Untitled

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5/4/2021

La función del coeficiente:

```
rhot <- function(a,b,c,d){
  set.seed(2021)
  a = ifelse(a==0,0.5,a)
  b = ifelse(b==0,0.5,b)
  c = ifelse(c==0,0.5,c)
  d = ifelse(d==0,0.5,d)
  N = a+b+c+d
  h = qnorm(0.5 + ((a+c)-(b+d))/(2*N))
  k = qnorm(0.5 + ((a+b)-(c+d))/(2*N))
  H = (1/sqrt(2*pi))*exp(-0.5*h^2)
  K = (1/sqrt(2*pi))*exp(-0.5*k^2)
  peh <- qnorm(3/4)/(H*sqrt(N))*sqrt((b+d)*(a+c)/(N^2))
  pek <- qnorm(3/4)/(K*sqrt(N))*sqrt((c+d)*(a+b)/(N^2))
  eps = (a*d-b*c)/(N*N*H*K)
  coef1 = 1
  coef2 = h*k/factorial(2)
  coef3 = (h^2-1)*(k^2-1)/factorial(3)
  coef4 = h*(h^2-3)*k*(k^2-3)/factorial(4)
  coef5 = (h^4-6*h^2+3)*(k^4-6*k^2+3)/factorial(5)
  coef6 = h*(h^4-10*h^2+15)*k*(k^4-10*k^2+15)/factorial(6)
  coef7 = (h^6-15*h^4+45*h^2-15)*(k^6-15*k^4+45*k^2-15)/factorial(7)
  coef8 = h*(h^6-21*h^4+105*h^2-105)*k*(k^6-21*k^4+105*k^2-105)/factorial(8)
  serie1 <- function(x){
    return(-1*eps+coef1*x+coef2*x^2+coef3*x^3+coef4*x^4+coef5*x^5+coef6*x^6+coef7*x^7+coef8*x^8)
  }
  r1 <-  uniroot.all(serie1, c(-1,1))
  serie2 <- function(x){
    return(-1*eps+ x + h*k/2*x^2-(h^2+k^2-(h^2)*(k^2))/6*x^3 + h*k*((h^2)*(k^2)-3*(h^2+k^2)+5)/24*x^4)
  }
  tet <-  uniroot.all(serie2, c(-1,1))
  r2 <- sin(tet)
  per <- function (r){
    beta1 <- (h-r*k)/sqrt(1-r^2)
    beta2 <- (k-r*h)/sqrt(1-r^2)
    psi1 <- pnorm(beta1)-0.5
    psi2 <- pnorm(beta2)-0.5
    chi0 <- (1/(2*pi))*(1/sqrt(1-r^2))*exp(-0.5*(1/(1-r^2))*(h^2+k^2-2*r*h*k))
    return(qnorm(3/4)/(sqrt(N)*chi0*N)*sqrt(((a+d)*(c+b))/(4)+psi2^2*((a+c)*(b+d))+psi1^2*((a+b)*(c+d))
  }
  if(length(r1)==1 & length(r2)==1){
    x <- data.frame(Estimacion = c(r1,r2,h,k),
```

```
                    P.E. = c(per(r1),per(r2),peh,pek),
                    l.lim = c(r1-per(r1),r2-per(r2),h-peh,k-pek),
                    u.lim = c(r1+per(r1),r2+per(r2),h+peh,k+pek),
                    row.names = c("Coef. Corr. 1","Coef. Corr. 2","h","k"))

    return(x)
  }
  if(length(r1)==1 & length(r2)!=1){
    x <- data.frame(Estimacion = c(r1,h,k),
                    P.E. = c(per(r1),peh,pek),
                    l.lim = c(r1-per(r1),h-peh,k-pek),
                    u.lim = c(r1+per(r1),h+peh,k+pek),
                    row.names = c("Coef. Corr. 1","h","k"))

    return(list(x, "La serie 2 obtiene los siguientes valores:",r2))
  }
  if(length(r1)!=1 & length(r2)==1){
    x <- data.frame(Estimacion = c(r2,h,k),
                    P.E. = c(per(r2),peh,pek),
                    l.lim = c(r2-per(r2),h-peh,k-pek),
                    u.lim = c(r2+per(r2),h+peh,k+pek),
                    row.names = c("Coef. Corr. 2","h","k"))

    return(list(x, "La serie 1 obtiene los siguientes valores:",r1))
  }
  if(length(r1)==0 & length(r2)==0){
    return("No se pudo calcular.")
  }
  else{
    return(list("La serie 1 obtiene:",r1,"La serie 2 obtiene:",r2))
  }
}
```

La función de la tablita de frecuencias simuladas:

```
frecuencias <- function(N,sigma1,sigma2,rhot,h,k){
  z <- function(x,y){
    N/(2*pi*sigma1*sigma2*sqrt(1-rhot^2))*exp(-0.5*(1/(1-rhot^2))*((x/sigma1)^2+(y/sigma2)^2-2*rhot*x*y/
  }
  aux1 <- pbivnorm::pbivnorm(x=c(h/s1), y=c(k/s2), rho=p)
  a <- N*aux1
  aux2 <- pbivnorm::pbivnorm(x=c(Inf), y=c(k/s2), rho=p)
  b <- N*(aux2-aux1)
  aux3 <- pbivnorm::pbivnorm(x=c(h/s1), y=c(Inf), rho=p)
  c <- N*(aux3-aux1)
  d <- N*(1-aux2-aux3+aux1)
  return(c(round(a),round(b),round(c),round(d)))
}
```

Aplicando mi función a las ilustraciones de Pearson:

```
library(psych)
library(pbivnorm)
library(rootSolve)

```

```r
#Ilustración 1 de Pearson
rhot(631,125,147,147) #mi función
```

```
##               Estimacion       P.E.     l.lim     u.lim
## Coef. Corr. 1  0.5419234 0.02858312 0.5133402 0.5705065
## Coef. Corr. 2  0.5411731 0.02860379 0.5125693 0.5697769
## h              0.6462843 0.02816790 0.6181164 0.6744522
## k              0.5828415 0.02776398 0.5550775 0.6106055
```

```r
(tetrachoric(matrix(c(631,125,147,147),2,2)))  #función de la librería psych
```

```
## Call: tetrachoric(x = matrix(c(631, 125, 147, 147), 2, 2))
## tetrachoric correlation
## [1] 0.54
##
##  with tau of
## [1] 0.65 0.58
```

```r
#Ilustración 3 de Pearson
rhot(1766,842,842,722)
```

```
##               Estimacion       P.E.     l.lim     u.lim
## Coef. Corr. 1  0.2221271 0.01636714 0.2057600 0.2384943
## Coef. Corr. 2  0.2221256 0.01636715 0.2057585 0.2384928
## h              0.3189554 0.01333251 0.3056229 0.3322879
## k              0.3189554 0.01333251 0.3056229 0.3322879
```

```r
(tetrachoric(matrix(c(1766,842,842,722),2,2)))  #función de la librería psych
```

```
## Call: tetrachoric(x = matrix(c(1766, 842, 842, 722), 2, 2))
## tetrachoric correlation
## [1] 0.22
##
##  with tau of
## [1] 0.32 0.32
```

```r
#Ilustración 6 de Pearson
rhot(1562,42,383,94)
```

```
##               Estimacion       P.E.     l.lim     u.lim
## Coef. Corr. 1  0.5956617 0.02721521 0.5684465 0.6228769
## Coef. Corr. 2  0.5968316 0.02719090 0.5696407 0.6240225
## h              1.5113222 0.02869930 1.4826229 1.5400215
## k              0.7414289 0.02050633 0.7209225 0.7619352
```

```r
(tetrachoric(matrix(c(1562,42,383,94),2,2)))  #función de la librería psych
```

```
## Call: tetrachoric(x = matrix(c(1562, 42, 383, 94), 2, 2))
## tetrachoric correlation
## [1] 0.6
##
##  with tau of
## [1] 1.51 0.74
```

Ejemplo simulados

```r
#Ejemplo 1
N <- 1000
s1 <- 5
```

```
s2 <- 5
p <- 0.4
h <- 4
k <- 1
ns <- frecuencias(N,s1,s2,p,h,k)
ns
```

```
## [1] 504  75 284 136
```

```
sum(ns)
```

```
## [1] 999
```

```
rhot(ns[1],ns[2],ns[3],ns[4]) #Mi función
```

```
##               Estimacion       P.E.     l.lim     u.lim
## Coef. Corr. 1  0.4008761 0.03349095 0.3673851 0.4343670
## Coef. Corr. 2  0.4005529 0.03349532 0.3670576 0.4340482
## h              0.8022257 0.03012104 0.7721046 0.8323467
## k              0.2008181 0.02694251 0.1738755 0.2277606
```

```
(tetrachoric(matrix(c(ns[1],ns[2],ns[3],ns[4]),2,2))) #Función de la librería psych
```

```
## Call: tetrachoric(x = matrix(c(ns[1], ns[2], ns[3], ns[4]), 2, 2))
## tetrachoric correlation
## [1] 0.4
##
##  with tau of
## [1] 0.8 0.2
```

```
#Ejemplo 4, NO se rechaza que p=0 porque N es pequeña
N <- 1000
s1 <- 5
s2 <- 5
p <- 0.05
h <- 4
k <- 1
ns <- frecuencias(N,s1,s2,p,h,k)
ns
```

```
## [1] 462 117 326  95
```

```
sum(ns)
```

```
## [1] 1000
```

```
rhot(ns[1],ns[2],ns[3],ns[4]) #Mi función
```

```
##               Estimacion       P.E.      l.lim      u.lim
## Coef. Corr. 1 0.05049398 0.03785009 0.01264389 0.08834406
## Coef. Corr. 2 0.05049649 0.03785007 0.01264642 0.08834656
## h              0.79950094 0.03008134 0.76941960 0.82958229
## k              0.19933590 0.02692613 0.17240977 0.22626203
```

```
(tetrachoric(matrix(c(ns[1],ns[2],ns[3],ns[4]),2,2))) #Función de la librería psych
```

```
## Call: tetrachoric(x = matrix(c(ns[1], ns[2], ns[3], ns[4]), 2, 2))
## tetrachoric correlation
## [1] 0.051
```

```
##
##  with tau of
## [1] 0.8 0.2
```

```
#Ejemplo 7 ejemplo loco
N <- 1000
s1 <- 1
s2 <- 1
p <- -0.89
h <- 15 #vs 3
k <- 0.3
ns <- frecuencias(N,s1,s2,p,h,k)
ns
```

```
## [1] 618   0 382   0
```

```
sum(ns)
```

```
## [1] 1000
```

```
rhot(ns[1],ns[2],ns[3],ns[4]) #Mi función
```

```
## [[1]]
##                Estimacion      P.E.     l.lim     u.lim
## Coef. Corr. 1 0.08906063 0.2500356 -0.160975 0.3390962
## h             3.09052914 0.2002018  2.890327 3.2907309
## k             0.29992316 0.0271602  0.272763 0.3270834
##
## [[2]]
## [1] "La serie 2 obtiene los siguientes valores:"
##
## [[3]]
## [1] 0.08907405 0.68770911
```

```
(tetrachoric(matrix(c(ns[1],ns[2],ns[3],ns[4]),2,2))) #Función de la librería psych
```

```
## For i = 1 j = 1  A cell entry of 0 was replaced with correct =  0.5.  Check your data!
```

```
## Call: tetrachoric(x = matrix(c(ns[1], ns[2], ns[3], ns[4]), 2, 2))
## tetrachoric correlation
## [1] 0.089
##
##  with tau of
## [1] 3.1 0.3
```

```
#Ejemplo 8 ejemplo loco
N <- 1000
s1 <- 1
s2 <- 1
p <- -0.89
h <- 3 #vs15
k <- 0.3
ns <- frecuencias(N,s1,s2,p,h,k)
ns
```

```
## [1] 617   1 382   0
```

```r
sum(ns)
```

```
## [1] 1000
```

```r
rhot(ns[1],ns[2],ns[3],ns[4]) #Mi función
```

```
## [[1]]
##                Estimacion      P.E.      l.lim     u.lim
## Coef. Corr. 1 -0.04037005 0.2181101 -0.2584802 0.1777401
## h              2.96789158 0.1691545  2.7987371 3.1370461
## k              0.29942251 0.0271655  0.2722570 0.3265880
##
## [[2]]
## [1] "La serie 2 obtiene los siguientes valores:"
##
## [[3]]
## [1] -0.80036495 -0.04035908  0.74608258
```

```r
(tetrachoric(matrix(c(ns[1],ns[2],ns[3],ns[4]),2,2))) #Función de la librería psych
```

```
## For i = 1 j = 1  A cell entry of 0 was replaced with correct =  0.5.  Check your data!
```

```
## Call: tetrachoric(x = matrix(c(ns[1], ns[2], ns[3], ns[4]), 2, 2))
## tetrachoric correlation
## [1] -0.04
##
##  with tau of
## [1] 3.0 0.3
```

```r
#Ejemplo 9 ejemplo loco
N <- 1000
s1 <- 1
s2 <- 1
p <- -0.89
h <- 0.1 #vs15
k <- 0.3
ns <- frecuencias(N,s1,s2,p,h,k)
ns
```

```
## [1] 178 439 361  21
```

```r
sum(ns)
```

```
## [1] 999
```

```r
rhot(ns[1],ns[2],ns[3],ns[4]) #Mi función
```

```
## [[1]]
##                Estimacion       P.E.       l.lim      u.lim
## Coef. Corr. 1 -0.89360564 0.01172868 -0.90533432 -0.8818770
## h              0.09927375 0.02679356  0.07248019  0.1260673
## k              0.29922973 0.02718531  0.27204442  0.3264150
##
## [[2]]
## [1] "La serie 2 obtiene los siguientes valores:"
##
## [[3]]
```

```
## numeric(0)
```

```
(tetrachoric(matrix(c(ns[1],ns[2],ns[3],ns[4]),2,2))) #Función de la librería psych
```

```
## Call: tetrachoric(x = matrix(c(ns[1], ns[2], ns[3], ns[4]), 2, 2))
## tetrachoric correlation
## [1] -0.89
##
##  with tau of
## [1] 0.099 0.299
```