



## Parameter Editing for the Orinoquía Agricultural Linear Programming Model

Carlos Fontanilla  
PhD Student, Department of Agricultural Economics  
Purdue University

Email Contact: [orinoquia@purdue.edu](mailto:orinoquia@purdue.edu)

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### I. Introduction

Orinoquía Agricultural Linear Programming Model is a decision-making tool that allows determining between different options of agricultural and livestock enterprises, those options that maximize the returns to the factors of production (family and existing permanent labor, land, capital) in a typical farm. It should be noted that, although this model was coded in the GAMS Software (General Algebraic Modeling System), an interface has been designed in Excel to make it easier for users to modify the values of the initial resources available to the producer, as well as restrictive parameters, and the technical coefficients of the predefined enterprises. You can also include new enterprises or eliminate existing ones.

This document provides guidance on how to examine and modify an Excel file for use by the GAMS model.

### II. Some points to keep in mind

- Choose any of these files as a starting point:
  - Altillanura: <Altillanura><M for small/medium or L for large><creation data in format yyyyymmdd>.<gms or xlsx>),
  - Piedemonte: <region><S for small or M for medium/large><creation data in format yyyyymmdd>.<gms or xlsx>),
- You can work on as many Excel files as you want. However, GAMS only works with one file at a time. Each time you change the file, you must make sure that it matches the one indicated in line three of the code in GAMS.
- When working in the Excel file, make sure you do not change the locations of the shaded cells.
- Avoid using the options insert/delete rows or columns in the Excel file; to add or delete data use the cell options to copy, paste, or delete data.

- Make sure that the cells that contain the values of the parameters are formatted as numbers rather than text.
- The "000 pesos" notation is used to express units in thousands of pesos; for example, in the parameters that represent monetary units, instead of writing 1,000,000 (one million pesos) you must write 1000 (thousand units of thousand pesos).
- Enterprises, or commodities must be completely specified. Each enterprise that is declared must include the type of land where it is developed (Irrg or NoIr), at least one commodity produced in said enterprise with its respective monthly production, and its per unit sale price. In addition, the monthly usage of labor and money must be specified for each enterprise.
- When entering data in the Excel document it is recommended to ensure information is not repeated. For example, the price for a commodity can only be declared one time. If it has a different quality or characteristics, it should be treated as a different commodity and given a different name.

### **III. Description of the initial resources and restrictive parameters**

#### **Family Labor (adult male equivalent) “flab”**

Family labor is one of the resources available to the farmer, and represents the number of equivalent adults available (from the household) to carry out the fieldwork activities. For example, if there are two adults, but one of them only spends half time on farm activities this value is 1.5. Here those who perform managerial activities that are not included in the enterprise monthly labor usage should be excluded.

The value of this parameter can be modified in the "Scalars\_and\_Parameters" spreadsheet in cell "C3".

#### **Permanent Labor (adult male equivalent) “plab”**

Permanent labor is one of the resources available to the farmer, and represents the number of workers with whom a permanent contract exists (whether or not farming activities are carried out). These workers can be employed in any type of agricultural or livestock activity.

The value of this parameter can be modified in the "Scalars\_and\_Parameters" spreadsheet in cell "C4".

#### **Maximum hired temporary labor (man days/ period) “thlab”**

This is the maximum temporary labor that can be hired in a month. In remote municipalities, there may be limitations on the availability of temporary labor and this parameter represents this restriction. It is noteworthy that temporary labor may be hired on an as needed basis with no commitment to continue employment in every period.

The value of this parameter can be modified in the "Scalars\_and\_Parameters" spreadsheet in cell "C5".

### **Maximum hired permanent labor (adult male equivalent) “phlab”**

This is the maximum number of workers that can be hired permanently. In remote municipalities, there may be limitations on the availability of permanent labor and this parameter represents this restriction. Permanent labor is hired in all periods of the year.

The value of this parameter can be modified in the "Scalars\_and\_Parameters" spreadsheet in cell "C6".

### **Initial cash available (000 pesos) “initcash”**

This parameter is part of the initial endowment of the producer. It represents the amount of money (not borrowed) available to invest in the agricultural enterprises of the farm during the year. It should be noted that it is expressed in thousands of pesos.

The value of this parameter can be modified in the "Scalars\_and\_Parameters" spreadsheet in cell "C7".

### **Monthly interest rate “intrst”**

This parameter represents the monthly interest rate at which it is possible to borrow money. If the monthly interest rate is 1.5%, you must enter in the calculation sheet 0.015.

The value of this parameter can be modified in the "Scalars\_and\_Parameters" spreadsheet in cell "C8".

### **Maximum borrowing allowed (000 pesos) “mxborrow”**

This parameter represents the maximum amount of money that can be borrowed by the producer. It is expressed in thousands of pesos.

The value of this parameter can be modified in the "Scalars\_and\_Parameters" spreadsheet in cell "C9".

### **Temporary wage (000 pesos per 8 hour man day) “twlab”**

This parameter is the payment a temporary worker receives in consideration for a day of work expressed in thousands of pesos.

The value of this parameter can be modified in the "Scalars\_and\_Parameters" spreadsheet in cell "C10".

### **Permanent labor wage (000 pesos per man year) “pwlab”**

This parameter represents the annual salary paid to a permanent hired worker. It is expressed in thousands of pesos per year and includes any benefits paid by the producer.

The value of this parameter can be modified in the "Scalars\_and\_Parameters" spreadsheet in cell "C11".

### **Land Available (ha) “Ind(l)”**

This parameter is part of the initial endowment of the producer. This parameter refers to the area available to implement the agricultural projects (expressed in hectares). Areas equipped for irrigation (Irrigated) and others areas (Nonirrigated) are entered separately.

The values assigned to this parameter can be modified in the "Scalars\_and\_Parameters" spreadsheet in cells "C16" (for Irrigated) and "C17" (for Nonirrigated).

### **Good field days (days suitable for fieldwork by period) “gfd(t)”**

Weather conditions and other factors may limit the number of days available for the execution of fieldwork: planting, fertilizer application, harvesting, etc. This parameter represents the number of days in each month of the year when it is feasible to carry out fieldwork. This parameter will vary by region and should be based on conservative estimates such that the days will be available with high probability (85% is the customary cut-off).

The values assigned to this parameter can be modified in the "Scalars\_and\_Parameters" spreadsheet in cells "G4" to "G16". Note that each cell represents a month: cell "G4" contains the value corresponding to January, "G5" to February, "G6" to March, and so on up to "G16" whose value represents the working days for December.

### **Lower Bounds on Activities “lobd(l,e)”**

This parameter represents the lower limit of land (in hectares) with and without irrigation that must be used in every enterprise. By default, all enterprises have a lower limit of zero hectares, but this parameter can be modified in accordance to the requirements of each farm. In other words, this parameter allows the model user to assign a strictly positive minimum area to any enterprise.

The values assigned to this parameter can be modified in the "Scalars\_and\_Parameters" spreadsheet in descending order from "N4", "O4", and "P4" cells.

The information on type of land (Irrg, NoIr), enterprise, and lower limit of land area must be declared starting from the row 4 in the columns "N", "O", and "P", respectively. Below is an example of how to declare five alternatives (Empty rows must be avoided between the declared alternatives).

Table 1. Declaring lower bounds to the land area

Row \ Column	N	O	P
4	Irrg	OilPalm	0
5	NoIr	Rice_Soybeans	0
6	NoIr	Corn_Soybeans	0
7	NoIr	Crop_Beef	10
8	NoIr	OilPalm	0
9			

It is possible that some agricultural enterprises can be produced on both irrigated and nonirrigated land. In that case, each enterprise is treated as a different alternative (one with irrigation and another without irrigation), and a lower limit of area is assigned in each case. In our example, OilPalm is produced on both Irrigated and Nonirrigated land.

Note that the information for the first alternative must be entered in "row 4" and the information of the fifth alternative in "row 8". Column "N" must contain the type of land where an enterprise can be implemented, the column "O" indicates the name of the enterprise, and the column "P" the lower limit.

In our example, all alternatives have a lower limit of 0 hectares, with the exception of the Crop\_Beef enterprise. If this were the case, the results of the linear programming model will have at least 10 hectares of "NoIr" land dedicated to the Crop\_Beef enterprise.

### Upper Bounds on Activities “upbd(l,e)”

This parameter allows the producer to limit the maximum area (in hectares) that each enterprise can occupy on each of the two types of land.

The values assigned to this parameter can be modified in the "Scalars\_and\_Parameters" spreadsheet in descending order from cells "S4", "T4", and "U4".

In our example of five alternatives below, information on land type (Irrg, NoIr), name of the enterprise and upper limit of the area are declared in cells "S4" to "U8". Empty rows must be avoided between the declared alternatives.)

Table 2. Declaring upper bounds to the land area

Row \ Column	S	T	U
4	Irrg	OilPalm	10000
5	NoIr	Rice_Soybeans	10000
6	NoIr	Corn_Soybeans	10000
7	NoIr	Crop_Beef	10
8	NoIr	OilPalm	10000
9			

It is possible that some agricultural activities can be produced on both irrigated and nonirrigated land. In that case, each enterprise can be treated as a different alternative (one with irrigation and another without irrigation), and there must be assigned an upper limit of area in each case. In our example, OilPalm is produced in both Irrigated and Nonirrigated land.

Note that the information for the first alternative must be entered in "row 4" and the information of the fifth alternative in "row 8". The "S" column must contain the type of land where an enterprise can be implemented; the "T" column indicates the name of the enterprise, and the "U" column the upper limit in hectares. In our example, all alternatives have an upper limit of 10 thousand hectares, with the exception of the Crop\_Beef. According to this parameter, the model will not allow an area greater than 10 hectares to be allocated to the Crop\_Beef enterprise in the "NoIr" type of land. Note that specifying an upper limit that is smaller than the lower limit for a given enterprise and land type will result in a model that has no feasible solution.

#### IV. Description of the technical coefficients

##### Selling prices for commodities (000 pesos per unit) "sprc(c)"

This parameter specifies the prices at which the different commodities produced by the different enterprises are sold. These prices are expressed in thousands of pesos (000 pesos) per unit of the commodity.

The values assigned to this parameter can be modified in the "Scalars\_and\_Parameters" spreadsheet starting in the cells "I4", "J4", and "K4". For example, in the case of producing five commodities in Table 3, the information of units of sale are indicted in column I, name of the commodity in column J and price in thousands of pesos per unit in column K. (Empty rows should be avoided between the declared commodity prices.)

Note that the price information of the first commodity should be entered in "row 4" and the information of the fifth commodity in "row 8".

Table 3. Declaring commodity price information

Row \ Column	I	J	K
4	(000 pesos per ton)	Rice	1050
5	(000 pesos per ton)	Soybeans	1300
6	(000 pesos per ton)	Corn	820
7	(000 pesos per ton)	FFB	320
8	(000 pesos per kilo)	Novillo	4.5
9			

If you want to add a new commodity, enter the price information in the next available row. (In the example in Table 3, this would be in row 9). If you want to eliminate a commodity, delete the information contained in the cells that refer to said commodity and occupy the empty spaces with the information of the commodities that precede it). For example, if you want to eliminate the FFB commodity, you must delete the information contained in cells "I7", "J7", "K7" and replace it with the information of the commodities that follow, in our example, Novillo. See the result in Table 4. On the other hand, when you only need to change the price of a commodity, it will suffice to modify the value contained in cell "K".

Table 4. Deleting commodity price information

Row/Column	I	J	K
4	(000 pesos per ton)	Rice	1050
5	(000 pesos per ton)	Soybeans	1300
6	(000 pesos per ton)	Corn	820
7	(000 pesos per kilo)	Novillo	4.5
8			
9			

**Labor use by period “wu(l,e,t)”**

This parameter represents the monthly labor requirement that each enterprise requires per hectare according to whether it is grown on irrigated or non-irrigated land. This requirement is expressed in man days per hectare in the month. In crops whose production cycle is longer than one year, this value corresponds to the monthly average of the labor requirement across years during the enterprise life span (from the year of sowing to the year of eradication of the crop). In other words, if the project lasts five years, the labor demand for the month of January will be the average of the quantities of labor required in all the months of January from the first year of the project to the fifth.

The values assigned to this technical coefficient can be modified in the "Labor\_use\_ (R)" worksheet in descending order from cells "A2", "B2", ..., "N2". Each enterprise will occupy a whole row; For example, if there are four alternatives, the first will occupy row 2 and the fourth row will be row 5 (There should be no empty rows until the last enterprise). Given that an agricultural activity may have different labor requirements when grown on irrigated land than when it is not, the monthly labor use per hectare is specified separately for each enterprise and land type.

*Table 5. Declaring labor demand by enterprise*

Row \ Column	A	B	C	D	E	F	G	H	I	J	K	L	M	N	R
2	Irrg	OilPalm	3.46	2.69	3.86	3.30	3.20	2.73	1.75	2.05	2.04	1.17	3.88	2.03	32.15
3	NoIr	Rice_Soybeans	0.05	0.01	0.01	0.43	0.43	0.04	0.04	0.30	0.32	0.28	0.02	0.04	1.99
4	NoIr	Corn_Soybeans	0.04	0.01	0.01	0.44	0.44	0.04	0.01	0.32	0.34	0.28	0.02	0.04	2.01
5	NoIr	Crop_Beef	0.09	0.07	0.07	0.32	0.32	0.09	0.08	0.24	0.26	0.23	0.08	0.09	1.94
6															

Note that the column "A" is used to describe the type of land: with irrigation (Irrg) or without irrigation (NoIr), while the column "B" is used for the name of the enterprise. Columns "C" through "N" are used to indicate the man days required per hectare in every month for every enterprise; the labor requirement for January is located in column "C", for February in column "D", and so on until December, whose information is located in column "N".

To illustrate this, we will describe the agricultural alternative that occupies row 3. This is the Rice\_Soybeans enterprise (cell "B3") produced on land without irrigation (indicated by "NoIr" in cell "A3"). The requirement of labor per hectare is 0.05 man days (Cell "C3") in January, 0.01 man days in February (Cell "D3"), and so on until December where it demands 0.04 man days per hectare (Cell "N3"). The relationship is linear; so 0.04 man days per hectare is equivalent to say 4 man days per 100 hectares.

Note that the columns "O", "P", "Q" should be empty, and the column "R" is used to calculate the sum of labor required on a hectare per year for every enterprise.



### Cash use (000 pesos) by period “cu (l,e,t)”

This parameter represents the amount of money per hectare that is needed month by month for each declared enterprise, according to the type of land (with and without irrigation). It is expressed in thousands of pesos (000 pesos) per hectare for the month. For crops whose production cycle is longer than one year, this value is the monthly average across years of the money required during the project life span (from the year of sowing to the year of eradication of the alternative). In other words, if the project lasts five years, the money required for the month of January will be the average of the money required in all the months of January from the first year to the fifth year of the project.

The values assigned to this technical coefficient can be modified in the "Cash\_use\_ (R)" spreadsheet beginning in row 2 (i.e., cells "A2", "B2", ..., "N2"). Each production alternative will occupy an entire row; for example, if there were four alternatives, the first will occupy row 2, and the fourth enterprise will be row 5. (There should be no empty rows until the end of the data.) Given that the same enterprise may have a different monthly cash requirement when irrigation is used or not, the land type must be indicated in addition to the enterprise name.

Table 6. Declaring cash use by enterprise in every period

Row \ Column	A	B	C	D	E	F	G	H	I	J	K	L	M	N	R
2	Irrg	OilPalm	313.9	514.6	105.0	444.1	85.7	434.6	83.6	433.1	91.4	89.5	444.4	307.0	3346.9
3	NoIr	Rice_Soybeans	315.0	0.0	80.0	1198.8	736.9	138.0	237.5	1192.9	621.9	427.8	1492.1	250.0	6691.0
4	NoIr	Corn_Soybeans	315.0	0.0	80.0	2044.4	1191.7	156.0	0.0	1360.4	1026.9	427.8	1017.0	250.0	7869.3
5	NoIr	Crop_Beef	299.6	119.6	261.7	1188.0	716.6	204.2	187.4	849.1	590.7	409.4	882.4	308.4	6017.2
6															

Note that the agricultural alternatives are indicated in columns "A" and "B". The first column is used to describe the type of land (irrigated “Irrg” or non-irrigated “NoIr”). Column “B” specifies the name of the enterprise. Columns "C" through "N" indicate the per hectare monthly requirement of money (000 pesos) for the enterprise; the money demanded for January is located in column "C", for February in column "D", and so on until December, whose information is located in column "N".

To illustrate this, we will describe the agricultural alternative that occupies row 3. This is the Rice\_Soybeans enterprise (cell "B3") produced on land without irrigation "NoIr" (cell "A3"), which has cash requirements of 315 thousand pesos per hectare in January (cell "C3"), 0 thousand pesos in February (cell "D3"), and so on until December where it requires 250 thousand pesos per hectare (Cell "N3").

Note that the columns "O", "P", "Q" should be empty, and the "R" column is used to calculate the total amount of money required per hectare in a year for every enterprise.

### Commodity produced by period “entcom (l,e,c,t)”

This parameter includes the harvested yield per hectare of the different commodities produced from the enterprises in each month, separately for irrigated and non-irrigated land. Depending on the commodity, it can be expressed in several output units (tons, kilograms, liters, among others) per hectare in the month. For crops whose production cycle is longer than one year, this value is the average monthly harvested yield during the production cycle. In other words, if the project lasts five years, the yield per hectare for the month of January will be the average of the quantities produced in all the months of January from the first year of the project to the fifth.

The values assigned to this technical coefficient can be modified in the "Commodity produced\_ (R)" spreadsheet in beginning in row 2 and below. Each commodity according to the production alternative will occupy an entire row; for example, if there were four commodities produced in a total of five alternatives, the first alternative would occupy row 2 and the fifth, row 6 (There should be no empty spaces between rows). Given that the same commodity can be produced by several agricultural alternatives, and that yields per hectare can be different when irrigation is used or not, the monthly output of the different commodities must be declared according to the various production alternatives that exist.

Table 7. Declaring commodity outputs by enterprise in every period

Row \ Column	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	S	T
2	Irrg	OilPalm	FFB	2.92	3.21	3.80	2.63	1.75	0.73	0.58	0.73	1.02	1.17	1.02	1.17	20.74	ton
3	NoIr	Rice_Soybeans	Rice	0.00	0.00	0.00	0.00	0.00	0.00	2.25	2.25	0.00	0.00	0.00	0.00	4.50	ton
4	NoIr	Rice_Soybeans	Soybeans	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	2.60	ton
5	NoIr	Corn_Soybeans	Corn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.50	3.50	0.00	0.00	0.00	7.00	ton
6	NoIr	Corn_Soybeans	Soybeans	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	2.60	ton

Note that the commodity is indicated in column “C”, and is preceded by the land type (column “A”) and enterprise (Column “B”) that produces it. Columns “D” to “O” are used to denote the monthly harvested yield per hectare of the different commodities for the various agricultural alternatives. Thus, the harvested yields obtained in January are indicated in column “D”,

for February in column “E”, and so on until December, whose harvested yield is located in column “O”. It is important to mention that the amounts must be expressed in the corresponding units in which the prices of the commodities have been declared so that their product is in thousands of pesos.

To illustrate this, we will describe the agricultural alternative that occupies row 3; this is the commodity named Rice ("C3" cell) produced in the Rice\_Soybeans enterprise (cell "B3"), on nonirrigated land "NoIr" (cell "A3"). The output of this commodity takes place in the months of July and August (Cells "J3" and "K3") when 2.25 tons per hectare is obtained each month.

Note that the columns "P", "Q" and "R" must be empty, but the column "S" is used to calculate the annual output per hectare for every enterprise, and column "T" will indicate the units used to measure the output.

### Land use by period “lu(l,e,t)

Not all the enterprises occupy the area destined for its production throughout the entire year, an example of this is the semi-annual crops. This parameter indicates the months of the year that an enterprise occupies the land. Thus, this parameter will take the value of zero or one to indicate whenever the enterprise is occupying the land (1) or not (0) during the given month. This is important, because it allows the same land to be used for more than one enterprise per year provided that they do not simultaneously occupy the land. For example, Rice (row 5) and Soybeans (row 6) both produced without irrigation occupy the land with complementary schedules such that both enterprises could be on the same hectare of land within the year.

Table 8. Declaring land use by enterprise in every period

Row \ Column	A	B	C	D	E	F	G	H	I	J	K	L	M	N
2	Irrg	OilPalm	1	1	1	1	1	1	1	1	1	1	1	1
3	NoIr	Rice_Soybeans	1	1	1	1	1	1	1	1	1	1	1	1
4	NoIr	Corn_Soybeans	1	1	1	1	1	1	1	1	1	1	1	1
5	NoIr	Rice	0	0	1	1	1	1	1	0	0	0	0	0
6	NoIr	Soybeans	1	0	0	0	0	0	0	1	1	1	1	1

The values assigned to these technical coefficients can be modified in the spreadsheet "Land\_use\_ (R)" beginning in row 2. Each agricultural alternative will occupy an entire row. For example, if there are five alternatives, the first will be entered in row 2, and the fifth will be in row 6. (There should be no empty rows between alternatives.) Given that the land occupation periods of an enterprise may vary depending on whether it is irrigated, land use is indicated by land type and enterprise.

Note that the agricultural alternatives must be declared in columns "A" and "B", in the first column the type of land, and the second column the name of the enterprise. Columns "C" through "N" indicate whether the land is occupied in the month associated with the column, where January is located in the "C" column, February in the column "D", and so on until December, whose information is located in the "N" column.

**Commodity use by period “fu (l,e,c,t)”**

This parameter is useful when there is an enterprise that uses a commodity produced by another agricultural alternative as an input to its production process. This technical coefficient indicates for the enterprise that requires it, the quantity of the commodity consumed in each period, expressed in the same units reported in the **entcom parameter (l, e, c, and t)**.

The values assigned to this technical coefficient can be modified in the spreadsheet "Commodity use\_ (R)" beginning in row 2. Each commodity occupies an entire row. The commodities must be declared in column "C", and are preceded by the description of the enterprises (Column "B") that consume it and by the type of land (Irrg or NoIr) that is occupied by the enterprise (Column "A"). Columns "D" to "O" are used to indicate the monthly per hectare commodity consumption as input for the agricultural alternative; the demand for commodities in January is located in column "D", for February in column "E", and so on until December, whose information is located in column "O". It is important to mention that the amounts must be expressed in the same units that conform with the prices of the commodities such that their product yields thousands of pesos.

To illustrate the above, we will describe the agricultural option from row 2 in Table 9; this is the Silage commodity (Cell "C2") consumed in the Beef enterprise (Cell "B2"), in lands without Irrigation "NoIr" (Cell "A2"). The consumption of this commodity is 0.3 tons per hectare in January (cell "D2"), 0.3 in February (cell "E2"), and so on until December (Cell "O2"). It is noteworthy that the consumption of this commodity only occurs between the months of December to March, when the availability of forage decreases due to the dry season in the Orinoquía region.

*Table 9. Declaring commodity intake by enterprise in every period*

Row \ Column	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	S	T
2	NoIr	Beef	Silage	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	1.20	ton
3																	
4																	

5																	
6																	

In the example in Table 9 there is only one alternative, additional alternatives would be specified in rows 3 and below with no blank lines between alternatives. Note that the same commodity can be consumed by different agricultural alternatives as intermediate inputs, and that there may be multiple commodities used as intermediate inputs by the same agricultural alternative.

Columns "P", "Q" and "R" should remain empty, but column "S" is used to compute the annual amount of the commodity that is consumed per year in one hectare by the described agricultural alternative. Finally, column "T" will indicate the units of measure for the commodity.

#### V. How to save changes

Once you have made the changes in the Excel file, it is suggested to save a copy following the following format (<region><M for small or medium producer, or L for large producer><date in format yyymmdd (year-month-day)>.<gms or xls>); for example: [AltillanuraL20171130.xlsx](#)

In order for the Excel file to be read in GAMS, you must open the latest version of the LP Orinoquía model in GAMS and modify line three of the code making sure that the name of the .xlsx file reported in GAMS matches the name of the Excel file that contains the data you want to use. It is suggested that you save the GAMS file using the same name format that you used in the Excel file, so you can track the changes (in this case it would be [AltillanuraL20171130.gms](#)).

In addition to naming the Excel and GAMS files so that they can easily be associated with each other, it is recommended that these files be stored in the same folder and that one logical choice for this folder would be the location of the GAMS project file on your computer.