Exercise 1. Vectors

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Create the Vectors

1a

```
c(1:20)
```

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

1b

```
c(20:1)
```

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

1c

```
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
```

1d

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

1e

```
rep(tmp, times=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
```

1f

```
rep(tmp, 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
```

1g

```
rep(tmp, times=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 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 3 3 3 3 3 3 3 3 3
```

2

```
x <- seq(3.1, 6, by=.1)
exp(x)*cos(x)
```

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

3a

```
x <- .1
y <- .2
(x^seq(3,36,by=3))*(y^seq(1,34,by=3))
```

```
##  [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
```

3b

```
f <- 2
(f^seq(1,25))/seq(1,25)
```

```
##  [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
```

4a

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

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

4b

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

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

5a

```
paste(c("label"), 1:30)
```

```
##  [1] "label 1"  "label 2"  "label 3"  "label 4"  "label 5"  "label 6"
##  [7] "label 7"  "label 8"  "label 9"  "label 10" "label 11" "label 12"
## [13] "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"
## [25] "label 25" "label 26" "label 27" "label 28" "label 29" "label 30"
```

5b

```
paste(c("fn"), 1:30, sep="")
```

```
##  [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

```
xVec <- sample(0:999, 250, replace=T)
yVec <- sample(0:999, 250, replace=T)
```

6a

```
yVec[-1]-xVec[-length(xVec)]
```

```
##   [1]  381 -796  -59 -494 -569 -108  -56  433  114  509 -678  292 -140  -44
##  [15]  108  134  264 -707 -406 -331  -18  866  -70 -608 -123 -607   -2 -420
##  [29]  773  -57  -37   -2 -260 -188 -576 -259  220 -418  389  668  487  261
##  [43] -278  345  298  147 -290  599  180 -137 -870   65  170 -100   31  670
##  [57]  -15 -299 -327   62 -656  595  411   31  -99  -98 -199 -154 -570 -615
##  [71] -419   69 -435 -554  347  796 -238   32 -150 -443  406  189  281 -338
##  [85] -559 -224  486  758  221  429 -306 -675 -422 -548  -16 -676 -197  331
##  [99]  720  246 -128  640   23 -679  175  614  902  584  -31 -406  387 -421
## [113]   84  474 -117  -45  -53 -105 -213 -752  622 -289 -261 -302  683   55
## [127] -177  -65  124 -203  129  299 -437 -385 -606  -26  378  545 -586  279
## [141]  378 -119 -421  662  -71  104  492 -319 -183  -34  325  -18  948 -452
## [155] -169  272  847  -70  639 -228   90   82  666  402  236   29  258 -329
```

```
## [169] -286   18  570   70  230  338  507 -537 -105   50 -258  738 -434  -92
## [183] -681  277 -178  163 -316 -119 -582   17 -197 -749  -20 -226  412   26
## [197]  575  725  383 -604  192 -358  280  104 -121  732  721  142   80  506
## [211]  130 -159  445 -210 -178  688  292  -91  368    7  573  -83  671  119
## [225] -100  302 -498   34  -79  171 -909   28 -678  535  190 -321  151 -181
## [239] -428  563 -343 -214  212  361 -195 -268  -98  695 -274
```

6b

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

```
##   [1]    1.58089968   -0.16423888   -0.02890107    1.01420136   -0.16045957
##   [6]    0.20834406    0.63871561    0.17156429    0.58092679    1.71540782
##  [11]    0.11340065   -1.02171935    0.69155891    1.20056908    2.02199815
##  [16]   -7.44066799   -1.38754600  -11.89201236    6.15521422    1.29923212
##  [21]    0.38235311    1.27353942    5.38675283    0.37915054    0.23786072
##  [26]    1.37923580    1.33739339    1.15763002    0.25190595   28.08202768
##  [31]    0.82258895   -1.12267914    2.27146355   -1.01563492    1.30284949
##  [36]    0.79489711   -1.03933116   -0.24568868   -0.91602434   -0.94900252
##  [41]    1.25759072   -0.36657715    5.43377005    0.58697940   -0.75528121
##  [46]   -0.97722568   -0.68967611    0.58571907   -2.79811648   -0.81361957
##  [51]   -1.82282105   -0.60054343   -0.26022527   -1.22022140    0.70806815
##  [56]    0.42938780   -0.54579872    0.90271462    1.90177504   39.46221998
##  [61]    2.89061584    0.89196196    0.10254381   -0.19470046    9.27433680
##  [66]    1.01479826   -2.35376030   -0.75106592    5.53657429   -1.04812493
##  [71]    0.83137992   -5.81871128   -2.41309824    1.01555841   -0.30695987
##  [76]   -0.47790397    1.00861636   -1.45602669    1.36252517    1.00601713
##  [81]   -1.87290280    7.53207838   -0.81992213    0.10172000    0.93008381
##  [86]   -0.12792676  -10.80154379    0.36196262    0.70064621   -0.27507238
##  [91]   -1.03710846   -0.84612800    0.17900503    1.45539529   -1.49640924
##  [96]    1.00210622    3.10320214   -1.25887080    0.58720456    0.59002698
## [101]   -1.45160317    0.75048720   15.75172723   15.60432116    1.51353105
## [106]   -4.86866402    1.75135875   -1.04757596    1.01639391   -4.16346803
## [111]   -1.05482361   -2.81719178    0.94761000   -0.53426757   -0.05151350
## [116]   -4.10457142    0.25150044   -3.18823690    0.67662009   -6.95686519
## [121]    6.12068510    4.08949602    0.98750804   -0.89312060   -0.83033628
## [126]    5.49299856    0.65811250   -4.16624775   -2.58572085   -0.02436294
## [131]   -0.19353574   -0.77440378   -1.57194065    0.80058016   -0.29447967
## [136]    0.84579038    0.13538983   -1.92667877   -0.46621037   -0.71049810
## [141] -170.84703178   -0.07623348  -10.02190251    0.57136651   -1.10704981
## [146]    0.48469923   -1.48685136   -0.70335768   -0.46837815   -0.94154355
## [151]   -1.11819024   -0.91025326    0.39092925    0.31471428    1.57275358
## [156]   -0.60926296    0.92238142    0.79477665    0.35720712    1.50169003
## [161]   -9.43951020   -1.10232215    8.14120427    1.66059277    1.93143803
## [166]   -0.53248647   -1.01236299   -0.38549365   -1.22439886    7.77447664
## [171]   -0.21313266   -0.08369878    0.21379742    0.33923956   -2.04917185
## [176]   -0.90592186   -1.60274058   -1.88621766    0.99473632   -0.92944011
## [181]    0.43475238   -0.76925141    0.44114769    1.01851770   -1.69585181
## [186]    4.17796217   -0.74735659    0.78900361   -1.86191986   -0.13552571
## [191]    0.01804382   -1.13995235   -1.04250135   -0.82868189    0.53564341
## [196]    0.69892874    1.41120846    8.37342968   -0.65137698    1.33814053
## [201]   -1.36852834   -0.65185089    1.13554262   -1.41204693    1.13881969
```

```
## [206]    0.82283680   -3.07924139   -1.26515624   -1.69181967   -9.51005567
## [211]    8.80583684    0.43579291    0.47998492    0.69832320    0.01906567
## [216]    0.09073012    2.10393725    0.13586540   -1.82064257    0.70025539
## [221]    1.07466965   21.66023734    1.16587849    0.23787521   -1.38032613
## [226]    0.42076163    0.99370381    1.12611952    0.67677664   20.29630562
## [231]   -0.98092311    0.50066147   -0.42650502    0.12579765    0.32481615
## [236]   15.44632385    0.06505888   -0.99477662    0.12511727   -2.90512051
## [241]   -0.50284744    0.74061941    0.35114070  -10.69496034    3.05391304
## [246]   -1.02778186    0.61337783    3.72005690   -0.87440812
```

6c

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

```
##   [1] 1920  398 1099 1559 2075 1668  -82 1454  916 1491 1733  619 1225 1710
##  [15]  847  425 1560 2048 2319  942 -319  544 1564 1663 1585 1768 1956  -99
##  [29] 1500 1300 -417 1210 1580 1647 1522  982 2352 1151 -177  514    3 1513
##  [43] 1357  560 -226 1211  254  -27  695 1844 1763  922  369  731  245 -521
##  [57] 1499 1207  558 1376 1315  -27 1288  700 1335 2548  623  949 1471 2369
##  [71]  301  892 2353  768 -475 1058  715   90 1567 1384  555 -363 1351 1552
##  [85] 1752 1222  325  801 -275  859 1248 1849 2321 1015 1503 1164  343  -80
##  [99]  578 2051  822  570 1886  678  435  -25 -322 1347 2550   77 1833  840
## [113] -431 1748 1141  286  171 -185 1749 1248  368 1236 2376  326  186 1641
## [127] 2135 1154 1872  817  542 1071  813 1969  735 1393  133 1168  634   56
## [141]   12 1771 1163 -175 1395  247  628 1280  384  565 2057 -173 1097 1991
## [155] 1649  439  740  230  692   69 1705 1219  383  935  815  591 1569 2630
## [169]  781  577 -107  950 1285 -221 1529 2088  616  827   92 1581  301 1640
## [183]  155  832  727 1653  959 1439 1507 1383 1879 2096 2022  964  406  124
## [197]  229   -1 1377  462 1624  737  638 2094 1041  384 -331 1387 1219  208
## [211]  874  767  111 1471  689  294  623  149  592  -75 1480  597 1653  746
## [225] -281 1660  751  690 1085 2130 1180 2095  858  340  255 1670  574 1923
## [239]  713 1198  672  799 1188 1277 1189 1117  282  981
```

6d

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

```
## [1] 0.001778297
```

7a

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

```
##  [1] 823 769 984 952 924 711 764 787 964 676 794 843 797 655 839 696 845
## [18] 692 638 720 999 802 821 728 855 786 826 926 923 856 717 889 811 938
## [35] 878 915 666 759 991 724 612 792 789 666 742 982 609 893 766 874 738
## [52] 952 612 780 995 777 960 985 699 766 817 620 602 867 858 756 686 952
```

```
## [69] 626 754 616 874 628 665 921 636 708 717 918 890 860 819 716 807 761
## [86] 702 949 863 903 682 960 785 768 970 892
```

7b

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

```
##  [1]   2   7  10  11  13  15  16  18  23  26  28  30  31  34  38  41  42
## [18]  45  53  57  63  65  67  68  77  82  88  89 100 101 102 103 107 108
## [35] 109 110 115 116 122 126 127 128 129 130 133 138 139 145 147 152 153
## [52] 154 156 157 158 160 163 164 165 166 168 169 170 172 174 175 176 181
## [69] 187 191 192 194 196 198 199 200 205 206 207 208 210 211 214 217 222
## [86] 223 224 225 231 235 238 241 244 245 249
```

7c

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

```
##  [1] 840 474 443 840 371 656 357 978 651 791 615 854 278 730 929 358 230
## [18] 152 272 148 170 424 927 225 610 181 168 351 610 845 249 521  36 294
## [35] 946 839 876 196 407 557 969 854 542 784 582  64 599 128  57 756   4
## [52] 937 508 148 365 411 319 297 530 422 949 888  95 112 418 179 997 758
## [69] 837 813 980 672 140 196 253 703 838 186 169 140 313 187 254 217 785
## [86] 278 744 113 966 290 335 636 609 586 517
```

7d

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

```
##   [1]  6.382789 18.901323 16.755298 19.059381 17.670880 19.855981  2.956349
##   [8] 18.048269 19.678923  6.303967 18.901323 12.217201 10.570714 16.500303
##  [15] 13.162826 11.213385  6.345077 22.254438 20.886838 16.889642 18.620956
##  [22] 19.614790 12.971507 19.319938 17.783700 17.557335 17.699153 11.500435
##  [29] 20.316004 19.268108 14.308739 19.306476 20.790863 15.724503 17.670880
##  [36] 13.793477 11.673046 21.124867 18.914016 21.324634 11.168706 15.897799
##  [43] 18.228000 11.650751 18.186259 19.792423  8.789767 21.971345 13.294360
##  [50] 12.500400 20.155892  9.500526 14.516887 16.962901 13.774614 20.802404
##  [57] 18.295901 19.602551  9.986992  7.532596 13.937719  8.873556 17.684456
##  [64] 16.978221  7.664203 20.886838 21.077476 16.054283 16.469973 17.356843
##  [71] 19.190102 19.124330 17.356843 17.614199 21.581010 20.584946 11.280957
##  [78] 16.178381 12.072282 17.951602 10.136074 17.370665 17.197093 20.862886
##  [85] 13.757180 15.075145 11.947385 17.740913 11.477805 20.340600 16.770808
##  [92] 15.976858 22.566790 19.754999  8.108021 14.465822 13.591909 18.940433
##  [99] 16.725430 11.280957 19.033129 15.288558  6.185467 15.435673 20.142989
## [106] 16.903846 21.136225 13.738268 21.523476 18.874851 20.217319 20.670269
## [113] 20.536309 17.051100 19.830784 16.933399 18.861071 17.853291 14.097518
## [120] 20.838906 10.664896  8.702873 18.228000 17.839843 21.017612  8.617424
## [127] 22.051304 19.268108  7.698052 17.356843 15.644168  6.303967  9.962931
```

```
## [134]  7.297945 18.927757 15.288558 11.011812 20.463138 10.782393 19.716491
## [141] 18.158744 11.778795 18.608063 15.866317 18.834543 13.388801 20.633468
## [148]  6.801470  2.063977 16.116451  8.140025 16.530578 21.880128 21.313376
## [155] 17.270206  5.025933 18.295901 10.850806 18.567175  8.469947 14.654010
## [162] 19.881147 12.796093 13.628646  6.874591  7.793587  8.732697 21.593054
## [169] 20.131071 19.691115 13.628646 19.254610 12.052386  8.046117 17.428138
## [176] 22.677301 12.698819 16.903846  7.793587 16.393291 16.590961 18.268552
## [183] 16.500303 21.534623 12.460337  4.442972 18.821796  1.122497 19.059381
## [190] 15.945532 18.173057 22.299327 20.279546 13.757180 16.332177 18.513239
## [197] 19.817669 16.933399 15.157177 14.841159 14.168274 17.951602 14.654010
## [204] 11.011812 18.848342 17.226143 17.712707 18.513239 17.241230 13.028430
## [211] 17.197093  1.933908 14.551289 15.124153 13.611025 19.071969 16.301534
## [218] 14.957941 19.254610 12.195901 17.167993 17.385626 14.308739 16.163539
## [225] 19.228624 16.085397 18.954155 15.321227 10.210779 15.787970 21.983175
## [232]  7.159609 19.268108 18.323209 13.883083  9.784682 18.062669 12.154834
## [239] 20.548966 16.147446 12.379822 13.665284  8.559206 11.236548 10.161693
## [246]  4.610857  8.817029 16.903846  5.853204 15.255819
```

7e

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

```
## [1] 46
```

7f

```
sum(xVec%%2)
```

```
## [1] 121
```

7g

```
xVec[sort(yVec)]
```

```
##   [1] 371 371 357 919 136 230 347 347  50 148 148 148 383 170 919 851 851
##  [18] 793 793 181 417 203 845 294  61  61 164 164 582 829 128 128 549 549
##  [35] 937 878 297 530 422 949 888 997 149 755  19  19 463 837 846 216 313
##  [52] 112 278 113 224 966 966 290 387 335 905 636 556 405 197  NA  NA  NA
##  [69]  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA
##  [86]  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA
## [103]  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA
## [120]  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA
## [137]  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA
## [154]  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA
## [171]  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA
## [188]  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA
## [205]  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA
## [222]  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA
## [239]  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA
```

7h

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

```
##  [1] 590 143 769 984 924 764 271 118 248 794 797 655 414 514 491 450 599
## [18]  19  95 133 488 581 821 184 186 364 253 786 580 826 498 570  16 923
## [35] 889 252 878 461 666  74 165 554 612 666 742 235 609 531 893 549 189
## [52] 952 780 777 960 766 620 867 756 539 952  74 626 264 231 628 921 474
## [69] 708 890 819 716 807 480 702  13 282  57 682 960 785 768 236 243
```

8

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

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