DM8101FinalExam

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Quarto

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Running Code

When you click the **Render** button a document will be generated that includes both content and the output of embedded code. You can embed code like this:

```
1 + 1
```

```
[1] 2
```

You can add options to executable code like this

```
[1] 4
```

The `echo: false` option disables the printing of code (only output is displayed). ## excel相关操作 and tools

```
handle_error <- function(expr) {
  result <- tryCatch(
    {
      expr
    },
    error = function(e) {
      message("发生错误,但继续执行：", conditionMessage(e))
      return(NA)
    }
  )
  return(result)
}
saveExcel <- function(data,sheetname,fileName=NULL){
  library(openxlsx)
  #library(xlsx)
  if (!is.null(fileName)) {
    excel_file <- fileName
  }else{
    excel_file <- "analysisResult.xlsx"
  }
  # 检查文件是否存在
  if (!file.exists(excel_file)) {
    # 如果文件不存在，则创建一个新的 Excel 工作簿
    wb <- createWorkbook()
```

```
  }else{
    wb <- loadWorkbook(excel_file)
  }

  name_str = names(wb)
  index <- which(name_str == sheetname)[1]
  if (!is.na(index)) {
    Rows = wb$worksheets[[index]]$sheet_data$rows
    Cols = wb$worksheets[[index]]$sheet_data$cols
    #print(length(Cols))
    #print(length(Rows))
    #print(Cols)
    #print(Rows)
    deleteData(wb,sheet=index,cols=1:max(Cols),rows=1:max(Rows),T)
    #for(i in 1:length(Rows)) {
    #    writeData(wb,index,"",  startCol = Cols[i], startRow = Rows[i])
    #}
  }else{
    print("~~~")
    handle_error( addWorksheet(wb, sheetname) )
    #handle_error( removeWorksheet(wb, sheetname) )
    print("~~~")
  }
  writeData(wb, sheetname, data)
  saveWorkbook(wb, excel_file,overwrite = TRUE)
}

cat_ <-function(...){
  cat(...,sep = "")
}
getNumber <- function(num){
  num = format(round(num, digits = 3), nsmall = 3)
  return(num)
}
getCumulativeList <-function(list_src){
  newlist = list();
  for(i in 1:length(list_src)){
    total=as.numeric(list_src[i])
    if(i>1){
      total=total+newlist[[i-1]]
    }
    newlist <- append(newlist, total)
  }
  return(as.numeric(newlist) )
}
#因为loadings的数据结构太怪异,没有办法直接转matrix或data frames ,所以也保存不了excel,因此手工转拚
transLoadings2Matrix<-function(loading){
  #loading[1:dataL,1:dataW ] <- ifelse(loading[1:dataL,1:dataW ] < 0.5, NA, loading[1:
  #summary(loading)
  #saveExcel(loading,"Factor Analysis loading")
  #str(loading)
  row_names <- c("",rownames(loading))
  col_names <- c("",colnames(loading))
  print(col_names)
```

```r
  tr_matrix <- matrix(nrow = length(row_names), ncol = length(col_names))
  #rownames(tr_matrix) <- row_names
  #colnames(tr_matrix) <- col_names
  #tr_matrix[2,3] = 1 第二行,第三列
  for (i in 2:length(row_names)) {
    tr_matrix[i,1] <- row_names[i]#loading[i, j]
    #loading[i, j]
    for (j in 2:length(col_names)) {
      #print(paste("Row:", i,row_names[i], ", Column:", j,col_names[j], ", Value:", lo
      if(loading[i-1, j-1]>0.5){
        tr_matrix[i,j] <- getNumber( loading[i-1, j-1] )
      }
    }
  }
  for (j in 2:length(col_names)) {
     tr_matrix[1,j] <- col_names[j]
  }
  #print(tr_matrix)
  return(tr_matrix)
}
```

加载数据

```r
library(memisc)
```

```
Loading required package: lattice

Loading required package: MASS


Attaching package: 'memisc'

The following objects are masked from 'package:stats':

    contr.sum, contr.treatment, contrasts

The following object is masked from 'package:base':

    as.array
```

```r
#data0 = as.data.set(spss.system.file("spss/telework_new_office_12_srcdata.sav"))
data_src <- read.csv("spss/sh/data.csv")
dataL_src = nrow(data_src)
filtered_data <- data_src[data_src$totalseconds<30,]
cat("过滤掉:",nrow(filtered_data),"条填写时间少于30s的数据\n")
```

```
过滤掉: 13 条填写时间少于30s的数据
```

```r
data_src = data_src[data_src$totalseconds>=30,]
#过滤选项全相同的,后面补上
cat("原始数据:",dataL_src,"条","有效数据:",nrow(data_src),"条\n")
```

原始数据: 106 条 有效数据: 93 条

```
rm(dataL_src,filtered_data)

data0 = data_src
#data = as.data.frame(data0)
#data = data[1:100,]
cols_base = c("age","gender","education","natrue_enterprise","type_work","job_title_s_
cols_independent =c("organisationalCulture2","organisationalCulture0","organisationalC

cols_independent_all=c("environment0","environment1","environment2","environment3","jo

cols_dependent = c("job_effectiveness1","job_effectiveness2","job_effectiveness3","job

#data <- lapply(data, as.numeric)
#data <- data0[,13:ncol(data0)]
##---
#data_independent <- data0[cols_independent]
#data_independent_all <- data0[cols_independent_all]
#data_dependent <- data0[cols_dependent]
#data_dependent_all <- data0[cols_dependent]
```

数据整理,分类

```
# Cronbach's α
#按每个变量单独测!!
#自变量
scaleName=c("Teleworker Characteristics","Communication","Management","Organisational
cols_independent_teleworkerCharacteristics=c("teleworkerCharacteristics0","teleworkerC
cols_independent_communication=c("communication0","communication1","communication2","c
cols_independent_management=c("management2","management3","management4")
cols_independent_organisationalCulture=c("organisationalCulture0","organisationalCultu
#因变量
cols_dependent_job_effectiveness = c("job_effectiveness1","job_effectiveness2","job_ef
cols_dependent_work.life_balance = c("work.life_balance1","work.life_balance2","work.l
cols_dependent_well.being = c("well.being1","well.being2","well.being3","well.being4")
#所有变量
all_var = list( cols_independent_teleworkerCharacteristics, cols_independent_communica
#对每个变量求均值
data0$teleworkerCharacteristics = rowMeans(data0[cols_independent_teleworkerCharacteri
data0$communication = rowMeans(data0[cols_independent_communication])
data0$management = rowMeans(data0[cols_independent_management])
data0$organisationalCulture = rowMeans(data0[cols_independent_organisationalCulture])
data0$job_effectiveness = rowMeans(data0[cols_dependent_job_effectiveness])
data0$work.life_balance = rowMeans(data0[cols_dependent_work.life_balance])
data0$well.being = rowMeans(data0[cols_dependent_well.being])

all_var_calculated = c("teleworkerCharacteristics","communication","management","organ
#str(data0)
```

描述性分析

```
library(psych)
library(knitr)
options(cat.sep = "")
data_t <- data0[cols_base]
desc_data <- describe(data_t)
psych::describe(data_t)
```

```
                    vars  n mean   sd median trimmed  mad min max range  skew
age                    1 93 1.97 1.10      2    1.97 1.48   0   4     4  0.01
gender                 2 93 0.43 0.50      0    0.41 0.00   0   1     1  0.28
education              3 93 1.69 0.88      2    1.61 1.48   0   4     4  0.64
natrue_enterprise      4 93 0.86 0.69      1    0.83 0.00   0   2     2  0.18
type_work              5 93 1.46 0.90      1    1.44 0.00   0   3     3  0.55
job_title_s_data       6 93 0.12 0.44      0    0.00 0.00   0   3     3  4.40
work_experience        7 93 1.59 0.78      1    1.53 1.48   0   3     3  0.44
marital_status         8 93 1.44 1.13      2    1.37 1.48   0   4     4  0.17
partners_work          9 93 0.86 1.06      0    0.76 0.00   0   3     3  0.55
telework_is_active    10 93 0.19 0.40      0    0.12 0.00   0   1     1  1.53
hours_per_day         11 93 2.28 0.73      2    2.37 1.48   0   3     3 -0.81
days_per_week         12 93 2.23 0.78      2    2.32 1.48   0   3     3 -0.81
                    kurtosis   se
age                    -0.67 0.11
gender                 -1.94 0.05
education              -0.16 0.09
natrue_enterprise      -0.91 0.07
type_work              -0.73 0.09
job_title_s_data       21.74 0.05
work_experience        -0.69 0.08
marital_status         -0.74 0.12
partners_work          -1.40 0.11
telework_is_active      0.33 0.04
hours_per_day           0.41 0.08
days_per_week           0.23 0.08
```

```
freq_tables <- lapply(data_t, table)
print(freq_tables)
```

```
$age

 0  1  2  3  4 
 9 22 33 21  8 

$gender

 0  1 
53 40 

$education

 0  1  2  3  4 
```

```
 3 43 30 14  3

$natrue_enterprise

 0  1  2
29 48 16

$type_work

 0  1  2  3
 8 52 15 18

$job_title_s_data

 0  1  2  3
85  6  1  1

$work_experience

 0  1  2  3
 3 46 30 14

$marital_status

 0  1  2  3  4
27 14 40  8  4

$partners_work

 0  1  2  3
54  3 31  5

$telework_is_active

 0  1
75 18

$hours_per_day

 0  1  2  3
 2  9 43 39

$days_per_week

 0  1  2  3
 3 11 41 38
```

```
describe_item=c("Age","Gender","Education","Nature of corporate ownership","work type"
describe_str=list(
  c("~25","25~30","30~40","40~45","45~"), #age
  c("男","女"), #gender
  c("Junior", "college", "Undergraduate Postgraduate", "Doctor", "Other"), #education
  c("Foreign-funded enterprise", "Private enterprise", "State-owned enterprise"), #nat
  c("management", "R&D", "Salse", "Operation and maintenance"), #type work
```

```
  c("Ordinary staff", "Grass-roots management", "Middle management",    "Top managemen
  c("1", "2~5", "5~10", "10~"), #work experience
  c("unmarried", "Married without children", "Married with children", "Divorced and ch
  c("unemployed", "In the same company", "Different companies in the same city", "in d
  c("active", "passive"), #telework is active
  c("1~2", "2~4", "4~8", "8~"), # hours per day
  c("1", "2~3", "3~5", "5~") #days per week
)
content = list("Classification percentage");
itemName = list("Item name");
for (i in 1:length(freq_tables)) {
  #cat_(names(data_t)[i], ": ")
  cat_(describe_item[i],": ")
  itemName <- append(itemName,describe_item[i])
  result_str=""
  for(e in freq_tables[i]){
    #print(names(e))
    #输出均值,标准差,
    #输出频数与非分比
    total = sum(e)
    for(name in names(e)){
      num = e[name]
      freq = num/total*100
      freq = getNumber(freq)#format(round(freq, digits = 3), nsmall = 3)
      namestr = describe_str[[i]][as.integer(name)+1]
      result_str = paste(result_str,namestr,":",e[name]," ",freq,"% \n")
      cat_(namestr,":",e[name]," ",freq,"%, ")
    }
    content <- append(content,result_str)
    cat_("\n")
  }
}
```

```
Age: ~25:9 9.677%, 25~30:22 23.656%, 30~40:33 35.484%, 40~45:21 22.581%, 45~:8 8.602%,
Gender: 男:53 56.989%, 女:40 43.011%,
Education: Junior:3 3.226%, college:43 46.237%, Undergraduate Postgraduate:30 32.258%,
Doctor:14 15.054%, Other:3 3.226%,
Nature of corporate ownership: Foreign-funded enterprise:29 31.183%, Private
enterprise:48 51.613%, State-owned enterprise:16 17.204%,
work type: management:8 8.602%, R&D:52 55.914%, Salse:15 16.129%, Operation and
maintenance:18 19.355%,
Job title: Ordinary staff:85 91.398%, Grass-roots management:6 6.452%, Middle
management:1 1.075%, Top management:1 1.075%,
work experience: 1:3 3.226%, 2~5:46 49.462%, 5~10:30 32.258%, 10~:14 15.054%,
marital status: unmarried:27 29.032%, Married without children:14 15.054%, Married
with children:40 43.011%, Divorced and childless:8 8.602%, Divorced with children:4
4.301%,
partners work: unemployed:54 58.065%, In the same company:3 3.226%, Different
companies in the same city:31 33.333%, in different cities:5 5.376%,
telework is active: active:75 80.645%, passive:18 19.355%,
working hours pre day: 1~2:2 2.151%, 2~4:9 9.677%, 4~8:43 46.237%, 8~:39 41.935%,
working days pre week: 1:3 3.226%, 2~3:11 11.828%, 3~5:41 44.086%, 5~:38 40.860%,
```

```
# 使用cbind函数将两个列表按列组合成一个数据集
#dataset0 <- data.frame(itemName, content)
dataset <- cbind(itemName, content)
# 转换结果为数据框
dataset <- as.data.frame(dataset)
#dataset
saveExcel(dataset,"descriptive statistics")
rm(content,data_t,desc_data,describe_str,freq_tables,itemName,dataset,e,describe_item,
```

##三大验验 ### 独立验检 检验两个分类变量之间是否存在关联

```
data <- table(data0$age, data0$gender)
chisq.test(data)
```

```
Warning in chisq.test(data): Chi-squared approximation may be incorrect


    Pearson's Chi-squared test

data:  data
X-squared = 1.684, df = 4, p-value = 0.7936
```

正态性检验

```
library(nortest)
data <- data0[,13]
result = shapiro.test(data) # 对应group 每组水平下的检验
print(result$p.value)
```

```
[1] 5.841864e-10
```

方差齐性

方差齐性特指两个或两个以上总体方差是否具有显著差异的特性

```
bartlett.test(data0$environment0~data0$gender, data = data0)
```

```

    Bartlett test of homogeneity of variances

data:  data0$environment0 by data0$gender
Bartlett's K-squared = 0.0062887, df = 1, p-value = 0.9368
```

信度分析 Cronbach's α（克朗巴哈系数）

Internal Reliability • 再测信度 • Cronbach's α（克朗巴哈系数） • 折半信度 • Guttman • 平行模型检验 • 严密平行模型检验 • 库李20信度 Inter-rater Reliability • Kappa系数 • 组内相关系数ICC

```
#print(all_var)
library(psych)
#names(all_var)
```

```r
get_var_name <- function(x) {
  deparse(substitute(x))
}
tr_matrix <- matrix(nrow = length(all_var)+sum(lengths(all_var))+1, ncol = 3)
tr_matrix[1,] = c("","Cronbach's alpha", "N of Items")
#-   |Cronbach's alpha|N of Items
#name|0.829           |5
tr_matrixrow=2
for(i in seq_len(length(all_var))){
  selected_column_name = unlist(all_var[i])
  data_t <- data0[ selected_column_name ]
  alpha_result <- psych::alpha(data_t,check.keys=TRUE)
  tr_matrix[tr_matrixrow,1] = scaleName[i]
  tr_matrix[tr_matrixrow,2] = getNumber( alpha_result$total$raw_alpha )
  tr_matrix[tr_matrixrow,3] = length(alpha_result$keys[[1]])
  tr_matrixrow=tr_matrixrow+1
  for(j in 1:length(alpha_result$keys[[1]]) ){
    tr_matrix[tr_matrixrow,1] = alpha_result$keys[[1]][j]
    tr_matrix[tr_matrixrow,2] = getNumber( alpha_result$item.stats$raw.r[j] )
    tr_matrixrow=tr_matrixrow+1
  }
}
```

```
Warning in psych::alpha(data_t, check.keys = TRUE): Some items were negatively
correlated with the first principal component and were automatically reversed.
 This is indicated by a negative sign for the variable name.
```

```r
saveExcel(tr_matrix,"Cronbach's alpha")
print(tr_matrix)
```

```
      [,1]                             [,2]               [,3]        
 [1,] ""                               "Cronbach's alpha" "N of Items"
 [2,] "Teleworker Characteristics"     "0.889"            "4"         
 [3,] "teleworkerCharacteristics0"     "0.903"            NA          
 [4,] "teleworkerCharacteristics1"     "0.828"            NA          
 [5,] "teleworkerCharacteristics2"     "0.834"            NA          
 [6,] "teleworkerCharacteristics3"     "0.903"            NA          
 [7,] "Communication"                  "0.724"            "4"         
 [8,] "-communication0"                "0.364"            NA          
 [9,] "communication1"                 "0.854"            NA          
[10,] "communication2"                 "0.899"            NA          
[11,] "communication3"                 "0.868"            NA          
[12,] "Management"                     "0.899"            "3"         
[13,] "management2"                    "0.902"            NA          
[14,] "management3"                    "0.960"            NA          
[15,] "management4"                    "0.873"            NA          
[16,] "Organisational Culture"         "0.946"            "4"         
[17,] "organisationalCulture0"         "0.948"            NA          
[18,] "organisationalCulture1"         "0.908"            NA          
[19,] "organisationalCulture2"         "0.938"            NA          
[20,] "organisationalCulture3"         "0.924"            NA          
[21,] "Job Effectiveness"              "0.962"            "4"         
[22,] "job_effectiveness1"             "0.953"            NA          
```

```
[23,] "job_effectiveness2"        "0.943"          NA
[24,] "job_effectiveness3"        "0.961"          NA
[25,] "job_effectiveness4"        "0.936"          NA
[26,] "work-life balance"         "0.966"          "4"
[27,] "work.life_balance1"        "0.950"          NA
[28,] "work.life_balance2"        "0.967"          NA
[29,] "work.life_balance3"        "0.959"          NA
[30,] "work.life_balance4"        "0.941"          NA
[31,] "well-being"                "0.951"          "4"
[32,] "well.being1"               "0.953"          NA
[33,] "well.being2"               "0.950"          NA
[34,] "well.being3"               "0.959"          NA
[35,] "well.being4"               "0.904"          NA
```

KMO检测 and bartlett’s test

```
#data_independent <- data0[cols_independent]
#data_independent_all <- data0[cols_independent_all]
#data_dependent <- data0[cols_dependent]
#data_dependent_all <- data0[cols_dependent]
data = data0[c(cols_independent,cols_dependent)]
item = list()
content = list()
kmo <- KMO(data)
bartlett <- bartlett.test(data)

item <- append(item, "Overall MSA" )
content <- append(content,getNumber(kmo$MSA) )

item <- append(item, names(bartlett$statistic) )
content <- append(content, getNumber(bartlett$statistic) )
item <- append(item, "df" )
content <- append(content, bartlett$parameter )
item <- append(item, "Sig." )
content <- append( content,getNumber(bartlett$p.value) )

item <- append(item, names(kmo$MSAi) )
content <- append(content, getNumber(kmo$MSAi) )

#dataset0 <- data.frame(itemName, content)
dataset <- cbind(item, content)
# 转换结果为数据框
dataset <- as.data.frame(dataset)
#dataset
saveExcel(dataset,"KMO and Bartlett's Test")

print(kmo)
```

```
Kaiser-Meyer-Olkin factor adequacy
Call: KMO(r = data)
Overall MSA =  0.91
MSA for each item =
```

```
     organisationalCulture2      organisationalCulture0
                       0.80                        0.82
     organisationalCulture3      organisationalCulture1
                       0.88                        0.91
                management2                 management3
                       0.94                        0.89
                management4 teleworkerCharacteristics1
                       0.86                        0.79
teleworkerCharacteristics2 teleworkerCharacteristics3
                       0.88                        0.92
teleworkerCharacteristics0              communication3
                       0.85                        0.85
             communication2              communication1
                       0.88                        0.87
         job_effectiveness1          job_effectiveness2
                       0.92                        0.89
         job_effectiveness3          job_effectiveness4
                       0.93                        0.97
         work.life_balance1          work.life_balance2
                       0.91                        0.97
         work.life_balance3          work.life_balance4
                       0.94                        0.91
                well.being1                 well.being2
                       0.91                        0.98
                well.being3                 well.being4
                       0.97                        0.92
```

```
print(bartlett)
```

```

	Bartlett test of homogeneity of variances

data:  data
Bartlett's K-squared = 256.41, df = 25, p-value < 2.2e-16
```

```
rm(item,content,kmo,bartlett,dataset,data)
```

因子分析 EFA:

Factor Analysis Total Variance Explained & commualities

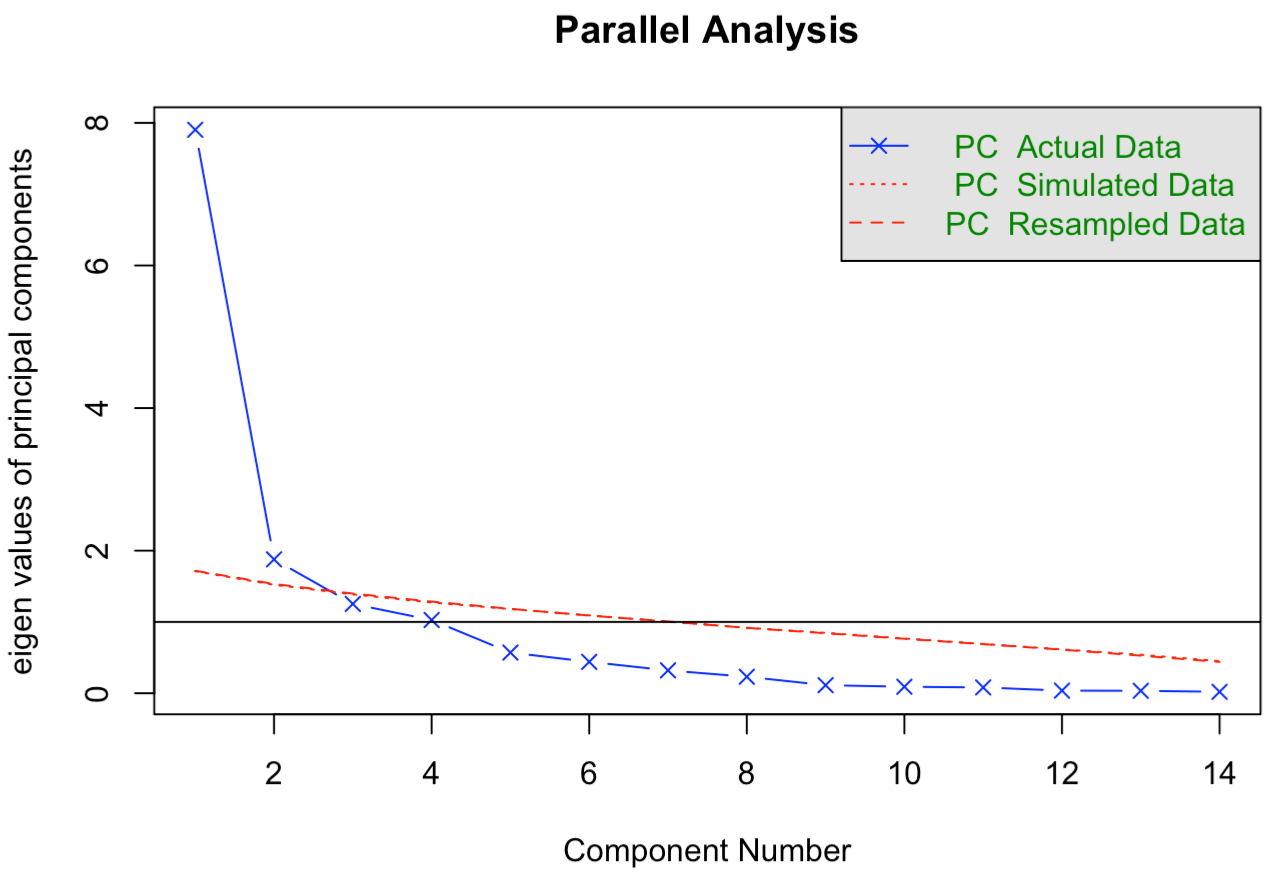
```
library(psych)
library(paran)
#library(rgl) #需要opengl
library(ggfortify)
```

```
Loading required package: ggplot2
```

```

Attaching package: 'ggplot2'
```

```
The following objects are masked from 'package:psych':

    %+%, alpha

The following object is masked from 'package:memisc':

    syms
```

```
data <- data0[cols_independent]
#data <- data0[cols_dependent]

# AIC BIC 比较模型 parallel平行分析 可得因子数,否则只能自已手动尝试观察
parallel_result <- fa.parallel(data, fa = "pc", n.iter = 100, main = "Parallel Analysi
```




```
Parallel analysis suggests that the number of factors =  NA  and the number of
components =  2
```

```
factors = parallel_result$nfact
if( is.na(parallel_result$nfact) ){
  factors = parallel_result$ncomp
  if( is.na(parallel_result$ncomp) ){
    stop("没有得到因子数,请检查数据")  # 抛出异常
    quit(save = "no", status = 1)  # 退出当前会话
  }
}
print(factors)
```

```
[1] 2
```

```
rm(parallel_result)
## 因子分析
fa_results <- fa(data, nfactors = factors, rotate = "varimax")
#得到Comunalities表 Initial都为1 , Extraction就是下面的值
communalities = fa_results$communalities
component = names(communalities)
Initial = rep(1,length(component))
Extraction = getNumber( as.numeric(abs(communalities)) )
dataset <- cbind(component, Initial, Extraction)
dataset <- as.data.frame(dataset)
saveExcel(dataset,"Factor Analysis commualities")
#得到Total Variance Explained
dataL = length(fa_results$values)
print(dataL)
```

```
[1] 14
```

```
component <- 1:dataL
#得到Initial Eigenvalues

variance_explained = abs(fa_results$values) / sum(abs(fa_results$values)) *100
Total =  getNumber( abs(fa_results$values))  # Total
Variance =  getNumber( variance_explained)  # % of Variance
Cumulative = getNumber( getCumulativeList(variance_explained)) # Cumulative %
print(Total)
```

```
 [1] "7.580" "1.508" "0.873" "0.604" "0.224" "0.077" "0.000" "0.088" "0.147"
[10] "0.234" "0.268" "0.316" "0.331" "0.395"
```

```
print(Variance)
```

```
 [1] "59.938" "11.928" " 6.903" " 4.780" " 1.775" " 0.606" " 0.003" " 0.697"
 [9] " 1.161" " 1.849" " 2.122" " 2.497" " 2.617" " 3.125"
```

```
print(Cumulative)
```

```
 [1] " 59.938" " 71.866" " 78.769" " 83.549" " 85.324" " 85.930" " 85.933"
 [8] " 86.630" " 87.791" " 89.640" " 91.762" " 94.258" " 96.875" "100.000"
```

```
#得到 Extraction Sums of Squared Loadings 与Initial Eigenvalues一样,只是只显示因子项
print(class(Total))
```

```
[1] "character"
```

```
Total1 = Total
Variance1 = Variance
Cumulative1 = Cumulative
startIndex = factors+1
endIndex = dataL
```

```
Total1[startIndex:endIndex] <- NA  # Total
Variance1[startIndex:endIndex] <- NA  # % of Variance
Cumulative1[startIndex:endIndex] <- NA # Cumulative %
#得到 Rotation Sums of Squared Loadings
variance_explained = abs(fa_results$e.values) / sum(abs(fa_results$e.values)) *100
Total2 = getNumber( abs(fa_results$e.values) ) # Total
Variance2 = getNumber( variance_explained) # % of Variance
Cumulative2 = getNumber( getCumulativeList(variance_explained)) # Cumulative %
print(Total2)
```

```
 [1] "7.904" "1.878" "1.253" "1.027" "0.570" "0.440" "0.320" "0.231" "0.113"
[10] "0.091" "0.081" "0.037" "0.034" "0.020"
```

```
print(Variance2)
```

```
 [1] "56.457" "13.412" " 8.948" " 7.337" " 4.074" " 3.145" " 2.289" " 1.651"
 [9] " 0.806" " 0.650" " 0.581" " 0.261" " 0.244" " 0.142"
```

```
print(Cumulative2)
```

```
 [1] " 56.457" " 69.869" " 78.817" " 86.155" " 90.229" " 93.374" " 95.663"
 [8] " 97.314" " 98.121" " 98.771" " 99.352" " 99.613" " 99.858" "100.000"
```

```
Total2[startIndex:endIndex] <- NA  # Total
Variance2[startIndex:endIndex] <- NA  # % of Variance
Cumulative2[startIndex:endIndex] <- NA # Cumulative %
dataset <- cbind(component, "Total"=Total, "% of Variance"=Variance,"Cumulative %"=Cum
dataset <- as.data.frame(dataset)
saveExcel(dataset,"Factor Analysis Total")

##获得旋转矩阵 loadings
#summary(fa_results)
print(fa_results$loadings)
```

```
Loadings:
                            MR1   MR2  
organisationalCulture2      0.770 0.186
organisationalCulture0      0.786 0.165
organisationalCulture3      0.765 0.392
organisationalCulture1      0.813 0.439
management2                 0.457 0.642
management3                 0.516 0.688
management4                 0.632 0.349
teleworkerCharacteristics1        0.715
teleworkerCharacteristics2 0.203 0.696
teleworkerCharacteristics3 0.302 0.854
teleworkerCharacteristics0 0.365 0.823
communication3              0.654 0.170
communication2              0.743 0.261
communication1              0.746 0.194
```

```
                  MR1   MR2
SS loadings     5.136 3.953
Proportion Var 0.367 0.282
Cumulative Var 0.367 0.649
```

```
tr_matrix = transLoadings2Matrix(fa_results$loadings)
```

```
[1] ""    "MR1" "MR2"
```

```
#saveExcel(tr_matrix,"Factor Analysis loading")
print(fa_results$Vaccounted)
```

```
                            MR1       MR2
SS loadings           5.1357240 3.9525900
Proportion Var        0.3668374 0.2823279
Cumulative Var        0.3668374 0.6491653
Proportion Explained  0.5650910 0.4349090
Cumulative Proportion 0.5650910 1.0000000
```

```
tr_matrix1 = transLoadings2Matrix(fa_results$Vaccounted)
```

```
[1] ""    "MR1" "MR2"
```

```
tr_matrix = rbind(tr_matrix,tr_matrix1)
#print(tr_matrix)
saveExcel(tr_matrix,"Factor Analysis loading")
## EFA 分析,探索性分析
#fa = factanal(data,factors=factors,rotation = "varimax")
#summary(fa)
#autoplot3d(fa, color = "Factor")
#scatter3d(fa$scores[, 1], fa$scores[, 2], fa$scores[, 3], color = fa$loadings[, 1])
#print(fa)

rm(data,dataset,factors,fa_results,fa,loadings,filtered_loadings,tr_matrix,tr_matrix1,
```

```
Warning in rm(data, dataset, factors, fa_results, fa, loadings,
filtered_loadings, : object 'fa' not found

Warning in rm(data, dataset, factors, fa_results, fa, loadings,
filtered_loadings, : object 'loadings' not found

Warning in rm(data, dataset, factors, fa_results, fa, loadings,
filtered_loadings, : object 'filtered_loadings' not found

Warning in rm(data, dataset, factors, fa_results, fa, loadings,
filtered_loadings, : object 'Cumulative3' not found
```

T-Test

单样本T检验

- 默认前提条件是数据需要符合正态分布性 • 结果是否显著等于某一值 • 男性的工资显著等于3000元

```
# 创建一个数值向量
data <- c(1, 2, 3, 4, 5, 6, 7, 8, 9)
# 执行单样本t检验，检验均值是否显著不同于0
t_test_result <- t.test(data, mu = 0)
# 打印结果
print(t_test_result)
```

```
	One Sample t-test

data:  data
t = 5.4772, df = 8, p-value = 0.0005894
alternative hypothesis: true mean is not equal to 0
95 percent confidence interval:
 2.894916 7.105084
sample estimates:
mean of x 
        5 
```

独立样本T检验

- 要求因变量(y)需要符合正态分布性 • X与Y的差异是否显著 • 例:研究男性工资与女性工资之间的差异

```
# 创建两个数值向量
#group1 <- c(1, 2, 3, 4, 5)
#group2 <- c(6, 7, 8, 9, 10)
# 执行独立样本t检验
#t_test_result <- t.test(group1, group2)
# 打印结果
#print(t_test_result)
t_test_result <- t.test(data0[data0$gender==0,]$job_effectiveness, data0[data0$gender=
print(t_test_result)
```

```
	Welch Two Sample t-test

data:  data0[data0$gender == 0, ]$job_effectiveness and data0[data0$gender == 1, 
]$job_effectiveness
t = 1.4103, df = 71.08, p-value = 0.1628
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.1059034  0.6176958
sample estimates:
mean of x mean of y 
 4.193396  3.937500 
```

```
t_test_result <- t.test(data0[data0$gender==0,]$work.life_balance, data0[data0$gender=
print(t_test_result)
```

```
	Welch Two Sample t-test

data:  data0[data0$gender == 0, ]$work.life_balance and data0[data0$gender == 1,
]$work.life_balance
t = 0.46999, df = 76.724, p-value = 0.6397
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.2565232  0.4150138
sample estimates:
mean of x mean of y 
 3.929245  3.850000 
```

```
t_test_result <- t.test(data0[data0$gender==0,]$well.being, data0[data0$gender==1,]$we
print(t_test_result)
```

```
	Welch Two Sample t-test

data:  data0[data0$gender == 0, ]$well.being and data0[data0$gender == 1, ]$well.being
t = 0.72014, df = 73.148, p-value = 0.4737
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.2601080  0.5544476
sample estimates:
mean of x mean of y 
  4.04717   3.90000 
```

配对样本T检验

• 默认前提条件是差值数据需要符合正态分布性 • 利用来自两个总体的配对样本，推断两个总体的均值是否存在显著差异。 • 办公室提供免费咖啡和没有提供免费咖啡的两组员工，生产力是否一样?

```
# 创建配对的数值向量
before <- c(1, 2, 3, 4, 5)
after <- c(2, 3, 4, 5, 6)
# 执行配对样本t检验
#t_test_result <- t.test(before, after, paired = TRUE)
# 打印结果
#print(t_test_result)
```

方差分析

ONE-WAY ANOVA 单因素方差分析 方差齐检验homogeneity of variance test

ANOVA, LevenTest, Tukey’s HSD, Duncan’s C

temp

```
library(car)
```

```
Loading required package: carData


Attaching package: 'car'

The following object is masked from 'package:psych':

    logit

The following object is masked from 'package:memisc':

    recode
```

```r
library(multcomp)
```

```
Loading required package: mvtnorm

Loading required package: survival

Loading required package: TH.data


Attaching package: 'TH.data'

The following object is masked from 'package:MASS':

    geyser
```

```r
library(multcompView)
## 按性别分析因变量
anova<-function(x_data,y_data,tr_matrix_old=NULL){

  #加一行title
  tr_matrix <- matrix(nrow = 2, ncol = 7)
  xname = paste(as.character(substitute(y_data)),collapse="")
  yname = paste(as.character(substitute(x_data)),collapse="")
  #str(xname)
  tempstr = paste("diff " ,xname , " by " ,yname )
  print(tempstr)
  tr_matrix[2,1] = tempstr
  if(!is.null(tr_matrix_old)){
    tr_matrix = rbind(tr_matrix_old, tr_matrix)
  }

  x <- factor( as.character(x_data) )
  y <- y_data
  data = data.frame(x,y)
  model <- aov(y ~ x, data=data)
  leveneTest_result = leveneTest(model)
  # 进行图基事后比较
  tukey_comparison <- glht(model, linfct = mcp(x = "Tukey"))
  # 进行邓尼特事后比较，其中"control"是对照组
  dunnett_comparison <- glht(model, linfct = mcp(x = "Dunnett"))
```

```r
print("model")
sum = summary(model) #spss中的ANOVA全在这个结果里面
#Df (自由度) : 这列显示了每个方差来源的自由度。
#Sum Sq (平方和) : 这列显示了每个方差来源的平方和。平方和(组间(值小),组内(值大),总计(前两相加))
#Mean Sq (均方) : 这列显示了每个方差来源的均方 (即平方和除以自由度) 。平方和/自由度
#F value (F统计量) : 这是组间均方与组内均方的比值。
#Pr(>F) (p值) : 这是与F统计量相关联的p值。
tr_matrix_old = tr_matrix
tr_matrix <- matrix(nrow = 4, ncol = 7)
tr_matrix[1,]=c("","平方和","自由度","均方","F","显著性",NA)
tr_matrix[,1]=c("","组间","组内","总计")
tr_matrix[2,2] = getNumber(sum[[1]]["Sum Sq"][1,1])
tr_matrix[3,2] = getNumber(sum[[1]]["Sum Sq"][2,1])
tr_matrix[4,2] = getNumber(sum(sum[[1]]["Sum Sq"]))
tr_matrix[2,3] = sum[[1]]["Df"][1,1]
tr_matrix[3,3] = sum[[1]]["Df"][2,1]
tr_matrix[4,3] = sum(sum[[1]]["Df"])
tr_matrix[2,4] = getNumber(sum[[1]]["Mean Sq"][1,1])
tr_matrix[3,4] = getNumber(sum[[1]]["Mean Sq"][2,1])
tr_matrix[2,5] = getNumber(sum[[1]]["F value"][1,1])
tr_matrix[2,6] = getNumber(sum[[1]]["Pr(>F)"][1,1])
print(tr_matrix)
tr_matrix = rbind(tr_matrix_old, tr_matrix)

print("leveneTest_result")
#print(leveneTest_result) #spss中的方差齐性检验
#F value 莱文统计
#df 自由度1,2
#Pr(>F) (p值) : 这是与F统计量相关联的p值
tr_matrix_old = tr_matrix
tr_matrix <- matrix(nrow = 2, ncol = 7)
tr_matrix[1,]=c("莱文统计","自由度1","自由度2","显著性",NA,NA,NA)
tr_matrix[2,1] = getNumber(leveneTest_result["F value"][1,1])
tr_matrix[2,2] = leveneTest_result["Df"][1,1]
tr_matrix[2,3] = leveneTest_result["Df"][2,1]
tr_matrix[2,4] = getNumber(leveneTest_result["Pr(>F)"][1,1])
print(tr_matrix)
tr_matrix = rbind(tr_matrix_old, tr_matrix)

print("tukey_comparison")
sum = summary(tukey_comparison) #图基HSD
str(sum$test)
print(sum)
diffname = names(sum$test$coefficients)
t_critical <- qt(0.975, 348)
tr_matrix_old = tr_matrix
tr_matrix <- matrix(nrow = length(diffname)+2, ncol = 7)
tr_matrix[1,]=c("","","","","","95%置信区间","")
tr_matrix[2,]=c("group","group","平均值差值","标准差","显著性","下限","上限")
lastname = ""
for(i in 1:length(diffname)){
  names = split_str <- strsplit(diffname[i]," - ")
  if(lastname!=names[[1]][2]){
```

```
      lastname = tr_matrix[2+i,1] = names[[1]][2]
    }
    tr_matrix[2+i,2] = names[[1]][1]
    c=""
    if( sum$test$pvalues[i]<0.001){
        c="***"
      }else if( sum$test$pvalues[i]<0.01){
        c="**"
      }else if( sum$test$pvalues[i]<0.05){
        c="*"
      }
    tr_matrix[2+i,3] = paste( getNumber( sum$test$coefficients[i] ), c,collapse="")
    tr_matrix[2+i,4] = getNumber( sum$test$sigma[i] )
    tr_matrix[2+i,5] = getNumber( sum$test$pvalues[i] )
    tr_matrix[2+i,6] = getNumber( sum$test$coefficients[i] - t_critical * sum$test$sig
    tr_matrix[2+i,7] = getNumber( sum$test$coefficients[i] + t_critical * sum$test$sig
  }
  print(tr_matrix)
  tr_matrix = rbind(tr_matrix_old, tr_matrix)
  #print(tr_matrix)
  ##multcomp_plot(tukey_comparison)
  #print("dunnett_comparison")
  #print(summary(dunnett_comparison))
  return(tr_matrix)
}
#anova(data0$gender,data0$job_effectiveness)
dataset = anova(data0$age,data0$job_effectiveness,tr_matrix_old=NULL)
```

```
[1] "diff  $data0job_effectiveness  by  $data0age"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"   "F"     "显著性" NA
[2,] "组间" "6.720"  "4"      "1.680" "2.535" "0.046"  NA
[3,] "组内" "58.322" "88"     "0.663" NA      NA       NA
[4,] "总计" "65.042" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "0.407"    "4"       "88"      "0.803"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:10] 0.527 0.902 0.786 0.521 0.375 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ sigma       : Named num [1:10] 0.322 0.306 0.324 0.396 0.224 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ tstat       : Named num [1:10] 1.63 2.94 2.42 1.32 1.67 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ pvalues     : num [1:10] 0.4694 0.0312 0.114 0.6728 0.445 ...
  ..- attr(*, "error")= num 0.000376
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"
```

```
	 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
            Estimate Std. Error t value Pr(>|t|)  
1 - 0 == 0  0.526515   0.322123   1.635   0.4694  
2 - 0 == 0  0.901515   0.306140   2.945   0.0312 *
3 - 0 == 0  0.785714   0.324342   2.422   0.1140  
4 - 0 == 0  0.520833   0.395578   1.317   0.6728  
2 - 1 == 0  0.375000   0.224072   1.674   0.4450  
3 - 1 == 0  0.259199   0.248363   1.044   0.8285  
4 - 1 == 0 -0.005682   0.336107  -0.017   1.0000  
3 - 2 == 0 -0.115801   0.227250  -0.510   0.9856  
4 - 2 == 0 -0.380682   0.320822  -1.187   0.7514  
4 - 3 == 0 -0.264881   0.338235  -0.783   0.9322  
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)

      [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]    
 [1,] ""      ""      ""           ""       ""       "95%置信区间" ""      
 [2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"  
 [3,] "0"     "1"     "0.527 "     "0.322"  "0.469"  "-0.107"      "1.160" 
 [4,] NA      "2"     "0.902 *"    "0.306"  "0.031"  "0.299"       "1.504" 
 [5,] NA      "3"     "0.786 "     "0.324"  "0.114"  "0.148"       "1.424" 
 [6,] NA      "4"     "0.521 "     "0.396"  "0.673"  "-0.257"      "1.299" 
 [7,] "1"     "2"     "0.375 "     "0.224"  "0.445"  "-0.066"      "0.816" 
 [8,] NA      "3"     "0.259 "     "0.248"  "0.829"  "-0.229"      "0.748" 
 [9,] NA      "4"     "-0.006 "    "0.336"  "1.000"  "-0.667"      "0.655" 
[10,] "2"     "3"     "-0.116 "    "0.227"  "0.986"  "-0.563"      "0.331" 
[11,] NA      "4"     "-0.381 "    "0.321"  "0.751"  "-1.012"      "0.250" 
[12,] "3"     "4"     "-0.265 "    "0.338"  "0.932"  "-0.930"      "0.400" 
```

```
dataset = anova(data0$age,data0$work.life_balance,tr_matrix_old=dataset)
```

```
[1] "diff  $data0work.life_balance  by  $data0age"
[1] "model"
     [,1]   [,2]     [,3]     [,4]     [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"   "F"     "显著性" NA  
[2,] "组间" "4.199"  "4"      "1.050"  "1.761" "0.144"  NA  
[3,] "组内" "52.466" "88"     "0.596"  NA      NA       NA  
[4,] "总计" "56.665" "92"     NA       NA      NA       NA  
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA  
[2,] "0.174"    "4"       "88"      "0.951"  NA   NA   NA  
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
```

```
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:10] 0.367 0.697 0.524 0.302 0.33 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ sigma       : Named num [1:10] 0.306 0.29 0.308 0.375 0.213 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ tstat       : Named num [1:10] 1.203 2.4 1.703 0.805 1.551 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ pvalues     : num [1:10] 0.742 0.12 0.427 0.925 0.523 ...
  ..- attr(*, "error")= num 0.000338
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0  0.36742    0.30552   1.203    0.742
2 - 0 == 0  0.69697    0.29037   2.400    0.120
3 - 0 == 0  0.52381    0.30763   1.703    0.427
4 - 0 == 0  0.30208    0.37519   0.805    0.925
2 - 1 == 0  0.32955    0.21253   1.551    0.523
3 - 1 == 0  0.15639    0.23557   0.664    0.962
4 - 1 == 0 -0.06534    0.31879  -0.205    1.000
3 - 2 == 0 -0.17316    0.21554  -0.803    0.926
4 - 2 == 0 -0.39489    0.30429  -1.298    0.685
4 - 3 == 0 -0.22173    0.32081  -0.691    0.956
(Adjusted p values reported -- single-step method)

      [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]
 [1,] ""      ""      ""           ""       ""       "95%置信区间" ""
 [2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"
 [3,] "0"     "1"     "0.367 "     "0.306"  "0.742"  "-0.233"      "0.968"
 [4,] NA      "2"     "0.697 "     "0.290"  "0.120"  "0.126"       "1.268"
 [5,] NA      "3"     "0.524 "     "0.308"  "0.427"  "-0.081"      "1.129"
 [6,] NA      "4"     "0.302 "     "0.375"  "0.925"  "-0.436"      "1.040"
 [7,] "1"     "2"     "0.330 "     "0.213"  "0.523"  "-0.088"      "0.748"
 [8,] NA      "3"     "0.156 "     "0.236"  "0.962"  "-0.307"      "0.620"
 [9,] NA      "4"     "-0.065 "    "0.319"  "1.000"  "-0.692"      "0.562"
[10,] "2"     "3"     "-0.173 "    "0.216"  "0.926"  "-0.597"      "0.251"
[11,] NA      "4"     "-0.395 "    "0.304"  "0.685"  "-0.993"      "0.204"
[12,] "3"     "4"     "-0.222 "    "0.321"  "0.956"  "-0.853"      "0.409"
```

```r
dataset = anova(data0$age,data0$well.being,tr_matrix_old=dataset)
```

```
[1] "diff  $data0well.being  by  $data0age"
[1] "model"
     [,1]   [,2]     [,3]     [,4]   [,5]   [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方" "F"    "显著性" NA
```

```
[2,] "组间" "5.877"  "4"      "1.469" "1.699" "0.157"  NA
[3,] "组内" "76.099" "88"     "0.865" NA      NA       NA
[4,] "总计" "81.976" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "0.500"    "4"       "88"      "0.736"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:10] 0.549 0.841 0.476 0.365 0.292 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ sigma       : Named num [1:10] 0.368 0.35 0.37 0.452 0.256 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ tstat       : Named num [1:10] 1.493 2.405 1.285 0.807 1.14 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ pvalues     : num [1:10] 0.56 0.119 0.692 0.925 0.778 ...
  ..- attr(*, "error")= num 0.00019
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

	 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0  0.54924    0.36796   1.493    0.560
2 - 0 == 0  0.84091    0.34970   2.405    0.119
3 - 0 == 0  0.47619    0.37049   1.285    0.692
4 - 0 == 0  0.36458    0.45186   0.807    0.925
2 - 1 == 0  0.29167    0.25595   1.140    0.778
3 - 1 == 0 -0.07305    0.28370  -0.257    0.999
4 - 1 == 0 -0.18466    0.38393  -0.481    0.988
3 - 2 == 0 -0.36472    0.25958  -1.405    0.617
4 - 2 == 0 -0.47633    0.36647  -1.300    0.683
4 - 3 == 0 -0.11161    0.38636  -0.289    0.998
(Adjusted p values reported -- single-step method)

      [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]
 [1,] ""      ""      ""           ""       ""       "95%置信区间" ""
 [2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"
 [3,] "0"     "1"     "0.549 "     "0.368"  "0.560"  "-0.174"      "1.273"
 [4,] NA      "2"     "0.841 "     "0.350"  "0.119"  "0.153"       "1.529"
 [5,] NA      "3"     "0.476 "     "0.370"  "0.692"  "-0.252"      "1.205"
 [6,] NA      "4"     "0.365 "     "0.452"  "0.925"  "-0.524"      "1.253"
 [7,] "1"     "2"     "0.292 "     "0.256"  "0.778"  "-0.212"      "0.795"
 [8,] NA      "3"     "-0.073 "    "0.284"  "0.999"  "-0.631"      "0.485"
 [9,] NA      "4"     "-0.185 "    "0.384"  "0.988"  "-0.940"      "0.570"
[10,] "2"     "3"     "-0.365 "    "0.260"  "0.617"  "-0.875"      "0.146"
```

```
[11,] NA      "4"     "-0.476 "    "0.366"  "0.683"  "-1.197"      "0.244"
[12,] "3"     "4"     "-0.112 "    "0.386"  "0.998"  "-0.872"      "0.648"
```

```
dataset = anova(data0$gender,data0$job_effectiveness,tr_matrix_old=dataset)
```

```
[1] "diff  $data0job_effectiveness  by  $data0gender"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"     "显著性" NA
[2,] "组间" "1.493"  "1"      "1.493" "2.138" "0.147"  NA
[3,] "组内" "63.549" "91"     "0.698" NA      NA       NA
[4,] "总计" "65.042" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "1.956"    "1"       "91"      "0.165"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num -0.256
  ..- attr(*, "names")= chr "1 - 0"
 $ sigma       : Named num 0.175
  ..- attr(*, "names")= chr "1 - 0"
 $ tstat       : Named num -1.46
  ..- attr(*, "names")= chr "1 - 0"
 $ pvalues     : num 0.147
  ..- attr(*, "error")= num 0
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0  -0.2559     0.1750  -1.462    0.147
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]         [,4]     [,5]     [,6]           [,7]
[1,] ""      ""      ""           ""       ""       "95%置信区间"  ""
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"         "上限"
[3,] "0"     "1"     "-0.256 "    "0.175"  "0.147"  "-0.600"       "0.088"
```

```
dataset = anova(data0$gender,data0$work.life_balance,tr_matrix_old=dataset)
```

```
[1] "diff  $data0work.life_balance  by  $data0gender"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
```

```
[1,] ""      "平方和" "自由度" "均方"  "F"     "显著性" NA
[2,] "组间" "0.143"  "1"      "0.143" "0.230" "0.632"  NA
[3,] "组内" "56.522" "91"     "0.621" NA      NA       NA
[4,] "总计" "56.665" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "0.441"    "1"       "91"      "0.509"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num -0.0792
  ..- attr(*, "names")= chr "1 - 0"
 $ sigma       : Named num 0.165
  ..- attr(*, "names")= chr "1 - 0"
 $ tstat       : Named num -0.48
  ..- attr(*, "names")= chr "1 - 0"
 $ pvalues     : num 0.632
  ..- attr(*, "error")= num 0
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0 -0.07925    0.16507   -0.48    0.632
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]         [,4]     [,5]     [,6]           [,7]
[1,] ""      ""      ""           ""       ""       "95%置信区间" ""
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"         "上限"
[3,] "0"     "1"     "-0.079 "    "0.165"  "0.632"  "-0.404"       "0.245"
```

```
dataset = anova(data0$gender,data0$well.being,tr_matrix_old=dataset)
```

```
[1] "diff  $data0well.being  by  $data0gender"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""      "平方和" "自由度" "均方"  "F"     "显著性" NA
[2,] "组间" "0.494"  "1"      "0.494" "0.551" "0.460"  NA
[3,] "组内" "81.482" "91"     "0.895" NA      NA       NA
[4,] "总计" "81.976" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "1.092"    "1"       "91"      "0.299"  NA   NA   NA
```

```
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num -0.147
  ..- attr(*, "names")= chr "1 - 0"
 $ sigma       : Named num 0.198
  ..- attr(*, "names")= chr "1 - 0"
 $ tstat       : Named num -0.743
  ..- attr(*, "names")= chr "1 - 0"
 $ pvalues     : num 0.46
  ..- attr(*, "error")= num 0
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0  -0.1472     0.1982  -0.743     0.46
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]
[1,] ""      ""      ""           ""       ""       "95%置信区间" ""
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"
[3,] "0"     "1"     "-0.147 "    "0.198"  "0.460"  "-0.537"      "0.243"
```

```
dataset = anova(data0$education,data0$job_effectiveness,tr_matrix_old=dataset)
```

```
[1] "diff  $data0job_effectiveness  by  $data0education"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]     [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"      "显著性" NA
[2,] "组间" "27.240" "4"      "6.810" "15.853" "0.000"  NA
[3,] "组内" "37.802" "88"     "0.430" NA       NA       NA
[4,] "总计" "65.042" "92"     NA      NA       NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "0.516"    "4"       "88"      "0.724"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:10] 0.891 1.742 1.405 -0.583 0.85 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ sigma       : Named num [1:10] 0.391 0.397 0.417 0.535 0.156 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
```

```
 $ tstat       : Named num [1:10] 2.28 4.39 3.37 -1.09 5.45 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ pvalues     : num [1:10] 1.44e-01 2.21e-04 8.11e-03 7.91e-01 3.16e-06 ...
  ..- attr(*, "error")= num 0.00037
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0   0.8915     0.3914   2.278  0.14355
2 - 0 == 0   1.7417     0.3969   4.388  < 0.001 ***
3 - 0 == 0   1.4048     0.4170   3.369  0.00811 **
4 - 0 == 0  -0.5833     0.5351  -1.090  0.79141
2 - 1 == 0   0.8502     0.1559   5.453  < 0.001 ***
3 - 1 == 0   0.5133     0.2017   2.545  0.07848 .
4 - 1 == 0  -1.4748     0.3914  -3.768  0.00229 **
3 - 2 == 0  -0.3369     0.2121  -1.588  0.47757
4 - 2 == 0  -2.3250     0.3969  -5.858  < 0.001 ***
4 - 3 == 0  -1.9881     0.4170  -4.768  < 0.001 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)

      [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]
 [1,] ""      ""      ""           ""       ""       "95%置信区间" ""
 [2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"
 [3,] "0"     "1"     "0.891 "     "0.391"  "0.144"  "0.122"       "1.661"
 [4,] NA      "2"     "1.742 ***"  "0.397"  "0.000"  "0.961"       "2.522"
 [5,] NA      "3"     "1.405 **"   "0.417"  "0.008"  "0.585"       "2.225"
 [6,] NA      "4"     "-0.583 "    "0.535"  "0.791"  "-1.636"      "0.469"
 [7,] "1"     "2"     "0.850 ***"  "0.156"  "0.000"  "0.544"       "1.157"
 [8,] NA      "3"     "0.513 "     "0.202"  "0.078"  "0.117"       "0.910"
 [9,] NA      "4"     "-1.475 **"  "0.391"  "0.002"  "-2.245"      "-0.705"
[10,] "2"     "3"     "-0.337 "    "0.212"  "0.478"  "-0.754"      "0.080"
[11,] NA      "4"     "-2.325 ***" "0.397"  "0.000"  "-3.106"      "-1.544"
[12,] "3"     "4"     "-1.988 ***" "0.417"  "0.000"  "-2.808"      "-1.168"
```

```
dataset = anova(data0$education,data0$work.life_balance,tr_matrix_old=dataset)
```

```
[1] "diff  $data0work.life_balance  by  $data0education"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"     "显著性" NA
[2,] "组间" "9.109"  "4"      "2.277" "4.214" "0.004"  NA
[3,] "组内" "47.557" "88"     "0.540" NA      NA       NA
[4,] "总计" "56.665" "92"     NA      NA      NA       NA
```

```
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "0.149"    "4"       "88"      "0.963"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:10] 8.62e-01 1.26 1.15 1.76e-15 3.96e-01 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ sigma       : Named num [1:10] 0.439 0.445 0.468 0.6 0.175 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ tstat       : Named num [1:10] 1.96 2.83 2.47 2.93e-15 2.26 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ pvalues     : num [1:10] 0.2651 0.0385 0.0939 1 0.1477 ...
  ..- attr(*, "error")= num 0.000702
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
             Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0  8.624e-01  4.390e-01   1.965   0.2651
2 - 0 == 0  1.258e+00  4.451e-01   2.827   0.0385 *
3 - 0 == 0  1.155e+00  4.677e-01   2.469   0.0939 .
4 - 0 == 0  1.756e-15  6.002e-01   0.000   1.0000
2 - 1 == 0  3.959e-01  1.749e-01   2.264   0.1477
3 - 1 == 0  2.924e-01  2.262e-01   1.292   0.6700
4 - 1 == 0 -8.624e-01  4.390e-01  -1.965   0.2652
3 - 2 == 0 -1.036e-01  2.379e-01  -0.435   0.9913
4 - 2 == 0 -1.258e+00  4.451e-01  -2.827   0.0386 *
4 - 3 == 0 -1.155e+00  4.677e-01  -2.469   0.0941 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)

      [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]
 [1,] ""      ""      ""           ""       ""       "95%置信区间" ""
 [2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"
 [3,] "0"     "1"     "0.862 "     "0.439"  "0.265"  "-0.001"      "1.726"
 [4,] NA      "2"     "1.258 *"    "0.445"  "0.039"  "0.383"       "2.134"
 [5,] NA      "3"     "1.155 "     "0.468"  "0.094"  "0.235"       "2.075"
 [6,] NA      "4"     "0.000 "     "0.600"  "1.000"  "-1.181"      "1.181"
 [7,] "1"     "2"     "0.396 "     "0.175"  "0.148"  "0.052"       "0.740"
 [8,] NA      "3"     "0.292 "     "0.226"  "0.670"  "-0.153"      "0.737"
 [9,] NA      "4"     "-0.862 "    "0.439"  "0.265"  "-1.726"      "0.001"
[10,] "2"     "3"     "-0.104 "    "0.238"  "0.991"  "-0.572"      "0.364"
```

```
[11,] NA      "4"     "-1.258 *"   "0.445"  "0.039"  "-2.134"      "-0.383"
[12,] "3"     "4"     "-1.155 "    "0.468"  "0.094"  "-2.075"      "-0.235"
```

```
dataset = anova(data0$education,data0$well.being,tr_matrix_old=dataset)
```

```
[1] "diff  $data0well.being  by  $data0education"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""      "平方和" "自由度" "均方"  "F"     "显著性" NA
[2,] "组间" "13.246" "4"      "3.312" "4.240" "0.003"  NA
[3,] "组内" "68.730" "88"     "0.781" NA      NA       NA
[4,] "总计" "81.976" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "0.668"    "4"       "88"      "0.616"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:10] 1.0097 1.5583 1.1845 0.0833 0.5486 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ sigma       : Named num [1:10] 0.528 0.535 0.562 0.722 0.21 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ tstat       : Named num [1:10] 1.913 2.912 2.107 0.115 2.61 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ pvalues     : num [1:10] 0.2901 0.0307 0.2034 1 0.0672 ...
  ..- attr(*, "error")= num 0.000345
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0  1.00969    0.52773   1.913   0.2901
2 - 0 == 0  1.55833    0.53514   2.912   0.0307 *
3 - 0 == 0  1.18452    0.56225   2.107   0.2034
4 - 0 == 0  0.08333    0.72158   0.115   1.0000
2 - 1 == 0  0.54864    0.21023   2.610   0.0672 .
3 - 1 == 0  0.17483    0.27194   0.643   0.9630
4 - 1 == 0 -0.92636    0.52773  -1.755   0.3757
3 - 2 == 0 -0.37381    0.28604  -1.307   0.6606
4 - 2 == 0 -1.47500    0.53514  -2.756   0.0463 *
4 - 3 == 0 -1.10119    0.56225  -1.959   0.2680
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)
```

```
      [,1]    [,2]    [,3]         [,4]     [,5]     [,6]           [,7]
 [1,] ""      ""      ""           ""       ""       "95%置信区间" ""
 [2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"         "上限"
 [3,] "0"     "1"     "1.010 "     "0.528"  "0.290"  "-0.028"       "2.048"
 [4,] NA      "2"     "1.558 *"    "0.535"  "0.031"  "0.506"        "2.611"
 [5,] NA      "3"     "1.185 "     "0.562"  "0.203"  "0.079"        "2.290"
 [6,] NA      "4"     "0.083 "     "0.722"  "1.000"  "-1.336"       "1.503"
 [7,] "1"     "2"     "0.549 "     "0.210"  "0.067"  "0.135"        "0.962"
 [8,] NA      "3"     "0.175 "     "0.272"  "0.963"  "-0.360"       "0.710"
 [9,] NA      "4"     "-0.926 "    "0.528"  "0.376"  "-1.964"       "0.112"
[10,] "2"     "3"     "-0.374 "    "0.286"  "0.661"  "-0.936"       "0.189"
[11,] NA      "4"     "-1.475 *"   "0.535"  "0.046"  "-2.528"       "-0.422"
[12,] "3"     "4"     "-1.101 "    "0.562"  "0.268"  "-2.207"       "0.005"
```

```
dataset = anova(data0$natrue_enterprise,data0$job_effectiveness,tr_matrix_old=dataset)
```

```
[1] "diff  $data0job_effectiveness  by  $data0natrue_enterprise"
[1] "model"
     [,1]   [,2]     [,3]     [,4]     [,5]     [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"   "F"      "显著性" NA
[2,] "组间" "28.248" "2"      "14.124" "34.548" "0.000"  NA
[3,] "组内" "36.794" "90"     "0.409"  NA       NA       NA
[4,] "总计" "65.042" "92"     NA       NA       NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "0.437"    "2"       "90"      "0.647"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:3] -0.989 -1.51 -0.521
  ..- attr(*, "names")= chr [1:3] "1 - 0" "2 - 0" "2 - 1"
 $ sigma       : Named num [1:3] 0.15 0.199 0.185
  ..- attr(*, "names")= chr [1:3] "1 - 0" "2 - 0" "2 - 1"
 $ tstat       : Named num [1:3] -6.58 -7.58 -2.82
  ..- attr(*, "names")= chr [1:3] "1 - 0" "2 - 0" "2 - 1"
 $ pvalues     : num [1:3] 4.08e-09 4.17e-11 1.59e-02
  ..- attr(*, "error")= num 0.000406
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0  -0.9889     0.1504  -6.576   <0.001 ***
```

```
2 - 0 == 0  -1.5097     0.1991  -7.582   <0.001 ***
2 - 1 == 0  -0.5208     0.1846  -2.822   0.0159 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]    
[1,] ""      ""      ""           ""       ""       "95%置信区间" ""      
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"  
[3,] "0"     "1"     "-0.989 ***" "0.150"  "0.000"  "-1.285"      "-0.693"
[4,] NA      "2"     "-1.510 ***" "0.199"  "0.000"  "-1.901"      "-1.118"
[5,] "1"     "2"     "-0.521 *"   "0.185"  "0.016"  "-0.884"      "-0.158"
```

```
dataset = anova(data0$natrue_enterprise,data0$work.life_balance,tr_matrix_old=dataset)
```

```
[1] "diff  $data0work.life_balance  by  $data0natrue_enterprise"
[1] "model"
     [,1]   [,2]     [,3]     [,4]     [,5]     [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"   "F"      "显著性" NA  
[2,] "组间" "36.428" "2"      "18.214" "81.005" "0.000"  NA  
[3,] "组内" "20.237" "90"     "0.225"  NA       NA       NA  
[4,] "总计" "56.665" "92"     NA       NA       NA       NA  
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA  
[2,] "1.958"    "2"       "90"      "0.147"  NA   NA   NA  
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:3] -1.253 -1.56 -0.307
  ..- attr(*, "names")= chr [1:3] "1 - 0" "2 - 0" "2 - 1"
 $ sigma       : Named num [1:3] 0.112 0.148 0.137
  ..- attr(*, "names")= chr [1:3] "1 - 0" "2 - 0" "2 - 1"
 $ tstat       : Named num [1:3] -11.24 -10.57 -2.24
  ..- attr(*, "names")= chr [1:3] "1 - 0" "2 - 0" "2 - 1"
 $ pvalues     : num [1:3] 0 0 0.068
  ..- attr(*, "error")= num 0.000197
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)    
1 - 0 == 0  -1.2531     0.1115 -11.236   <0.001 ***
2 - 0 == 0  -1.5603     0.1477 -10.566   <0.001 ***
2 - 1 == 0  -0.3073     0.1369  -2.245    0.068 .  
```

```
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]    
[1,] ""      ""      ""           ""       ""       "95%置信区间" ""      
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"  
[3,] "0"     "1"     "-1.253 ***" "0.112"  "0.000"  "-1.472"      "-1.034"
[4,] NA      "2"     "-1.560 ***" "0.148"  "0.000"  "-1.851"      "-1.270"
[5,] "1"     "2"     "-0.307 "    "0.137"  "0.068"  "-0.577"      "-0.038"
```

```
dataset = anova(data0$natrue_enterprise,data0$well.being,tr_matrix_old=dataset)
```

```
[1] "diff  $data0well.being  by  $data0natrue_enterprise"
[1] "model"
     [,1]   [,2]     [,3]     [,4]     [,5]     [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"   "F"      "显著性" NA  
[2,] "组间" "49.969" "2"      "24.984" "70.253" "0.000"  NA  
[3,] "组内" "32.007" "90"     "0.356"  NA       NA       NA  
[4,] "总计" "81.976" "92"     NA       NA       NA       NA  
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA  
[2,] "2.746"    "2"       "90"      "0.070"  NA   NA   NA  
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)  
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)  
 $ coefficients: Named num [1:3] -1.248 -2.061 -0.813
  ..- attr(*, "names")= chr [1:3] "1 - 0" "2 - 0" "2 - 1"
 $ sigma       : Named num [1:3] 0.14 0.186 0.172
  ..- attr(*, "names")= chr [1:3] "1 - 0" "2 - 0" "2 - 1"
 $ tstat       : Named num [1:3] -8.9 -11.1 -4.72
  ..- attr(*, "names")= chr [1:3] "1 - 0" "2 - 0" "2 - 1"
 $ pvalues     : num [1:3] 4.75e-14 0.00 2.11e-05
  ..- attr(*, "error")= num 2.36e-06
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)    
1 - 0 == 0  -1.2484     0.1403  -8.901  < 1e-05 ***
2 - 0 == 0  -2.0609     0.1857 -11.097  < 1e-05 ***
2 - 1 == 0  -0.8125     0.1722  -4.720 2.11e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]          [,4]     [,5]     [,6]          [,7]
[1,] ""      ""      ""            ""       ""       "95%置信区间" ""
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"
[3,] "0"     "1"     "-1.248 ***" "0.140"  "0.000"  "-1.524"      "-0.973"
[4,] NA      "2"     "-2.061 ***" "0.186"  "0.000"  "-2.426"      "-1.696"
[5,] "1"     "2"     "-0.813 ***" "0.172"  "0.000"  "-1.151"      "-0.474"
```

```
dataset = anova(data0$type_work,data0$job_effectiveness,tr_matrix_old=dataset)
```

```
[1] "diff  $data0job_effectiveness  by  $data0type_work"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"     "显著性" NA
[2,] "组间" "7.168"  "3"      "2.389" "3.674" "0.015"  NA
[3,] "组内" "57.874" "89"     "0.650" NA      NA       NA
[4,] "总计" "65.042" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "0.369"    "3"       "89"      "0.776"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:6] 0.452 -0.075 -0.167 -0.527 -0.619 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ sigma       : Named num [1:6] 0.306 0.353 0.343 0.236 0.221 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ tstat       : Named num [1:6] 1.476 -0.212 -0.486 -2.23 -2.805 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ pvalues     : num [1:6] 0.4458 0.9964 0.9603 0.1179 0.0295 ...
  ..- attr(*, "error")= num 0.000342
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0  0.45192    0.30625   1.476   0.4458
2 - 0 == 0 -0.07500    0.35304  -0.212   0.9964
3 - 0 == 0 -0.16667    0.34265  -0.486   0.9603
2 - 1 == 0 -0.52692    0.23634  -2.230   0.1179
3 - 1 == 0 -0.61859    0.22052  -2.805   0.0295 *
3 - 2 == 0 -0.09167    0.28192  -0.325   0.9875
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]          [,4]     [,5]     [,6]          [,7]
[1,] ""      ""      ""            ""       ""       "95%置信区间" ""
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"
[3,] "0"     "1"     "0.452 "      "0.306"  "0.446"  "-0.150"      "1.054"
[4,] NA      "2"     "-0.075 "     "0.353"  "0.996"  "-0.769"      "0.619"
[5,] NA      "3"     "-0.167 "     "0.343"  "0.960"  "-0.841"      "0.507"
[6,] "1"     "2"     "-0.527 "     "0.236"  "0.118"  "-0.992"      "-0.062"
[7,] NA      "3"     "-0.619 *"    "0.221"  "0.030"  "-1.052"      "-0.185"
[8,] "2"     "3"     "-0.092 "     "0.282"  "0.988"  "-0.646"      "0.463"
```

```
dataset = anova(data0$type_work,data0$work.life_balance,tr_matrix_old=dataset)
```

```
[1] "diff  $data0work.life_balance  by  $data0type_work"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"     "显著性" NA
[2,] "组间" "8.859"  "3"      "2.953" "5.498" "0.002"  NA
[3,] "组内" "47.806" "89"     "0.537" NA      NA       NA
[4,] "总计" "56.665" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "0.620"    "3"       "89"      "0.604"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:6] 0.748 0.36 0.066 -0.387 -0.682 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ sigma       : Named num [1:6] 0.278 0.321 0.311 0.215 0.2 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ tstat       : Named num [1:6] 2.686 1.123 0.212 -1.803 -3.401 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ pvalues     : num [1:6] 0.03987 0.66707 0.99646 0.27003 0.00505 ...
  ..- attr(*, "error")= num 0.000453
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0  0.74760    0.27834   2.686  0.03987 *
2 - 0 == 0  0.36042    0.32086   1.123  0.66707
3 - 0 == 0  0.06597    0.31142   0.212  0.99646
```

```
2 - 1 == 0 -0.38718    0.21480  -1.803  0.27003
3 - 1 == 0 -0.68162    0.20043  -3.401  0.00505 **
3 - 2 == 0 -0.29444    0.25622  -1.149  0.65083
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]          [,4]     [,5]     [,6]          [,7]
[1,] ""      ""      ""            ""       ""       "95%置信区间" ""
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"         "上限"
[3,] "0"     "1"     "0.748 *"     "0.278"  "0.040"  "0.200"       "1.295"
[4,] NA      "2"     "0.360 "      "0.321"  "0.667"  "-0.271"      "0.991"
[5,] NA      "3"     "0.066 "      "0.311"  "0.996"  "-0.547"      "0.678"
[6,] "1"     "2"     "-0.387 "     "0.215"  "0.270"  "-0.810"      "0.035"
[7,] NA      "3"     "-0.682 **"   "0.200"  "0.005"  "-1.076"      "-0.287"
[8,] "2"     "3"     "-0.294 "     "0.256"  "0.651"  "-0.798"      "0.209"
```

```
dataset = anova(data0$type_work,data0$well.being,tr_matrix_old=dataset)
```

```
[1] "diff  $data0well.being  by  $data0type_work"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"     "显著性" NA
[2,] "组间" "13.471" "3"      "4.490" "5.834" "0.001"  NA
[3,] "组内" "68.505" "89"     "0.770" NA      NA       NA
[4,] "总计" "81.976" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "0.211"    "3"       "89"      "0.888"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:6] 0.558 -0.05 -0.361 -0.608 -0.919 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ sigma       : Named num [1:6] 0.333 0.384 0.373 0.257 0.24 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ tstat       : Named num [1:6] 1.674 -0.13 -0.969 -2.363 -3.83 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ pvalues     : num [1:6] 0.33372 0.99917 0.76009 0.08796 0.00112 ...
  ..- attr(*, "error")= num 0.000596
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
```

```
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0   0.5577     0.3332   1.674  0.33372
2 - 0 == 0  -0.0500     0.3841  -0.130  0.99917
3 - 0 == 0  -0.3611     0.3728  -0.969  0.76009
2 - 1 == 0  -0.6077     0.2571  -2.363  0.08796 .
3 - 1 == 0  -0.9188     0.2399  -3.830  0.00112 **
3 - 2 == 0  -0.3111     0.3067  -1.014  0.73348
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]
[1,] ""      ""      ""           ""       ""       "95%置信区间" ""
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"
[3,] "0"     "1"     "0.558 "     "0.333"  "0.334"  "-0.098"      "1.213"
[4,] NA      "2"     "-0.050 "    "0.384"  "0.999"  "-0.805"      "0.705"
[5,] NA      "3"     "-0.361 "    "0.373"  "0.760"  "-1.094"      "0.372"
[6,] "1"     "2"     "-0.608 "    "0.257"  "0.088"  "-1.113"      "-0.102"
[7,] NA      "3"     "-0.919 **"  "0.240"  "0.001"  "-1.391"      "-0.447"
[8,] "2"     "3"     "-0.311 "    "0.307"  "0.733"  "-0.914"      "0.292"
```

```
dataset = anova(data0$job_title_s_data,data0$job_effectiveness,tr_matrix_old=dataset)
```

```
[1] "diff  $data0job_effectiveness  by  $data0job_title_s_data"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"     "显著性" NA
[2,] "组间" "0.547"  "3"      "0.182" "0.251" "0.860"  NA
[3,] "组内" "64.495" "89"     "0.725" NA      NA       NA
[4,] "总计" "65.042" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "1.154"    "3"       "89"      "0.332"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:6] -0.1863 -0.6029 -0.1029 -0.4167 0.0833 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ sigma       : Named num [1:6] 0.36 0.856 0.856 0.919 0.919 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ tstat       : Named num [1:6] -0.518 -0.7042 -0.1202 -0.4532 0.0906 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ pvalues     : num [1:6] 0.949 0.883 0.999 0.965 1 ...
  ..- attr(*, "error")= num 1.7e-05
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts
```

```
Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0 -0.18627    0.35959  -0.518    0.949
2 - 0 == 0 -0.60294    0.85626  -0.704    0.883
3 - 0 == 0 -0.10294    0.85626  -0.120    0.999
2 - 1 == 0 -0.41667    0.91948  -0.453    0.965
3 - 1 == 0  0.08333    0.91948   0.091    1.000
3 - 2 == 0  0.50000    1.20388   0.415    0.972
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]
[1,] ""      ""      ""           ""       ""       "95%置信区间" ""
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"
[3,] "0"     "1"     "-0.186 "    "0.360"  "0.949"  "-0.894"      "0.521"
[4,] NA      "2"     "-0.603 "    "0.856"  "0.883"  "-2.287"      "1.081"
[5,] NA      "3"     "-0.103 "    "0.856"  "0.999"  "-1.787"      "1.581"
[6,] "1"     "2"     "-0.417 "    "0.919"  "0.965"  "-2.225"      "1.392"
[7,] NA      "3"     "0.083 "     "0.919"  "1.000"  "-1.725"      "1.892"
[8,] "2"     "3"     "0.500 "     "1.204"  "0.972"  "-1.868"      "2.868"
```

```
dataset = anova(data0$job_title_s_data,data0$work.life_balance,tr_matrix_old=dataset)
```

```
[1] "diff  $data0work.life_balance  by  $data0job_title_s_data"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"     "显著性" NA
[2,] "组间" "2.532"  "3"      "0.844" "1.388" "0.252"  NA
[3,] "组内" "54.133" "89"     "0.608" NA      NA       NA
[4,] "总计" "56.665" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "0.833"    "3"       "89"      "0.479"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:6] -0.4 -0.941 -0.941 -0.542 -0.542 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ sigma       : Named num [1:6] 0.329 0.784 0.784 0.842 0.842 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ tstat       : Named num [1:6] -1.213 -1.2 -1.2 -0.643 -0.643 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ pvalues     : num [1:6] 0.59 0.598 0.598 0.907 0.907 ...
  ..- attr(*, "error")= num 3.29e-05
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses
```

```
Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
             Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0 -3.995e-01  3.294e-01  -1.213    0.590
2 - 0 == 0 -9.412e-01  7.845e-01  -1.200    0.598
3 - 0 == 0 -9.412e-01  7.845e-01  -1.200    0.598
2 - 1 == 0 -5.417e-01  8.424e-01  -0.643    0.907
3 - 1 == 0 -5.417e-01  8.424e-01  -0.643    0.907
3 - 2 == 0  1.665e-15  1.103e+00   0.000    1.000
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]          [,4]     [,5]     [,6]          [,7]
[1,] ""      ""      ""            ""       ""       "95%置信区间" ""
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"
[3,] "0"     "1"     "-0.400 "     "0.329"  "0.590"  "-1.047"      "0.248"
[4,] NA      "2"     "-0.941 "     "0.784"  "0.598"  "-2.484"      "0.602"
[5,] NA      "3"     "-0.941 "     "0.784"  "0.598"  "-2.484"      "0.602"
[6,] "1"     "2"     "-0.542 "     "0.842"  "0.907"  "-2.198"      "1.115"
[7,] NA      "3"     "-0.542 "     "0.842"  "0.907"  "-2.198"      "1.115"
[8,] "2"     "3"     "0.000 "      "1.103"  "1.000"  "-2.169"      "2.169"
```

```
dataset = anova(data0$job_title_s_data,data0$well.being,tr_matrix_old=dataset)
```

```
[1] "diff  $data0well.being  by  $data0job_title_s_data"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"     "显著性" NA
[2,] "组间" "0.645"  "3"      "0.215" "0.235" "0.871"  NA
[3,] "组内" "81.330" "89"     "0.914" NA      NA       NA
[4,] "总计" "81.976" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "1.038"    "3"       "89"      "0.380"  NA   NA   NA
[1] "tukey_comparison"

Warning in RET$pfunction("adjusted", ...): lower == upper

List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:6] -0.173 -0.506 -0.506 -0.333 -0.333 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ sigma       : Named num [1:6] 0.404 0.962 0.962 1.033 1.033 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ tstat       : Named num [1:6] -0.427 -0.526 -0.526 -0.323 -0.323 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ pvalues     : num [1:6] 0.97 0.946 0.946 0.987 0.987 ...
  ..- attr(*, "error")= num 6.41e-06
 $ type        : chr "single-step"
```

```
 - attr(*, "class")= chr "mtest"

	 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0  -0.1725     0.4038  -0.427    0.970
2 - 0 == 0  -0.5059     0.9615  -0.526    0.946
3 - 0 == 0  -0.5059     0.9615  -0.526    0.946
2 - 1 == 0  -0.3333     1.0325  -0.323    0.987
3 - 1 == 0  -0.3333     1.0325  -0.323    0.987
3 - 2 == 0   0.0000     1.3519   0.000    1.000
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]         [,4]    [,5]    [,6]          [,7]
[1,] ""      ""      ""           ""      ""      "95%置信区间" ""
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"
[3,] "0"     "1"     "-0.173 "    "0.404" "0.970" "-0.967"      "0.622"
[4,] NA      "2"     "-0.506 "    "0.962" "0.946" "-2.397"      "1.385"
[5,] NA      "3"     "-0.506 "    "0.962" "0.946" "-2.397"      "1.385"
[6,] "1"     "2"     "-0.333 "    "1.033" "0.987" "-2.364"      "1.697"
[7,] NA      "3"     "-0.333 "    "1.033" "0.987" "-2.364"      "1.697"
[8,] "2"     "3"     "0.000 "     "1.352" "1.000" "-2.659"      "2.659"
```

```
dataset = anova(data0$work_experience,data0$job_effectiveness,tr_matrix_old=dataset)
```

```
[1] "diff  $data0job_effectiveness  by  $data0work_experience"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]     [,6]    [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"      "显著性" NA
[2,] "组间" "25.011" "3"      "8.337" "18.536" "0.000" NA
[3,] "组内" "40.031" "89"     "0.450" NA       NA      NA
[4,] "总计" "65.042" "92"     NA      NA       NA      NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "0.926"    "3"       "89"      "0.431"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:6] 1.417 2.325 1.988 0.908 0.571 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ sigma       : Named num [1:6] 0.4 0.406 0.427 0.157 0.205 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ tstat       : Named num [1:6] 3.54 5.73 4.66 5.77 2.79 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ pvalues     : num [1:6] 2.97e-03 4.17e-07 1.08e-04 3.73e-07 2.83e-02 ...
```

```
  ..- attr(*, "error")= num 0.000815
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0   1.4167     0.3996   3.545  0.00297 **
2 - 0 == 0   2.3250     0.4061   5.725  < 0.001 ***
3 - 0 == 0   1.9881     0.4267   4.659  < 0.001 ***
2 - 1 == 0   0.9083     0.1574   5.771  < 0.001 ***
3 - 1 == 0   0.5714     0.2047   2.791  0.02827 *
3 - 2 == 0  -0.3369     0.2171  -1.552  0.38918
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]
[1,] ""      ""      ""           ""       ""       "95%置信区间" ""
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"
[3,] "0"     "1"     "1.417 **"   "0.400"  "0.003"  "0.631"       "2.203"
[4,] NA      "2"     "2.325 ***"  "0.406"  "0.000"  "1.526"       "3.124"
[5,] NA      "3"     "1.988 ***"  "0.427"  "0.000"  "1.149"       "2.827"
[6,] "1"     "2"     "0.908 ***"  "0.157"  "0.000"  "0.599"       "1.218"
[7,] NA      "3"     "0.571 *"    "0.205"  "0.028"  "0.169"       "0.974"
[8,] "2"     "3"     "-0.337 "    "0.217"  "0.389"  "-0.764"      "0.090"
```

```
dataset = anova(data0$work_experience,data0$work.life_balance,tr_matrix_old=dataset)
```

```
[1] "diff  $data0work.life_balance  by  $data0work_experience"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"     "显著性" NA
[2,] "组间" "7.023"  "3"      "2.341" "4.197" "0.008"  NA
[3,] "组内" "49.643" "89"     "0.558" NA      NA       NA
[4,] "总计" "56.665" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "0.119"    "3"       "89"      "0.949"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:6] 0.806 1.258 1.155 0.452 0.349 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ sigma       : Named num [1:6] 0.445 0.452 0.475 0.175 0.228 ...
```

```
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ tstat      : Named num [1:6] 1.81 2.78 2.43 2.58 1.53 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ pvalues    : num [1:6] 0.2556 0.0293 0.0709 0.0493 0.4024 ...
  ..- attr(*, "error")= num 0.000974
 $ type       : chr "single-step"
 - attr(*, "class")= chr "mtest"

	 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)  
1 - 0 == 0   0.8062     0.4450   1.811   0.2556  
2 - 0 == 0   1.2583     0.4522   2.782   0.0293 *
3 - 0 == 0   1.1548     0.4752   2.430   0.0709 .
2 - 1 == 0   0.4522     0.1753   2.580   0.0493 *
3 - 1 == 0   0.3486     0.2280   1.529   0.4024  
3 - 2 == 0  -0.1036     0.2417  -0.428   0.9711  
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]    
[1,] ""      ""      ""           ""       ""       "95%置信区间" ""      
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"  
[3,] "0"     "1"     "0.806 "     "0.445"  "0.256"  "-0.069"      "1.681" 
[4,] NA      "2"     "1.258 *"    "0.452"  "0.029"  "0.369"       "2.148" 
[5,] NA      "3"     "1.155 "     "0.475"  "0.071"  "0.220"       "2.089" 
[6,] "1"     "2"     "0.452 *"    "0.175"  "0.049"  "0.107"       "0.797" 
[7,] NA      "3"     "0.349 "     "0.228"  "0.402"  "-0.100"      "0.797" 
[8,] "2"     "3"     "-0.104 "    "0.242"  "0.971"  "-0.579"      "0.372" 
```

```
dataset = anova(data0$work_experience,data0$well.being,tr_matrix_old=dataset)
```

```
[1] "diff  $data0well.being  by  $data0work_experience"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"     "显著性" NA  
[2,] "组间" "10.387" "3"      "3.462" "4.304" "0.007"  NA  
[3,] "组内" "71.589" "89"     "0.804" NA      NA       NA  
[4,] "总计" "81.976" "92"     NA      NA      NA       NA  
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA  
[2,] "0.776"    "3"       "89"      "0.510"  NA   NA   NA  
[1] "tukey_comparison"
List of 7
 $ pfunction  :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
```

```
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:6] 0.861 1.475 1.101 0.614 0.241 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ sigma       : Named num [1:6] 0.534 0.543 0.571 0.21 0.274 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ tstat       : Named num [1:6] 1.61 2.716 1.93 2.92 0.879 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ pvalues     : num [1:6] 0.3566 0.0347 0.2059 0.0202 0.8026 ...
  ..- attr(*, "error")= num 0.000881
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

	 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0   0.8605     0.5344   1.610   0.3566
2 - 0 == 0   1.4750     0.5431   2.716   0.0347 *
3 - 0 == 0   1.1012     0.5706   1.930   0.2059
2 - 1 == 0   0.6145     0.2105   2.920   0.0202 *
3 - 1 == 0   0.2407     0.2738   0.879   0.8026
3 - 2 == 0  -0.3738     0.2903  -1.288   0.5517
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]   
[1,] ""      ""      ""           ""       ""       "95%置信区间" ""     
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限" 
[3,] "0"     "1"     "0.861 "     "0.534"  "0.357"  "-0.191"      "1.912"
[4,] NA      "2"     "1.475 *"    "0.543"  "0.035"  "0.407"       "2.543"
[5,] NA      "3"     "1.101 "     "0.571"  "0.206"  "-0.021"      "2.223"
[6,] "1"     "2"     "0.614 *"    "0.210"  "0.020"  "0.201"       "1.028"
[7,] NA      "3"     "0.241 "     "0.274"  "0.803"  "-0.298"      "0.779"
[8,] "2"     "3"     "-0.374 "    "0.290"  "0.552"  "-0.945"      "0.197"
```

```
dataset = anova(data0$marital_status,data0$job_effectiveness,tr_matrix_old=dataset)
```

```
[1] "diff  $data0job_effectiveness  by  $data0marital_status"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"     "显著性" NA  
[2,] "组间" "11.549" "4"      "2.887" "4.750" "0.002"  NA  
[3,] "组内" "53.493" "88"     "0.608" NA      NA       NA  
[4,] "总计" "65.042" "92"     NA      NA      NA       NA  
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA  
```

```
[2,] "1.835"    "4"       "88"      "0.129"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:10] 0.479 0.788 0.926 0.426 0.309 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ sigma       : Named num [1:10] 0.257 0.194 0.314 0.418 0.242 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ tstat       : Named num [1:10] 1.87 4.06 2.95 1.02 1.28 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ pvalues     : num [1:10] 0.324078 0.000896 0.02929 0.834869 0.689899 ...
  ..- attr(*, "error")= num 0.000111
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0  0.47950    0.25678   1.867 0.324078
2 - 0 == 0  0.78843    0.19419   4.060 0.000896 ***
3 - 0 == 0  0.92593    0.31384   2.950 0.029290 *
4 - 0 == 0  0.42593    0.41771   1.020 0.834869
2 - 1 == 0  0.30893    0.24211   1.276 0.689899
3 - 1 == 0  0.44643    0.34555   1.292 0.679929
4 - 1 == 0 -0.05357    0.44203  -0.121 0.999945
3 - 2 == 0  0.13750    0.30196   0.455 0.990146
4 - 2 == 0 -0.36250    0.40886  -0.887 0.893571
4 - 3 == 0 -0.50000    0.47744  -1.047 0.821095
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)

      [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]
 [1,] ""      ""      ""           ""       ""       "95%置信区间" ""
 [2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"
 [3,] "0"     "1"     "0.479 "     "0.257"  "0.324"  "-0.026"      "0.985"
 [4,] NA      "2"     "0.788 ***"  "0.194"  "0.001"  "0.406"       "1.170"
 [5,] NA      "3"     "0.926 *"    "0.314"  "0.029"  "0.309"       "1.543"
 [6,] NA      "4"     "0.426 "     "0.418"  "0.835"  "-0.396"      "1.247"
 [7,] "1"     "2"     "0.309 "     "0.242"  "0.690"  "-0.167"      "0.785"
 [8,] NA      "3"     "0.446 "     "0.346"  "0.680"  "-0.233"      "1.126"
 [9,] NA      "4"     "-0.054 "    "0.442"  "1.000"  "-0.923"      "0.816"
[10,] "2"     "3"     "0.138 "     "0.302"  "0.990"  "-0.456"      "0.731"
[11,] NA      "4"     "-0.363 "    "0.409"  "0.894"  "-1.167"      "0.442"
[12,] "3"     "4"     "-0.500 "    "0.477"  "0.821"  "-1.439"      "0.439"
```

```
dataset = anova(data0$marital_status,data0$work.life_balance,tr_matrix_old=dataset)
```

```
[1] "diff  $data0work.life_balance  by  $data0marital_status"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"     "显著性" NA
[2,] "组间" "9.248"  "4"      "2.312" "4.291" "0.003"  NA
[3,] "组内" "47.417" "88"     "0.539" NA      NA       NA
[4,] "总计" "56.665" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "0.586"    "4"       "88"      "0.674"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:10] 0.476 0.74 0.659 0.315 0.264 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ sigma       : Named num [1:10] 0.242 0.183 0.295 0.393 0.228 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ tstat       : Named num [1:10] 1.97 4.05 2.23 0.8 1.16 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ pvalues     : num [1:10] 0.27354 0.00093 0.16613 0.92413 0.76006 ...
  ..- attr(*, "error")= num 8.19e-05
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0  0.47553    0.24175   1.967  0.27354
2 - 0 == 0  0.73981    0.18283   4.046  0.00093 ***
3 - 0 == 0  0.65856    0.29548   2.229  0.16613
4 - 0 == 0  0.31481    0.39327   0.800  0.92413
2 - 1 == 0  0.26429    0.22794   1.159  0.76006
3 - 1 == 0  0.18304    0.32533   0.563  0.97827
4 - 1 == 0 -0.16071    0.41617  -0.386  0.99475
3 - 2 == 0 -0.08125    0.28430  -0.286  0.99837
4 - 2 == 0 -0.42500    0.38494  -1.104  0.79110
4 - 3 == 0 -0.34375    0.44951  -0.765  0.93507
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)

      [,1]   [,2]   [,3]       [,4]    [,5]    [,6]            [,7]
 [1,] ""     ""     ""         ""      ""      "95%置信区间"   ""
```

```
 [2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"
 [3,] "0"     "1"     "0.476 "     "0.242" "0.274" "0.000"       "0.951"
 [4,] NA      "2"     "0.740 ***"  "0.183" "0.001" "0.380"       "1.099"
 [5,] NA      "3"     "0.659 "     "0.295" "0.166" "0.077"       "1.240"
 [6,] NA      "4"     "0.315 "     "0.393" "0.924" "-0.459"      "1.088"
 [7,] "1"     "2"     "0.264 "     "0.228" "0.760" "-0.184"      "0.713"
 [8,] NA      "3"     "0.183 "     "0.325" "0.978" "-0.457"      "0.823"
 [9,] NA      "4"     "-0.161 "    "0.416" "0.995" "-0.979"      "0.658"
[10,] "2"     "3"     "-0.081 "    "0.284" "0.998" "-0.640"      "0.478"
[11,] NA      "4"     "-0.425 "    "0.385" "0.791" "-1.182"      "0.332"
[12,] "3"     "4"     "-0.344 "    "0.450" "0.935" "-1.228"      "0.540"
```

```
dataset = anova(data0$marital_status,data0$well.being,tr_matrix_old=dataset)
```

```
[1] "diff  $data0well.being  by  $data0marital_status"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"     "显著性" NA
[2,] "组间" "16.836" "4"      "4.209" "5.686" "0.000"  NA
[3,] "组内" "65.139" "88"     "0.740" NA      NA       NA
[4,] "总计" "81.976" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "1.065"    "4"       "88"      "0.379"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:10] 0.575 0.992 0.83 0.236 0.417 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ sigma       : Named num [1:10] 0.283 0.214 0.346 0.461 0.267 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ tstat       : Named num [1:10] 2.031 4.631 2.396 0.512 1.561 ...
  ..- attr(*, "names")= chr [1:10] "1 - 0" "2 - 0" "3 - 0" "4 - 0" ...
 $ pvalues     : num [1:10] 0.244041 0.000102 0.116209 0.984655 0.506516 ...
  ..- attr(*, "error")= num 0.000135
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0   0.5754     0.2834   2.031 0.244041
2 - 0 == 0   0.9924     0.2143   4.631 0.000102 ***
3 - 0 == 0   0.8299     0.3463   2.396 0.116209
4 - 0 == 0   0.2361     0.4609   0.512 0.984655
```

```
2 - 1 == 0   0.4170     0.2672   1.561 0.506516
3 - 1 == 0   0.2545     0.3813   0.667 0.959661
4 - 1 == 0  -0.3393     0.4878  -0.696 0.953290
3 - 2 == 0  -0.1625     0.3332  -0.488 0.987236
4 - 2 == 0  -0.7563     0.4512  -1.676 0.433943
4 - 3 == 0  -0.5938     0.5269  -1.127 0.778477
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)

      [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]
 [1,] ""      ""      ""           ""       ""       "95%置信区间" ""
 [2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"
 [3,] "0"     "1"     "0.575 "     "0.283"  "0.244"  "0.018"       "1.133"
 [4,] NA      "2"     "0.992 ***"  "0.214"  "0.000"  "0.571"       "1.414"
 [5,] NA      "3"     "0.830 "     "0.346"  "0.116"  "0.149"       "1.511"
 [6,] NA      "4"     "0.236 "     "0.461"  "0.985"  "-0.670"      "1.143"
 [7,] "1"     "2"     "0.417 "     "0.267"  "0.507"  "-0.109"      "0.942"
 [8,] NA      "3"     "0.254 "     "0.381"  "0.960"  "-0.496"      "1.004"
 [9,] NA      "4"     "-0.339 "    "0.488"  "0.953"  "-1.299"      "0.620"
[10,] "2"     "3"     "-0.162 "    "0.333"  "0.987"  "-0.818"      "0.493"
[11,] NA      "4"     "-0.756 "    "0.451"  "0.434"  "-1.644"      "0.131"
[12,] "3"     "4"     "-0.594 "    "0.527"  "0.778"  "-1.630"      "0.442"
```

```
dataset = anova(data0$partners_work,data0$job_effectiveness,tr_matrix_old=dataset)
```

```
[1] "diff  $data0job_effectiveness  by  $data0partners_work"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"     "显著性" NA
[2,] "组间" "4.569"  "3"      "1.523" "2.241" "0.089"  NA
[3,] "组内" "60.473" "89"     "0.679" NA      NA       NA
[4,] "总计" "65.042" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "0.367"    "3"       "89"      "0.777"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:6] 1.065 0.315 0.165 -0.75 -0.9 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ sigma       : Named num [1:6] 0.489 0.186 0.385 0.498 0.602 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ tstat       : Named num [1:6] 2.178 1.695 0.428 -1.505 -1.495 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ pvalues     : num [1:6] 0.123 0.307 0.971 0.412 0.418 ...
  ..- attr(*, "error")= num 0.000517
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

     Simultaneous Tests for General Linear Hypotheses
```

```
Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0   1.0648     0.4890   2.178    0.123
2 - 0 == 0   0.3148     0.1857   1.695    0.307
3 - 0 == 0   0.1648     0.3853   0.428    0.971
2 - 1 == 0  -0.7500     0.4984  -1.505    0.412
3 - 1 == 0  -0.9000     0.6020  -1.495    0.418
3 - 2 == 0  -0.1500     0.3973  -0.378    0.979
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]
[1,] ""      ""      ""           ""       ""       "95%置信区间" ""
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限"
[3,] "0"     "1"     "1.065 "     "0.489"  "0.123"  "0.103"       "2.026"
[4,] NA      "2"     "0.315 "     "0.186"  "0.307"  "-0.051"      "0.680"
[5,] NA      "3"     "0.165 "     "0.385"  "0.971"  "-0.593"      "0.923"
[6,] "1"     "2"     "-0.750 "    "0.498"  "0.412"  "-1.730"      "0.230"
[7,] NA      "3"     "-0.900 "    "0.602"  "0.418"  "-2.084"      "0.284"
[8,] "2"     "3"     "-0.150 "    "0.397"  "0.979"  "-0.931"      "0.631"
```

```
dataset = anova(data0$partners_work,data0$work.life_balance,tr_matrix_old=dataset)
```

```
[1] "diff  $data0work.life_balance  by  $data0partners_work"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"     "显著性" NA
[2,] "组间" "5.662"  "3"      "1.887" "3.294" "0.024"  NA
[3,] "组内" "51.003" "89"     "0.573" NA      NA       NA
[4,] "总计" "56.665" "92"     NA      NA      NA       NA
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA
[2,] "2.057"    "3"       "89"      "0.112"  NA   NA   NA
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)
 $ coefficients: Named num [1:6] 1.1019 0.3814 0.0185 -0.7204 -1.0833 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ sigma       : Named num [1:6] 0.449 0.171 0.354 0.458 0.553 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ tstat       : Named num [1:6] 2.4538 2.236 0.0523 -1.574 -1.9596 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ pvalues     : num [1:6] 0.0657 0.1081 0.9999 0.372 0.1916 ...
  ..- attr(*, "error")= num 0.000923
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"
```

```
	 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)  
1 - 0 == 0  1.10185    0.44904   2.454   0.0657 .
2 - 0 == 0  0.38142    0.17058   2.236   0.1081  
3 - 0 == 0  0.01852    0.35387   0.052   0.9999  
2 - 1 == 0 -0.72043    0.45772  -1.574   0.3720  
3 - 1 == 0 -1.08333    0.55284  -1.960   0.1916  
3 - 2 == 0 -0.36290    0.36483  -0.995   0.7328  
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]          [,4]     [,5]     [,6]           [,7]    
[1,] ""      ""      ""            ""       ""       "95%置信区间"  ""      
[2,] "group" "group" "平均值差值"  "标准差" "显著性" "下限"         "上限"  
[3,] "0"     "1"     "1.102 "      "0.449"  "0.066"  "0.219"        "1.985" 
[4,] NA      "2"     "0.381 "      "0.171"  "0.108"  "0.046"        "0.717" 
[5,] NA      "3"     "0.019 "      "0.354"  "1.000"  "-0.677"       "0.715" 
[6,] "1"     "2"     "-0.720 "     "0.458"  "0.372"  "-1.621"       "0.180" 
[7,] NA      "3"     "-1.083 "     "0.553"  "0.192"  "-2.171"       "0.004" 
[8,] "2"     "3"     "-0.363 "     "0.365"  "0.733"  "-1.080"       "0.355" 
```

```r
dataset = anova(data0$partners_work,data0$well.being,tr_matrix_old=dataset)
```

```
[1] "diff  $data0well.being  by  $data0partners_work"
[1] "model"
     [,1]   [,2]     [,3]     [,4]    [,5]    [,6]     [,7]
[1,] ""     "平方和" "自由度" "均方"  "F"     "显著性" NA  
[2,] "组间" "8.226"  "3"      "2.742" "3.309" "0.024"  NA  
[3,] "组内" "73.750" "89"     "0.829" NA      NA       NA  
[4,] "总计" "81.976" "92"     NA      NA      NA       NA  
[1] "leveneTest_result"
     [,1]       [,2]      [,3]      [,4]     [,5] [,6] [,7]
[1,] "莱文统计" "自由度1" "自由度2" "显著性" NA   NA   NA  
[2,] "0.466"    "3"       "89"      "0.707"  NA   NA   NA  
[1] "tukey_comparison"
List of 7
 $ pfunction   :function (type = c("univariate", "adjusted", p.adjust.methods), ...)  
 $ qfunction   :function (conf.level, adjusted = TRUE, ...)  
 $ coefficients: Named num [1:6] 1.31 0.477 0.177 -0.833 -1.133 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ sigma       : Named num [1:6] 0.54 0.205 0.426 0.55 0.665 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
 $ tstat       : Named num [1:6] 2.426 2.325 0.416 -1.514 -1.705 ...
  ..- attr(*, "names")= chr [1:6] "1 - 0" "2 - 0" "3 - 0" "2 - 1" ...
```

```
 $ pvalues     : num [1:6] 0.0701 0.0887 0.973 0.4062 0.3021 ...
  ..- attr(*, "error")= num 0.000518
 $ type        : chr "single-step"
 - attr(*, "class")= chr "mtest"

	 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)  
1 - 0 == 0   1.3102     0.5400   2.426   0.0701 .
2 - 0 == 0   0.4769     0.2051   2.325   0.0887 .
3 - 0 == 0   0.1769     0.4255   0.416   0.9730  
2 - 1 == 0  -0.8333     0.5504  -1.514   0.4062  
3 - 1 == 0  -1.1333     0.6648  -1.705   0.3021  
3 - 2 == 0  -0.3000     0.4387  -0.684   0.8934  
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)

     [,1]    [,2]    [,3]         [,4]     [,5]     [,6]          [,7]   
[1,] ""      ""      ""           ""       ""       "95%置信区间" ""     
[2,] "group" "group" "平均值差值" "标准差" "显著性" "下限"        "上限" 
[3,] "0"     "1"     "1.310 "     "0.540"  "0.070"  "0.248"       "2.372"
[4,] NA      "2"     "0.477 "     "0.205"  "0.089"  "0.073"       "0.880"
[5,] NA      "3"     "0.177 "     "0.426"  "0.973"  "-0.660"      "1.014"
[6,] "1"     "2"     "-0.833 "    "0.550"  "0.406"  "-1.916"      "0.249"
[7,] NA      "3"     "-1.133 "    "0.665"  "0.302"  "-2.441"      "0.174"
[8,] "2"     "3"     "-0.300 "    "0.439"  "0.893"  "-1.163"      "0.563"
```

```r
saveExcel(dataset,"ANOVA")
rm(anova)
```

TWO-WAY ANOVA 双因素方差分析步骤

LSD.test and Bonferroni, duncan.test

```r
library(car)
library(multcomp)
library(knitr)
library(xtable)
library(agricolae)
library(multcomp)
library(multcompView)
library(emmeans)
## 按性别分析因变量
x0 <- factor( as.character(data0$age) )
x1 <- factor( as.character(data0$gender) )
y <- data0$job_effectiveness
```

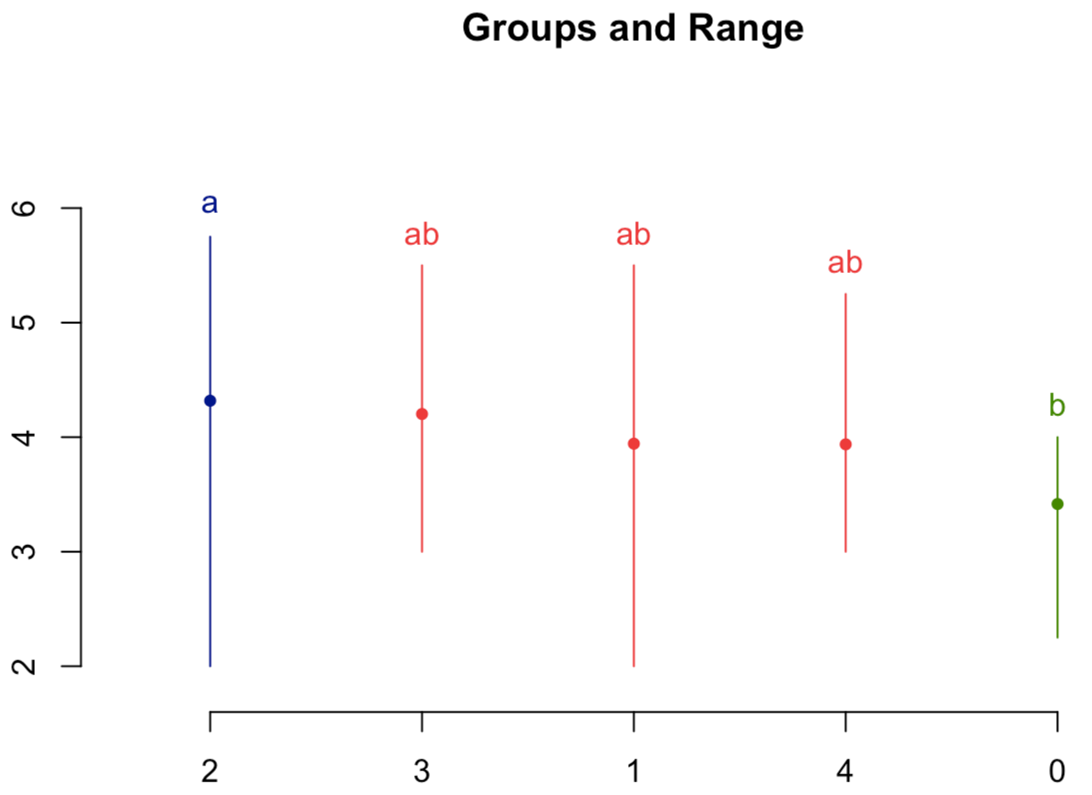
```
data = data.frame(x0,x1,y)
model <- aov(y ~ x0 * x1, data=data)
model <- aov(y ~ x0 * x1, data=data)
data_1 = data.frame(x0=data0$age,x1=data0$gender,y=data0$job_effectiveness)
model_1 <- aov(y ~ x0 * x1, data=data_1)

# 如果ANOVA拒绝原假设，执行Fisher's LSD
#if (summary(model)$'Pr(>F)'[1] < 0.05) {
  print("~~~~~~~ LSD.test")
```

```
[1] "~~~~~~~ LSD.test"
```

```
  pairwise_results <- LSD.test(model_1, "x0", p.adj="bonferroni") #bonferroni#对p值进行
  pairwise_results
```

```
$statistics
    MSerror Df     Mean       CV
  0.6866993 89 4.083333 20.29404

$parameters
        test  p.ajusted name.t ntr alpha
  Fisher-LSD bonferroni     x0   5  0.05

$means
         y       std  r        se      LCL      UCL  Min  Max    Q25 Q50   Q75
0 3.416667 0.6373774  9 0.2762244 2.867815 3.965519 2.25 4.00 3.0000 3.5 4.000
1 3.943182 0.8861763 22 0.1766737 3.592135 4.294229 2.00 5.50 3.0625 4.0 4.500
2 4.318182 0.8552977 33 0.1442535 4.031553 4.604810 2.00 5.75 4.0000 4.5 5.000
3 4.202381 0.7608344 21 0.1808313 3.843073 4.561689 3.00 5.50 3.7500 4.0 4.750
4 3.937500 0.7165144  8 0.2929802 3.355355 4.519645 3.00 5.25 3.4375 4.0 4.125

$comparison
NULL

$groups
         y groups
2 4.318182      a
3 4.202381     ab
1 3.943182     ab
4 3.937500     ab
0 3.416667      b

attr(,"class")
[1] "group"
```

```
  plot(pairwise_results)
```




```
print("~~~~~~~")
```

```
[1] "~~~~~~~"
```

```
#}

leveneTest_result = leveneTest(model)
# 进行图基事后比较
tukey_comparison0 <- glht(model, linfct = mcp(x0 = "Tukey"))
```

```
Warning in mcp2matrix(model, linfct = linfct): covariate interactions found --
default contrast might be inappropriate
```

```
tukey_comparison1 <- glht(model, linfct = mcp(x1 = "Tukey"))
```

```
Warning in mcp2matrix(model, linfct = linfct): covariate interactions found --
default contrast might be inappropriate
```

```
tuk <- TukeyHSD(model)
duncan <- duncan.test(model,'x0')

# 进行邓尼特事后比较，其中"control"是对照组
#dunnett_comparison <- glht(model, linfct = mcp(x = "Dunnett"))
#xtable(summary(model), type = "html", digits = 2, width = "600px", include.rownames =
```

```r
#kable(summary(model), format = "html")
summary(model)
```

```
            Df Sum Sq Mean Sq F value Pr(>F)
x0           4   6.72  1.6800   2.443  0.053 .
x1           1   1.14  1.1355   1.651  0.202
x0:x1        4   0.11  0.0275   0.040  0.997
Residuals   83  57.08  0.6877
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
summary(leveneTest_result)
```

```
       Df          F value           Pr(>F)
 Min.   : 9.0   Min.   :0.9691   Min.   :0.4715
 1st Qu.:27.5   1st Qu.:0.9691   1st Qu.:0.4715
 Median :46.0   Median :0.9691   Median :0.4715
 Mean   :46.0   Mean   :0.9691   Mean   :0.4715
 3rd Qu.:64.5   3rd Qu.:0.9691   3rd Qu.:0.4715
 Max.   :83.0   Max.   :0.9691   Max.   :0.4715
                NA's   :1        NA's   :1
```

```r
summary(tukey_comparison0)
```

```

	 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: aov(formula = y ~ x0 * x1, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0   0.5000     0.4414   1.133    0.779
2 - 0 == 0   0.9125     0.4146   2.201    0.179
3 - 0 == 0   0.8077     0.4364   1.851    0.338
4 - 0 == 0   0.6667     0.6056   1.101    0.796
2 - 1 == 0   0.4125     0.3028   1.362    0.640
3 - 1 == 0   0.3077     0.3320   0.927    0.879
4 - 1 == 0   0.1667     0.5353   0.311    0.998
3 - 2 == 0  -0.1048     0.2954  -0.355    0.996
4 - 2 == 0  -0.2458     0.5134  -0.479    0.988
4 - 3 == 0  -0.1410     0.5311  -0.266    0.999
(Adjusted p values reported -- single-step method)
```

```r
summary(tukey_comparison1)
```

```

	 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts
```

```
Fit: aov(formula = y ~ x0 * x1, data = data)

Linear Hypotheses:
           Estimate Std. Error t value Pr(>|t|)
1 - 0 == 0  -0.1875     0.5563  -0.337    0.737
(Adjusted p values reported -- single-step method)
```

```
summary(tuk)
```

```
      Length Class  Mode
x0     40    -none- numeric
x1      4    -none- numeric
x0:x1 180    -none- numeric
```

```
duncan
```

```
$statistics
    MSerror Df     Mean       CV
  0.6876646 83 4.083333 20.3083

$parameters
    test name.t ntr alpha
  Duncan     x0   5  0.05

$duncan
NULL

$means
         y       std  r        se  Min  Max    Q25 Q50   Q75
0 3.416667 0.6373774  9 0.2764185 2.25 4.00 3.0000 3.5 4.000
1 3.943182 0.8861763 22 0.1767979 2.00 5.50 3.0625 4.0 4.500
2 4.318182 0.8552977 33 0.1443548 2.00 5.75 4.0000 4.5 5.000
3 4.202381 0.7608344 21 0.1809584 3.00 5.50 3.7500 4.0 4.750
4 3.937500 0.7165144  8 0.2931861 3.00 5.25 3.4375 4.0 4.125

$comparison
NULL

$groups
         y groups
2 4.318182      a
3 4.202381      a
1 3.943182     ab
4 3.937500     ab
0 3.416667      b

attr(,"class")
[1] "group"
```

```
#multcomp_plot(tukey_comparison)
```

```
#summary(dunnett_comparison)
```

相关性分析

Pearson(皮尔逊)相关系数

```
library(corrplot)
```

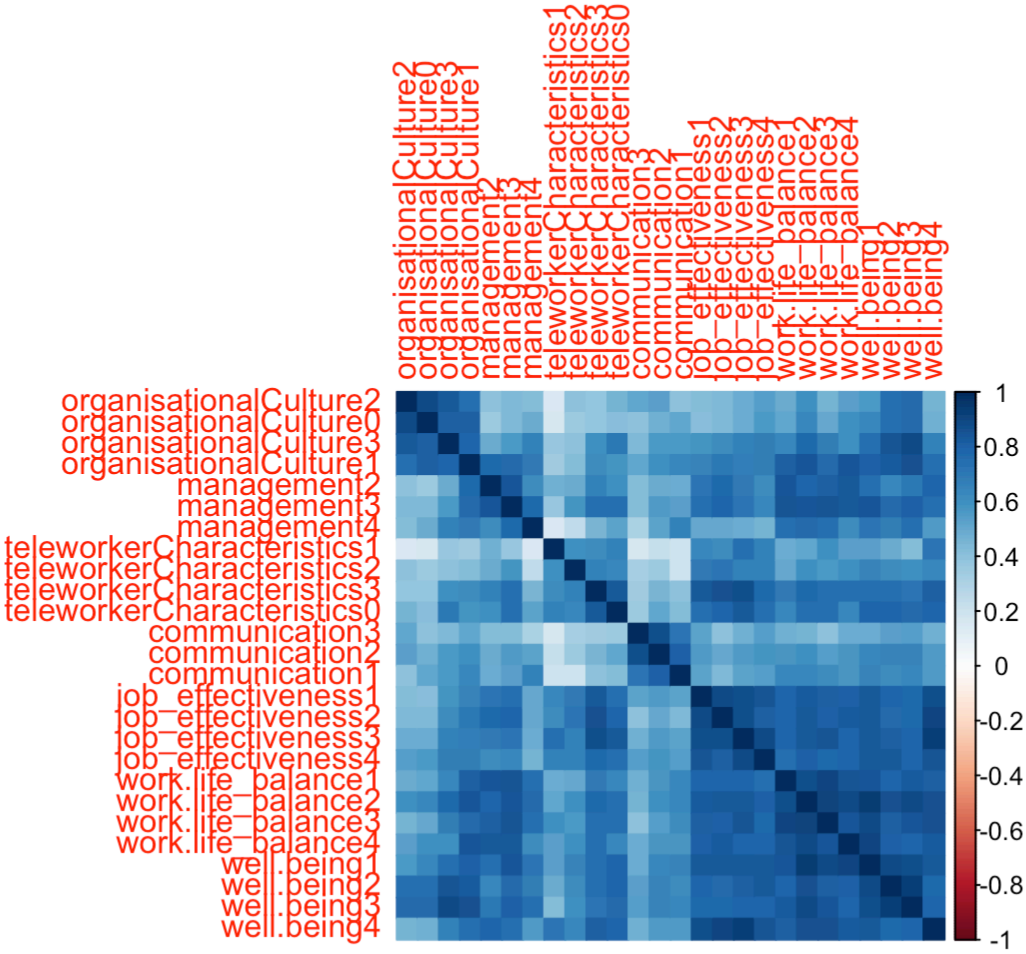
```
corrplot 0.92 loaded
```

```
getCol <-function(data){
  correlation_result0 <- corr.test(data)
  r_value = correlation_result0$r
  p_value = correlation_result0$p
  # 使用 for 循环遍历矩阵
  for (i in 1:nrow(p_value)) {
    for (j in 1:ncol(p_value)) {
      # 访问矩阵元素
      #保留上3角
      if(i>1&&j<i){
        r_value[i, j] = NA
        next
      }
      c = ""
      if( p_value[i,j]<0.001){
        c="***"
      }else if( p_value[i,j]<0.01){
        c="**"
      }else if( p_value[i,j]<0.05){
        c="*"
      }
      r_value[i, j]=format(as.numeric(r_value[i, j]), digits = 3)
      #r_value[i, j]=round(as.numeric(r_value[i, j]),3)
      #r_value[i, j]=paste(as.character(r_value[i, j]),c)
      r_value[i, j]=paste(r_value[i, j],c)
    }
  }

  return(r_value)
}
data <- data0[c(cols_independent,cols_dependent)]
r_value = getCol(data)
kable(r_value)
```

	organisationalCulture2	organisationalCulture0	organisationalCulture3	organi
organisationalCulture2	1 ***	0.889 ***	0.839 ***	0.755 *
organisationalCulture0	NA	1 ***	0.816 ***	0.813 *
organisationalCulture3	NA	NA	1 ***	0.798 *
organisationalCulture1	NA	NA	NA	1 ***

	organisationalCulture2	organisationalCulture0	organisationalCulture3	organi
management2	NA	NA	NA	NA
management3	NA	NA	NA	NA
management4	NA	NA	NA	NA
teleworkerCharacteristics1	NA	NA	NA	NA
teleworkerCharacteristics2	NA	NA	NA	NA
teleworkerCharacteristics3	NA	NA	NA	NA
teleworkerCharacteristics0	NA	NA	NA	NA
communication3	NA	NA	NA	NA
communication2	NA	NA	NA	NA
communication1	NA	NA	NA	NA
job_effectiveness1	NA	NA	NA	NA
job_effectiveness2	NA	NA	NA	NA
job_effectiveness3	NA	NA	NA	NA
job_effectiveness4	NA	NA	NA	NA
work.life_balance1	NA	NA	NA	NA
work.life_balance2	NA	NA	NA	NA
work.life_balance3	NA	NA	NA	NA
work.life_balance4	NA	NA	NA	NA
well.being1	NA	NA	NA	NA
well.being2	NA	NA	NA	NA
well.being3	NA	NA	NA	NA
well.being4	NA	NA	NA	NA

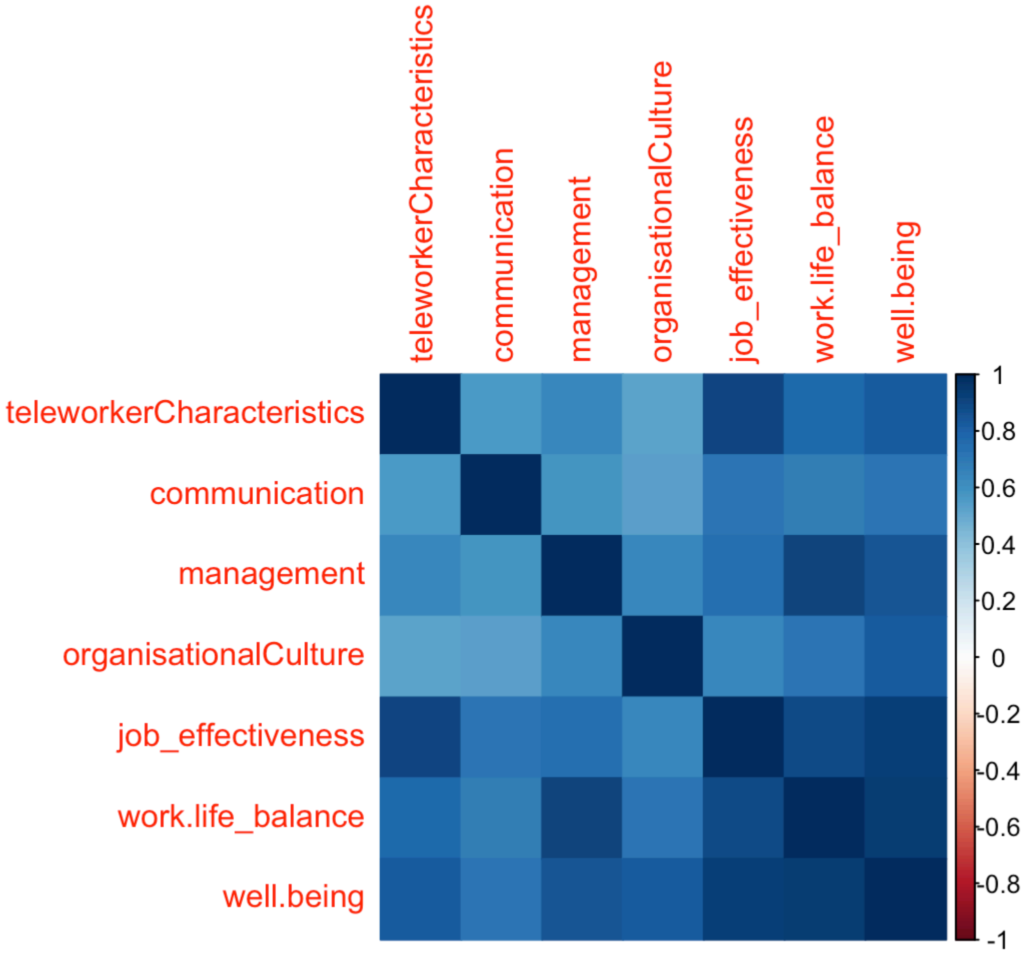
```r
correlation_result0 = cor(data)
corrplot(correlation_result0, method = "color")
```




```
saveExcel(r_value,"correlation Pearson")

data <- data0[all_var_calculated]
r_value = getCol(data)
kable(r_value)
```

	teleworkerCharacteristics	communication	management	organisationalCulture
teleworkerCharacteristics	1 ***	0.561 ***	0.639 ***	0.522 ***
communication	NA	1 ***	0.586 ***	0.534 ***
management	NA	NA	1 ***	0.639 ***
organisationalCulture	NA	NA	NA	1 ***
job_effectiveness	NA	NA	NA	NA
work.life_balance	NA	NA	NA	NA
well.being	NA	NA	NA	NA

```
correlation_result0 = cor(data)
corrplot(correlation_result0, method = "color")
```




```
saveExcel(r_value,"correlation Pearson2")
#data <- data0[cols_dependent]
#r_value = getCol(data)
#kable(r_value)
#correlation_result1 = cor(data)
#corrplot(correlation_result1, method = "color")
```

回归分析

一元回归分析

略... ## 多元回归分析 VIF 共线性诊断 Durbin-Watson (DW): 容差值（Tolerance）是VIF的倒数，即 Tolerance = 1/VIF Durbin-Watson (DW): 在“2”附近☰不存在序列相关，非伪回归方程; • 小于“2”存在正自相关; • 大于“2”存在负自相关

```
library(ggplot2)
library(car)
library(lmtest)
```

```
Loading required package: zoo
```

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

```
The following objects are masked from 'package:base':

    as.Date, as.Date.numeric
```

```
#environment, jobCharacteristics, teleworkerCharacteristics, communication, management
#job_effectiveness, work.life_balance, well.being
#"environment","jobCharacteristics","teleworkerCharacteristics","communication","manag
#data = data0[, c("environment","jobCharacteristics","teleworkerCharacteristics","comm
data = data0[, c("teleworkerCharacteristics","communication","management","organisatio
mylm<-function(...,data=NULL){
  # 因变 ~ 自变量1 + 自变量2 + ... ,
  #model <- lm(work.life_balance ~ teleworkerCharacteristics + communication + managem
  model <- lm(..., data = data)
  # 查看模型摘要，获取回归系数、标准误、t值和p值等信息
  sum = summary(model)
  print(sum)
  #result = cor(data) #变量间如果相关性为1,则不能进行vif验证
  #print(result)
  vif = vif(model)
  #容差值（Tolerance）是VIF的倒数，即Tolerance = 1/VIF
  Tolerance = 1/vif
  print(vif)
  print(Tolerance)
  # Durbin-Watson (DW): 德宾沃森
  dw_test <- dwtest(model)
  print(dw_test)
  #coef(model)
  #predict(model)
  AIC(model)
  BIC(model)
  #plot(model$resid)
  # 输出模型的详细结果
  print(model)
  # 预测新数据点的mpg值
  # 假设我们有一个新的数据点，马力为120，车重为3
  #newdata <- data.frame(environment = 5.2, jobCharacteristics = 6)
  #predictions <- predict(model, newdata)
  #print(predictions)
  # 绘制回归拟合线
  # 首先，安装并加载所需的绘图包
  # 创建散点图并添加拟合线
  #ggplot(mtcars, aes(x = environment, y = job_effectiveness, color = factor(cyl))) +
  #  geom_point() +
  #  geom_smooth(method = lm, se = FALSE, formula = job_effectiveness ~ environment) +
  #  labs(title = "Regression of mpg on hp", x = "Horsepower", y = "Miles/(US) gallon"
}
```

```
mylm(work.life_balance ~ teleworkerCharacteristics + communication + management + orga
```

```
Call:
lm(formula = ..1, data = data)
```

```
Residuals:
     Min       1Q   Median       3Q      Max 
-0.65736 -0.13461 -0.01356  0.11863  0.52079 

Coefficients:
                          Estimate Std. Error t value Pr(>|t|)    
(Intercept)                0.69842    0.12330   5.664 1.83e-07 ***
teleworkerCharacteristics  0.21022    0.03445   6.102 2.75e-08 ***
communication              0.11732    0.03723   3.151  0.00222 ** 
management                 0.40776    0.03077  13.252  < 2e-16 ***
organisationalCulture      0.08599    0.02089   4.116 8.65e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2194 on 88 degrees of freedom
Multiple R-squared:  0.9252,	Adjusted R-squared:  0.9218 
F-statistic: 272.2 on 4 and 88 DF,  p-value: < 2.2e-16

teleworkerCharacteristics             communication                management 
                 1.884931                  1.750454                  2.288005 
    organisationalCulture 
                 1.839745 
teleworkerCharacteristics             communication                management 
                0.5305233                 0.5712803                 0.4370619 
    organisationalCulture 
                0.5435536 

	Durbin-Watson test

data:  model
DW = 2.0762, p-value = 0.6304
alternative hypothesis: true autocorrelation is greater than 0


Call:
lm(formula = ..1, data = data)

Coefficients:
              (Intercept)  teleworkerCharacteristics  
                  0.69842                    0.21022  
            communication                 management  
                  0.11732                    0.40776  
    organisationalCulture  
                  0.08599  
```

```r
mylm(job_effectiveness ~ teleworkerCharacteristics + communication + management + orga
```

```
Call:
lm(formula = ..1, data = data)

Residuals:
     Min       1Q   Median       3Q      Max 
```

```
-0.63471 -0.13687  0.01613  0.14390  0.57467

Coefficients:
                           Estimate Std. Error t value Pr(>|t|)    
(Intercept)                 0.33096    0.14615   2.265  0.02600 *  
teleworkerCharacteristics   0.58346    0.04084  14.287  < 2e-16 ***
communication               0.24359    0.04413   5.520 3.39e-07 ***
management                  0.10474    0.03647   2.872  0.00511 ** 
organisationalCulture       0.05452    0.02476   2.202  0.03029 *  
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2601 on 88 degrees of freedom
Multiple R-squared:  0.9085,	Adjusted R-squared:  0.9043 
F-statistic: 218.4 on 4 and 88 DF,  p-value: < 2.2e-16

teleworkerCharacteristics             communication                management 
                 1.884931                  1.750454                  2.288005 
    organisationalCulture 
                 1.839745 
teleworkerCharacteristics             communication                management 
                0.5305233                 0.5712803                 0.4370619 
    organisationalCulture 
                0.5435536 

	Durbin-Watson test

data:  model
DW = 1.7299, p-value = 0.08962
alternative hypothesis: true autocorrelation is greater than 0


Call:
lm(formula = ..1, data = data)

Coefficients:
              (Intercept)  teleworkerCharacteristics  
                  0.33096                    0.58346  
            communication                 management  
                  0.24359                    0.10474  
    organisationalCulture  
                  0.05452  
```

```
mylm(well.being ~ teleworkerCharacteristics + communication + management + organisatio
```

```
Call:
lm(formula = ..1, data = data)

Residuals:
     Min       1Q   Median       3Q      Max 
-0.59375 -0.10624 -0.01171  0.10151  0.42853 
```

```
Coefficients:
                          Estimate Std. Error t value Pr(>|t|)    
(Intercept)               -0.01850    0.09900  -0.187    0.852    
teleworkerCharacteristics  0.37731    0.02766  13.640  < 2e-16 ***
communication              0.17162    0.02989   5.741 1.32e-07 ***
management                 0.25245    0.02470  10.219  < 2e-16 ***
organisationalCulture      0.23158    0.01677  13.808  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1762 on 88 degrees of freedom
Multiple R-squared:  0.9667,	Adjusted R-squared:  0.9652 
F-statistic: 638.3 on 4 and 88 DF,  p-value: < 2.2e-16

teleworkerCharacteristics             communication                management 
                 1.884931                  1.750454                  2.288005 
    organisationalCulture 
                 1.839745 
teleworkerCharacteristics             communication                management 
                0.5305233                 0.5712803                 0.4370619 
    organisationalCulture 
                0.5435536 

	Durbin-Watson test

data:  model
DW = 1.9892, p-value = 0.4782
alternative hypothesis: true autocorrelation is greater than 0


Call:
lm(formula = ..1, data = data)

Coefficients:
              (Intercept)  teleworkerCharacteristics  
                  -0.0185                     0.3773  
            communication                 management  
                   0.1716                     0.2525  
    organisationalCulture  
                   0.2316  
```

```
#mylm(work.life_balance ~ teleworkerCharacteristics + communication + management ,data
#mylm(work.life_balance ~ teleworkerCharacteristics + communication + organisationalCu
#mylm(work.life_balance ~ teleworkerCharacteristics  + management + organisationalCult
#mylm(work.life_balance ~ communication + management + organisationalCulture,data=data
```

多元回归可始化

```
library(plotly)
```

```
Attaching package: 'plotly'
```

```
The following object is masked from 'package:ggplot2':

    last_plot

The following objects are masked from 'package:memisc':

    rename, style

The following object is masked from 'package:MASS':

    select

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

    filter

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

    layout
```

```
library(reshape2)
library(tidyverse)
```

```
── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0 ──
✔ dplyr     1.1.4     ✔ readr     2.1.5
✔ forcats   1.0.0     ✔ stringr   1.5.1
✔ lubridate 1.9.3     ✔ tibble    3.2.1
✔ purrr     1.0.2     ✔ tidyr     1.3.1

── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
✖ purrr::%@%()             masks memisc::%@%()
✖ ggplot2::%+%()           masks psych::%+%()
✖ ggplot2::alpha()         masks psych::alpha()
✖ lubridate::as.interval() masks memisc::as.interval()
✖ dplyr::collect()         masks memisc::collect()
✖ dplyr::filter()          masks plotly::filter(), stats::filter()
✖ lubridate::is.interval() masks memisc::is.interval()
✖ dplyr::lag()             masks stats::lag()
✖ dplyr::recode()          masks car::recode(), memisc::recode()
✖ dplyr::rename()          masks plotly::rename(), memisc::rename()
✖ dplyr::select()          masks plotly::select(), MASS::select()
✖ purrr::some()            masks car::some()
✖ dplyr::syms()            masks ggplot2::syms(), memisc::syms()
✖ tibble::view()           masks memisc::view()
ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts
to become errors
```

```
library(tidymodels)
```

```
Registered S3 method overwritten by 'parsnip':
  method          from
  autoplot.glmnet ggfortify
── Attaching packages ────────────────────────────────────── tidymodels 1.1.1 ──
```

```
✔ broom        1.0.5     ✔ rsample      1.2.0
✔ dials        1.2.1     ✔ tune         1.1.2
✔ infer        1.0.6     ✔ workflows    1.1.4
✔ modeldata    1.3.0     ✔ workflowsets 1.0.1
✔ parsnip      1.2.0     ✔ yardstick    1.3.0
✔ recipes      1.0.10
── Conflicts ───────────────────────────────────────── tidymodels_conflicts() ──
✖ purrr::%@%()      masks memisc::%@%()
✖ ggplot2::%+%()    masks psych::%+%()
✖ scales::alpha()   masks ggplot2::alpha(), psych::alpha()
✖ dplyr::collect()  masks memisc::collect()
✖ scales::discard() masks purrr::discard()
✖ dplyr::filter()   masks plotly::filter(), stats::filter()
✖ recipes::fixed()  masks stringr::fixed()
✖ dplyr::lag()      masks stats::lag()
✖ dplyr::recode()   masks car::recode(), memisc::recode()
✖ dplyr::rename()   masks plotly::rename(), memisc::rename()
✖ dplyr::select()   masks plotly::select(), MASS::select()
✖ purrr::some()     masks car::some()
✖ yardstick::spec() masks readr::spec()
✖ recipes::step()   masks stats::step()
✖ dplyr::syms()     masks ggplot2::syms(), memisc::syms()
✖ tibble::view()    masks memisc::view()
• Use tidymodels_prefer() to resolve common conflicts.
```

```
library(plotly)
#install.packages("kernlab")
library(kernlab)
```

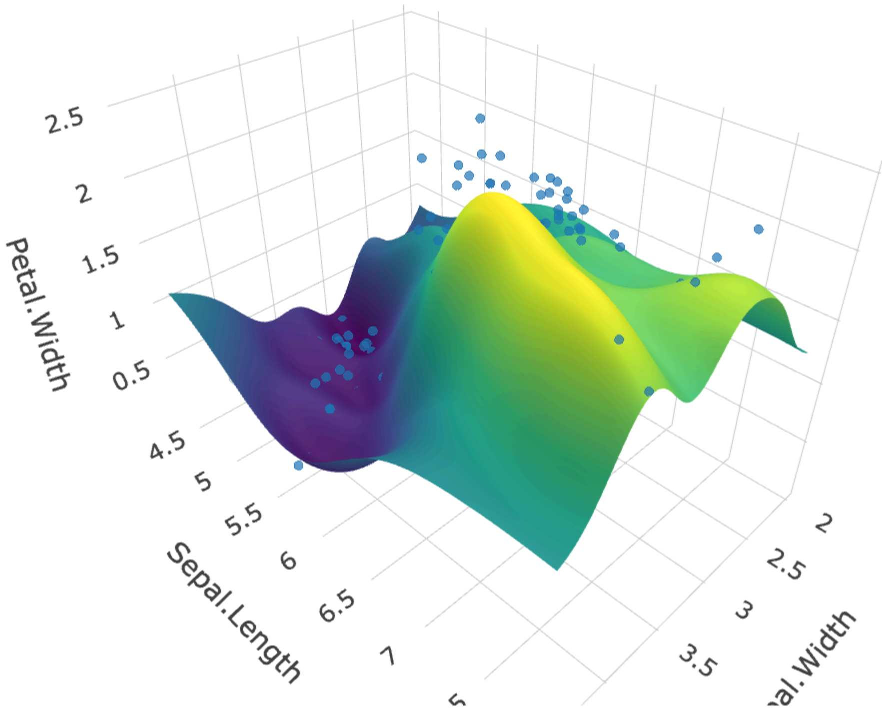
```
Attaching package: 'kernlab'

The following object is masked from 'package:scales':

    alpha

The following object is masked from 'package:purrr':

    cross

The following object is masked from 'package:ggplot2':

    alpha

The following object is masked from 'package:psych':

    alpha
```

```
#install.packages("pracma")
library(pracma) #为了在曲面上显示网格线
```

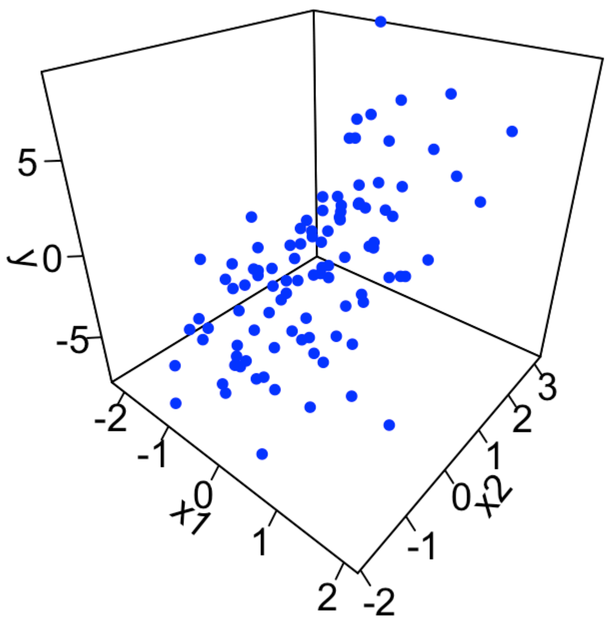
```
Attaching package: 'pracma'
```

```
The following objects are masked from 'package:kernlab':

    cross, eig, size

The following object is masked from 'package:purrr':

    cross

The following object is masked from 'package:car':

    logit

The following objects are masked from 'package:psych':

    logit, polar

The following object is masked from 'package:memisc':

    Reshape
```

```
data(iris)
#选择自变量和因变量
mesh_size <- .02
margin <- 0
X <- iris %>% select(Sepal.Width, Sepal.Length)
y <- iris %>% select(Petal.Width)
model <- svm_rbf(cost = 1.0) %>%
  set_engine("kernlab") %>%
  set_mode("regression") %>%
  fit(Petal.Width ~ Sepal.Width + Sepal.Length, data = iris)
x_min <- min(X$Sepal.Width) - margin
x_max <- max(X$Sepal.Width) - margin
y_min <- min(X$Sepal.Length) - margin
y_max <- max(X$Sepal.Length) - margin
xrange <- seq(x_min, x_max, mesh_size)
yrange <- seq(y_min, y_max, mesh_size)
xy <- meshgrid(x = xrange, y = yrange)
xx <- xy$X
yy <- xy$Y
dim_val <- dim(xx)
xx1 <- matrix(xx, length(xx), 1)
yy1 <- matrix(yy, length(yy), 1)
final <- cbind(xx1, yy1)
pred <- model %>%
  predict(final)

pred <- pred$.pred
pred <- matrix(pred, dim_val[1], dim_val[2])
fig <- plot_ly(iris, x = ~Sepal.Width, y = ~Sepal.Length, z = ~Petal.Width ) %>%
  add_markers(size = 5) %>%
  add_surface(x=xrange, y=yrange, z=pred, alpha = 0.65, type = 'mesh3d', name = 'pred_
fig
```

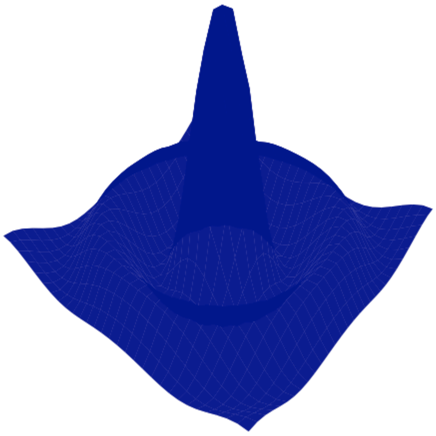



```
library(plot3D)
set.seed(123)
n <- 100
x1 <- rnorm(n)
x2 <- rnorm(n)
y <- 2*x1 + 3*x2 + rnorm(n)

data <- data.frame(x1, x2, y)
model <- lm(y ~ x1 + x2, data = data)
# 创建一个网格
grid_x1 <- seq(min(data$x1), max(data$x1), length.out = 50)
grid_x2 <- seq(min(data$x2), max(data$x2), length.out = 50)
grid <- expand.grid(x1 = grid_x1, x2 = grid_x2)

# 预测网格上的y值
grid$y_pred <- predict(model, newdata = grid)

# 绘制三维散点图
scatter3D(data$x1, data$x2, data$y, pch = 20, colvar = NULL, col = "blue",
          xlab = "x1", ylab = "x2", zlab = "y", theta = 40, phi = 30,
          ticktype = "detailed", cex.lab = 1.2, cex.axis = 1.2)
```




```
# 绘制三维拟合曲面
#surf3D(grid_x1, grid_x2, matrix(grid$y_pred, nrow = length(grid_x2)),   add = TRUE, c

library(plot3D)

# 创建网格
x <- seq(-10, 10, length.out = 30)
y <- seq(-10, 10, length.out = 30)

# 创建网格矩阵
x_grid <- outer(x, y, Vectorize(function(x, y) x))
y_grid <- outer(x, y, Vectorize(function(x, y) y))

# 计算z值（这里使用一个简单的函数作为例子）
z_grid <- outer(x, y, function(x, y) sin(sqrt(x^2 + y^2)) / sqrt(x^2 + y^2))

# 使用surf3D绘制3D曲面图
surf3D(x = x_grid, y = y_grid, z = z_grid, colvar = NULL,
       color = "green", alpha = 0.8, xlab = "X", ylab = "Y", zlab = "Z",
       main = "3D Surface Plot")
```

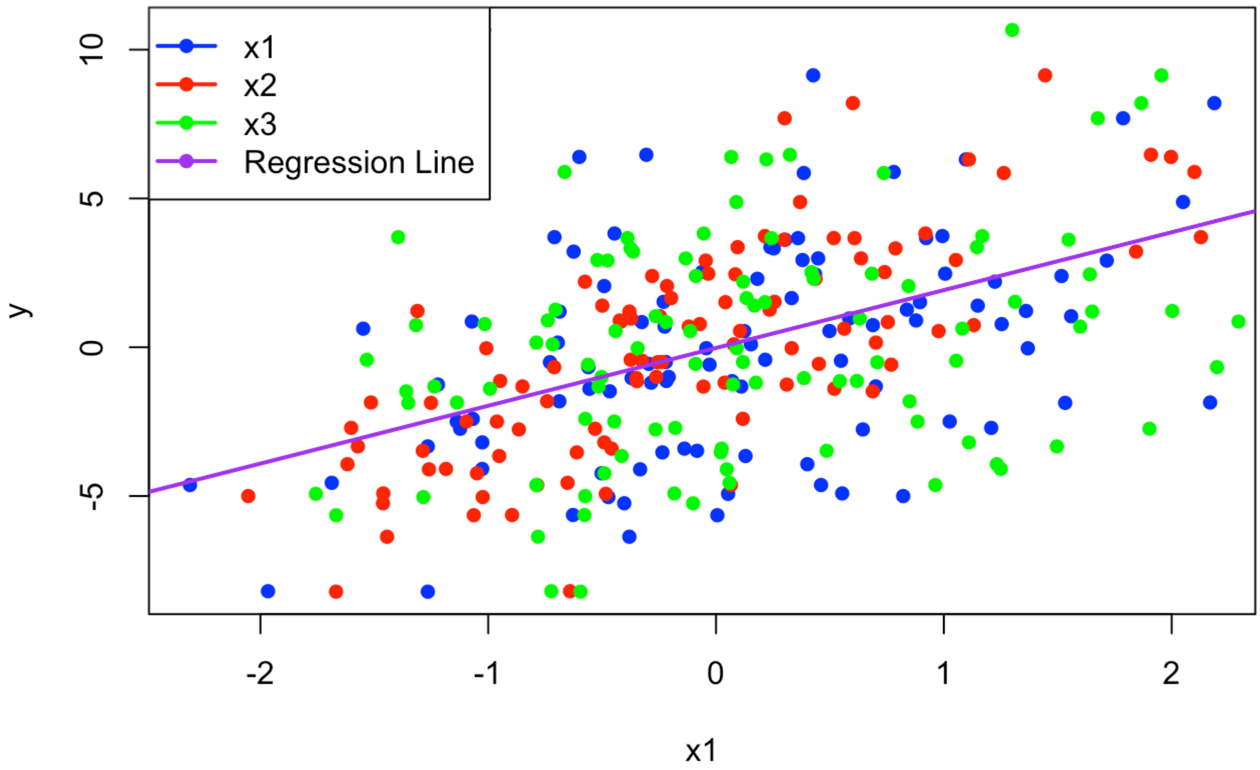
3D Surface Plot



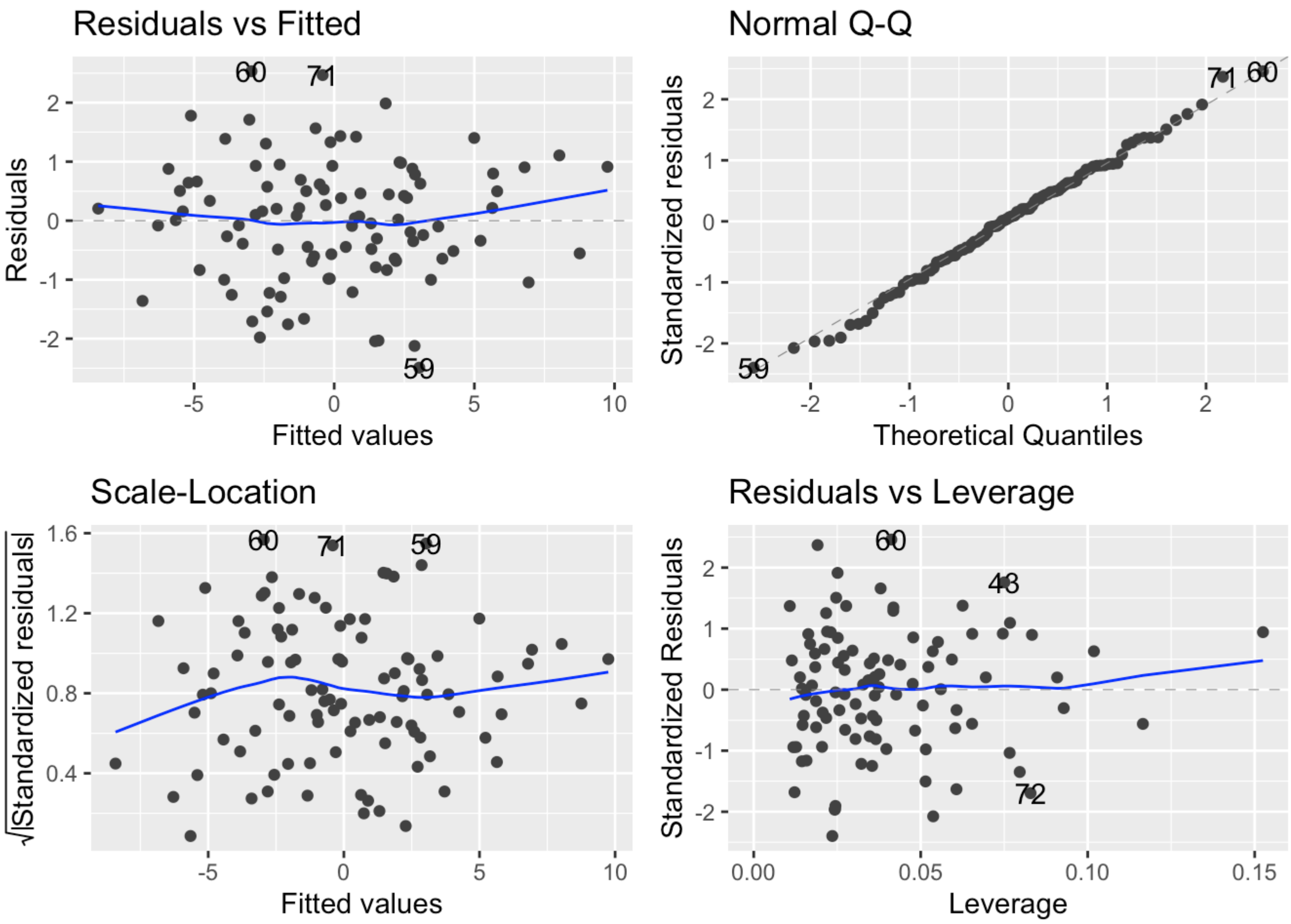
```
# 创建示例数据
set.seed(123)
x1 <- rnorm(100)
x2 <- rnorm(100)
x3 <- rnorm(100)
y <- 2*x1 + 3*x2 + 1.5*x3 + rnorm(100)

# 拟合多元回归模型
model <- lm(y ~ x1 + x2 + x3)

# 绘制多元回归模型
plot(y ~ x1, col="blue", pch=16, xlab="x1", ylab="y")
points(x2, y, col="red", pch=16)
points(x3, y, col="green", pch=16)
abline(model, col="purple", lwd=2)
```

```
Warning in abline(model, col = "purple", lwd = 2): only using the first two of
4 regression coefficients
```

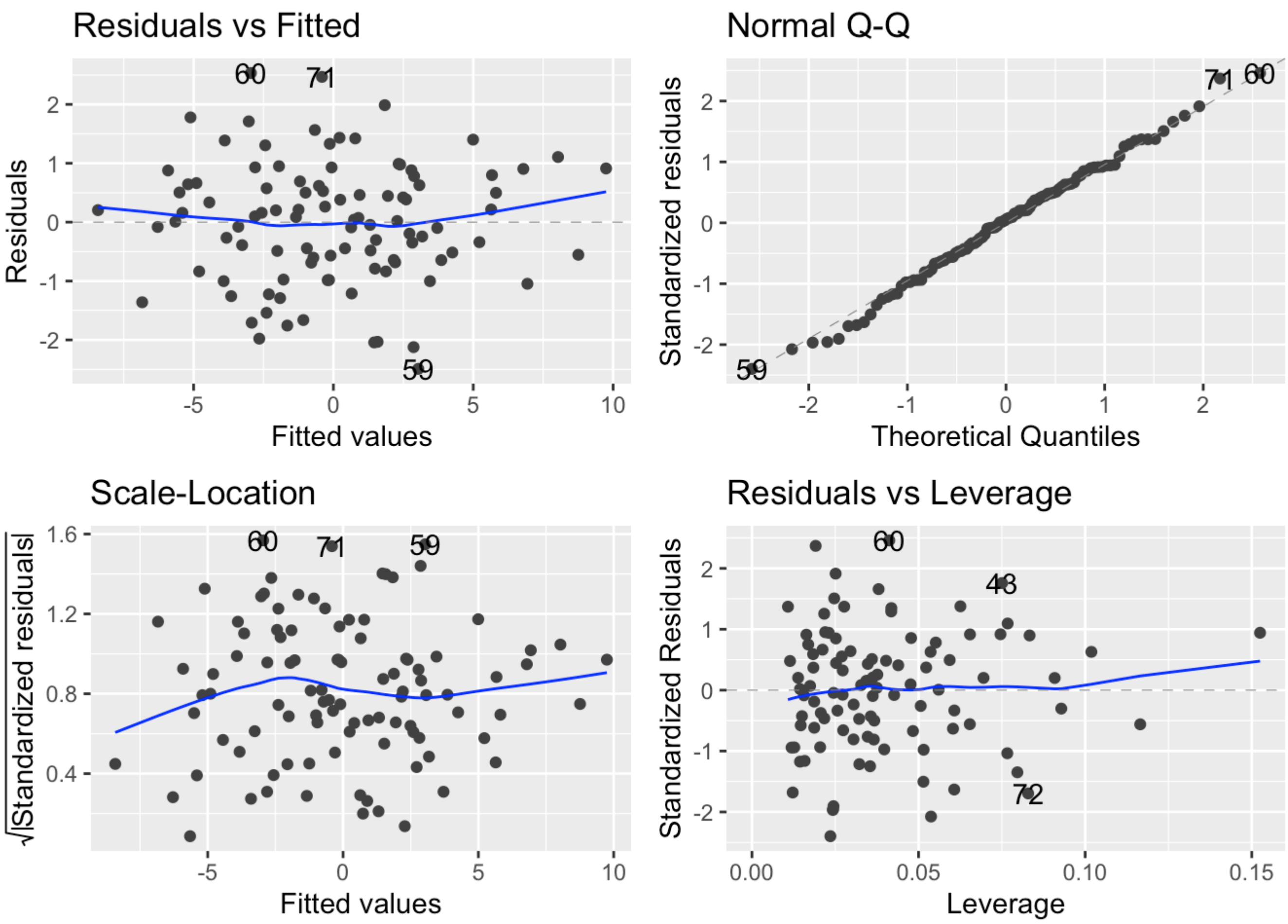
```
legend("topleft", legend=c("x1", "x2", "x3", "Regression Line"),
       col=c("blue", "red", "green", "purple"), pch=16, lwd=2)
```



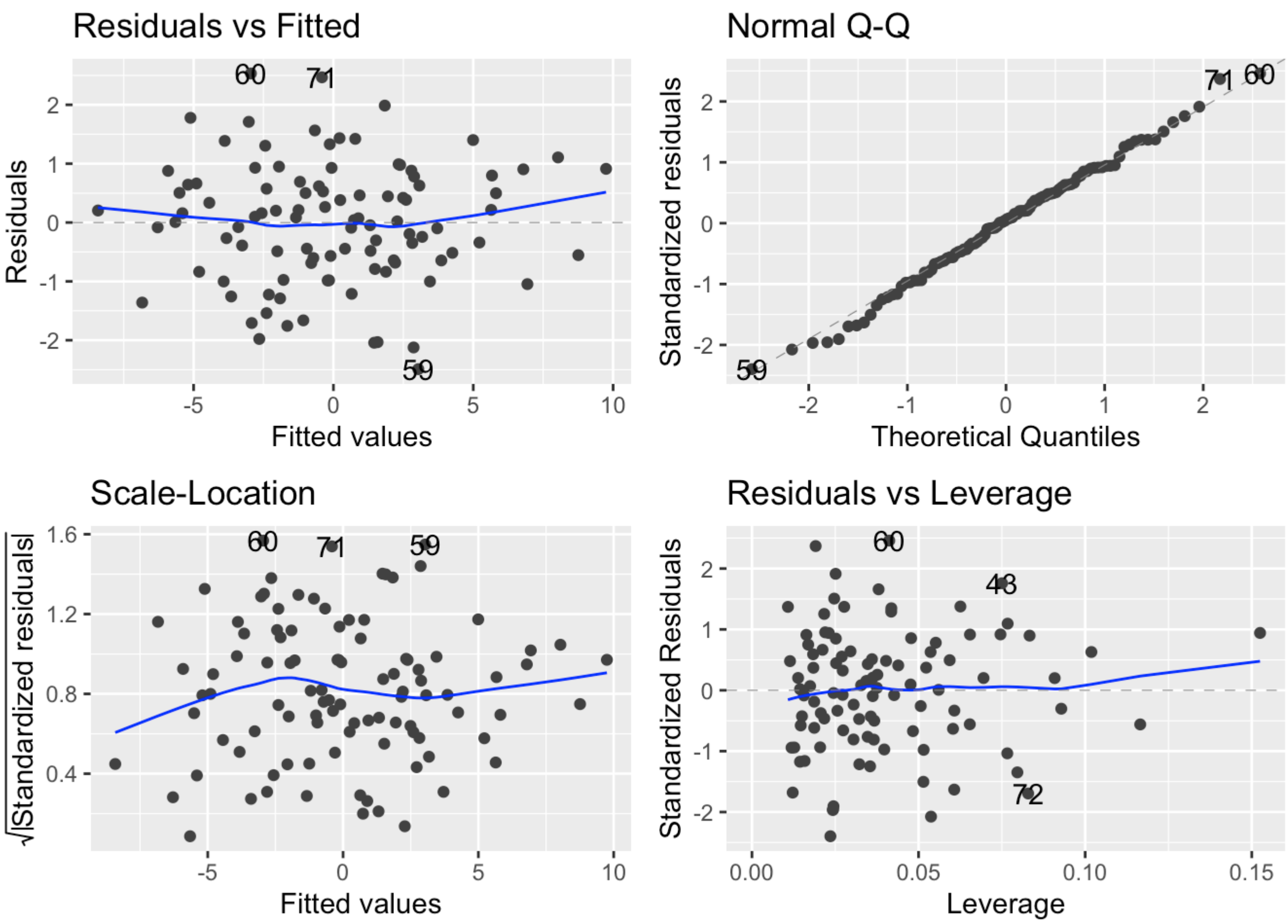

```r
library(ggfortify)

autoplot(model)
```



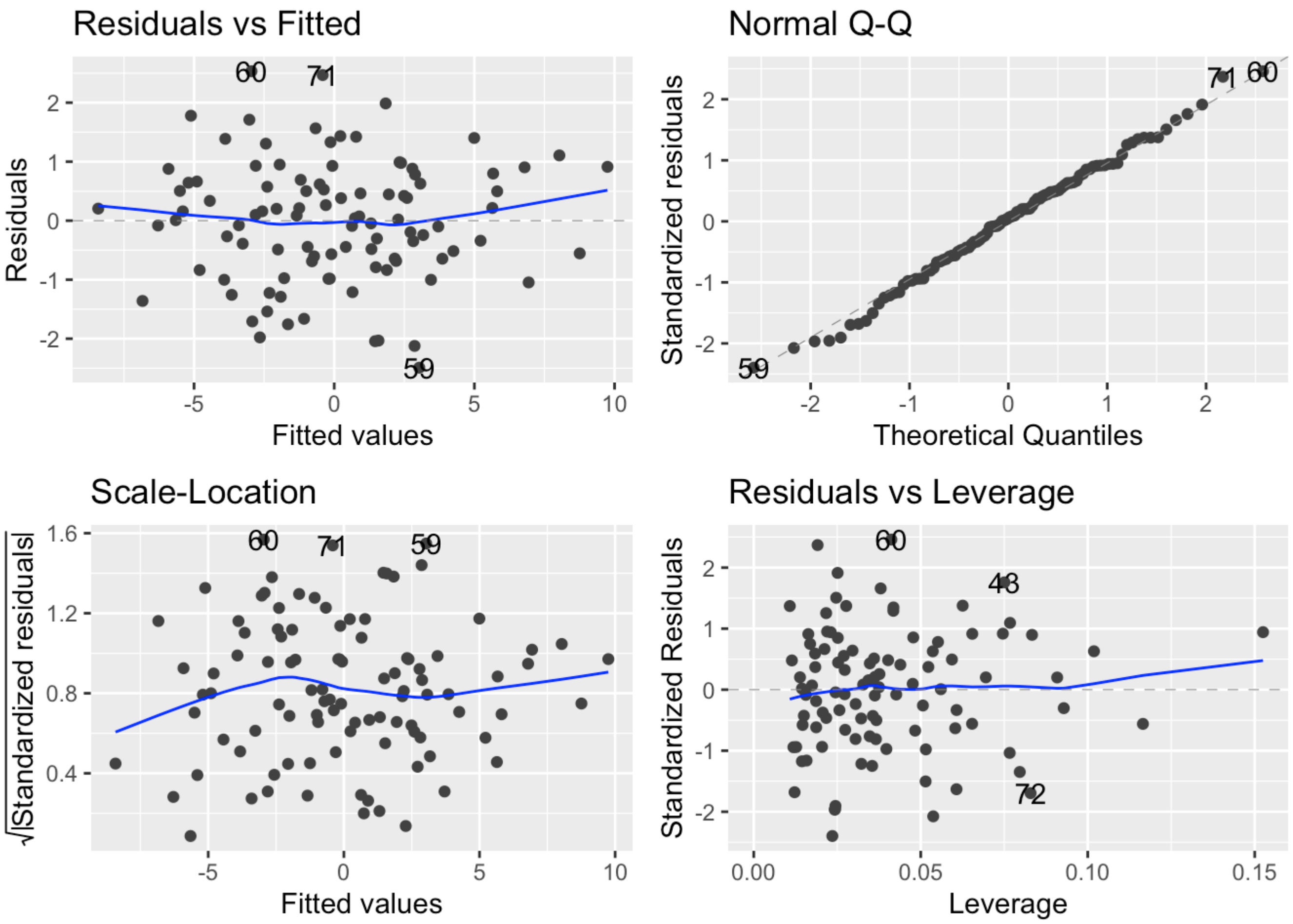

```
autoplot(model, type = "resid")
```



```r
autoplot(model, type = "fit")
```




```r
autoplot(model, type = "conf")
```



中介效应分析

调节分析

共线性诊断不通过

取标准化值 ## SEM https://lavaan.ugent.be/tutorial/ a->b->c a->c b为中介变量,中介效应: a->b的系数 * b-c的系数 总效应 中介效应+a->c的系数

```
library(lavaan)
```

```
This is lavaan 0.6-17
lavaan is FREE software! Please report any bugs.


Attaching package: 'lavaan'

The following object is masked from 'package:psych':

    cor2cov
```

```
library(semPlot)
#SEM
model <- '
```

```
# 潜变量 =~ 测量指标1(既量表) + 测量指标2 + ...
teleworkerCharacteristics =~ teleworkerCharacteristics1 + teleworkerCharacteristics2 +
communication =~ communication1 + communication2 + communication3
management =~ management2 + management3 + management4
organisationalCulture =~ organisationalCulture1 + organisationalCulture2 + organisatio
#因变量
job_effectiveness =~ job_effectiveness1 + job_effectiveness2 + job_effectiveness3 + jo
work.life_balance =~ work.life_balance1 + work.life_balance2 + work.life_balance3 + wo
well.being =~ well.being1 + well.being2 + well.being3 + well.being4
#回归方程
# 因变量~ 自变量1+自变量2+...
#中介
work.life_balance ~ beta_work_tel*teleworkerCharacteristics + beta_work_com*communicat
well.being ~ beta_well_tel*teleworkerCharacteristics + beta_well_com*communication + b
#直接
job_effectiveness ~ beta_job_tel*teleworkerCharacteristics + beta_job_com*communicatio
#中介效应
indirect_work_job_tel:=beta_work_tel*beta_job_tel
indirect_work_job_com:=beta_work_com*beta_job_com
indirect_work_job_man:=beta_work_man*beta_job_man
indirect_work_job_org:=beta_work_org*beta_job_org

indirect_well_job_tel:=beta_well_tel*beta_job_tel
indirect_well_job_com:=beta_well_com*beta_job_com
indirect_well_job_man:=beta_well_man*beta_job_man
indirect_well_job_org:=beta_well_org*beta_job_org
#整体效应
all:=indirect_work_job_tel+indirect_work_job_com+indirect_work_job_man+indirect_work_j
'
result <- sem(model,data=data_src)
```

```
Warning in lav_object_post_check(object): lavaan WARNING: some estimated lv
variances are negative
```

```
#summary(result,standardized = TRUE)
summary(result,standardized=TRUE, fit.measures=TRUE) #后面画图后,显示不全
```

```
lavaan 0.6.17 ended normally after 140 iterations

  Estimator                                         ML
  Optimization method                           NLMINB
  Number of model parameters                        70

  Number of observations                            93

Model Test User Model:

  Test statistic                              1235.326
  Degrees of freedom                               255
  P-value (Chi-square)                           0.000

Model Test Baseline Model:
```

```
  Test statistic                              4436.925
  Degrees of freedom                               300
  P-value                                        0.000

User Model versus Baseline Model:

  Comparative Fit Index (CFI)                    0.763
  Tucker-Lewis Index (TLI)                       0.721

Loglikelihood and Information Criteria:

  Loglikelihood user model (H0)              -1829.675
  Loglikelihood unrestricted model (H1)      -1212.012
                                                      
  Akaike (AIC)                                3799.350
  Bayesian (BIC)                              3976.632
  Sample-size adjusted Bayesian (SABIC)       3755.658

Root Mean Square Error of Approximation:

  RMSEA                                          0.203
  90 Percent confidence interval - lower         0.192
  90 Percent confidence interval - upper         0.215
  P-value H_0: RMSEA <= 0.050                    0.000
  P-value H_0: RMSEA >= 0.080                    1.000

Standardized Root Mean Square Residual:

  SRMR                                           0.085

Parameter Estimates:

  Standard errors                             Standard
  Information                                 Expected
  Information saturated (h1) model          Structured

Latent Variables:
                               Estimate  Std.Err  z-value  P(>|z|)   Std.lv
  teleworkerCharacteristics =~                                             
    tlwrkrChrctrs1                1.000                               0.781
    tlwrkrChrctrs2                0.929    0.127    7.314    0.000    0.726
    tlwrkrChrctrs3                1.271    0.141    8.993    0.000    0.993
  communication =~                                                         
    communication1                1.000                               0.910
    communication2                1.026    0.081   12.669    0.000    0.934
    communication3                1.210    0.108   11.189    0.000    1.101
  management =~                                                            
    management2                   1.000                               1.023
    management3                   1.220    0.086   14.227    0.000    1.248
    management4                   0.920    0.091   10.097    0.000    0.941
  organisationalCulture =~                                                 
    organstnlCltr1                1.000                               1.336
    organstnlCltr2                1.036    0.106    9.786    0.000    1.384
    organstnlCltr3                1.076    0.084   12.745    0.000    1.437
```

```
    organstnlCltr4            0.931    0.088   10.529    0.000    1.243
  job_effectiveness =~
    job_effctvnss1            1.000                               0.785
    job_effctvnss2            1.087    0.067   16.321    0.000    0.853
    job_effctvnss3            1.143    0.059   19.290    0.000    0.897
    job_effctvnss4            0.955    0.058   16.425    0.000    0.749
  work.life_balance =~
    work.lif_blnc1            1.000                               0.682
    work.lif_blnc2            1.213    0.062   19.535    0.000    0.828
    work.lif_blnc3            1.191    0.064   18.484    0.000    0.813
    work.lif_blnc4            1.099    0.067   16.368    0.000    0.750
  well.being =~
    well.being1               1.000                               0.823
    well.being2               0.971    0.061   15.820    0.000    0.800
    well.being3               1.362    0.078   17.411    0.000    1.121
    well.being4               1.140    0.072   15.919    0.000    0.939
  Std.all

    0.729
    0.723
    0.876

    0.833
    0.973
    0.889

    0.869
    0.946
    0.801

    0.804
    0.840
    0.997
    0.882

    0.931
    0.916
    0.956
    0.918

    0.931
    0.960
    0.947
    0.917

    0.920
    0.913
    0.940
    0.915

Regressions:
                      Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  work.life_balance ~
    tlC (bt_wrk_t)       0.219    0.059    3.740    0.000    0.251    0.251
```

```
    cmm (bt_wrk_c)       0.014    0.032    0.434    0.664    0.019    0.019
    mng (bt_wrk_m)       0.440    0.053    8.321    0.000    0.659    0.659
    orC (bt_wrk_r)       0.084    0.024    3.579    0.000    0.165    0.165
  well.being ~
    tlC (bt_wll_t)       0.398    0.067    5.987    0.000    0.378    0.378
    cmm (bt_wll_c)       0.101    0.029    3.456    0.001    0.112    0.112
    mng (bt_wll_m)       0.263    0.043    6.065    0.000    0.327    0.327
    orC (bt_wll_r)       0.223    0.028    7.946    0.000    0.361    0.361
  job_effectiveness ~
    tlC  (bt_jb_t)       0.605    0.273    2.217    0.027    0.603    0.603
    cmm  (bt_jb_c)       0.092    0.046    1.975    0.048    0.106    0.106
    mng  (bt_jb_m)      -0.546    0.620   -0.881    0.379   -0.712   -0.712
    orC  (bt_jb_r)      -0.146    0.106   -1.383    0.167   -0.249   -0.249
    w._ (bt_jb_wr)       0.936    1.453    0.644    0.520    0.814    0.814
    wl. (bt_jb_wl)       0.378    0.279    1.353    0.176    0.396    0.396

Covariances:
                               Estimate  Std.Err  z-value  P(>|z|)   Std.lv
  teleworkerCharacteristics ~~
    communication                 0.336    0.096    3.489    0.000    0.473
    management                    0.613    0.129    4.768    0.000    0.767
    organistnlCltr                0.653    0.155    4.200    0.000    0.626
  communication ~~
    management                    0.561    0.127    4.405    0.000    0.603
    organistnlCltr                0.704    0.165    4.256    0.000    0.579
  management ~~
    organistnlCltr                0.854    0.190    4.503    0.000    0.625
  Std.all

    0.473
    0.767
    0.626

    0.603
    0.579

    0.625

Variances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
   .tlwrkrChrctrs1    0.537    0.079    6.767    0.000    0.537    0.468
   .tlwrkrChrctrs2    0.482    0.071    6.778    0.000    0.482    0.477
   .tlwrkrChrctrs3    0.300    0.052    5.802    0.000    0.300    0.233
   .communication1    0.364    0.061    5.974    0.000    0.364    0.305
   .communication2    0.049    0.029    1.710    0.087    0.049    0.054
   .communication3    0.323    0.062    5.185    0.000    0.323    0.210
   .management2       0.339    0.055    6.162    0.000    0.339    0.244
   .management3       0.184    0.040    4.629    0.000    0.184    0.106
   .management4       0.496    0.077    6.456    0.000    0.496    0.359
   .organstnlCltr1    0.978    0.146    6.677    0.000    0.978    0.354
   .organstnlCltr2    0.799    0.121    6.607    0.000    0.799    0.294
   .organstnlCltr3    0.014    0.028    0.508    0.611    0.014    0.007
   .organstnlCltr4    0.441    0.069    6.439    0.000    0.441    0.222
   .job_effctvnss1    0.094    0.015    6.155    0.000    0.094    0.132
```

```
   .job_effctvnss2     0.139    0.022    6.305    0.000    0.139    0.161
   .job_effctvnss3     0.075    0.013    5.627    0.000    0.075    0.085
   .job_effctvnss4     0.105    0.017    6.292    0.000    0.105    0.158
   .work.lif_blnc1     0.072    0.012    6.192    0.000    0.072    0.133
   .work.lif_blnc2     0.059    0.011    5.612    0.000    0.059    0.079
   .work.lif_blnc3     0.075    0.013    5.948    0.000    0.075    0.103
   .work.lif_blnc4     0.106    0.017    6.316    0.000    0.106    0.158
   .well.being1        0.124    0.017    7.341    0.000    0.124    0.154
   .well.being2        0.127    0.017    7.342    0.000    0.127    0.166
   .well.being3        0.166    0.023    7.294    0.000    0.166    0.117
   .well.being4        0.171    0.023    7.342    0.000    0.171    0.163
    tlwrkrChrctrst     0.610    0.149    4.094    0.000    1.000    1.000
    communication      0.829    0.169    4.899    0.000    1.000    1.000
    management         1.047    0.198    5.276    0.000    1.000    1.000
    organistnlCltr     1.785    0.380    4.695    0.000    1.000    1.000
   .job_effectvnss    -0.036    0.012   -2.979    0.003   -0.058   -0.058
   .work.life_blnc     0.005    0.005    0.993    0.321    0.010    0.010
   .well.being        -0.022    0.005   -4.637    0.000   -0.033   -0.033

Defined Parameters:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
    indrct_wrk_jb_     0.133    0.084    1.572    0.116    0.151    0.151
    indrct_wrk_jb_     0.001    0.003    0.453    0.650    0.002    0.002
    indrct_wrk_jb_    -0.240    0.289   -0.831    0.406   -0.470   -0.470
    indrct_wrk_jb_    -0.012    0.010   -1.215    0.224   -0.041   -0.041
    indrct_wll_jb_     0.241    0.129    1.871    0.061    0.228    0.228
    indrct_wll_jb_     0.009    0.006    1.680    0.093    0.012    0.012
    indrct_wll_jb_    -0.144    0.172   -0.838    0.402   -0.233   -0.233
    indrct_wll_jb_    -0.033    0.024   -1.353    0.176   -0.090   -0.090
    all                1.269    0.652    1.946    0.052    0.769    0.769
```

```
#chisq_result = chisq.test(result)
#summary(chisq_result)
#获取模型拟合参数
fits = fitMeasures(result)
fits
```

```
               npar                fmin               chisq 
             70.000               6.642            1235.326 
                 df              pvalue      baseline.chisq 
            255.000               0.000            4436.925 
        baseline.df     baseline.pvalue                 cfi 
            300.000               0.000               0.763 
                tli                nnfi                 rfi 
              0.721               0.721               0.672 
                nfi                pnfi                 ifi 
              0.722               0.613               0.766 
                rni                logl   unrestricted.logl 
              0.763           -1829.675           -1212.012 
                aic                 bic              ntotal 
           3799.350            3976.632              93.000 
               bic2               rmsea      rmsea.ci.lower 
           3755.658               0.203               0.192 
```

```
       rmsea.ci.upper        rmsea.ci.level          rmsea.pvalue
                0.215                 0.900                 0.000
       rmsea.close.h0 rmsea.notclose.pvalue     rmsea.notclose.h0
                0.050                 1.000                 0.080
                  rmr            rmr_nomean                  srmr
                0.127                 0.127                 0.085
         srmr_bentler   srmr_bentler_nomean                  crmr
                0.085                 0.085                 0.088
          crmr_nomean            srmr_mplus     srmr_mplus_nomean
                0.088                 0.085                 0.085
                cn_05                 cn_01                   gfi
               23.077                24.372                 0.503
                 agfi                  pgfi                   mfi
                0.366                 0.394                 0.005
                 ecvi
               14.788
```

```
summary(fits)
```

```
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max. 
-1829.675     0.085     0.558   325.208    12.752  4436.925 
```

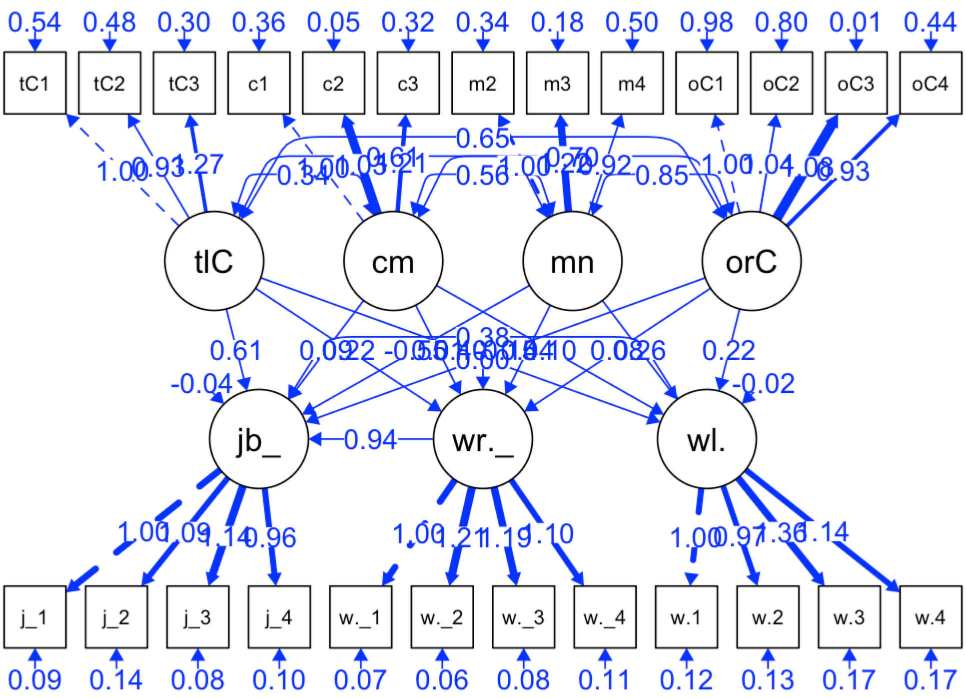
```
fits['rmsea']
```

```
   rmsea 
0.203317 
```

```
#summary(result)
#模型概览
```

```
semPaths(result,
         what = "std.all", #"est",      # 显示估计的系数
         whatLabels = "est", # 标签显示估计的系数
         style="lisrel", #"lisrel"、"ram"、"dot"、"jgraph"等。默认为"lisrel"。
         intervals=T,
         node.color = "blue",
         estimlegend.cex = 1.5, #系数字体大小
         edge.color = "blue",
         edge.label.cex = 1, # 调整标签大小
         fade = F,        # 不使用渐变效果
         layout="tree",
         rotation=1,
         nCharNodes = 0.05,
         residuals=T,
         curvePivot = TRUE)  # 曲线在变量处弯曲
```

```
Warning in qgraph::qgraph(Edgelist, labels = nLab, bidirectional = Bidir, : The
following arguments are not documented and likely not arguments of qgraph and
thus ignored: intervals; node.color; estimlegend.cex
```




```
# semPaths(fit, whatLabels="est.std", style="lisrel", edge.label.cex=1, layout="tree2"
```

```
model <- '
# 潜变量 =~ 测量指标1(既量表) + 测量指标2 + ...
environment =~ environment0 + environment1 + environment2 + environment3
jobCharacteristics =~ jobCharacteristics0 + jobCharacteristics1 + jobCharacteristics2
teleworkerCharacteristics =~ teleworkerCharacteristics0 + teleworkerCharacteristics1 +
communication =~ communication0 + communication1 + communication2 + communication3 + c
management =~ management0 + management1 + management2 + management3 + management4
organisationalCulture =~ organisationalCulture0 + organisationalCulture1 + organisatio
technology =~ technology0 + technology1 + technology2 + technology3 + technology4
asynchronousWork =~ asynchronousWork0 + asynchronousWork1 + asynchronousWork2 + asynch
#因变量
job_effectiveness =~ job_effectiveness1 + job_effectiveness2 + job_effectiveness3 + jo
work.life_balance =~ work.life_balance1 + work.life_balance2 + work.life_balance3 + wo
well.being =~ well.being1 + well.being2 + well.being3 + well.being4
#回归方程
# 因变量~ 自变量1+自变量2+...
#job_effectiveness ~ environment + jobCharacteristics + teleworkerCharacteristics + co
#work.life_balance ~ environment + jobCharacteristics + teleworkerCharacteristics + co
well.being ~ environment + jobCharacteristics + teleworkerCharacteristics + communicat
'
'
model: SEM模型的拟合对象，通常是由sem()函数拟合后得到的对象。
what: 指定要显示的内容，可以是"std"（标准化估计值）、"std.lv"（标准化潜变量）、"std.all"（标准化估
style: 图形风格，可以是"lisrel"、"ram"、"dot"、"jgraph"等。默认为"lisrel"。
residuals: 是否显示残差。默认为TRUE。
```

```
intervals: 是否显示参数估计的置信区间。默认为FALSE。
whatLabels: 是否显示节点标签。默认为FALSE。
layout: 图形的布局。默认为circular（圆形布局）。
rotation: 图形的旋转角度。默认为0。
edge.label.cex: 边标签的大小。默认为1。
edge.label.offset: 边标签的偏移。默认为0。
edge.label: 是否显示边标签。默认为TRUE。
edge.color: 边的颜色。默认为黑色。
edge.width: 边的宽度。默认为1。
edge.lwd: 边的线宽。默认为1。
edge.curved: 边的曲率。默认为FALSE。
edge.lty: 边的线型。默认为1。
label.prop: 是否根据参数大小调整节点标签的大小。默认为FALSE。
label.cex: 节点标签的大小。默认为1。
label.offset: 节点标签的偏移。默认为0.5。
node.color: 节点的颜色。默认为黑色。
node.width: 节点的宽度。默认为0.3。
node.size: 节点的大小。默认为2。
curvePivot: 弯曲箭头的位置。默认为0.5。
curveAngle: 弯曲箭头的角度。默认为60。
curveArrowSize: 弯曲箭头的大小。默认为0.5。
'
```

```
[1] "\nmodel: SEM模型的拟合对象，通常是由sem()函数拟合后得到的对象。\nwhat: 指定要显示的内容，可以是\"std\"（标准化估计值）、\"std.lv\"（标准化潜变量）、\"std.all\"（标准化估计值和标准化潜变量）、\"std.nox\"（标准化估计值但不包括残差）等。默认值为\"std\".\nstyle: 图形风格，可以是\"lisrel\"、\"ram\"、\"dot\"、\"jgraph\"等。默认为\"lisrel\"。\nresiduals: 是否显示残差。默认为TRUE。\nintervals: 是否显示参数估计的置信区间。默认为FALSE。\nwhatLabels: 是否显示节点标签。默认为FALSE。\nlayout: 图形的布局。默认为circular（圆形布局）。\nrotation: 图形的旋转角度。默认为0。\nedge.label.cex: 边标签的大小。默认为1。\nedge.label.offset: 边标签的偏移。默认为0。\nedge.label: 是否显示边标签。默认为TRUE。\nedge.color: 边的颜色。默认为黑色。\nedge.width: 边的宽度。默认为1。\nedge.lwd: 边的线宽。默认为1。\nedge.curved: 边的曲率。默认为FALSE。\nedge.lty: 边的线型。默认为1。\nlabel.prop: 是否根据参数大小调整节点标签的大小。默认为FALSE。\nlabel.cex: 节点标签的大小。默认为1。\nlabel.offset: 节点标签的偏移。默认为0.5。\nnode.color: 节点的颜色。默认为黑色。\nnode.width: 节点的宽度。默认为0.3。\nnode.size: 节点的大小。默认为2。\ncurvePivot: 弯曲箭头的位置。默认为0.5。\ncurveAngle: 弯曲箭头的角度。默认为60。\ncurveArrowSize: 弯曲箭头的大小。默认为0.5。\n"
```

```
library(lavaan)

set.seed(123) # 设置随机种子以便结果可复现
n <- 100 # 样本量

# 创建潜在变量
eta1 <- rnorm(n) # 潜在变量1
eta2 <- rnorm(n) # 潜在变量2

# 创建观测变量
x1 <- eta1 + rnorm(n) # x1是eta1的指标
x2 <- eta1 + rnorm(n) # x2也是eta1的指标
y <- eta2 + rnorm(n)  # y是eta2的指标

# 将数据整合到数据框中
```

```
data <- data.frame(x1, x2, y)

# 定义SEM模型
model <- '
  # 测量模型
  eta1 =~ x1 + x2
  eta2 =~ y
'
#在这个模型中，eta1 =~ x1 + x2表示eta1是由x1和x2测量的潜在变量，而eta2 =~ y表示eta2是由y测量的潜

# 拟合模型
fit <- sem(model, data = data)

# 显示摘要信息
summary(fit)
```

```
lavaan 0.6.17 ended normally after 23 iterations

  Estimator                                         ML
  Optimization method                           NLMINB
  Number of model parameters                         6

  Number of observations                           100

Model Test User Model:

  Test statistic                                 0.000
  Degrees of freedom                                 0

Parameter Estimates:

  Standard errors                             Standard
  Information                                 Expected
  Information saturated (h1) model          Structured

Latent Variables:
                   Estimate  Std.Err  z-value  P(>|z|)
  eta1 =~
    x1                1.000
    x2                0.908    0.840    1.082    0.279
  eta2 =~
    y                 1.000

Covariances:
                   Estimate  Std.Err  z-value  P(>|z|)
  eta1 ~~
    eta2             -0.211    0.158   -1.331    0.183

Variances:
                   Estimate  Std.Err  z-value  P(>|z|)
   .x1                0.804    0.647    1.244    0.214
   .x2                1.239    0.554    2.237    0.025
   .y                 0.000
```

```
eta1              0.692    0.661    1.047    0.295
eta2              1.647    0.233    7.071    0.000
```

多层SEM模型

ESEM 探索性结构方程模型，Exploratory Structural Equation Modeling

是一种相对较新的方法，用于探索性的数据分析。这种方法结合了探索性因素分析（EFA）和验证性因素分析（CFA）的思想，同时融合了结构方程模型（SEM）的灵活性，旨在同时实现理论的探索与验证。 ### CFA

##其它 ###图形 https://plotly.com/r/