MA415 Assignment 1

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1.

(a)

```
1:20
```

```
##  [1]  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20
```

(b)

```
20:1
```

```
##  [1] 20 19 18 17 16 15 14 13 12 11 10  9  8  7  6  5  4  3  2  1
```

(c)

```
c(1:20, 19:1)
```

```
##  [1]  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 19 18 17
## [24] 16 15 14 13 12 11 10  9  8  7  6  5  4  3  2  1
```

(d)

```
tmp <- c(4,6,3)
```

(e)

```
rep(tmp, 10)
```

```
##  [1] 4 6 3 4 6 3 4 6 3 4 6 3 4 6 3 4 6 3 4 6 3 4 6 3 4 6 3 4 6 3
```

(f)

```
rep(tmp, 11, length = 31)
```

```
##  [1] 4 6 3 4 6 3 4 6 3 4 6 3 4 6 3 4 6 3 4 6 3 4 6 3 4 6 3 4 6 3 4
```

(g)

```
      rep(tmp, c(10, 20, 30))
```

```
##  [1] 4 4 4 4 4 4 4 4 4 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 3 3 3 3 3
## [36] 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
```

2.

```
      x <- seq(3,6,by=0.1)
      exp(x)*cos(x)
```

```
##  [1] -19.884531 -22.178753 -24.490697 -26.773182 -28.969238 -31.011186
##  [7] -32.819775 -34.303360 -35.357194 -35.862834 -35.687732 -34.685042
## [13] -32.693695 -29.538816 -25.032529 -18.975233 -11.157417  -1.362099
## [19]  10.632038  25.046705  42.099201  61.996630  84.929067 111.061586
## [25] 140.525075 173.405776 209.733494 249.468441 292.486707 338.564378
## [31] 387.360340
```

3.

(a)

```
      i <- seq(3,36,by=3)
      j<- seq(1,34,by=3)
      ThreeA <- (0.1^i*0.2^j)
      ThreeA
```

```
##  [1] 2.000000e-04 1.600000e-09 1.280000e-14 1.024000e-19 8.192000e-25
##  [6] 6.553600e-30 5.242880e-35 4.194304e-40 3.355443e-45 2.684355e-50
## [11] 2.147484e-55 1.717987e-60
```

(b)

```
      ThreeB <- (2^(1:25)/(1:25))
      ThreeB
```

```
##  [1] 2.000000e+00 2.000000e+00 2.666667e+00 4.000000e+00 6.400000e+00
##  [6] 1.066667e+01 1.828571e+01 3.200000e+01 5.688889e+01 1.024000e+02
## [11] 1.861818e+02 3.413333e+02 6.301538e+02 1.170286e+03 2.184533e+03
## [16] 4.096000e+03 7.710118e+03 1.456356e+04 2.759411e+04 5.242880e+04
## [21] 9.986438e+04 1.906502e+05 3.647221e+05 6.990507e+05 1.342177e+06
```

4.

(a)

```
      sum((10:100)^3+4*(10:100)^2)
```

```
## [1] 26852735
```

(b)

```
sum((2^(1:25)/(1:25))+(3^(1:25)/(1:25)^2))
```

```
## [1] 2129170437
```

5.

(a)

```
n <- paste(1:30)
label <- paste("label ", n)
label
```

```
##  [1] "label  1"  "label  2"  "label  3"  "label  4"  "label  5"
##  [6] "label  6"  "label  7"  "label  8"  "label  9"  "label  10"
## [11] "label  11" "label  12" "label  13" "label  14" "label  15"
## [16] "label  16" "label  17" "label  18" "label  19" "label  20"
## [21] "label  21" "label  22" "label  23" "label  24" "label  25"
## [26] "label  26" "label  27" "label  28" "label  29" "label  30"
```

(b)

```
fn <- paste0("fn",n)
fn
```

```
##  [1] "fn1"  "fn2"  "fn3"  "fn4"  "fn5"  "fn6"  "fn7"  "fn8"  "fn9"  "fn10"
## [11] "fn11" "fn12" "fn13" "fn14" "fn15" "fn16" "fn17" "fn18" "fn19" "fn20"
## [21] "fn21" "fn22" "fn23" "fn24" "fn25" "fn26" "fn27" "fn28" "fn29" "fn30"
```

6.

(a)

```
set.seed(50)
xVec <- sample(0:999, 250, replace=T)
yVec <- sample(0:999, 250, replace=T)
yminusx <- yVec[-1] - xVec[-length(xVec)]
yminusx
```

```
##   [1]  163 -122  317 -146  417  393  249 -489  741  771   81  402 -549  338
##  [15]  583 -403  -67  217  307 -121 -269   36 -706 -563  102   48  397  297
##  [29]  -45 -152  497  405  339 -400  499  -89  211 -670   87   74  554  149
##  [43] -183  612  193 -453  -70 -141  127 -709 -708 -722  -64  388 -184 -212
##  [57]  242  430  275  672 -150  275  -96 -255  512  577  264  439  149 -916
##  [71]  374 -889 -332  324 -553  394  -87  -75  345 -735  -55  100  -40   15
##  [85]  279  409  790 -547 -487 -399 -619 -168 -185   19  645  551  227 -366
##  [99]  242  147  247 -499 -614  758   63 -227  247  379 -472  566 -762  152
## [113]  493  360   69  190  544 -176  216 -676 -205  782 -109  189 -233  505
## [127] -219  288  -57  487  256  300 -192 -263  704  674  217  280   17  -68
## [141]  259  612 -127    1  545 -231 -191 -338  333  495  -21   -4  294 -668
```

```
## [155] -814  420  793  631  -67  655  143  611 -220 -518 -285  327  523  -13
## [169] -679 -241   39  193  342  588  469   68  895 -658  232 -331   27  441
## [183] -733 -182 -399   79 -469  371  475  265 -407  211   59 -974  -90  218
## [197]  396 -486 -963 -327  425  220  128  235  294 -107 -365  146 -588  449
## [211] -434  221  846  386 -910  161  206  109  712 -334 -434    7  640 -350
## [225]  923  353 -579  225  327  410  568 -195  -83  154 -486 -195  667 -144
## [239]  272  410  546  380 -559  414  674  193  222  -92  553
```

(b) Create the vector (sin(y1)/cos(x2),sin(y2)/cos(x3), . . . ,sin(yn−1)/cos(xn)).

```
sinycosx <- sin(yVec[-length(yVec)])/cos(xVec[-1])
sinycosx
```

```
##   [1]   0.88603405  -1.44184825   0.82807258  -1.61591717  -0.86017343
##   [6]  20.26356465  -0.79930406   1.72414444  -0.08094240  -0.74895634
##  [11]  -2.59866958  -0.37361045  31.11471579   0.12355916  -0.35925226
##  [16]  -0.90743608   0.34374436   5.78205917  -2.57418558  -0.78661325
##  [21]  -0.59855406   0.98936263   0.33042931  -1.75124647  -0.59435547
##  [26]   1.05374692   0.65497397  -0.11596582  -0.97176537   0.57180267
##  [31]   0.75799030  -0.49259143  -0.99433357   0.05377148  -3.77616264
##  [36]  20.54902944   0.77784817   1.28146891  -0.51650728   6.66902699
##  [41]  -0.92970072 -10.93066299  -3.13102962  30.87943423  -1.14281543
##  [46]   0.36757630   1.18479716   0.94594159   0.93339520   0.93632658
##  [51] -11.05384468   2.76893270   0.97488334  -0.08932225  -1.33616578
##  [56]  -3.30065552   0.62663162  -1.96486337   0.08653876   0.56695489
##  [61]  44.07630714  -1.11764853   0.11230330  -0.46073106  -0.13860882
##  [66]   0.84026052   2.64708780  -1.63174570  -9.63022830  -2.15553419
##  [71]  -0.42770826   3.24955062  -4.23453154   0.93067452  -0.88388390
##  [76]   0.69339350   1.72841015  -8.22082884   1.69276461   1.02074555
##  [81]  -3.21968328  -0.90739226   1.11331935   0.59579467   0.19571363
##  [86]  -0.17975474   4.38929818   0.64431266  -1.54509170  -0.26536991
##  [91]  -0.81679156   1.34164181  -1.03400420  -1.33639979  -0.44444499
##  [96]   0.96777754  -0.09545121  -0.63686070  -2.30844090  -0.11384497
## [101]   1.08800453   1.06851885  -0.30428029  -1.77044888  -1.45269351
## [106]   0.97943716  -2.15021752   1.56128032   0.61018741   5.59692239
## [111]  -1.03020002  -1.14632240  -0.81548097   0.95359082  74.12815803
## [116]  -0.20329495  -0.08875385  -0.76023984  -0.42372635  -0.68385723
## [121]   1.28860542   0.94117702   1.89561343   0.69369539   4.15021756
## [126]  -1.08026240   1.26615554   0.02147428   3.32694398   0.22930300
## [131]   1.14217476   0.73847767   8.72339712 -17.15727240   0.90435970
## [136]   1.07791792   0.75391899  -0.26297571   0.83894657  -1.22542984
## [141]  -0.57277292  -1.22429033   2.10719833  -1.35745285  -0.84117115
## [146]  -0.69663176  -0.99207337  -1.17363312  -5.50814669  -1.12309426
## [151]   0.60767585   0.32903697  -0.08845387  -4.42251048  -1.31360561
## [156]  -1.05268827  -1.45007537  -1.03184453   0.38034305   2.06381128
## [161]  -1.64568068   0.47938401  46.18666528   1.75988821  14.03349520
## [166]   1.99884446  -1.02170635   1.02445028  -0.15250370  -1.11793279
## [171]  -4.12228606   1.02355677   0.89546497   0.74732250  -2.09533197
## [176]  -2.40630344  -0.73530615   0.90759126  -0.87474163  -4.22536917
## [181]  -2.04450866  -7.41320483   0.03607946  -0.85674969  -0.85648584
## [186]   2.58973778   8.68248704  -0.74202802   1.07347586   1.37638585
## [191]   1.73104746  -0.57596355  -0.49915725   0.11786229  -0.45584137
## [196]  -0.97726281  -6.86428063  -0.60929448  -0.72132361   0.00000000
```

```
## [201]   1.00734878   4.20789995  -0.81616263  -1.72455176  10.00784534
## [206]   0.71310632   8.77005056  -0.64297796   0.24086573  -6.12424634
## [211]   0.94848253   9.22132979  -5.85933168  -0.77292827  -0.85749485
## [216]   0.80000340 -10.45187777   2.91489552   0.86914823   0.93956496
## [221]   1.15020196  -4.25009579  -0.97278301   1.05669698  23.96919924
## [226]  -0.11659711   0.58615433  -1.23512544   1.08111948   3.37846777
## [231]   0.96204558  -1.18727215   0.77801767   2.39161655   1.01270315
## [236]   0.30508064  -1.13987140   1.35085069   2.13213714   0.95034702
## [241]   0.48941676  -1.03804260   1.11768517  -0.25446052 -15.07630921
## [246]   1.12429826   0.28067653  -0.75125301  -1.91160477
```

(c)

```
xVecLength <- length(xVec)
xAdd <- xVec[-c(xVecLength - 1, xVecLength)] + 2*xVec[-c(1, xVecLength)] -       xVec[-c(1,2)]
xAdd
```

```
##   [1] 1382   70 1221 1749  -98  796 1949  623 -134  618  288 1472  517  -45
##  [15]  794 1982 1489  344 -206 1207  292  771 2085  810 1032 1547  767  537
##  [29]  702  676  737  664 1451  435 1355  168 1150  989  926  348 1757 1299
##  [43]  409 -497  501 2150 1157 1081 1323 2030 1887 1744  879  590  493 1330
##  [57] 1254 1281  465  767 1691  464 1238  805 -519 1425  710 -611 1517  963
##  [71] 1836 2243 -158 1860  606  506 1917 1304 2021 2025  238  226  733 1538
##  [85]  581 -659  824 1109 1136 1339 1239 1584 2300  562  567 -375 1372  761
##  [99] 1142  714 1801 2220  624 -806 1738  268  398 1941  668 2037  829  345
## [113]  337  -45  635 -285 1225  691 1792 2216  123  538 1130 1124 1172  944
## [127]  271  -62  229  785  -70 1346 1622  381  104 1036 1015  199  589 1399
## [141]  601  506  560 -145  171 1204 1427 1278 1128  615  269   37 1521 2172
## [155] 1602  464   74 1575  599   88 -267 1185 1655 1564 1420  880  229 1651
## [169]  959 1306 2008 1243  267 1110  556 -791 1300  844 1578 2427  708 1554
## [183] 1439 1150 1269 2274 1419 1067  187 2071  781 -148 1767 1851 1019 -196
## [197]  554 2223 1710  -90  788 1209  876 1322  275 1191  323 1570 1234  768
## [211] 1715  903 -768 1546 1452  -47 1125 -330  871 2463  894  133  975  201
## [225] -137 1553  299  865  746  184  267  839  -63  863 2411  133 1739 1145
## [239] 1015   47  209 1468  846   10 1146   31 1405 1058
```

(d)

```
xsum <- sum(exp(-xVec[-1])/(xVec[-length(xVec)]+10))
xsum
```

```
## [1] 0.01269872
```

7. This question uses the vectors xVec and yVec created in the previous question and the functions sort, order, mean, sqrt, sum and abs.

(a)

```
yVec[yVec>600]
```

```
##   [1] 709 871 621 930 948 783 878 671 860 768 698 974 855 813 776 721 917
```

```
##  [18] 985 705 884 840 687 957 955 786 938 930 641 615 988 881 881 997 823
##  [35] 791 643 779 693 845 815 752 766 635 993 919 686 635 613 660 800 743
##  [52] 965 743 615 615 803 948 760 604 800 772 863 902 689 881 941 924 693
##  [69] 835 632 872 876 850 961 681 791 947 915 712 665 921 798 866 828 942
##  [86] 841 645 681 827 884 890 970 632 717 846 952 609 824 695 675 777 813
## [103] 792 783 611 853 738 668 791
```

(b)

```
(1:length(yVec))[yVec>600]
```

```
##   [1]   1   2   5   6   8  10  11  13  16  18  27  28  32  33  34  36  42
##  [18]  43  45  48  50  55  58  59  60  61  63  66  67  68  72  79  80  86
##  [35]  88  94  95  96  97 101 102 105 107 109 111 114 118 119 120 123 125
##  [52] 127 131 132 134 136 137 138 139 142 143 150 151 154 157 158 159 161
##  [69] 163 164 167 168 172 173 174 175 176 178 180 181 182 183 187 189 190
##  [86] 203 204 205 206 211 213 214 219 220 224 226 227 230 232 237 238 239
## [103] 241 243 245 246 247 249 250
```

(c)

```
xVec[yVec>600]
```

```
##   [1] 708 437 513  44 646 107 390 640 676 364 577 257 408 437 618 627 836
##  [18] 278  55 458 803 358 525 511 266 578 197  38 724  61 995 652 956  19
##  [35] 680 760  48 294  69 505 964  24  10 840 878 113 789 444 986 537 515
##  [52] 263 359 189 457 274 543 324 176 160 260 407 216 977 148 293 660 137
##  [69] 852 743 353 371 768 339 203 478  49 880 996 894 357 900 972 467 324
##  [86] 517 446 533 190 501 124  14   5 863 399 256 678 188 258 110 957 285
## [103]  34 631 179 545 123 238 178
```

(d)

```
sqrt(abs(xVec-mean(xVec)))
```

```
##   [1] 16.0044994  3.8543482 15.8699716 17.7522956  7.8194629 20.1954450
##   [7] 15.7208142 13.9335566 20.2449006 18.5702989  7.8648585 13.5224258
##  [13] 13.7165593 19.3611983 13.2233127 14.9714395 19.5740645  9.3731532
##  [19] 19.4385185 16.8480266 12.8118695 16.0890025 16.0668603 19.7520632
##  [25] 11.9522383 14.0763632 11.1867779 13.9590831 11.3073427  9.1572922
##  [31]  9.6879306  6.6223863  3.8543482 12.8896858 15.1610026 13.2341981
##  [37] 18.1894475 15.7842960  8.8800901  2.4787093  9.4263461 19.5995918
##  [43] 13.1854465 18.9434949 19.9212449 15.7525871 22.4085698  2.4787093
##  [49] 16.1599505 18.7388367 23.3268943 17.6958752 13.6800585 12.3634947
##  [55]  9.6879306  5.1822775 16.2217138  8.5524266  7.6905136 13.6329014
##  [61] 11.2313846 14.2528594 15.9642100 11.5388041 17.9681941 20.3434510
##  [67] 16.4967876 19.7700784 17.7723381 22.1843188  7.4259006 23.3054500
##  [73] 14.4618118 19.4385185 22.6967839 17.4314658 14.3228489 22.4531512
##  [79] 14.1472259 22.4531512  9.5469367 20.8532012 10.6233705  4.1405314
##  [85]  9.5991666 20.8051917 21.2333700 15.1044364  9.2273506 13.8976257
##  [91] 15.4642814 15.3669776 19.3944322 17.5540309 20.0961688 12.5640758
```

```
##  [97] 19.5667064 18.8452647 11.8682770 14.7018366  7.2899931 22.6305988
## [103] 13.4217734 21.0678903 20.6846803 20.2520122 21.0203711 12.7335777
## [109] 19.7013705  9.9426355 20.6432556 19.4898948 16.0890025 18.4080417
## [115] 19.2316406 11.3954377 18.9962101 18.3614814  2.8028557 23.1115556
## [121] 13.1203658 20.8292103  9.2273506 10.1066315  7.9463199  2.8537694
## [127] 13.7424889 20.2449006 19.3870060 13.9948562  9.6361818 16.2128344
## [133] 18.8452647  2.2680388 18.7844617 13.3362663  9.5469367 11.3073427
## [139] 16.6089133  5.0143793  9.4416100 17.0837935 13.8512093 16.6690132
## [145] 20.0961688  6.0709143 15.9732276 13.1584194  8.8399095  6.6974622
## [151] 15.3576040 15.0948998  7.5402918 22.9160206 19.3944322  3.0239048
## [157] 17.4314658 12.6038089 14.4271965 20.3434510 17.7441821 15.0948998
## [163] 20.0035997 17.0629423 15.2034207  9.6511139  9.9426355  8.9919964
## [169] 20.3505282  0.3794733 18.9510950 17.7804387 10.6233705 15.7751704
## [175]  5.1131204 20.0712730 20.7811453 20.6916408  5.3050919 23.3268943
## [181] 21.0272205  9.7394045 21.1694119 12.2940636 14.6677878 18.3069386
## [187] 22.8066657  2.2680388  3.8915293 11.3073427 21.8207241 18.5163711
## [193]  9.3196566 23.1331796 10.9610219 13.1093860 18.4080417 15.8159413
## [199] 22.6084940  6.8451443 19.7194320 13.0055373  8.0711833  2.4199174
## [205]  9.0079964 16.1819653 13.6434600 13.2987217 20.3259440  4.1056059
## [211]  7.0102782 14.7358067 18.1067943 20.9250090 21.6366356 11.9939985
## [217] 19.1795725  8.4346903 21.1389688 20.2766861 20.2025741 18.2169152
## [223] 15.6797959  7.2702132 20.5634627 13.9948562 15.0380850 19.8205953
## [229]  6.7189285 16.2436449 18.0237621 13.9232180  8.7095350 16.7587589
## [235] 18.1423262 20.4485696 18.4893483 22.4754088 12.9172753  8.3579902
## [241] 20.4415264  6.9897067 13.3844686 15.9642100 16.5183534  9.6511139
## [247] 18.1343872 17.5540309 14.6238162 16.5485951
```

(e)

```
sum(yVec>max(yVec)-200)
```

```
## [1] 57
```

(f)

```
sum(xVec%%2==0)
```

```
## [1] 124
```

(g)

```
xVec[order(yVec)]
```

```
##   [1] 405 842 308 572 461   8 256 507 373 639  42 616  29 645 376 669 688
##  [18] 197  63 638 862  77 996  93  59 585 661  72 339  20 206 537 174 322
##  [35]  42 603 425  48 707 452 477  99 224 811 715 358 963 222 395 543 480
##  [52] 193 683 710 691 954 700 614 787 835 275 435 309 368 224 460 497 944
##  [69] 530 765 523 171 870 807 469 828 624 200 713 365 781  74 129  76 701
##  [86] 760 193 866 353 168 967 545 920 541 650 148 277  18 667 865 987 120
## [103] 655   1 554 699 311 458 632  84 269  82 280 544  17 621 807 113 136
## [120] 457 702  91 625 767 828 109 860 363 121 657 668 324 382 956 299 403
```

```
## [137]  74 928 415  38 127 176 678 179 444 724 189 457 513 743   5  10 789
## [154]  38 760 446 986 894 238 640 110 203 533 113 358 977 294 137 258 577
## [171]  55 708 996 863 627 123 515 359 964 324  24 364 260 618 957  48 107
## [188] 631 266 680 478 178  34 900 537 160 274 437 285 505  19 188 190 467
## [205] 852 803 517  69 399 768 545 408 676 407 972 437 353 371 390 995 652
## [222] 148 458 501 124 216 880 836 878 357 660  44 197 578 293 324  49 646
## [239] 543 256 511 525 339 263  14 257 278  61 840 956
```

(h)

```
    yVec[c(T,F,F)]
```

```
##  [1] 709 517 437 783 671 860 581 347 279 974 216 776 538 460 985 248 317
## [18] 288 687 957 938 101 615 285 106 414 881 488 484 791 246 643 845 553
## [35] 465  87 993 116 473 635 310 428 965  19 489 803 604 800 175 516 902
## [52] 689 881 593 835 398 358 850 791 915 665 167 866 942 320 482 216 488
## [69] 681 273 884 970 469 717 127 952 284 695 325 777 792  72 738 791
```

8.

```
    1 + sum(cumprod(seq(2,38,by=2)/seq(3,39,by=2)))
```

```
## [1] 6.976346
```