Extra Credit Problem #1 (5 points)

This problem illustrates quartile calculations using random samples of different sizes from the standard normal distribution.

Use *set.seed(1237)* and *rnorm(n, mean = 0, sd = 1)* with *n* = 10, *n* = 30, *n* = 100 and *n* = 300 to draw four different random samples from the standard normal distribution. Reset *set.seed(1237)* prior to drawing each of the four samples.

For each sample, calculate the first, second and third quartile using *quantile()*. Use “type = 2” (method used in Business Statistics) and “type = 7” (R default) and generate quartiles for each.

Display the results. The quartiles for the standard normal distribution are -0.6745, 0.0 and +0.6745 as shown using *qnorm(c(0.25, 0.5, 0.75), mean = 0, sd = 1, lower.tail = TRUE)*. Note below.

```
qnorm(c(0.25, 0.5, 0.75), mean = 0, sd = 1, lower.tail = TRUE)
```

```
## [1] -0.6744898  0.0000000  0.6744898
```

Take note of the results for the first and third quartile. Compare the computed results between the two methods (type = 2 and type = 7). Comment on the rate of convergence for these estimates as the sample size is increased. What does this exercise indicate about describing a population distribution with samples?

```
# Add your set.seed(), rnorm() and quantile() code to this code 'chunk':

set.seed(1237)
sample1 = rnorm(10, mean = 0, sd = 1)
sample1
```

```
##  [1] -0.4448532 -1.9732164 -0.8559826  1.7137530  0.9392717 -1.1769761
##  [7] -0.9256115  0.0336911  0.8581240 -0.3075549
```

```
set.seed(1237)
sample2 = rnorm(30, mean = 0, sd = 1)
sample2
```

```
##  [1] -0.44485320 -1.97321637 -0.85598262  1.71375298  0.93927166
##  [6] -1.17697610 -0.92561145  0.03369110  0.85812402 -0.30755489
## [11] -0.02058666  1.81681629 -1.13020054  1.00108987  1.06564415
## [16]  2.44900776  0.07325534 -0.60973790 -0.28549277 -1.27718700
## [21]  0.71017604  0.14531931 -0.09999525 -1.05494900  0.34294721
## [26]  0.17487679  0.02907445 -1.60803324  1.61825097  0.38081074
```

```
set.seed(1237)
sample3 = rnorm(100, mean = 0, sd = 1)
sample3
```

```
##   [1] -0.44485320 -1.97321637 -0.85598262  1.71375298  0.93927166
##   [6] -1.17697610 -0.92561145  0.03369110  0.85812402 -0.30755489
##  [11] -0.02058666  1.81681629 -1.13020054  1.00108987  1.06564415
```

```
## [16]  2.44900776  0.07325534 -0.60973790 -0.28549277 -1.27718700
## [21]  0.71017604  0.14531931 -0.09999525 -1.05494900  0.34294721
## [26]  0.17487679  0.02907445 -1.60803324  1.61825097  0.38081074
## [31]  1.96957189  0.59965550  0.90773565  0.54202279  0.85328364
## [36]  1.54505841 -1.36749562  0.38671768 -0.07992726  0.15567559
## [41]  0.47800803  0.55188017  1.59550928 -0.81325782  0.44495539
## [46]  0.27478120 -0.05810994  0.50409840  0.48521713 -2.61504187
## [51] -0.37211369 -0.92663696  1.16402035 -0.72587910  0.49746933
## [56]  1.97320372 -1.46117459  0.26606436  0.09833704  0.37248346
## [61]  0.52313740 -0.01107619 -1.59172534  0.20545265 -1.40210324
## [66] -0.18464462  0.40027478 -1.26029486 -0.60907695  0.94723291
## [71] -2.19712358 -0.71947310 -1.02289608  0.25443031 -2.35984298
## [76] -0.97816220  1.01970220  1.01530899  0.68227550  0.60969555
## [81]  1.02049494  0.02172312  0.08668338 -1.28594034  1.59535244
## [86] -0.62694105 -1.08448522  0.97025618  0.38839217  1.38182596
## [91]  0.88656502  1.04427606  0.09731418 -1.15428621 -2.13677789
## [96] -0.29925729  0.59111029  0.36122478 -1.16511625  0.30731162
```

```
set.seed(1237)
sample4 = rnorm(300, mean = 0, sd = 1)
sample4
```

In the programming tests I ask that listings of this nature do not appear.

```
##   [1] -0.444853196 -1.973216371 -0.855982621  1.713752984  0.939271664
##   [6] -1.176976101 -0.925611451  0.033691103  0.858124020 -0.307554887
##  [11] -0.020586657  1.816816291 -1.130200537  1.001089868  1.065644148
##  [16]  2.449007756  0.073255338 -0.609737897 -0.285492771 -1.277186996
##  [21]  0.710176044  0.145319307 -0.099995252 -1.054948999  0.342947214
##  [26]  0.174876791  0.029074453 -1.608033241  1.618250968  0.380810744
##  [31]  1.969571888  0.599655501  0.907735655  0.542022787  0.853283638
##  [36]  1.545058411 -1.367495618  0.386717681 -0.079927262  0.155675588
##  [41]  0.478008034  0.551880165  1.595509284 -0.813257815  0.444955394
##  [46]  0.274781202 -0.058109938  0.504098405  0.485217131 -2.615041869
##  [51] -0.372113694 -0.926636961  1.164020349 -0.725879096  0.497469333
##  [56]  1.973203715 -1.461174588  0.266064361  0.098337040  0.372483463
##  [61]  0.523137400 -0.011076191 -1.591725340  0.205452652 -1.402103238
##  [66] -0.184644617  0.400274777 -1.260294865 -0.609076950  0.947232913
##  [71] -2.197123577 -0.719473098 -1.022896085  0.254430310 -2.359842977
##  [76] -0.978162203  1.019702202  1.015308993  0.682275501  0.609695552
##  [81]  1.020494941  0.021723116  0.086683380 -1.285940340  1.595352444
##  [86] -0.626941047 -1.084485216  0.970256180  0.388392169  1.381825962
##  [91]  0.886565020  1.044276063  0.097314178 -1.154286214 -2.136777886
##  [96] -0.299257293  0.591110289  0.361224781 -1.165116246  0.307311619
## [101] -0.476905100  0.052701539  1.272719662  0.496144797 -0.497035726
## [106]  1.441176215  0.443645586 -0.847983848  0.129924268  1.297142102
## [111]  0.413698866  2.276106169 -0.654189106  0.246238049  0.353277238
## [116] -0.203132981 -0.984621076 -0.450360845  0.120702825 -0.099961627
## [121] -0.043508679 -0.397631378  0.239572805 -1.300367014 -0.562845248
## [126] -1.035461472 -0.463362369  1.530457560 -0.893972689 -0.005119477
## [131]  1.931313421  0.676166123 -0.473071353 -0.401029598  1.186238031
## [136]  1.017638919 -0.890180074  0.155512092 -1.526891142  0.562556055
## [141] -1.817557315 -0.743329014 -0.130739615  0.703332730 -0.592154040
## [146]  1.532150645  0.110832971 -0.549746310 -0.264733763  1.220983672
```

```
## [151]  0.659719925 -1.516442556 -2.448138447 -0.053848182  0.430619567
## [156] -0.471749211 -1.114059348 -0.075248640 -0.192809831  0.061744899
## [161] -0.534050910 -1.411668403  2.082982683  1.176429843 -0.168698419
## [166] -0.723493676  0.165867917 -0.336852752 -0.095257064 -0.859125033
## [171] -0.179638205  0.049697262 -0.156575454 -0.605842210 -0.382067511
## [176]  0.612750682 -0.222039755 -0.736334578  1.506150705  1.153043398
## [181]  1.850998355 -1.477262212  1.523168196 -1.351395471  0.824309912
## [186] -0.080551282  2.066416245 -0.441009399 -1.115846896  0.321174470
## [191] -0.065169957  1.275660732  1.194074309 -0.377246262  0.907375007
## [196]  0.579176850 -0.275083221 -0.315540135  0.875494248 -2.201465522
## [201] -0.431626065  1.260837805  0.943199244 -1.327869131  0.397562321
## [206] -0.398501611 -0.231018818  0.902391853  1.518938665 -0.116343425
## [211] -0.522966338  0.557972473  0.346131216  0.162891368  1.704140603
## [216] -1.117872975  1.808045723 -0.364870702  1.572791797 -0.434817209
## [221]  0.533733651  0.381569456 -1.947740723  0.356090956 -0.376567478
## [226]  0.751152771 -0.280705203 -1.255449891  1.480103596  1.473333541
## [231] -0.810343869 -0.170487847  3.090978456 -0.170771554  0.631007964
## [236] -1.433814584  1.158406432  0.125961491 -0.457556211  0.498130183
## [241] -1.763120209 -1.094706233 -0.799777716 -1.359564037 -0.867762074
## [246]  0.019068380  1.887067136 -0.018716098 -0.174114496 -1.419803389
## [251]  0.559771654 -0.156809202 -1.297798632  0.704780656  1.709111768
## [256] -0.502409942 -1.945345599  0.327179602 -1.006755182 -0.137208610
## [261] -1.283226915 -0.282070453 -0.218423912 -0.567196119 -0.621515449
## [266]  1.704152622  0.153550423  0.005018718 -0.781448724 -0.769005081
## [271] -0.630622724  0.400582149 -0.695264522 -1.265535176  1.480579096
## [276]  1.939596827  0.146858151 -0.197750106 -0.009118009  1.023934449
## [281]  0.438287150 -1.357073384 -1.257965054  0.290299064  2.264024515
## [286] -1.332199748  0.408034099  0.338605884  0.302959389  0.004564553
## [291] -0.784392802 -0.654213303 -0.179211097  1.396841586 -0.572645356
## [296] -0.639925233  0.156621826  0.449131836  2.024200640  0.765317937
```

```
# Quantiles

quantile(sample1,c(0.25,0.5,0.75),type=2)
```

```
##        25%        50%        75%
## -0.9256115 -0.3762040  0.8581240
```

```
#       25%        50%        75%
# -0.9256115 -0.3762040  0.8581240
quantile(sample1,c(0.25,0.5,0.75),type=7)
```

```
##        25%        50%        75%
## -0.9082042 -0.3762040  0.6520158
```

```
#       25%        50%        75%
# -0.9082042 -0.3762040  0.6520158

quantile(sample2,c(0.25,0.5,0.75),type=2)
```

```
##         25%         50%         75% 
## -0.85598262  0.03138278  0.85812402
```

```
#        25%         50%         75% 
# -0.85598262  0.03138278  0.85812402
quantile(sample2,c(0.25,0.5,0.75),type=7)
```

```
##         25%         50%         75% 
## -0.79442144  0.03138278  0.82113703
```

```
#        25%         50%         75% 
# -0.79442144  0.03138278  0.82113703

quantile(sample3,c(0.25,0.5,0.75),type=2)
```

```
##        25%        50%        75% 
## -0.7695685  0.1652762  0.6962258
```

```
#        25%        50%        75% 
# -0.7695685  0.1652762  0.6962258
quantile(sample3,c(0.25,0.5,0.75),type=7)
```

```
##        25%        50%        75% 
## -0.7477238  0.1652762  0.6892506
```

```
#        25%        50%        75% 
# -0.7477238  0.1652762  0.6892506

quantile(sample4,c(0.25,0.5,0.75),type=2)
```

```
##          25%          50%          75% 
## -0.628781886  0.004791636  0.621879323
```

```
 #        25%          50%          75% 
 #-0.628781886  0.004791636  0.621879323

quantile(sample4,c(0.25,0.5,0.75),type=7)
```

```
##          25%          50%          75% 
## -0.627861466  0.004791636  0.617315003
```

```
#         25%          50%          75% 
#-0.627861466  0.004791636  0.617315003

# As the sample size increases, the computed results between the two methods becomes closer an
d closer to each other.
# Also, I noted that as the sample size increases, the three quartiles approach the standard n
```

```
ormal quartiles mentioned above.
# [1] -0.6744898  0.0000000  0.6744898
```

You have mentioned the key points. There are a couple more things to address. The two methods provide different Q1 and Q3 results using the same samples. Method 7 provides Q1 and Q3 values which are slightly smaller in absolute value. Is method 7 preferred in this situation with a continuous distribution? Check the help function in R, i.e., enter ?quantile in the console of RStudio.

Regarding the second question, (What does this exercise indicate about describing a population distribution with samples?) It is important to make sure the sample size is large enough for your purposes to adequately represent the population. Sample size affects the precision with which parameters are estimated.

4 points