MA415 Assignment 1
Zirui Liu
U75461502
liuzirui@bu.edu

3.
x contains 21 items. Length(x) = 21.
sum(x) = 67
mean(x) = 3.190476

```
x <- scan("/Users/mac/Desktop/read_this_1.txt", character(0))
write.csv(x, "/Users/mac/Desktop/test.csv")
MyData <- read.csv(file="/Users/mac/Desktop/test.csv", header=TRUE, sep=",")
```

Exercises 1
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 16 15 14 13 12 11 10  9
[32]  8  7  6  5  4  3  2  1
```
(d).
```
> temp <- c(4, 6, 3)
```
(e).
```
> rep(temp, length = 30)
 [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(temp, 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).
```
> c(rep(4,10), rep(6, 10), rep(3, 10))
 [1] 4 4 4 4 4 4 4 4 4 4 6 6 6 6 6 6 6 6 6 6 3 3 3 3 3 3 3 3 3 3
```

2.
```
> x <- seq(3, 6, by=0.1)
> y <- exp(x)*cos(x)
> y
 [1] -19.884531 -22.178753 -24.490697 -26.773182 -28.969238 -31.011186 -32.819775 -34.303360 -35.357194
[10] -35.862834 -35.687732 -34.685042 -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 140.525075 173.405776 209.733494
[28] 249.468441 292.486707 338.564378 387.360340
```

3.

(a).
```
> x1 <- seq(3, 36, by = 3)
> x2 <- seq(1, 34, by = 3)
> y <- (0.1^x1)*(0.2^x2)
> y
 [1] 2.000000e-04 1.600000e-09 1.280000e-14 1.024000e-19 8.192000e-25 6.553600e-30 5.242880e-35 4.194304e-40
 [9] 3.355443e-45 2.684355e-50 2.147484e-55 1.717987e-60
```

(b).
```
> x1 <- seq(1, 25, by = 1)
> y <- (2^x1)/x1
> y
 [1] 2.000000e+00 2.000000e+00 2.666667e+00 4.000000e+00 6.400000e+00 1.066667e+01 1.828571e+01 3.200000e+01
 [9] 5.688889e+01 1.024000e+02 1.861818e+02 3.413333e+02 6.301538e+02 1.170286e+03 2.184533e+03 4.096000e+03
[17] 7.710118e+03 1.456356e+04 2.759411e+04 5.242880e+04 9.986438e+04 1.906502e+05 3.647221e+05 6.990507e+05
[25] 1.342177e+06
```

4.

(a).
```
> i <- seq(10, 100)
> s <- sum(i^3 + 4*i^2)
> s
[1] 26852735
```

(b).
```
> i <- seq(1, 25)
> s <- sum((2^i/i)+(3^i/i^2))
> s
[1] 2129170437
```

5.

(a).
```
> l <- paste("label", 1:30)
> l
 [1] "label 1"  "label 2"  "label 3"  "label 4"  "label 5"  "label 6"  "label 7"  "label 8"  "label 9"
[10] "label 10" "label 11" "label 12" "label 13" "label 14" "label 15" "label 16" "label 17" "label 18"
[19] "label 19" "label 20" "label 21" "label 22" "label 23" "label 24" "label 25" "label 26" "label 27"
[28] "label 28" "label 29" "label 30"
```

(b).
```
> l1 <- paste("fn", 1:30, sep = "")
> l1
 [1] "fn1"  "fn2"  "fn3"  "fn4"  "fn5"  "fn6"  "fn7"  "fn8"  "fn9"  "fn10" "fn11" "fn12" "fn13" "fn14" "fn15"
[16] "fn16" "fn17" "fn18" "fn19" "fn20" "fn21" "fn22" "fn23" "fn24" "fn25" "fn26" "fn27" "fn28" "fn29" "fn30"
```

6.
```
> set.seed(50)
> xVec <- sample(0:999, 250, replace=T)
> yVec <- sample(0:999, 250, replace=T)
```

(a).

```
> x6a <- yVec[2:250] - xVec[1:249]
> x6a
  [1]  163 -122  317 -146  417  393  249 -489  741  771   81  402 -549  338  583 -403  -67  217  307 -121 -269
 [22]   36 -706 -563  102   48  397  297  -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  242  430  275  672 -150  275  -96
 [64] -255  512  577  264  439  149 -916  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  242  147  247 -499 -614  758   63
[106] -227  247  379 -472  566 -762  152  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  259  612 -127    1  545 -231 -191
[148] -338  333  495  -21   -4  294 -668 -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 -733 -182 -399   79 -469  371  475
[190]  265 -407  211   59 -974  -90  218  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  923  353 -579  225  327  410  568
[232] -195  -83  154 -486 -195  667 -144  272  410  546  380 -559  414  674  193  222  -92  553
```

(b).
```
> x6b <- sin(yVec[1:249]/cos(2:250))
> x6b
  [1] -0.831796650 -0.158039615  0.949080997  0.449982091 -0.396600085  0.874423082 -0.073086179  0.563624273
  [9]  0.982600275 -0.633784952 -0.562352702 -0.625611108  0.055085240 -0.394487747  0.190428620 -0.451391895
 [17] -0.949694631 -0.717755191 -0.557837223  0.965448564 -0.121745795  0.799364364 -0.468437529 -0.779525805
 [25] -0.768570908  0.537986965 -0.558730172 -0.988582145 -0.642656925 -0.266179367  0.966919396 -0.933514148
 [33] -0.103463094  0.864751905 -0.761129294 -0.482909237 -0.820486408  0.862469313 -0.599448491 -0.809265270
 [41]  0.914850283 -0.533486091 -0.965074618 -0.980088203  0.707476146  0.987406843 -0.535768311  0.321505962
 [49]  0.977497906  0.762330153  0.971933046  0.505867450 -0.999901088 -0.578314141  0.805928789 -0.988165891
 [57]  0.348182421  0.185813007  0.521171231  0.895112401 -0.832838854  0.550386138 -0.987244759  0.478992525
 [65]  0.246582168 -0.212763549  0.671064246  0.966472195 -0.814311745  0.979098172  0.623879606 -0.246707455
 [73]  0.999566371 -0.936425821 -0.835861592 -0.954683083  0.376961885 -0.999961012 -0.975566994  0.949717440
 [81]  0.230579520  0.999029933 -0.670377374 -0.835456400  0.998330110 -0.597411461  0.847788831 -0.997810483
 [89] -0.998527161 -0.017738826 -0.006639693  0.587461373  0.738548728  0.822961745 -0.786288882 -0.980039832
 [97] -0.807940304  0.274398439  0.619304545 -0.871385623 -0.748100543 -0.025628978 -0.843775708  0.641716063
[105] -0.532265948  0.531044990  0.756857487  0.644645729 -0.942491099  0.278887646 -0.987896078 -0.307679561
[113] -0.282822293 -0.609796560 -0.116826686 -0.928526826 -0.790676373 -0.811849181 -0.881188971  0.238100065
[121]  0.471241075 -0.584668271 -0.696945641  0.150891988  0.992744335  0.832686740  0.830614987 -0.761140939
[129]  0.026153933  0.894222461  0.486783404 -0.970100717  0.965404216 -0.995727278 -0.557281094  0.311363724
[137] -0.234578069  0.167188339  0.245575027  0.200494954 -0.237882794 -0.993888961  0.255576042 -0.315232810
[145] -0.994294505  0.034474454 -0.683430683 -0.304603888  0.895411300  0.999708091 -0.867033138 -0.123932428
[153] -0.489472759 -0.563914175  0.992619362  0.995710151 -0.363007001 -0.986523093  0.994046885  0.570142514
[161]  0.841510915 -0.865346148  0.852017046 -0.971102657  0.566864112 -0.043474834 -0.534996116 -0.602305081
[169] -0.999268211  0.770338712  0.569373946 -0.628725106 -0.223210403  0.579466480  0.965130283  0.664338654
[177]  0.846241771  0.048173151 -0.241716569  0.191849370  0.991700720 -0.997514245 -0.793820704 -0.859038754
[185]  0.509404362  0.269578436 -0.893344125  0.339558956  0.421196498  0.128533110 -0.991364326  0.771464310
[193] -0.313907896  0.869628205  0.257863328  0.910798192  0.071092487  0.994111380 -0.386105088  0.000000000
[201] -0.044264334 -0.949709016  0.876559047  0.926122508  0.786042062 -0.736413207 -0.829207528 -0.909097952
[209]  0.936221971  0.625671643 -0.050156827  0.906135811  0.186143217 -0.308228652  0.868782378  0.748592944
[217] -0.625609205  0.823075065 -0.117547589  0.251444524 -0.692342680  0.609799124  0.586907877 -0.375974707
[225] -0.316578213 -0.896155616 -0.500538191  0.932394036 -0.672767832  0.543421734  0.906813643 -0.672770022
[233]  0.875846244 -0.988657514  0.969986072 -0.975484529  0.773590161  0.982232883  0.897724066 -0.524761000
[241]  0.811114055 -0.251440971 -0.236938582  0.185083342 -0.247345017  0.039261574  0.086344170  0.079684798
[249]  0.859362364
```

(c).
```
> x6c <- xVec[1:248] + 2*xVec[2:249] - xVec[3:250]
> x6c
  [1] 1382    70 1221 1749  -98  796 1949  623 -134  618  288 1472  517  -45  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  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 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 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  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 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 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 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 1015   47  209 1468  846   10 1146   31 1405 1058
```

(d).
```
> n <- length(xVec)
> x <- sum(exp(-xVec[-1])/(xVec[-n]+10))
> x
[1] 0.01269872
```

7.
(a).
```
> x <- yVec[yVec > 600]
> x
  [1] 709 871 621 930 948 783 878 671 860 768 698 974
 [13] 855 813 776 721 917 985 705 884 840 687 957 955
 [25] 786 938 930 641 615 988 881 881 997 823 791 643
 [37] 779 693 845 815 752 766 635 993 919 686 635 613
 [49] 660 800 743 965 743 615 615 803 948 760 604 800
 [61] 772 863 902 689 881 941 924 693 835 632 872 876
 [73] 850 961 681 791 947 915 712 665 921 798 866 828
 [85] 942 841 645 681 827 884 890 970 632 717 846 952
 [97] 609 824 695 675 777 813 792 783 611 853 738 668
[109] 791
```

(b).
```
> x <- which(yVec > 600)
> x
  [1]   1   2   5   6   8  10  11  13  16  18  27  28
 [13]  32  33  34  36  42  43  45  48  50  55  58  59
 [25]  60  61  63  66  67  68  72  79  80  86  88  94
 [37]  95  96  97 101 102 105 107 109 111 114 118 119
 [49] 120 123 125 127 131 132 134 136 137 138 139 142
 [61] 143 150 151 154 157 158 159 161 163 164 167 168
 [73] 172 173 174 175 176 178 180 181 182 183 187 189
 [85] 190 203 204 205 206 211 213 214 219 220 224 226
 [97] 227 230 232 237 238 239 241 243 245 246 247 249
[109] 250
```

(c).
```
> x <- xVec[yVec > 600]
> x
  [1] 708 437 513  44 646 107 390 640 676 364 577 257
 [13] 408 437 618 627 836 278  55 458 803 358 525 511
 [25] 266 578 197  38 724  61 995 652 956  19 680 760
 [37]  48 294  69 505 964  24  10 840 878 113 789 444
 [49] 986 537 515 263 359 189 457 274 543 324 176 160
 [61] 260 407 216 977 148 293 660 137 852 743 353 371
 [73] 768 339 203 478  49 880 996 894 357 900 972 467
 [85] 324 517 446 533 190 501 124  14   5 863 399 256
 [97] 678 188 258 110 957 285  34 631 179 545 123 238
[109] 178
```

(d).
```
> x <- sqrt(abs(xVec-mean(xVec)))
> x
  [1] 16.0044994  3.8543482 15.8699716 17.7522956
  [5]  7.8194629 20.1954450 15.7208142 13.9335566
  [9] 20.2449006 18.5702989  7.8648585 13.5224258
 [13] 13.7165593 19.3611983 13.2233127 14.9714395
 [17] 19.5740645  9.3731532 19.4385185 16.8480266
 [21] 12.8118695 16.0890025 16.0668603 19.7520632
 [25] 11.9522383 14.0763632 11.1867779 13.9590831
 [29] 11.3073427  9.1572922  9.6879306  6.6223863
 [33]  3.8543482 12.8896858 15.1610026 13.2341981
 [37] 18.1894475 15.7842960  8.8800901  2.4787093
 [41]  9.4263461 19.5995918 13.1854465 18.9434949
 [45] 19.9212449 15.7525871 22.4085698  2.4787093
 [49] 16.1599505 18.7388367 23.3268943 17.6958752
 [53] 13.6800585 12.3634947  9.6879306  5.1822775
 [57] 16.2217138  8.5524266  7.6905136 13.6329014
 [61] 11.2313846 14.2528594 15.9642100 11.5388041
 [65] 17.9681941 20.3434510 16.4967876 19.7700784
 [69] 17.7723381 22.1843188  7.4259006 23.3054500
 [73] 14.4618118 19.4385185 22.6967839 17.4314658
 [77] 14.3228489 22.4531512 14.1472259 22.4531512
 [81]  9.5469367 20.8532012 10.6233705  4.1405314
 [85]  9.5991666 20.8051917 21.2333700 15.1044364
 [89]  9.2273506 13.8976257 15.4642814 15.3669776
 [93] 19.3944322 17.5540309 20.0961688 12.5640758
 [97] 19.5667064 18.8452647 11.8682770 14.7018366
[101]  7.2899931 22.6305988 13.4217734 21.0678903
[105] 20.6846803 20.2520122 21.0203711 12.7335777
[109] 19.7013705  9.9426355 20.6432556 19.4898948
[113] 16.0890025 18.4080417 19.2316406 11.3954377
[117] 18.9962101 18.3614814  2.8028557 23.1115556
[121] 13.1203658 20.8292103  9.2273506 10.1066315
[125]  7.9463199  2.8537694 13.7424889 20.2449006
[129] 19.3870060 13.9948562  9.6361818 16.2128344
[133] 18.8452647  2.2680388 18.7844617 13.3362663
[137]  9.5469367 11.3073427 16.6089133  5.0143793
[141]  9.4416100 17.0837935 13.8512093 16.6690132
[145] 20.0961688  6.0709143 15.9732276 13.1584194
[149]  8.8399095  6.6974622 15.3576040 15.0948998
[153]  7.5402918 22.9160206 19.3944322  3.0239048
[157] 17.4314658 12.6038089 14.4271965 20.3434510
[161] 17.7441821 15.0948998 20.0035997 17.0629423
[165] 15.2034207  9.6511139  9.9426355  8.9919964
[169] 20.3505282  0.3794733 18.9510950 17.7804387
```

```
[173] 10.6233705 15.7751704  5.1131204 20.0712730
[177] 20.7811453 20.6916408  5.3050919 23.3268943
[181] 21.0272205  9.7394045 21.1694119 12.2940636
[185] 14.6677878 18.3069386 22.8066657  2.2680388
[189]  3.8915293 11.3073427 21.8207241 18.5163711
[193]  9.3196566 23.1331796 10.9610219 13.1093860
[197] 18.4080417 15.8159413 22.6084940  6.8451443
[201] 19.7194320 13.0055373  8.0711833  2.4199174
[205]  9.0079964 16.1819653 13.6434600 13.2987217
[209] 20.3259440  4.1056059  7.0102782 14.7358067
[213] 18.1067943 20.9250090 21.6366356 11.9939985
[217] 19.1795725  8.4346903 21.1389688 20.2766861
[221] 20.2025741 18.2169152 15.6797959  7.2702132
[225] 20.5634627 13.9948562 15.0380850 19.8205953
[229]  6.7189285 16.2436449 18.0237621 13.9232180
[233]  8.7095350 16.7587589 18.1423262 20.4485696
[237] 18.4893483 22.4754088 12.9172753  8.3579902
[241] 20.4415264  6.9897067 13.3844686 15.9642100
[245] 16.5183534  9.6511139 18.1343872 17.5540309
[249] 14.6238162 16.5485951
```

(e).
```
> x <- sum(yVec > max(yVec) - 200)
> x
[1] 57
```

(f).
```
> x <- sum(xVec %% 2 == 0)
> x
[1] 124
```

(g).
```
> x <- xVec[order(yVec)]
> x
  [1] 405 842 308 572 461   8 256 507 373 639  42 616  29 645 376 669 688 197  63 638 862  77 996  93  59 585
 [27] 661  72 339  20 206 537 174 322  42 603 425  48 707 452 477  99 224 811 715 358 963 222 395 543 480 193
 [53] 683 710 691 954 700 614 787 835 275 435 309 368 224 460 497 944 530 765 523 171 870 807 469 828 624 200
 [79] 713 365 781  74 129  76 701 760 193 866 353 168 967 545 920 541 650 148 277  18 667 865 987 120 655   1
[105] 554 699 311 458 632  84 269  82 280 544  17 621 807 113 136 457 702  91 625 767 828 109 860 363 121 657
[131] 668 324 382 956 299 403  74 928 415  38 127 176 678 179 444 724 189 457 513 743   5  10 789  38 760 446
[157] 986 894 238 640 110 203 533 113 358 977 294 137 258 577  55 708 996 863 627 123 515 359 964 324  24 364
[183] 260 618 957  48 107 631 266 680 478 178  34 900 537 160 274 437 285 505  19 188 190 467 852 803 517  69
[209] 399 768 545 408 676 407 972 437 353 371 390 995 652 148 458 501 124 216 880 836 878 357 660  44 197 578
[235] 293 324  49 646 543 256 511 525 339 263  14 257 278  61 840 956
```

(h).
```
> x <- yVec[c(T, F, F)]
> x
  [1] 709 517 437 783 671 860 581 347 279 974 216 776 538 460 985 248 317 288 687 957 938 101 615 285 106 414
 [27] 881 488 484 791 246 643 845 553 465  87 993 116 473 635 310 428 965  19 489 803 604 800 175 516 902 689
 [53] 881 593 835 398 358 850 791 915 665 167 866 942 320 482 216 488 681 273 884 970 469 717 127 952 284 695
 [79] 325 777 792  72 738 791
```

8.
```
> x <- 1 + sum(cumprod(seq(2, 38, by = 2) / seq(3, 39, by = 2)))
> x
[1] 6.976346
```