

## Practical No. 03

**AIM** - Practical of Principal Component Analysis.

### Source Code -

```
data("iris")
head(iris)
summary(iris)
library()

"to find principal component"
mypr<-prcomp(iris[,-5],scale=T)

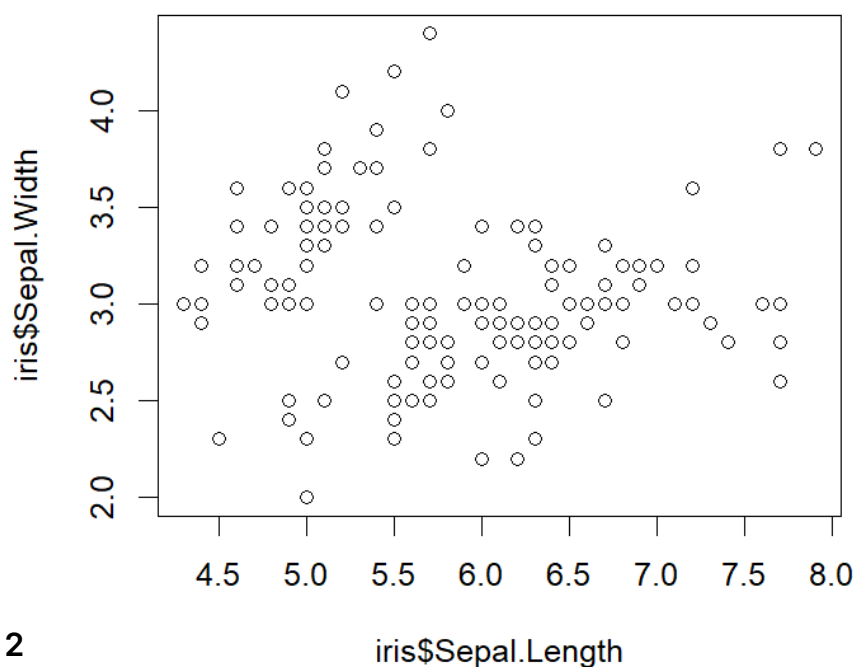
"to understand use of scale"
plot(iris$Sepal.Length,iris$Sepal.Width)
plot(scale(iris$Sepal.Length),scale(iris$Sepal.Width))
mypr
summary(mypr)
plot(mypr,type="l")
biplot(mypr,scale=0)

"extract pc scores"
str(mypr)
mypr$x
iris2<-cbind(iris,mypr$x[,1:2])
head(iris2)
cor(iris[,-5],iris2[,6:7])

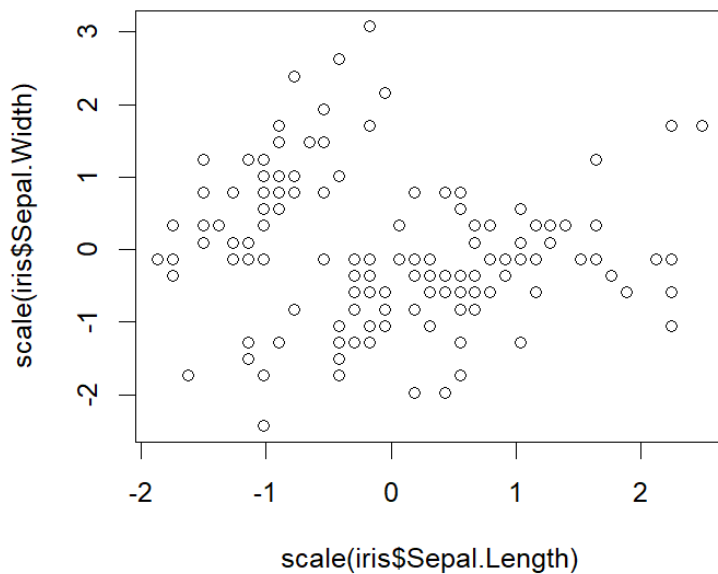
"End of prog"
install.packages("pls")
library(pls)
names(iris)
pcmodel<-pcr(Sepal.Length~Species+Sepal.Width+Petal.Length+Petal.Width,
ncomp=3,data=iris,scale=T)
iris$pred<-predict(pcmodel,iris,ncomp = 2)
head(iris)
```

## OUTPUT -

```
> data("iris")
> head(iris)
  Sepal.Length Sepal.Width Petal.Length Petal.Width Species
1          5.1         3.5          1.4         0.2  setosa
2          4.9         3.0          1.4         0.2  setosa
3          4.7         3.2          1.3         0.2  setosa
4          4.6         3.1          1.5         0.2  setosa
5          5.0         3.6          1.4         0.2  setosa
6          5.4         3.9          1.7         0.4  setosa
> summary(iris)
  Sepal.Length      Sepal.Width      Petal.Length      Petal.Width      Species
Min.   :4.300   Min.   :2.000   Min.   :1.000   Min.   :0.100   setosa    :50
1st Qu.:5.100   1st Qu.:2.800   1st Qu.:1.600   1st Qu.:0.300   versicolor:50
Median :5.800   Median :3.000   Median :4.350   Median :1.300   virginica :50
Mean   :5.843   Mean   :3.057   Mean   :3.758   Mean   :1.199
3rd Qu.:6.400   3rd Qu.:3.300   3rd Qu.:5.100   3rd Qu.:1.800
Max.   :7.900   Max.   :4.400   Max.   :6.900   Max.   :2.500
> library()
> "to find principal component"
[1] "to find principal component"
> mypr<-prcomp(iris[,-5],scale=T)
> "to understand use of scale"
[1] "to understand use of scale"
> plot(iris$Sepal.Length,iris$Sepal.Width)
```



```
> plot(scale(iris$Sepal.Length),scale(iris$Sepal.Width))
```



```
> mypr
```

```
Standard deviations (1, .., p=4):  
[1] 1.7083611 0.9560494 0.3830886 0.1439265
```

```
Rotation (n x k) = (4 x 4):
```

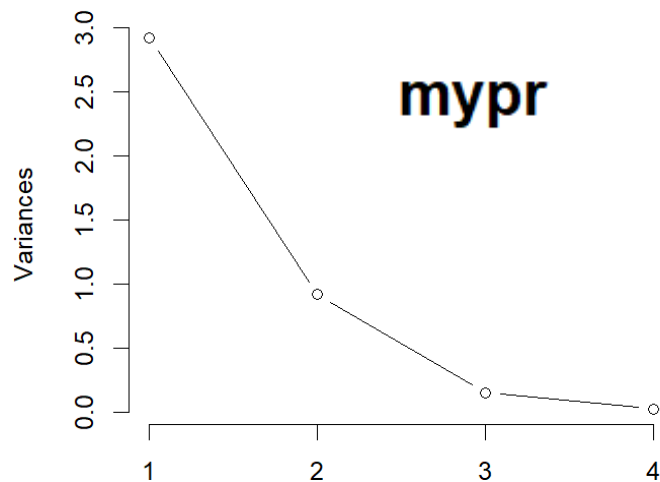
	PC1	PC2	PC3	PC4
Sepal.Length	0.5210659	-0.37741762	0.7195664	0.2612863
Sepal.Width	-0.2693474	-0.92329566	-0.2443818	-0.1235096
Petal.Length	0.5804131	-0.02449161	-0.1421264	-0.8014492
Petal.Width	0.5648565	-0.06694199	-0.6342727	0.5235971

```
> summary(mypr)
```

```
Importance of components:
```

	PC1	PC2	PC3	PC4
Standard deviation	1.7084	0.9560	0.38309	0.14393
Proportion of Variance	0.7296	0.2285	0.03669	0.00518
Cumulative Proportion	0.7296	0.9581	0.99482	1.00000

```
> plot(mypr,type="l")
```



```
> biplot(mypr,scale=0)
```



```
> "extract pc scores"
[1] "extract pc scores"
> str(mypr)
List of 5
 $ sdev      : num [1:4] 1.708 0.956 0.383 0.144
 $ rotation: num [1:4, 1:4] 0.521 -0.269 0.58 0.565 -0.377 ...
 ..- attr(*, "dimnames")=List of 2
 .. ..$ : chr [1:4] "Sepal.Length" "Sepal.Width" "Petal.Length" "Petal.Width"
 .. ..$ : chr [1:4] "PC1" "PC2" "PC3" "PC4"
 $ center   : Named num [1:4] 5.84 3.06 3.76 1.2
 ..- attr(*, "names")= chr [1:4] "Sepal.Length" "Sepal.Width" "Petal.Length" "Petal.Width"
 $ scale     : Named num [1:4] 0.828 0.436 1.765 0.762
 ..- attr(*, "names")= chr [1:4] "Sepal.Length" "Sepal.Width" "Petal.Length" "Petal.Width"
 $ x         : num [1:150, 1:4] -2.26 -2.07 -2.36 -2.29 -2.38 ...
 ..- attr(*, "dimnames")=List of 2
 .. ..$ : NULL
 .. ..$ : chr [1:4] "PC1" "PC2" "PC3" "PC4"
 - attr(*, "class")= chr "prcomp"
> mypr$x
```

	PC1	PC2	PC3	PC4
[1,]	-2.25714118	-0.478423832	0.127279624	0.024087508
[2,]	-2.07401302	0.671882687	0.233825517	0.102662845
[3,]	-2.35633511	0.340766425	-0.044053900	0.028282305
[4,]	-2.29170679	0.595399863	-0.090985297	-0.065735340
[5,]	-2.38186270	-0.644675659	-0.015685647	-0.035802870
[6,]	-2.06870061	-1.484205297	-0.026878250	0.006586116
[7,]	-2.43586845	-0.047485118	-0.334350297	-0.036652767
[8,]	-2.22539189	-0.222403002	0.088399352	-0.024529919
[9,]	-2.32684533	1.111603700	-0.144592465	-0.026769540
[10,]	-2.17703491	0.467447569	0.252918268	-0.039766068
[11,]	-2.15907699	-1.040205867	0.267784001	0.016675503
[12,]	-2.31836413	-0.132633999	-0.093446191	-0.133037725
[13,]	-2.21104370	0.726243183	0.230140246	0.002416941
[14,]	-2.62430902	0.958296347	-0.180192423	-0.019151375
[15,]	-2.19139921	-1.853846555	0.471322025	0.194081578
[16,]	-2.25466121	-2.677315230	-0.030424684	0.050365010
[17,]	-2.20021676	-1.478655729	0.005326251	0.188186988
[18,]	-2.18303613	-0.487206131	0.044067686	0.092779618
[19,]	-1.89223284	-1.400327567	0.373093377	0.060891973
[20,]	-2.33554476	-1.124083597	-0.132187626	-0.037630354
[21,]	-1.90793125	-0.407490576	0.419885937	0.010884821
[22,]	-2.19964383	-0.921035871	-0.159331502	0.059398340
[23,]	-2.76508142	-0.456813301	-0.331069982	0.019582826
[24,]	-1.81259716	-0.085272854	-0.034373442	0.150636353
[25,]	-2.21972701	-0.136796175	-0.117599566	-0.269238379
[26,]	-1.94532930	0.623529705	0.304620475	0.043416203
[27,]	-2.04430277	-0.241354991	-0.086075649	0.067454082
[28,]	-2.16133650	-0.525389422	0.206125707	0.010241084
[29,]	-2.13241965	-0.312172005	0.270244895	0.083977887
[30,]	-2.25769799	0.336604248	-0.068207276	-0.107918349
[31,]	-2.13297647	0.502856075	0.074757996	-0.048027970
[32,]	-1.82547925	-0.422280389	0.269564311	0.239069476
[33,]	-2.60621687	-1.787587272	-0.047070727	-0.228470534
[34,]	-2.43800983	-2.143546796	0.082392024	-0.048053409
[35,]	-2.10292986	0.458665270	0.169706329	0.028926042
[36,]	-2.20043723	0.205419224	0.224688852	0.168343905
[37,]	-2.03831765	-0.659349230	0.482919584	0.195702902
[38,]	-2.51889339	-0.590315163	-0.019370918	-0.136048774
[39,]	-2.42152026	0.901161067	-0.192609402	-0.009705907
[40,]	-2.16246625	-0.267981199	0.175296561	0.007023875
[41,]	-2.27884081	-0.440240541	-0.034778398	0.106626042
[42,]	-1.85191836	2.329610745	0.203552303	0.288896090
[43,]	-2.54511203	0.477501017	-0.304745527	-0.066379077
[44,]	-1.95788857	-0.470749613	-0.308567588	0.176501717
[45,]	-2.12992356	-1.138415464	-0.247604064	-0.150539117
[46,]	-2.06283361	0.708678586	0.063716370	0.139801160
[47,]	-2.37677076	-1.116688691	-0.057026813	-0.151722682
[48,]	-2.38638171	0.384957230	-0.139002234	-0.048671707
[49,]	-2.22200263	-0.994627669	0.180886792	-0.014878291
[50,]	-2.19647504	-0.009185585	0.152518539	0.049206884
[51,]	1.09810244	-0.860091033	0.682300393	0.034717469
[52,]	0.72889556	-0.592629362	0.093807452	0.004887251
[53,]	1.23683580	-0.614239894	0.552157058	0.009391933
[54,]	0.40612251	1.748546197	0.023024633	0.065549239
[55,]	1.07188379	0.207725147	0.396925784	0.104387166
[56,]	0.38738955	0.591302717	-0.123776885	-0.240027187
[57,]	0.74403715	-0.770438272	-0.148472007	-0.077111455
[58,]	-0.48569562	1.846243998	-0.248432992	-0.040384912
[59,]	0.92480346	-0.032118478	0.594178807	-0.029779844
[60,]	0.01138804	1.030565784	-0.537100055	-0.028366154

[60,]	0.01138804	1.030565784	-0.537100055	-0.028366154
[61,]	-0.10982834	2.645211115	0.046634215	0.013714785
[62,]	0.43922201	0.063083852	-0.204389093	0.039992104
[63,]	0.56023148	1.758832129	0.763214554	0.045578465
[64,]	0.71715934	0.185602819	0.068429700	-0.164256922
[65,]	-0.03324333	0.437537419	-0.194282030	0.108684396
[66,]	0.87248429	-0.507364239	0.501830204	0.104593326
[67,]	0.34908221	0.195656268	-0.489234095	-0.190869932
[68,]	0.15827980	0.789451008	0.301028700	-0.204612265
[69,]	1.22100316	1.616827281	0.480693656	0.225145511
[70,]	0.16436725	1.298259939	0.172260719	-0.051554138
[71,]	0.73521959	-0.395247446	-0.614467782	-0.083006045
[72,]	0.47469691	0.415926887	0.264067576	0.113189079
[73,]	1.23005729	0.930209441	0.367182178	-0.009911322
[74,]	0.63074514	0.414997441	0.290921638	-0.273304557
[75,]	0.70031506	0.063200094	0.444537765	0.043313222
[76,]	0.87135454	-0.249956017	0.471001057	0.101376117
[77,]	1.25231375	0.076998069	0.724727099	0.039556002
[78,]	1.35386953	-0.330205463	0.259955701	0.066604931
[79,]	0.66258066	0.225173502	-0.085577197	-0.036318171
[80,]	-0.04012419	1.055183583	0.318506304	0.064571834
[81,]	0.13035846	1.557055553	0.149482697	-0.009371129
[82,]	0.02337438	1.567225244	0.240745761	-0.032663020
[83,]	0.24073180	0.774661195	0.150707074	0.023572390
[84,]	1.05755171	0.631726901	-0.104959762	-0.183354200
[85,]	0.22323093	0.286812663	-0.663028512	-0.253977520
[86,]	0.42770626	-0.842758920	-0.449129446	-0.109308985
[87,]	1.04522645	-0.520308714	0.394464890	0.037084781
[88,]	1.04104379	1.378371048	0.685997804	0.136378719
[89,]	0.06935597	0.218770433	-0.290605718	-0.146653279
[90,]	0.28253073	1.324886147	-0.089111491	0.008876070
[91,]	0.27814596	1.116288852	-0.094172116	-0.269753497
[92,]	0.62248441	-0.024839814	0.020412763	-0.147193289
[93,]	0.33540673	0.985103828	0.198724011	0.006508757
[94,]	-0.36097409	2.012495825	-0.105467721	0.019505467
[95,]	0.28762268	0.852873116	-0.130452657	-0.107043742
[96,]	0.09105561	0.180587142	-0.128547696	-0.229191812
[97,]	0.22695654	0.383634868	-0.155691572	-0.132163118
[98,]	0.57446378	0.154356489	0.270743347	-0.019794366
[99,]	-0.44617230	1.538637456	-0.189765199	0.199278855
[100,]	0.25587339	0.596852285	-0.091572385	-0.058426315
[101,]	1.83841002	-0.867515056	-1.002044077	-0.049865303
[102,]	1.15401555	0.696536401	-0.528389994	-0.040385459
[103,]	2.19790361	-0.560133976	0.202236658	0.058986583
[104,]	1.43534213	0.046830701	-0.163083761	-0.234982858
[105,]	1.86157577	-0.294059697	-0.394307408	-0.016243853
[106,]	2.74268509	-0.797736709	0.580364827	-0.101045973
[107,]	0.36579225	1.556289178	-0.983598122	-0.132679346
[108,]	2.29475181	-0.418663020	0.649530452	-0.237246445
[109,]	1.99998633	0.709063226	0.392675073	-0.088621779
[110,]	2.25223216	-1.914596301	-0.396224508	0.104488870
[111,]	1.35962064	-0.690443405	-0.283661780	0.107500284
[112,]	1.59732747	0.420292431	-0.023108991	0.058136869
[113,]	1.87761053	-0.417849815	-0.026250468	0.145926073
[114,]	1.25590769	1.158379741	-0.578311891	0.098826244
[115,]	1.46274487	0.440794883	-1.000517746	0.274738504
[116,]	1.58476820	-0.673986887	-0.636297054	0.191222383
[117,]	1.46651849	-0.254768327	-0.037306280	-0.154921637
[118,]	2.41822770	-2.548124795	0.127454475	-0.272892966
[119,]	3.29964148	-0.017721580	0.700957033	0.045037725
[120,]	1.25954707	1.701046715	0.266643612	-0.064963167
[121,]	2.03091256	-0.907427443	-0.234015510	0.167390481
[122,]	0.97471535	0.569855257	-0.825362161	0.027662914
[123,]	2.88797650	-0.412259950	0.854558973	-0.126911337
[124,]	1.32878064	0.480220496	0.005410239	0.139491837
[125,]	1.69505530	-1.010536476	-0.297454114	-0.061437911



```

[126,] 1.94780139 -1.004412720 0.418582432 -0.217609339
[127,] 1.17118007 0.315338060 -0.129503907 0.125001677
[128,] 1.01754169 -0.064131184 -0.336588365 -0.008625505
[129,] 1.78237879 0.186735633 -0.269754304 0.030983849
[130,] 1.85742501 -0.560413289 0.713244682 -0.207519953
[131,] 2.42782030 -0.258418706 0.725386035 -0.017863520
[132,] 2.29723178 -2.617554417 0.491826144 -0.210968943
[133,] 1.85648383 0.177953334 -0.352966242 0.099675959
[134,] 1.11042770 0.291944582 0.182875741 -0.185721512
[135,] 1.19845835 0.808606364 0.164173760 -0.487849130
[136,] 2.78942561 -0.853942542 0.541093785 0.294893130
[137,] 1.57099294 -1.065013214 -0.942695700 0.035486875
[138,] 1.34179696 -0.421020154 -0.180271551 -0.214702016
[139,] 0.92173701 -0.017165594 -0.415434449 0.005220919
[140,] 1.84586124 -0.673870645 0.012629804 0.194543500
[141,] 2.00808316 -0.611835930 -0.426902678 0.246711805
[142,] 1.89543421 -0.687273065 -0.129640697 0.468128374
[143,] 1.15401555 0.696536401 -0.528389994 -0.040385459
[144,] 2.03374499 -0.864624030 -0.337014969 0.045036251
[145,] 1.99147547 -1.045665670 -0.630301866 0.213330527
[146,] 1.86425786 -0.385674038 -0.255418178 0.387957152
[147,] 1.55935649 0.893692855 0.026283300 0.219456899
[148,] 1.51609145 -0.268170747 -0.179576781 0.118773236
[149,] 1.36820418 -1.007877934 -0.930278721 0.026041407
[150,] 0.95744849 0.024250427 -0.526485033 -0.162533529
> iris2<-cbind(iris,mypr$x[,1:2])
> head(iris2)
  Sepal.Length Sepal.Width Petal.Length Petal.Width Species      PC1      PC2
1         5.1         3.5         1.4         0.2  setosa -2.257141 -0.4784238
2         4.9         3.0         1.4         0.2  setosa -2.074013  0.6718827
3         4.7         3.2         1.3         0.2  setosa -2.356335  0.3407664
4         4.6         3.1         1.5         0.2  setosa -2.291707  0.5953999
5         5.0         3.6         1.4         0.2  setosa -2.381863 -0.6446757
6         5.4         3.9         1.7         0.4  setosa -2.068701 -1.4842053
> cor(iris[,5],iris2[,6:7])
              PC1      PC2
Sepal.Length 0.8901688 -0.36082989
Sepal.Width  -0.4601427 -0.88271627
Petal.Length 0.9915552 -0.02341519
Petal.Width  0.9649790 -0.06399985
> "End of prog"
[1] "End of prog"
> install.packages("pls")

```

package 'pls' successfully unpacked and MD5 sums checked

The downloaded binary packages are in

C:\Users\Kunal\AppData\Local\Temp\Rtmp8Ch6jW\downloaded\_packages

```
> library(pls)
```

```
> names(iris)
```

```
[1] "Sepal.Length" "Sepal.Width" "Petal.Length" "Petal.Width" "Species"
```

```
> pcmodel<-pcr(Sepal.Length~Species+Sepal.Width+Petal.Length+Petal.Width,ncomp=3,data=iris,scale=T)
```

```
> iris$pred<-predict(pcmodel,iris,ncomp = 2)
```

```
> head(iris)
```

	Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species	pred
1	5.1	3.5	1.4	0.2	setosa	5.025168
2	4.9	3.0	1.4	0.2	setosa	5.125999
3	4.7	3.2	1.3	0.2	setosa	5.073053
4	4.6	3.1	1.5	0.2	setosa	5.118447
5	5.0	3.6	1.4	0.2	setosa	5.005002
6	5.4	3.9	1.7	0.4	setosa	5.041960

```
>
```