Simultaneous Equations

The Pearson square allows us to balance a diet for one nutrient, but in most cases we want to be able balance a diet for **two** nutrients, usually protein and energy. In order to do this we use simultaneous equations. In this method we are balancing for **two** nutrients using **two** feeds (or mixtures of feeds).

Feed A contains 10% CP and 80% TDN.
Feed B contains 35% CP and 50% TDN.

Requirements: our animal needs 0.8 lbs CP and 4.0 lbs TDN per day

Let A = lbs. of Feed A to meet the requirements
Let B = lbs. of Feed B to meet the requirements

The diet must supply 0.8 lbs of CP so: $(A \times 0.1) + (B \times 0.35) = 0.8$ lbs CP

The diet must supply 4.0 lbs of TDN so: $(A \times 0.8) + (B \times 0.5) = 4.0$ lbs TDN

We have two equations with the same unknowns which we can solve.

$0.1\ A + 0.35\ B = 0.8$ lbs CP
$0.8\ A + 0.5\ B = 4.0$ lbs TDN

Multiply one equation by a factor which will make one of the unknowns the same in both equations. In this case 0.8/0.1 = 8, so let's multiply the first equation by 8.

$8\ (0.1\ A + 0.35\ B = 0.8) \quad = \quad 0.8\ A + 2.8\ B = 6.4$

Now subtract the second equation from this equation.

$0.8\ A + 2.8\ B = 6.4$
$-\quad \underline{0.8\ A + 0.5\ B = 4.0}$
$0 \quad + 2.3\ B = 2.4$

$2.3\ B = 2.4$
$B = 2.4/2.3$
$B = 1.04$

Now substitute 1.04 for B in either of the original equations.

$0.1\ A + 0.35\ (1.04) = 0.8$ lbs
$0.1\ A + 0.364 = 0.8$ lbs
$0.1\ A = 0.8 - 0.364$
$0.1\ A = 0.436$
$A = 4.36$

Therefore, we need 4.36 lbs of Feed A and 1.04 lbs of Feed B

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To check our calculations:

(4.36 lbs x 0.1) + (1.04 lbs x 0.35) = (0.436 + 0.364) = 0.8 lbs CP
(4.36 lbs x 0.8) + (1.04 lbs x 0.5) = (3.48 + 0.52) = 4.0 lbs TDN

On a percentage basis the diet would be:

$\frac{4.34}{4.34 + 1.04}$ x 100 = 80.6% Feed A $\frac{1.04}{4.34 + 1.04}$ x 100 = 19.4% Feed B

We could use a mixture of two feeds as one of the ingredients. In order to do this, we must calculate the % CP and % TDN of the mixture. The mixture then becomes Feed A. After you find the lbs. of Feed A required, you must figure the amounts of each of the two feeds in the mix. Say Feed A was a 75/25 mixture of corn and oats. Since we needed 4.34 lbs of Feed A, we need 0.75 X 4.34 lbs = 3.255 lbs of corn, and 0.25 X 4.34 lbs = 1.085 lbs of oats.

HINTS:

1. Always check your final answer. This will help uncover any math errors.
2. Always remember if you use a mixture of feeds as one of the ingredients to convert your mix to individual feeds in the final answer.
3. Make sure that your units for the requirements are in amounts.