Penugasan Praktikum 12

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Library

```
library(haven)
```

```
## Warning: package 'haven' was built under R version 4.2.2
```

```
library(GGally)
```

```
## Warning: package 'GGally' was built under R version 4.2.2
```

```
## Loading required package: ggplot2
```

```
## Warning: package 'ggplot2' was built under R version 4.2.2
```

```
## Registered S3 method overwritten by 'GGally':
##   method from
##   +.gg   ggplot2
```

```
library(lmtest)
```

```
## Warning: package 'lmtest' was built under R version 4.2.2
```

```
## Loading required package: zoo
```

```
## Warning: package 'zoo' was built under R version 4.2.2
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
library(CCA)
```

```
## Warning: package 'CCA' was built under R version 4.2.2
```

```
## Loading required package: fda
```

```
## Warning: package 'fda' was built under R version 4.2.2
```

```
## Loading required package: splines
```

```
## Loading required package: fds

## Warning: package 'fds' was built under R version 4.2.2

## Loading required package: rainbow

## Warning: package 'rainbow' was built under R version 4.2.2

## Loading required package: MASS

## Loading required package: pcaPP

## Warning: package 'pcaPP' was built under R version 4.2.2

## Loading required package: RCurl

##
## Attaching package: 'RCurl'

## The following object is masked from 'package:lmtest':
##
##     reset

## Loading required package: deSolve

## Warning: package 'deSolve' was built under R version 4.2.2

##
## Attaching package: 'fda'

## The following object is masked from 'package:graphics':
##
##     matplot

## Loading required package: fields

## Warning: package 'fields' was built under R version 4.2.2

## Loading required package: spam

## Warning: package 'spam' was built under R version 4.2.2

## Spam version 2.9-1 (2022-08-07) is loaded.
## Type 'help( Spam)' or 'demo( spam)' for a short introduction
## and overview of this package.
## Help for individual functions is also obtained by adding the
## suffix '.spam' to the function name, e.g. 'help( chol.spam)'.

##
## Attaching package: 'spam'

## The following objects are masked from 'package:base':
##
##     backsolve, forwardsolve
```

```
## Loading required package: viridis

## Warning: package 'viridis' was built under R version 4.2.2

## Loading required package: viridisLite

## Warning: package 'viridisLite' was built under R version 4.2.2

##
## Try help(fields) to get started.

library(MVN)

## Warning: package 'MVN' was built under R version 4.2.2

library(car)

## Warning: package 'car' was built under R version 4.2.2

## Loading required package: carData

## Warning: package 'carData' was built under R version 4.2.2

library(CCP)
library(candisc)

## Warning: package 'candisc' was built under R version 4.2.2

## Loading required package: heplots

## Warning: package 'heplots' was built under R version 4.2.2

## Loading required package: broom

## Warning: package 'broom' was built under R version 4.2.2

##
## Attaching package: 'candisc'

## The following object is masked from 'package:stats':
##
##     cancor

library(expm)

## Warning: package 'expm' was built under R version 4.2.2

## Loading required package: Matrix

## Warning: package 'Matrix' was built under R version 4.2.2

##
## Attaching package: 'Matrix'
```

```
## The following object is masked from 'package:spam':
##
##     det

##
## Attaching package: 'expm'

## The following object is masked from 'package:Matrix':
##
##     expm
```

1. Gunakan data mmreg.sav. Hitung dan lakukan analisis korelasi kanonik.

Data ini terdiri dari 600 observasi dengan 8 variabel yang terbagi menajdi variabel psychology dan variabel academic. Variabel psychology yaitu locus_of_control, self_concept, dan motivation. Sedangan variabel academic yaitu read, write, math, and science

```
data1 <- read_sav("mmreg.sav")
head(data1)
```

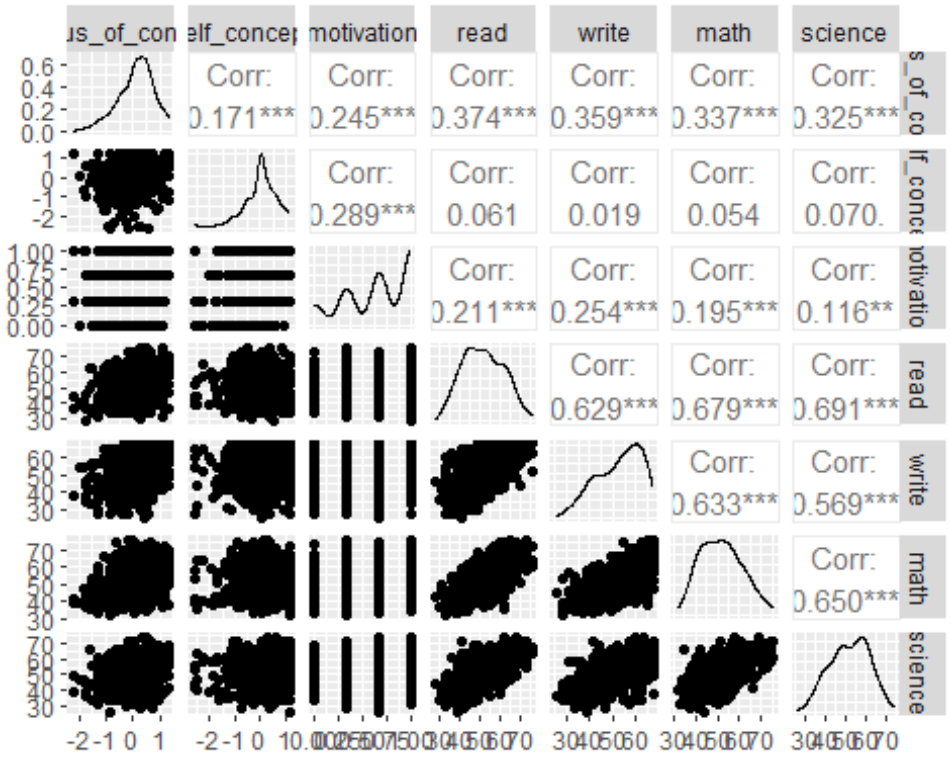
```
## # A tibble: 6 × 9
##      id locus_of_control self_concept motivat…¹  read write  math science
female
##   <dbl>            <dbl>        <dbl>     <dbl> <dbl> <dbl> <dbl>   <dbl>
<dbl>
## 1   303           -0.840      -0.240       1      54.8  64.5  44.5    52.6
1
## 2   404           -0.380      -0.470       0.670  62.7  43.7  44.7    52.6
1
## 3   225            0.890       0.590       0.670  60.6  56.7  70.5    58
0
## 4   553            0.710       0.280       0.670  62.7  56.7  54.7    58
0
## 5   433           -0.640       0.0300      1      41.6  46.3  38.4    36.3
1
## 6   189            1.11        0.900       0.330  62.7  64.5  61.4    58
1
## # … with abbreviated variable name ¹motivation
```

Mengambil Variabel psychology dan variabel academic

```
psychology <- data1[,2:4]
academic <- data1[,5:8]
```

Melihat Sebaran Data

```
ggpairs(data1[2:8])
```



Berdasarkan gambar di atas, dapat diketahui bahwa variabel psychology memiliki korelasi yang rendah satu sama lain sedangkan variabel academic memiliki korelasi yangcenderung tinggi. Meskipun demikian, secara umum, variabel pada data mmreg.sav dapat dikatakan memiliki korelasi pada masing-masing variabelnya.

Selain itu, berdasarkan sebaran data pada masing-masing variabel, secara umum grafik menunjukkan menceng kanan pada sebagian besar variabel dan dari scatter plot yang terbentuk, dapat dilihat bahwa sebagian besar variabel menunjukkan bentuk linier.

Uji Asumsi Linieritas (Ramsey Reset Test) Variabel psychology Sebagai Dependent Variabel

H0 : Terdapat Hubungan Linier Antar Variabel

H1 :Tidak Terdapat Hubungan Linier Antar Variabel

```
resettest(locus_of_control+self_concept+motivation~read+write+math+science,po
wer=2, data=data1)

##
##  RESET test
##
## data:  locus_of_control + self_concept + motivation ~ read + write +     m
ath + science
## RESET = 0.76063, df1 = 1, df2 = 594, p-value = 0.3835

resettest(locus_of_control~read,power=2, data=data1)
```

```
##
##  RESET test
##
## data:  locus_of_control ~ read
## RESET = 2.4093, df1 = 1, df2 = 597, p-value = 0.1211

resettest(locus_of_control~write,power=2, data=data1)

##
##  RESET test
##
## data:  locus_of_control ~ write
## RESET = 0.088794, df1 = 1, df2 = 597, p-value = 0.7658

resettest(locus_of_control~math,power=2, data=data1)

##
##  RESET test
##
## data:  locus_of_control ~ math
## RESET = 6.3767, df1 = 1, df2 = 597, p-value = 0.01182

resettest(locus_of_control~science,power=2, data=data1)

##
##  RESET test
##
## data:  locus_of_control ~ science
## RESET = 0.020483, df1 = 1, df2 = 597, p-value = 0.8862

resettest(self_concept~read,power=2, data=data1)

##
##  RESET test
##
## data:  self_concept ~ read
## RESET = 0.053118, df1 = 1, df2 = 597, p-value = 0.8178

resettest(self_concept~write,power=2, data=data1)

##
##  RESET test
##
## data:  self_concept ~ write
## RESET = 2.0557, df1 = 1, df2 = 597, p-value = 0.1522

resettest(self_concept~math,power=2, data=data1)

##
##  RESET test
##
```

```
## data:  self_concept ~ math
## RESET = 0.39576, df1 = 1, df2 = 597, p-value = 0.5295

resettest(self_concept~science,power=2, data=data1)

##
##  RESET test
##
## data:  self_concept ~ science
## RESET = 1.2586, df1 = 1, df2 = 597, p-value = 0.2624

resettest(motivation~read,power=2, data=data1)

##
##  RESET test
##
## data:  motivation ~ read
## RESET = 1.3358, df1 = 1, df2 = 597, p-value = 0.2482

resettest(motivation~write,power=2, data=data1)

##
##  RESET test
##
## data:  motivation ~ write
## RESET = 0.21779, df1 = 1, df2 = 597, p-value = 0.6409

resettest(motivation~math,power=2, data=data1)

##
##  RESET test
##
## data:  motivation ~ math
## RESET = 0.33315, df1 = 1, df2 = 597, p-value = 0.564

resettest(motivation~science,power=2, data=data1)

##
##  RESET test
##
## data:  motivation ~ science
## RESET = 0.93821, df1 = 1, df2 = 597, p-value = 0.3331
```

Berdasarkan hasil dari uji linieritas di atas, didapatkan kesimpulan bahwa dengan menggunakan variabel psychology sebagai dependen variabel, secara umum, terdapat hubungan antar variabel linier (gagal tolak H0) meskipun terdapat satu uji parsial antaralocus_of_control dengan math menunjukkan hasil yang tidak signifikan.

Uji Asumsi Linieritas (Ramsey Reset Test) Variabel academic Sebagai Dependent Variabel

H0 : Terdapat Hubungan Linier Antar Variabel

H1 : Tidak Terdapat Hubungan Linier Antar Variabel

```
resettest(read+write+math+science~locus_of_control+self_concept+motivation,po
wer=2, data=data1)

##
##  RESET test
##
## data:  read + write + math + science ~ locus_of_control + self_concept +
motivation
## RESET = 0.016305, df1 = 1, df2 = 595, p-value = 0.8984

resettest(read~locus_of_control, power=2, data=data1)

##
##  RESET test
##
## data:  read ~ locus_of_control
## RESET = 0.22402, df1 = 1, df2 = 597, p-value = 0.6362

resettest(read~self_concept, power=2, data=data1)

##
##  RESET test
##
## data:  read ~ self_concept
## RESET = 0.90822, df1 = 1, df2 = 597, p-value = 0.341

resettest(read~motivation, power=2, data=data1)

##
##  RESET test
##
## data:  read ~ motivation
## RESET = 0.0024506, df1 = 1, df2 = 597, p-value = 0.9605

resettest(write~locus_of_control, power=2, data=data1)

##
##  RESET test
##
```

```
## data:  write ~ locus_of_control
## RESET = 0.52204, df1 = 1, df2 = 597, p-value = 0.4703

resettest(write~self_concept, power=2, data=data1)

##
##  RESET test
##
## data:  write ~ self_concept
## RESET = 0.52005, df1 = 1, df2 = 597, p-value = 0.4711

resettest(write~motivation, power=2, data=data1)

##
##  RESET test
##
## data:  write ~ motivation
## RESET = 0.43367, df1 = 1, df2 = 597, p-value = 0.5104

resettest(math~locus_of_control, power=2, data=data1)

##
##  RESET test
##
## data:  math ~ locus_of_control
## RESET = 1.0367, df1 = 1, df2 = 597, p-value = 0.309

resettest(math~self_concept, power=2, data=data1)

##
##  RESET test
##
## data:  math ~ self_concept
## RESET = 0.9481, df1 = 1, df2 = 597, p-value = 0.3306

resettest(math~motivation, power=2, data=data1)

##
##  RESET test
##
## data:  math ~ motivation
## RESET = 0.22893, df1 = 1, df2 = 597, p-value = 0.6325

resettest(science~locus_of_control, power=2, data=data1)

##
##  RESET test
##
## data:  science ~ locus_of_control
## RESET = 0.04553, df1 = 1, df2 = 597, p-value = 0.8311

resettest(science~self_concept, power=2, data=data1)
```

```
##
##  RESET test
##
## data:  science ~ self_concept
## RESET = 0.03026, df1 = 1, df2 = 597, p-value = 0.862
```

```
resettest(science~motivation, power=2, data=data1)
```

```
##
##  RESET test
##
## data:  science ~ motivation
## RESET = 0.088366, df1 = 1, df2 = 597, p-value = 0.7664
```

Berdasarkan keputusan yang diambil dari uji linieritas di atas, didapatkan kesimpulan bahwa dengan menggunakan variabel academic sebagai dependen variabel, terdapat hubungan antar variabel linier baik pada pengujian simultan maupun parsial (gagal tolak H0).

Melihat Korelasi Antar Variabel

```
matcor(psychology, academic)
```

```
## $Xcor
##                   locus_of_control self_concept motivation
## locus_of_control         1.0000000    0.1711878  0.2451323
## self_concept             0.1711878    1.0000000  0.2885707
## motivation               0.2451323    0.2885707  1.0000000
##
## $Ycor
##              read     write      math   science
## read    1.0000000 0.6285909 0.6792757 0.6906929
## write   0.6285909 1.0000000 0.6326664 0.5691498
## math    0.6792757 0.6326664 1.0000000 0.6495261
## science 0.6906929 0.5691498 0.6495261 1.0000000
##
## $XYcor
##                   locus_of_control self_concept motivation       read
write
## locus_of_control         1.0000000   0.17118778  0.2451323 0.37356504 0.358
87684
## self_concept             0.1711878   1.00000000  0.2885707 0.06065584 0.019
44857
## motivation               0.2451323   0.28857075  1.0000000 0.21060992 0.254
24817
## read                     0.3735650   0.06065584  0.2106099 1.00000000 0.628
59089
## write                    0.3588768   0.01944857  0.2542482 0.62859089 1.000
00000
## math                     0.3372690   0.05359771  0.1950135 0.67927568 0.632
66641
## science                  0.3246269   0.06982633  0.1156695 0.69069291 0.569
```

```
14983
##                       math    science
## locus_of_control 0.33726899 0.32462694
## self_concept     0.05359771 0.06982633
## motivation       0.19501348 0.11566948
## read             0.67927568 0.69069291
## write            0.63266641 0.56914983
## math             1.00000000 0.64952612
## science          0.64952612 1.00000000
```

Uji Multivariate Normal

```
norm <- mvn(data1[,2:8], mvnTest="mardia")
norm

## $multivariateNormality
##              Test         Statistic               p value Result
## 1 Mardia Skewness  294.179645070743 4.04137840175186e-25     NO
## 2 Mardia Kurtosis 0.912042414348872    0.361746390396368    YES
## 3             MVN              <NA>                 <NA>     NO
##
## $univariateNormality
##               Test         Variable Statistic   p value Normality
## 1 Anderson-Darling locus_of_control    4.8796  <0.001      NO
## 2 Anderson-Darling   self_concept      9.1124  <0.001      NO
## 3 Anderson-Darling    motivation      40.1498  <0.001      NO
## 4 Anderson-Darling       read          3.4338  <0.001      NO
## 5 Anderson-Darling      write          8.5102  <0.001      NO
## 6 Anderson-Darling       math          2.3356  <0.001      NO
## 7 Anderson-Darling     science         3.4705  <0.001      NO
##
## $Descriptives
##                     n        Mean    Std.Dev Median   Min   Max    25th   7
5th
## locus_of_control 600  0.09653333  0.6702799   0.21 -2.23  1.36 -0.3725  0.
510
## self_concept     600  0.00491667  0.7055125   0.03 -2.62  1.19 -0.3000  0.
440
## motivation       600  0.66083334  0.3427294   0.67  0.00  1.00  0.3300  1.
000
## read             600 51.90183341 10.1029830  52.10 28.30 76.00 44.2000 60.
100
## write            600 52.38483328  9.7264550  54.10 25.50 67.10 44.3000 59.
900
## math             600 51.84900000  9.4147363  51.30 31.80 75.50 44.5000 58.
375
## science          600 51.76333315  9.7061789  52.60 26.00 74.20 44.4000 58.
650
##                       Skew   Kurtosis
## locus_of_control -0.6080030  0.3051534
## self_concept     -0.8906122  1.5222414
```

```
## motivation       -0.5878532 -0.8945072
## read              0.1261887 -0.7693523
## write            -0.4701256 -0.7142251
## math              0.2631610 -0.6530141
## science          -0.1596012 -0.7016073
```

Berdasarkan hasil uji multivariate normal menggunakan mardia diperoleh hasilkurtosis yang signifikan. Namun, hasil ini berbeda dengan skewness data yang tidak signifikan. Dengan demikian, asumsi multivariate normal tidak terpenuhi.

Uji Asumsi Non-Multikolinieritas

Variabel psychology sebagai dependent variabel

```
model1 <- lm(locus_of_control+self_concept+motivation~read+write+math+science
, data=data1)
vif(model1)

##     read    write     math  science
## 2.498214 1.934695 2.315015 2.201460
```

Berdasarkan hasil di atas, setiap variabel memiliki nilai VIF yang kurang dari 10 sehingga dapat disimpulkan bahwa asumsi nonmultikolinieritas dapat terpenuhi.

Variabel academic sebagai dependent variabel

```
model2 <- lm(read+write+math+science~locus_of_control+self_concept+motivation
, data=data1)
vif(model2)

## locus_of_control     self_concept       motivation
##         1.076538         1.103763         1.139914
```

Berdasarkan hasil di atas, setiap variabel memiliki nilai VIF yang kurang dari 10 sehingga dapat disimpulkan bahwa asumsi nonmultikolinieritas dapat terpenuhi.

Koefisien Korelasi Kanonik

```
cc1 <- cc(psychology, academic)
cc1$cor

## [1] 0.44643648 0.15335902 0.02250348

cc1$xcoef

##                          [,1]       [,2]       [,3]
## locus_of_control -1.2501212  0.7659633  0.4966529
## self_concept      0.2367331  0.8421110 -1.2051226
## motivation       -1.2491434 -2.6359626 -1.0935084

cc1$ycoef

##                 [,1]         [,2]        [,3]
## read    -0.044047126 -0.001592913 -0.08833162
```

```
## write   -0.055088843 -0.090414603  0.09612884
## math    -0.019401099 -0.002955461 -0.08782254
## science  0.003797757  0.124208982  0.08849518
```

Berdasarkan hasil di atas, dapat diperoleh hasil bahwa hubungan antara variabelpsychology dengan academic menunjukkan hasil sedang pada korelasi kanonik pertama dengan hubungan yang cukup rendah pada korelasi kanonik yang kedua dan ketiga.

Menghitung Loadings Kanonik

```
cc2 <- comput(psychology, academic, cc1)
cc2$corr.X.xscores

##                          [,1]       [,2]        [,3]
## locus_of_control -0.91428519  0.3936580  0.09547755
## self_concept     -0.09996774  0.4213082 -0.90139105
## motivation       -0.58532550 -0.6061228 -0.53852500

cc2$corr.Y.xscores

##               [,1]        [,2]         [,3]
## read    -0.3930571  0.03755921 -0.006144733
## write   -0.4063140 -0.03388766  0.007646604
## math    -0.3571452  0.02882125 -0.006381343
## science -0.3098729  0.10365353  0.005348464

cc2$corr.X.yscores

##                          [,1]        [,2]         [,3]
## locus_of_control -0.40817026  0.06037101  0.002148577
## self_concept     -0.04462925  0.06461141 -0.020284438
## motivation       -0.26131066 -0.09295440 -0.012118688

cc2$corr.Y.yscores

##               [,1]       [,2]       [,3]
## read    -0.8804322  0.2449103 -0.2730570
## write   -0.9101273 -0.2209695  0.3397965
## math    -0.7999910  0.1879332 -0.2835713
## science -0.6941031  0.6758881  0.2376727
```

Uji Korelasi Kanonik Simultan (Uji Rao's F)

H0 : p1 = p2 = p3 (Seluruh koefisien korelasi kanonik memiliki nilai yang sama)

H1 : p1 /= p2 /= p3 (Minimal terdapat satu koefisien korelasi kanonik yang berbeda)

```
rho <- cc1$cor
n = dim(psychology)[1]
p = length(psychology)
q = length(academic)

p.asym(rho,n,p,q,tstat="Wilks")
```

```
## Wilks' Lambda, using F-approximation (Rao's F):
##                stat     approx df1      df2    p.value
## 1 to 3:  0.7814670 12.7735400  12 1569.222 0.00000000
## 2 to 3:  0.9759865  2.4210262   6 1188.000 0.02487712
## 3 to 3:  0.9994936  0.1507323   2  595.000 0.86011071
```

Pengujian menggunakan tiga koefisien korelasi kanonik, diperoleh hasil tolak H0 yang menunjukkan bahwa terdapat minimal satu nilai korelasi kanonik yang berbeda. Karena p1 > p2 > p3, maka dapat disimpulkan bahwa koefisien korelasi kanonik yang berbeda adalah p1 yang menunjukkan hasil signifikan.

Pengujian menggunakan dua koefisien korelasi kanonik yaitu 2 dan 3, diperoleh hasil tolak H0 yang menunjukkan bahwa terdapat minimal satu nilai korelasi kanonik yang berbeda. Karena p2 > p3, maka dapat disimpulkan bahwa koefisien korelasi kanonik yang berbeda adalah p2 yang menunjukkan hasil signifikan.

Pengujian menggunakan koefisien korelasi kanonik ketiga menghasilkan keputusan gagal tolak H0 sehingga dapat disimpulkan bahwa koefisien korelasi kanonik ketiga tidak signifikan dan tidak perlu diinterpretasikan dalam menjelaskan hubungan antara variabel psychology dengan academic.

```
korUV2 <- cc1$cor^2
```

Analisis Redundansi variabel psychology

a. Loadings Kanonik X dengan U

```
loadings_psychology <- cc1$scores$corr.X.xscores
loadings_psychology2 <- loadings_psychology^2
average_psychology <- colSums(loadings_psychology2)/3
```

b. Keragaman psychology yang dapat dijelaskan oleh U1 dan U2 (Koefisien Redundansi)

```
ragam_psychology <- average_psychology*korUV2
ragam_psychology

## [1] 0.0789593299 0.0054866047 0.0001876458
```

c. Persentase U

```
persen_psychology <- ragam_psychology[1]+ragam_psychology[2]+ragam_psychology
[3]
persen_psychology

## [1] 0.08463358
```

Berdasarkan hasil analisis redundansi di atas, dapat diketahui bahwa ketika variabel psychology menjadi independen variabel, koefisien korelasi kanonik yang pertama menjadi penyumbang terbesar dalam menjelaskan keragaman pada variabel academic. Secara keseluruhan, variabel psychology dapat menjelaskan keragaman variabel academic sebesar 8,46 %.

Analisis Redundansi variabel academic

a. Loadings Kanonik Y dengan V

```
loadings_academic <- cc1$scores$corr.Y.yscores
loadings_academic2 <- loadings_academic^2
average_academic <- colSums(loadings_academic2)/4
```

b. Keragaman psychology yang dapat dijelaskan oleh U1 dan U2 (Koefisien Redundansi)

```
ragam_academic <- average_academic*korUV2
ragam_academic
```

```
## [1] 1.357897e-01 3.533447e-03 4.138898e-05
```

c. Persentase V

```
persen_academic <- ragam_academic[1]+ragam_academic[2]+ragam_academic[3]
persen_academic
```

```
## [1] 0.1393646
```

Berdasarkan hasil analisis redundansi di atas, dapat diketahui bahwa ketika variabel academic menjadi independen variabel, koefisien korelasi kanonik yang pertama juga menjadi penyumbang terbesar dalam menjelaskan keragaman variabel psychology. Secara keseluruhan, variabel academic dapat menjelaskan keragaman variabel psychology sebesar 13,94 %.

Analisis Korelasi Kanonik Dengan Package candisc

```
cc <- cancor(academic, psychology)
redundancy(cc)
```

```
##
## Redundancies for the X variables & total X canonical redundancy
##
##     Xcan1     Xcan2     Xcan3 total X|Y
## 1.358e-01 3.533e-03 4.139e-05 1.394e-01
##
## Redundancies for the Y variables & total Y canonical redundancy
##
##     Ycan1     Ycan2     Ycan3 total Y|X
## 0.0789593 0.0054866 0.0001876 0.0846336
```

Kesimpulan

Berdasarkan analisis korelasi kanonik yang telah dilakukan, dapat disimpulkan bahwa variabel academic dapat diindikasikan sebagai variabel independen untuk menjelaskan variabel psychology (dependen variabel). Namun, keragaman variabel psychology yang dapat dijelaskan oleh variabel academic sangat kecil, yaitu hanya mencapai 13,94 %. Selain itu, nilai korelasi kanonik itu sendiri juga relatif sedang hingga rendah yaitu hanya 0,4464. Hal ini dapat terjadi karena mungkin terdapat asumsi yang tidak terpenuhi yaitu asumsi multivariat normal pada data.

2. Kerjakan Penugasan Modul 12 Analisis Korelasi Kanonik

Dewasa ini, kehadiran Big Data menjadi arus besar dalam melengkapi data official statistics. Salah satu yang dilakukan adalah harmonisasi data remote sensing dengan data kewilayahan berbasis administratif. Dalam rangka itu, sebuah grup riset melakukan analisis hubungan antara hasil remote sensing dengan data Potensi Desa(PODES) di suatu wilayah provinsi.

Data Remote Sensing yang digunakan adalah Normalized Build-up Index (X1) dan Night light intensity (X2), sedangkan data PODES yang digunakan adalah dan Rasio keluarga Pertanian (Y1) dan Rasio keluarga pengguna listrik PLN (Y2). Ringkasan data sampel (vektor rata-rata dan matriks korelasi) ditampilkan sebagai berikut:

```
(xbar <- matrix(c(0.3,1),2,1))
```

```
##      [,1]
## [1,]  0.3
## [2,]  1.0
```

```
(ybar <- matrix(c(0.4,0.9),2,1))
```

```
##      [,1]
## [1,]  0.4
## [2,]  0.9
```

```
(r11 <- matrix(c(1,0.56,0.56,1),2,2))
```

```
##      [,1] [,2]
## [1,] 1.00 0.56
## [2,] 0.56 1.00
```

```
(r12 <- matrix(c(0.68,0.55,0.72,0.58),2,2))
```

```
##      [,1] [,2]
## [1,] 0.68 0.72
## [2,] 0.55 0.58
```

```
(r21 <- t(r12))
```

```
##      [,1] [,2]
## [1,] 0.68 0.55
## [2,] 0.72 0.58
```

```
(r22 <- matrix(c(1,0.98,0.98,1),2,2))
```

```
##      [,1] [,2]
## [1,] 1.00 0.98
## [2,] 0.98 1.00
```

```
p <- 2
q <- 2
(min.pq <- min(p,q))
```

```
## [1] 2
```

Menghitung Akar Invers (Square Roots)

```
(r11.sqrt.inv <- solve(sqrtm(r11)))
```

```
##           [,1]      [,2]
## [1,]  1.154099 -0.353458
## [2,] -0.353458  1.154099
```

```
(r22.sqrt.inv <- solve(sqrtm(r22)))
```

```
##           [,1]      [,2]
## [1,]  3.890868 -3.180199
## [2,] -3.180199  3.890868
```

Mencari Eigen Value

```
m1 <- r11.sqrt.inv%*%r12%*%solve(r22)%*%r21%*%r11.sqrt.inv
m2 <- r22.sqrt.inv%*%r21%*%solve(r11)%*%r12%*%r22.sqrt.inv

(eig_m1 <- eigen(m1)) # e
```

```
## eigen() decomposition
## $values
## [1] 0.5809343915 0.0001621214
##
## $vectors
##            [,1]       [,2]
## [1,] -0.8351271  0.5500570
## [2,] -0.5500570 -0.8351271
```

```
(eig_m2 <- eigen(m2)) # f
```

```
## eigen() decomposition
## $values
## [1] 0.5809343915 0.0001621214
##
```

```
## $vectors
##           [,1]       [,2]
## [1,] 0.4910735 -0.8711181
## [2,] 0.8711181  0.4910735
```

Menghitung Korelasi Kanonik

```
sqrt(eig_m1$values)[1:min.pq]

## [1] 0.76219052 0.01273269

(rho <- sqrt(eig_m2$values)[1:min.pq])

## [1] 0.76219052 0.01273269
```

Berdasarkan hasil di atas, dapat diperoleh hasil bahwa hubungan antara variabel remote sensing dengan PODES menunjukkan hasil yang cukup tinggi pada korelasi kanonik pertama dengan hubungan yang sangat rendah pada korelasi kanonik yang kedua.

Koefisien Dari Variat Kanonik U

```
U <- r11.sqrt.inv%*%eig_m1$vectors[,1:min.pq]
dimnames(U) <- list(c("X1","X2"), c("U1","U2"))
U

##            U1         U2
## X1 -0.7693971  0.9300025
## X2 -0.3396378 -1.1582412
```

u1 = -0.7693971x1-0.3396378x2

u2 = 0.9300025x1-1.1582412x2

Koefisien Dari Variat Kanonik V

```
V <- r22.sqrt.inv%*%eig_m2$vectors[,1:min.pq]
dimnames(V) <- list(c("Y1","Y2"), c("V1","V2"))
V

##           V1        V2
## Y1 -0.859627 -4.951118
## Y2  1.827694  4.681032
```

v1= -0.859627y1-4.951118y2

v2= 1.827694y1+4.681032y2

Korelasi X dengan U

```
r11%*%U

##              U1         U2
## [1,] -0.9595942  0.2813874
## [2,] -0.7705002 -0.6374398
```

Korelasi X dengan V

```
r12%*%V
```

```
##              V1           V2
## [1,] 0.7313936  0.003582819
## [2,] 0.5872679 -0.008116324
```

Korelasi Y dengan U

```
r21%*%U
```

```
##               U1           U2
## [1,] -0.7099908 -0.004630964
## [2,] -0.7509558 -0.002178100
```

Korelasi Y dengan V

```
r22%*%V
```

```
##              V1         V2
## [1,] 0.9315136 -0.3637066
## [2,] 0.9852600 -0.1710636
```