

# Modeling extreme values with a GEV mixture probability distributions

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```
source("./src/estimate_gev_mixture_model_parameters.R")
source("./src/plot_gev_mixture_model_pdf.R")
source("./src/generate_gev_sample.R")
source("./src/plot_normalized_gev_mixture_model_pdf.R")
source("./src/calculate_gev_inverse_cdf.R")
source("./src/calculate_gev_mixture_model_inverse_cdf.R")
source("./src/calculate_gev_mixture_model_cdf.R")

n <- 20000

nlargest <- 1000

x <- generate_gev_sample(n = n, loc = 1, scale = 0.5, shape = 0.1)
#x <- rnorm(n = n)

gev_mixture_model <- estimate_gev_mixture_model_parameters(x,
                                                             nsloc = NULL,
                                                             std.err = FALSE,
                                                             block_sizes = NULL,
                                                             minimum_nblocks = 50,
                                                             nlargest = nlargest,
                                                             confidence_level = 0.95,
                                                             log_mv = TRUE,
                                                             log_pw = TRUE,
                                                             trace = TRUE)

## iter: 0 f-value: 0.0818045692229777 pgrad: 0.116557301520905
## iter: 10 f-value: 0.00645277788901075 pgrad: 0.00490695616336123
## iter: 20 f-value: 0.00644207597742333 pgrad: 0.00490210395299373
## iter: 30 f-value: 0.00643139528540268 pgrad: 0.00489725654445849
## iter: 40 f-value: 0.00642073577085853 pgrad: 0.00489241393299966
## iter: 50 f-value: 0.00641009739178396 pgrad: 0.00488757611386559
## iter: 60 f-value: 0.0063994801062556 pgrad: 0.00488274308230963
## iter: 70 f-value: 0.00638888387243312 pgrad: 0.00487791483359035
## iter: 80 f-value: 0.00637830864855929 pgrad: 0.00487309136297054
## iter: 90 f-value: 0.00636775439295979 pgrad: 0.0048682726657171
## iter: 100 f-value: 0.00635722106404289 pgrad: 0.00486345873710292
## iter: 110 f-value: 0.00634670862029943 pgrad: 0.00485864957240467
## iter: 120 f-value: 0.00633621702030267 pgrad: 0.00485384516690379
## iter: 130 f-value: 0.00632574622270798 pgrad: 0.00484904551588683
## iter: 140 f-value: 0.00631529618625292 pgrad: 0.00484425061464422
```

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## iter: 150 f-value: 0.00630486686975674 pgrad: 0.00483946045847228
## iter: 160 f-value: 0.0062944582321205 pgrad: 0.00483467504267077
## iter: 170 f-value: 0.00628407023232702 pgrad: 0.00482989436254466
## iter: 180 f-value: 0.00627370282944006 pgrad: 0.00482511841340383
## iter: 190 f-value: 0.00626335598260489 pgrad: 0.0048203471905619
## iter: 200 f-value: 0.00625302965104794 pgrad: 0.00481558068933841
## iter: 210 f-value: 0.00624272379407645 pgrad: 0.00481081890505652
## iter: 220 f-value: 0.00623243837107827 pgrad: 0.00480606183304455
## iter: 230 f-value: 0.00622217334152204 pgrad: 0.00480130946863488
## iter: 240 f-value: 0.00621192866495676 pgrad: 0.00479656180716537
## iter: 250 f-value: 0.00620170430101157 pgrad: 0.00479181884397784
## iter: 260 f-value: 0.006191500209396 pgrad: 0.00478708057441901
## iter: 270 f-value: 0.00618131634989931 pgrad: 0.00478234699384028
## iter: 280 f-value: 0.00617115268239048 pgrad: 0.00477761809759725
## iter: 290 f-value: 0.00616100916681847 pgrad: 0.0047728938810504
## iter: 300 f-value: 0.00615088576321122 pgrad: 0.004768174339565
## iter: 310 f-value: 0.00614078243167655 pgrad: 0.00476345946851064
## iter: 320 f-value: 0.00613069913240094 pgrad: 0.00475874926326159
## iter: 330 f-value: 0.00612063582565017 pgrad: 0.00475404371919652
## iter: 340 f-value: 0.00611059247176879 pgrad: 0.00474934283169925
## iter: 350 f-value: 0.00610056903118001 pgrad: 0.00474464659615725
## iter: 360 f-value: 0.00609056546438562 pgrad: 0.00473995500796343
## iter: 370 f-value: 0.00608058173196571 pgrad: 0.00473526806251501
## iter: 380 f-value: 0.00607061779457868 pgrad: 0.00473058575521335
## iter: 390 f-value: 0.00606067361296091 pgrad: 0.004725908081465
## iter: 400 f-value: 0.00605074914792679 pgrad: 0.00472123503668076
## iter: 410 f-value: 0.00604084436036833 pgrad: 0.00471656661627606
## iter: 420 f-value: 0.00603095921125538 pgrad: 0.00471190281567024
## iter: 430 f-value: 0.00602109366163493 pgrad: 0.0047072436302884
## iter: 440 f-value: 0.00601124767263149 pgrad: 0.00470258905555954
## iter: 450 f-value: 0.00600142120544667 pgrad: 0.00469793908691674
## iter: 460 f-value: 0.00599161422135897 pgrad: 0.0046932937197981
## iter: 470 f-value: 0.00598182668172387 pgrad: 0.00468865294964649
## iter: 480 f-value: 0.00597205854797332 pgrad: 0.00468401677190888
## iter: 490 f-value: 0.0059623097816161 pgrad: 0.0046793851820367
## iter: 500 f-value: 0.00595258034423708 pgrad: 0.00467475817548624
## iter: 510 f-value: 0.0059428701974976 pgrad: 0.00467013574771802
## iter: 520 f-value: 0.00593317930313479 pgrad: 0.00466551789419734
## iter: 530 f-value: 0.00592350762296206 pgrad: 0.00466090461039337
## iter: 540 f-value: 0.0059138551188682 pgrad: 0.00465629589178063
## iter: 550 f-value: 0.00590422175281807 pgrad: 0.00465169173383728
## iter: 560 f-value: 0.0058946074868515 pgrad: 0.00464709213204706
## iter: 570 f-value: 0.00588501228308416 pgrad: 0.00464249708189701
## iter: 580 f-value: 0.0058754361037064 pgrad: 0.00463790657887908
## iter: 590 f-value: 0.00586587891098403 pgrad: 0.00463332061849009
## iter: 600 f-value: 0.0058563406672575 pgrad: 0.00462873919623052
## iter: 610 f-value: 0.00584682133494182 pgrad: 0.00462416230760632
## iter: 620 f-value: 0.00583732087652701 pgrad: 0.00461958994812728
## iter: 630 f-value: 0.00582783925457722 pgrad: 0.00461502211330722
## iter: 640 f-value: 0.005818376431731 pgrad: 0.00461045879866551
## iter: 650 f-value: 0.00580893237070086 pgrad: 0.00460589999972505
## iter: 660 f-value: 0.00579950703427359 pgrad: 0.00460134571201354
## iter: 670 f-value: 0.00579010038530959 pgrad: 0.00459679593106277
## iter: 680 f-value: 0.00578071238674303 pgrad: 0.00459225065240954

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## iter: 690 f-value: 0.00577134300158158 pgrad: 0.00458770987159485
## iter: 700 f-value: 0.00576199219290647 pgrad: 0.00458317358416382
## iter: 710 f-value: 0.00575265992387194 pgrad: 0.00457864178566647
## iter: 720 f-value: 0.00574334615770559 pgrad: 0.00457411447165679
## iter: 730 f-value: 0.00573405085770787 pgrad: 0.00456959163769355
## iter: 740 f-value: 0.00572477398725196 pgrad: 0.00456507327933942
## iter: 750 f-value: 0.00571551550978384 pgrad: 0.00456055939216193
## iter: 760 f-value: 0.00570627538882193 pgrad: 0.0045560499717332
## iter: 770 f-value: 0.00569705358795729 pgrad: 0.00455154501362898
## iter: 780 f-value: 0.00568785007085287 pgrad: 0.00454704451342969
## iter: 790 f-value: 0.00567866480124399 pgrad: 0.00454254846672075
## iter: 800 f-value: 0.0056694977429378 pgrad: 0.00453805686909103
## iter: 810 f-value: 0.00566034885981314 pgrad: 0.0045335697161345
## iter: 820 f-value: 0.00565121811582092 pgrad: 0.00452908700344934
## iter: 830 f-value: 0.00564210547498315 pgrad: 0.00452460872663762
## iter: 840 f-value: 0.0056330109013935 pgrad: 0.00452013488130631
## iter: 850 f-value: 0.00562393435921681 pgrad: 0.00451566546306637
## iter: 860 f-value: 0.00561487581268884 pgrad: 0.00451120046753328
## iter: 870 f-value: 0.00560583522611678 pgrad: 0.00450673989032724
## iter: 880 f-value: 0.00559681256387817 pgrad: 0.00450228372707207
## iter: 890 f-value: 0.0055878077904215 pgrad: 0.00449783197339626
## iter: 900 f-value: 0.00557882087026555 pgrad: 0.00449338462493309
## iter: 910 f-value: 0.00556985176799984 pgrad: 0.00448894167731906
## iter: 920 f-value: 0.0055609004482839 pgrad: 0.00448450312619608
## iter: 930 f-value: 0.0055519668758476 pgrad: 0.00448006896720987
## iter: 940 f-value: 0.00554305101549046 pgrad: 0.00447563919601057
## iter: 950 f-value: 0.00553415283208223 pgrad: 0.00447121380825255
## iter: 960 f-value: 0.00552527229056205 pgrad: 0.00446679279959483
## iter: 970 f-value: 0.00551640935593881 pgrad: 0.00446237616570011
## iter: 980 f-value: 0.00550756399329078 pgrad: 0.00445796390223574
## iter: 990 f-value: 0.00549873616776556 pgrad: 0.00445355600487363
## iter: 1000 f-value: 0.00548992584457976 pgrad: 0.0044491524692899
## iter: 1010 f-value: 0.00548113298901929 pgrad: 0.00444475329116412
## iter: 1020 f-value: 0.00547235756643857 pgrad: 0.00444035846618152
## iter: 1030 f-value: 0.0054635995422611 pgrad: 0.00443596799003021
## iter: 1040 f-value: 0.00545485888197876 pgrad: 0.00443158185840353
## iter: 1050 f-value: 0.00544613555115211 pgrad: 0.00442720006699904
## iter: 1060 f-value: 0.00543742951540975 pgrad: 0.00442282261151805
## iter: 1070 f-value: 0.00542874074044874 pgrad: 0.00441844948766656
## iter: 1080 f-value: 0.0054200691920342 pgrad: 0.00441408069115434
## iter: 1090 f-value: 0.00541141483599901 pgrad: 0.00440971621769615
## iter: 1100 f-value: 0.00540277763824387 pgrad: 0.00440535606301051
## iter: 1110 f-value: 0.00539415756473733 pgrad: 0.0044010022281997
## iter: 1120 f-value: 0.00538555458151521 pgrad: 0.00439664869285228
## iter: 1130 f-value: 0.00537696865468089 pgrad: 0.00439230146883818
## iter: 1140 f-value: 0.00536839975040499 pgrad: 0.00438795854651342
## iter: 1150 f-value: 0.00535984783492521 pgrad: 0.00438361992161784
## iter: 1160 f-value: 0.00535131287454635 pgrad: 0.00437928558989531
## iter: 1170 f-value: 0.00534279483563974 pgrad: 0.00437495554709422
## iter: 1180 f-value: 0.00533429368464393 pgrad: 0.00437062978896685
## iter: 1190 f-value: 0.00532580938806365 pgrad: 0.00436630831126994
## iter: 1200 f-value: 0.0053173419124703 pgrad: 0.00436199110976443
## iter: 1210 f-value: 0.0053088912245015 pgrad: 0.00435767818021515
## iter: 1220 f-value: 0.00530045729086117 pgrad: 0.0043533695183916

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## iter: 1230 f-value: 0.00529204007831924 pgrad: 0.00434906512006705
## iter: 1240 f-value: 0.00528363955371155 pgrad: 0.00434476498101921
## iter: 1250 f-value: 0.00527525568393974 pgrad: 0.00434046909703012
## iter: 1260 f-value: 0.00526688843597127 pgrad: 0.00433617746388548
## iter: 1270 f-value: 0.00525853777683894 pgrad: 0.00433189007737567
## iter: 1280 f-value: 0.00525020367364101 pgrad: 0.00432760693329481
## iter: 1290 f-value: 0.00524188609354119 pgrad: 0.00432332802744184
## iter: 1300 f-value: 0.00523358500376812 pgrad: 0.00431905335561922
## iter: 1310 f-value: 0.00522530037161555 pgrad: 0.00431478291363363
## iter: 1320 f-value: 0.00521703216444223 pgrad: 0.00431051669729621
## iter: 1330 f-value: 0.00520878034967143 pgrad: 0.00430625470242207
## iter: 1340 f-value: 0.00520054489479136 pgrad: 0.00430199692483069
## iter: 1350 f-value: 0.00519232576735442 pgrad: 0.00429774336034561
## iter: 1360 f-value: 0.00518412293497774 pgrad: 0.00429349400479406
## iter: 1370 f-value: 0.00517593636534228 pgrad: 0.00428924885400805
## iter: 1380 f-value: 0.00516776602619362 pgrad: 0.00428500790382313
## iter: 1390 f-value: 0.00515961188534097 pgrad: 0.00428077115007974
## iter: 1400 f-value: 0.00515147391065747 pgrad: 0.00427653858862165
## iter: 1410 f-value: 0.00514335207008011 pgrad: 0.00427231021529728
## iter: 1420 f-value: 0.00513524633160947 pgrad: 0.00426808602595896
## iter: 1430 f-value: 0.0051271566633095 pgrad: 0.00426386601646289
## iter: 1440 f-value: 0.00511908303330771 pgrad: 0.00425965018266983
## iter: 1450 f-value: 0.00511102540979471 pgrad: 0.00425543852044452
## iter: 1460 f-value: 0.00510298376102426 pgrad: 0.00425123102565561
## iter: 1470 f-value: 0.00509495805531309 pgrad: 0.00424702769417629
## iter: 1480 f-value: 0.00508694826104092 pgrad: 0.00424282852188296
## iter: 1490 f-value: 0.00507895434664998 pgrad: 0.00423863350465714
## iter: 1500 f-value: 0.00507097628064527 pgrad: 0.00423444263838368
## iter: 0 f-value: 0.0818045692229777 pgrad: 0.116557301520905
## iter: 10 f-value: 0.00565150664868701 pgrad: 0.00452923344402456
## iter: 20 f-value: 0.0048173251476876 pgrad: 0.00409896428094347
## iter: 30 f-value: 0.00428973234223551 pgrad: 0.00208851171368815
## iter: 40 f-value: 0.00399092398543415 pgrad: 0.00179597829685192
## iter: 50 f-value: 0.00376996021247007 pgrad: 0.00154441941676664
## Successful convergence.
## iter: 0 f-value: 0.0808505295557911 pgrad: 0.298285027768035
## iter: 10 f-value: 0.0221356618135646 pgrad: 0.234220714924961
## iter: 20 f-value: 0.0163306973407655 pgrad: 0.190501419463078
## iter: 30 f-value: 0.0124882088894578 pgrad: 0.158815736163187
## iter: 40 f-value: 0.00988449826158982 pgrad: 0.133649149798946
## iter: 50 f-value: 0.00808942464421206 pgrad: 0.113010540495617
## iter: 60 f-value: 0.00683521554817273 pgrad: 0.0958153237745902
## iter: 70 f-value: 0.0059494522695678 pgrad: 0.0818905860696397
## iter: 80 f-value: 0.00531825091912158 pgrad: 0.0703964119265424
## iter: 90 f-value: 0.0048648941017042 pgrad: 0.0606954403924165
## iter: 100 f-value: 0.00453689312699397 pgrad: 0.0524851990372676
## iter: 110 f-value: 0.00429788744934875 pgrad: 0.0455207052300079
## iter: 120 f-value: 0.00412243453220038 pgrad: 0.0396016542396601
## iter: 130 f-value: 0.00399258449686564 pgrad: 0.0345629950449209
## iter: 140 f-value: 0.00389558738380447 pgrad: 0.0302678489295685
## iter: 150 f-value: 0.00382233545372471 pgrad: 0.0266020910484547
## iter: 160 f-value: 0.00376629166913751 pgrad: 0.0234701370747463
## iter: 170 f-value: 0.00372274489276432 pgrad: 0.0207916242757186
## iter: 180 f-value: 0.00368828756068676 pgrad: 0.0184987634790533

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## iter: 190 f-value: 0.00366044658901953 pgrad: 0.0165342065954048
## iter: 200 f-value: 0.00363742077104073 pgrad: 0.0148493110851241
## iter: 210 f-value: 0.00361789272201691 pgrad: 0.0134027164717722
## iter: 220 f-value: 0.00360089326425507 pgrad: 0.0121591666016866
## iter: 230 f-value: 0.00358570271097087 pgrad: 0.0110885253693718
## iter: 240 f-value: 0.00357177793535135 pgrad: 0.0101649463550474
## iter: 250 f-value: 0.00355869691071027 pgrad: 0.00961240986705104
## iter: 260 f-value: 0.00354611401726685 pgrad: 0.00935754512189675
## iter: 270 f-value: 0.00353371952748566 pgrad: 0.00913310492969202
## iter: 280 f-value: 0.00352119455004405 pgrad: 0.00893356010024722
## iter: 290 f-value: 0.00350814464643004 pgrad: 0.00875358666352545
## iter: 300 f-value: 0.00349396857067213 pgrad: 0.00858749626530403
## iter: 310 f-value: 0.00347751192665673 pgrad: 0.00842789335006082
## iter: 320 f-value: 0.00345575412823342 pgrad: 0.00826104187227199
## iter: 330 f-value: 0.0034131990024046 pgrad: 0.00826018918590035
## iter: 340 f-value: 0.00292864417948742 pgrad: 0.00761390977254997
## iter: 350 f-value: 0.00252683033632397 pgrad: 0.00671738461178008
## iter: 360 f-value: 0.00220459393006409 pgrad: 0.005927204092121
## iter: 370 f-value: 0.0019466869383843 pgrad: 0.00523043878627594
## iter: 380 f-value: 0.00174063934385388 pgrad: 0.00461575000344738
## iter: 390 f-value: 0.0015762941140159 pgrad: 0.0040732320998191
## iter: 400 f-value: 0.00144540619323016 pgrad: 0.00359422118783862
## iter: 410 f-value: 0.00134130370068582 pgrad: 0.00317113084982187
## iter: 420 f-value: 0.00125860333682877 pgrad: 0.00279731114534569
## iter: 430 f-value: 0.00119297321077633 pgrad: 0.00249265860024324
## iter: 440 f-value: 0.00114093600658978 pgrad: 0.00222937851832185
## iter: 450 f-value: 0.00109970671700223 pgrad: 0.00199611840728461
## iter: 460 f-value: 0.00106705932643387 pgrad: 0.00178945686137494
## iter: 470 f-value: 0.0010412179898452 pgrad: 0.0016063606294647
## iter: 480 f-value: 0.00102076837792102 pgrad: 0.00144414081289207
## iter: 490 f-value: 0.00100458581729854 pgrad: 0.00130041454384291
## iter: 500 f-value: 0.000991777207072398 pgrad: 0.00117307016156581
## iter: 510 f-value: 0.000981634234613364 pgrad: 0.00106023713758893
## iter: 520 f-value: 0.00097359576398791 pgrad: 0.000960257894546263
## iter: 530 f-value: 0.000967217718211271 pgrad: 0.000871664319894216
## iter: 540 f-value: 0.000962148963108319 pgrad: 0.00079315563734525
## iter: 550 f-value: 0.000958112097853491 pgrad: 0.000723579868489227
## iter: 560 f-value: 0.000954888116248917 pgrad: 0.000661916334756152
## iter: 570 f-value: 0.00095230423499862 pgrad: 0.000607261006493387
## iter: 580 f-value: 0.000950224213991097 pgrad: 0.000558813043581574
## iter: 590 f-value: 0.000948540675578742 pgrad: 0.000515862971224024
## iter: 600 f-value: 0.000947169033988041 pgrad: 0.000477782316846836
## iter: 610 f-value: 0.000946042674981681 pgrad: 0.000444014263882075
## iter: 620 f-value: 0.000945109156771679 pgrad: 0.000414065545779052
## iter: 630 f-value: 0.000944327197179668 pgrad: 0.000387498794790081
## iter: 640 f-value: 0.000943664304286144 pgrad: 0.000363926830688782
## iter: 650 f-value: 0.000943094897116522 pgrad: 0.000343006161274029
## iter: 660 f-value: 0.00094259882898013 pgrad: 0.000324432448531781
## iter: 670 f-value: 0.000942160216505754 pgrad: 0.000307935697241968
## iter: 680 f-value: 0.000941766522224711 pgrad: 0.000293276500583167
## iter: 690 f-value: 0.000941407814139493 pgrad: 0.000280242310773005
## iter: 700 f-value: 0.000941076193430645 pgrad: 0.000268644352344444
## iter: 710 f-value: 0.000940765328668992 pgrad: 0.000258314979156682
## iter: 720 f-value: 0.000940470078829594 pgrad: 0.000249104646711268

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## iter: 730 f-value: 0.00094018618399507 pgrad: 0.000240880228878859
## iter: 740 f-value: 0.000939910000006777 pgrad: 0.000233522528571284
## iter: 750 f-value: 0.000939638261876039 pgrad: 0.000226924569432824
## iter: 760 f-value: 0.000939367834954649 pgrad: 0.000220989349077855
## iter: 770 f-value: 0.000939095445047416 pgrad: 0.000215628352846803
## iter: 780 f-value: 0.000938817332252797 pgrad: 0.000210759378995007
## iter: 790 f-value: 0.000938528669871896 pgrad: 0.00020630328559354
## iter: 800 f-value: 0.000938222618070778 pgrad: 0.000202180684993752
## iter: 810 f-value: 0.000937888360326332 pgrad: 0.000198305035291252
## iter: 820 f-value: 0.000937506488340221 pgrad: 0.00019456783534777
## iter: 830 f-value: 0.000937035442629204 pgrad: 0.000190801001892005
## iter: 840 f-value: 0.000936397257838085 pgrad: 0.000187033302947198
## iter: 850 f-value: 0.000935706462817269 pgrad: 0.000183523789402479
## iter: 860 f-value: 0.000935223006430148 pgrad: 0.000183513129033946
## iter: 870 f-value: 0.000935219146702352 pgrad: 0.000183201340974048
## iter: 880 f-value: 0.000935215015275442 pgrad: 0.000182926262521338
## iter: 890 f-value: 0.000935210423939326 pgrad: 0.000182678254132734
## iter: 900 f-value: 0.00093520500340034 pgrad: 0.000182447059354274
## iter: 910 f-value: 0.000935197760088436 pgrad: 0.000182216037949628
## iter: 920 f-value: 0.000935184155737379 pgrad: 0.000181938531475356
## iter: 930 f-value: 0.000934318758398091 pgrad: 0.000178366635500304
## iter: 940 f-value: 0.000934314349951214 pgrad: 0.000178567084572145
## iter: 950 f-value: 0.000934309096820704 pgrad: 0.000178751573399472
## iter: 960 f-value: 0.000934302154344617 pgrad: 0.000178926831822301
## iter: 970 f-value: 0.000934289981239566 pgrad: 0.000179108874492351
## iter: 980 f-value: 0.000930753569932613 pgrad: 0.000183461456155498
## iter: 990 f-value: 0.000930726268763319 pgrad: 0.000169900661563638
## iter: 1000 f-value: 0.00093072295021543 pgrad: 0.000170322732302969
## iter: 1010 f-value: 0.000930719550275278 pgrad: 0.000170684314023145
## iter: 1020 f-value: 0.000930716024126893 pgrad: 0.00017099606965551
## iter: 1030 f-value: 0.00093071231049726 pgrad: 0.000171266749697169
## iter: 1040 f-value: 0.000930708301400532 pgrad: 0.000171504593493327
## iter: 1050 f-value: 0.000930703788324123 pgrad: 0.000171717970788937
## iter: 1060 f-value: 0.000930698316531485 pgrad: 0.000171916477463258
## iter: 1070 f-value: 0.000930690590696089 pgrad: 0.000172114594219064
## iter: 1080 f-value: 0.000930672315827153 pgrad: 0.000172359272037126
## iter: 1090 f-value: 0.000929552654633175 pgrad: 0.000177134678452956
## iter: 1100 f-value: 0.000929549533637528 pgrad: 0.000176393707977451
## iter: 1110 f-value: 0.000929546399217766 pgrad: 0.000175763890894326
## iter: 1120 f-value: 0.000929543241261897 pgrad: 0.000175227692106178
## iter: 1130 f-value: 0.00092954004816145 pgrad: 0.000174770523376971
## iter: 1140 f-value: 0.000929536798010724 pgrad: 0.000174379259256785
## iter: 1150 f-value: 0.000929533469612865 pgrad: 0.000174043447642325
## iter: 1160 f-value: 0.000929530017652257 pgrad: 0.000173753319576309
## iter: 1170 f-value: 0.000929526378872964 pgrad: 0.000173500553117212
## iter: 1180 f-value: 0.000929522440221145 pgrad: 0.000173277165481489
## iter: 1190 f-value: 0.000929517995659022 pgrad: 0.000173075732644024
## iter: 1200 f-value: 0.000929512611801471 pgrad: 0.000172887768258856
## iter: 1210 f-value: 0.000929504995397941 pgrad: 0.000172698449902198
## iter: 1220 f-value: 0.00092948770820166 pgrad: 0.000172466126173637
## iter: 1230 f-value: 0.000927033170227906 pgrad: 0.000243299761354954
## iter: 1240 f-value: 0.000927027644571644 pgrad: 0.000221088601478625
## iter: 1250 f-value: 0.000927022845171311 pgrad: 0.000202281227989404
## iter: 1260 f-value: 0.000927018566155787 pgrad: 0.000186355718873238

```

```

## iter: 1270 f-value: 0.000927014659951009 pgrad: 0.00017287043186609
## iter: 1280 f-value: 0.00092701102073066 pgrad: 0.00016145130913614
## iter: 1290 f-value: 0.000927007572508781 pgrad: 0.000151781446470656
## iter: 1300 f-value: 0.00092700426073075 pgrad: 0.000153378326749387
## iter: 1310 f-value: 0.000927001046167038 pgrad: 0.00015601953145622
## iter: 1320 f-value: 0.000926997900522447 pgrad: 0.000158255809321273
## iter: 1330 f-value: 0.000926994803171658 pgrad: 0.00016014956751445
## iter: 1340 f-value: 0.000926991738824516 pgrad: 0.000161753314439794
## iter: 1350 f-value: 0.000926988696212463 pgrad: 0.000163111651907744
## iter: 1360 f-value: 0.00092698566625103 pgrad: 0.000164262375107416
## iter: 1370 f-value: 0.000926982641257248 pgrad: 0.000165237568242271
## iter: 1380 f-value: 0.00092697961448026 pgrad: 0.000166064339816446
## iter: 1390 f-value: 0.000926976578282681 pgrad: 0.000166765695417265
## iter: 1400 f-value: 0.000926973524914943 pgrad: 0.00016736112949256
## iter: 1410 f-value: 0.000926970443384563 pgrad: 0.000167867380941156
## iter: 1420 f-value: 0.000926967319501393 pgrad: 0.000168298536900424
## iter: 1430 f-value: 0.000926964131443727 pgrad: 0.0001686670286353
## iter: 1440 f-value: 0.000926960848010878 pgrad: 0.000168983135368145
## iter: 1450 f-value: 0.000926957421197675 pgrad: 0.000169255988840905
## iter: 1460 f-value: 0.000926953780870564 pgrad: 0.000169493181130076
## iter: 1470 f-value: 0.000926949786904251 pgrad: 0.00016970270211572
## iter: 1480 f-value: 0.000926945155729468 pgrad: 0.000169892711503361
## iter: 1490 f-value: 0.000926939251411093 pgrad: 0.000170072110494274
## iter: 1500 f-value: 0.000926929730026061 pgrad: 0.000170258795915174
## iter: 0 f-value: 0.0808505295557911 pgrad: 0.298285027768035
## iter: 10 f-value: 0.00548798061356966 pgrad: 0.0736229270327704
## iter: 20 f-value: 0.00375137544122695 pgrad: 0.0220798236760894
## iter: 30 f-value: 0.00352446703823117 pgrad: 0.00872028563350478
## iter: 40 f-value: 0.00245379051364538 pgrad: 0.006552974486036
## iter: 50 f-value: 0.00129724788647376 pgrad: 0.00539672147484921
## iter: 60 f-value: 0.00116336349069024 pgrad: 0.00333775280378497
## iter: 70 f-value: 0.00108903466397249 pgrad: 0.00190921293452803
## iter: 80 f-value: 0.00101864754852102 pgrad: 0.00142504956225517
## iter: 90 f-value: 0.000976654378619111 pgrad: 0.000997552748068009
## iter: 100 f-value: 0.000958449297472636 pgrad: 0.000744402940192845
## iter: 110 f-value: 0.00095166681308669 pgrad: 0.0006398708971532
## iter: 120 f-value: 0.000948031278701184 pgrad: 0.000493636979067735
## iter: 130 f-value: 0.000944572041868178 pgrad: 0.000389096222985164
## iter: 140 f-value: 0.000943078043273489 pgrad: 0.000351752915581288
## iter: 150 f-value: 0.000941792566572578 pgrad: 0.000260500752026244
## iter: 160 f-value: 0.000940741435894291 pgrad: 0.000276463268609362
## iter: 170 f-value: 0.000940636432666963 pgrad: 0.000240171951534279
## iter: 180 f-value: 0.000939234800584778 pgrad: 0.000238212914218244
## iter: 190 f-value: 0.00093902315453756 pgrad: 0.000201735673817816
## iter: 200 f-value: 0.000938571292168387 pgrad: 0.000192644573155154
## iter: 210 f-value: 0.000937952033971741 pgrad: 0.000177217643574396
## iter: 220 f-value: 0.00093739079839151 pgrad: 0.000244182425818085
## iter: 230 f-value: 0.000937207441240713 pgrad: 0.000185814173194215
## iter: 240 f-value: 0.000936779838412506 pgrad: 0.000181145989543663
## iter: 250 f-value: 0.000936199021137431 pgrad: 0.000175474987286844
## iter: 260 f-value: 0.000933859784910175 pgrad: 0.000176623839547807
## iter: 270 f-value: 0.000933323755560183 pgrad: 0.000177107718977415
## iter: 280 f-value: 0.000932422885391989 pgrad: 0.000176963697996163
## iter: 290 f-value: 0.000931944483337105 pgrad: 0.000211438375784329

```

## iter:	300	f-value:	0.000931416984018967	pgrad:	0.000234455486610552
## iter:	310	f-value:	0.000930866248624855	pgrad:	0.000232578872019246
## iter:	320	f-value:	0.000930372144892009	pgrad:	0.000218021374214145
## iter:	330	f-value:	0.000929805626990325	pgrad:	0.000166046154887661
## iter:	340	f-value:	0.000928935132850013	pgrad:	0.000172391493145824
## iter:	350	f-value:	0.000911299335602487	pgrad:	0.000150133355183657
## iter:	360	f-value:	0.000910792702328878	pgrad:	0.000137121159005937
## iter:	370	f-value:	0.000910380532074656	pgrad:	0.000135984944698297
## iter:	380	f-value:	0.000910019026358382	pgrad:	0.000150158233286707
## iter:	390	f-value:	0.000909662998212293	pgrad:	0.000167893313677225
## iter:	400	f-value:	0.000909320259350745	pgrad:	0.000217217289964738
## iter:	410	f-value:	0.000909080264169477	pgrad:	0.000147726878078791
## iter:	420	f-value:	0.000908564351074193	pgrad:	0.000173908430467329
## iter:	430	f-value:	0.000908457529040839	pgrad:	0.000152011648711287
## iter:	440	f-value:	0.000908132796990118	pgrad:	0.000149683361802988
## iter:	450	f-value:	0.000907777811892765	pgrad:	0.000138964265146313
## iter:	460	f-value:	0.000907330602978034	pgrad:	0.000142268590275829
## iter:	470	f-value:	0.000906992611653637	pgrad:	0.000138196809484514
## iter:	480	f-value:	0.000906532298810811	pgrad:	0.000142670470115208
## iter:	490	f-value:	0.000905745636456882	pgrad:	0.000148490649227395
## iter:	500	f-value:	0.000904408525301197	pgrad:	0.00014785292495928
## iter:	510	f-value:	0.00090396535369911	pgrad:	0.000130137298605448
## iter:	520	f-value:	0.000903655815251337	pgrad:	0.000152002905409288
## iter:	530	f-value:	0.000901041716584621	pgrad:	0.00024087325351637
## iter:	540	f-value:	0.000900995864844732	pgrad:	0.000153050174727609
## iter:	550	f-value:	0.000900204100776305	pgrad:	0.000135934240603791
## iter:	560	f-value:	0.000885205148947248	pgrad:	0.000111407053386026
## iter:	570	f-value:	0.000884596670800475	pgrad:	0.000178650669660191
## iter:	580	f-value:	0.000884555542932767	pgrad:	0.000120847076920061
## iter:	590	f-value:	0.000884360728121233	pgrad:	0.000119138622282827
## iter:	600	f-value:	0.000884161146366584	pgrad:	0.000112818966605727
## iter:	610	f-value:	0.000883938323542387	pgrad:	0.000115237668878582
## iter:	620	f-value:	0.000883740069550177	pgrad:	0.000136013136517454
## iter:	630	f-value:	0.000883252093375448	pgrad:	0.000375274211366773
## iter:	640	f-value:	0.000882981640486224	pgrad:	0.000159285328574399
## iter:	650	f-value:	0.000882910483332704	pgrad:	0.000118839115670927
## iter:	660	f-value:	0.000882749149308992	pgrad:	0.000119455416399794
## iter:	670	f-value:	0.000881677156954622	pgrad:	0.000175297068429031
## iter:	680	f-value:	0.000881641854953563	pgrad:	0.000116008775739085
## iter:	690	f-value:	0.000881456040322125	pgrad:	0.000110492970813725
## iter:	700	f-value:	0.000880987318158473	pgrad:	0.000114432273138759
## iter:	710	f-value:	0.000880683606117975	pgrad:	0.000119135613326105
## iter:	720	f-value:	0.000880293184436292	pgrad:	0.000113563192447513
## iter:	730	f-value:	0.000876705979090863	pgrad:	0.000790468558171775
## iter:	740	f-value:	0.000876430521342055	pgrad:	0.000195832757759383
## iter:	750	f-value:	0.000876403272013374	pgrad:	0.000117113659757972
## iter:	760	f-value:	0.00087606310415655	pgrad:	0.000146040552894994
## iter:	770	f-value:	0.000876036817299847	pgrad:	0.000106351367205409
## iter:	780	f-value:	0.000875284973329705	pgrad:	0.00011862494375367
## iter:	790	f-value:	0.000874715235623463	pgrad:	0.00197781697131819
## iter:	800	f-value:	0.000871503592612927	pgrad:	0.000106341014158878
## iter:	810	f-value:	0.000870921476208527	pgrad:	0.000637461427453218
## iter:	820	f-value:	0.000870788360100893	pgrad:	0.000188148525523735
## iter:	830	f-value:	0.000870769965051153	pgrad:	9.24562728696621e-05



```

## iter: 840 f-value: 0.000869782707384213 pgrad: 0.000325517248099677
## iter: 850 f-value: 0.000869747206300914 pgrad: 0.000103503975828922
## iter: 860 f-value: 0.000869570069737923 pgrad: 0.000257909816845953
## iter: 870 f-value: 0.000869540297747904 pgrad: 9.11766312308437e-05
## iter: 880 f-value: 0.0008694246915281 pgrad: 8.72849172989798e-05
## iter: 890 f-value: 0.000868198110230017 pgrad: 0.000134129363432017
## iter: 900 f-value: 0.000868176127136443 pgrad: 9.10889848200203e-05
## iter: 910 f-value: 0.000868072793085388 pgrad: 8.9365836384997e-05
## iter: 920 f-value: 0.000867813932850335 pgrad: 0.000106845205426198
## iter: 930 f-value: 0.000867717224645632 pgrad: 0.000103926104819463
## iter: 940 f-value: 0.000867682126906662 pgrad: 8.98477865260983e-05
## iter: 950 f-value: 0.000867341512251412 pgrad: 9.25783919814016e-05
## iter: 960 f-value: 0.000867050873213932 pgrad: 8.40392770761478e-05
## iter: 970 f-value: 0.000866938857328822 pgrad: 8.25200164079887e-05
## iter: 980 f-value: 0.000866679500668022 pgrad: 0.000133552854302749
## iter: 990 f-value: 0.000866661127223277 pgrad: 8.75565078733431e-05
## iter: 1000 f-value: 0.000866516710082035 pgrad: 7.8479457386621e-05
## iter: 1010 f-value: 0.000866117637541737 pgrad: 0.000106777812799053
## iter: 1020 f-value: 0.00086602629052526 pgrad: 7.64240393270332e-05
## iter: 1030 f-value: 0.00086599477481023 pgrad: 8.63397245310094e-05
## iter: 1040 f-value: 0.000865895959497257 pgrad: 8.77184576159595e-05
## iter: 1050 f-value: 0.000865795391732938 pgrad: 8.93039748645352e-05
## iter: 1060 f-value: 0.000865672996838399 pgrad: 8.80494766625495e-05
## iter: 1070 f-value: 0.000865498958359052 pgrad: 0.000102973811512891
## iter: 1080 f-value: 0.000865318428573917 pgrad: 0.000247509317630151
## iter: 1090 f-value: 0.000865184575917115 pgrad: 8.72462030020449e-05
## iter: 1100 f-value: 0.000865073110103693 pgrad: 8.33993905146602e-05
## iter: 1110 f-value: 0.000864957068275234 pgrad: 8.53151332724233e-05
## iter: 1120 f-value: 0.000864874306091054 pgrad: 8.38849431639144e-05
## iter: 1130 f-value: 0.000864792322682233 pgrad: 8.51009338558584e-05
## iter: 1140 f-value: 0.000864700369003013 pgrad: 8.71433028523383e-05
## iter: 1150 f-value: 0.000864610522984255 pgrad: 9.13145288353179e-05
## iter: 1160 f-value: 0.00086449849776892 pgrad: 9.00534203512604e-05
## iter: 1170 f-value: 0.000864108350910587 pgrad: 0.000148768819233355
## iter: 1180 f-value: 0.000864092889006071 pgrad: 8.89389917064221e-05
## iter: 1190 f-value: 0.000863800535660713 pgrad: 0.000124423856240209
## iter: 1200 f-value: 0.000863787491205523 pgrad: 8.47025907825816e-05
## iter: 1210 f-value: 0.000863702727329401 pgrad: 8.80376615201017e-05
## iter: 1220 f-value: 0.000862196264113388 pgrad: 0.000120063345510867
## iter: 1230 f-value: 0.000862184446974828 pgrad: 8.06323868154379e-05
## iter: 1240 f-value: 0.000862102726797721 pgrad: 8.67939028335041e-05
## iter: 1250 f-value: 0.000862001793217786 pgrad: 8.46278722012594e-05
## iter: 1260 f-value: 0.000861927250550088 pgrad: 8.79723704710345e-05
## iter: 1270 f-value: 0.000861784158658091 pgrad: 0.000109589034993918
## iter: 1280 f-value: 0.000861773284966722 pgrad: 7.72994024770268e-05
## iter: 1290 f-value: 0.000861699894980909 pgrad: 7.97618504348452e-05
## iter: 1300 f-value: 0.000861549170700408 pgrad: 9.67140279438672e-05
## iter: 1310 f-value: 0.00086152767315823 pgrad: 7.50012033618463e-05
## iter: 1320 f-value: 0.000861428316846219 pgrad: 8.00046366158935e-05
## iter: 1330 f-value: 0.000861345804007183 pgrad: 8.02023776463878e-05
## iter: 1340 f-value: 0.000861274417501135 pgrad: 8.42467795730828e-05
## iter: 1350 f-value: 0.000861178077337278 pgrad: 8.18326180374029e-05
## iter: 1360 f-value: 0.000861100982858868 pgrad: 8.20784587116652e-05
## iter: 1370 f-value: 0.000861026995136708 pgrad: 8.88299045077034e-05

```

```

## iter: 1380 f-value: 0.000860831869927721 pgrad: 0.000373105120426154
## iter: 1390 f-value: 0.000860770708730074 pgrad: 7.25359427864447e-05
## iter: 1400 f-value: 0.000860566696698535 pgrad: 7.94805589122705e-05
## iter: 1410 f-value: 0.000860372626439614 pgrad: 0.0004845223067656
## iter: 1420 f-value: 0.000860292452083116 pgrad: 7.33000123863681e-05
## iter: 1430 f-value: 0.000860215684247431 pgrad: 7.15001185034314e-05
## iter: 1440 f-value: 0.000860135281639201 pgrad: 6.7874554028069e-05
## iter: 1450 f-value: 0.000859878185426882 pgrad: 0.000203972963342069
## iter: 1460 f-value: 0.000859863859550065 pgrad: 6.48983722467134e-05
## iter: 1470 f-value: 0.000859798437004844 pgrad: 7.1289266511787e-05
## iter: 1480 f-value: 0.000859718311564438 pgrad: 6.45226654421016e-05
## iter: 1490 f-value: 0.00085964745612598 pgrad: 9.08451055661175e-05
## iter: 1500 f-value: 0.000859624134684047 pgrad: 6.85731964621961e-05
## iter: 0 f-value: 0.0808505295557911 pgrad: 0.298285027768035
## iter: 10 f-value: 0.00107719875960105 pgrad: 0.00185150310625298
## iter: 20 f-value: 0.0192359365849244 pgrad: 0.189777432462782
## iter: 30 f-value: 0.000939654216641966 pgrad: 0.000711360798332492
## iter: 40 f-value: 0.000920209469651887 pgrad: 0.00662663137460659
## iter: 50 f-value: 0.000896611743056737 pgrad: 0.00019918306567715
## iter: 60 f-value: 0.00088583552053203 pgrad: 0.000708953825057285
## iter: 70 f-value: 0.0464650323721035 pgrad: 0.228110269437323
## iter: 80 f-value: 0.000851978873905954 pgrad: 3.99448020233506e-05
## iter: 90 f-value: 0.000849216847718312 pgrad: 0.000320976213371849
## iter: 100 f-value: 0.000849144568390781 pgrad: 2.17019862071011e-05
## iter: 110 f-value: 0.000855877138303113 pgrad: 0.000482232001332183
## Successful convergence.

```

```
names(gev_mixture_model)
```

```

## [1] "data"
## [2] "data_largest"
## [3] "block_sizes"
## [4] "equivalent_block_sizes"
## [5] "rejected_block_sizes"
## [6] "block_maxima_indexes_object"
## [7] "gev_models_object"
## [8] "extremal_indexes"
## [9] "normalized_gev_parameters_object"
## [10] "weighted_normalized_gev_parameters_object"
## [11] "identic_weights_mw"
## [12] "pessimistic_weights_mw"
## [13] "pessimistic_weights_pw_shape"
## [14] "pessimistic_weights_pw_scale"
## [15] "pessimistic_weights_pw_loc"
## [16] "automatic_weights_mw"
## [17] "automatic_weights_mw_statistics"
## [18] "automatic_weights_pw_shape"
## [19] "automatic_weights_pw_scale"
## [20] "automatic_weights_pw_loc"
## [21] "automatic_weights_pw_statistics"

```

```
gev_mixture_model$block_sizes
```

```
## [1] 10 11 12 13 14 15 16 17 18 19 20
```

```
gev_mixture_model$normalized_gev_parameters_object
```

```
##           loc_star      scale_star      shape_star
## 10 2.91331481647741 0.557778942787110 0.161970648893821
## 11 2.96206166835856 0.504669570501020 0.190946663105825
## 12 3.25805424025380 0.363819198216133 0.272634333744191
## 13 2.97569910760020 0.573679252734363 0.148186663152879
## 14 3.28103398642466 0.396035969252894 0.243229178127215
## 15 3.22872025550140 0.420675763009360 0.228491424009938
## 16 2.98489828985661 0.554891759147021 0.157253339653076
## 17 3.68872366009854 0.234473016638563 0.379269119513422
## 18 3.60179011004418 0.267525276338887 0.345794054989248
## 19 3.56487287280516 0.305417079312862 0.310152835762093
## 20 3.45934838387646 0.343904011149439 0.274174802601684
```

```
gev_mixture_model$weighted_normalized_gev_parameters_object
```

```
##           loc_star      scale_star      shape_star
## identic_weights      3.26531976284518 0.411169985371605 0.246554823959399
## pessimistic_weights 3.33813544954861 0.424583307490144 0.252164095173749
## automatic_weights    3.19056898022041 0.341195137135598 0.335591914464968
```

```
gev_mixture_model$automatic_weights_mw
```

```
##           10           11           12
## 0.000000000000000e+00 1.000000000000000e+00 -1.33226762955019e-15
##           13           14           15
## 0.000000000000000e+00 0.000000000000000e+00 0.000000000000000e+00
##           16           17           18
## 0.000000000000000e+00 0.000000000000000e+00 0.000000000000000e+00
##           19           20
## 0.000000000000000e+00 0.000000000000000e+00
```

```
gev_mixture_model$automatic_weights_mw_statistics
```

```
## $function_value
## [1] 0.0036225431298914
##
## $gradient_value
## [1] 1.42941214420489e-15
##
## $function_reduction
## [1] 0.0781820260930863
##
## $number_iterations
## [1] 1560
##
## $convergence
## [1] 0
##
## $message
## [1] "Successful convergence"
```

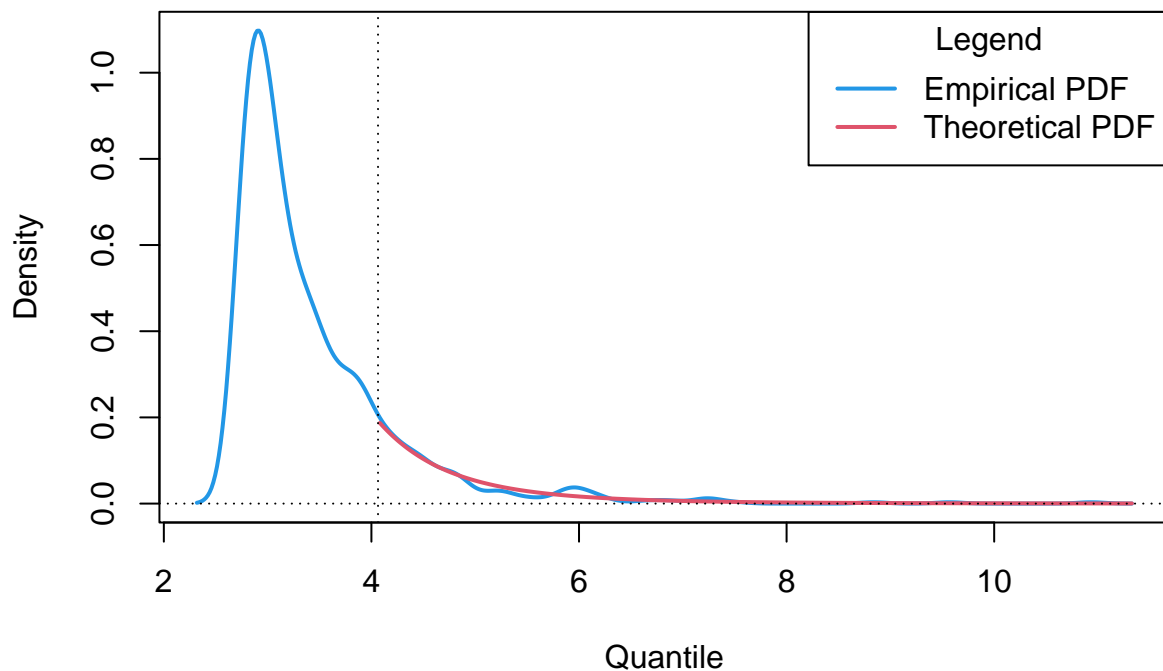
```
gev_mixture_model$automatic_weights_pw_statistics
```

```
## $function_value
## [1] 0.000848757832158418
```

```
##
## $gradient_value
## [1] 1.36055174386751e-05
##
## $function_reduction
## [1] 0.0800017717236326
##
## $number_iterations
## [1] 3118
##
## $convergence
## [1] 0
##
## $message
## [1] "Successful convergence"
```

```
plot_gev_mixture_model_pdf(gev_mixture_model,
  type = "automatic_weights",
  model_wise = TRUE,
  zoom = FALSE,
  xlab = "Quantile",
  ylab = "Density",
  main = "Probability Density Function (PDF) Plot")
```

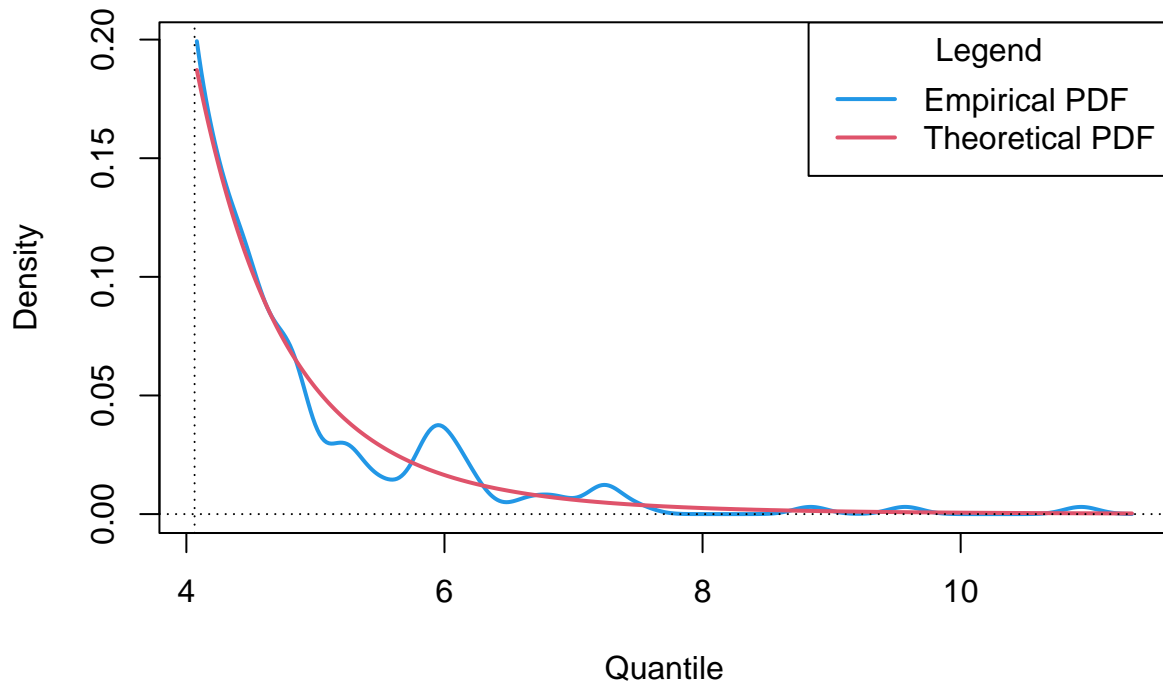
**Probability Density Function (PDF) Plot : automatic\_weights – model\_wise = TRUE : zoom**



```
plot_gev_mixture_model_pdf(gev_mixture_model,
  type = "automatic_weights",
  model_wise = TRUE,
  zoom = TRUE,
  xlab = "Quantile",
  ylab = "Density",
```

```
main = "Probability Density Function (PDF) Plot")
```

Probability Density Function (PDF) Plot : automatic\_weights – model\_wise = TRUE : zoc



```
gev_mixture_model_parameters <- gev_mixture_model$normalized_gev_parameters_object
```

```
shapes <- gev_mixture_model_parameters$shape_star
```

```
scales <- gev_mixture_model_parameters$scale_star
```

```
locations <- gev_mixture_model_parameters$loc_star
```

```
weights <- gev_mixture_model$automatic_weights_mw
```

```
#
```

```
p <- 0.95
```

```
q_initial_guesses <- sapply(1:length(weights), function(j) calculate_gev_inverse_cdf(p = p,
loc = locations[j],
scale = scales[j],
shape = shapes[j]))
```

```
q_initial_guesses
```

```
## [1] 5.04093114394992 4.97927579575552 4.92266737439822 5.11627189727924
```

```
## [5] 5.00607229061463 5.01687599937565 5.08556643559924 4.97762713999913
```

```
## [9] 4.98886604924849 5.05412052001466 5.03692884375668
```

```
range(q_initial_guesses)
```

```
## [1] 4.92266737439822 5.11627189727924
```

```
block_size <- max(gev_mixture_model$block_sizes)
```

```
y <- gev_mixture_model$data_largest
```

```
threshold <- find_threshold_associated_with_given_block_size(x = y, block_size = block_size)
```

```

library(evd)

data <- y[y > threshold]

M3 <- fgev(data, prob = 0.95)

M3

##
## Call: fgev(x = data, prob = 0.95)
## Deviance: 278.014037403653
##
## Estimates
##      quantile      scale      shape
## 4.120534480188 0.37355979542 0.680349618047
##
## Standard Errors
##      quantile      scale      shape
## 0.0177001900922 0.0404264382965 0.1156345016665
##
## Optimization Information
##   Convergence: successful
##  Function Evaluations: 65
##  Gradient Evaluations: 14

M4 <- fgev(data)

M4

##
## Call: fgev(x = data)
## Deviance: 278.01403743192
##
## Estimates
##      loc      scale      shape
## 4.409323933609 0.373559795532 0.680363739474
##
## Standard Errors
##      loc      scale      shape
## 0.0381669578725 0.0404251481620 0.1156445110604
##
## Optimization Information
##   Convergence: successful
##  Function Evaluations: 61
##  Gradient Evaluations: 14

Fn <- ecdf(y)

p <- seq(from = Fn(threshold), to = 0.999, length.out = 20)
p

## [1] 0.856000000000000 0.863526315789474 0.871052631578947 0.878578947368421
## [5] 0.886105263157895 0.893631578947368 0.901157894736842 0.908684210526316
## [9] 0.916210526315789 0.923736842105263 0.931263157894737 0.938789473684211
## [13] 0.946315789473684 0.953842105263158 0.961368421052632 0.968894736842105
## [17] 0.976421052631579 0.983947368421053 0.991473684210526 0.999000000000000

```

```
quantiles <- calculate_gev_mixture_model_inverse_cdf(p = p*0.1, locations, scales, shapes, weights, iter = 1000)
```

```
quantiles
```

```
## [1] 2.54500903948768 2.54652594666024 2.54803607637323 2.54953953953945
## [5] 2.55103644445846 2.55252689690042 2.55401100018660 2.55548885526666
## [9] 2.55696056079287 2.55842621319139 2.55988590673084 2.56133973358820
## [13] 2.56278778391210 2.56423014588387 2.56566690577614 2.56709814800931
## [17] 2.56852395520596 2.56994440824319 2.57135958630309 2.57276956692134
```

```
probaility <- calculate_gev_mixture_model_cdf(q = quantiles, locations, scales, shapes, weights)
```

```
probaility
```

```
## [1] 0.0856000000000000 0.0863526315789475 0.0871052631578949 0.0878578947368423
## [5] 0.0886105263157893 0.0893631578947368 0.0901157894736844 0.0908684210526317
## [9] 0.0916210526315789 0.0923736842105263 0.0931263157894738 0.0938789473684212
## [13] 0.0946315789473683 0.0953842105263156 0.0961368421052631 0.0968894736842103
## [17] 0.0976421052631580 0.0983947368421055 0.0991473684210526 0.0999000000000002
```

```
qnorm(p = p)
```

```
## [1] 1.06251930227087 1.09630032226387 1.13138106688499 1.16791239148275
## [5] 1.20607266469006 1.24607505418858 1.28817741907656 1.33269602289698
## [9] 1.38002500058479 1.43066476621983 1.48526483109878 1.54469087695126
## [13] 1.61013484724568 1.68330641362096 1.76679146935076 1.86479227652848
## [17] 1.98487936474799 2.14309758739059 2.38557097390240 3.09023230616781
```

```
calculate_gev_inverse_cdf(p = p*0.1, loc = 2.52214, scale = 0.5222, shape = 0.1487)
```

```
## [1] 2.08253632084543 2.08416658253954 2.08578931634005 2.08740464488087
## [5] 2.08901268789773 2.09061356232131 2.09220738236667 2.09379425961898
## [9] 2.09537430311604 2.09694761942739 2.09851431273046 2.10007448488366
## [13] 2.10162823549681 2.10317566199874 2.10471685970246 2.10625192186782
## [17] 2.10778093976187 2.10930400271701 2.11082119818693 2.11233261180067
```

```
calculate_gev_inverse_cdf(p = p, loc = 1, scale = 0.5, shape = 0.1)
```

```
## [1] 2.02283799771981 2.05784063947258 2.09488419187596 2.13422869874810
## [5] 2.17618590500976 2.22113381047765 2.26953669811663 2.32197329748089
## [9] 2.37917738058723 2.44209798210797 2.51199179015200 2.59057069417566
## [13] 2.68024915905050 2.78458473159841 2.90912515505341 3.06321218520797
## [17] 3.26441171406689 3.55204289090937 4.04837225469639 5.97581256378162
```