HW2 Program

Subhrajyoty Roy

August 25, 2019

We first load the required packages in *R*.

```
library(vcd)
```

```
Loading required package: grid
```

```
library(lpSolve)
```

Now, we load the *SexualFun* data from **vcd** package.

```
data <- vcd::SexualFun
ftable(data)
```

```
             Wife Never Fun Fairly Often Very Often Always fun
Husband
Never Fun                 7           7          2          3
Fairly Often              2           8          3          7
Very Often                1           5          4          9
Always fun                2           8          9         14
```

We first obtain the actual values of Cohen's Kappa κ and the measure λ_r for the actual table;

```
kp <- Kappa(data)   #compute the actual Kappa
print(kp)
```

```
            value     ASE     z Pr(>|z|)
Unweighted 0.1293 0.06860 1.885 0.059387
Weighted   0.2374 0.07832 3.031 0.002437
```

We note that the actual value of Cohen's Kappa for *SexualFun* data is 0.12933025.

Consider the following code which computes λ_r;

```
n <- sum(data)
rowMar <- rowSums(data)/n
colMar <- colSums(data)/n

a <- sum(diag(data))/n
b <- max((rowMar + colMar)/2)

lambda <- (a - b)/(1-b)
print(lambda)
```

```
[1] 0
```

We find that the actual value of λ_r for *SexualFun* data is 0.

Now, we consider the minimization and maximization problem, where we try to find extremal values of $\sum_i p_{ii}$ or correspondingly $\sum_i n_{ii}$. We shall use **lpSolve** package to solve the corresponding linear programming for us.

```
lpMax = lp.transport(cost.mat = diag(4), direction = "max",
             row.signs = rep("==", 4), row.rhs = rowSums(data),
             col.signs = rep("==", 4), col.rhs = colSums(data))
```

The maximizing configuration would look like;

```
print(lpMax$solution)
```

```
     [,1] [,2] [,3] [,4]
[1,]   12    7    0    0
[2,]    0   20    0    0
[3,]    0    1   18    0
[4,]    0    0    0   33
```

Therefore, the maximum value of Cohen's kappa and λ_r is obtained using the following code;

```
Kappa(lpMax$solution)
```

```
            value     ASE     z   Pr(>|z|)
Unweighted 0.8799 0.03969 22.17 6.661e-109
Weighted   0.9291 0.02348 39.57  0.000e+00
```

```
a <- lpMax$objval/n
lambda <- (a - b)/(1-b)
print(lambda)
```

```
[1] 0.862069
```

Therefore, the maximum value of Cohen's Kappa given the marginals is 0.8799, while the maximum value of λ_r given the marginals is 0.8621.

We use similar method to find the minimum value of these measures given the marginals.

```
lpMin = lp.transport(cost.mat = diag(4), direction = "min",
             row.signs = rep("==", 4), row.rhs = rowSums(data),
             col.signs = rep("==", 4), col.rhs = colSums(data))
```

The maximizing configuration would look like;

```
print(lpMin$solution)
```

```
     [,1] [,2] [,3] [,4]
[1,]    0    0    0   19
[2,]    0    0    6   14
[3,]    0   19    0    0
[4,]   12    9   12    0
```

```
Kappa(lpMin$solution)
```

```
             value     ASE      z   Pr(>|z|)
Unweighted -0.3661 0.01593 -22.98 7.992e-117
Weighted   -0.5607 0.02691 -20.84  1.951e-96
```

```
a <- lpMin$objval/n
lambda <- (a - b)/(1-b)
print(lambda)
```

```
[1] -0.5689655
```

Therefore, the maximum value of Cohen's Kappa given the marginals is -0.3661, while the maximum value of λ_r given the marginals is -0.5689.