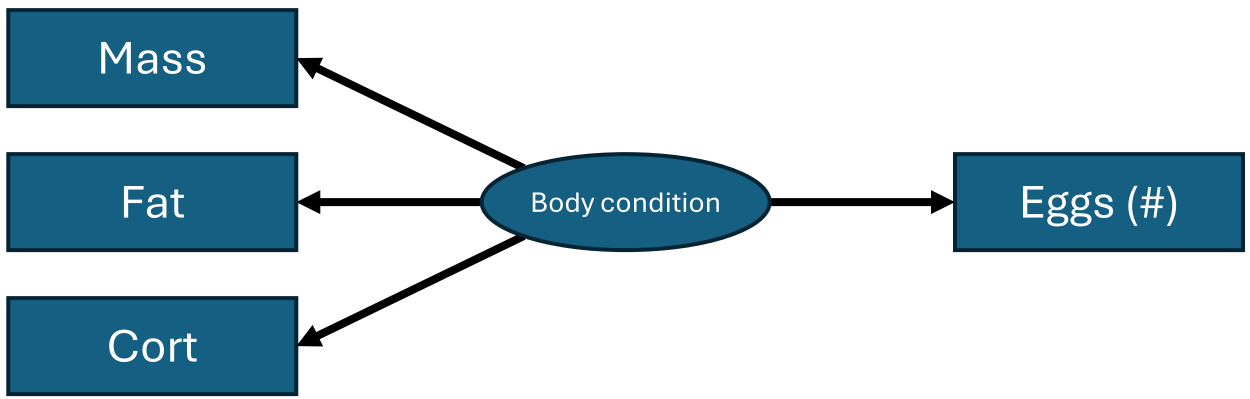
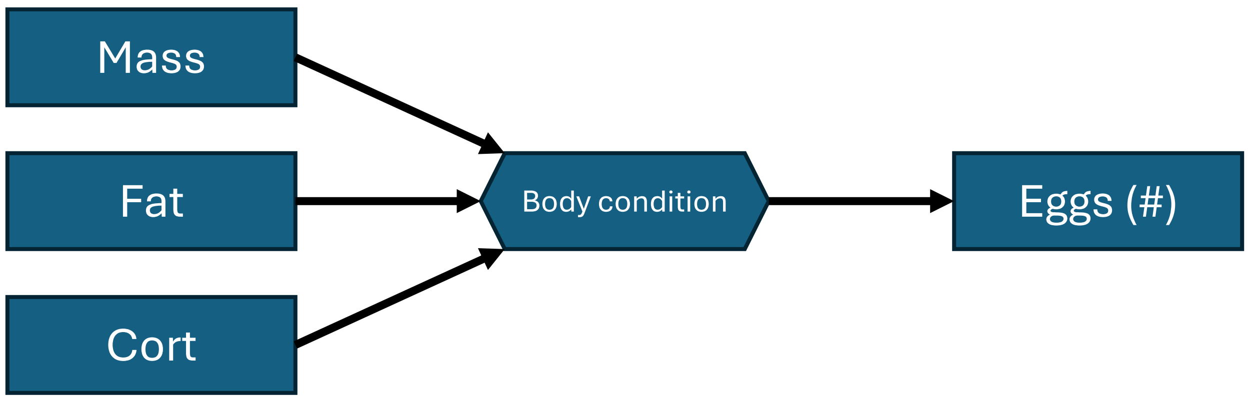
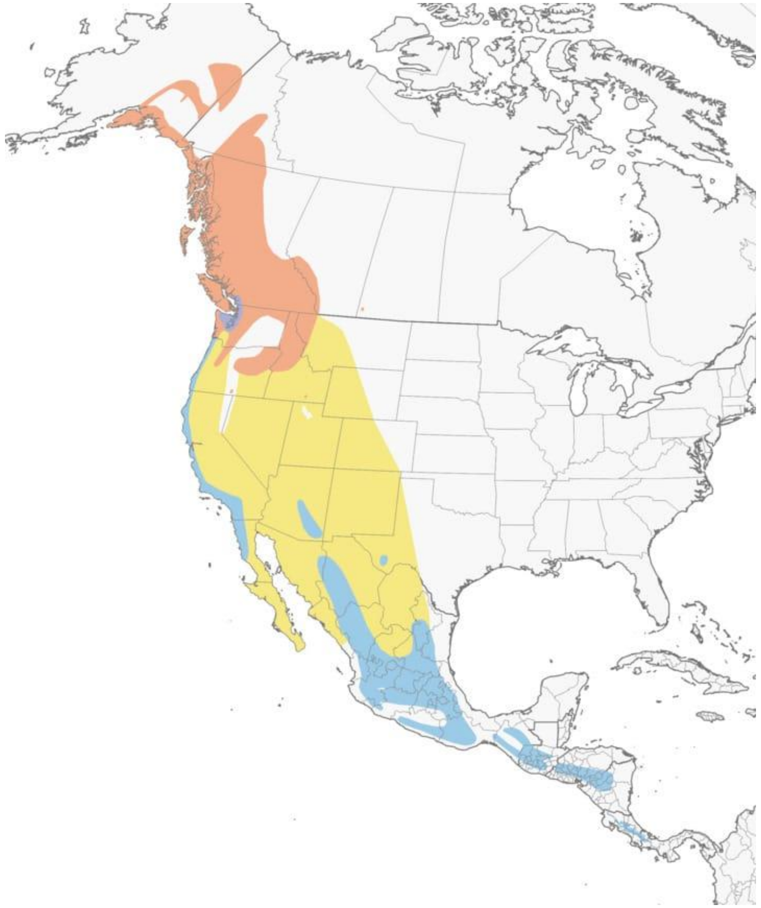
Modeling body condition





Still yellow-footed weeble-wobbles…



We're going to capture warblers prior to breeding and mark them

1. Mass (g)

2. Corticosterone (z-standardized)

3. Fat (g)

4. Clutch size (eggs)

We'll then monitor their breeding efforts

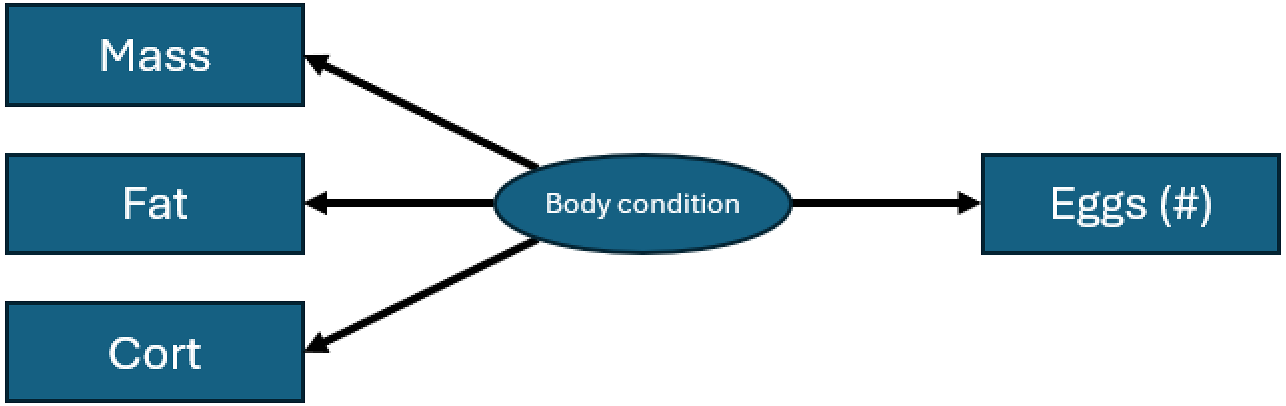
Our predictions

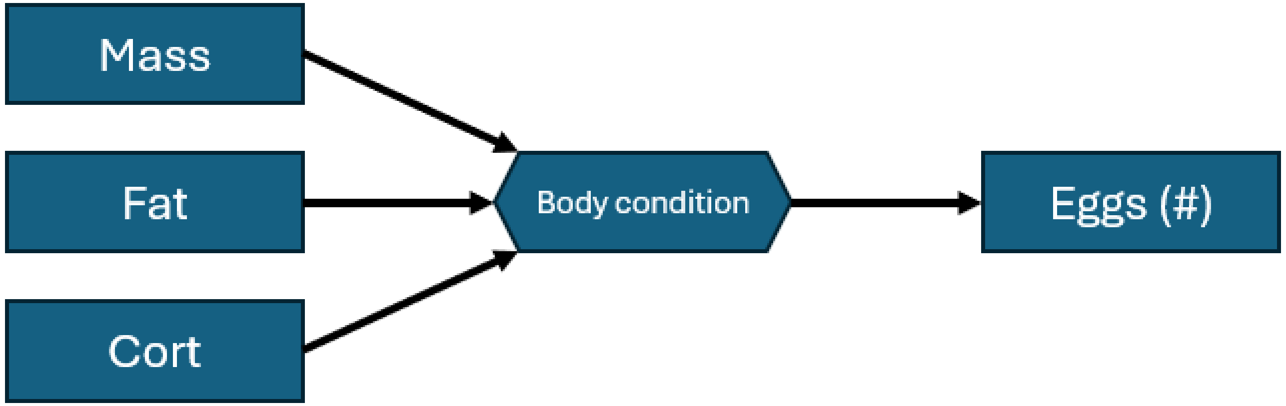
1. Heavier birds will lay more eggs

2. More corticosterone (z-standardized) will lead to smaller clutches

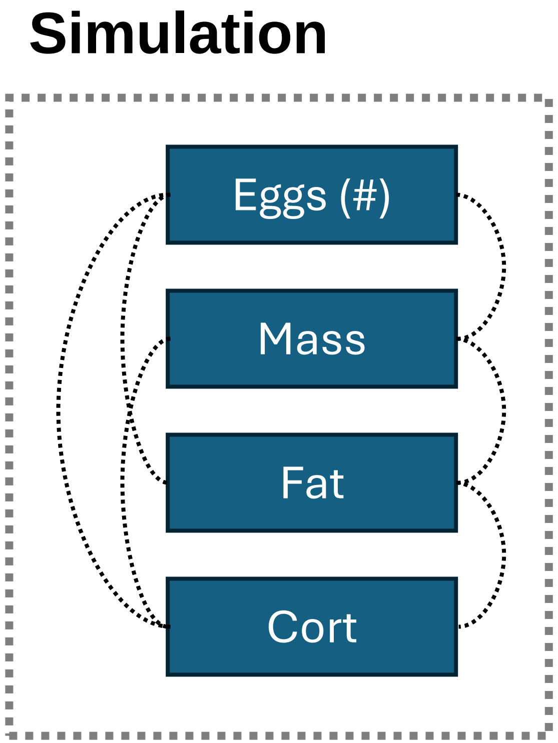
3. Birds with more fat reserves will lay more eggs

We’ll build two models (mL and mC for latent and composite parameterizations)





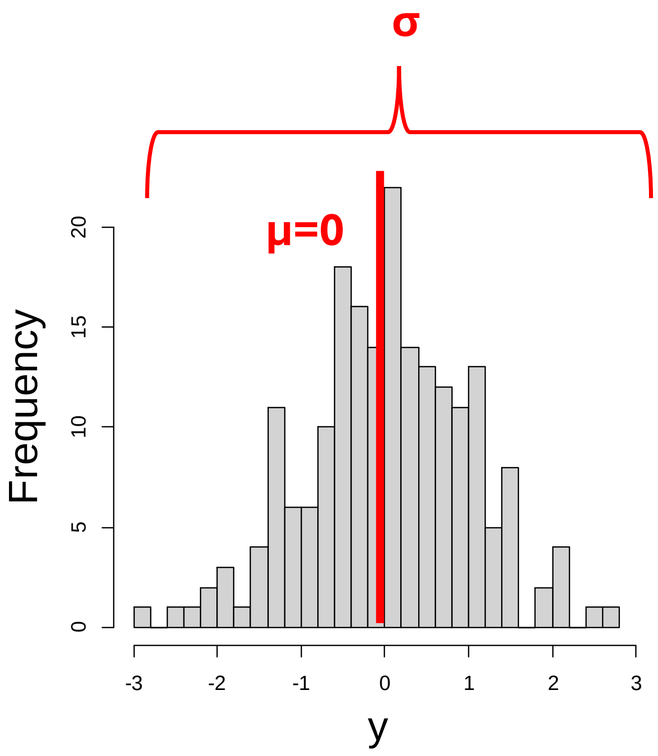
Data simulation: multivariate normal



$$\mathbf{y} \sim \mathrm{N}_4(\mathbf{0}, \boldsymbol{\Sigma})$$

What is a multivariate normal distribution (a bivariate normal example)?

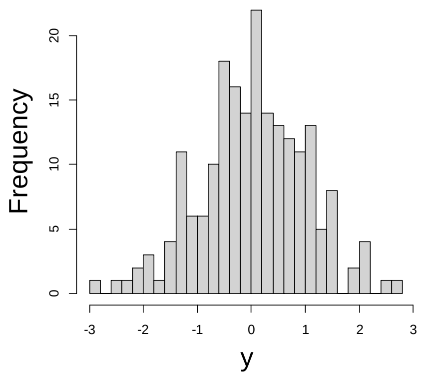
Recall a normal distribution

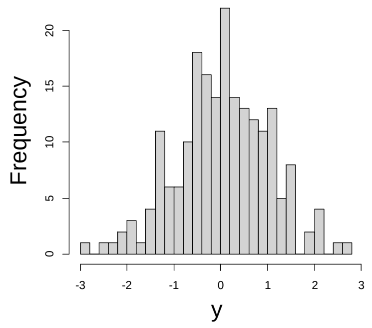


$$\mathbf{y} \sim \text{Normal}(0, \sigma^2)$$

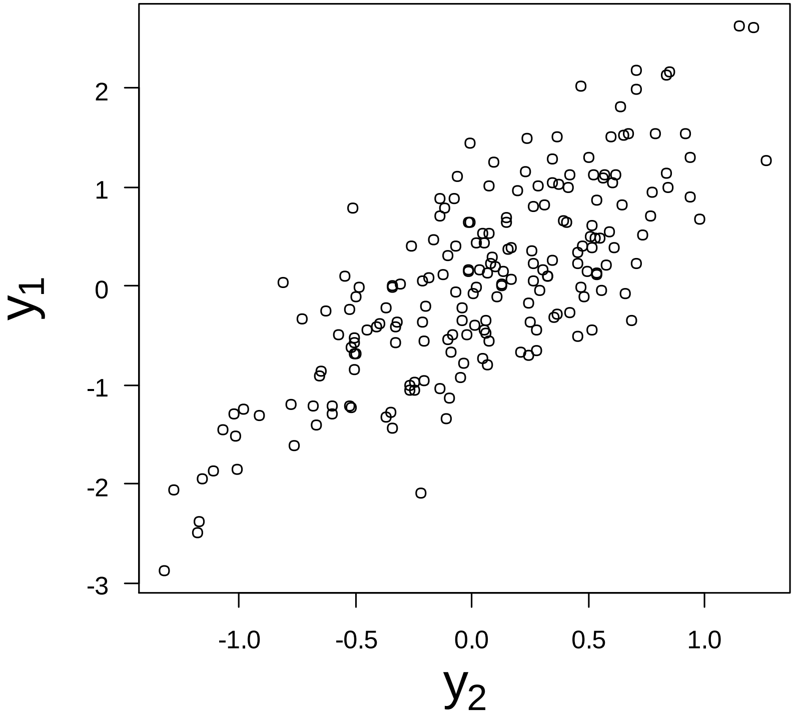
What is a multivariate normal distribution (a bivariate normal example)?

Two normal distributions would have four parameters (two means, and two variances or standard deviations)



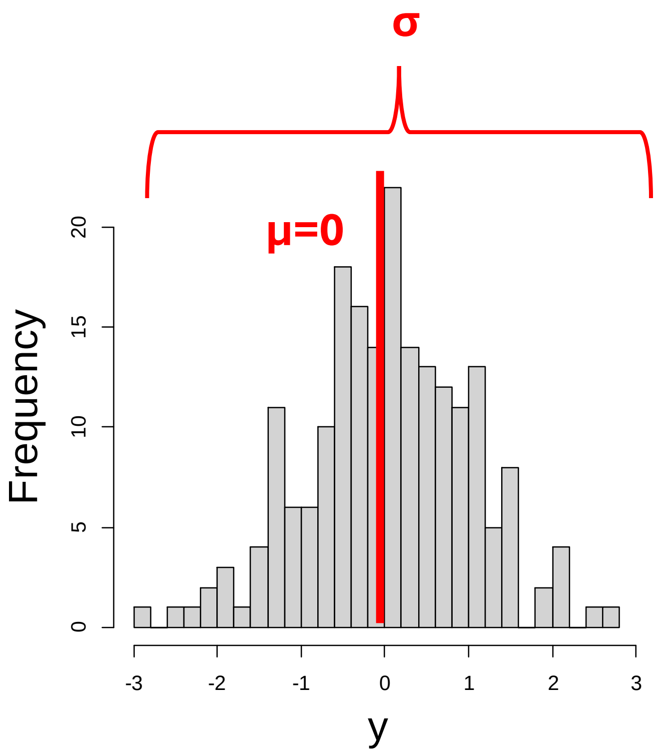


A bivariate normal distribution has those same four parameters plus a fifth <u>correlation</u> parameter.



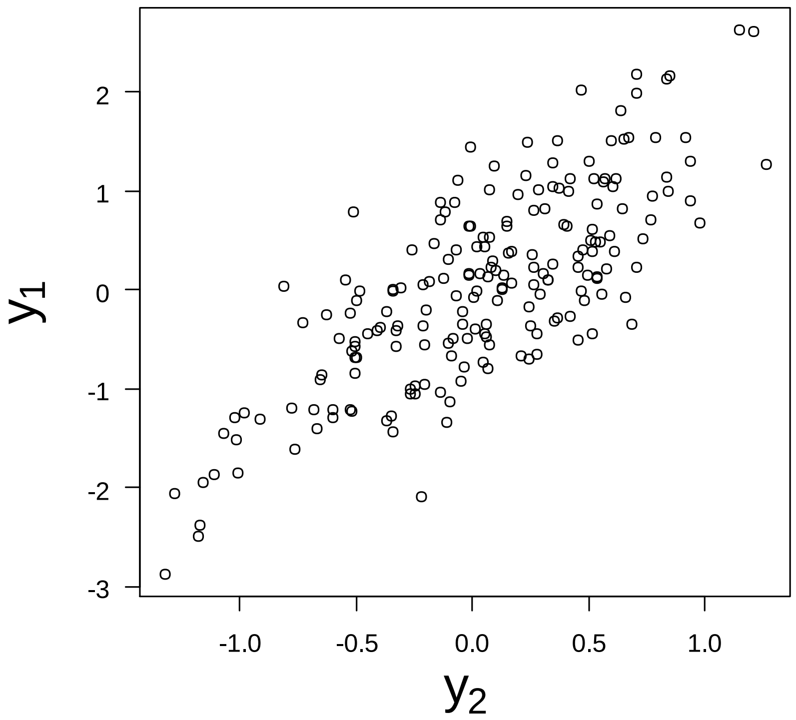
What is a multivariate normal distribution (a bivariate normal example)?

Recall a normal distribution



$$\mathbf{y} \sim \mathrm{Normal}(0, \sigma^2)$$

Multivariate normal distributions include correlations

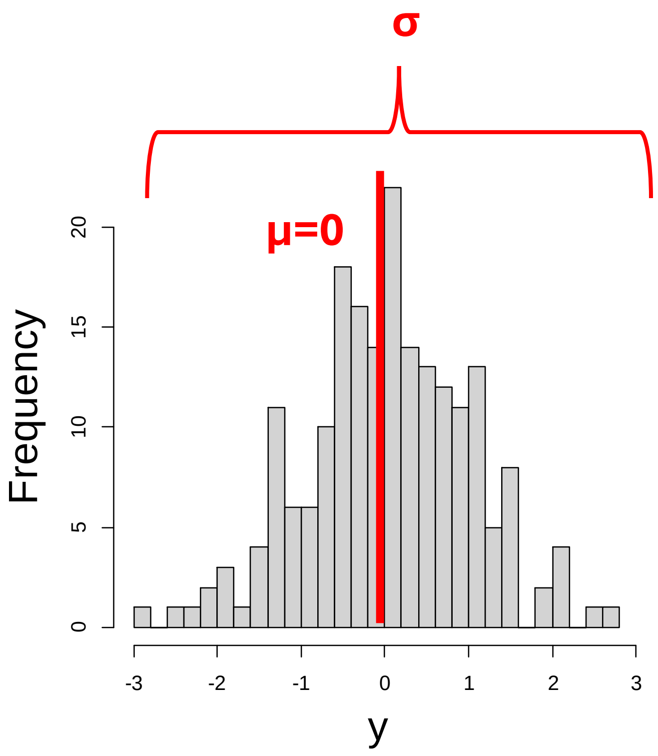


$$\mathbf{Y} \sim \mathrm{N}_2(\mathbf{0}, \mathbf{\Sigma})$$

$$\mathbf{\Sigma} = \begin{bmatrix} \sigma_1^2 & \sigma_1\sigma_2\rho \\ \sigma_1\sigma_2\rho & \sigma_2^2 \end{bmatrix}$$

What is a multivariate normal distribution (a bivariate normal example)?

Recall a normal distribution



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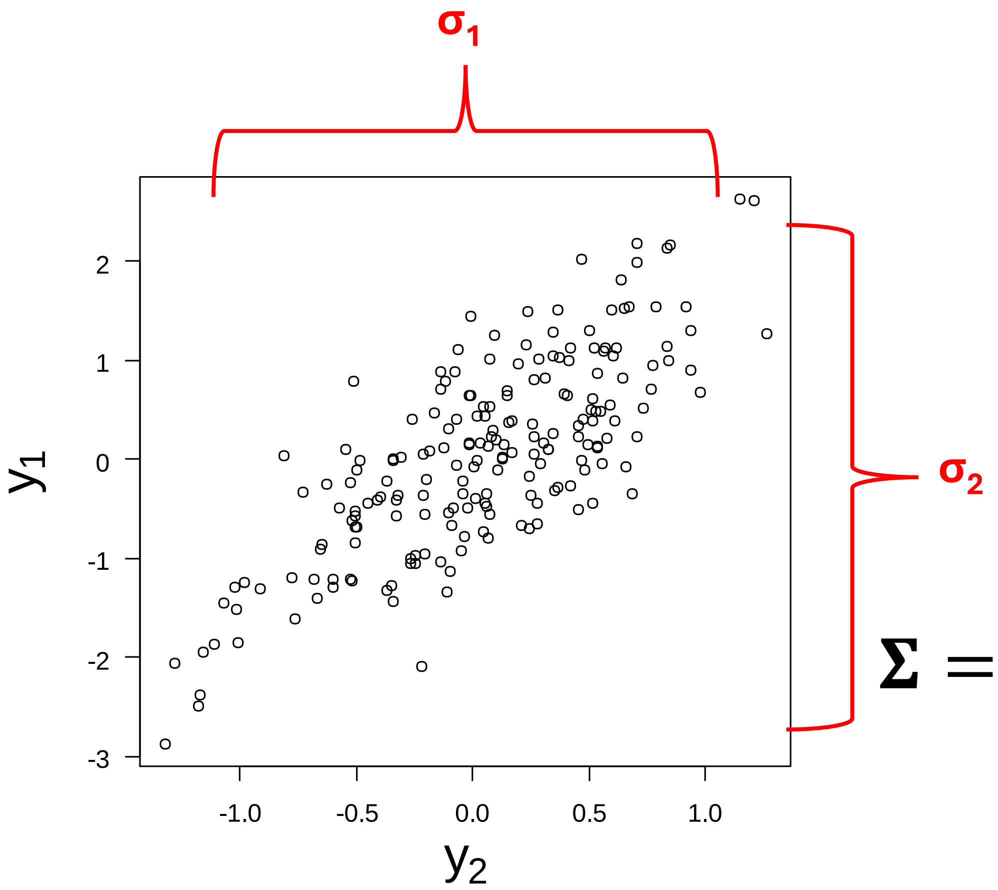

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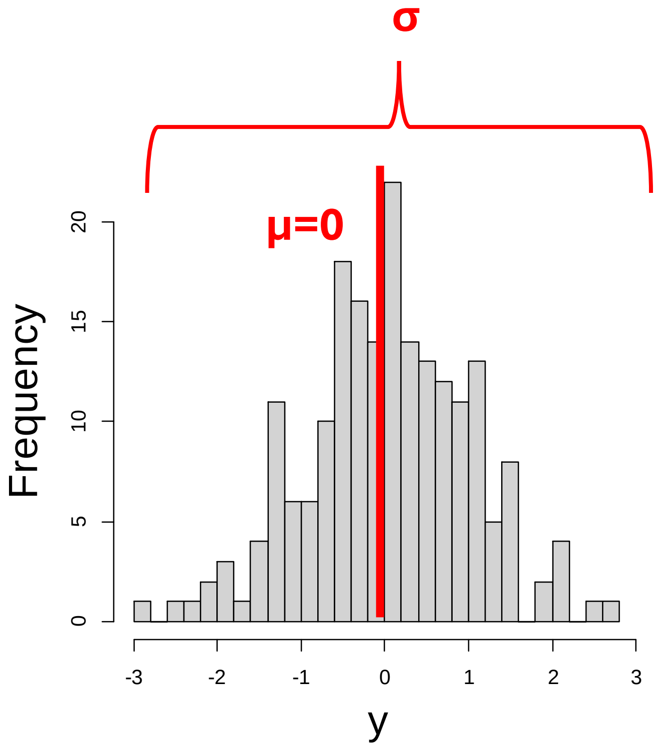

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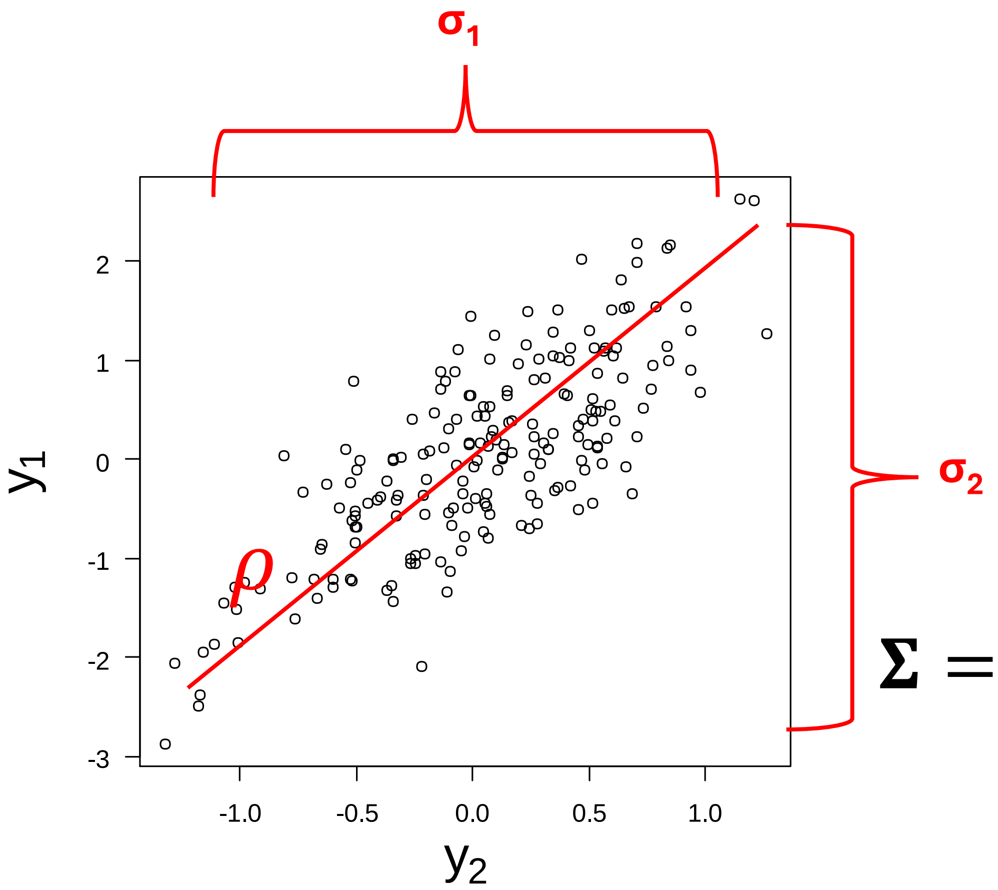
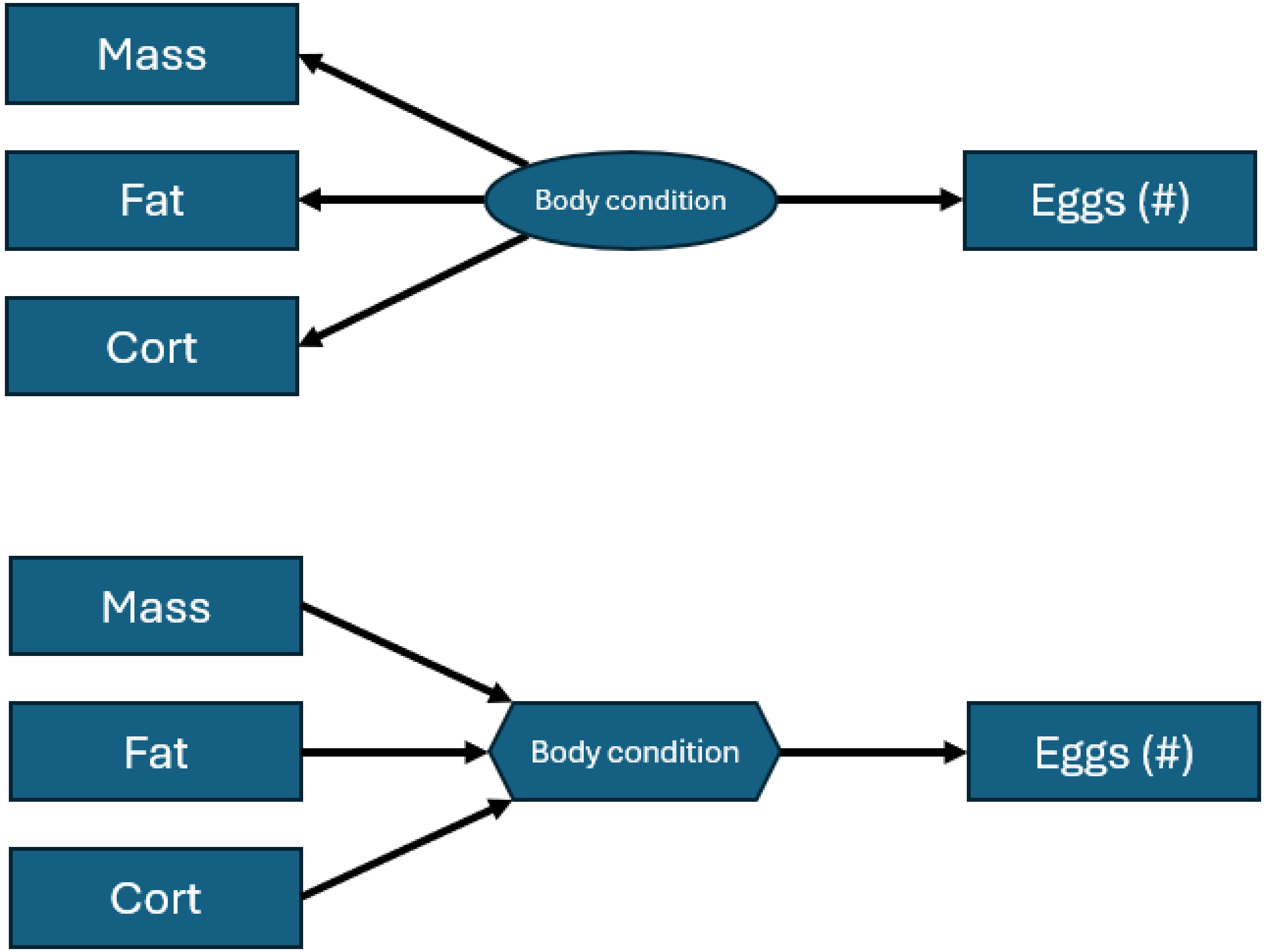
Multivariate normal distributions include correlations

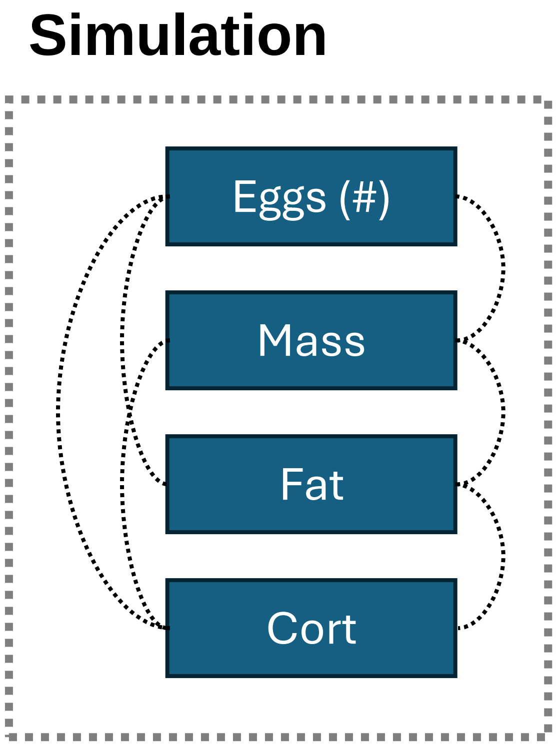


$$\mathbf{Y} \sim \mathrm{N}_2(\mathbf{0}, \mathbf{\Sigma})$$

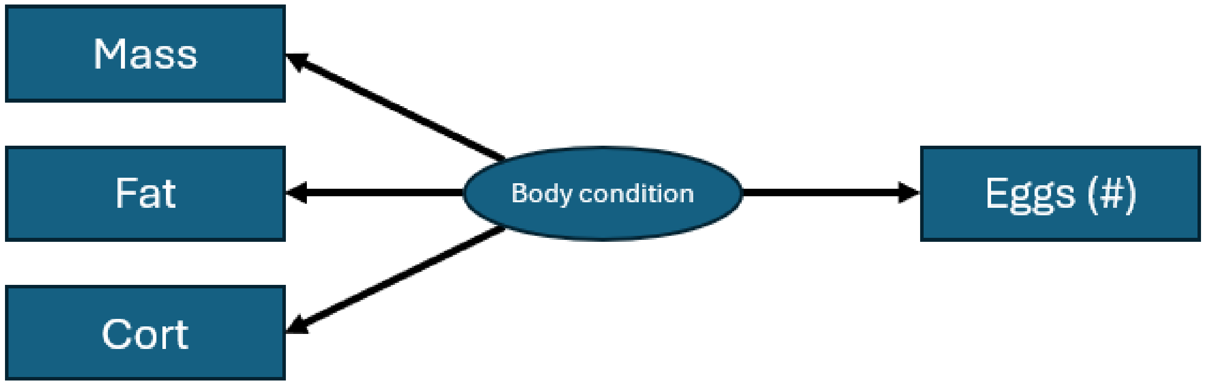
$$\mathbf{\Sigma} = \begin{bmatrix} \sigma_1^2 & \sigma_1\sigma_2\rho \\ \sigma_1\sigma_2\rho & \sigma_2^2 \end{bmatrix}$$

We did that so neither of these would be the ‘data-generating’ model





The latent variable model



$$\mathbf{b} \sim \text{Normal}(0, \sigma_c^2)$$

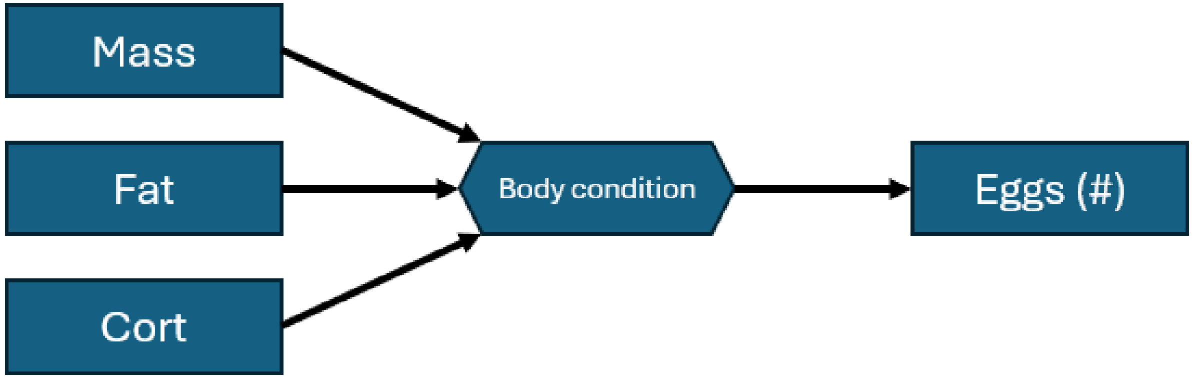
$$\mathbf{m} \sim \text{Normal}(\alpha_1 + \beta_1 \mathbf{b}, \sigma_m^2)$$

$$\mathbf{f} \sim \text{Normal}(\alpha_2 + \beta_2 \mathbf{b}, \sigma_m^2)$$

$$\mathbf{c} \sim \text{Normal}(\alpha_3 + \beta_3 \mathbf{b}, \sigma_m^2)$$

$$\mathbf{e} \sim \text{Poisson}(e^{\alpha_4 + \beta_4 \mathbf{b}})$$

The composite variable model



$$\mathbf{b} \sim N(\beta_1 \mathbf{m} + \beta_2 \mathbf{f} + \beta_3 \mathbf{c}, \boldsymbol{\sigma}_{\boldsymbol{b}}^{\mathbf{2}})$$

$$\mathbf{e} \sim \mathrm{Poisson}(e^{\alpha_4 + \beta_4 \mathbf{b}})$$

Let's think ahead… how would we make predictions from each model…