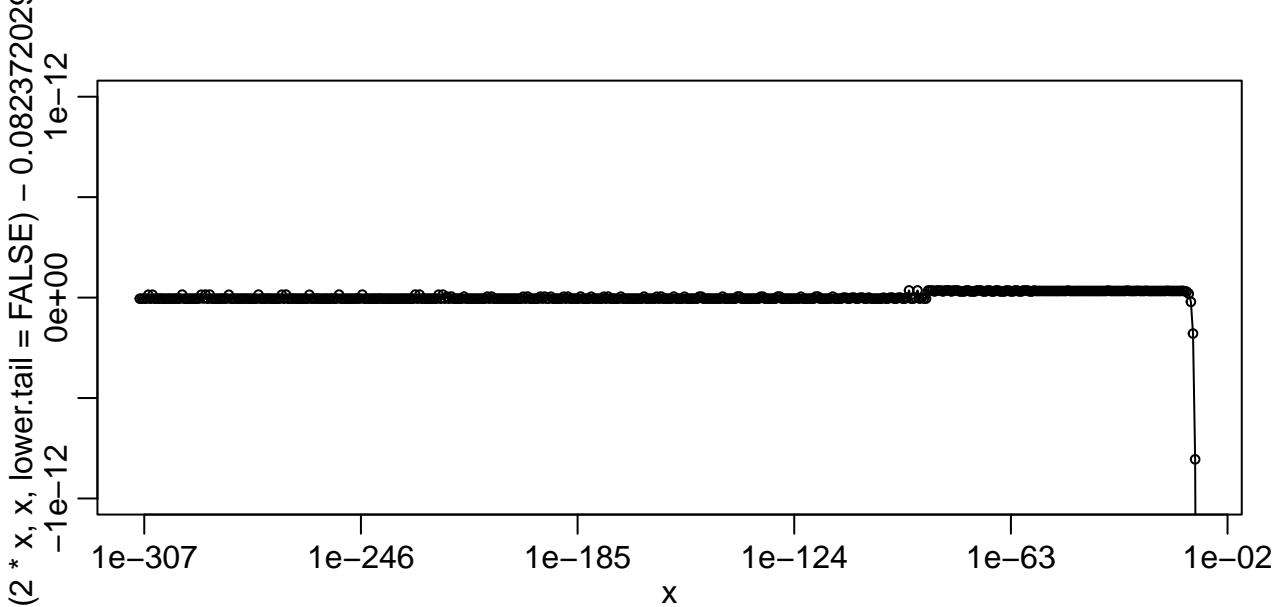
mma(2 \* x, x, lower.tail = FALSE) - 0.08237202

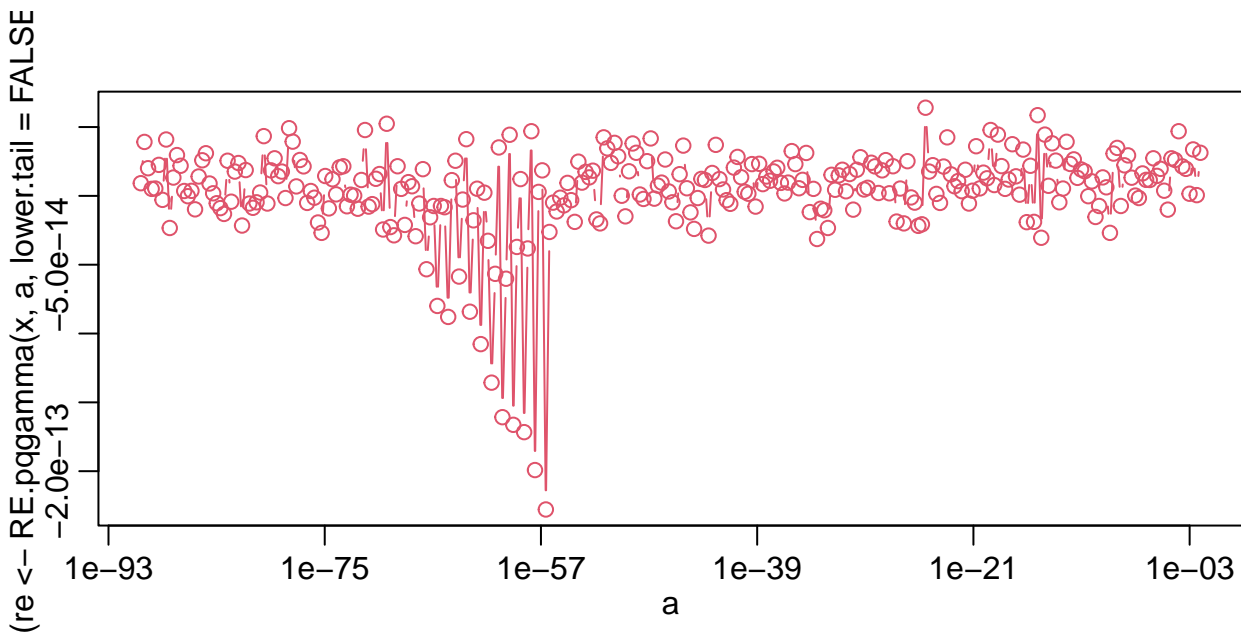
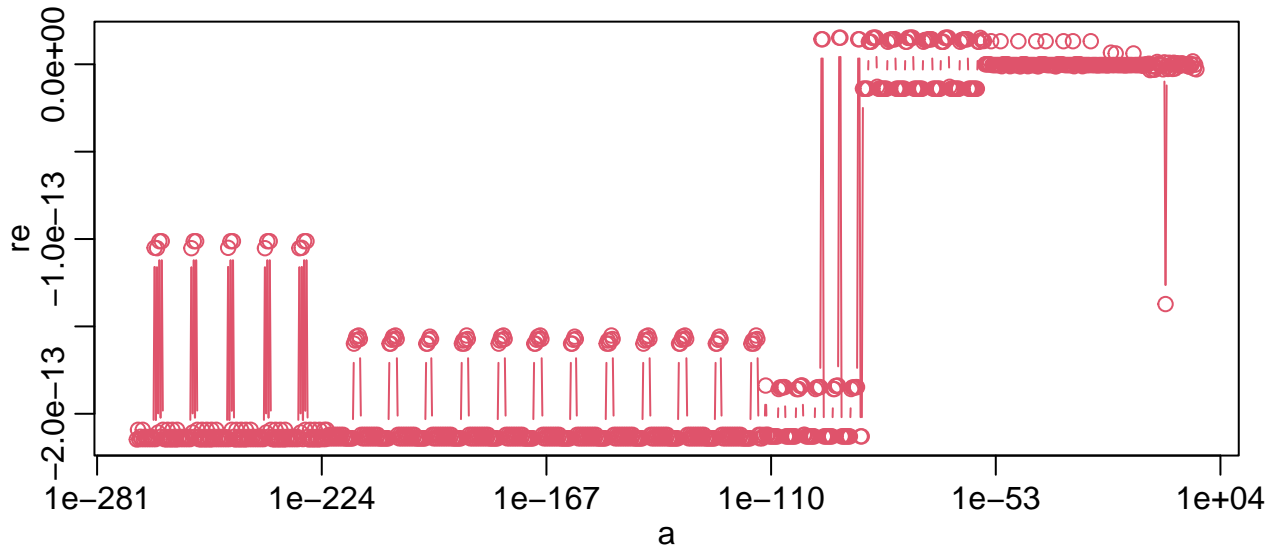


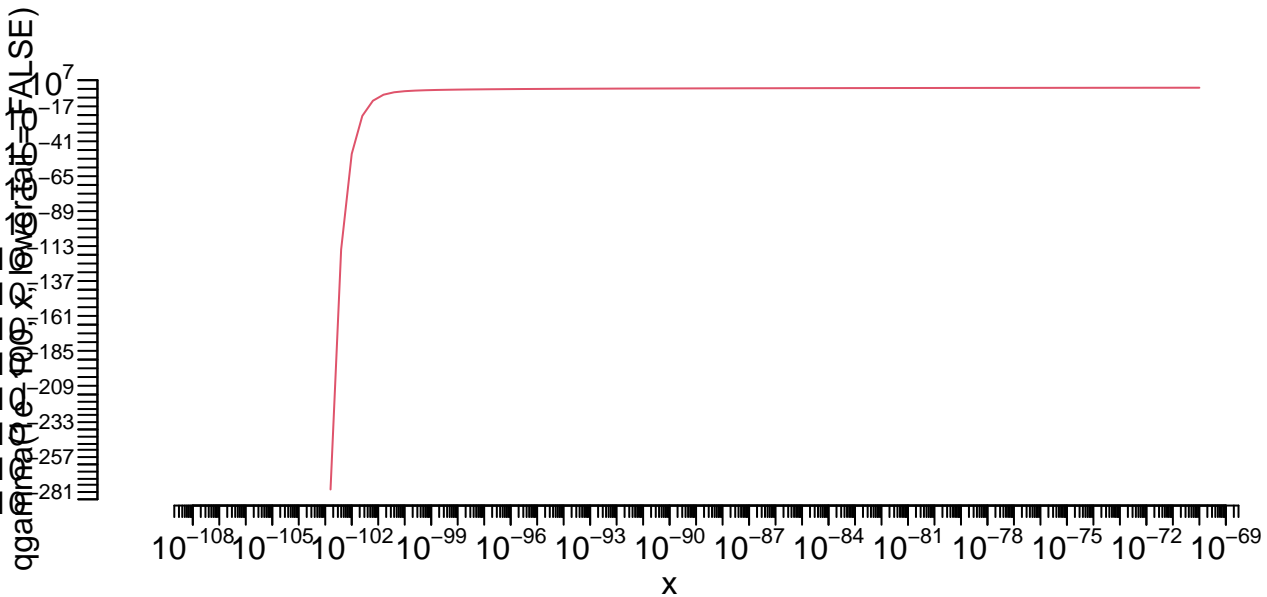
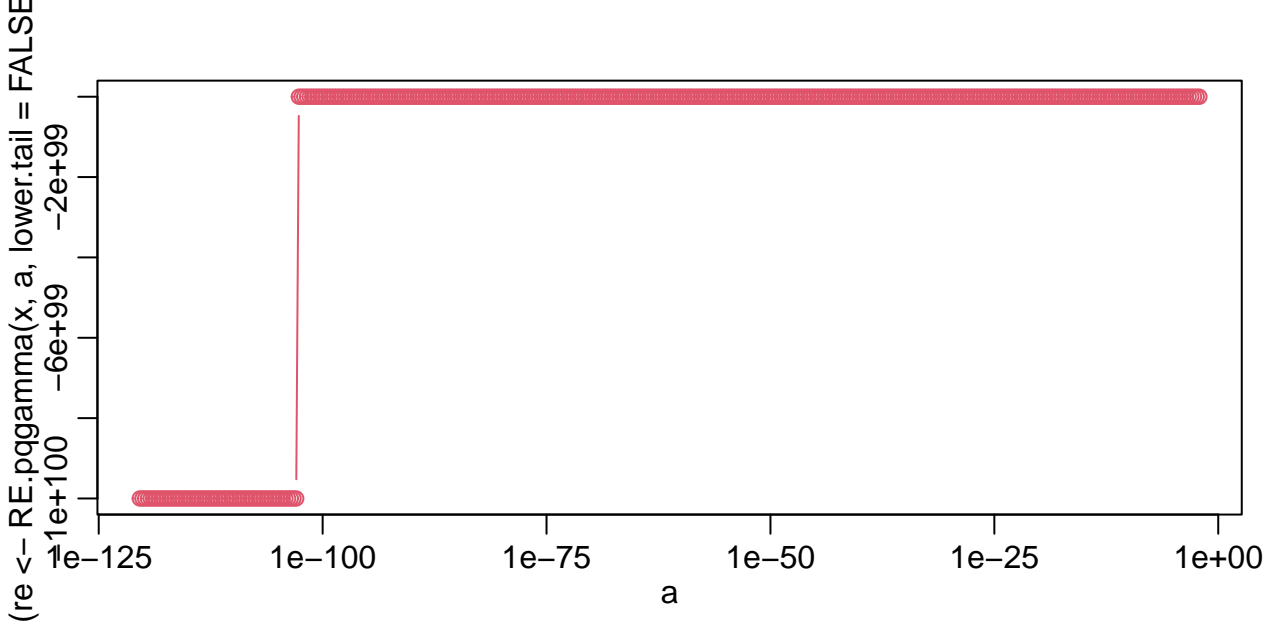
qgamma(2 \* x, x, lower.tail = FALSE)  
0.0823685

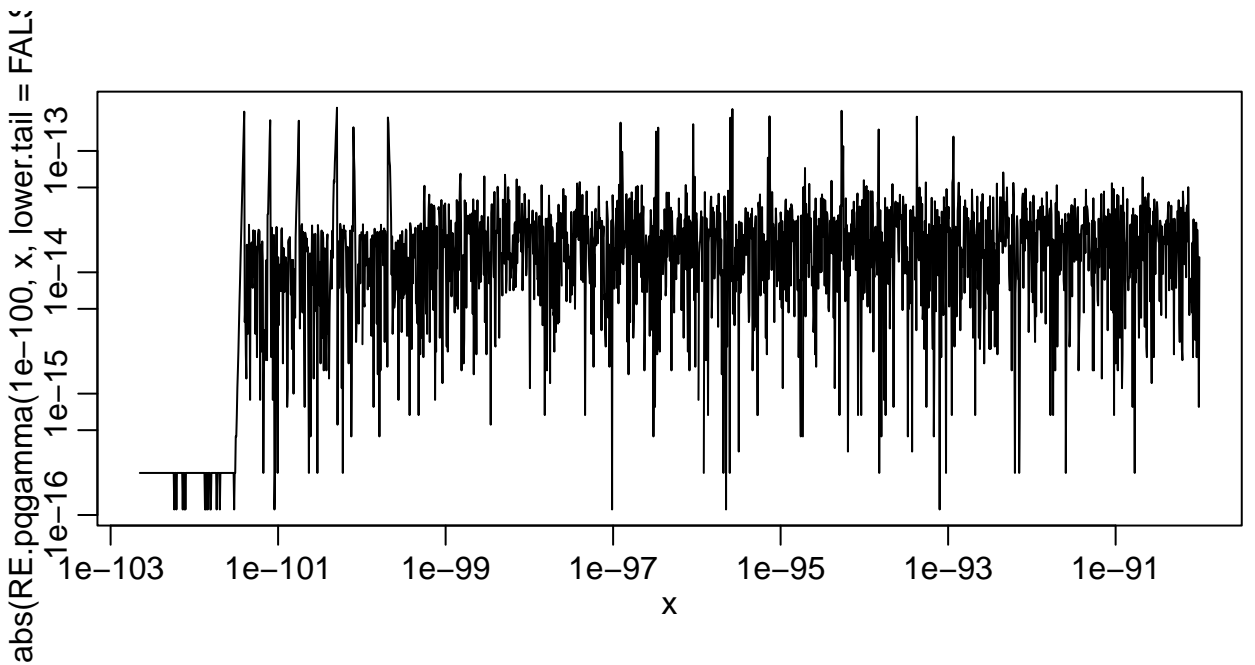
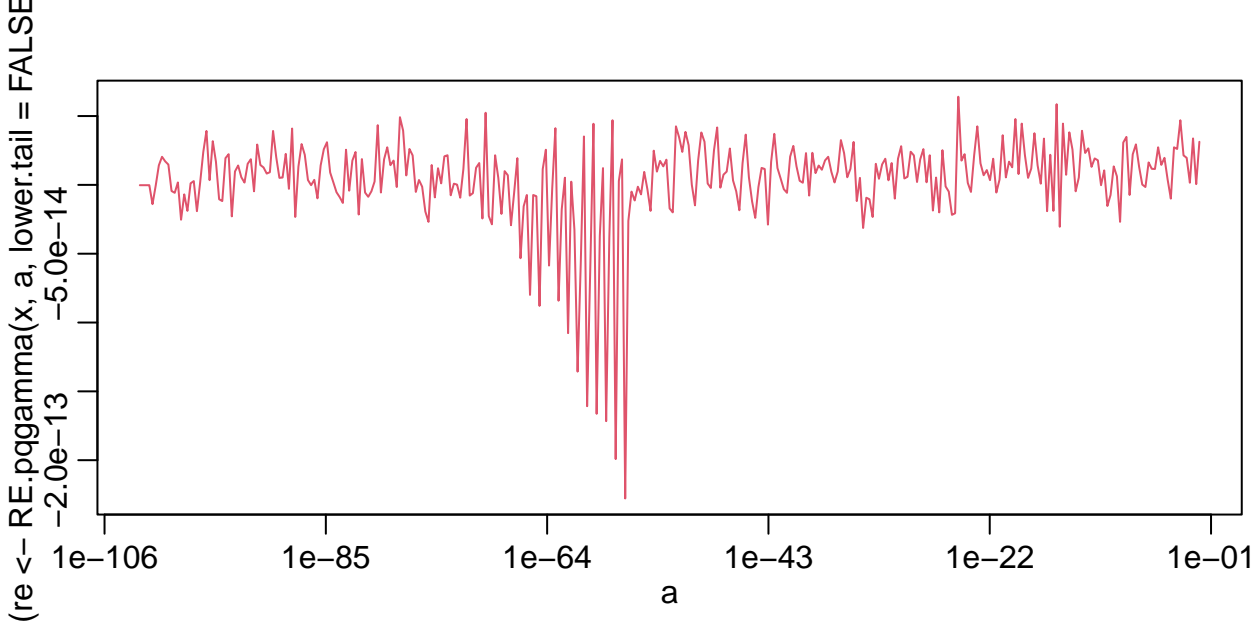


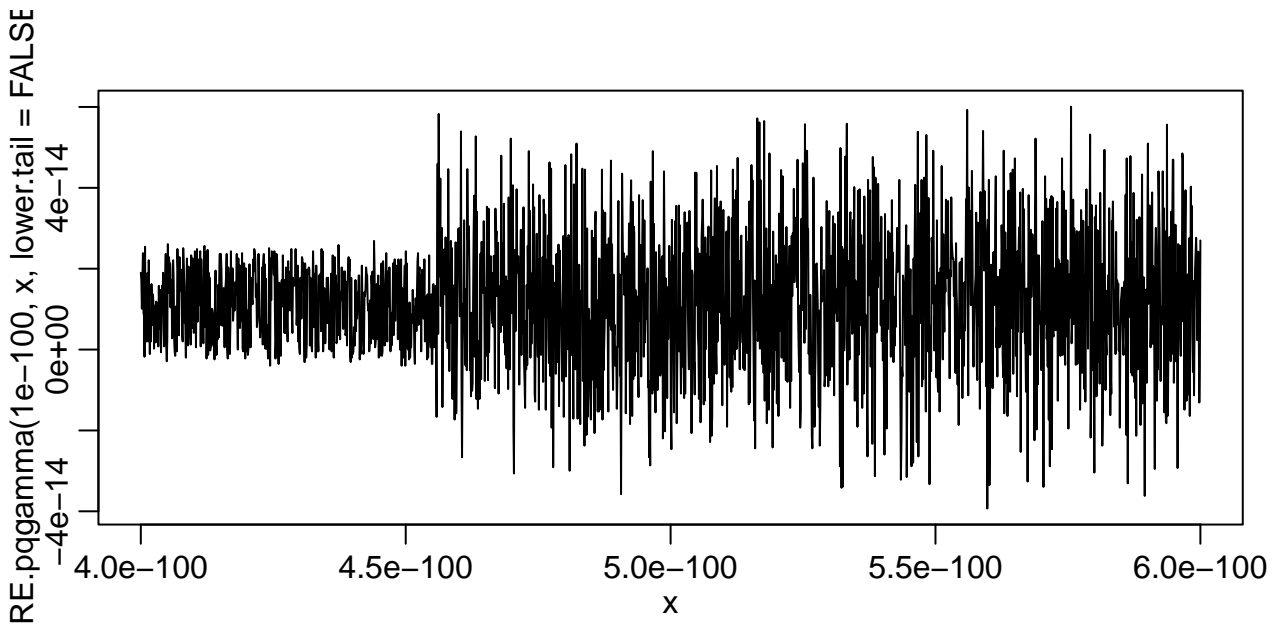
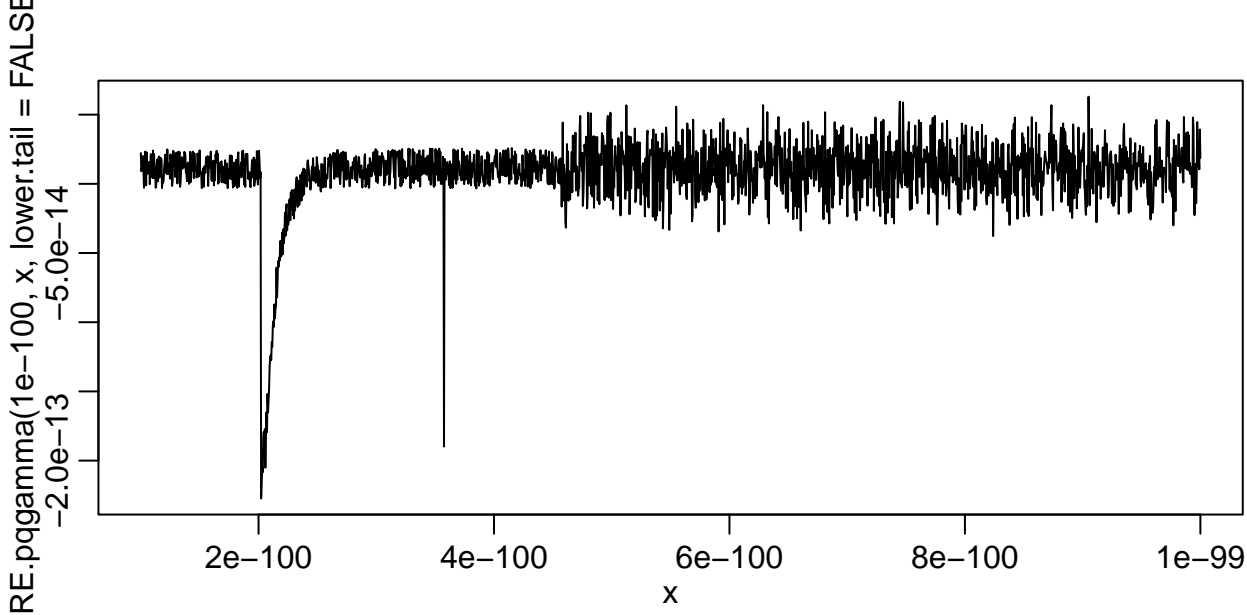


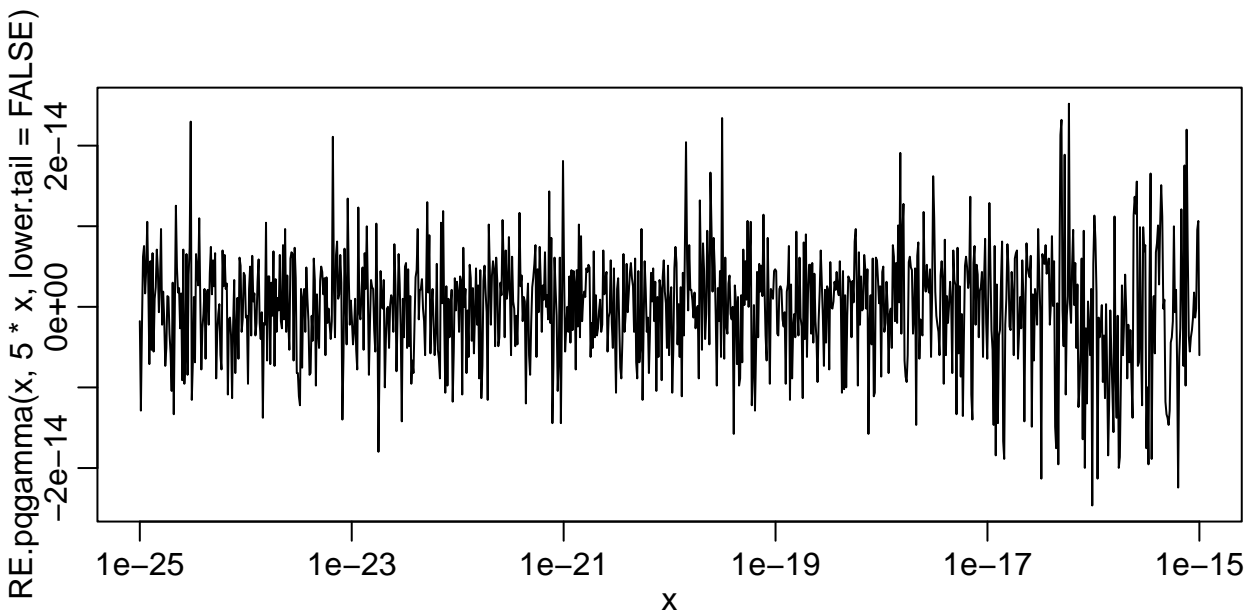
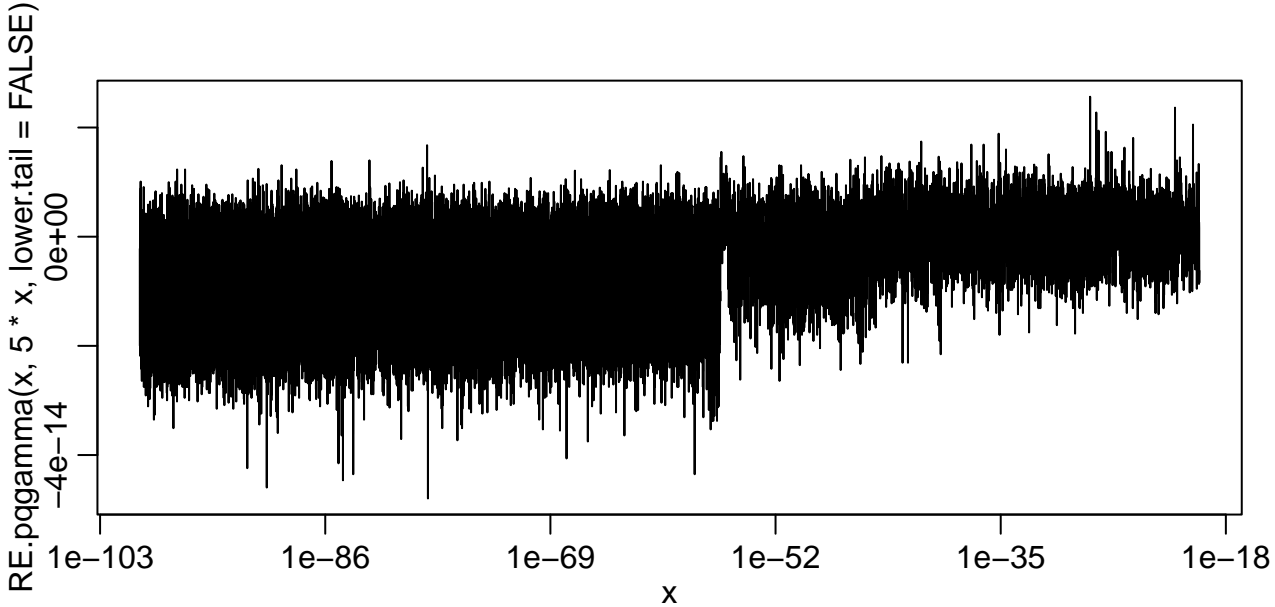




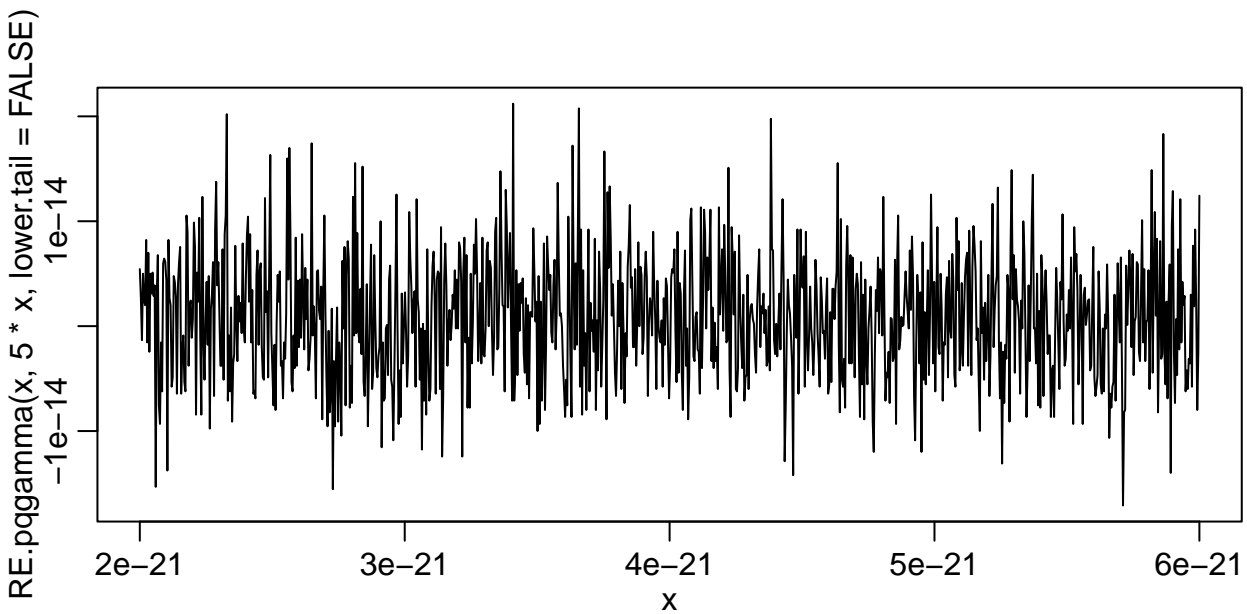
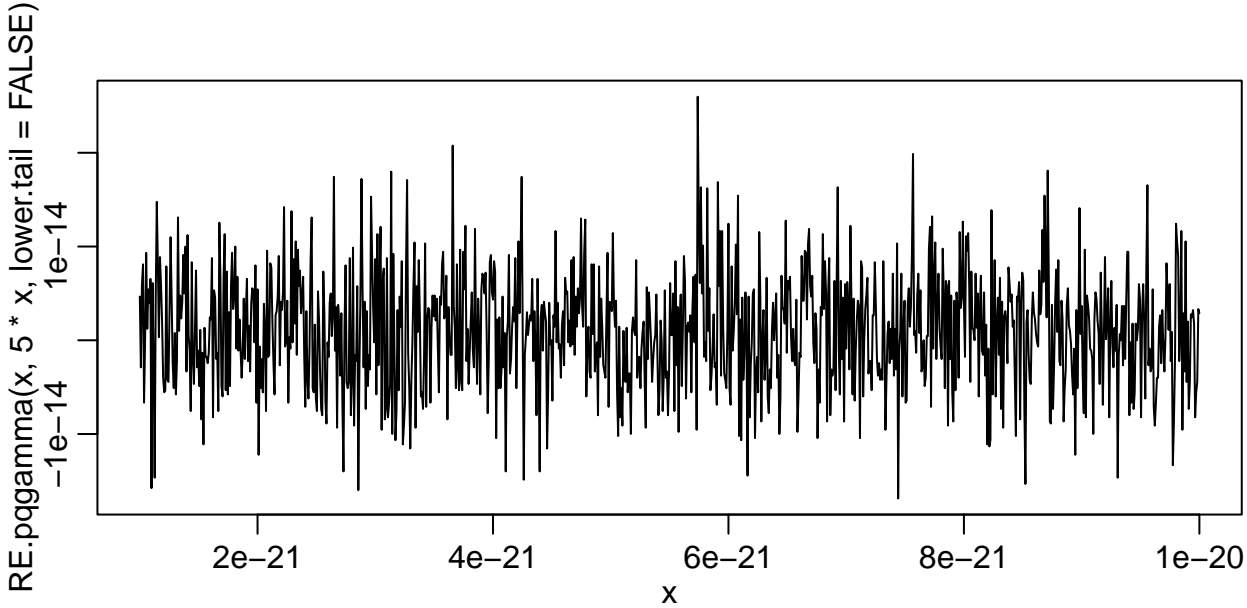


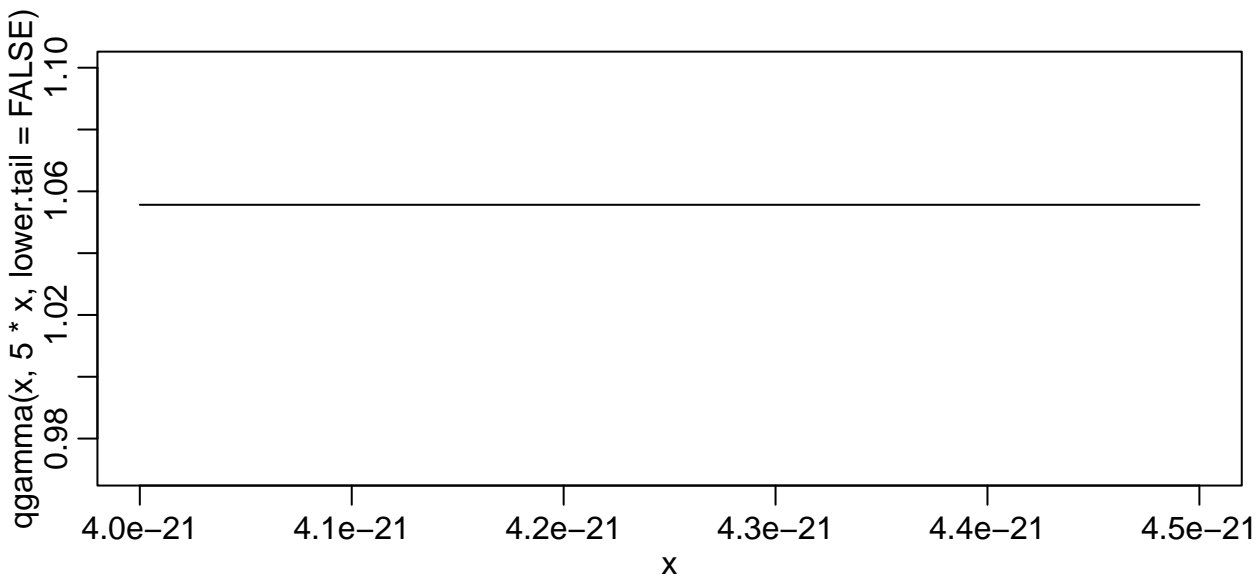
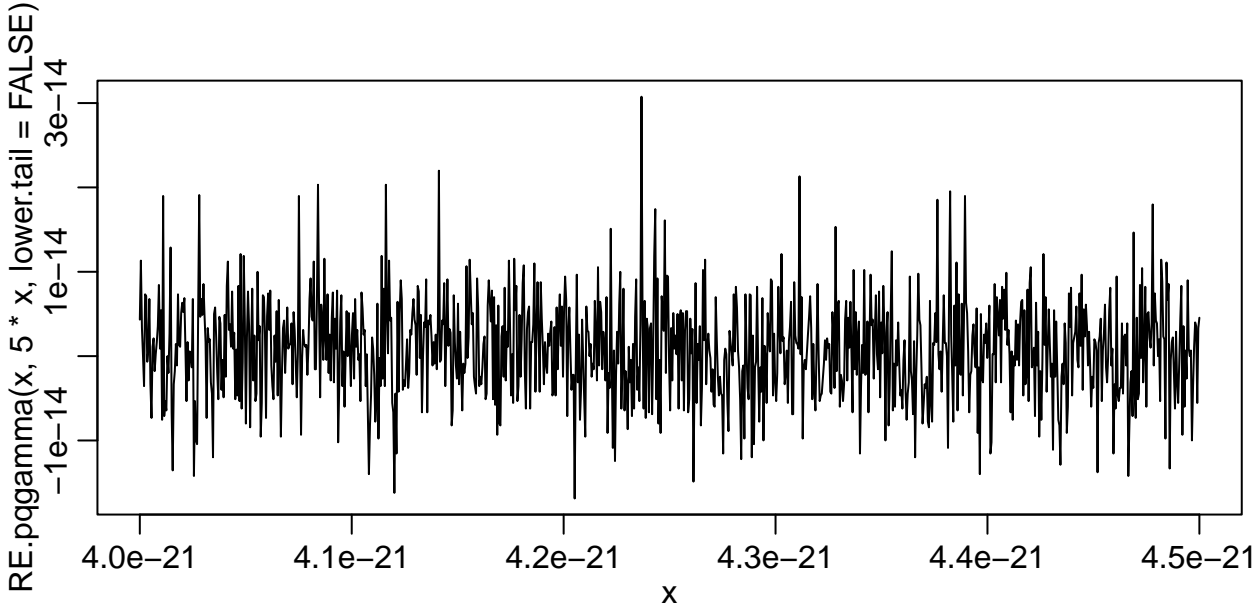


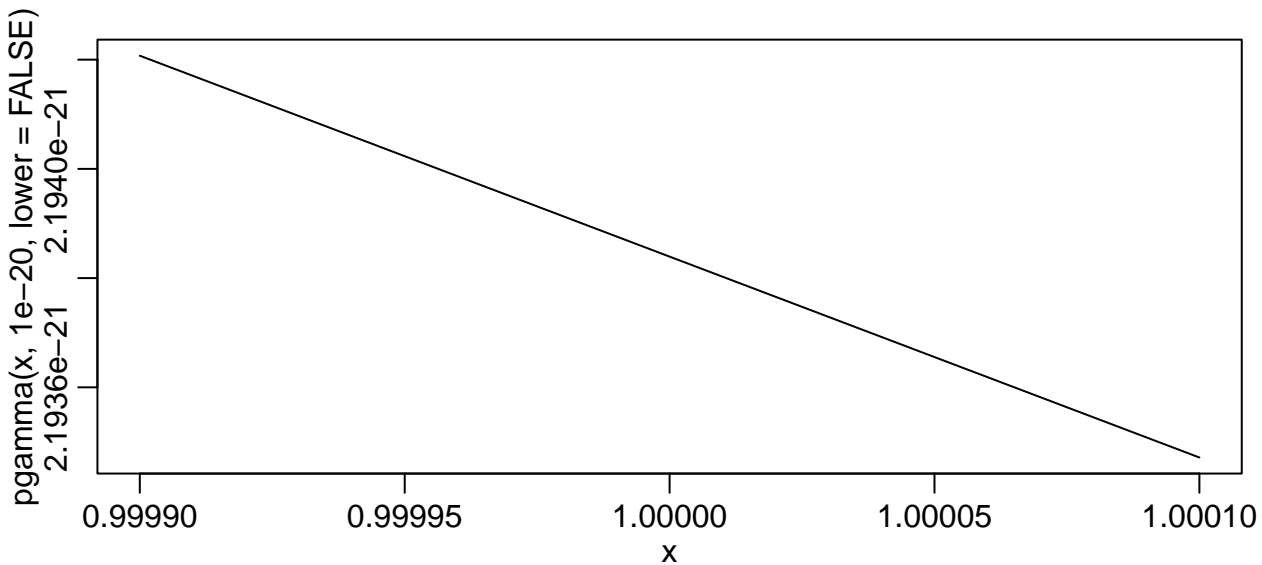
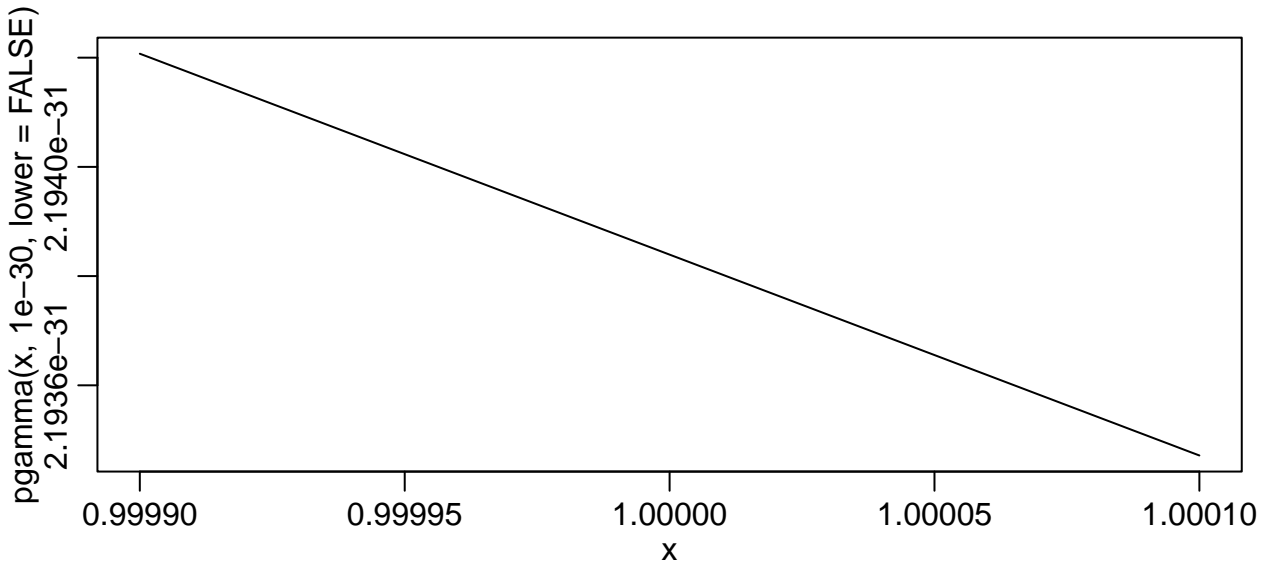


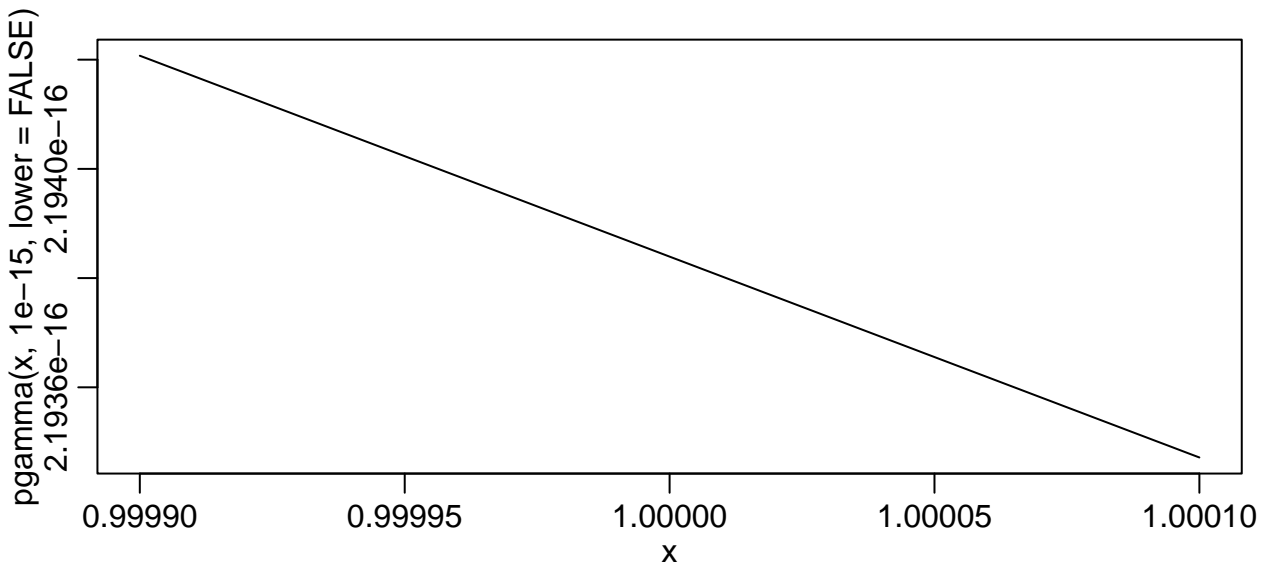
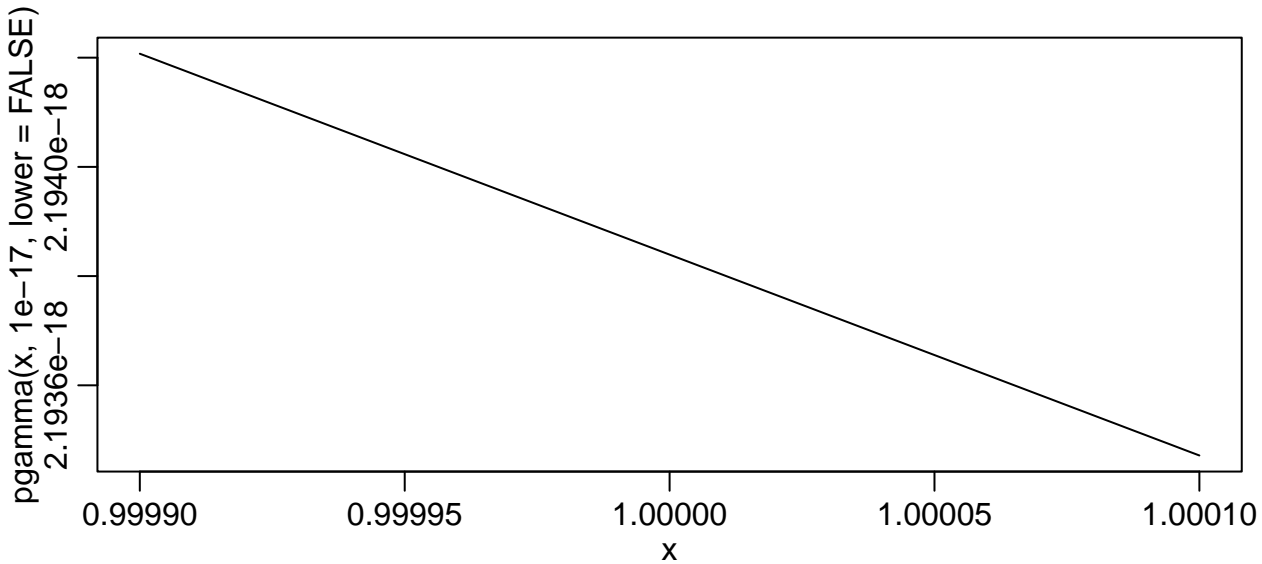


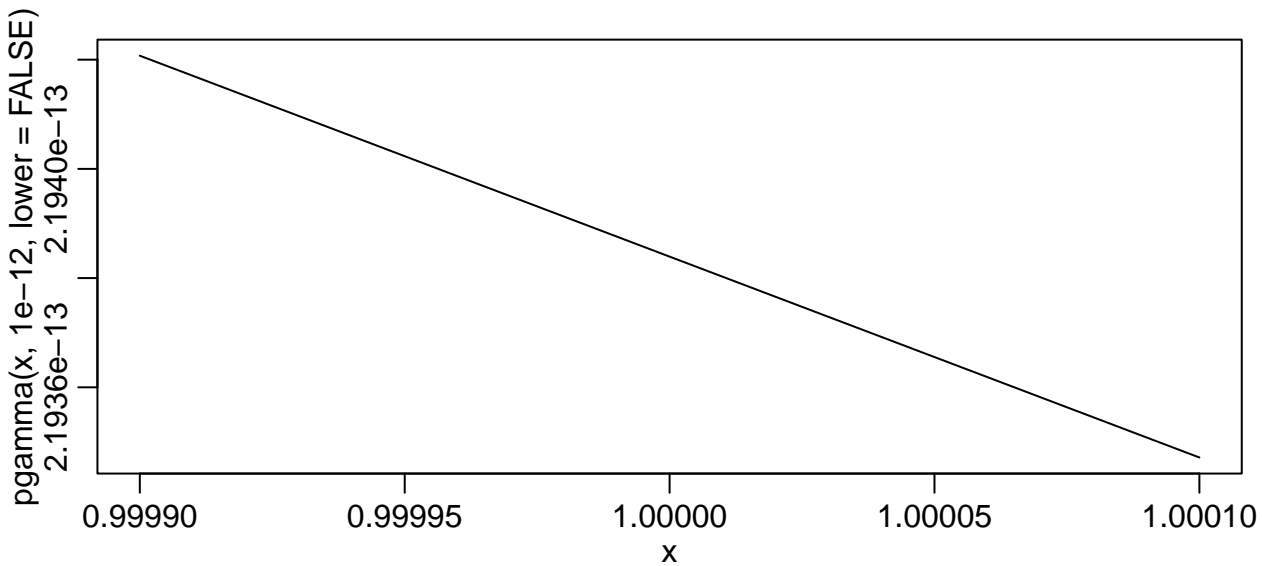
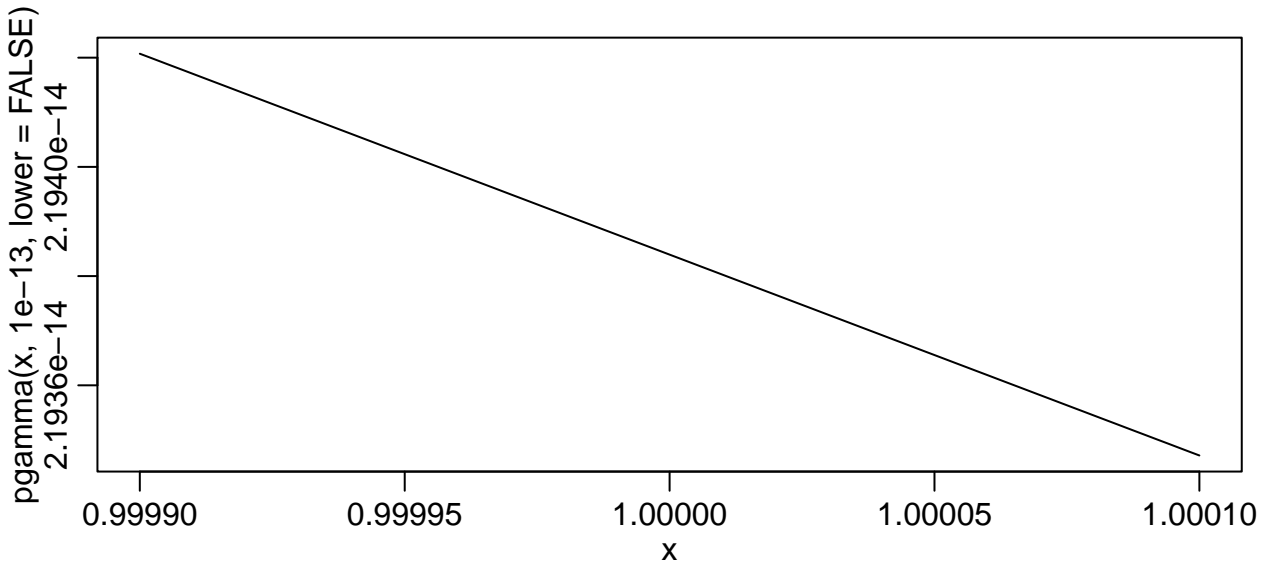


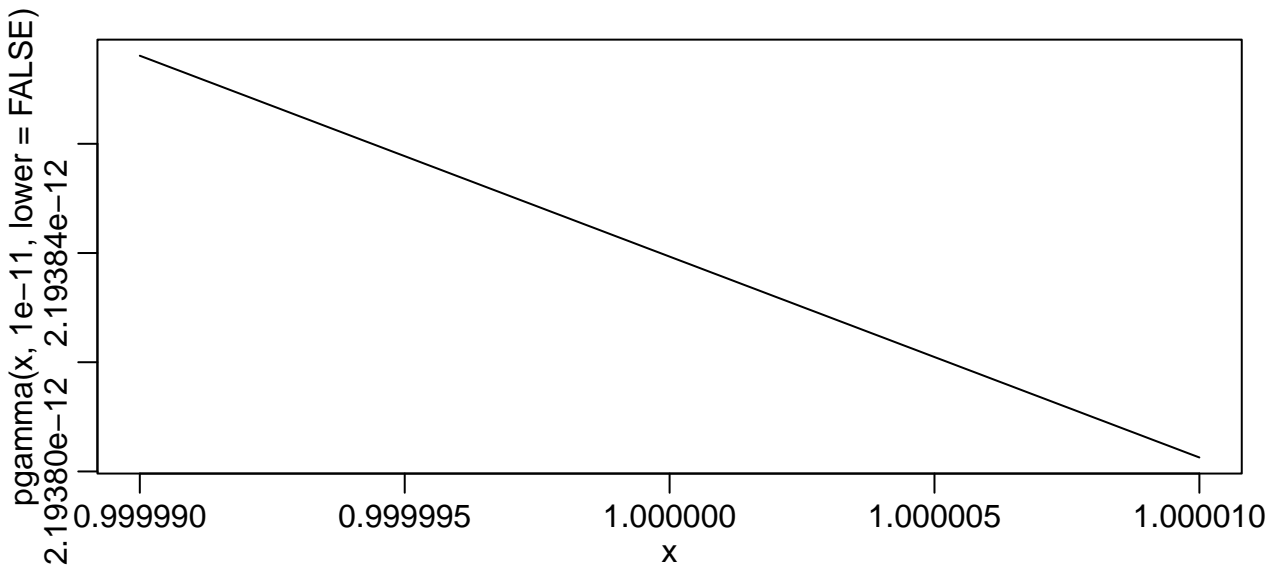
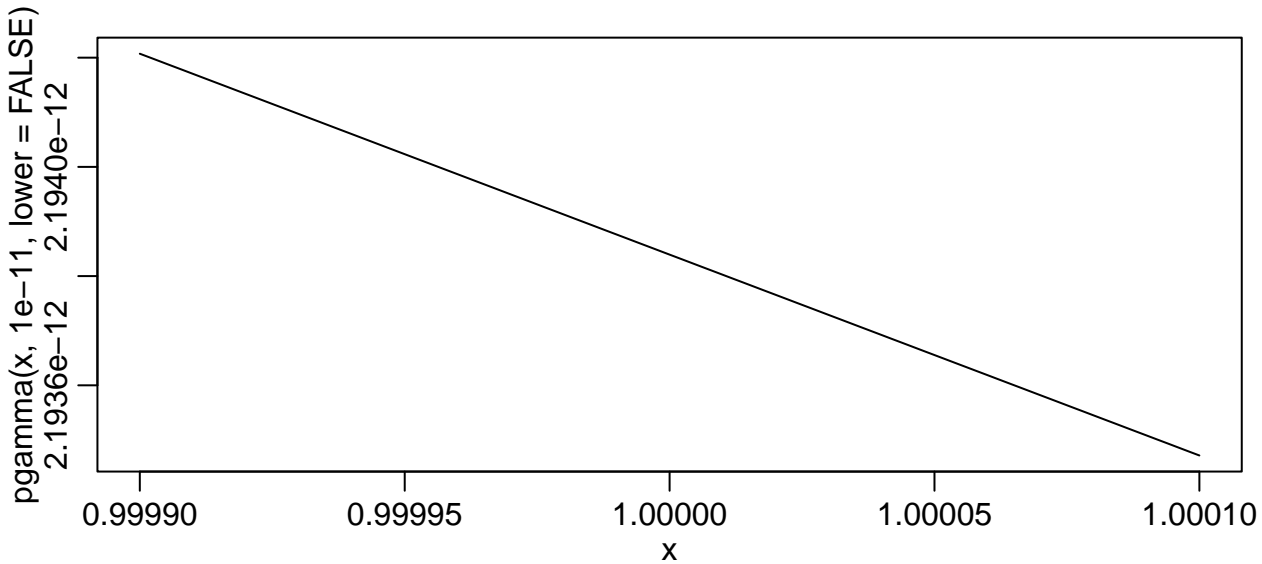


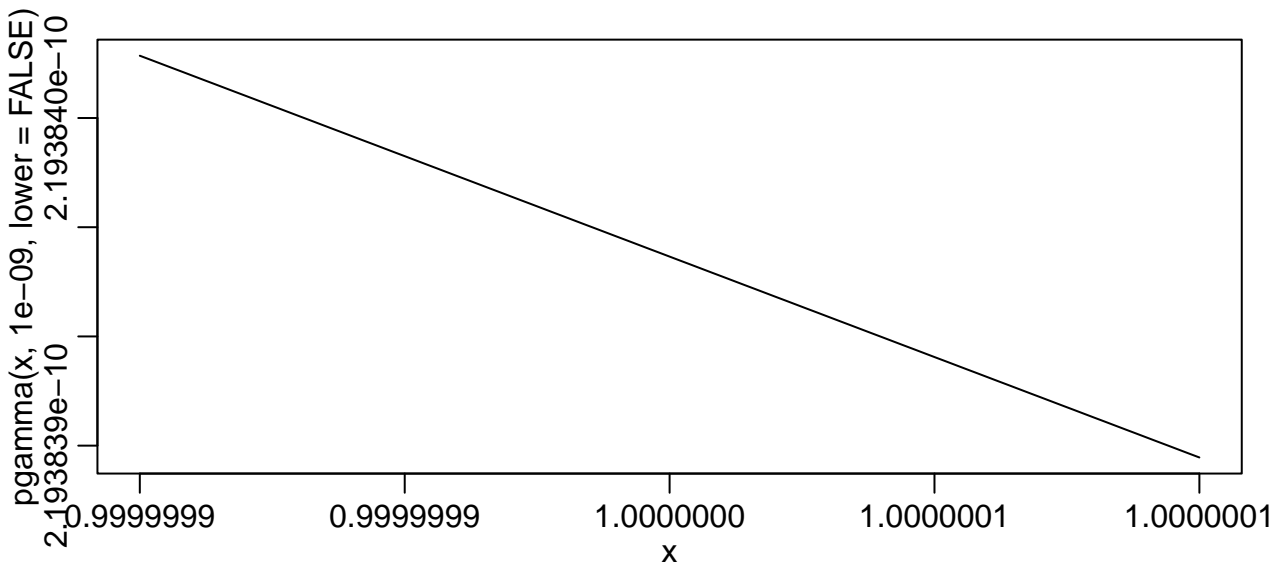
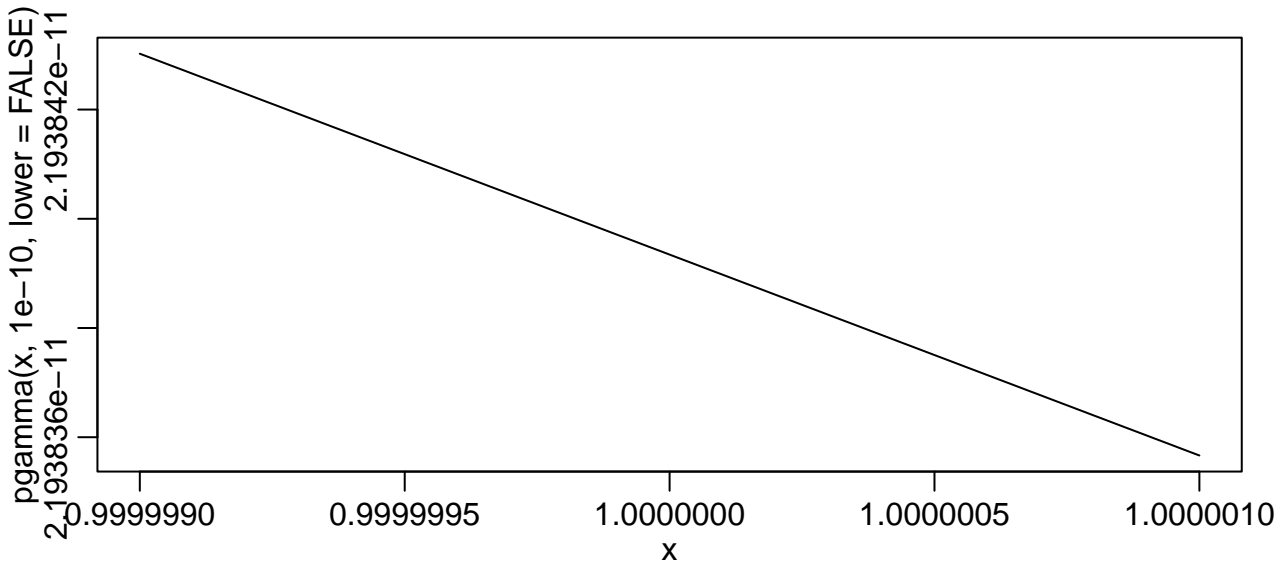




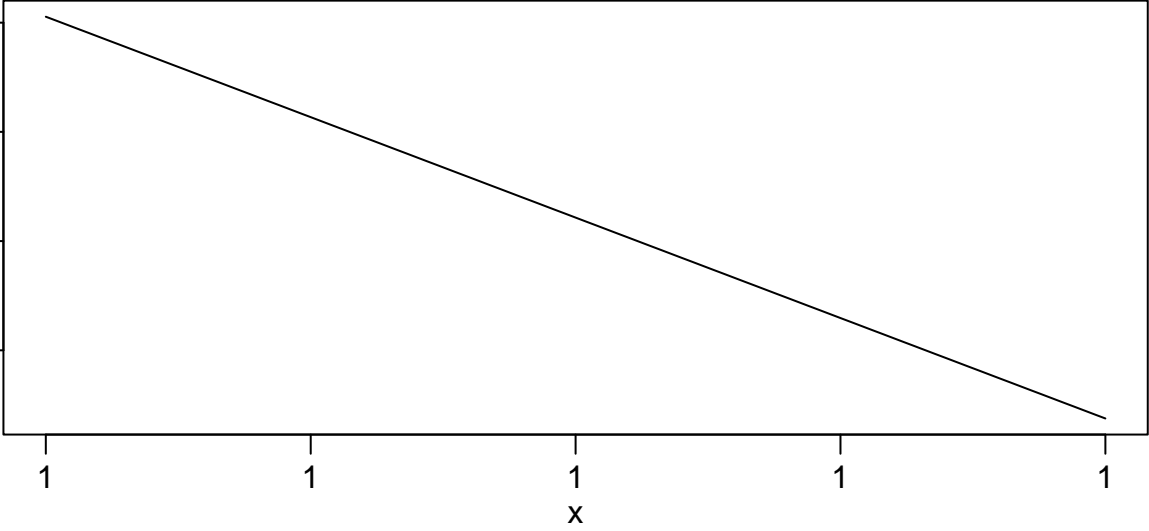




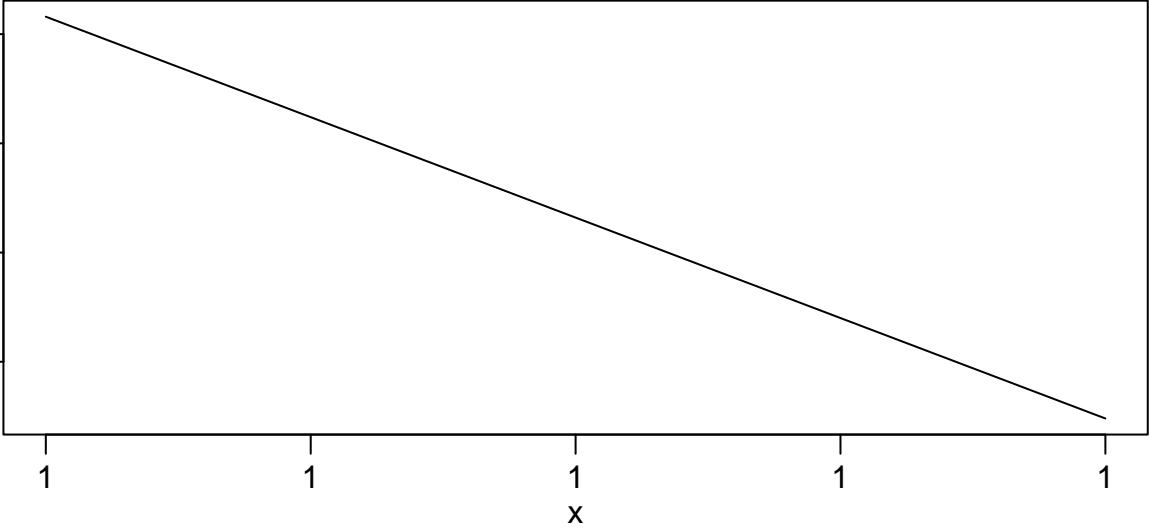




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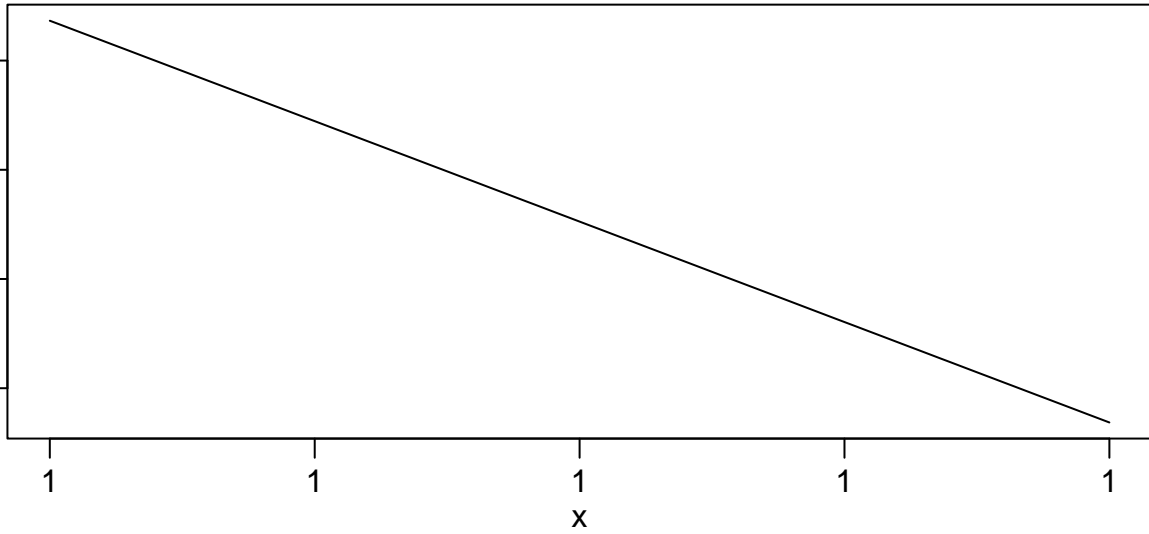


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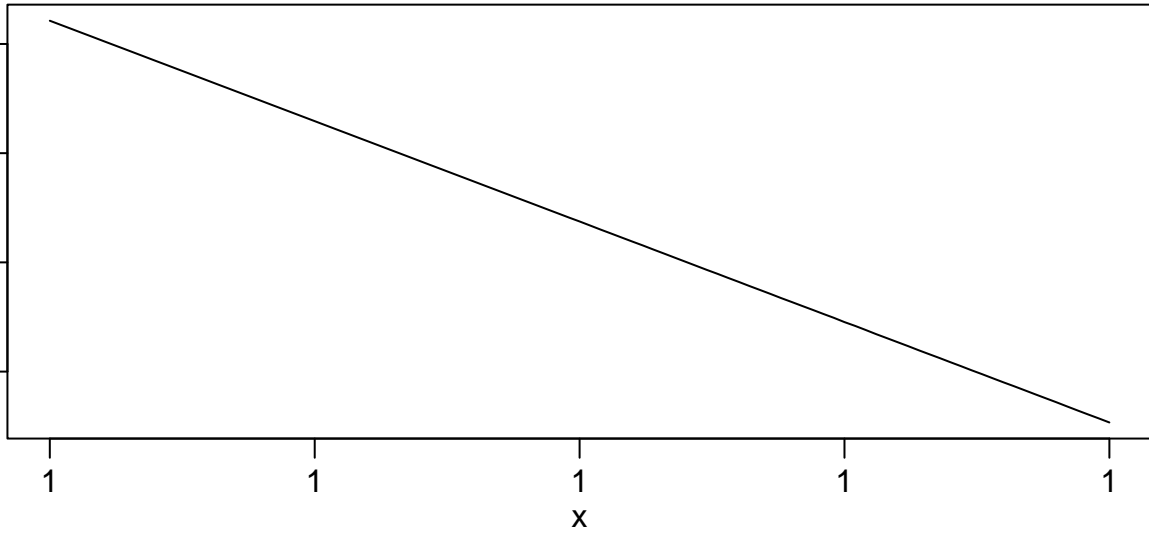




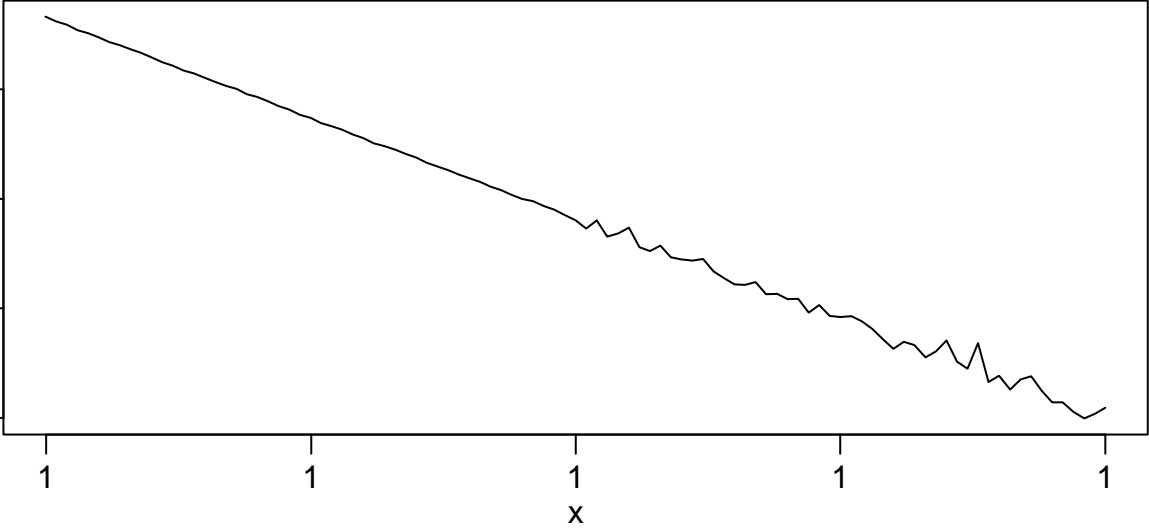
pgamma(x, 1e-06, lower = FALSE)  
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pgamma(x, 1e-05, lower = FALSE)  
2.193862e-06



pgamma(x, 0.001, lower = FALSE)  
0.0002196084



pgamma(x, 1e-04, lower = FALSE)  
2.194064e-05

