multivariate interpretation 3rd task

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Contents

Setting d1

```
library(MASS)
```

```
## Warning: package 'MASS' was built under R version 4.2.3
```

```
D=diag(c(1,2,.4,2))

rr=matrix(c(  1,  0.6,  0.1, -0.1,

            0.6,    1,  0.2, -0.2,

            0.1,  0.2,    1,  0.7,

           -0.1, -0.2,  0.7,    1),nrow=4,byrow=T)

Sigma=D^{1/2}%*%rr%*%D^{1/2}

nn=10000

mu=rep(0, dim(rr)[1])

set.seed(320)

d1=scale(mvrnorm(nn,mu,Sigma))
```

extracting principal component

```
d1.pc=prcomp(d1)

R = cov(d1)
eeR = eigen(R)
print(eeR)
```

```
## eigen() decomposition
## $values
## [1] 1.7112773 1.6499820 0.4481886 0.1905522
##
## $vectors
```

```
##            [,1]       [,2]       [,3]       [,4]
## [1,]  0.3026135 -0.6066332  0.7187940 -0.1541308
## [2,]  0.3018811 -0.6341060 -0.5711289  0.4249578
## [3,] -0.5714332 -0.4485601 -0.2732051 -0.6305687
## [4,] -0.7005405 -0.1694091  0.2872385  0.6309022
```

```
cumsum(eeR$values) / sum(eeR$values) * 100
```

```
## [1]  42.78193  84.03148  95.23620 100.00000
```

scatter plot and arrows

```
P = d1%*%eeR$vectors[,1:2]
P=data.frame(P)

X1 <- P[,1]
X2 <- P[,2]

plot(X1, X2, pch=19, col='grey', cex = .4, xlab="PC1", ylab="PC2",
     xlim = c(min(-5, 5), max(-5, 5)), ylim = c(min(-5, 5), max(-5, 5)))
pc_contributions <- d1.pc$sdev^2 / sum(d1.pc$sdev^2)
arrows(0, 0, d1.pc$rotation[, 1] * sqrt(pc_contributions[1]) * 5,
               d1.pc$rotation[, 2] * sqrt(pc_contributions[2]) * 5,
               col = "red", length = 0.1, lwd=2)

text(d1.pc$rotation[, 1] * sqrt(pc_contributions[1]) * 5,
     d1.pc$rotation[, 2] * sqrt(pc_contributions[2]) * 5,
     labels = c("v1", "v2", "v3", "v4"), pos = 2, col="blue")
```