Exercises: Prediction of breeding values

Exercise 1: sire model with no fixed effects.

The following data regarding number of daughters and their milk production (kg protein during 305 days) is available for four progeny tested bulls.

Sire	No. daughters($n_{i\bullet}$)	Sum of observations ($Y_{i\bullet}$)
1	10	2 000
2	25	4 700
3	50	8 500
4	100	22 000
Total	185	37 200

a) Set up a complete statistical model describing the data. Also give expectations and (co)variances for the random effects. What is this model called?

b) Assume that heritability for protein production is 0.25. What is the value of the variance ratio σ^2_e/σ^2_s?

c) Set up the mixed model equations (MME) in matrix form for this example.

d) Solve the equation system using Excel.

e) What are the additive breeding values and ranking for the 4 sires? What are the average breeding value (μ_T) and the phenotypic average (μ_P)?