Average Daily Gain (ADG) Equation Derivation

Step 1: Initial Form

$$\text{ADG} = \frac{\text{NE}_g}{\text{E}_{\text{req}}} \tag{1}$$

Step 2: Expand Net Energy for Growth

$$\text{ADG} = \frac{\text{ME} - \text{ME}_m}{\text{E}_{\text{req}}} \tag{2}$$

Step 3: Express ME in terms of Digestible Energy

Rewrite $\text{ME} = \text{DE} \cdot \alpha$ (where α is a coefficient), so during model training we can use DE directly:

$$\text{ADG} = \frac{\text{DE} - \text{ME}_m}{\text{E}_{\text{req}}} \tag{3}$$

Step 4: Substitute Gross Energy

$$\text{ADG} = \frac{\text{GE} - \text{ME}_m}{\text{E}_{\text{req}}} \tag{4}$$

Step 5: Expand into Feed Components

Express gross energy as sum of TDN (Total Digestible Nutrients) from different feed sources:

$$\text{ADG} = \frac{\text{TDN}_{\text{slobb}} \cdot \beta_1 + \text{TDN}_{\text{grass}} \cdot \beta_2 + \text{TDN}_{\text{cornstalk}} \cdot \beta_3 - \text{ME}_m}{\text{E}_{\text{req}}} \tag{5}$$

Step 6: Express Maintenance Energy in terms of Metabolic Weight

Let $\text{ME}_m = \text{MW} \cdot \beta_4$, where MW is metabolic weight and β_4 is the coefficient (biological value, BV):

$$\text{ADG} = \frac{\text{TDN}_{\text{slobb}} \cdot \beta_1 + \text{TDN}_{\text{grass}} \cdot \beta_2 + \text{TDN}_{\text{cornstalk}} \cdot \beta_3 - \text{MW} \cdot \beta_4}{\text{E}_{\text{req}}} \tag{6}$$

Step 7: Linear Form

Since E_{req} depends on MW, we can incorporate it into the coefficients. The final linear equation becomes:

$$\text{ADG} = \gamma_1 \cdot \frac{\text{TDN}_{\text{slobb}}}{\text{MW}} + \gamma_2 \cdot \frac{\text{TDN}_{\text{grass}}}{\text{MW}} + \gamma_3 \cdot \frac{\text{TDN}_{\text{cornstalk}}}{\text{MW}} - \gamma_4 \cdot \text{MW} \tag{7}$$

where γ_i are the combined coefficients incorporating the energy requirements.

Note on Metabolic Weight

The metabolic weight (MW) also depends on breed characteristics, which should be incorporated in the model training phase.