**Příklad řešení soustavy rovnic**

> A <- matrix(c(3,1,4,6),2,2)

> A

 [,1] [,2]

[1,] 3 4

[2,] 1 6

> y <- matrix(c(4,2),2,1)

> y

 [,1]

[1,] 4

[2,] 2

> x <- solve(A) %\*% y

> x

 [,1]

[1,] 1.1428571

[2,] 0.1428571

**Otcovský (sire) model**

> X <- matrix(c(1,0,1,1,1,0,

+ 0,1,0,0,0,1),6,2)

> X

 [,1] [,2]

[1,] 1 0

[2,] 0 1

[3,] 1 0

[4,] 1 0

[5,] 1 0

[6,] 0 1

> Z <- matrix(c(1,1,0,0,0,0,

+ 0,0,1,1,0,0,

+ 0,0,0,0,1,1),6,3)

> Z

 [,1] [,2] [,3]

[1,] 1 0 0

[2,] 1 0 0

[3,] 0 1 0

[4,] 0 1 0

[5,] 0 0 1

[6,] 0 0 1

> R <- diag(c(1,1,1,1,1,1)\*6

+ R <- diag(c(1,1,1,1,1,1)\*6>

> R <- diag(c(1,1,1,1,1,1))\*6

> R

 [,1] [,2] [,3] [,4] [,5] [,6]

[1,] 6 0 0 0 0 0

[2,] 0 6 0 0 0 0

[3,] 0 0 6 0 0 0

[4,] 0 0 0 6 0 0

[5,] 0 0 0 0 6 0

[6,] 0 0 0 0 0 6

> Va <- 8

> Vo <- Va/4

> G <- diag(3)\*Vo

> G

 [,1] [,2] [,3]

[1,] 2 0 0

[2,] 0 2 0

[3,] 0 0 2

> V <- Z %\*% G%\*%t(Z) + R

> V

 [,1] [,2] [,3] [,4] [,5] [,6]

[1,] 8 2 0 0 0 0

[2,] 2 8 0 0 0 0

[3,] 0 0 8 2 0 0

[4,] 0 0 2 8 0 0

[5,] 0 0 0 0 8 2

[6,] 0 0 0 0 2 8

> y <-matrix(c(9,12,11,6,7,14),6,1)

> y

 [,1]

[1,] 9

[2,] 12

[3,] 11

[4,] 6

[5,] 7

[6,] 14

> BLUE <- solve(t(X)%\*%solve(V)%\*%X)%\*%(t(X)%\*%solve(V)%\*%y)

> BLUE

 [,1]

[1,] 8.222222

[2,] 13.055556

> BLUP <- G%\*%t(Z)%\*%solve(V) %\*%(y-(X%\*%BLUE))

> BLUP

 [,1]

[1,] -0.05555556

[2,] 0.11111111

[3,] -0.05555556

> # metodou normálních rovnic smíšeného modelu

> XRX <- t(X)%\*%solve(R)%\*%X

> XRX

 [,1] [,2]

[1,] 0.6666667 0.0000000

[2,] 0.0000000 0.3333333

> XRZ <- t(X)%\*%solve(R)%\*%Z

> XRZ

 [,1] [,2] [,3]

[1,] 0.1666667 0.3333333 0.1666667

[2,] 0.1666667 0.0000000 0.1666667

> ZRX <- t(Z)%\*%solve(R)%\*%X

> ZRX

 [,1] [,2]

[1,] 0.1666667 0.1666667

[2,] 0.3333333 0.0000000

[3,] 0.1666667 0.1666667

> ZRZG <- t(Z)%\*%solve(R)%\*%Z + solve(G)

> ZRZG

 [,1] [,2] [,3]

[1,] 0.8333333 0.0000000 0.0000000

[2,] 0.0000000 0.8333333 0.0000000

[3,] 0.0000000 0.0000000 0.8333333

> LS1 <-rbind(XRX,ZRX)

> LS1

 [,1] [,2]

[1,] 0.6666667 0.0000000

[2,] 0.0000000 0.3333333

[3,] 0.1666667 0.1666667

[4,] 0.3333333 0.0000000

[5,] 0.1666667 0.1666667

> LS2 <- rbind(XRZ,ZRZG)

> LS2

 [,1] [,2] [,3]

[1,] 0.1666667 0.3333333 0.1666667

[2,] 0.1666667 0.0000000 0.1666667

[3,] 0.8333333 0.0000000 0.0000000

[4,] 0.0000000 0.8333333 0.0000000

[5,] 0.0000000 0.0000000 0.8333333

> LS <- cbind(LS1,LS2)

> LS

 [,1] [,2] [,3] [,4] [,5]

[1,] 0.6666667 0.0000000 0.1666667 0.3333333 0.1666667

[2,] 0.0000000 0.3333333 0.1666667 0.0000000 0.1666667

[3,] 0.1666667 0.1666667 0.8333333 0.0000000 0.0000000

[4,] 0.3333333 0.0000000 0.0000000 0.8333333 0.0000000

[5,] 0.1666667 0.1666667 0.0000000 0.0000000 0.8333333

> XRy <- t(X)%\*%solve(R)%\*%y

> XRy

 [,1]

[1,] 5.500000

[2,] 4.333333

> ZRy <- t(Z)%\*%solve(R)%\*%y

> ZRy

 [,1]

[1,] 3.500000

[2,] 2.833333

[3,] 3.500000

> PS <- rbind(XRy,ZRy)

> PS

 [,1]

[1,] 5.500000

[2,] 4.333333

[3,] 3.500000

[4,] 2.833333

[5,] 3.500000

> bu <- solve(LS)%\*%PS

> bu

 [,1]

[1,] 8.22222222

[2,] 13.05555556

[3,] -0.05555556

[4,] 0.11111111

[5,] -0.05555556

**Animal model**

> h2 <- 0.25

> K <- (1-h2)/h2

> X <- matrix(c(1,1,1,0,0,

+ 0,0,0,1,1,

+ 1,1,0,0,1,

+ 0,0,1,1,0),5,4)

> X

 [,1] [,2] [,3] [,4]

[1,] 1 0 1 0

[2,] 1 0 1 0

[3,] 1 0 0 1

[4,] 0 1 0 1

[5,] 0 1 1 0

> Z <- diag(1,5)

> Z

 [,1] [,2] [,3] [,4] [,5]

[1,] 1 0 0 0 0

[2,] 0 1 0 0 0

[3,] 0 0 1 0 0

[4,] 0 0 0 1 0

[5,] 0 0 0 0 1

> y <- matrix(c(4500,5000,6500,8000,7000),5,1)

> y

 [,1]

[1,] 4500

[2,] 5000

[3,] 6500

[4,] 8000

[5,] 7000

> A <- matrix(c(1,0,0,0,0,0,

+ 0,1,0,0,0.25,0.5,

+ 0,0,1,0,0,0,

+ 0,0,0,1,0,0,

+ 0,0.25,0,0,1,0.5,

+ 0,0.5,0,0,0.5,1),6,6)

> A

 [,1] [,2] [,3] [,4] [,5] [,6]

[1,] 1 0.00 0 0 0.00 0.0

[2,] 0 1.00 0 0 0.25 0.5

[3,] 0 0.00 1 0 0.00 0.0

[4,] 0 0.00 0 1 0.00 0.0

[5,] 0 0.25 0 0 1.00 0.5

[6,] 0 0.50 0 0 0.50 1.0

> XX <-(tX)%\*%X

Error: object 'tX' not found

> XX <-t(X)%\*%X

> XX

 [,1] [,2] [,3] [,4]

[1,] 3 0 2 1

[2,] 0 2 1 1

[3,] 2 1 3 0

[4,] 1 1 0 2

> XZ <- t(X)%\*%Z

> XZ

 [,1] [,2] [,3] [,4] [,5]

[1,] 1 1 1 0 0

[2,] 0 0 0 1 1

[3,] 1 1 0 0 1

[4,] 0 0 1 1 0

> ZZ <- t(Z)%\*%Z

> ZZ

 [,1] [,2] [,3] [,4] [,5]

[1,] 1 0 0 0 0

[2,] 0 1 0 0 0

[3,] 0 0 1 0 0

[4,] 0 0 0 1 0

[5,] 0 0 0 0 1

> AK <- solve(A)\*K

> AK

 [,1] [,2] [,3] [,4] [,5] [,6]

[1,] 3 0 0 0 0.000000e+00 0

[2,] 0 4 0 0 1.665335e-16 -2

[3,] 0 0 3 0 0.000000e+00 0

[4,] 0 0 0 3 0.000000e+00 0

[5,] 0 0 0 0 4.000000e+00 -2

[6,] 0 -2 0 0 -2.000000e+00 5

> ZX <- t(Z)%\*%X

> ZX

 [,1] [,2] [,3] [,4]

[1,] 1 0 1 0

[2,] 1 0 1 0

[3,] 1 0 0 1

[4,] 0 1 0 1

[5,] 0 1 1 0

> Z0 <- matrix(c(0,0,0,0,0),1,5)

> Z0

 [,1] [,2] [,3] [,4] [,5]

[1,] 0 0 0 0 0

> Z00 <- matrix(c(0,0,0,0,0,0),6,1)

> Z00

 [,1]

[1,] 0

[2,] 0

[3,] 0

[4,] 0

[5,] 0

[6,] 0

> ZZZ <- cbind(rbind(ZZ,Z0),Z00)

> ZZZ

 [,1] [,2] [,3] [,4] [,5] [,6]

[1,] 1 0 0 0 0 0

[2,] 0 1 0 0 0 0

[3,] 0 0 1 0 0 0

[4,] 0 0 0 1 0 0

[5,] 0 0 0 0 1 0

[6,] 0 0 0 0 0 0

> ZAK <- ZZZ+AK

> ZAK

 [,1] [,2] [,3] [,4] [,5] [,6]

[1,] 4 0 0 0 0.000000e+00 0

[2,] 0 5 0 0 1.665335e-16 -2

[3,] 0 0 4 0 0.000000e+00 0

[4,] 0 0 0 4 0.000000e+00 0

[5,] 0 0 0 0 5.000000e+00 -2

[6,] 0 -2 0 0 -2.000000e+00 5

> 01 <- matrix(c(0,0,0,0),4,1)

Error in 1 <- matrix(c(0, 0, 0, 0), 4, 1) :

 invalid (do\_set) left-hand side to assignment

> X01 <- matrix(c(0,0,0,0),4,1)

> XZ0 <- cbind(XZ,X01)

> XZ0

 [,1] [,2] [,3] [,4] [,5] [,6]

[1,] 1 1 1 0 0 0

[2,] 0 0 0 1 1 0

[3,] 1 1 0 0 1 0

[4,] 0 0 1 1 0 0

> Z01 <- matrix(c(0,0,0,0),1,4)

> ZX0 <- rbind(ZX,Z01)

> ZX0

 [,1] [,2] [,3] [,4]

[1,] 1 0 1 0

[2,] 1 0 1 0

[3,] 1 0 0 1

[4,] 0 1 0 1

[5,] 0 1 1 0

[6,] 0 0 0 0

> LS1 <- rbind(XX,ZX0)

> LS1 <- rbind(XZ0,ZAK)

> LS1 <- rbind(XX,ZX0)

> LS2 <- rbind(XZ0,ZAK)

> LS <- cbind(LS1,LS2)

> LS

 [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10]

 [1,] 3 0 2 1 1 1 1 0 0.000000e+00 0

 [2,] 0 2 1 1 0 0 0 1 1.000000e+00 0

 [3,] 2 1 3 0 1 1 0 0 1.000000e+00 0

 [4,] 1 1 0 2 0 0 1 1 0.000000e+00 0

 [5,] 1 0 1 0 4 0 0 0 0.000000e+00 0

 [6,] 1 0 1 0 0 5 0 0 1.665335e-16 -2

 [7,] 1 0 0 1 0 0 4 0 0.000000e+00 0

 [8,] 0 1 0 1 0 0 0 4 0.000000e+00 0

 [9,] 0 1 1 0 0 0 0 0 5.000000e+00 -2

[10,] 0 0 0 0 0 -2 0 0 -2.000000e+00 5

> Xy <- t(X)%\*%y

> Xy

 [,1]

[1,] 16000

[2,] 15000

[3,] 16500

[4,] 14500

> Zy <- t(Z)%\*%y

> Zy

 [,1]

[1,] 4500

[2,] 5000

[3,] 6500

[4,] 8000

[5,] 7000

> PS <- rbind(Xy,Zy,0)

> PS

 [,1]

 [1,] 16000

 [2,] 15000

 [3,] 16500

 [4,] 14500

 [5,] 4500

 [6,] 5000

 [7,] 6500

 [8,] 8000

 [9,] 7000

[10,] 0

> invLS <- solve(LS)

Error in solve.default(LS) :

 system is computationally **singular**: reciprocal condition number = 1.23358e-17

**Protože matice LS je singulární (má nulový determinant), nelze ji invertovat standardním způsobem. Řešením je úprava matice LS, nebo použít zobecněnou inverzi.**

**Zde je potřeba načíst balíček MASS, aby bylo možné použít příkaz pro zobecněnou inverzi.**

> bu <- ginv(LS)%\*%PS

> bu

 [,1]

 [1,] 2302.23138

 [2,] 4229.74702

 [3,] 2547.96760

 [4,] 3984.01080

 [5,] -87.54974

 [6,] 47.47015

 [7,] 53.43945

 [8,] -53.43945

 [9,] 61.96703

[10,] 43.77487

>