Artigo

## Códigos

require(magrittr)

Carregando pacotes exigidos: magrittr

RouteR::gerar\_variaveis(5,5,3)

# A tibble: 60 × 4  
 i j k x   
 <int> <int> <int> <chr>  
 1 1 2 1 x121   
 2 1 2 2 x122   
 3 1 2 3 x123   
 4 1 3 1 x131   
 5 1 3 2 x132   
 6 1 3 3 x133   
 7 1 4 1 x141   
 8 1 4 2 x142   
 9 1 4 3 x143   
10 1 5 1 x151   
# ℹ 50 more rows

custo=c(2,2,4,4,2,2,6,6,4,4,6,6)  
RouteR::gerar\_custo(3,3,2,custo)

cod x121 x122 x131 x132 x211 x212 x231 x232 x311 x312 x321 x322 direcao b  
custo 1 2 2 4 4 2 2 6 6 4 4 6 6 = 1

RouteR::gerar\_restricoes\_saida\_origem(3,3,2)

cod x121 x122 x131 x132 x211 x212 x231 x232 x311 x312 x321 x322 direcao b  
R\_1 1 1 0 1 0 0 0 0 0 0 0 0 0 = 1  
R\_2 2 0 1 0 1 0 0 0 0 0 0 0 0 = 1

RouteR::gerar\_restricoes\_retorno\_origem(3,3,2)

cod x121 x122 x131 x132 x211 x212 x231 x232 x311 x312 x321 x322 direcao b  
R\_1 1 0 0 0 0 1 0 0 0 1 0 0 0 = 1  
R\_2 2 0 0 0 0 0 1 0 0 0 1 0 0 = 1

RouteR::gerar\_restricoes\_unicidade(3,3,2)

cod x121 x122 x131 x132 x211 x212 x231 x232 x311 x312 x321 x322 direcao b  
R\_1 1 0 0 0 0 1 1 1 1 0 0 0 0 = 1  
R\_2 2 0 0 0 0 0 0 0 0 1 1 1 1 = 1

RouteR::gerar\_restricoes\_equilibrio(3,3,2)

cod x121 x122 x131 x132 x211 x212 x231 x232 x311 x312 x321 x322 direcao b  
R\_1 1 -1 0 0 0 1 0 1 0 0 0 -1 0 = 0  
R\_2 2 0 0 -1 0 0 0 -1 0 1 0 1 0 = 0  
R\_3 3 0 -1 0 0 0 1 0 1 0 0 0 -1 = 0  
R\_4 4 0 0 0 -1 0 0 0 -1 0 1 0 1 = 0

RouteR::gerar\_restricoes\_subrota(4,4,1, n\_restricao=1, n=2)

cod x121 x131 x141 x211 x231 x241 x311 x321 x341 x411 x421 x431 direcao b  
R\_1 1 1 0 0 1 0 0 0 0 0 0 0 0 <= 1  
R\_2 2 0 1 0 0 0 0 1 0 0 0 0 0 <= 1  
R\_3 3 0 0 1 0 0 0 0 0 0 1 0 0 <= 1  
R\_4 4 0 0 0 0 1 0 0 1 0 0 0 0 <= 1  
R\_5 5 0 0 0 0 0 1 0 0 0 0 1 0 <= 1  
R\_6 6 0 0 0 0 0 0 0 0 1 0 0 1 <= 1

n=5  
k=1  
vetor\_custos=c(2.8,2,100,100,  
+ 2.8,2.4,4.4,5.2,  
+ 2,2.1,4.2,5,  
+ 100,3.6,4.1,0.65,  
+ 0,0,0,0)  
custo <- RouteR::gerar\_custo(n,n,k,vetor\_custos)  
print(custo)

cod x121 x131 x141 x151 x211 x231 x241 x251 x311 x321 x341 x351 x411 x421  
custo 1 2.8 2 100 100 2.8 2.4 4.4 5.2 2 2.1 4.2 5 100 3.6  
 x431 x451 x511 x521 x531 x541 direcao b  
custo 4.1 0.65 0 0 0 0 = 1

n\_restricao<-1  
saida <- RouteR::gerar\_restricoes\_saida\_origem(n,n,k,n\_restricao)  
saida

cod x121 x131 x141 x151 x211 x231 x241 x251 x311 x321 x341 x351 x411 x421  
R\_1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0  
 x431 x451 x511 x521 x531 x541 direcao b  
R\_1 0 0 0 0 0 0 = 1

n\_restricao<- nrow(saida)+1  
n\_restricao

[1] 2

retorno <- RouteR::gerar\_restricoes\_retorno\_origem(n,n,k,n\_restricao)  
retorno

cod x121 x131 x141 x151 x211 x231 x241 x251 x311 x321 x341 x351 x411 x421  
R\_2 1 0 0 0 0 1 0 0 0 1 0 0 0 1 0  
 x431 x451 x511 x521 x531 x541 direcao b  
R\_2 0 0 1 0 0 0 = 1

n\_restricao<- n\_restricao+nrow(retorno)  
n\_restricao

[1] 3

equilibrio <- RouteR::gerar\_restricoes\_equilibrio(n,n,k,n\_restricao)  
equilibrio

cod x121 x131 x141 x151 x211 x231 x241 x251 x311 x321 x341 x351 x411 x421  
R\_3 1 -1 0 0 0 1 1 1 1 0 -1 0 0 0 -1  
R\_4 2 0 -1 0 0 0 -1 0 0 1 1 1 1 0 0  
R\_5 3 0 0 -1 0 0 0 -1 0 0 0 -1 0 1 1  
R\_6 4 0 0 0 -1 0 0 0 -1 0 0 0 -1 0 0  
 x431 x451 x511 x521 x531 x541 direcao b  
R\_3 0 0 0 -1 0 0 = 0  
R\_4 -1 0 0 0 -1 0 = 0  
R\_5 1 1 0 0 0 -1 = 0  
R\_6 0 -1 1 1 1 1 = 0

n\_restricao<- n\_restricao+nrow(equilibrio)  
n\_restricao

[1] 7

unicidade <- RouteR::gerar\_restricoes\_unicidade(n,n,k,n\_restricao)  
unicidade

cod x121 x131 x141 x151 x211 x231 x241 x251 x311 x321 x341 x351 x411 x421  
R\_7 1 0 0 0 0 1 1 1 1 0 0 0 0 0 0  
R\_8 2 0 0 0 0 0 0 0 0 1 1 1 1 0 0  
R\_9 3 0 0 0 0 0 0 0 0 0 0 0 0 1 1  
R\_10 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
 x431 x451 x511 x521 x531 x541 direcao b  
R\_7 0 0 0 0 0 0 = 1  
R\_8 0 0 0 0 0 0 = 1  
R\_9 1 1 0 0 0 0 = 1  
R\_10 0 0 1 1 1 1 = 1

Dados <- dplyr::bind\_rows(custo,saida,retorno,equilibrio,unicidade)  
RouteR::gerar\_rota(Dados)

$rota  
 var solucao  
1 x131 1  
2 x211 1  
3 x321 1  
4 x451 1  
5 x541 1  
  
$solucao  
 [1] 0 1 0 0 1 0 0 0 0 1 0 0 0 0 0 1 0 0 0 1  
  
$objetivo  
[1] 7.55

vetor\_rota<-RouteR::gerar\_rota(Dados)$rota$var  
#Organizando a rota obtida  
RouteR::organizar\_rota(vetor\_rota)

Rota Veiculo  
1 13 1  
2 21 1  
3 32 1  
4 45 1  
5 54 1

subrota1 <- RouteR::gerar\_restricoes\_subrota(n,n,k,n\_restricao,2)  
  
Dados <- dplyr::bind\_rows(custo,saida,retorno,equilibrio,unicidade, subrota1)  
RouteR::gerar\_rota(Dados)

$rota  
 var solucao  
1 x131 1  
2 x241 1  
3 x321 1  
4 x451 1  
5 x511 1  
  
$solucao  
 [1] 0 1 0 0 0 0 1 0 0 1 0 0 0 0 0 1 1 0 0 0  
  
$objetivo  
[1] 9.15

vetor\_rota<-RouteR::gerar\_rota(Dados)$rota$var  
#Organizando a rota obtida  
RouteR::organizar\_rota(vetor\_rota)

Rota Veiculo  
1 13 1  
2 24 1  
3 32 1  
4 45 1  
5 51 1

RouteR::ordenar\_rota(vetor\_rota)

# A tibble: 5 × 4  
 Veiculo Rota origem destino  
 <dbl> <chr> <dbl> <dbl>  
1 1 13 1 3  
2 1 32 3 2  
3 1 24 2 4  
4 1 45 4 5  
5 1 51 5 1