PRODUCTS 3.11

Background

FSIS conducted risk assessments for *Salmonella* Enteritidis in shell eggs and *Salmonella* spp. in liquid egg products. Two models were created as part of the assessments, one for the shell eggs and one for liquid egg products. The instructions below explain how to run the model created for liquid egg products. The model is included in an Excel workbook titled "Products311.xls."

In brief, Products 3.11 models estimates illness from *Salmonella* in liquid eggs. It does so by first estimating the number of *Salmonella* cells in liquid egg products. Next, "pasteurization" is modeled by inputting a log_{10} reduction value (this value refers to the reduction of *Salmonella* cells). After "pasteurization, the effect of egg product storage and further heat treatment (cooking) is modeled. Finally, consumption of egg products is estimated and a dose-response function is added to estimate the likelihood of illness and translate this likelihood into total illnesses/year in the U.S. A full description of the model may be found in the Risk Characterization chapter of the risk assessment report.

Opening the model

- On the accompanying disk find an Excel file titled "Products311.xls."
- Without any other programs open on your computer, double click on the file

- You should be given a box with three options, i.e. "Disable Macros," "Enable Macros," and "More Info" – Select "Enable Macros"

  - If you do not see this message on your screen, the security settings in your version of Excel are likely too high. To change this, in Excel select "Tools" followed by "Macro" followed by "Security." Select the "Medium" option and click "OK."
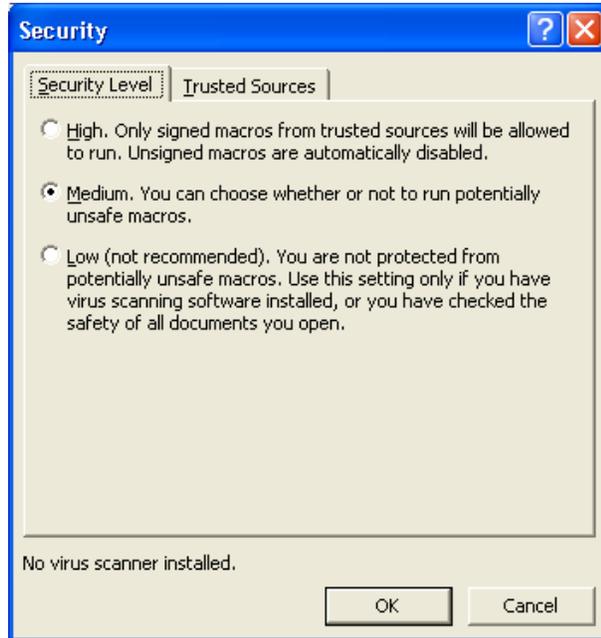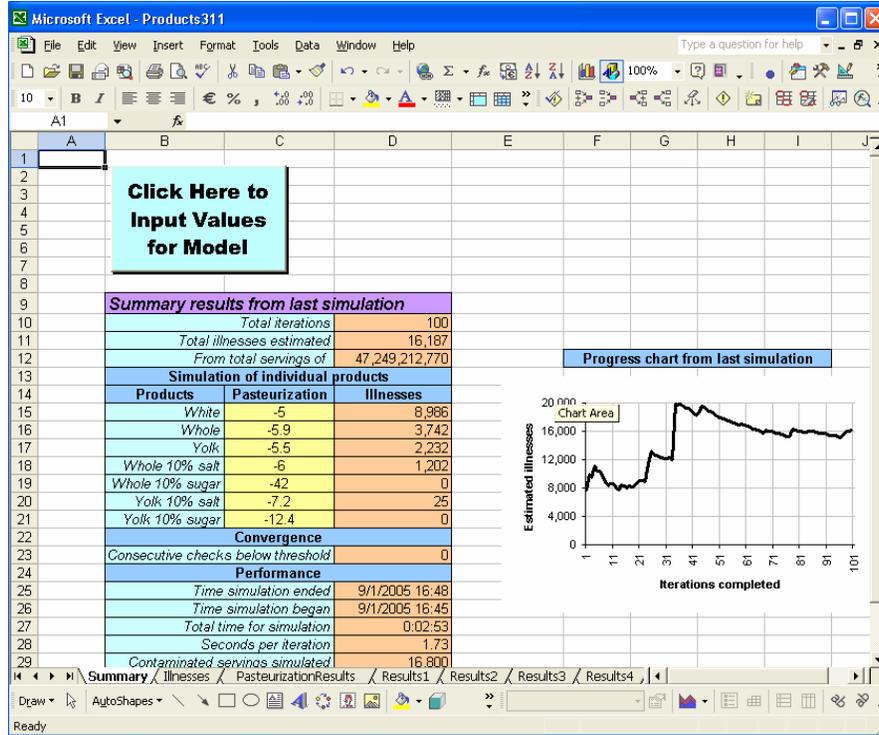
- You will see a Welcome box with a picture of a chicken. Click the box in the lower left to continue

The Summary Sheet

- You will see a table and graph. The table presents values from the last model simulation while the graph shows a picture of model stability.

- o In the table, reading down from row 10:

  - Cell D10 shows the number of model iterations. Each iteration represents one estimate. The model is typically run 5,000 times to achieve stable results (more below)

  - Cell D11 shows the estimated number of annual illnesses

  - Cell D12 shows the number of servings from which those illnesses were estimated to result

  - Cells B15-B21 show the seven categories of egg products modeled

  - Cells C15-C21 show the levels of pasteurization and are expressed in units of $\log_{10}$ reduction of *Salmonella* (the values shown here, i.e. -5 for egg whites, -5.9 for whole egg, etc. are estimates based on current time-temp regulations set forth by FSIS

  - Cells D15-D21 show the estimated number of illnesses by product, given the levels of pasteurization shown in cells C15-C21

- Cell D23 shows the model's convergence (more below)

- Cells D25-D31 describe the model's performance

o The graph plots Estimated Illnesses vs. Completed Iterations. The estimate of illnesses after each iteration is calculated as if the model was run for that many iterations. In the figure below the model estimated about 8000 illnesses after it was run for 10 iterations. After 100 iterations, the model estimated about 16,000 illnesses.

- It shows that the model becomes more "stable" as it completes additional iterations.
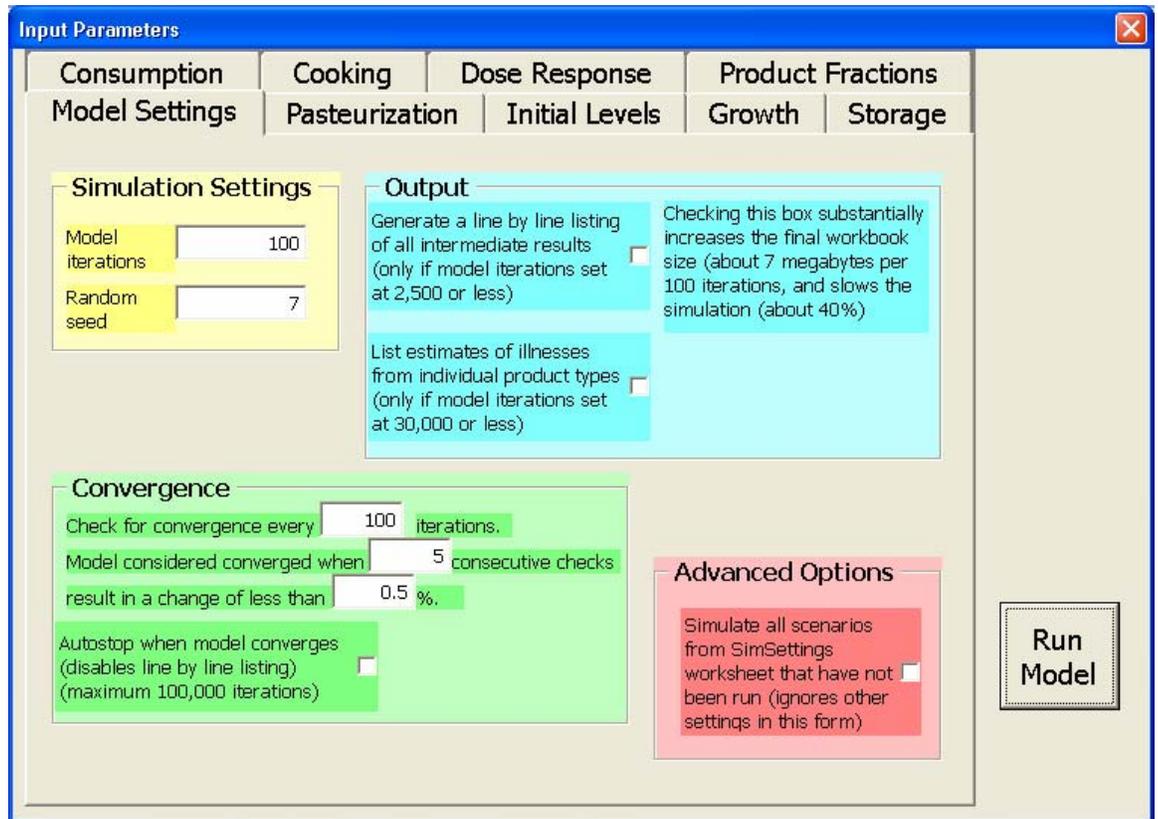

Input Parameters

Model parameters may be changed by the user. This is allowed so that the user of the model may examine various scenarios about risk.
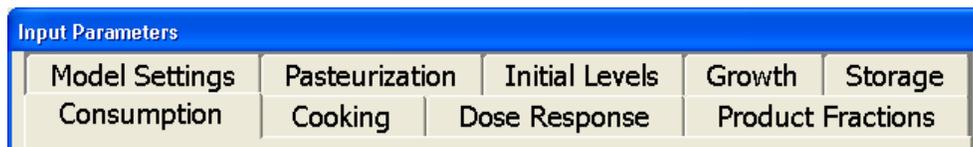
- On the summary sheet, click on "Click Here to Input Values for Model"

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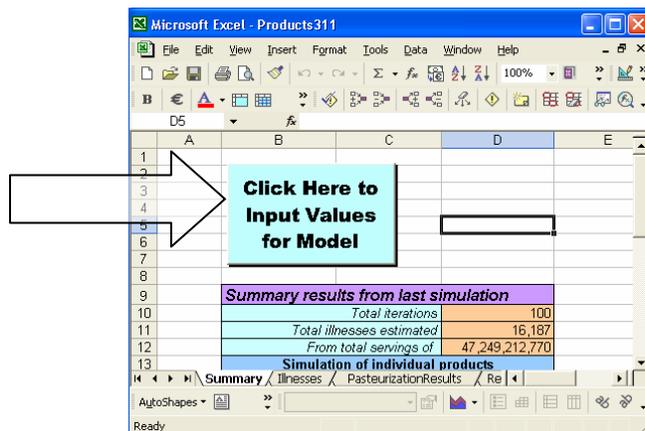
- You will now see a window titled "Input Parameters"

- This window has a set of tabbed pages.

- First, select the tab titled "Consumption"

- o Then click on the secondary tab for "Serving Fractions." You should now see a yellow box titled "Serving Fractions"

  - The left-hand side of the chart lists the types of products consumed. These are: EggUC (undercooked eggs), BevUC (undercooked egg-containing beverages), and IngUC (undercooked egg-containing foods, e.g. cakes). The next three product types are the same except that they are "well-cooked" (WC)

- The first column of values represents the serving fractions for each product type. For example, EggUC (undercooked) eggs represent 10.9% of all egg products consumed.

- The second column simply provides a cumulative total of serving fractions. ***Note that unless the total for this column is equal to 1, the model may not run correctly.*** In other words, if you adjust the serving fraction for one product, make sure you also adjust it for others so that the cumulative total is 1.
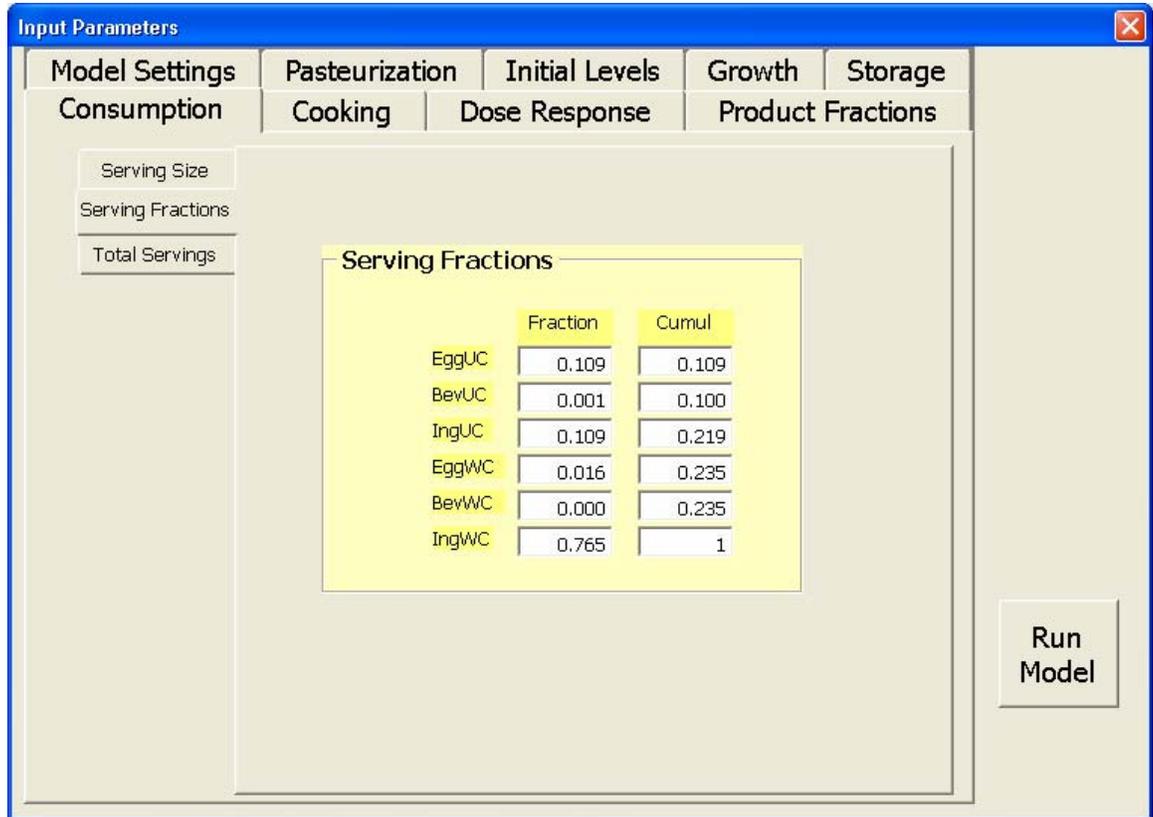
o Now, in the upper left of the "Consumption" window, click on "Serving Size"

- You should now see a tan box

- Locate the 50th percentile on the left-most column

- Reading across the table indicates an average serving of EggUC (undercooked eggs) contains 77 grams of egg product; an average serving of BevUC (undercooked-egg containing beverage) contains 191 grams; and so forth

- o Now click on "Total Servings" in the upper left of the "Consumption" window

- This is the number of servings of egg product consumed per annum in the U.S.

- Second, click on "Cooking"

    - You should now see a blue box
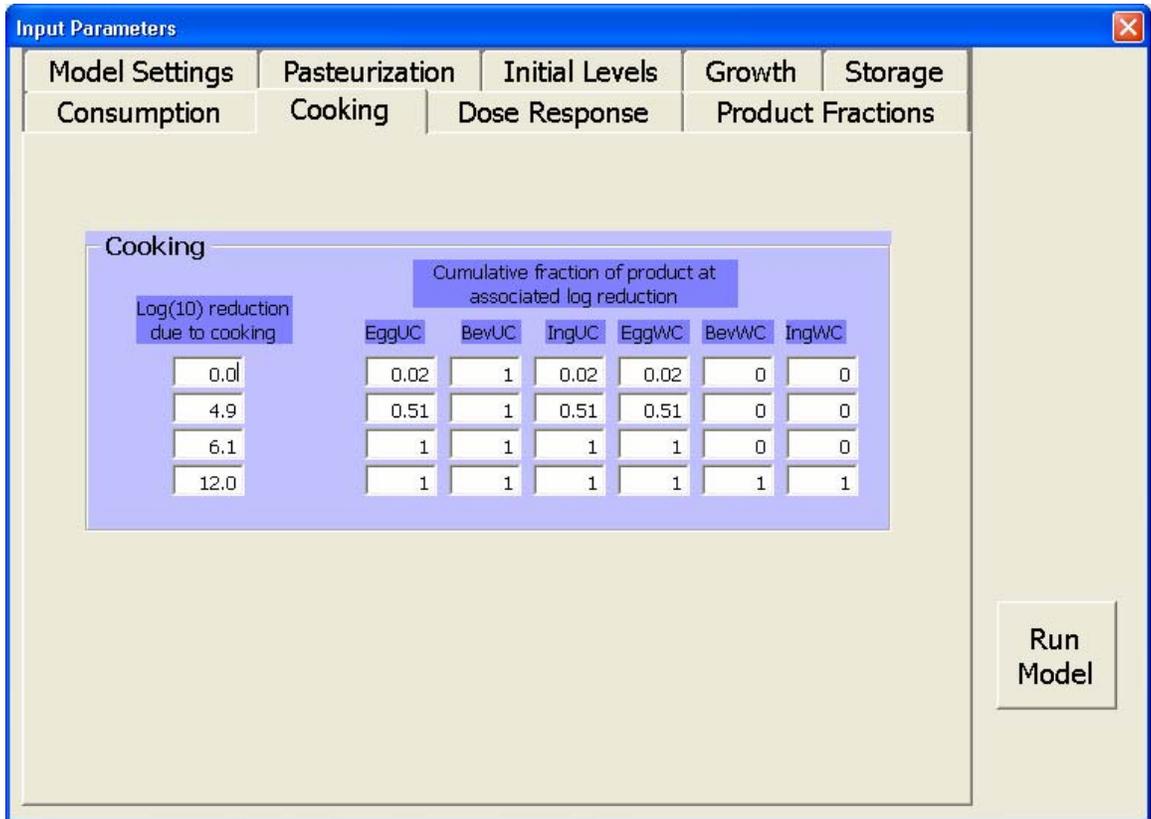
- The left-most column shows $\log_{10}$ reduction of *Salmonella* due to cooking

- The remainder of the table shows the cumulative fraction of product for each $\log_{10}$ reduction

- Thus, the values listed under EggUC indicate that 2% of this products undergoes no log reductions due to cooking (0.02 cumulative), 49% undergoes 4.9 log reductions (0.51 cumulative), and 49% undergoes 6.1 log reductions (1.00 cumulative).

- Third, click on "Dose-Response"

    - The green box gives the alpha and beta parameters for the beta-poisson *Salmonella* dose-response model developed by the World Health Organization. More information about the model is available from http://www.who.int/foodsafety/publications/micro/salmonella/en/
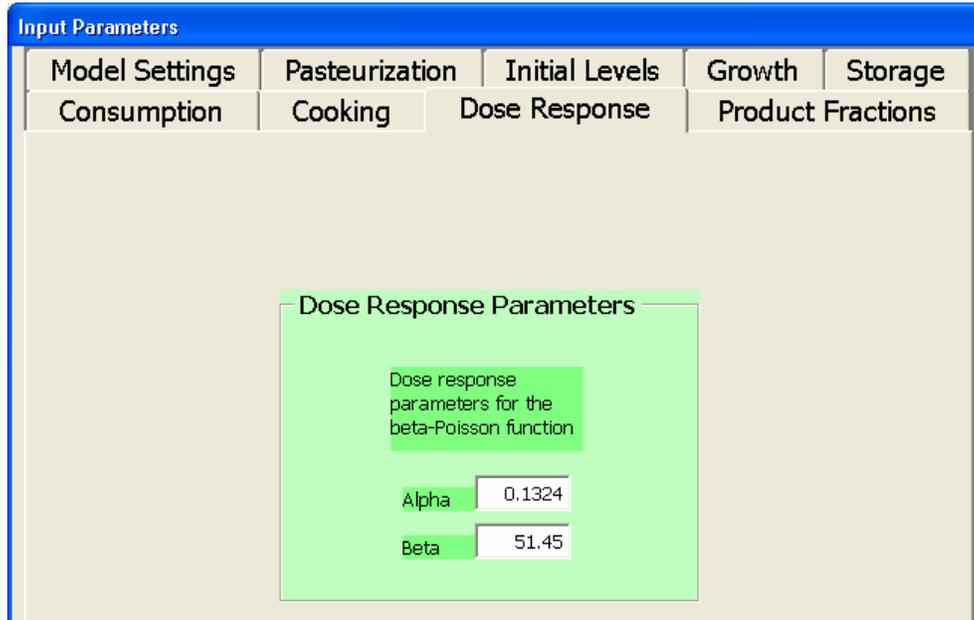
- Fourth, click on "Product Fractions"
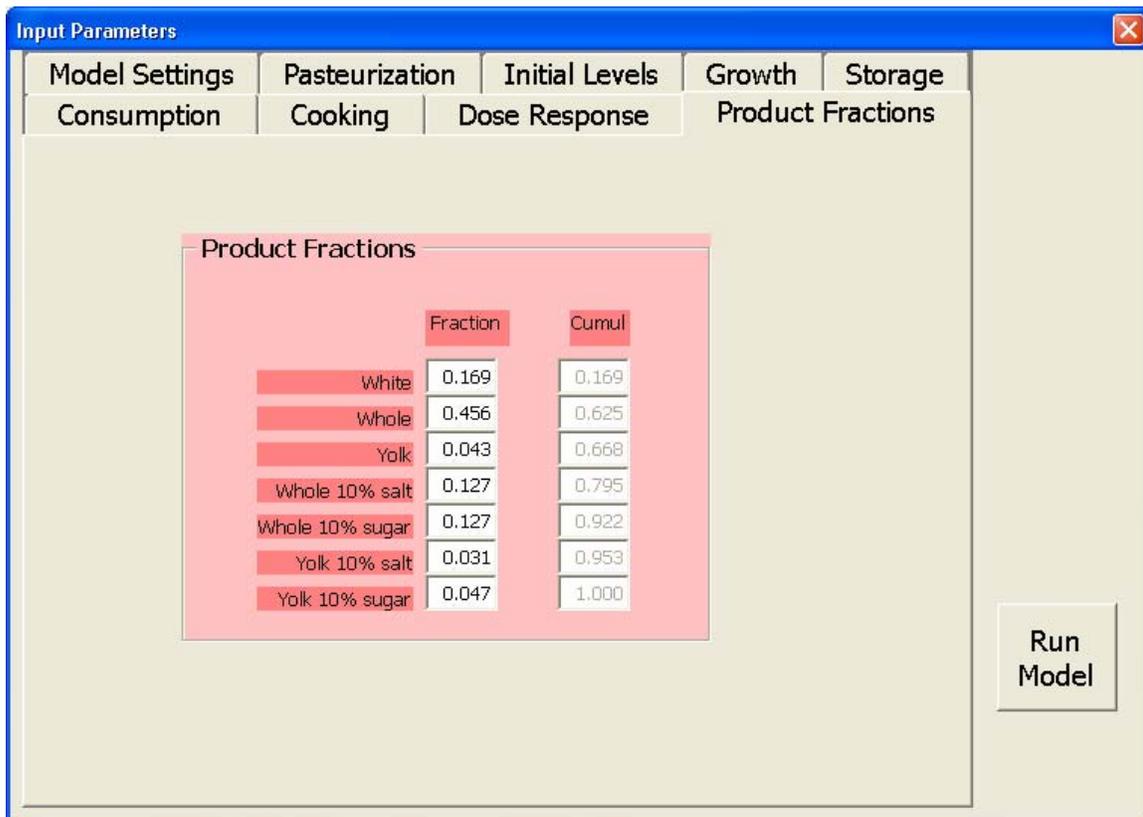
- o The left column in the pink box indicates the fraction of egg product consumption attributed to specific products. For instance, consumption of

products made with egg white comprises 16.9% of all egg product consumption

- o The second column simply provides a cumulative total of product fractions. *Note that unless the total for this column is equal to 1, the model may not run correctly.*

- Fifth, click on "Storage"

- o The blue box shows storage parameters for the three product types for which information is known

- o Reading across the top row, for instance, we see that Egg White is stored for a minimum of 2 days, an average of 10 days, and a maximum of 22 days.

- Sixth, click on "Growth"

- o The gray box shows information about the growth model developed for this risk assessment. More information about the growth model may be found in Annex E of the report

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    o Tabs in the upper left allow you to view model parameters for growth in egg yolk and in egg albumen
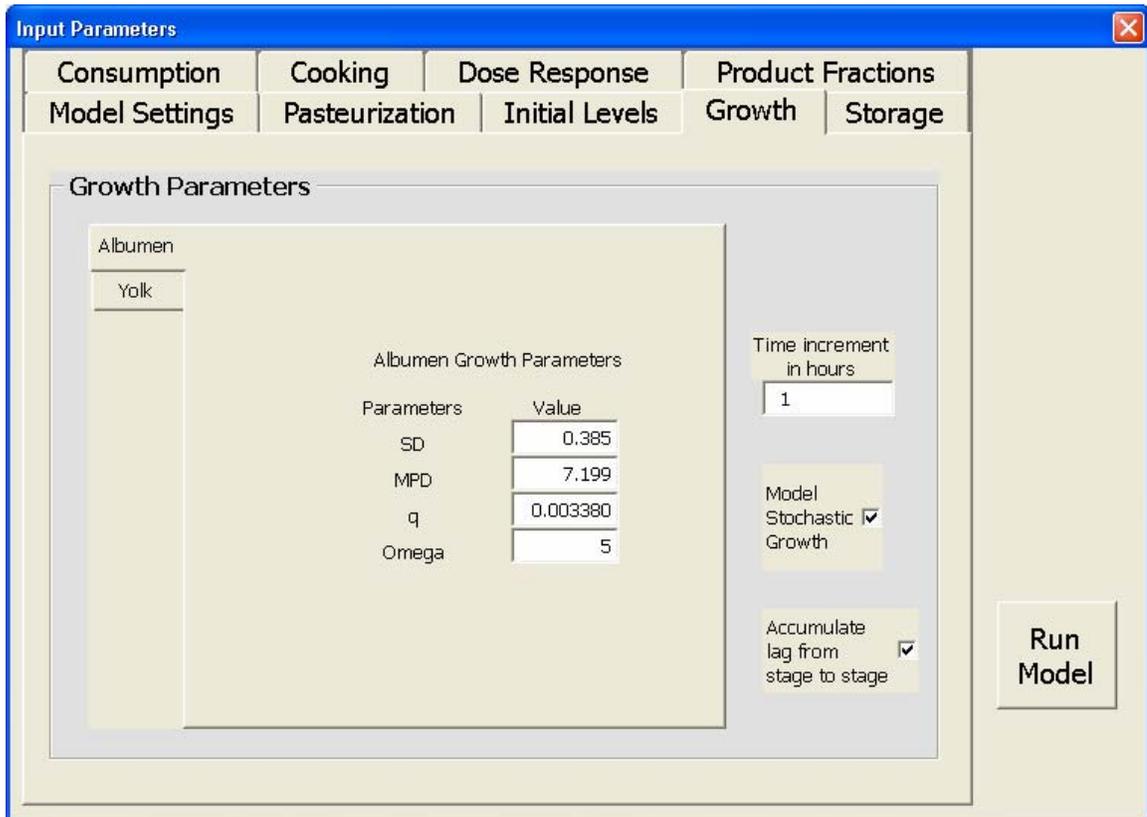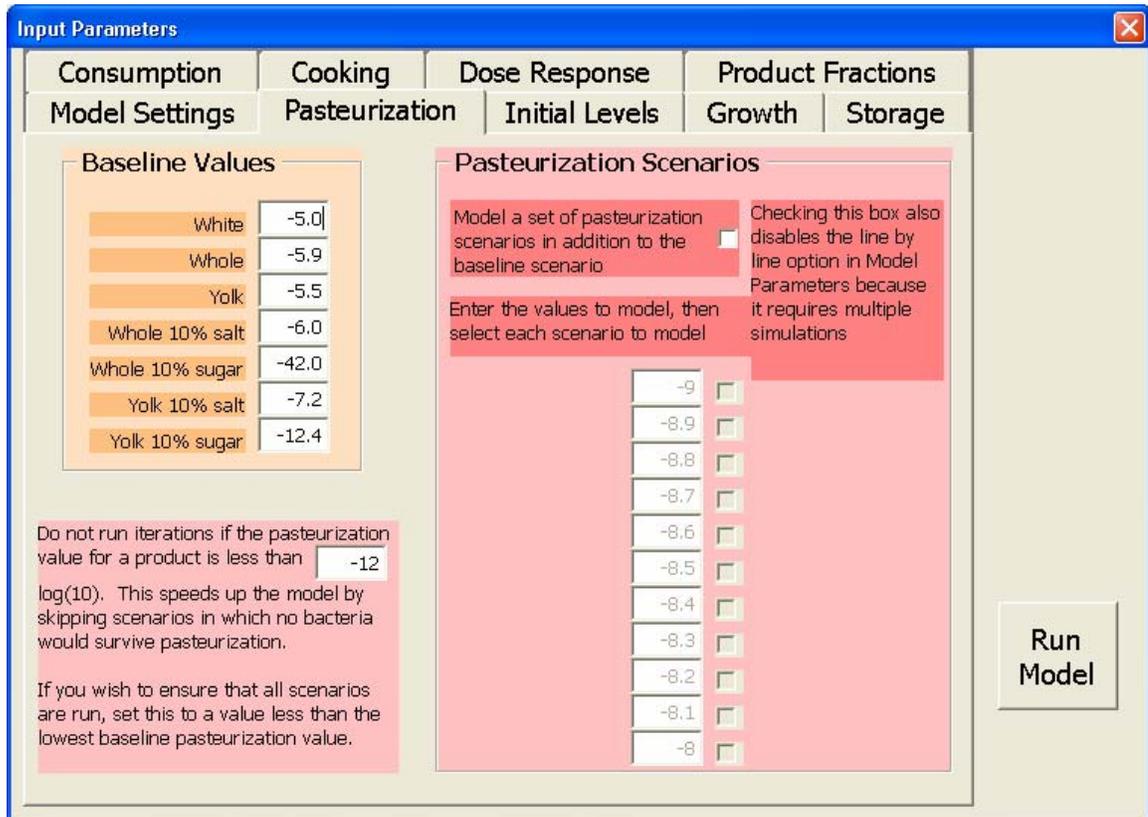

• Seventh, click on "Initial Levels"
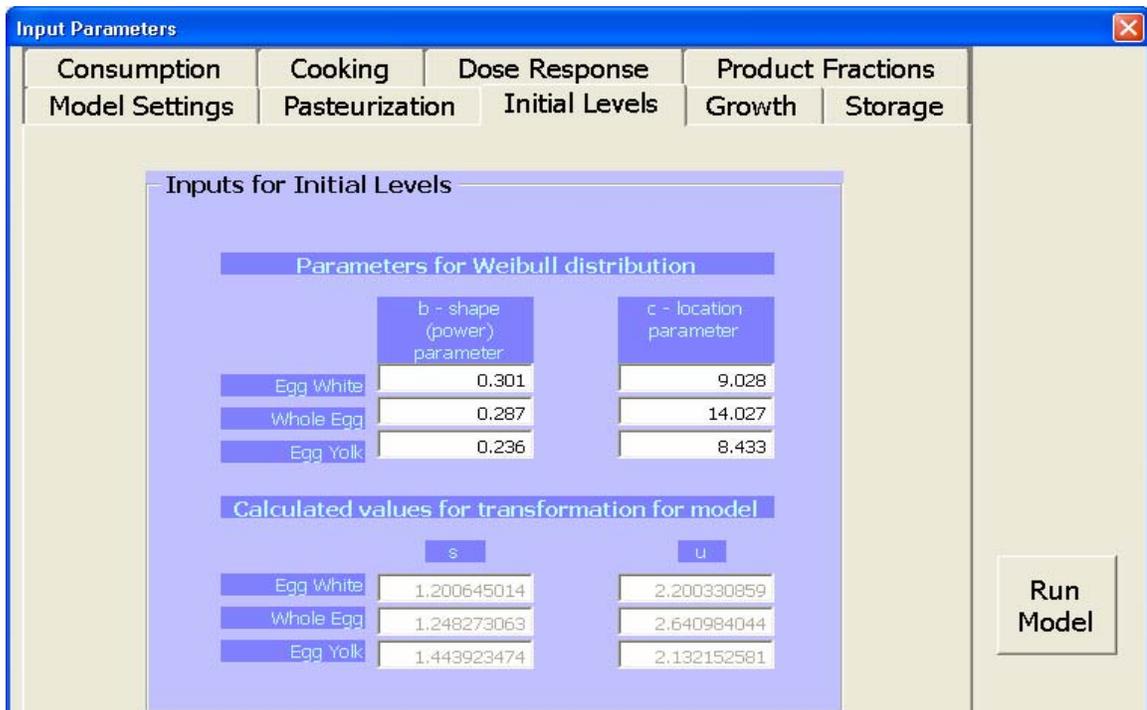
- o The purple box shows values for "u" and "s" of the transformed Weibull for estimating *Salmonella* levels in Egg White, Egg Yolk, and Egg Whole. Detailed information about the Weibull and Initial Level parameters may be found in Annex F

- Eighth, click on "Pasteurization"

- o The orange box in the upper left-hand corner shows pasteurization values for each of the egg product categories in the model. The units of the values are $\log_{10}$ reductions of *Salmonella*

  - The default values given are those expected from current FSIS time-temperature regulations for egg products

- o In the red box in the lower left you will see the model is set not to run iterations if the pasteurization value is less than -12. The reason for this is because any value less than -12 results in the same result, i.e. 0 estimated illnesses

- o The red box to the right enables you to use one pasteurization level for all products

- By checking the box at the top, you may choose any of the pasteurization values given, from -9 to -8.

- Lastly, click on "Model Settings"
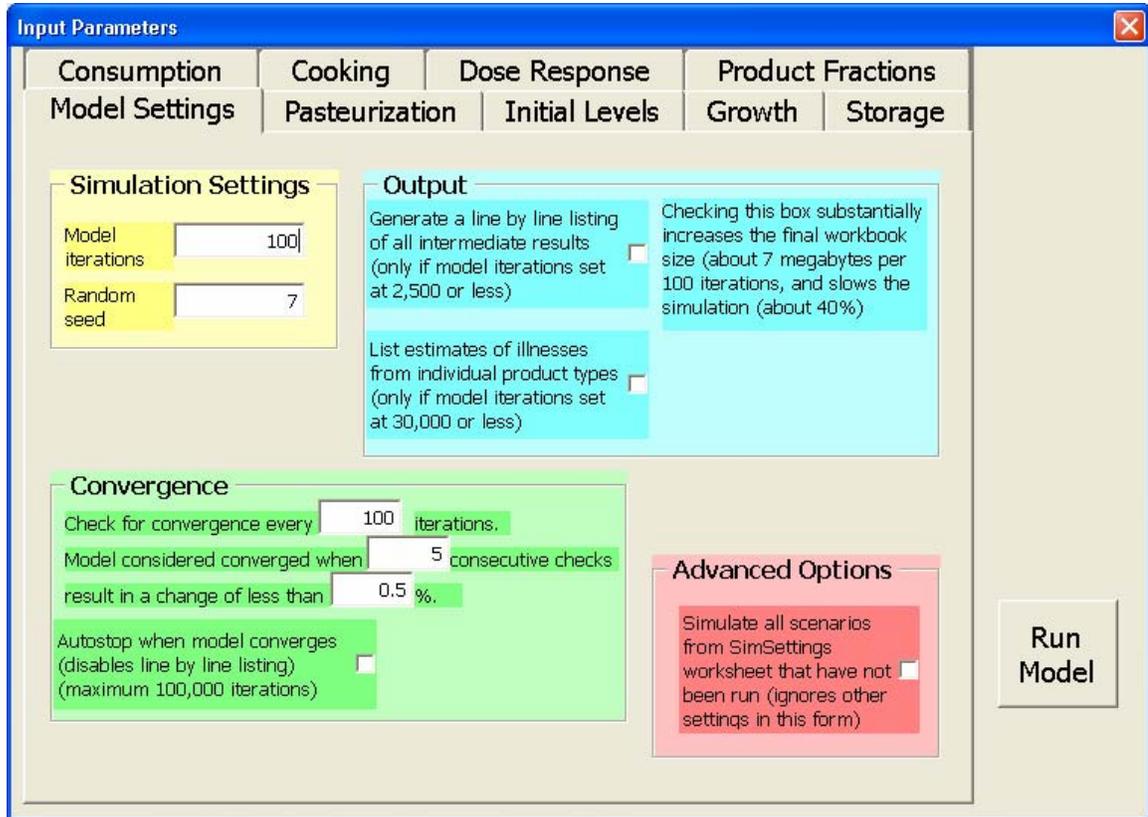
 o You are now back to the first page that appeared when you selected "Click Here to Input Values for Model"

  o The yellow box in the upper left allows you to set the number of iterations and random seed value
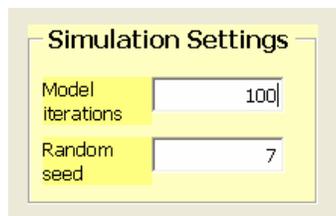

- Running 100 iterations will take about 5-10 minutes on most computers

- 10 iterations can be run in about a minute

- Remember that model stability increases with the number of iterations run; therefore, the user must balance estimate accuracy for model run time

    o We typically run 5,000 iterations to achieve model stability

- The random seed value refers to the number first drawn by Excel in running the model

    o A model run with a random seed of 7 for 1,000 iterations, for instance, should always yield the same result
    o By changing the random see we can examine the model

        - Changes in the random seed value should not significantly affect the model result

o The green box in the lower left shows values used to determine convergence
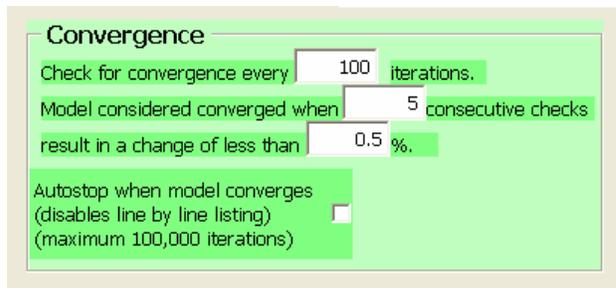
        - As the default, the model is said to "converge" if 5 consecutive sets of 100 iterations yield results within 0.05% of each other.

o The blue box in the upper right allows you to examine outputs and intermediate outputs more closely by capturing information in the worksheets labeled "Results1" through "Results7." Workbook size can increase substantially by checking the line by line listing box.
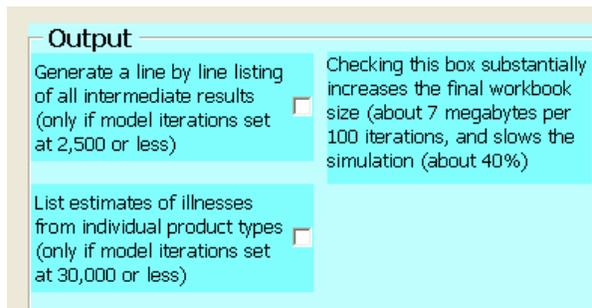

o The red box in the lower right gives the user an option of setting up model simulations in a worksheet named "SimSettings." If this option is

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checked, the program looks for simulations that have not been run in the SimSettings workbook, runs them, and stores the output in SimSettings. **Input parameters from the input parameters window are ignored**. This option allows for many simulations to be set up and then run unattended.
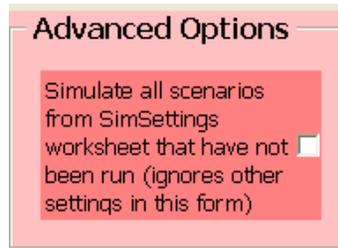
Running the Model

- Once the user is satisfied with the input parameter values, the model is ready to run. Before beginning a simulation, try a trial run; make sure under "Simulation Settings" the number of model iterations is set to 10.

- Click "Run Model"

- As the model runs you will see a window titled "Simulation Progress"

The purple box in the upper left of the window gives a snapshot of the results from each completed iteration

The red bar moving left to right across the top of the window indicates the progress of the model. In this instance, because we have set the model iterations to 10, the model is 10% completed when 1 iteration has been run

The pink box at the lower left shows the number of iterations completed and the number left to complete

The green box at the lower right shows information about model convergence

- NOTE: under Excel XP, it is common for the "Simulation Progress" window to lose "focus." This may happen when another window is selected either by the user or as the result of some other action by the computer. When this happens the "Simulation Progress" window will cease showing updates. It may also simple

appear as a blank window. Nevertheless, the simulation will continue to run until finished. This problem does not appear to occur under Excel 2000.

Viewing Model Results

- When the model is finished running the Simulation Progress window will automatically close and you will see a new Summary Sheet

- The Summary Sheet is similar to that described above beginning on page 1 of this document

  o If the model was run with the default input parameters at 10 iterations with a random seed value of 7, you should see the following results:

Summary results from last simulation		
Total iterations		10
Total illnesses estimated		8,617
From total servings of		47,249,212,770
Simulation of individual products		
Products	**Pasteurization**	**Illnesses**
White	-5	5,464
Whole	-5.9	1,690
Yolk	-5.5	732
Whole 10% salt	-6	718
Whole 10% sugar	-42	0
Yolk 10% salt	-7.2	14
Yolk 10% sugar	-12.4	0
Convergence		
Consecutive checks below threshold		0
Performance		
Time simulation ended		9/19/2005 18:31
Time simulation began		9/19/2005 18:30
Total time for simulation		0:01:17
Seconds per iteration		7.70
Contaminated servings simulated		1,680
Seconds per serving		0.04583
Servings per second		21.8