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# Evaluation of a Commercial Model for Predicting Growth Performance of Pigs with Varying Diet Composition and Stocking Density

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# Evaluation of a Commercial Model for Predicting Growth Performance of Pigs with Varying Diet Composition and Stocking Density

*Mariana B. Menegat,[1] Fangzhou Wu, Jason C. Woodworth, Mike D. Tokach, Joel M. DeRouchey, Steve S. Dritz,[1] and Robert D. Goodband*

## Summary

The objective of this study was to validate the growth performance predictions of a commercial model (CAMERA®; INTL FCStone, New York, NY) by comparing the optimally-solved estimates with observed growth performance from published studies. Three studies were selected to create 3 feeding scenarios: 1) variation in dietary energy concentrations and fiber sources (Nitikanchana et al., 2015)[2]; 2) variation in dietary lysine level (Menegat et al., 2017)[3]; and 3) variation in space allowance (Carpenter et al., 2018)[4]. For each validation scenario, the growth performance of pigs from the best-performing treatment group was first estimated, calibrated using the observed performance, and used as the baseline for the prediction of other treatment groups. The model estimates were then compared with the observed growth performance to determine the prediction accuracy: deviation, % = (estimated value − observed value) ÷ observed value × 100. Results from scenario 1 indicated that the model-estimated final body weight (BW), average daily gain (ADG), average daily feed intake (ADFI), and feed-to-gain ratio (F/G) were reasonably close to observed performance for pigs fed medium energy with 8.7% neutral detergent fiber (NDF) as well as those fed low energy with 22.1% NDF. For pigs fed medium energy with 16.1% NDF, the model accurately estimated final BW and ADG (0.5 and 1.1% deviation, respectively), but overestimated ADFI and F/G (3.3 and 2.1% deviation, respectively). The model underestimated the

[1] Department of Diagnostic Medicine/Pathobiology, College of Veterinary Medicine, Kansas State University.

[2] Nitikanchana, S., Dritz, S.S., Tokach, M.D., DeRouchey, J.M., Goodband, R.D., White, B.J. 2015. Regression analysis to predict growth performance from dietary net energy in growing-finishing pigs. J. Anim. Sci. 93:2826-2839.

[3] Menegat, M.B., Vier, C.M., Dritz, S.S., Tokach, M.D., Woodworth, J.C., DeRouchey, J.M., Goodband, R.D. 2017. Evaluation of phase feeding strategies and lysine specifications for grow-finish pigs on growth performance and carcass characteristics. Kansas Agricultural Experiment Station Research Reports. 3(7):1-11.

[4] Carpenter, C. B., C. J. Holder, F. Wu, J. C. Woodworth, J. M. DeRouchey, M. D. Tokach, R. D. Goodband, and S. S. Dritz. 2018. Effects of increasing space allowance by removing a pig or gate adjustment on finishing pig growth performance. J. Anim. Sci., sky167.

ADG and ADFI (-2.6 and -3.8% deviation, respectively) and overestimated the F/G (5.0% deviation) of pigs fed low energy with 16.4% NDF. Carcass yield differences were not accurately captured by the model among pigs fed various NDF levels. For validation scenario 2, model-estimated growth responses were generally underestimated (-5.5% deviation) and were not sensitive to changing dietary lysine levels. For validation scenario 3, the model accurately predicted final BW and ADG (< 0.9% deviation) but overestimated ADFI and F/G (3.6% deviation) of pigs allowed restricted space. Model-estimated growth responses were generally accurate for pigs that received increasing space by gate adjustment or pig removal, except for an overestimation of ADFI (3.0% deviation) for the pig removal treatment. In summary, the commercial model was able to capture changes in growth performance of pigs that received various dietary energy and fiber concentrations as well as pigs with changing space allowance. However, the model was not able to predict carcass yield in response to changes in dietary fiber nor the differences in growth performance due to variation in dietary lysine. For model improvements, the consistency of prediction accuracy and ease of user operability should be enhanced.

## Introduction

Accurate prediction of pig growth performance is important to make maximum-profit diet formulation decisions and develop optimal marketing strategies in commercial production. Major factors that are often considered in growth performance predictions include genetic background, nutritional program, and environmental factors, such as stocking density and ambient temperature.

The NRC[5] provided a growth prediction model based on dietary energy density and user-defined genetic potential for lean deposition. Nitikanchana et al.[2] published a meta-analysis that resulted in regression equations using dietary net energy and nutrient concentration as predictors. Furthermore, Flohr et al.[6] developed a set of equations that predict growth performance of pigs based on stocking density and floor space. More recently, a commercially available growth model (CAMERA®; INTL FCStone, New York, NY) has been developed that comprehensively incorporates genetic, nutritional, and environmental factors. The commercial model provides predictions for growth performance by solving for optimal growth to maximize profit. However, this model has not been subject to a validation using pig growth performance data. Therefore, the objective of this study was to validate the growth performance predictions of a commercial model by comparing the optimally-solved estimates with observed growth performance in published studies.

## Procedures

### *Model Structure*

The model is a commercial software that provides diet formulation for commercial pig production by solving for maximal profitability. Meanwhile, the model can be used reversibly to estimate growth performance of pigs based on inputs of dietary compo-

[5] National Research Council. 2012. Nutrient Requirements of Swine: Eleventh Revised Edition. Washington, DC: The National Academies Press. https://doi.org/10.17226/13298.

[6] Flohr, J.R., Dritz, S.S., Tokach, M.D., Woodworth, J.C., DeRouchey, J.M., Goodband, R.D. 2017. Development of equations to predict the influence of floor space on average daily gain, average daily feed intake and gain: feed ratio of finishing pigs. Animal. 12(5):1022-1029.

sition, stocking density, ambient temperature, etc. The model consists of 4 general functions: 1) set up business production unit (BPU); 2) ingredient database and diet formulation; 3) input production variables and model optimization; and 4) optimal solutions and reports (Figure 1). Specifically, in the ingredient database, the user defines availability, nutrient composition, and price of ingredients, chooses the number of diets to be fed, and sets constraints on the inclusion rate of each ingredient (Figure 2). To set up production background for optimization, inputs of "production," "static," and "table" variables are required (Figure 3). Static variables include initial pig age, weight, and diet form (Figure 4). Production variables include floor space allowance, sex, feed form, costs, optimization methods, etc. (Figure 5). The user is able to fine-tune the values in the "table variables" table, in which modifications on nutrient composition, feed waste, environmental temperature, and genetics, among others, can be performed. Finally, once the optimal solution is achieved, a comprehensive set of reports (Figure 6) are generated depicting the estimated growth performance, feed usage, mortality, and economics (Figure 7).

### *Modeling Steps*

In order to validate the predictions obtained by the model, the optimally-solved growth performance predictions were compared with observed growth performance in published studies. Three studies were selected to create 3 feeding scenarios: 1) variation in dietary energy concentrations and fiber sources[2]; 2) variation in dietary lysine level[3]; and 3) variation in space allowance.[4]

### *Baseline Procedure*

For growth prediction, baseline performance is established and calibrated by observed performance. The first step is defining the baseline and setting diet composition and production constraint variables. Because the designed function of this commercial model is to provide maximum-profit diet formulation using the optimization procedure, it does not allow users to simply input diet composition for growth prediction. Using a reverse approach, diet composition can be set by adjusting the lower and upper constraints on inclusion rate of each ingredient, such as corn, soybean meal, distillers dried grain with solubles, calcium carbonate, monocalcium phosphate, and feed-grade amino acids. Many optimization iterations are needed before a designed diet formulation can be established. Next, inputs of production variables are needed, including initial body weight, initial age, days to market, final body weight, floor space allowance, genetics, sex, and feed form. The second step consisted of optimizing the model to obtain the estimated baseline growth performance. If discrepancies exist between the estimated and observed baseline growth responses, calibration of the baseline performance is needed. Specifically, final BW can be adjusted by forcing the predicted value to match the observed final BW (specified by the user). Because the initial BW and feeding length are set, once final BW is calibrated ADG is automatically adjusted. Feed efficiency can be calibrated by adjusting the percentage of feed wastage.

The model is designed to have baseline performance representing the growth potential of the tested pigs. Therefore, in each validation trial, growth performance of the best-performing group of pigs served as the baseline and was calibrated using the observed performance reported by the reference study.

## *Validation Procedure*

Once the baseline performance was calibrated, validation procedures were conducted. In each validation scenario, diet composition or space allowance was changed according to the reference studies and the model was allowed to predict performance based on changes from the baseline. For our analysis, only measures exhibiting significant statistical difference ($P < 0.05$) in the reference papers were used to assess the accuracy of the model predictions relative to actual performance.

The first scenario aimed to validate the model's ability to predict growth performance of pigs fed various energy concentrations and fiber levels. The study by Nitikanchana et al.[2] was used as reference. In the study, five treatments consisted of: 1) high energy diets containing corn, soybean meal, and choice white grease, diet NDF = 8.4%; 2) medium energy diets containing corn and soybean meal, diet NDF = 8.7%; 3) medium energy diets containing wheat middlings, soybean hulls, and choice white grease, diet NDF = 16.1%; 4) low energy diets containing wheat middlings and soybean hulls, diet NDF = 16.4%; and 5) low energy diets containing dried distillers grains with solubles, wheat middlings, and soybean hulls, diet NDF = 22.2%. The high energy treatment group had the best observed growth performance and, therefore, was set as the baseline for this validation scenario.

The second validation considered a scenario with variation in lysine level in the diet and used the study by Menegat et al.[5] as reference. In the study, the 4 dietary treatments were: 1) high lysine throughout the growing-finishing period (1.13, 0.96, and 0.82% SID Lys in phase 1 to 3, respectively); 2) low lysine throughout the growing-finishing period (1.02, 0.87, and 0.76% SID Lys in phase 1 to 3, respectively); 3) low lysine in early finishing (1.02, 0.87, and 0.82% SID Lys in phase 1 to 3, respectively); and 4) high lysine in late finishing (0.96% SID Lys in phase 1 to 3). In the original reference study, pigs were fed for 4 phases from d 0 to 117. The overall (d 0 to 117) growth performance of the high-lysine treatment group had the best performance and was therefore used to calibrate the baseline performance. However, no evidence of different final BW was observed on d 117, thus growth performance of the first 3 phases (d 0 to 81), when significant differences in growth responses were observed, was used for model validation.

For the third validation, a scenario with variation in space allowance was considered. The study by Carpenter et al.[4] was used as reference. In the study, four treatments with different floor space allowances during the finisher phase were evaluated: 1) ample space allowance (9.8 $ft^2$/pig in phase 1 to 4); 2) restricted space allowance (6.8 $ft^2$/pig in phase 1 to 4); 3) increasing space allowance by gate adjustment (6.8, 7.8, 8.8, and 9.8 $ft^2$/pig in phase 1 to 4, respectively); and 4) increasing space allowance by pig removal (6.8, 7.8, 9.1, and 9.1 $ft^2$/pig in phase 1 to 4, respectively). The ample space allowance treatment was set as the baseline. As diets were the same for all treatments within phase, a single set of nutritional values (e.g. metabolizable energy, crude protein, amino acids, and mineral concentrations etc.), instead of ingredient inclusion levels, were assigned across treatments in each phase.

## Results and Discussion

### *Scenario 1 (Dietary Energy and Fiber)*

The model accurately predicted final BW, ADG, ADFI, and F/G of pigs fed diets containing medium energy and 8.7% NDF, with the percentage deviation [(estimated value – observed value) ÷ observed value] ranged from -0.2 to 1.6% (Table 1). For diets with medium energy and 16.1% NDF, the model estimated final BW and ADG was reasonably close to the observation (deviation < 1.1%); however, the model overestimated ADFI and F/G (3.3 and 2.1% deviation, respectively). For diets containing low energy and 16.4% NDF, the model underestimated final BW and ADG (-2.6 and -3.8% deviation, respectively) and overestimated F/G by 5%. However, when diets contained low energy with 22.1% NDF, the model precisely predicted ADG, ADFI, and F/G, with percentage deviation less than 0.1%. Estimated carcass yields were fairly constant (74.2 to 74.3%) across treatments, while the observed carcass yield varied from 72.4 to 74.0%. This indicates that the model is not sensitive enough to detect the change of carcass yield in response to variation in dietary fiber.

### *Scenario 2 (Dietary Amino Acids)*

In general, the model underestimated the final BW, ADG, ADFI, and F/G by an average of 3.5, 4.9, 9.6, and 5.0%, respectively across all the treatments (Table 2). This is likely a result of using growth performance of the overall period (d 0 to 117) as the calibration basis to predict the growth responses during phases 1 to 3 (d 0 to 81), suggesting that the accuracy of the growth curve built into the model needs to be improved. Moreover, the model prediction in absolute values remained unchanged to the varying lysine level in the diets. This would suggest that the model was not able to predict the growth performance changes due to variation in dietary lysine level. It is also possible that the model underestimated the amino acid requirements, or overestimated pigs' efficiency of utilizing amino acids, resulting in unchanged growth performance estimates.

### *Scenario 3 (Space Allowance)*

The model precisely predicted the final BW and ADG of pigs allowed restricted space with the percentage deviation less than 0.9%; however, it overestimated ADFI and F/G of those pigs by 3.6% (Table 3). For pens of pigs that received gate adjustments, final BW, ADG, ADFI, and F/G were precisely predicted by the model with the deviation less than 0.4%. For pens of pigs that received increasing space by pig removal, the model-estimated final BW, ADG, and F/G (1.8, -0.3, and 1.5% deviation, respectively) were reasonably close to the observed performance, but ADFI was overestimated by 3.0%. It is expected that the model was more precise in predicting growth performance of pigs that received increasing space by gate adjustment than pig removal because removing the heaviest pigs from a pen often results in a change in social dynamics and consequently, increased prediction difficulty for growth responses of pigs remaining in the pen.

### *User Experience*

The commercial model that was evaluated herein was primarily designed as a maximum-profit diet formulator and was based on a complex model originally designed for use in the poultry industry. The potential of using the model to perform predictions on growth performance of growing-finishing pigs is a recent feature. At this point, the model is not fully developed to be independently operated by the model user, and technical support from the model developers was needed throughout the validation process. The interface is not regarded as intuitive and contains many features that require further understanding of growth performance prediction. Moreover, the procedure to determine and calibrate the baseline is extensive, primarily because many optimization runs are needed before a designed diet formulation can be established. Overall, the model was challenging to use and did not necessarily provide benefits over other alternatives that are designed to generate similar predictions.

## Conclusions

In summary, the commercial model was able to capture the changes in growth performance of pigs that received various dietary concentrations of energy and NDF, as well as changing floor space allowance. However, the consistency of prediction accuracy needs to be improved. The model was not able to predict carcass yield changes in response to various dietary NDF levels. Moreover, the model was not successful in detecting the differences in growth performance due to variation in dietary lysine. The prediction feature of this model is currently not ready to be independently operated by the user, which makes the system complicated to use.

**Table 1. Validation of growth performance prediction for changing dietary energy and fiber level[1]**

| | Net energy, kcal/lb | | | | |
|---|---|---|---|---|---|
| Dietary phases | High energy 8.4% NDF (baseline)[2] | Medium energy 8.7% NDF | Medium energy 16.1% NDF | Low energy 16.4% NDF | Low energy 22.1% NDF |
| d 0 to 21 | 1190 | 1115 | 1115 | 1041 | 1041 |
| d 21 to 44 | 1207 | 1132 | 1132 | 1057 | 1057 |
| d 44 to 74 | 1217 | 1142 | 1142 | 1068 | 1068 |
| Observation | | | | | |
| Initial BW, lb | 125.2 | 125.2 | 125.2 | 125.2 | 125.2 |
| Final BW, lb | 282.9 | 275.8 | 273.1 | 271.6 | 268.5 |
| Overall ADG, lb | 2.12 | 2.03 | 2.00 | 1.96 | 1.94 |
| Overall ADFI, lb | 5.65 | 5.73 | 5.54 | 5.77 | 5.87 |
| Overall F/G | 2.66 | 2.82 | 2.78 | 2.95 | 3.03 |
| Carcass yield, % | 74.3 | 74.0 | 73.2 | 73.4 | 72.4 |
| Model estimates | | | | | |
| Final BW, lb | --- | 275.4 | 274.6 | 264.5 | 268.8 |
| Overall ADG, lb | --- | 2.03 | 2.02 | 1.88 | 1.94 |
| Overall ADFI, lb | --- | 5.81 | 5.72 | 5.83 | 5.87 |
| Overall F/G | --- | 2.86 | 2.84 | 3.10 | 3.03 |
| Carcass yield, % | --- | 74.3 | 74.3 | 74.2 | 74.2 |
| Estimate/observation, % | | | | | |
| Final BW | --- | 99.9 | 100.5 | 97.4 | 100.1 |
| Overall ADG | --- | 99.8 | 101.1 | 96.2 | 100.1 |
| Overall ADFI | --- | 101.4 | 103.3 | 101.0 | 100.0 |
| Overall F/G | --- | 101.6 | 102.1 | 105.0 | 99.9 |
| Carcass yield | --- | 100.4 | 101.5 | 101.1 | 102.5 |

[1]Based on the study by Nitikanchana et al. (Nitikanchana, S., Dritz, S.S., Tokach, M.D., DeRouchey, J.M., Goodband, R.D., White, B.J. 2015. Regression analysis to predict growth performance from dietary net energy in growing-finishing pigs. J. Anim. Sci. 93:2826-2839).
[2]Used as the baseline for prediction of other treatment groups. Model-estimated growth responses of the baseline group were calibrated to match the observed growth performance.
NDF = neutral detergent fiber. BW = body weight. ADG = average daily gain. ADFI = average daily feed intake. F/G = feed efficiency.

**Table 2. Validation of growth performance prediction for changing dietary lysine level[1]**

| | Standardized ileal digestible lysine, % | | | |
|---|---|---|---|---|
| Dietary phases | High lysine (baseline)[2] | Low lysine | Low lysine early | High lysine late |
| d 0 to 25 | 1.13 | 1.02 | 1.02 | 0.96 |
| d 25 to 53 | 0.96 | 0.87 | 0.87 | 0.96 |
| d 53 to 81 | 0.82 | 0.76 | 0.82 | 0.96 |
| Observation | | | | |
| Initial BW, lb | 61.5 | 61.5 | 61.5 | 61.5 |
| Final BW, lb | 220.7 | 216.8 | 219.4 | 222.6 |
| Overall ADG, lb | 1.97 | 1.92 | 1.95 | 1.99 |
| Overall ADFI, lb | 4.74 | 4.66 | 4.70 | 4.65 |
| Overall F/G | 2.41 | 2.43 | 2.41 | 2.34 |
| Model estimates | | | | |
| Final BW, lb | 212.1 | 212.2 | 212.1 | 212.2 |
| Overall ADG, lb | 1.86 | 1.86 | 1.86 | 1.86 |
| Overall ADFI, lb | 4.24 | 4.24 | 4.24 | 4.23 |
| Overall F/G | 2.28 | 2.28 | 2.28 | 2.28 |
| Estimate/observation, % | | | | |
| Final BW | 96.1 | 97.9 | 96.7 | 95.3 |
| Overall ADG | 94.6 | 97.0 | 95.4 | 93.5 |
| Overall ADFI | 89.5 | 90.9 | 90.4 | 90.9 |
| Overall F/G | 94.6 | 93.7 | 94.7 | 97.2 |

[1]Based on the study of Menegat et al. (Menegat, M.B., Vier, C.M., Dritz, S.S., Tokach, M.D., Woodworth, J.C., DeRouchey, J.M., Goodband, R.D. 2017. Evaluation of phase feeding strategies and lysine specifications for grow-finish pigs on growth performance and carcass characteristics. Kansas Agricultural Experiment Station Research Reports. 3(7):1-11.). The best performing treatment served as the baseline to calibrate the model for predictions and the other treatments were then used to validate the model.

[2]Used as the baseline for prediction of other treatment groups. The baseline calibration was based on overall growth performance until marketing (d 0 to 117), whereas the validation was only performed on the period with a significant statistical difference between treatments (d 0 to 81).

BW = body weight. ADG = average daily gain. ADFI = average daily feed intake. F/G = feed efficiency.

**Table 3. Validation of growth performance prediction for changing space allowance[1]**

| | Floor space allowance, $ft^2$/pig | | | |
|---|---|---|---|---|
| Dietary phases | Ample space (baseline)[2] | Restricted space | Gate adjustment | Pig removal |
| d 0 to 28 | 9.8 | 6.8 | 6.8 | 6.8 |
| d 28 to 45 | 9.8 | 6.8 | 7.8 | 7.8 |
| d 45 to 62 | 9.8 | 6.8 | 8.8 | 9.1 |
| d 62 to 71 | 9.8 | 6.8 | 9.8 | 9.1 |
| Observation | | | | |
| Initial BW, lb | 123.3 | 123.4 | 123.2 | 122.6 |
| Final BW, lb | 280.6 | 268.3 | 275.4 | 270.0 |
| Overall ADG, lb | 2.21 | 2.04 | 2.14 | 2.15 |
| Overall ADFI, lb | 6.09 | 5.68 | 6.01 | 5.85 |
| Overall F/G | 2.76 | 2.81 | 2.82 | 2.77 |
| Model estimates | | | | |
| Final BW, lb | --- | 267.0 | 275.1 | 274.9 |
| Overall ADG, lb | --- | 2.02 | 2.14 | 2.14 |
| Overall ADFI, lb | --- | 5.89 | 6.01 | 6.03 |
| Overall F/G | --- | 2.91 | 2.81 | 2.81 |
| Estimate/observation, % | | | | |
| Final BW | --- | 99.5 | 99.9 | 101.8 |
| Overall ADG | --- | 99.1 | 99.9 | 99.7 |
| Overall ADFI | --- | 103.6 | 100.0 | 103.0 |
| Overall F/G | --- | 103.6 | 99.6 | 101.5 |

[1]Based on the study of Carpenter et al. (Carpenter, C. B., C. J. Holder, F. Wu, J. C. Woodworth, J. M. DeRouchey, M. D. Tokach, R. D. Goodband, and S. S. Dritz. 2018. Effects of increasing space allowance by removing a pig or gate adjustment on finishing pig growth performance. J. Anim. Sci., sky167.).
[2]Used as the baseline for prediction of other treatment groups. Model-estimated growth responses of the baseline group were calibrated to match the observed growth performance.
BW = body weight. ADG = average daily gain. ADFI = average daily feed intake. F/G = feed efficiency.

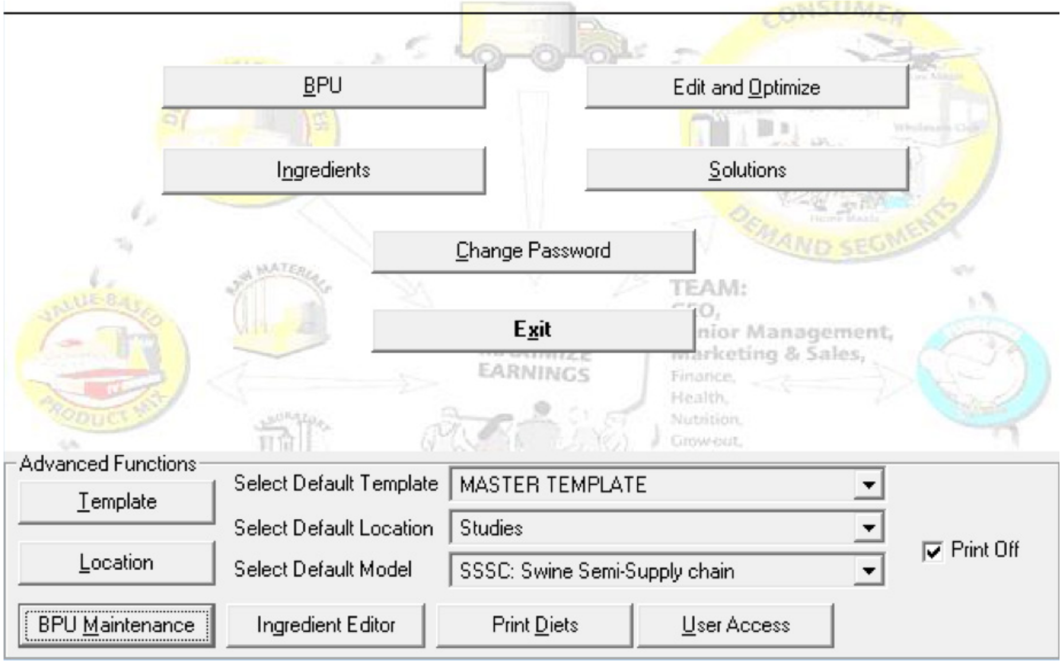



**Figure 1. Commercial model interface: general functions.**

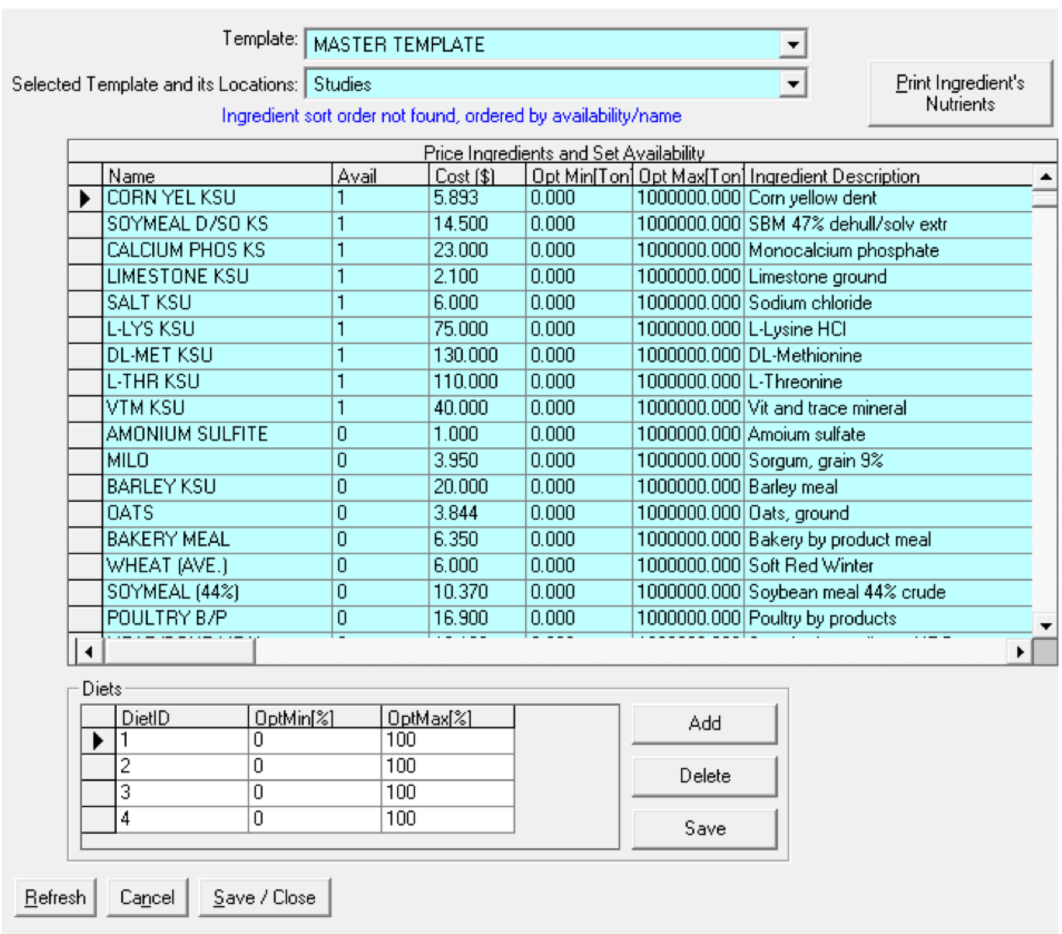



**Figure 2. Commercial model interface: ingredients table.**

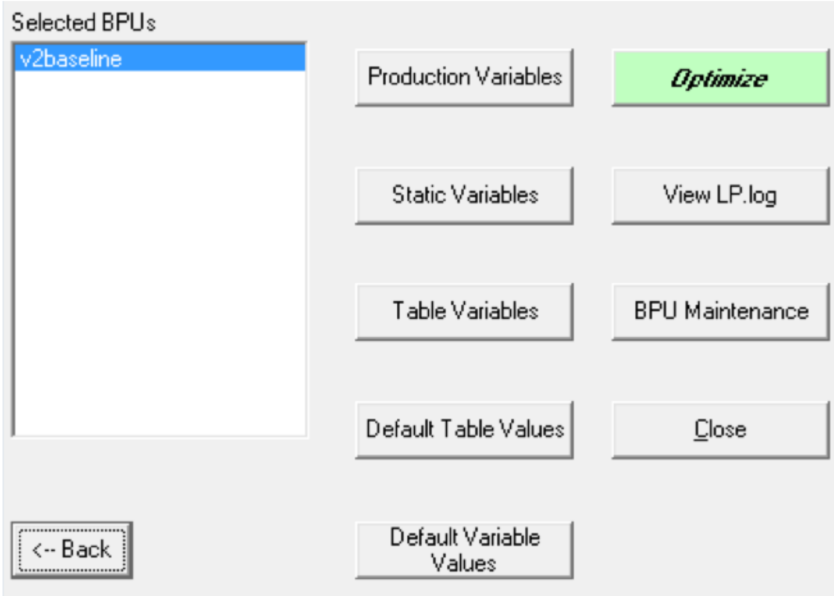
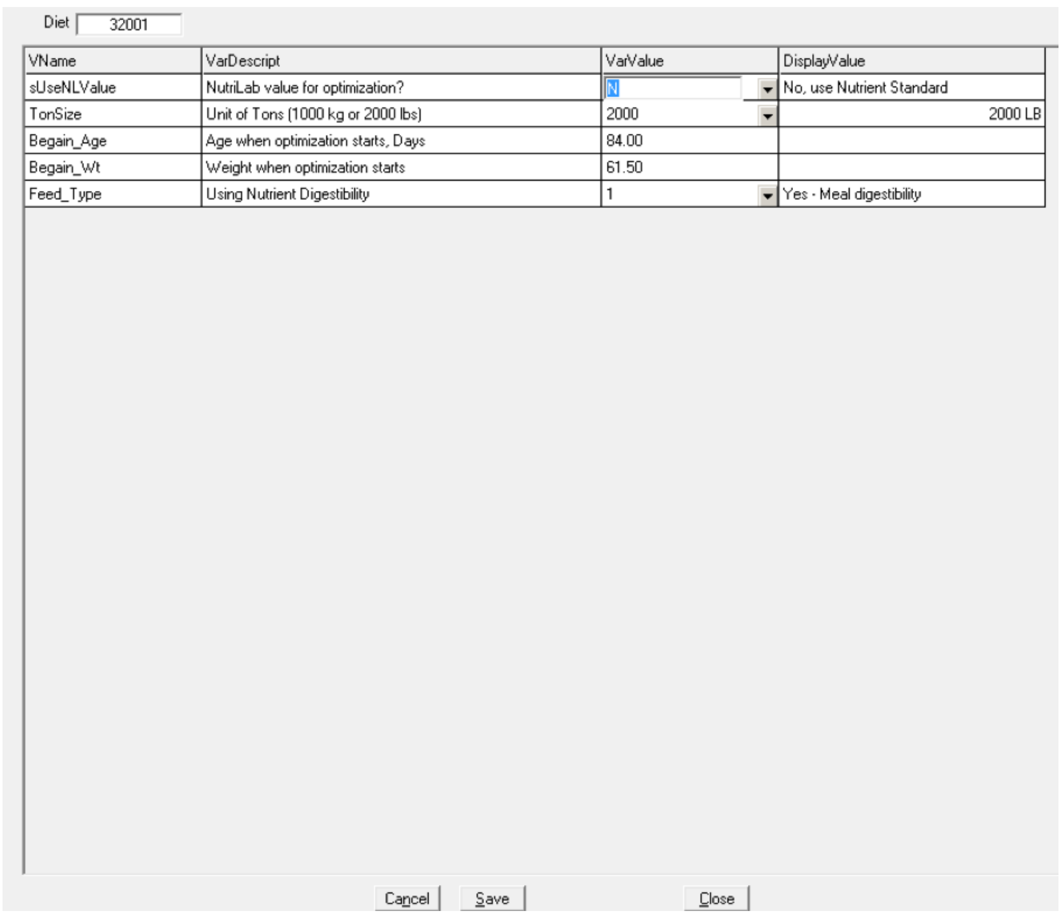
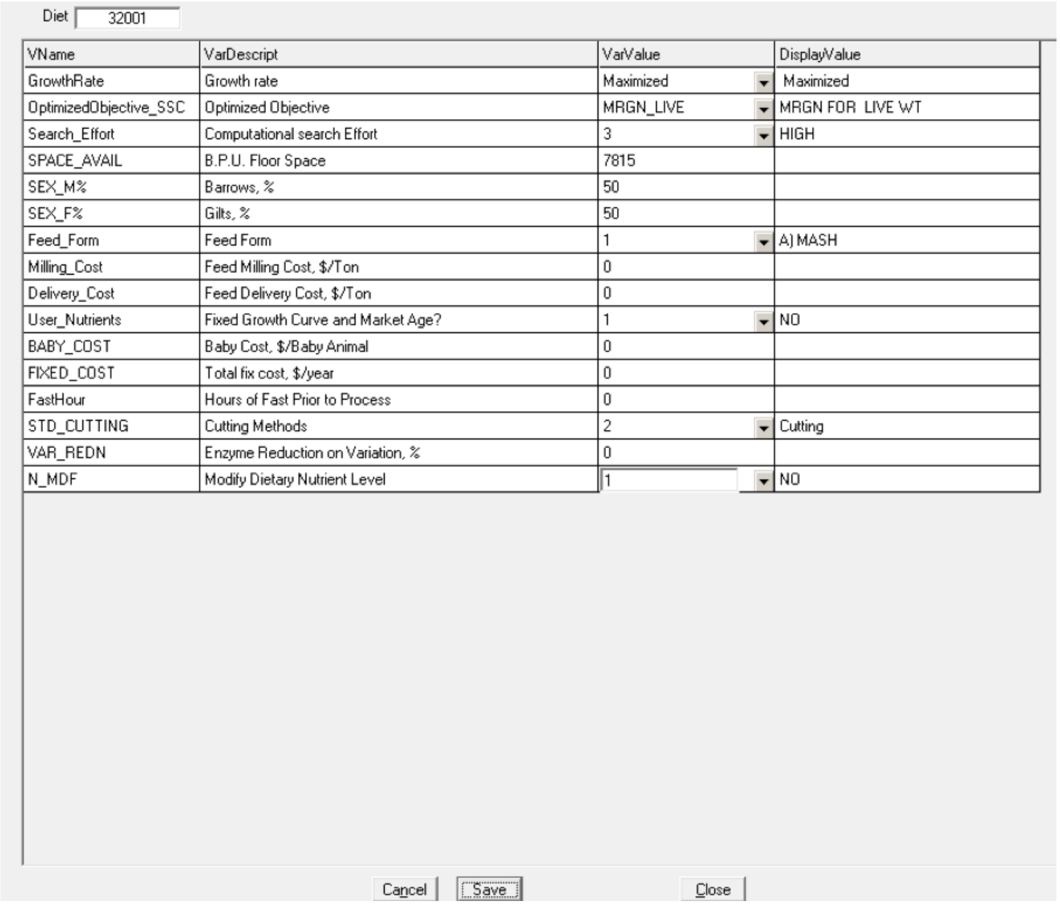



Figure 3. Commercial model interface: variables inclusion and edition.




| VName | VarDescript | VarValue | DisplayValue |
|---|---|---|---|
| sUseNLValue | NutriLab value for optimization? | N | No, use Nutrient Standard |
| TonSize | Unit of Tons (1000 kg or 2000 lbs) | 2000 | 2000 LB |
| Begain_Age | Age when optimization starts, Days | 84.00 | |
| Begain_Wt | Weight when optimization starts | 61.50 | |
| Feed_Type | Using Nutrient Digestibility | 1 | Yes - Meal digestibility |

Figure 4. Commercial model interface: static variables table.




| VName | VarDescript | VarValue | DisplayValue |
|---|---|---|---|
| GrowthRate | Growth rate | Maximized | Maximized |
| OptimizedObjective_SSC | Optimized Objective | MRGN_LIVE | MRGN FOR LIVE WT |
| Search_Effort | Computational search Effort | 3 | HIGH |
| SPACE_AVAIL | B.P.U. Floor Space | 7815 | |
| SEX_M% | Barrows, % | 50 | |
| SEX_F% | Gilts, % | 50 | |
| Feed_Form | Feed Form | 1 | A) MASH |
| Milling_Cost | Feed Milling Cost, $/Ton | 0 | |
| Delivery_Cost | Feed Delivery Cost, $/Ton | 0 | |
| User_Nutrients | Fixed Growth Curve and Market Age? | 1 | NO |
| BABY_COST | Baby Cost, $/Baby Animal | 0 | |
| FIXED_COST | Total fix cost, $/year | 0 | |
| FastHour | Hours of Fast Prior to Process | 0 | |
| STD_CUTTING | Cutting Methods | 2 | Cutting |
| VAR_REDN | Enzyme Reduction on Variation, % | 0 | |
| N_MDF | Modify Dietary Nutrient Level | 1 | NO |

**Figure 5. Commercial model interface: production variables table.**

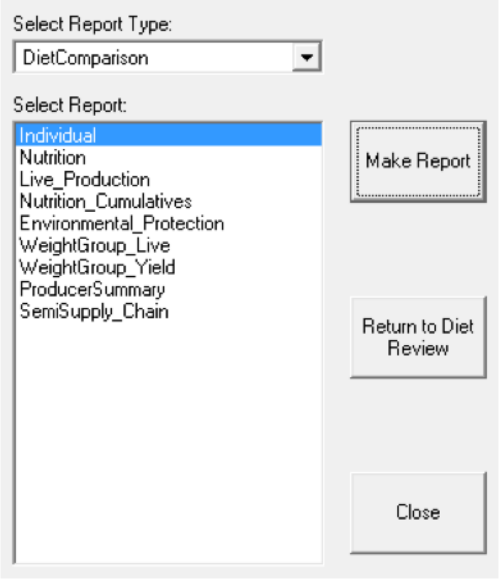



**Figure 6. Commercial model interface: report types.**

| Description | DietValue1 | DietValue2 | DietValue3 | DietValue4 |
|---|---|---|---|---|
| BPU Name | v2baseline | v2baseline | v2baseline | v2baseline |
| Diet Code | 31004 | 31003 | 31002 | 31001 |
| PER CYCLE BASIS: | | | | |
| Optimized objective | MRGN_LIVE | MRGN_LIVE | MRGN_LIVE | MRGN_LIVE |
| B.P.U floor space.....sqft | 7815.000 | 7815.000 | 7815.000 | 7815.000 |
| | | | | |
| Total margin.....$ | 1644621.506 | 0.000 | 0.000 | 0.000 |
| Revenues from obj product.....$ | 1698599.619 | 0.000 | 0.000 | 0.000 |
| Cumulative feed cost.....$ | 53978.114 | 32253.764 | 19292.478 | 8033.051 |
| Total baby animal cost.....$ | 0.000 | 0.000 | 0.000 | 0.000 |
| Fix cost.....$/cycle | 0.000 | 0.000 | 0.000 | 0.000 |
| Cumulative ave. feed cost.....$ | 154.449 | 150.691 | 156.703 | 163.571 |
| Feed conv. plant | 2.621 | 0.000 | 0.000 | 0.000 |
| Feed cost/lb plant wt.....$ | 0.159 | 0.000 | 0.000 | 0.000 |
| | | | | |
| Animal genetics | PIC337RG X Cmbrgh | PIC337RG X Cmbrgh | PIC337RG X Cmbrgh | PIC337RG X Cmbrgh |
| | | | | |
| | | | | |
| Marketing age.....days | 201.000 | 0.000 | 0.000 | 0.000 |
| Ending age.....days | 201.000 | 165.000 | 137.000 | 109.000 |
| Farm weight.....lbs | 286.031 | 212.126 | 152.327 | 98.897 |
| Live plant weight.....lbs | 286.031 | 0.000 | 0.000 | 0.000 |
| Hours of fast prior to process | 0.000 | 0.000 | 0.000 | 0.000 |
| Shrink farm to plant | 0.000 | 0.000 | 0.000 | 0.000 |
| Feed conv. farm | 2.621 | 2.279 | 2.098 | 1.965 |
| No. of newly born animals needed | 1677.423 | 1677.423 | 1677.423 | 1677.423 |
| Animal number at processing | 1187.703 | 1187.703 | 1187.703 | 1187.703 |
| Feed Tonage for this period | 135.449 | 90.924 | 74.004 | 49.111 |
| Cumulative tonage of feed | 349.488 | 214.039 | 123.115 | 49.111 |
| Finished density.....sqft/animal | 6.580 | 0.000 | 0.000 | 0.000 |
| Density at birth..finish sqft/animal | 4.659 | 0.000 | 0.000 | 0.000 |
| Mortality from birth.....% | 29.196 | 25.654 | 22.962 | 20.317 |
| Live from birth.....% | 70.804 | 74.346 | 77.038 | 79.683 |
| Mortality after optimization start..% | 17.767 | 14.225 | 11.533 | 8.888 |
| TOTAL TONS: | | | | |
| Live weight to plant | 169.860 | 0.000 | 0.000 | 0.000 |
| Carcass yield | 123.265 | 0.000 | 0.000 | 0.000 |
| | | | | |

**Figure 7. Commercial model interface: report.**