Normal distribution

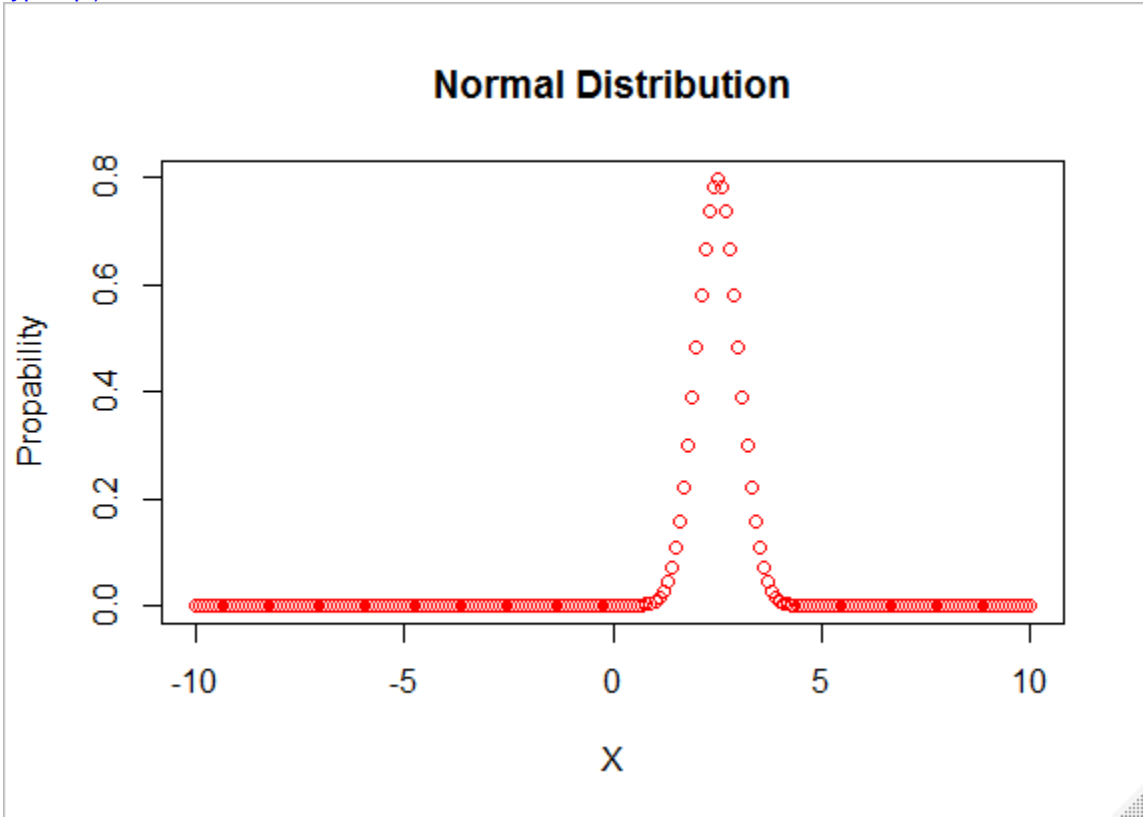
Problem 1 : Create a sequence of numbers between -10 and 10 incrementing by 0.1. Let the mean be 2.5 and deviation be 0.5 visualize the normal curve for the above sequence. Also find its cumulative distribution function.

```
> x = seq(-10, 10, by=0.1)
> x
  [1] -10.0  -9.9  -9.8  -9.7  -9.6  -9.5  -9.4  -9.3  -9.2  -9.1  -9.0  -8.9  -8.8  -8.7
 [15]  -8.6  -8.5  -8.4  -8.3  -8.2  -8.1  -8.0  -7.9  -7.8  -7.7  -7.6  -7.5  -7.4  -7.3
 [29]  -7.2  -7.1  -7.0  -6.9  -6.8  -6.7  -6.6  -6.5  -6.4  -6.3  -6.2  -6.1  -6.0  -5.9
 [43]  -5.8  -5.7  -5.6  -5.5  -5.4  -5.3  -5.2  -5.1  -5.0  -4.9  -4.8  -4.7  -4.6  -4.5
 [57]  -4.4  -4.3  -4.2  -4.1  -4.0  -3.9  -3.8  -3.7  -3.6  -3.5  -3.4  -3.3  -3.2  -3.1
 [71]  -3.0  -2.9  -2.8  -2.7  -2.6  -2.5  -2.4  -2.3  -2.2  -2.1  -2.0  -1.9  -1.8  -1.7
 [85]  -1.6  -1.5  -1.4  -1.3  -1.2  -1.1  -1.0  -0.9  -0.8  -0.7  -0.6  -0.5  -0.4  -0.3
 [99]  -0.2  -0.1   0.0   0.1   0.2   0.3   0.4   0.5   0.6   0.7   0.8   0.9   1.0   1.1
[113]   1.2   1.3   1.4   1.5   1.6   1.7   1.8   1.9   2.0   2.1   2.2   2.3   2.4   2.5
[127]   2.6   2.7   2.8   2.9   3.0   3.1   3.2   3.3   3.4   3.5   3.6   3.7   3.8   3.9
[141]   4.0   4.1   4.2   4.3   4.4   4.5   4.6   4.7   4.8   4.9   5.0   5.1   5.2   5.3
[155]   5.4   5.5   5.6   5.7   5.8   5.9   6.0   6.1   6.2   6.3   6.4   6.5   6.6   6.7
[169]   6.8   6.9   7.0   7.1   7.2   7.3   7.4   7.5   7.6   7.7   7.8   7.9   8.0   8.1
[183]   8.2   8.3   8.4   8.5   8.6   8.7   8.8   8.9   9.0   9.1   9.2   9.3   9.4   9.5
[197]   9.6   9.7   9.8   9.9  10.0
> length(x)
[1] 201

> pb = dnorm(x, mean=2.5, sd=0.5)
> pb
  [1] 1.530786e-136 2.226901e-134 3.112546e-132 4.179831e-130 5.392993e-128 6.685429e-126
  [7] 7.962637e-124 9.111980e-122 1.001836e-119 1.058301e-117 1.074112e-115 1.047414e-113
 [13] 9.813304e-112 8.833655e-110 7.640008e-108 6.348563e-106 5.068568e-104
3.887974e-102
 [19] 2.865429e-100  2.029010e-98  1.380406e-96  9.023141e-95  5.666787e-93  3.419356e-91
 [25]  1.982348e-89  1.104190e-87  5.909296e-86  3.038477e-84  1.501082e-82  7.124939e-81
 [31]  3.249272e-79  1.423702e-77  5.993501e-76  2.424210e-74  9.420804e-73  3.517499e-71
 [37]  1.261851e-69  4.349213e-68  1.440262e-66  4.582477e-65  1.400836e-63  4.114365e-62
 [43]  1.161038e-60  3.147880e-59  8.200081e-58  2.052326e-56  4.935178e-55  1.140217e-53
 [49]  2.531048e-52  5.398107e-51  1.106142e-49  2.177752e-48  4.119402e-47  7.486661e-46
 [55]  1.307285e-44  2.193213e-43  3.535245e-42  5.475028e-41  8.146695e-40  1.164675e-38
 [61]  1.599766e-37  2.111233e-36  2.676974e-35  3.261221e-34  3.817198e-33  4.292767e-32
 [67]  4.638294e-31  4.815122e-30  4.802691e-29  4.602461e-28  4.237639e-27  3.748745e-26
 [73]  3.186222e-25  2.601923e-24  2.041461e-23  1.538920e-22  1.114600e-21  7.756224e-21
 [79]  5.185729e-20  3.331176e-19  2.055955e-18  1.219152e-17  6.945925e-17  3.802163e-16
 [85]  1.999676e-15  1.010454e-14  4.905711e-14  2.288313e-13  1.025551e-12  4.415980e-12
 [91]  1.826944e-11  7.261923e-11  2.773360e-10  1.017628e-09  3.587568e-09  1.215177e-08
 [97]  3.954639e-08  1.236524e-07  3.714724e-07  1.072207e-06  2.973439e-06  7.922598e-06
```

```
[103] 2.028170e-05 4.988494e-05 1.178861e-04 2.676605e-04 5.838939e-04 1.223804e-03
[109] 2.464438e-03 4.768176e-03 8.863697e-03 1.583090e-02 2.716594e-02 4.478906e-02
[115] 7.094919e-02 1.079819e-01 1.579003e-01 2.218417e-01 2.994549e-01 3.883721e-01
[121] 4.839414e-01 5.793831e-01 6.664492e-01 7.365403e-01 7.820854e-01 7.978846e-01
[127] 7.820854e-01 7.365403e-01 6.664492e-01 5.793831e-01 4.839414e-01 3.883721e-01
[133] 2.994549e-01 2.218417e-01 1.579003e-01 1.079819e-01 7.094919e-02 4.478906e-02
[139] 2.716594e-02 1.583090e-02 8.863697e-03 4.768176e-03 2.464438e-03 1.223804e-03
[145] 5.838939e-04 2.676605e-04 1.178861e-04 4.988494e-05 2.028170e-05 7.922598e-06
[151] 2.973439e-06 1.072207e-06 3.714724e-07 1.236524e-07 3.954639e-08 1.215177e-08
[157] 3.587568e-09 1.017628e-09 2.773360e-10 7.261923e-11 1.826944e-11 4.415980e-12
[163] 1.025551e-12 2.288313e-13 4.905711e-14 1.010454e-14 1.999676e-15 3.802163e-16
[169] 6.945925e-17 1.219152e-17 2.055955e-18 3.331176e-19 5.185729e-20 7.756224e-21
[175] 1.114600e-21 1.538920e-22 2.041461e-23 2.601923e-24 3.186222e-25 3.748745e-26
[181] 4.237639e-27 4.602461e-28 4.802691e-29 4.815122e-30 4.638294e-31 4.292767e-32
[187] 3.817198e-33 3.261221e-34 2.676974e-35 2.111233e-36 1.599766e-37 1.164675e-38
[193] 8.146695e-40 5.475028e-41 3.535245e-42 2.193213e-43 1.307285e-44 7.486661e-46
[199] 4.119402e-47 2.177752e-48 1.106142e-49
```

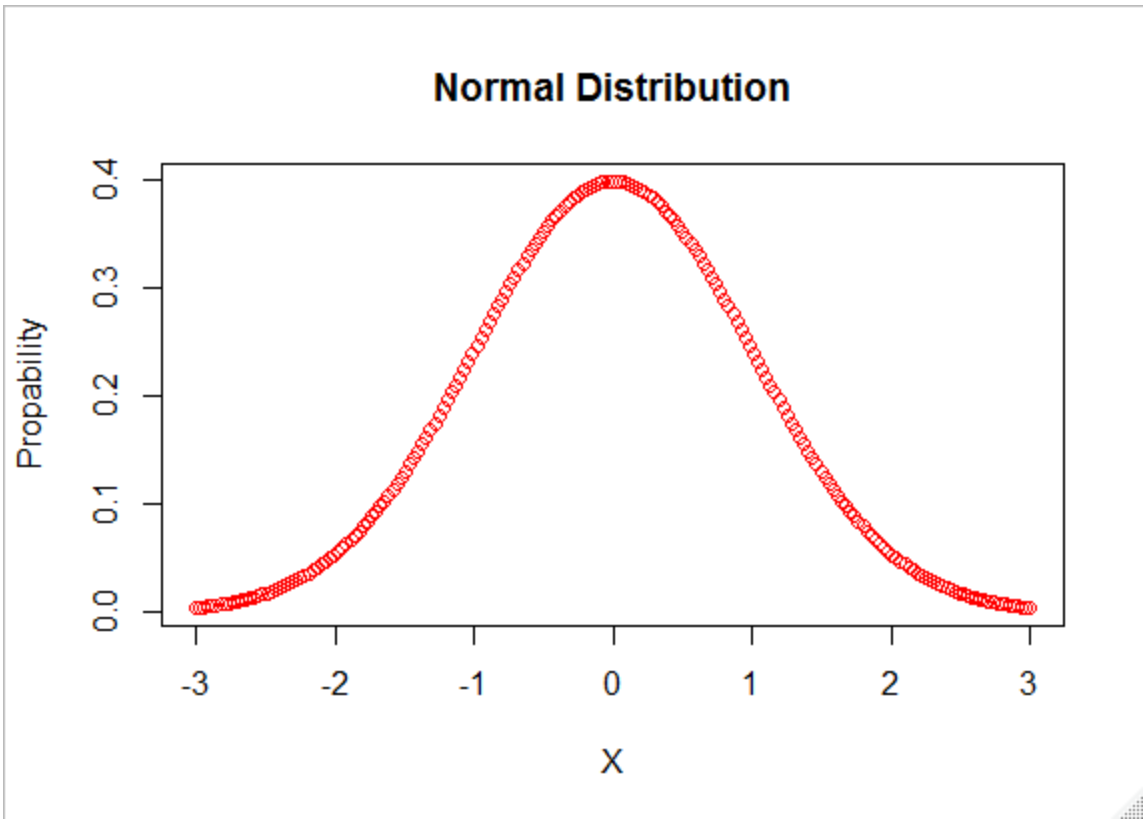
```
> plot(x, pb, main='Normal Distribution', col='red', xlab='X', ylab='Propability',
type='p')
```



Problem 2 : To create a sequence of 200 numbers with x=-3 to 3 for standard normal pdf with mean=0 and sd=1, and visualize the normal curve.

```
> x = seq(-3, 3, length=200)
> x
  [1] -3.00000000 -2.96984925 -2.93969849 -2.90954774 -2.87939698 -2.84924623 -2.81909548
  [8] -2.78894472 -2.75879397 -2.72864322 -2.69849246 -2.66834171 -2.63819095 -2.60804020
 [15] -2.57788945 -2.54773869 -2.51758794 -2.48743719 -2.45728643 -2.42713568 -2.39698492
 [22] -2.36683417 -2.33668342 -2.30653266 -2.27638191 -2.24623116 -2.21608040 -2.18592965
 [29] -2.15577889 -2.12562814 -2.09547739 -2.06532663 -2.03517588 -2.00502513 -1.97487437
 [36] -1.94472362 -1.91457286 -1.88442211 -1.85427136 -1.82412060 -1.79396985 -1.76381910
 [43] -1.73366834 -1.70351759 -1.67336683 -1.64321608 -1.61306533 -1.58291457 -1.55276382
 [50] -1.52261307 -1.49246231 -1.46231156 -1.43216080 -1.40201005 -1.37185930 -1.34170854
 [57] -1.31155779 -1.28140704 -1.25125628 -1.22110553 -1.19095477 -1.16080402 -1.13065327
 [64] -1.10050251 -1.07035176 -1.04020101 -1.01005025 -0.97989950 -0.94974874 -0.91959799
 [71] -0.88944724 -0.85929648 -0.82914573 -0.79899497 -0.76884422 -0.73869347 -0.70854271
 [78] -0.67839196 -0.64824121 -0.61809045 -0.58793970 -0.55778894 -0.52763819 -0.49748744
 [85] -0.46733668 -0.43718593 -0.40703518 -0.37688442 -0.34673367 -0.31658291 -0.28643216
 [92] -0.25628141 -0.22613065 -0.19597990 -0.16582915 -0.13567839 -0.10552764 -0.07537688
 [99] -0.04522613 -0.01507538  0.01507538  0.04522613  0.07537688  0.10552764  0.13567839
[106]  0.16582915  0.19597990  0.22613065  0.25628141  0.28643216  0.31658291  0.34673367
[113]  0.37688442  0.40703518  0.43718593  0.46733668  0.49748744  0.52763819  0.55778894
[120]  0.58793970  0.61809045  0.64824121  0.67839196  0.70854271  0.73869347  0.76884422
[127]  0.79899497  0.82914573  0.85929648  0.88944724  0.91959799  0.94974874  0.97989950
[134]  1.01005025  1.04020101  1.07035176  1.10050251  1.13065327  1.16080402  1.19095477
[141]  1.22110553  1.25125628  1.28140704  1.31155779  1.34170854  1.37185930  1.40201005
[148]  1.43216080  1.46231156  1.49246231  1.52261307  1.55276382  1.58291457  1.61306533
[155]  1.64321608  1.67336683  1.70351759  1.73366834  1.76381910  1.79396985  1.82412060
[162]  1.85427136  1.88442211  1.91457286  1.94472362  1.97487437  2.00502513  2.03517588
[169]  2.06532663  2.09547739  2.12562814  2.15577889  2.18592965  2.21608040  2.24623116
[176]  2.27638191  2.30653266  2.33668342  2.36683417  2.39698492  2.42713568  2.45728643
[183]  2.48743719  2.51758794  2.54773869  2.57788945  2.60804020  2.63819095  2.66834171
[190]  2.69849246  2.72864322  2.75879397  2.78894472  2.81909548  2.84924623  2.87939698
[197]  2.90954774  2.93969849  2.96984925  3.00000000
> pb = dnorm(x, mean=0, sd=1)
> pb
  [1] 0.004431848 0.004849204 0.005301041 0.005789713 0.006317688 0.006887545
0.007501981
  [8] 0.008163805 0.008875944 0.009641434 0.010463426 0.011345180 0.012290062
0.013301541
 [15] 0.014383184 0.015538651 0.016771688 0.018086121 0.019485848 0.020974826
0.022557066
 [22] 0.024236621 0.026017569 0.027904007 0.029900029 0.032009718 0.034237125
0.036586252
 [29] 0.039061035 0.041665325 0.044402866 0.047277273 0.050292015 0.053450387
0.056755488
 [36] 0.060210200 0.063817160 0.067578738 0.071497009 0.075573732 0.079810321
0.084207825
 [43] 0.088766896 0.093487773 0.098370254 0.103413675 0.108616885 0.113978231
0.119495535
 [50] 0.125166077 0.130986579 0.136953192 0.143061479 0.149306413 0.155682361
0.162183083
```

[57] 0.168801730 0.175530839 0.182362343 0.189287570 0.196297253 0.203381547
0.210530038
[64] 0.217731762 0.224975229 0.232248445 0.239538940 0.246833799 0.254119698
0.261382935
[71] 0.268609473 0.275784985 0.282894893 0.289924418 0.296858629 0.303682494
0.310380932
[78] 0.316938871 0.323341298 0.329573318 0.335620213 0.341467495 0.347100969
0.352506785
[85] 0.357671497 0.362582117 0.367226171 0.371591752 0.375667569 0.379442995
0.382908116
[92] 0.386053772 0.388871599 0.391354064 0.393494501 0.395287138 0.396727126
0.397810559
[99] 0.398534490 0.398896950 0.398896950 0.398534490 0.397810559 0.396727126
0.395287138
[106] 0.393494501 0.391354064 0.388871599 0.386053772 0.382908116 0.379442995
0.375667569
[113] 0.371591752 0.367226171 0.362582117 0.357671497 0.352506785 0.347100969
0.341467495
[120] 0.335620213 0.329573318 0.323341298 0.316938871 0.310380932 0.303682494
0.296858629
[127] 0.289924418 0.282894893 0.275784985 0.268609473 0.261382935 0.254119698
0.246833799
[134] 0.239538940 0.232248445 0.224975229 0.217731762 0.210530038 0.203381547
0.196297253
[141] 0.189287570 0.182362343 0.175530839 0.168801730 0.162183083 0.155682361
0.149306413
[148] 0.143061479 0.136953192 0.130986579 0.125166077 0.119495535 0.113978231
0.108616885
[155] 0.103413675 0.098370254 0.093487773 0.088766896 0.084207825 0.079810321
0.075573732
[162] 0.071497009 0.067578738 0.063817160 0.060210200 0.056755488 0.053450387
0.050292015
[169] 0.047277273 0.044402866 0.041665325 0.039061035 0.036586252 0.034237125
0.032009718
[176] 0.029900029 0.027904007 0.026017569 0.024236621 0.022557066 0.020974826
0.019485848
[183] 0.018086121 0.016771688 0.015538651 0.014383184 0.013301541 0.012290062
0.011345180
[190] 0.010463426 0.009641434 0.008875944 0.008163805 0.007501981 0.006887545
0.006317688
[197] 0.005789713 0.005301041 0.004849204 0.004431848
> plot(x, pb, main='Normal Distribution', col='red', xlab='X', ylab='Propability',
type='p')


Normal Distribution
Propability
0.0
0.1
0.2
0.3
0.4
-3
-2
-1
0
1
2
3
X