100225776.R

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```
## Question 1 ##########################################################################
# 1. We simulate a random vector a with 100 elements from
# the uniform distribution on the interval (-15, 15).
a <- runif(100,-15,15)
a
```

```
##   [1]  -6.9823587  14.3765892 -10.3437864  12.3632869  14.5501719
##   [6] -10.1166868   2.7511617 -12.0214960 -12.3353799  -5.0387139
##  [11]  -7.4967177   1.9224990  -7.0321740  14.2419651   0.3390482
##  [16]  -4.7734352  -9.2170082   7.8777428   5.2522632  -6.5163244
##  [21]  12.9432270 -11.4538642 -11.8073900  11.4743312  -6.9329793
##  [26]   8.3202671  -6.6371657 -11.0909687  -8.0602146  -3.4151425
##  [31]   8.9597712   9.4417364  -2.3777796 -13.1081955  14.5319454
##  [36]   5.5305462  11.5973188 -11.6708259   6.6573470  -7.5768280
##  [41]   0.7708796  -3.8118600  10.0918692  -9.7594696  13.2992206
##  [46]   6.4529084 -14.3515969  13.1429875  -6.6271717  -9.5135734
##  [51]  14.1276514   0.4210866   4.8701157  13.8834110  10.6920718
##  [56]   3.3402494  -8.4372060  -4.3358743  14.9330900   4.2764843
##  [61]  -9.6625366  13.3447865   9.8922811  10.3702630  -5.6513741
##  [66]  14.0474553   3.6605804 -10.4155968  -3.6975992  -9.2282907
##  [71]   0.5140426  -1.5336730   6.0928244  11.0708784   0.6163168
##  [76]  14.1934767   9.2252365 -13.3232256   8.5623963  -3.4887308
##  [81]  -2.1419190 -10.3911525   9.3938433  11.3193048   3.5529958
##  [86] -14.7020758  13.5708439  -1.2891583   3.2444623   1.9779076
##  [91] -10.8182080   2.0350144  -9.3642579   1.6465961 -11.9584592
##  [96] -13.2951898  -2.4137501 -12.1926534  -8.4795939 -14.9162645
```

```
# See below the first 12 elements of a:
# [1]  -1.79508310 -11.13477352 -10.22914929 -12.85614219   9.37987752
# [6]  13.20459132  -3.44664085  -2.37019319 -12.92224264   1.77791717
#######################################################################################
# 1a. We write a program to calculate the
# sum of the positive elements in vector a.
aPosSum <- sum(sum(a[a>0]))
aPosSum
```

```
## [1] 421.7647
```

```
# The output of which is:
# [1] 407.1542
#######################################################################################
# 1b. We calculate the sum of the vector elements of a until
# the first appearance of the first positive element in a.
#
# Sorry, I've tried for 2 hours and I still can't work this out without
# cumsum so I give up. There's nothing out there to hint how this should
# even be attempted without proper programming constructs like loops.
aSumToFirst <- sum(a[cumsum(a>0)==0])
aSumToFirst
```

```
## [1] -6.982359
```

```
# The output of which is:
# [1] -36.01515
################################################################################

## Question 2 ##################################################################
# 2a. We write a program for simulating n = 1000 observations from
# the student-t distribution with 7 degrees of freedom.
x <- rt(1000,7)
x
```

```
##    [1]  0.442858256 -0.891984869  1.500565787  0.629480427  0.136947751
##    [6]  0.794322305 -0.496491441  1.484674148  1.254563002  0.227040768
##   [11] -0.764944868 -0.557677399 -1.671276225 -1.403217280  1.097810207
##   [16]  0.575802900  1.395083150 -1.289561611  1.221728378 -0.415070774
##   [21] -0.941172367 -1.114380326  2.061640974 -0.100721957 -1.346417522
##   [26] -0.794625018  1.932710096  1.266006317  0.372780332 -1.214627649
##   [31] -1.811654156 -0.066559189 -1.410894960  0.383286368 -0.252279792
##   [36] -0.594292175 -0.668802189  0.255689775 -0.817490548  3.908693544
##   [41]  1.683929674 -0.372947511 -0.301297743  1.452269336  0.436746566
##   [46] -1.267479188  0.554066833 -0.997676514  1.773157400  2.758759461
##   [51] -1.160793976 -0.734521708 -0.359319210 -0.460055430  2.506259529
##   [56] -0.548366751 -1.126411939 -0.384768312  0.339875112  0.388862499
##   [61] -0.309292707  0.343108033  1.194063698 -2.120671745 -1.134774490
##   [66] -0.734629546  3.019355808  0.404697283 -1.733377827 -0.692606174
##   [71]  1.268414083 -0.033089837  1.581087049 -0.118318889 -1.038115841
##   [76]  1.349573175 -0.717142138 -0.561231296  1.183453860  2.117258220
##   [81]  0.482498770  0.514319398 -0.434970395 -0.055972660 -0.587928626
##   [86] -1.169784053 -0.089129210 -0.561029827 -0.487776803  0.083462205
##   [91]  0.064950515  0.039359404 -0.580314084  0.358213192  0.391259766
##   [96] -0.345476018 -0.596885520 -1.523459418  1.045683558 -0.831092737
##  [101]  1.412461201 -0.220497846  2.787057674 -3.404152229  0.932180762
##  [106]  0.480385356 -0.153781072 -0.077644528 -1.224140468  0.782536449
##  [111] -0.016124993 -1.192119607  1.026852978 -0.696999745 -3.246163134
##  [116]  0.620895432  0.005601212  1.027552278 -0.652939179 -1.072103437
##  [121]  1.000388768  0.572443593 -0.999963507 -1.822628396 -1.136877625
##  [126] -0.668250056  0.163331637  0.777679791 -1.984051958  1.444944339
##  [131]  1.219875608  0.923213111  0.020675619 -0.264285050  1.436656525
##  [136]  4.226307424 -0.392097686 -0.086293537  0.683865839  0.649421166
##  [141] -0.877931107  1.465633694  0.881094248 -0.172759553 -0.420174476
##  [146]  0.796342104  0.577563499 -0.529321813 -0.475917114  0.775557976
##  [151]  0.170824618  0.437579944  1.071172642 -1.221082179  0.496642227
##  [156] -0.782323849 -0.660196814  0.687406388  0.248114930  0.511945930
##  [161]  0.203803722  1.949761971 -0.009979797  1.329386966 -1.411236261
##  [166] -1.702901572 -0.285118707 -0.823468514  2.353229485  0.441880939
##  [171]  0.234570298  3.591806762  0.159417938 -0.752251739  0.310994010
##  [176] -0.124634974  3.146811566 -0.261618415 -0.838814172  0.551432534
##  [181]  0.797471255 -0.115134373  0.191155746 -1.627928810 -0.740658869
##  [186]  2.356973280  0.930061272  0.551722628  0.132106086 -0.964819120
##  [191]  0.456629109  1.531831064 -2.577243694  0.116705798  0.064388549
##  [196]  1.115777811  1.459351768 -0.573818933 -2.586762171  1.821674668
##  [201] -0.656804288 -0.824416545  0.377299097 -1.819960886  0.830581458
##  [206]  0.010190724 -0.299093070  0.591437286 -1.158642534 -1.216575453
##  [211]  0.817603017  1.435972003  1.668931283  0.194973606  0.444748922
```

```
##  [216] -0.013838432 -0.790683137 -0.566830674 -2.100343118  1.670591542
##  [221]  0.078257820 -0.037052373  0.521273379 -0.182319387  0.073521400
##  [226]  0.601302619 -0.940187169 -0.848366241  0.216364321  0.281785752
##  [231]  0.647727777  0.220623525  0.229656239  0.231035209  1.503979278
##  [236] -0.738611388 -2.510388807  0.894857522 -0.401538942  0.104597288
##  [241] -0.622736086  0.456762928 -1.393209567  0.891926616  1.504157056
##  [246]  0.154692726  0.320274942 -0.484523201 -0.000873864  1.872863674
##  [251] -0.221023447 -0.650731296 -1.063234094  0.614916140  1.001624286
##  [256]  1.807853749  0.567363949 -0.431654461  0.982229444  3.191832743
##  [261] -1.928727569 -1.284700944 -0.252922849  0.875711566  0.434292360
##  [266] -1.442954223 -0.162643399 -0.654212089  1.756551903  1.170753417
##  [271]  0.422438776 -0.456527275  2.244900301  0.541829044  1.575235004
##  [276] -1.158978942  0.159564145 -1.479591926  1.044525613  1.169704096
##  [281]  0.916393715 -0.024464567  4.971985111  0.146875629  0.905021106
##  [286] -0.751503492 -0.107448335  1.450863024 -0.677536152 -1.470094340
##  [291]  1.209460348 -0.089098924  0.927080130  0.788002778 -1.334753580
##  [296]  1.280378062 -1.662452187  0.937743587 -0.716955174 -2.592386798
##  [301]  0.123640150  1.082846406  4.750317585  0.656892911 -0.224803212
##  [306] -0.403545184 -0.862273690 -0.499974540  0.756410848  0.312302064
##  [311] -0.876437173 -0.490621438  0.364356864  0.964838994 -1.034221804
##  [316]  3.932498122 -0.743856211  0.703009894 -2.472912537 -0.009902992
##  [321]  0.786913472  0.596405663 -0.183883549 -0.185775090  0.426570054
##  [326]  0.251669429 -1.125097656  0.638743742  0.580752242  0.686280505
##  [331]  1.238694472 -1.409020846  0.770874587 -2.092831963 -0.410093816
##  [336] -0.051485669 -0.085606170  0.680029525  0.308739896 -0.879489693
##  [341]  0.741880492  0.248691556 -2.173250414 -0.139702442  0.059059171
##  [346]  0.839430413  0.274048301 -0.819502108  0.299206102 -1.302969406
##  [351] -2.301739550  3.498047443  0.004991327 -0.124501058 -1.300256661
##  [356] -1.755987309 -0.392919266  0.346964554  0.708686533  1.034961588
##  [361] -1.587666935 -0.975854531  2.086501646  1.912077626 -0.130865905
##  [366]  1.400412341  0.134632744 -3.708555824  0.640681638  0.918415381
##  [371] -0.029008814 -0.708266622  1.377486478  0.024756272  2.035565581
##  [376]  0.396588306 -1.786140235 -1.199240150  0.209378309  0.539024199
##  [381] -0.870050618  0.636371542  0.402890068  0.934502306 -2.883008298
##  [386] -1.937038582 -0.490406816  0.151489200 -0.228944138  0.775001657
##  [391] -2.047435448 -1.505344670  0.369020000  1.076792473  0.769433228
##  [396] -0.172463532  0.458620389 -0.701842099 -0.538667684 -0.407954583
##  [401] -0.611055634 -0.248923149  0.191325293  0.005520640  0.396166618
##  [406]  0.596048765  1.426776759 -1.043434620 -0.130439154  0.224925924
##  [411] -1.517289996  0.238823184 -0.287819901  0.167223995  0.166774493
##  [416] -1.090319258  2.166656405  0.230100743 -0.258720529  0.859397380
##  [421]  0.081546987  0.312727521  1.741054176 -1.986803303  2.436526408
##  [426]  0.283808968 -0.160262957  0.403967373 -1.921565295 -1.563298654
##  [431] -0.095215552 -0.477658162 -0.190984750 -0.449865455  0.983561189
##  [436]  1.247001560  0.087654270  1.271081130  1.139587064 -0.242792879
##  [441]  0.675774603  0.177541317 -0.475644079 -0.193056564 -1.760255754
##  [446]  0.405923436 -0.550146578  0.536989186  0.256245701  0.624498304
##  [451]  1.138118036 -0.979190297  1.050425553  0.427296603 -0.228103354
##  [456]  1.228790038 -0.386030941 -1.774620781 -1.154342338 -0.711807439
##  [461] -1.077676171  0.365416911 -0.551767241  0.531634258 -0.402565639
##  [466] -1.976133573  1.046839630  0.233491842  1.265266423 -1.077539008
##  [471]  0.964034940 -0.316916223  1.775843959 -1.774811142 -0.510735311
##  [476] -0.110606199  1.052961665 -0.771795422 -1.927366115 -1.111217207
##  [481]  1.088667527 -0.972258517  2.241086814  0.171399296  1.864742686
```

```
##  [486] -0.071893694  1.600460688 -1.773163188  0.514380380  0.684603575
##  [491]  1.540947969  0.412418462 -0.409789568 -0.745302930  2.478518002
##  [496] -1.260662282 -0.158129147  0.039191148  0.632924309  1.309983616
##  [501]  0.548745248  0.939058195  1.060038733  0.418753471 -1.287693614
##  [506]  0.043318775  0.111187160  0.354381485 -0.425942367 -0.037096633
##  [511]  0.839260814 -0.495333199  0.043826545  1.101059810  0.411813326
##  [516] -1.189984205 -0.218357375 -1.238917838 -0.804078402  0.878934824
##  [521]  1.287474927 -0.222871970 -0.041550199 -1.355371565  0.015071599
##  [526] -0.216975114 -0.636604343 -2.464109531 -1.023661719  0.548370753
##  [531]  0.263036119  0.086215255  0.039946117 -1.554935486  1.698086093
##  [536] -1.163632041  1.270336159 -0.378926836  0.183403635 -1.463991485
##  [541] -3.517197216 -2.065443797  0.008080730 -1.224234352 -0.186102117
##  [546] -1.669375863 -0.509413165  0.360418010 -0.564803842 -1.069362780
##  [551] -0.471609813  0.234922127  1.013333290 -1.100128347 -0.606189101
##  [556] -0.672771601  0.753767827 -0.966402456 -0.054971316 -0.551068087
##  [561]  1.479339846  0.506414262 -0.644422778 -0.089167956  0.031474220
##  [566] -1.574899013  0.130077947  1.949561058 -0.482008270 -0.007198547
##  [571]  0.909561255 -0.665440767  0.571925339  1.659605959  0.521350932
##  [576] -0.103628994  1.383642238 -1.520508433 -0.770089857 -1.244349430
##  [581] -1.050438338 -0.107519371  1.884788748  0.230282403  0.730437068
##  [586] -0.551727293  0.715597617 -0.157640515  2.308390976 -0.728970909
##  [591] -0.491220757 -0.111997836  0.958399376  0.427672704 -1.257649842
##  [596] -1.955001088  0.131583159 -2.007055759 -0.391794076 -0.523609136
##  [601]  1.022921362 -0.385644230  0.736154077  1.592227781 -0.452567208
##  [606]  0.206595600 -2.051963602 -1.697463239 -0.850428346 -2.114792637
##  [611]  4.122362976  0.850816185 -0.303687502  1.357116252 -0.408461193
##  [616] -0.739112281 -0.958591331  0.112024476  2.798450041  1.115328100
##  [621] -0.654428358 -0.099523721  0.330235219  1.043648221 -1.486854904
##  [626]  1.346785452 -1.844137242  1.071415317  1.018690260  0.080342778
##  [631]  0.670961843  1.739551106 -1.493989365  2.092597165  1.020376159
##  [636] -0.547106926 -0.366784268  0.392723121 -0.334974040  0.920088464
##  [641] -1.315618400  0.738659665 -1.764743034  0.584656046 -1.204044544
##  [646]  1.356962609  0.578888165 -0.458163409 -1.853982080  0.100413990
##  [651]  0.529510819 -0.138213811 -0.392565511  0.241579127  0.083692349
##  [656] -1.285940319  2.237982834 -0.379156793  1.146963429  0.869846482
##  [661]  1.925857855 -0.500168706  1.194597435 -1.618744061  0.468862625
##  [666] -0.185244301  1.641016334  0.286347477 -0.735902866 -0.432845071
##  [671] -1.587455661  0.384553825  0.935830835  0.662414862 -1.152387497
##  [676]  1.070539738 -2.539970622  0.363727926 -1.926249849  1.629686984
##  [681]  0.692649637  1.318540380 -0.530007695  3.218611218 -0.306427209
##  [686]  0.459045165  0.195783774  1.309034953  1.182472203 -2.128360707
##  [691] -0.499873253 -0.992646114 -0.422362689  0.455069862  0.811626006
##  [696]  0.411733843  1.107365095  0.489443275  0.098412905  1.058026073
##  [701]  1.775996354  0.559472287 -1.342909980  1.180258893 -1.656261683
##  [706] -0.202580857  1.429683287 -0.928340531 -2.260703207  0.146635026
##  [711] -1.724106930  0.669818034  0.810586620  4.256972106  0.266896929
##  [716]  0.214319317  0.466015933 -0.403375809 -0.618215286 -0.164252444
##  [721] -1.563265325  0.848957590 -0.001309521  1.455669750  1.935041016
##  [726] -0.338980858 -0.870575064 -0.268012451  0.994239019  0.401883556
##  [731] -0.854308474  1.067026353 -0.640199797 -0.408445990 -0.286095377
##  [736] -0.788585055  1.778240477  0.464257838 -0.626781804  0.168787105
##  [741]  0.037579464  1.260247163  0.137541697  0.364894908  0.686537752
##  [746] -1.149510242  0.143039924  0.257122889  0.526842703  0.208704298
##  [751] -0.312034347 -0.881605018  0.723580878 -0.629786120 -0.822212466
```

```
##  [756]  1.731046510  0.337961504 -1.200940803  0.265420336 -0.741722767
##  [761]  0.387852412  1.325095744 -0.235541340  0.078327718  0.125838388
##  [766]  0.501602817 -0.410599697  0.075308862  0.193086041  1.290813594
##  [771]  0.216467809  0.892207185  0.438711888  0.242687794 -0.238613864
##  [776] -0.211210220  0.216937441  0.396564625  0.066615520  1.574220873
##  [781]  0.963879171 -1.264472756  1.049613949  1.089474149  0.732859626
##  [786]  0.466124244 -0.999663815  0.378446827 -2.002785435  0.594527345
##  [791] -0.711320125 -0.020821528  1.266227937 -0.762370268 -0.428475498
##  [796]  0.857639538 -0.041200516  0.983360769  0.174498465  1.030851297
##  [801]  1.381351971 -0.056195283 -2.072544503 -3.322466564 -0.148655149
##  [806] -1.263532646  0.818816190 -1.452558649 -0.734950966 -0.741287598
##  [811]  1.207582837 -0.179550085 -0.832546179 -0.634916445 -0.579826558
##  [816] -1.337725442  0.485226690  0.602531367  0.929141506 -1.125749263
##  [821]  0.620225972  0.910515816 -0.644691245  0.779321965  0.593021926
##  [826] -0.086360090  1.069990671  0.559971805 -0.218011820  2.760804174
##  [831] -1.939868407 -1.278127806 -1.432672460  0.183499548 -0.092948957
##  [836]  0.803506473 -0.558710962  0.508090292 -1.451039817 -0.450551787
##  [841] -1.584708785 -0.185478014  2.298730554 -1.784236939 -2.088116672
##  [846]  0.710723755  0.933206638 -0.235185767 -0.729109619 -0.234978645
##  [851]  1.011318307  0.785550849  2.371709318  1.768160953  0.625254214
##  [856] -0.032120630 -0.040408006 -2.139058093  1.272839677  1.434384092
##  [861]  2.013314265  0.793193515  0.440393451  2.222260498 -0.159642938
##  [866]  0.053358546 -0.025148939 -0.700552391  0.170256253  0.265589063
##  [871] -0.444597046  0.359912283 -0.634898430 -0.221147884  0.545765274
##  [876] -2.239038280  0.709911404 -1.105505171  0.952302963 -0.283905183
##  [881]  0.977645172  0.742620466 -1.489339095 -0.182183366 -0.136665065
##  [886] -0.965907645  0.280856771 -1.497170884  1.251869141 -0.979322561
##  [891]  0.980669159  0.500783103  0.320982697  0.003029376 -0.083021900
##  [896] -0.583944692 -0.690610466  1.800850202  0.218106380  1.478937199
##  [901] -0.363816092  1.733629092  0.936419629  1.585325697  0.362731302
##  [906] -1.184697829 -2.567043870 -0.084220407  0.824851019 -0.190603408
##  [911] -0.153251104 -0.417516479  0.705213114 -1.060950558 -2.458838908
##  [916]  0.068619673  0.198565001 -2.373806648  0.462181144  0.360047441
##  [921]  1.221928454 -0.008266583 -0.311379027  0.903705906  0.579979176
##  [926] -0.236486696  1.781039032 -0.227433039  1.076747329 -0.366387934
##  [931]  1.540065184 -0.810087344 -0.045641555  1.279194437  0.017116049
##  [936]  0.094224701 -1.145304303 -1.332561165  0.140908914 -1.291316922
##  [941] -0.541695533  0.279969468 -0.420455008 -1.173878570  0.290383637
##  [946]  0.837835490 -1.446162669 -2.727256586 -0.120598398  1.634275827
##  [951]  0.114915338 -0.491603624 -0.357344049  1.671202833  0.483391617
##  [956]  0.382562577  2.877984690 -0.303662450 -0.378804347 -0.596781685
##  [961]  0.691295831 -0.543999232 -1.305874492  1.288815976  0.640483103
##  [966] -0.743130384  0.751244428 -2.513685001 -0.656509731  1.900611061
##  [971]  2.486510121 -0.821997149 -1.046087132 -0.494184216  0.554289114
##  [976]  1.368587381  0.519326104  0.641581445  1.530286108  0.116688657
##  [981]  1.144712921  0.187145582 -2.823454553 -0.341822192 -0.435182735
##  [986] -0.841740602  0.684887016  1.253796456 -0.856123691  0.155184644
##  [991]  2.590635857 -0.520153086 -0.761617287  0.443453941 -0.013396686
##  [996] -0.059192777 -0.577015103  1.796299431 -0.614103663 -2.099882747
# The first 10 elements of which are:
# [1]  0.702581298 -0.477501788  0.959157477 -0.075433908  0.282358543
# [6]  0.543849132 -0.442303150  1.632454567  1.068697928  0.544330850
################################################################################
```

```r
# 2b. We then write a program for calculating the
# truncated mean from the above observations.
ytr <- mean(x, trim = 0.05)
ytr
```

```
## [1] 0.04950126
```

```r
# The output of which is:
# [1] 0.0147663
################################################################################
# 2c. We then write a program for calculating the given statistic, d,
# the sum of all elements from i=1 to m of c(i)x(i).
#
# First we find and order a vector of x(i) elements, which are
# the negative observations of vector x, above:
x <- sort(x[x<0])
x
```

```
##   [1] -3.708555824 -3.517197216 -3.404152229 -3.322466564 -3.246163134
##   [6] -2.883008298 -2.823454553 -2.727256586 -2.592386798 -2.586762171
##  [11] -2.577243694 -2.567043870 -2.539970622 -2.513685001 -2.510388807
##  [16] -2.472912537 -2.464109531 -2.458838908 -2.373806648 -2.301739550
##  [21] -2.260703207 -2.239038280 -2.173250414 -2.139058093 -2.128360707
##  [26] -2.120671745 -2.114792637 -2.100343118 -2.099882747 -2.092831963
##  [31] -2.088116672 -2.072544503 -2.065443797 -2.051963602 -2.047435448
##  [36] -2.007055759 -2.002785435 -1.986803303 -1.984051958 -1.976133573
##  [41] -1.955001088 -1.939868407 -1.937038582 -1.928727569 -1.927366115
##  [46] -1.926249849 -1.921565295 -1.853982080 -1.844137242 -1.822628396
##  [51] -1.819960886 -1.811654156 -1.786140235 -1.784236939 -1.774811142
##  [56] -1.774620781 -1.773163188 -1.764743034 -1.760255754 -1.755987309
##  [61] -1.733377827 -1.724106930 -1.702901572 -1.697463239 -1.671276225
##  [66] -1.669375863 -1.662452187 -1.656261683 -1.627928810 -1.618744061
##  [71] -1.587666935 -1.587455661 -1.584708785 -1.574899013 -1.563298654
##  [76] -1.563265325 -1.554935486 -1.523459418 -1.520508433 -1.517289996
##  [81] -1.505344670 -1.497170884 -1.493989365 -1.489339095 -1.486854904
##  [86] -1.479591926 -1.470094340 -1.463991485 -1.452558649 -1.451039817
##  [91] -1.446162669 -1.442954223 -1.432672460 -1.411236261 -1.410894960
##  [96] -1.409020846 -1.403217280 -1.393209567 -1.355371565 -1.346417522
## [101] -1.342909980 -1.337725442 -1.334753580 -1.332561165 -1.315618400
## [106] -1.305874492 -1.302969406 -1.300256661 -1.291316922 -1.289561611
## [111] -1.287693614 -1.285940319 -1.284700944 -1.278127806 -1.267479188
## [116] -1.264472756 -1.263532646 -1.260662282 -1.257649842 -1.244349430
## [121] -1.238917838 -1.224234352 -1.224140468 -1.221082179 -1.216575453
## [126] -1.214627649 -1.204044544 -1.200940803 -1.199240150 -1.192119607
## [131] -1.189984205 -1.184697829 -1.173878570 -1.169784053 -1.163632041
## [136] -1.160793976 -1.158978942 -1.158642534 -1.154342338 -1.152387497
## [141] -1.149510242 -1.145304303 -1.136877625 -1.134774490 -1.126411939
## [146] -1.125749263 -1.125097656 -1.114380326 -1.111217207 -1.105505171
## [151] -1.100128347 -1.090319258 -1.077676171 -1.077539008 -1.072103437
## [156] -1.069362780 -1.063234094 -1.060950558 -1.050438338 -1.046087132
## [161] -1.043434620 -1.038115841 -1.034221804 -1.023661719 -0.999963507
## [166] -0.999663815 -0.997676514 -0.992646114 -0.979322561 -0.979190297
## [171] -0.975854531 -0.972258517 -0.966402456 -0.965907645 -0.964819120
## [176] -0.958591331 -0.941172367 -0.940187169 -0.928340531 -0.891984869
## [181] -0.881605018 -0.879489693 -0.877931107 -0.876437173 -0.870575064
```

```
## [186] -0.870050618 -0.862273690 -0.856123691 -0.854308474 -0.850428346
## [191] -0.848366241 -0.841740602 -0.838814172 -0.832546179 -0.831092737
## [196] -0.824416545 -0.823468514 -0.822212466 -0.821997149 -0.819502108
## [201] -0.817490548 -0.810087344 -0.804078402 -0.794625018 -0.790683137
## [206] -0.788585055 -0.782323849 -0.771795422 -0.770089857 -0.764944868
## [211] -0.762370268 -0.761617287 -0.752251739 -0.751503492 -0.745302930
## [216] -0.743856211 -0.743130384 -0.741722767 -0.741287598 -0.740658869
## [221] -0.739112281 -0.738611388 -0.735902866 -0.734950966 -0.734629546
## [226] -0.734521708 -0.729109619 -0.728970909 -0.717142138 -0.716955174
## [231] -0.711807439 -0.711320125 -0.708266622 -0.701842099 -0.700552391
## [236] -0.696999745 -0.692606174 -0.690610466 -0.677536152 -0.672771601
## [241] -0.668802189 -0.668250056 -0.665440767 -0.660196814 -0.656804288
## [246] -0.656509731 -0.654428358 -0.654212089 -0.652939179 -0.650731296
## [251] -0.644691245 -0.644422778 -0.640199797 -0.636604343 -0.634916445
## [256] -0.634898430 -0.629786120 -0.626781804 -0.622736086 -0.618215286
## [261] -0.614103663 -0.611055634 -0.606189101 -0.596885520 -0.596781685
## [266] -0.594292175 -0.587928626 -0.583944692 -0.580314084 -0.579826558
## [271] -0.577015103 -0.573818933 -0.566830674 -0.564803842 -0.561231296
## [276] -0.561029827 -0.558710962 -0.557677399 -0.551767241 -0.551727293
## [281] -0.551068087 -0.550146578 -0.548366751 -0.547106926 -0.543999232
## [286] -0.541695533 -0.538667684 -0.530007695 -0.529321813 -0.523609136
## [291] -0.520153086 -0.510735311 -0.509413165 -0.500168706 -0.499974540
## [296] -0.499873253 -0.496491441 -0.495333199 -0.494184216 -0.491603624
## [301] -0.491220757 -0.490621438 -0.490406816 -0.487776803 -0.484523201
## [306] -0.482008270 -0.477658162 -0.475917114 -0.475644079 -0.471609813
## [311] -0.460055430 -0.458163409 -0.456527275 -0.452567208 -0.450551787
## [316] -0.449865455 -0.444597046 -0.435182735 -0.434970395 -0.432845071
## [321] -0.431654461 -0.428475498 -0.425942367 -0.422362689 -0.420455008
## [326] -0.420174476 -0.417516479 -0.415070774 -0.410599697 -0.410093816
## [331] -0.409789568 -0.408461193 -0.408445990 -0.407954583 -0.403545184
## [336] -0.403375809 -0.402565639 -0.401538942 -0.392919266 -0.392565511
## [341] -0.392097686 -0.391794076 -0.386030941 -0.385644230 -0.384768312
## [346] -0.379156793 -0.378926836 -0.378804347 -0.372947511 -0.366784268
## [351] -0.366387934 -0.363816092 -0.359319210 -0.357344049 -0.345476018
## [356] -0.341822192 -0.338980858 -0.334974040 -0.316916223 -0.312034347
## [361] -0.311379027 -0.309292707 -0.306427209 -0.303687502 -0.303662450
## [366] -0.301297743 -0.299093070 -0.287819901 -0.286095377 -0.285118707
## [371] -0.283905183 -0.268012451 -0.264285050 -0.261618415 -0.258720529
## [376] -0.252922849 -0.252279792 -0.248923149 -0.242792879 -0.238613864
## [381] -0.236486696 -0.235541340 -0.235185767 -0.234978645 -0.228944138
## [386] -0.228103354 -0.227433039 -0.224803212 -0.222871970 -0.221147884
## [391] -0.221023447 -0.220497846 -0.218357375 -0.218011820 -0.216975114
## [396] -0.211210220 -0.202580857 -0.193056564 -0.190984750 -0.190603408
## [401] -0.186102117 -0.185775090 -0.185478014 -0.185244301 -0.183883549
## [406] -0.182319387 -0.182183366 -0.179550085 -0.172759553 -0.172463532
## [411] -0.164252444 -0.162643399 -0.160262957 -0.159642938 -0.158129147
## [416] -0.157640515 -0.153781072 -0.153251104 -0.148655149 -0.139702442
## [421] -0.138213811 -0.136665065 -0.130865905 -0.130439154 -0.124634974
## [426] -0.124501058 -0.120598398 -0.118318889 -0.115134373 -0.111997836
## [431] -0.110606199 -0.107519371 -0.107448335 -0.103628994 -0.100721957
## [436] -0.099523721 -0.095215552 -0.092948957 -0.089167956 -0.089129210
## [441] -0.089098924 -0.086360090 -0.086293537 -0.085606170 -0.084220407
## [446] -0.083021900 -0.077644528 -0.071893694 -0.066559189 -0.059192777
## [451] -0.056195283 -0.055972660 -0.054971316 -0.051485669 -0.045641555
```

```
## [456] -0.041550199 -0.041200516 -0.040408006 -0.037096633 -0.037052373
## [461] -0.033089837 -0.032120630 -0.029008814 -0.025148939 -0.024464567
## [466] -0.020821528 -0.016124993 -0.013838432 -0.013396686 -0.009979797
## [471] -0.009902992 -0.008266583 -0.007198547 -0.001309521 -0.000873864
```

```
# The first 10 elements of which are:
# [1] -4.366663644 -4.168227773 -4.078276198 -3.969442934 -3.656899592
# [6] -3.548254827 -3.345174851 -3.294563514 -3.283500840 -3.267039472
#
# Next, we define the values for i using m (the number of elements now in x)
# and find the constants c using the formula given:
m <- length(x)
i <- seq(m)
c <- ((m-i)/m)^0.5-(((m-i)+1)/m)^0.5-(1/m)
c
```

```
##   [1] -0.003158449 -0.003159561 -0.003160676 -0.003161795 -0.003162917
##   [6] -0.003164043 -0.003165172 -0.003166305 -0.003167441 -0.003168582
##  [11] -0.003169726 -0.003170873 -0.003172025 -0.003173180 -0.003174339
##  [16] -0.003175502 -0.003176668 -0.003177838 -0.003179012 -0.003180190
##  [21] -0.003181372 -0.003182558 -0.003183748 -0.003184941 -0.003186139
##  [26] -0.003187341 -0.003188546 -0.003189756 -0.003190970 -0.003192188
##  [31] -0.003193410 -0.003194636 -0.003195866 -0.003197100 -0.003198339
##  [36] -0.003199582 -0.003200829 -0.003202080 -0.003203336 -0.003204596
##  [41] -0.003205860 -0.003207129 -0.003208402 -0.003209680 -0.003210962
##  [46] -0.003212248 -0.003213539 -0.003214834 -0.003216134 -0.003217439
##  [51] -0.003218748 -0.003220062 -0.003221381 -0.003222704 -0.003224032
##  [56] -0.003225364 -0.003226702 -0.003228044 -0.003229391 -0.003230743
##  [61] -0.003232100 -0.003233462 -0.003234828 -0.003236200 -0.003237577
##  [66] -0.003238958 -0.003240345 -0.003241737 -0.003243134 -0.003244536
##  [71] -0.003245944 -0.003247356 -0.003248774 -0.003250197 -0.003251626
##  [76] -0.003253060 -0.003254499 -0.003255944 -0.003257394 -0.003258849
##  [81] -0.003260310 -0.003261777 -0.003263250 -0.003264728 -0.003266211
##  [86] -0.003267701 -0.003269196 -0.003270696 -0.003272203 -0.003273716
##  [91] -0.003275234 -0.003276759 -0.003278289 -0.003279825 -0.003281368
##  [96] -0.003282916 -0.003284471 -0.003286032 -0.003287599 -0.003289172
## [101] -0.003290752 -0.003292338 -0.003293930 -0.003295529 -0.003297134
## [106] -0.003298746 -0.003300364 -0.003301989 -0.003303620 -0.003305259
## [111] -0.003306904 -0.003308555 -0.003310214 -0.003311879 -0.003313552
## [116] -0.003315231 -0.003316917 -0.003318611 -0.003320311 -0.003322019
## [121] -0.003323734 -0.003325456 -0.003327186 -0.003328923 -0.003330667
## [126] -0.003332419 -0.003334178 -0.003335945 -0.003337720 -0.003339502
## [131] -0.003341292 -0.003343090 -0.003344896 -0.003346710 -0.003348531
## [136] -0.003350361 -0.003352199 -0.003354045 -0.003355899 -0.003357761
## [141] -0.003359632 -0.003361511 -0.003363399 -0.003365295 -0.003367200
## [146] -0.003369113 -0.003371036 -0.003372967 -0.003374906 -0.003376855
## [151] -0.003378813 -0.003380780 -0.003382756 -0.003384741 -0.003386736
## [156] -0.003388740 -0.003390753 -0.003392776 -0.003394808 -0.003396850
## [161] -0.003398902 -0.003400963 -0.003403035 -0.003405116 -0.003407208
## [166] -0.003409309 -0.003411421 -0.003413543 -0.003415676 -0.003417819
## [171] -0.003419972 -0.003422136 -0.003424311 -0.003426497 -0.003428694
## [176] -0.003430901 -0.003433120 -0.003435350 -0.003437591 -0.003439843
## [181] -0.003442107 -0.003444383 -0.003446670 -0.003448969 -0.003451279
## [186] -0.003453602 -0.003455937 -0.003458284 -0.003460643 -0.003463015
## [191] -0.003465399 -0.003467796 -0.003470205 -0.003472627 -0.003475062
```

```
## [196] -0.003477511 -0.003479972 -0.003482447 -0.003484935 -0.003487437
## [201] -0.003489952 -0.003492481 -0.003495024 -0.003497581 -0.003500152
## [206] -0.003502738 -0.003505338 -0.003507952 -0.003510582 -0.003513226
## [211] -0.003515885 -0.003518559 -0.003521248 -0.003523953 -0.003526674
## [216] -0.003529410 -0.003532162 -0.003534930 -0.003537714 -0.003540514
## [221] -0.003543331 -0.003546165 -0.003549016 -0.003551883 -0.003554768
## [226] -0.003557670 -0.003560589 -0.003563526 -0.003566481 -0.003569454
## [231] -0.003572445 -0.003575455 -0.003578483 -0.003581530 -0.003584596
## [236] -0.003587681 -0.003590786 -0.003593910 -0.003597054 -0.003600218
## [241] -0.003603402 -0.003606606 -0.003609832 -0.003613078 -0.003616345
## [246] -0.003619634 -0.003622944 -0.003626276 -0.003629630 -0.003633006
## [251] -0.003636405 -0.003639826 -0.003643271 -0.003646739 -0.003650230
## [256] -0.003653745 -0.003657285 -0.003660849 -0.003664437 -0.003668050
## [261] -0.003671689 -0.003675353 -0.003679043 -0.003682759 -0.003686502
## [266] -0.003690271 -0.003694068 -0.003697892 -0.003701743 -0.003705623
## [271] -0.003709531 -0.003713468 -0.003717434 -0.003721429 -0.003725455
## [276] -0.003729510 -0.003733596 -0.003737714 -0.003741862 -0.003746042
## [281] -0.003750255 -0.003754500 -0.003758778 -0.003763090 -0.003767436
## [286] -0.003771816 -0.003776230 -0.003780680 -0.003785166 -0.003789688
## [291] -0.003794247 -0.003798843 -0.003803476 -0.003808148 -0.003812859
## [296] -0.003817609 -0.003822398 -0.003827229 -0.003832100 -0.003837013
## [301] -0.003841968 -0.003846965 -0.003852007 -0.003857092 -0.003862222
## [306] -0.003867397 -0.003872618 -0.003877886 -0.003883201 -0.003888564
## [311] -0.003893977 -0.003899438 -0.003904950 -0.003910514 -0.003916129
## [316] -0.003921797 -0.003927518 -0.003933294 -0.003939125 -0.003945012
## [321] -0.003950956 -0.003956959 -0.003963020 -0.003969141 -0.003975323
## [326] -0.003981567 -0.003987874 -0.003994245 -0.004000681 -0.004007184
## [331] -0.004013753 -0.004020392 -0.004027100 -0.004033879 -0.004040730
## [336] -0.004047655 -0.004054654 -0.004061730 -0.004068884 -0.004076116
## [341] -0.004083429 -0.004090825 -0.004098303 -0.004105867 -0.004113518
## [346] -0.004121257 -0.004129086 -0.004137007 -0.004145022 -0.004153132
## [351] -0.004161340 -0.004169648 -0.004178057 -0.004186569 -0.004195188
## [356] -0.004203914 -0.004212751 -0.004221700 -0.004230764 -0.004239945
## [361] -0.004249247 -0.004258671 -0.004268221 -0.004277899 -0.004287707
## [366] -0.004297650 -0.004307731 -0.004317951 -0.004328315 -0.004338826
## [371] -0.004349488 -0.004360303 -0.004371277 -0.004382412 -0.004393714
## [376] -0.004405185 -0.004416830 -0.004428654 -0.004440662 -0.004452857
## [381] -0.004465246 -0.004477833 -0.004490623 -0.004503623 -0.004516837
## [386] -0.004530272 -0.004543935 -0.004557831 -0.004571967 -0.004586350
## [391] -0.004600988 -0.004615889 -0.004631059 -0.004646508 -0.004662243
## [396] -0.004678275 -0.004694612 -0.004711264 -0.004728242 -0.004745556
## [401] -0.004763217 -0.004781238 -0.004799630 -0.004818407 -0.004837582
## [406] -0.004857169 -0.004877184 -0.004897642 -0.004918559 -0.004939954
## [411] -0.004961845 -0.004984250 -0.005007191 -0.005030690 -0.005054769
## [416] -0.005079452 -0.005104766 -0.005130737 -0.005157395 -0.005184770
## [421] -0.005212895 -0.005241805 -0.005271537 -0.005302131 -0.005333630
## [426] -0.005366078 -0.005399525 -0.005434023 -0.005469627 -0.005506400
## [431] -0.005544405 -0.005583713 -0.005624401 -0.005666551 -0.005710252
## [436] -0.005755603 -0.005802710 -0.005851690 -0.005902668 -0.005955787
## [441] -0.006011199 -0.006069074 -0.006129600 -0.006192988 -0.006259468
## [446] -0.006329301 -0.006402779 -0.006480230 -0.006562027 -0.006648590
## [451] -0.006740402 -0.006838016 -0.006942070 -0.007053305 -0.007172586
## [456] -0.007300934 -0.007439558 -0.007589908 -0.007753737 -0.007933187
## [461] -0.008130911 -0.008350240 -0.008595419 -0.008871964 -0.009187195
```

```
## [466] -0.009551073 -0.009977567 -0.010487004 -0.011110362 -0.011897725
## [471] -0.012936805 -0.014399615 -0.016688636 -0.021110685 -0.047988410
```

```
# The first 10 elements of which are:
# [1] -0.002941658 -0.002942622 -0.002943588 -0.002944558 -0.002945531
# [6] -0.002946506 -0.002947485 -0.002948466 -0.002949450 -0.002950437
#
# Finally we sum the values using the given statistic to find d:
d <- sum(c*x)
d
```

```
## [1] 1.410337
```

```
# The result of which is:
# [1] 1.500937
################################################################################

## Question 3 ##################################################################
# 3. We write a program to calculate the given matrix
# B size qxq from matrix A of size pxp where q<p.
#
# First we define our values for p (for size of A), q (for the size of the
# sub-matrix A1) and A (the transpose matrix we will test), where q<p:
p <- 4
q <- 2
A <- matrix(runif(p ^ 2) * 2 - 1, ncol = p)
A <- t(A) %*% A
A
```

```
##            [,1]        [,2]       [,3]        [,4]
## [1,]  1.1117954  1.18186686 -1.1115097 -0.37093123
## [2,]  1.1818669  1.82705554 -0.8961438  0.05269009
## [3,] -1.1115097 -0.89614384  1.3098669  0.54717943
## [4,] -0.3709312  0.05269009  0.5471794  1.10661358
```

```
# This gives matrix A as:
#            [,1]       [,2]       [,3]       [,4]
# [1,]  1.3167148 -0.9878378 -1.2989958 -0.1963702
# [2,] -0.9878378  1.8257676  0.7874083 -1.5637125
# [3,] -1.2989958  0.7874083  1.3247047  0.4911790
# [4,] -0.1963702 -1.5637125  0.4911790  2.7611680
#
# Next, we take the partitions of the generated matrix A:
A1 <- A[c(1:q),c(1:q)]
A2 <- A[c(1:q),c((q+1):p)]
A3 <- A[c((q+1):p),c(1:q)]
A4 <- A[c((q+1):p),c((q+1):p)]
A1
```

```
##          [,1]     [,2]
## [1,] 1.111795 1.181867
## [2,] 1.181867 1.827056
```

```
A2
```

```
##            [,1]        [,2]
## [1,] -1.1115097 -0.37093123
## [2,] -0.8961438  0.05269009
```

```
A3
```

```
##            [,1]        [,2]
## [1,] -1.1115097 -0.89614384
## [2,] -0.3709312  0.05269009
```

```
A4
```

```
##           [,1]      [,2]
## [1,] 1.3098669 0.5471794
## [2,] 0.5471794 1.1066136
```

```
# This gives sub-matrices A1-A4 as:
#  A1        [,1]       [,2]    A2        [,1]       [,2]
# [1,]  1.3167148 -0.9878378   [1,] -1.2989958 -0.1963702
# [2,] -0.9878378  1.8257676   [2,]  0.7874083 -1.5637125
#
#  A3        [,1]       [,2]    A4        [,1]       [,2]
# [1,] -1.2989958  0.7874083   [1,]   1.324705   0.491179
# [2,] -0.1963702 -1.5637125   [2,]   0.491179   2.761168
#
# And finally produce the assignment by testing for A being a
# Symmetric Positive Definite Matrix as per the requested rules:
B <- matrix(all(eigen(A)$values>0) *
              (A1-A2%*%A4^(-1)%*%A3), ncol = q)
B
```

```
##             [,1]        [,2]
## [1,] -1.46270717 -0.06137111
## [2,] -0.06137111  1.38403758
```

```
# Which gives us the following for matrix A:
#           [,1]      [,2]
# [1,] -1.009697 -4.147589
# [2,] -4.147589  5.485734
#
# And when called on either a non-symmetric matrix or a symmetric
# non-positive definite matrix where q=2 and p=3, the result is:
#      [,1] [,2]
# [1,]    0    0
# [2,]    0    0
################################################################################

## Question 4 ##################################################################
# 4. We find the expected value of a distribution
# f(x) using a given algorithm.
#
# 4a. We simulate a random vector with 1000 elements from
# the unform distribution in the unit interval h(x).
n <- 1000
x <- runif(n, 0, 1)
x
```

```
##    [1] 0.151640996 0.333132709 0.292725686 0.783046764 0.250183444
##    [6] 0.544913869 0.123292749 0.578801296 0.798777329 0.825974479
##   [11] 0.273557586 0.592545501 0.498921028 0.222197644 0.569962290
##   [16] 0.230285855 0.043922911 0.147490303 0.268566443 0.808348537
```

```
##   [21] 0.353712496 0.058912199 0.690219603 0.221520197 0.744565438
##   [26] 0.897150441 0.636908794 0.200527573 0.206570018 0.889354397
##   [31] 0.509338101 0.360165496 0.488773124 0.971578184 0.684109132
##   [36] 0.990196490 0.005179224 0.409501138 0.189886771 0.618503010
##   [41] 0.568104489 0.989028775 0.758765119 0.106758232 0.319943822
##   [46] 0.985499127 0.058652724 0.022742607 0.371338336 0.773921304
##   [51] 0.354125916 0.759879134 0.987281082 0.851147379 0.932413816
##   [56] 0.884506889 0.978331697 0.980042155 0.705195403 0.730698761
##   [61] 0.311361681 0.636073337 0.710972157 0.983768831 0.955073326
##   [66] 0.320343553 0.609892358 0.348174125 0.160117054 0.914397577
##   [71] 0.443395923 0.902944988 0.473241235 0.078582983 0.994798027
##   [76] 0.122154352 0.867288465 0.304038183 0.364119652 0.479922840
##   [81] 0.832719944 0.911899033 0.228480302 0.382816060 0.328221710
##   [86] 0.405907374 0.118846515 0.733109503 0.470852272 0.883165499
##   [91] 0.060867858 0.910928208 0.486803771 0.175694817 0.022840148
##   [96] 0.754806735 0.258193303 0.604483909 0.317010570 0.345064759
##  [101] 0.161493690 0.266293195 0.990862392 0.005217809 0.482757315
##  [106] 0.623334897 0.777874538 0.048920007 0.347349995 0.335541909
##  [111] 0.794890838 0.404663153 0.396998270 0.742766584 0.411200777
##  [116] 0.548477245 0.827561550 0.062833834 0.855914760 0.504381376
##  [121] 0.715356221 0.845283357 0.849431893 0.107025099 0.592396177
##  [126] 0.531813078 0.214498089 0.376028394 0.231075827 0.930638884
##  [131] 0.537936070 0.586215239 0.674248931 0.851609980 0.979734523
##  [136] 0.092630708 0.167699219 0.851731268 0.750554499 0.827001003
##  [141] 0.575070240 0.033727969 0.386516634 0.918236714 0.189959330
##  [146] 0.903432728 0.406220518 0.949793883 0.730628278 0.633019800
##  [151] 0.020301718 0.237332023 0.186395222 0.261070178 0.876623939
##  [156] 0.619975283 0.865979315 0.274361402 0.553402216 0.238837390
##  [161] 0.702622282 0.345890486 0.481255731 0.987618004 0.978476927
##  [166] 0.277252690 0.550507859 0.482793439 0.226487898 0.501988351
##  [171] 0.103408615 0.424186346 0.164772801 0.547266583 0.195266009
##  [176] 0.956752263 0.946038251 0.244327778 0.888387792 0.053420841
##  [181] 0.330399371 0.985704279 0.021866721 0.936869435 0.395403370
##  [186] 0.057998078 0.658182602 0.827371302 0.840063536 0.658183702
##  [191] 0.301601466 0.623305647 0.181625882 0.347640184 0.886977770
##  [196] 0.554463951 0.046538237 0.494282876 0.594512140 0.583482245
##  [201] 0.855612647 0.085877797 0.924694898 0.519108528 0.075794975
##  [206] 0.419094651 0.441499271 0.603595747 0.301593489 0.389000828
##  [211] 0.135838289 0.861288899 0.939779840 0.222109562 0.979958005
##  [216] 0.431628230 0.239574122 0.054942609 0.326018531 0.742905122
##  [221] 0.608962671 0.748743339 0.560361253 0.365499138 0.254037189
##  [226] 0.120453153 0.959494162 0.947258513 0.702522589 0.293153849
##  [231] 0.630587290 0.866771104 0.466324154 0.868187408 0.019259383
##  [236] 0.902349767 0.757699201 0.021254791 0.258994259 0.848886026
##  [241] 0.409067892 0.425432493 0.624311704 0.240213988 0.837371323
##  [246] 0.584908805 0.642837005 0.256505125 0.748594263 0.602787468
##  [251] 0.080206259 0.152080325 0.583597651 0.359398995 0.736728495
##  [256] 0.932722286 0.835397134 0.883727458 0.416421013 0.080564358
##  [261] 0.559205135 0.064028283 0.011004084 0.103475234 0.968328237
##  [266] 0.128357432 0.026245211 0.933675104 0.258156389 0.400161356
##  [271] 0.003950846 0.046028875 0.845262865 0.286445566 0.825054118
##  [276] 0.312256742 0.797942322 0.051420653 0.514096865 0.056500517
##  [281] 0.960954652 0.444845849 0.335700023 0.644650272 0.304377134
##  [286] 0.205332968 0.569747385 0.125942686 0.110456290 0.057036521
```

```
##  [291] 0.589329301 0.307627516 0.536354099 0.002504791 0.528372020
##  [296] 0.584339282 0.660855510 0.748756175 0.507176944 0.197823556
##  [301] 0.420994803 0.485510105 0.078906181 0.008738759 0.013045109
##  [306] 0.430569967 0.747115923 0.617648244 0.298775033 0.232410748
##  [311] 0.439956204 0.287066598 0.504447712 0.797371280 0.322430407
##  [316] 0.237050694 0.003874404 0.247009005 0.842237527 0.627665937
##  [321] 0.937611515 0.389402152 0.314304388 0.965980326 0.310327516
##  [326] 0.400090659 0.435108155 0.685779870 0.372100076 0.965753281
##  [331] 0.202277468 0.072748736 0.530024998 0.921794564 0.044886805
##  [336] 0.403411289 0.919847721 0.098117448 0.506353105 0.077009774
##  [341] 0.349998993 0.643828604 0.447219592 0.803864469 0.692304250
##  [346] 0.517414168 0.031519776 0.441196529 0.318356780 0.840993745
##  [351] 0.493297847 0.556860600 0.207598236 0.731230989 0.320950833
##  [356] 0.976734990 0.056331834 0.782804869 0.689664086 0.386761244
##  [361] 0.131951248 0.822177081 0.358819462 0.254949092 0.881743013
##  [366] 0.793571832 0.695379488 0.475550062 0.308704143 0.436048601
##  [371] 0.620409801 0.379144784 0.716598172 0.357937203 0.870005624
##  [376] 0.624046401 0.004214741 0.522222966 0.505730799 0.376889716
##  [381] 0.786769239 0.590113730 0.430718976 0.890111362 0.968565377
##  [386] 0.814350314 0.276369540 0.484175289 0.026166795 0.134771921
##  [391] 0.604583351 0.437410041 0.933143313 0.385346906 0.916571943
##  [396] 0.400991095 0.954687641 0.924352517 0.706300047 0.539148308
##  [401] 0.437101789 0.003053819 0.469335105 0.997277389 0.614421518
##  [406] 0.510337733 0.468011208 0.228466543 0.417218944 0.520636058
##  [411] 0.283101708 0.565721797 0.832214502 0.985541309 0.927526930
##  [416] 0.966070907 0.678980670 0.600067785 0.969638567 0.294331967
##  [421] 0.048167191 0.995788045 0.833147413 0.040244348 0.982779262
##  [426] 0.374459121 0.140892289 0.831376340 0.214523206 0.610926291
##  [431] 0.078437370 0.143842423 0.117942999 0.601136663 0.631386188
##  [436] 0.645887345 0.458154272 0.895843886 0.027257280 0.820694764
##  [441] 0.701966119 0.289304869 0.424386816 0.074095648 0.278066159
##  [446] 0.700296568 0.666004303 0.382662809 0.647450877 0.482144613
##  [451] 0.442008414 0.505437558 0.519492305 0.280513350 0.869960051
##  [456] 0.987427909 0.383786620 0.269852079 0.632428771 0.184601189
##  [461] 0.538860343 0.865460793 0.705251646 0.480943225 0.015451681
##  [466] 0.531379897 0.292063937 0.015180039 0.983704907 0.671299357
##  [471] 0.494228231 0.487350172 0.684264716 0.369309561 0.454376759
##  [476] 0.535432364 0.367297617 0.327771619 0.070076374 0.531094396
##  [481] 0.359031549 0.187220749 0.196071462 0.980550559 0.434879253
##  [486] 0.101740554 0.650295723 0.537921227 0.216100996 0.668272227
##  [491] 0.255315904 0.871104759 0.073709227 0.062706929 0.174591445
##  [496] 0.701049680 0.952921361 0.887489978 0.659197771 0.517273590
##  [501] 0.608537892 0.807098244 0.790760847 0.456838296 0.692429018
##  [506] 0.137247154 0.613363363 0.455163669 0.433869332 0.474357682
##  [511] 0.837557325 0.360449327 0.650123119 0.956878423 0.765118629
##  [516] 0.505540757 0.528594685 0.818218621 0.870979548 0.804193976
##  [521] 0.201265584 0.721683315 0.695407675 0.483434285 0.171434280
##  [526] 0.111475736 0.113595639 0.002477217 0.846704560 0.886188643
##  [531] 0.045966526 0.391978589 0.074934155 0.326028311 0.466070704
##  [536] 0.226545739 0.432854041 0.458102092 0.779957144 0.121260487
##  [541] 0.205918922 0.872927197 0.871922425 0.362770035 0.915605767
##  [546] 0.704453295 0.733745974 0.061487541 0.384448359 0.229234659
##  [551] 0.806719058 0.906289527 0.108089054 0.556695711 0.231480236
##  [556] 0.004663337 0.815806676 0.955973304 0.403451726 0.958391244
```

```
##  [561] 0.607622363 0.861922938 0.528431955 0.194177369 0.543480071
##  [566] 0.383854449 0.956607828 0.882454977 0.589170784 0.293364732
##  [571] 0.266497498 0.370232520 0.753038137 0.762888836 0.821912690
##  [576] 0.135973243 0.212323769 0.705842891 0.686246478 0.213618751
##  [581] 0.095641862 0.126867113 0.463624298 0.773777734 0.451648303
##  [586] 0.416549674 0.639267243 0.255524358 0.827879306 0.251903927
##  [591] 0.498786698 0.003732835 0.821664989 0.382692592 0.132123214
##  [596] 0.944899410 0.820391994 0.396190962 0.059298049 0.653184474
##  [601] 0.123470500 0.331861694 0.739081255 0.821348740 0.610303907
##  [606] 0.988617881 0.036256575 0.294964711 0.091067214 0.216455272
##  [611] 0.519272366 0.752121102 0.904102554 0.454167445 0.609029241
##  [616] 0.775527504 0.568688017 0.937999828 0.725778160 0.492913301
##  [621] 0.171582456 0.289884987 0.482520448 0.625757034 0.368185162
##  [626] 0.319641228 0.447119797 0.491373076 0.162625907 0.675054321
##  [631] 0.237445438 0.457944464 0.893216173 0.604077404 0.987216973
##  [636] 0.020727165 0.672421184 0.126115799 0.275034812 0.697381194
##  [641] 0.601225938 0.032136246 0.873019298 0.177445760 0.391527551
##  [646] 0.792715110 0.833598494 0.612767371 0.786845542 0.764360754
##  [651] 0.277108143 0.734337321 0.657943606 0.380689392 0.722250135
##  [656] 0.359317832 0.885356632 0.305177019 0.403356201 0.271151270
##  [661] 0.899630866 0.188388183 0.402899881 0.051947147 0.447170240
##  [666] 0.068370488 0.832059339 0.476578870 0.549770695 0.436132181
##  [671] 0.752744036 0.769737757 0.527935083 0.084040439 0.214102618
##  [676] 0.912241152 0.755481053 0.041293436 0.863032917 0.585348951
##  [681] 0.686167502 0.932457401 0.178002707 0.845137013 0.164437139
##  [686] 0.746243796 0.493527407 0.089658910 0.227933743 0.193581304
##  [691] 0.156495732 0.411160318 0.056292325 0.267684800 0.273691734
##  [696] 0.918135187 0.295692490 0.425306566 0.604856297 0.223957394
##  [701] 0.317959630 0.419695642 0.884864915 0.423188089 0.649784896
##  [706] 0.813918049 0.879737661 0.583285328 0.755393070 0.380523326
##  [711] 0.972258044 0.548642282 0.452972939 0.983465214 0.431057821
##  [716] 0.651696229 0.889904655 0.570397764 0.532050002 0.868854500
##  [721] 0.009408637 0.581829946 0.001852249 0.855737394 0.224749348
##  [726] 0.299181336 0.442994696 0.098552259 0.817615079 0.577925421
##  [731] 0.390874261 0.067114982 0.412223604 0.715715046 0.627890041
##  [736] 0.965821462 0.081935425 0.174288101 0.476259950 0.336241764
##  [741] 0.487903348 0.926795803 0.654019802 0.685317783 0.413473135
##  [746] 0.980846046 0.795669119 0.199451282 0.214025820 0.994995929
##  [751] 0.703378058 0.400074732 0.215859651 0.392424773 0.456614695
##  [756] 0.154731929 0.994323767 0.908555331 0.802798870 0.927384080
##  [761] 0.942423469 0.590675323 0.103910155 0.415786530 0.506079804
##  [766] 0.498103999 0.943079100 0.782413722 0.147356389 0.907887406
##  [771] 0.878190742 0.192429611 0.524958100 0.006846605 0.595153743
##  [776] 0.913443314 0.630316239 0.852361683 0.463348271 0.507991147
##  [781] 0.962422864 0.385757488 0.355990202 0.536829646 0.871737261
##  [786] 0.425998515 0.884309260 0.316945385 0.428626194 0.169611511
##  [791] 0.489774885 0.750018868 0.352137594 0.040542280 0.062851464
##  [796] 0.293648345 0.113510827 0.615974055 0.720984180 0.369266162
##  [801] 0.777476891 0.009766257 0.690703376 0.044532189 0.508310513
##  [806] 0.563936498 0.790990060 0.255351787 0.662438243 0.265763449
##  [811] 0.283193832 0.145125960 0.831775702 0.370764723 0.958873740
##  [816] 0.199297998 0.063192658 0.937628237 0.785631950 0.253714327
##  [821] 0.075989170 0.924286748 0.230460808 0.043661327 0.861504313
##  [826] 0.741283539 0.800626208 0.105445556 0.321676384 0.393809563
```

```
##  [831] 0.567219669 0.737064850 0.058562830 0.018768369 0.758875394
##  [836] 0.582137613 0.715309415 0.586091550 0.605755165 0.585149808
##  [841] 0.198631777 0.939776096 0.909297896 0.060437029 0.739495638
##  [846] 0.451438288 0.822284224 0.152090529 0.793050710 0.362997980
##  [851] 0.018345092 0.855982782 0.552587709 0.139937279 0.429879677
##  [856] 0.372045367 0.095772140 0.621541927 0.794712183 0.542710952
##  [861] 0.224563335 0.338271600 0.728576683 0.863748408 0.542377091
##  [866] 0.776526812 0.643202555 0.709689781 0.942620036 0.171305627
##  [871] 0.914066585 0.673278657 0.821484047 0.570656787 0.319210007
##  [876] 0.737460896 0.896093355 0.099374552 0.424060298 0.199188185
##  [881] 0.891141089 0.562448874 0.171850513 0.522724758 0.912579478
##  [886] 0.170463354 0.829829218 0.665813542 0.234436915 0.887639988
##  [891] 0.752159454 0.174386530 0.591098488 0.517189615 0.494679451
##  [896] 0.722653922 0.568679508 0.839766364 0.185486172 0.083029340
##  [901] 0.941064558 0.781485213 0.693297209 0.752445226 0.818365687
##  [906] 0.092503513 0.413328484 0.360687084 0.837403018 0.543853863
##  [911] 0.411350587 0.355622122 0.840278523 0.672552695 0.467250437
##  [916] 0.514166248 0.665437342 0.123832120 0.381115249 0.529212905
##  [921] 0.802404372 0.398998763 0.034870385 0.966836654 0.779219507
##  [926] 0.993379497 0.124113216 0.583932535 0.917666103 0.607074398
##  [931] 0.922845121 0.128370719 0.742447883 0.689849322 0.567297586
##  [936] 0.853498700 0.922329860 0.995244171 0.056028939 0.049234601
##  [941] 0.416041766 0.710553394 0.406705483 0.121754890 0.585168403
##  [946] 0.051402316 0.559699727 0.203099538 0.222471211 0.876418945
##  [951] 0.713805827 0.044585355 0.833071473 0.606764296 0.617702675
##  [956] 0.322156165 0.491984241 0.934999901 0.375368910 0.159128942
##  [961] 0.952310304 0.381484917 0.940352278 0.101268169 0.158703182
##  [966] 0.659958041 0.996548497 0.215346052 0.842682077 0.327482943
##  [971] 0.278630100 0.772560316 0.183240248 0.322921240 0.718774955
##  [976] 0.751289744 0.823747783 0.461305239 0.929558657 0.182606064
##  [981] 0.556200018 0.616272593 0.239914946 0.382795166 0.468093701
##  [986] 0.403661565 0.734044340 0.238487246 0.857945648 0.259085315
##  [991] 0.339234575 0.816322571 0.393341800 0.250518656 0.528577928
##  [996] 0.966048123 0.555847319 0.713944760 0.449218635 0.782257930
```

```
# The first 10 elements of which are:
# [1] 0.6010124290 0.3419877680 0.4283414048 0.0395805317 0.7722877008
# [6] 0.7631933882 0.9642461368 0.8303982457 0.9457602822 0.0455781214
################################################################################
# 4b. We then set y as the output of phi(x) / h(x) where phi(x)
# is the CDF of the normal distribution function and h is the
# uniform density in the unit interval:
y <- pnorm(x) / dunif(x, 0, 1)
y
```

```
##    [1] 0.5602650 0.6304829 0.6151341 0.7832002 0.5987773 0.7070936
##    [7] 0.5490624 0.7186384 0.7877902 0.7955907 0.6077877 0.7232573
##   [13] 0.6910825 0.5879200 0.7156484 0.5910652 0.5175171 0.5586275
##   [19] 0.6058683 0.7905550 0.6382228 0.5234890 0.7549720 0.5876563
##   [25] 0.7717328 0.8151807 0.7379079 0.5794660 0.5818272 0.8130937
##   [31] 0.6947424 0.6406383 0.6874988 0.8343698 0.7530469 0.8389610
##   [37] 0.5020662 0.6589140 0.5753011 0.7318781 0.7150180 0.8386755
##   [43] 0.7760035 0.5425096 0.6254945 0.8378105 0.5233856 0.5090722
##   [49] 0.6448072 0.7805113 0.6383777 0.7763366 0.8382476 0.8026563
##   [55] 0.8244386 0.8117887 0.8360449 0.8364673 0.7596557 0.7675184
```

```
##   [61] 0.6222372 0.7376357 0.7614493 0.8373854 0.8302297 0.6256460
##   [67] 0.7290334 0.6361453 0.5636056 0.8197460 0.6712603 0.8167225
##   [73] 0.6819795 0.5313178 0.8400827 0.5486116 0.8071080 0.6194506
##   [79] 0.6421157 0.6843589 0.7974987 0.8190891 0.5903636 0.6490719
##   [85] 0.6286280 0.6575947 0.5473015 0.7682542 0.6811269 0.8114266
##   [91] 0.5242678 0.8188334 0.6868013 0.5697331 0.5091111 0.7748175
##   [97] 0.6018711 0.7272390 0.6243822 0.6349772 0.5641477 0.6049933
##  [103] 0.8391236 0.5020816 0.6853660 0.7334678 0.7816785 0.5195085
##  [109] 0.6358358 0.6313918 0.7866615 0.6571374 0.6543156 0.7711885
##  [115] 0.6595373 0.7083179 0.7960406 0.5250506 0.8039775 0.6930033
##  [121] 0.7628055 0.8010237 0.8021795 0.5426155 0.7232073 0.7025723
##  [127] 0.5849207 0.6465521 0.5913721 0.8239798 0.7046894 0.7211346
##  [133] 0.7499235 0.8027847 0.8363914 0.5369015 0.5665900 0.8028184
##  [139] 0.7735396 0.7958818 0.7173781 0.5134530 0.6504430 0.8207525
##  [145] 0.5753295 0.8168519 0.6577097 0.8288915 0.7674969 0.7366396
##  [151] 0.5080987 0.5938004 0.5739326 0.6029808 0.8096545 0.7323630
##  [157] 0.8067492 0.6080965 0.7100060 0.5943842 0.7588544 0.6352875
##  [163] 0.6848326 0.8383301 0.8360808 0.6092070 0.7090145 0.6853788
##  [169] 0.5895890 0.6921621 0.5411807 0.6642850 0.5654386 0.7079022
##  [175] 0.5774076 0.8306538 0.8279355 0.5965115 0.8128339 0.5213017
##  [181] 0.6294509 0.8378609 0.5087229 0.8255871 0.6537274 0.5231249
##  [187] 0.7447896 0.7959867 0.7995636 0.7447900 0.6185221 0.7334582
##  [193] 0.5720618 0.6359448 0.8124546 0.7103693 0.5185594 0.6894468
##  [199] 0.7239152 0.7202156 0.8038940 0.5342182 0.8224377 0.6981575
##  [205] 0.5302089 0.6624265 0.6705742 0.7269438 0.6185190 0.6513622
##  [211] 0.5540254 0.8054605 0.8263347 0.5878857 0.8364466 0.6669942
##  [217] 0.5946698 0.5219079 0.6277948 0.7712304 0.7287254 0.7729940
##  [223] 0.7123835 0.6426306 0.6002666 0.5479379 0.8313451 0.8282465
##  [229] 0.7588233 0.6152977 0.7358448 0.8069663 0.6795083 0.8073541
##  [235] 0.5076829 0.8165645 0.7756845 0.5084788 0.6021802 0.8020276
##  [241] 0.6587551 0.6647393 0.7337886 0.5949178 0.7988081 0.7206955
##  [247] 0.7398351 0.6012196 0.7729491 0.7266750 0.5319634 0.5604382
##  [253] 0.7202545 0.6403517 0.7693563 0.8245183 0.7982529 0.8115783
##  [259] 0.6614490 0.5321058 0.7119891 0.5255261 0.5043899 0.5412071
##  [265] 0.8335598 0.5510669 0.5104691 0.8247642 0.6018569 0.6554812
##  [271] 0.5015762 0.5183564 0.8010180 0.6127316 0.7953296 0.6225773
##  [277] 0.7875480 0.5205048 0.6964079 0.5225285 0.8317125 0.6717844
##  [283] 0.6314515 0.7404231 0.6195797 0.5813440 0.7155755 0.5501114
##  [289] 0.5439762 0.5227419 0.7221798 0.6208171 0.7041431 0.5009993
##  [295] 0.7013794 0.7205040 0.7456475 0.7729979 0.6939847 0.5784084
##  [301] 0.6631206 0.6863427 0.5314464 0.5034862 0.5052041 0.6666095
##  [307] 0.7725032 0.7315964 0.6174441 0.5918905 0.6700156 0.6129693
##  [313] 0.6930266 0.7873823 0.6264367 0.5936913 0.5015457 0.5975494
##  [319] 0.8001725 0.7348886 0.8257780 0.6515107 0.6233551 0.8329730
##  [325] 0.6218440 0.6554551 0.6682580 0.7535740 0.6450908 0.8329162
##  [331] 0.5801501 0.5289970 0.7019527 0.8216821 0.5179012 0.6566772
##  [337] 0.8211738 0.5390805 0.6936956 0.5306921 0.6368303 0.7401567
##  [343] 0.6726417 0.7892624 0.7556269 0.6975665 0.5125725 0.6704646
##  [349] 0.6248928 0.7998243 0.6890989 0.7111887 0.5822287 0.7676810
##  [355] 0.6258762 0.8356498 0.5224613 0.7831291 0.7547973 0.6505335
##  [361] 0.5524886 0.7945119 0.6401349 0.6006188 0.8110421 0.7862776
##  [367] 0.7565912 0.6828025 0.6212267 0.6685993 0.7325060 0.6477098
##  [373] 0.7631890 0.6398048 0.8078513 0.7337014 0.5016814 0.6992425
##  [379] 0.6934772 0.6468722 0.7842915 0.7224428 0.6666636 0.8132970
```

```
##  [385] 0.8336190 0.7922779 0.6088679 0.6858693 0.5104378 0.5536039
##  [391] 0.7272721 0.6690930 0.8246270 0.6500098 0.8203165 0.6557867
##  [397] 0.8301322 0.8223486 0.7599992 0.7051077 0.6689812 0.5012183
##  [403] 0.6805849 0.8406851 0.7305316 0.6950926 0.6801117 0.5903582
##  [409] 0.6617409 0.6986898 0.6114506 0.7142085 0.7973561 0.8378209
##  [415] 0.8231735 0.8329956 0.7514249 0.7257695 0.8338867 0.6157479
##  [421] 0.5192085 0.8403234 0.7976192 0.5160508 0.8371420 0.6459686
##  [427] 0.5560225 0.7971195 0.5849305 0.7293758 0.5312599 0.5571875
##  [433] 0.5469436 0.7261255 0.7361060 0.7408238 0.6765792 0.8148319
##  [439] 0.5108727 0.7940899 0.7586499 0.6138260 0.6643581 0.5295329
##  [445] 0.6095192 0.7581289 0.7472958 0.6490151 0.7413299 0.6851484
##  [451] 0.6707584 0.6933742 0.6982913 0.6104582 0.8078389 0.8382835
##  [457] 0.6494317 0.6063630 0.7364466 0.5732291 0.7050084 0.8066070
##  [463] 0.7596732 0.6847216 0.5061641 0.7024222 0.6148811 0.5060557
##  [469] 0.8373697 0.7489851 0.6894275 0.6869949 0.7530960 0.6440515
##  [475] 0.6752212 0.7038245 0.6433015 0.6284578 0.5279336 0.7023233
##  [481] 0.6402143 0.5742562 0.5777229 0.8365928 0.6681750 0.5405187
##  [487] 0.7422494 0.7046843 0.5855455 0.7480201 0.6007604 0.8081515
##  [493] 0.5293791 0.5250001 0.5692997 0.7583640 0.8296850 0.8125924
##  [499] 0.7451156 0.6975174 0.7285846 0.7901951 0.7854582 0.6761064
##  [505] 0.7556660 0.5545823 0.7301819 0.6755043 0.6678083 0.6823776
##  [511] 0.7988603 0.6407444 0.7421937 0.8306857 0.7778995 0.6934105
##  [517] 0.7014567 0.7933838 0.8081173 0.7893575 0.5797545 0.7647554
##  [523] 0.7566001 0.6856063 0.5680588 0.5443804 0.5452208 0.5009883
##  [529] 0.8014201 0.8122421 0.5183315 0.6524630 0.5298664 0.6277985
##  [535] 0.6794176 0.5896115 0.6674396 0.6765605 0.7822919 0.5482576
##  [541] 0.5815729 0.8086486 0.8083747 0.6416117 0.8200631 0.7594247
##  [547] 0.7684482 0.5245145 0.6496769 0.5906567 0.7900858 0.8176087
##  [553] 0.5430375 0.7111323 0.5915291 0.5018604 0.7926946 0.8304571
##  [559] 0.6566920 0.8310672 0.7282810 0.8056350 0.7014002 0.5769815
##  [565] 0.7066003 0.6494568 0.8306174 0.8112346 0.7221266 0.6153783
##  [571] 0.6050720 0.6443954 0.7742865 0.7772352 0.7944367 0.5540788
##  [577] 0.5840728 0.7598571 0.7537212 0.5845778 0.5380975 0.5504772
##  [583] 0.6785415 0.7804689 0.6742388 0.6614961 0.7386755 0.6008409
##  [589] 0.7961306 0.5994423 0.6910352 0.5014892 0.7943662 0.6490261
##  [595] 0.5525566 0.8276449 0.7940037 0.6540179 0.5236426 0.7431813
##  [601] 0.5491327 0.6300032 0.7700712 0.7942762 0.7291697 0.8385749
##  [607] 0.5144611 0.6159896 0.5362804 0.5856836 0.6982146 0.7740109
##  [613] 0.8170295 0.6751458 0.7287475 0.7809860 0.7152161 0.8258778
##  [619] 0.7660126 0.6889631 0.5681171 0.6140479 0.6852819 0.7342628
##  [625] 0.6436324 0.6253798 0.6726057 0.6884187 0.5645935 0.7501794
##  [631] 0.5938444 0.6765038 0.8141293 0.7271039 0.8382319 0.5082684
##  [637] 0.7493422 0.5501799 0.6083553 0.7572179 0.7261552 0.5128183
##  [643] 0.8086737 0.5704209 0.6522963 0.7860281 0.7977464 0.7299849
##  [649] 0.7843139 0.7776739 0.6091515 0.7686284 0.7447128 0.6482831
##  [655] 0.7649296 0.6403213 0.8120178 0.6198843 0.6566569 0.6068627
##  [661] 0.8158416 0.5747138 0.6564891 0.5207146 0.6726239 0.5272546
##  [667] 0.7973123 0.6831690 0.7087617 0.6686296 0.7741981 0.7792723
##  [673] 0.7012278 0.5334879 0.5847665 0.8191791 0.7750198 0.5164690
##  [679] 0.8059403 0.7208434 0.7536963 0.8244499 0.5706396 0.8009828
##  [685] 0.5653065 0.7722399 0.6891800 0.5357209 0.5901511 0.5767481
##  [691] 0.5621789 0.6595225 0.5224455 0.6055290 0.6078392 0.8207260
##  [697] 0.6162675 0.6646934 0.7273628 0.5886048 0.6247422 0.6626461
##  [703] 0.8118853 0.6639210 0.7420844 0.7921540 0.8104993 0.7201494
```

```
##  [709] 0.7749934 0.6482215 0.8345389 0.7083745 0.6747159 0.8373107
##  [715] 0.6667868 0.7427014 0.8132415 0.7157960 0.7026543 0.8075366
##  [721] 0.5037534 0.7196594 0.5007389 0.8039285 0.5889129 0.6175992
##  [727] 0.6711152 0.5392531 0.7932115 0.7183428 0.6520549 0.5267549
##  [733] 0.6599122 0.7629163 0.7349620 0.8329332 0.5326510 0.5691805
##  [739] 0.6830554 0.6316557 0.6871908 0.8229837 0.7434505 0.7534283
##  [745] 0.6603700 0.8366657 0.7868878 0.5790451 0.5847365 0.8401309
##  [751] 0.7590899 0.6554493 0.5854514 0.6526278 0.6760260 0.5614837
##  [757] 0.8399674 0.8182076 0.7889545 0.8231364 0.8270121 0.7226310
##  [763] 0.5413797 0.6612169 0.6935997 0.6907946 0.8271798 0.7830143
##  [769] 0.5585746 0.8180311 0.8100799 0.5762972 0.7001938 0.5027314
##  [775] 0.7241296 0.8194953 0.7357561 0.8029933 0.6784426 0.6942702
##  [781] 0.8320814 0.6501619 0.6390760 0.7043074 0.8083241 0.6649455
##  [787] 0.8117354 0.6243575 0.6659024 0.5673422 0.6878534 0.7733783
##  [793] 0.6376325 0.5161696 0.5250576 0.6154867 0.5451872 0.7310442
##  [799] 0.7645404 0.6440353 0.7815613 0.5038961 0.7551240 0.5177599
##  [805] 0.6943822 0.7136013 0.7855251 0.6007743 0.7461548 0.6047893
##  [811] 0.6114859 0.5576943 0.7972322 0.6445936 0.8311888 0.5789852
##  [817] 0.5251935 0.8257823 0.7839584 0.6001419 0.5302861 0.8223315
##  [823] 0.5911331 0.5174128 0.8055198 0.7707392 0.7883260 0.5419889
##  [829] 0.6261511 0.6531392 0.7147175 0.7694585 0.5233498 0.5074871
##  [835] 0.7760365 0.7197630 0.7627911 0.7210930 0.7276613 0.7207765
##  [841] 0.5787246 0.8263338 0.8184035 0.5240962 0.7701970 0.6741632
##  [847] 0.7945424 0.5604422 0.7861259 0.6416968 0.5073182 0.8039963
##  [853] 0.7097271 0.5556452 0.6663584 0.6450705 0.5381492 0.7328784
##  [859] 0.7866095 0.7063356 0.5888405 0.6324207 0.7668697 0.8061369
##  [865] 0.7062206 0.7812810 0.7399537 0.7610517 0.8270624 0.5680083
##  [871] 0.8196591 0.7496150 0.7943147 0.7158838 0.6252164 0.7695789
##  [877] 0.8148985 0.5395796 0.6642391 0.5789422 0.8135733 0.7130949
##  [883] 0.5682225 0.6994171 0.8192681 0.5676771 0.7966823 0.7472349
##  [889] 0.5926771 0.8126328 0.7740224 0.5692192 0.7227728 0.6974881
##  [895] 0.6895868 0.7650537 0.7152132 0.7994803 0.5735761 0.5330859
##  [901] 0.8266641 0.7827414 0.7559385 0.7741083 0.7934258 0.5368510
##  [907] 0.6603170 0.6408333 0.7988170 0.7067290 0.6595923 0.6389382
##  [913] 0.7996239 0.7493840 0.6798396 0.6964321 0.7471146 0.5492759
##  [919] 0.6484411 0.7016711 0.7888405 0.6550529 0.5139085 0.8331872
##  [925] 0.7820748 0.8397375 0.5493872 0.7203671 0.8206032 0.7280992
##  [931] 0.8219560 0.5510722 0.7710920 0.7548555 0.7147440 0.8033086
##  [937] 0.8218217 0.8401912 0.5223406 0.5196338 0.6613103 0.7613195
##  [943] 0.6578878 0.5484534 0.7207828 0.5204975 0.7121579 0.5804714
##  [949] 0.5880265 0.8095988 0.7623264 0.5177811 0.7975978 0.7279963
##  [955] 0.7316143 0.6263328 0.6886348 0.8251058 0.6463069 0.5632164
##  [961] 0.8295302 0.6485783 0.8264816 0.5403312 0.5630486 0.7453596
##  [967] 0.8405081 0.5852512 0.8002969 0.6283487 0.6097356 0.7801087
##  [973] 0.5726952 0.6266226 0.7638602 0.7737608 0.7949586 0.6777102
##  [979] 0.8237002 0.5724464 0.7109629 0.7311427 0.5948019 0.6490642
##  [985] 0.6801412 0.6567692 0.7685391 0.5942484 0.8045388 0.6022153
##  [991] 0.6327835 0.7928422 0.6529665 0.5989069 0.7014509 0.8329899
##  [997] 0.7108424 0.7623693 0.6733630 0.7829685
# The first 14 elements of which are:
# [1] 0.7260841 0.6338200 0.6657987 0.5157862 0.7800280 0.7773260 0.8325387
# [8] 0.7968432 0.8278646 0.5181767 0.7295118 0.7695616 0.8266535 0.7962790
################################################################################
```

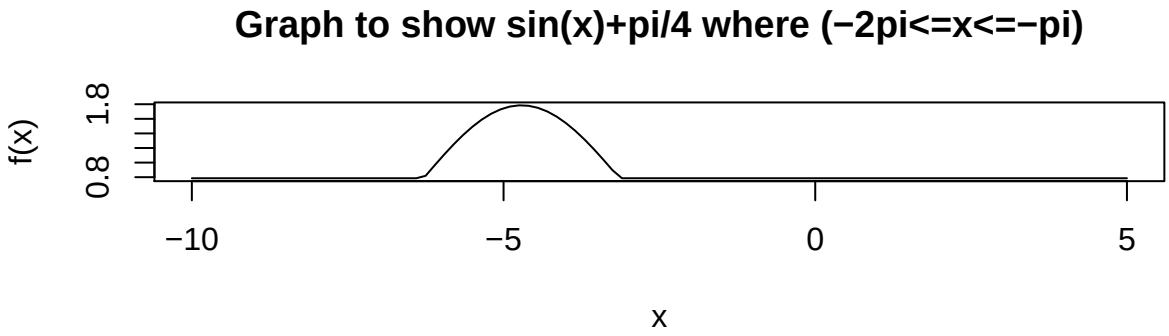
```r
# 4c. We then give the integration value by:
ybar <- mean(y)
ybar
```

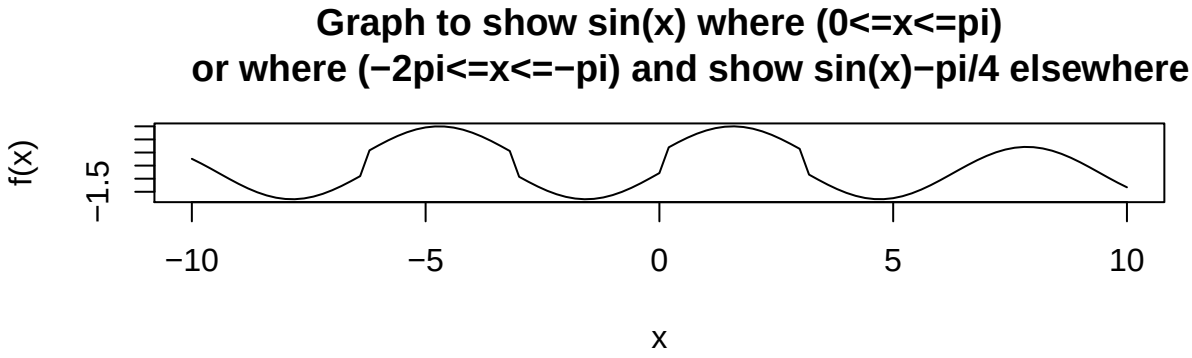
```
## [1] 0.6875293
```

```r
# The output of which is:
# [1] 0.6820499
##############################################################################
# Using the above value we can calculate the definite integral of
# x(x^5 - 1) dx between 0 and 1 where x is the integration value:
f <- function(x) {x*(x^5-1)}
integrate(f, 0, 1)
```

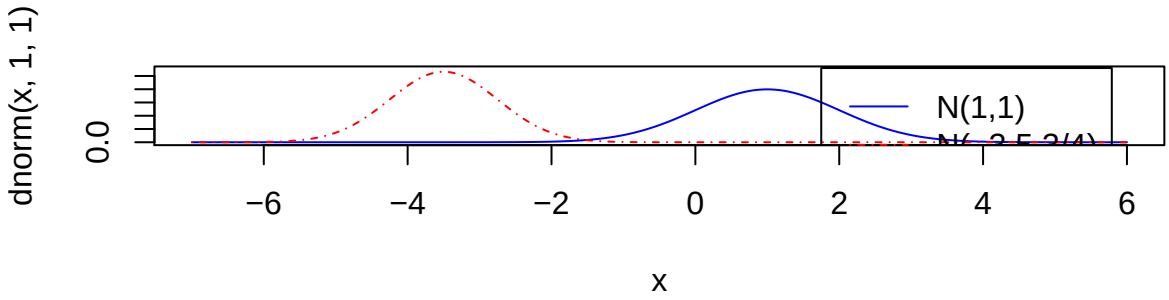
```
## -0.3571429 with absolute error < 4e-15
```

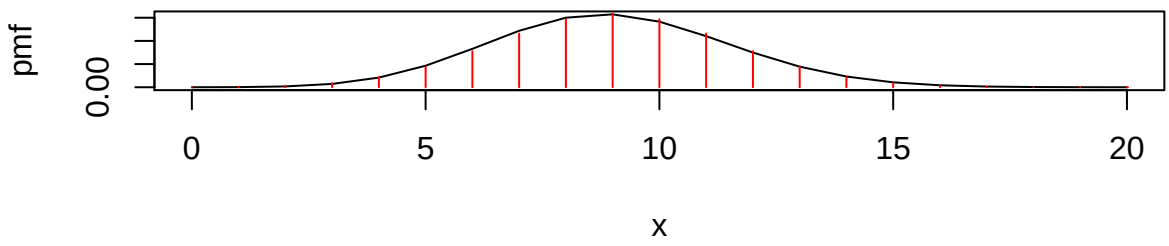
```r
# The output of which is:
# -0.3571429 with absolute error < 4e-15
# (Sorry, I messed up here somewhere but I can't quite work out how.)
##############################################################################

## Question 5 ################################################################
# 5a. We plot in the same figure, first the function f(x) = sin(x) + pi/4
# for -2pi <= x <= -pi and secondly g(x) = sin(x) where 0 <= x <= pi or
# -2pi <= x <= -pi and sin(x)-pi/4 elsewhere, with legends:
par(mfrow=c(2,1))
curve((-2*pi<=x&x<=-pi) * sin(x)+pi/4, -10, 5, ylab = "f(x)",
      main = "Graph to show sin(x)+pi/4 where (-2pi<=x<=-pi)")
curve((((0<=x&x<=pi)|(-2*pi<=x&x<=-pi))*(sin(x)) +
        ((-2*pi>=x)|(-pi<=x&x<=0)|(x>=pi))*(sin(x)-pi/4)),
      -10, 10, ylab = "f(x)", main = "Graph to show sin(x) where (0<=x<=pi)
      or where (-2pi<=x<=-pi) and show sin(x)-pi/4 elsewhere")
```






```r
# The plots of which are included as figure 1 at the end of this assignment.
################################################################################
# 5b. We plot in the same figure the densities of N(mu = 1, sigma^2 = 1)
# and N(mu = -3.5, sigma^2 = 3/4) with legends.
x <- seq(from = -7, to = 6, length = 1000)
plot(x, dnorm(x, 1, 1), type = "l", lty = 1, col = 4, ylim = c(0,0.55))
lines(x, dnorm(x, -3.5, 3/4), lty = 4, col = 2)
legend(1.75, 0.56, c("N(1,1)","N(-3.5,3/4)"), lty=c(1,4), col=c(4,2))
# The plots of which are included as figure 2 at the end of this assignment.
################################################################################
# 5c. We show a figure for comparing the probability mass function of
# binomial distribution with 30 trials and probability of success p=0.3
# with it's approximation by normal distributon. First we generate
# the binomial distribution by density.
x <- seq(0,20)
n <- 30
p <- 0.3
pmf <- dbinom(x, n, p)
# The first 10 values of which are:
# [1] 2.253934e-05 2.897915e-04 1.800847e-03 7.203389e-03 2.083838e-02
# 4.643981e-02 8.292823e-02 1.218537e-01 1.501412e-01 1.572908e-01
#
# Then we plot those points and generate and plot the normal.
plot(x, pmf, type = "l")
nor <- dnorm(x, 9, sqrt(n*p*(1-p)))
lines(x,nor, type="h", col=2)
```






```
# The plot of which is included as figure 3.
# Sorry, this is close but I can't quite remember how
# Normal Approximations work.
################################################################################
```