Food Balance Sheets

Food Balance Sheets Compilation at the national level

The two principal data pillars for the compilation of the Food Balance Sheets (FBS), whether at the national level or at FAO, are the agricultural trade and production data. The trade data are, on the whole, quite accurately recorded and compiled by the national Customs Office, based on the appropriate filled-in forms and on manual checks. The production data are obtained from the national surveys, which are most often yield-based extrapolations. Production and trade (imports and exports) are the main components of the "supply" side of the FBS.

Reliable data for the other components of the FBS balancing equation, such as withdrawals or additions from/to stocks (supply), feed, seed, industiral use, loss, etc, (all part of utilization) may or may not be available at the national level, depending on the agricultural data collection framework in a given country. In the absence of such data, one must resort to impuation using the methodolgies described in detail in the preceding chapter.

The FBS equation, as we saw earlier: Supply: Production + Imports - Exports - Stock changes = Utilization: Food + For Processing + Feed + Seed + Tourist consumption + Industrial use + Loss + Residuals/other utilizations

Of major importance in the FBS calculation is the "Food" component, expressed in Kcal/person/day. It is essential to bear in mind that this "Food" is an indicator of "availability", as a national average, and not of actual "consumption". Household consumption data are more accurately obtained from the various household surveys. The differences between the "food" data from the FBS and the "consumption" from the household surveys are described in detail elsewhere in this manual (such as the absence of data reflecting the public consumption of food in restaurants, at street level, etc. in the household surveys).

The possible data sources for the other components (such as the agri-food industry data) have been listed elsewhere in this manual.

In this chapter, we will show a step-by-step example of the FBS compilation, starting with the detailed Supply Utilization Accounts (SUA) of a given country in a given year, for a few selected commodities. These SUAs are then aggregated to produce the FBS. The "Residuals/other utilizations" component will be omitted in the example, in order to simplify the steps.

Wheat

For this example, we will first consider the full process for creating a food balance sheet for wheat. We start off with an empty SUA table showing some components of the wheat "commodity tree" (wheat as the primary commodity, flour, etc. as the processed commodities):

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat	0	0	0	0	0	0	0	0	0	0	0
Wheat flour	0	0	0	0	0	0	0	0	0	0	0
Bulgur	0	0	0	0	0	0	0	0	0	0	0
Breakfast cereals	0	0	0	0	0	0	0	0	0	0	0

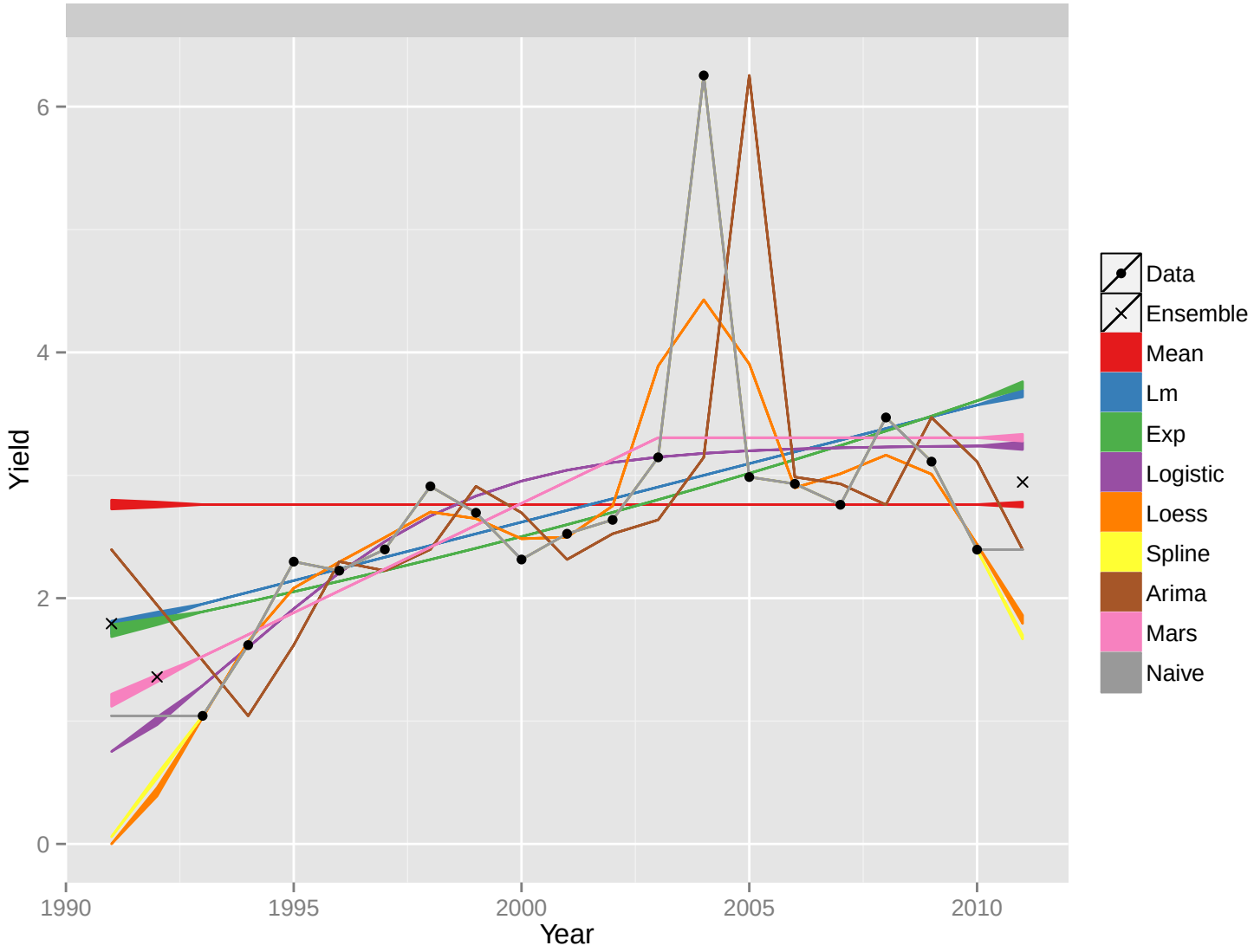
Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat starch	0	0	0	0	0	0	0	0	0	0	0
Wheat bran	0	0	0	0	0	0	0	0	0	0	0

Production

For production data, we first fill in the table with any available official figures. To impute any missing production figures, we must also consider "yield" and "area sown" data, since yield is defined as production divided by area harvested (and thus with any two elements the third is uniquely defined).

Name	Area Harvested	Yield	Production
Wheat	0	0	0
Wheat flour	0	0	0

In this case, the production quantity is only known for wheat flour (it is missing for wheat), and for wheat we are also missing the yield value. The first step in the imputation process is to impute the yield, using the previously described production imputation methodology.



The final imputed value for yield in 2011 is 2.94 tonnes/hectare, which is a reasonable estimate when compared to the historical time series. Some models fit the data fairly well (such as the logistic regression, spline, and loess regression). Some of these models do not produce good forecasts (in

particular, the forecast for the loess model is quite low) but by averaging together well-performing models, we get a good final estimate for the yield.

Name	Area Harvested	Yield	Production
Wheat	0	0	0
Wheat flour	0	0	0

Now, we have enough information to compute the production data:

Name	Area Harvested	Yield	Production
Wheat	0	0	0
Wheat flour	0	0	0

Next, we fill in the table with our imputed and official production quantities. Production is only imputed for primary products (and occassionally official figures are provided for processed products, as is the case here). So, in this case, no additional values are filled in outside of wheat and flour.

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat	**54420000**	0	0	0	0	0	0	0	0	0	0
Wheat flour	**18650000**	0	0	0	0	0	0	0	0	0	0
Bulgur	**-**	0	0	0	0	0	0	0	0	0	0
Breakfast cereals	**-**	0	0	0	0	0	0	0	0	0	0
Wheat starch	**-**	0	0	0	0	0	0	0	0	0	0
Wheat bran	**-**	0	0	0	0	0	0	0	0	0	0

Trade

The next step is to include the trade data. Trade data are usually recorded in much more detail, covering more commodities, than production data. The total imports and exports (the aggregated trade flows) for each respective commodity, as reported by the customs office, are inserted in the table.

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat	54420000	**1999100**	**32790000**	0	0	0	0	0	0	0	0
Wheat flour	18650000	**341500**	**572800**	0	0	0	0	0	0	0	0
Bulgur	-	**182500**	**580000**	0	0	0	0	0	0	0	0
Breakfast cereals	-	**312500**	**217300**	0	0	0	0	0	0	0	0

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat starch	-	**624900**	**224500**	0	0	0	0	0	0	0	0
Wheat bran	-	**258900**	**2343700**	0	0	0	0	0	0	0	0

SALAR TO INSERT EXAMPLE OF TRADE MIRRORING AND U.V.-BASED QUANTITY CORRECTION.

For all the next steps, this example will consider all the data for the various components as unavaiable, and thus all the figures are to be imputed.

Stock Changes

We now estimate the stock changes. Generally, stocks will be held for a select number of primary level products (such as wheat or rice). The numbers below represent the estimated stock changes (by the stock imputation methodology described previously) for the example country we are considering. In this case, our estimate represents a drawdown in the stocks held.

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat	54420000	1999100	32790000	**-230600**	0	0	0	0	0	0	0
Wheat flour	18650000	341500	572800	**-**	0	0	0	0	0	0	0
Bulgur	-	182500	580000	**-**	0	0	0	0	0	0	0
Breakfast cereals	-	312500	217300	**-**	0	0	0	0	0	0	0
Wheat starch	-	624900	224500	**-**	0	0	0	0	0	0	0
Wheat bran	-	258900	2343700	**-**	0	0	0	0	0	0	0

Food

The allocation to food, on the other hand, can potentially be considered at any processing level, although many primary commodities (such as wheat) are not usually eaten directly prior to further processing. We now impute food consumption numbers (as per the methodology)for the example country and update the SUA table below.

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat	54420000	1999100	32790000	-230600	**-**	0	0	0	0	0	0
Wheat flour	18650000	341500	572800	-	**18540000**	0	0	0	0	0	0
Bulgur	-	182500	580000	-	**3700**	0	0	0	0	0	0
Breakfast cereals	-	312500	217300	-	**98100**	0	0	0	0	0	0
Wheat starch	-	624900	224500	-	**-**	0	0	0	0	0	0
Wheat bran	-	258900	2343700	-	**-**	0	0	0	0	0	0

Feed

The Feed component is then imputed (based on the methodology described in Chapter 2). The assumption here is that some of the primary level quantities are used as feed, as well as all of the bran (which is a by-product of the flour production process). Negligible amounts of bran do go into such products as breakfast cereals, but for the sake of simplicity, such quantities will be ignored in this example.

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat	54420000	1999100	32790000	-230600	-	0	**4898000**	0	0	0	0
Wheat flour	18650000	341500	572800	-	18540000	0	**-**	0	0	0	0
Bulgur	-	182500	580000	-	3700	0	**-**	0	0	0	0
Breakfast cereals	-	312500	217300	-	98100	0	**-**	0	0	0	0
Wheat starch	-	624900	224500	-	-	0	**-**	0	0	0	0
Wheat bran	-	258900	2343700	-	-	0	**3355500**	0	0	0	0

Losses

These refer to harvest and post-harvest losses prior to the retail stage. Retail and household losses are therefore not included here. The methodology for calculating agricultural and food losses is continuously being revised and improved.

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat	54420000	1999100	32790000	-230600	-	0	4898000	0	0	0	**560300**
Wheat flour	18650000	341500	572800	-	18540000	0	-	0	0	0	**-**
Bulgur	-	182500	580000	-	3700	0	-	0	0	0	**-**
Breakfast cereals	-	312500	217300	-	98100	0	-	0	0	0	**-**
Wheat starch	-	624900	224500	-	-	0	-	0	0	0	**-**
Wheat bran	-	258900	2343700	-	-	0	3355500	0	0	0	**-**

Seed

The seed quantities are then imputed (again based on the methodology described in chapter 2). Seed, of course, is only allotted to the primary commodity.

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat	54420000	1999100	32790000	-230600	-	0	4898000	**1904200**	0	0	560300
Wheat flour	18650000	341500	572800	-	18540000	0	-	**-**	0	0	-

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Bulgur	-	182500	580000	-	3700	0	-	**-**	0	0	-
Breakfast cereals	-	312500	217300	-	98100	0	-	**-**	0	0	-
Wheat starch	-	624900	224500	-	-	0	-	**-**	0	0	-
Wheat bran	-	258900	2343700	-	-	0	3355500	**-**	0	0	-

Industrial Utilization

For most commodities, there is no industrial utilization and therefore it's value will be zero. This element can be important when considering commodities related to biofuels (such as maize) and vegetable oils (such as palm oil), but for wheat it is irrelevant.

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat	54420000	1999100	32790000	-230600	-	0	4898000	1904200	0	**-**	560300
Wheat flour	18650000	341500	572800	-	18540000	0	-	-	0	**-**	-
Bulgur	-	182500	580000	-	3700	0	-	-	0	**-**	-
Breakfast cereals	-	312500	217300	-	98100	0	-	-	0	**-**	-
Wheat starch	-	624900	224500	-	-	0	-	-	0	**-**	-
Wheat bran	-	258900	2343700	-	-	0	3355500	-	0	**-**	-

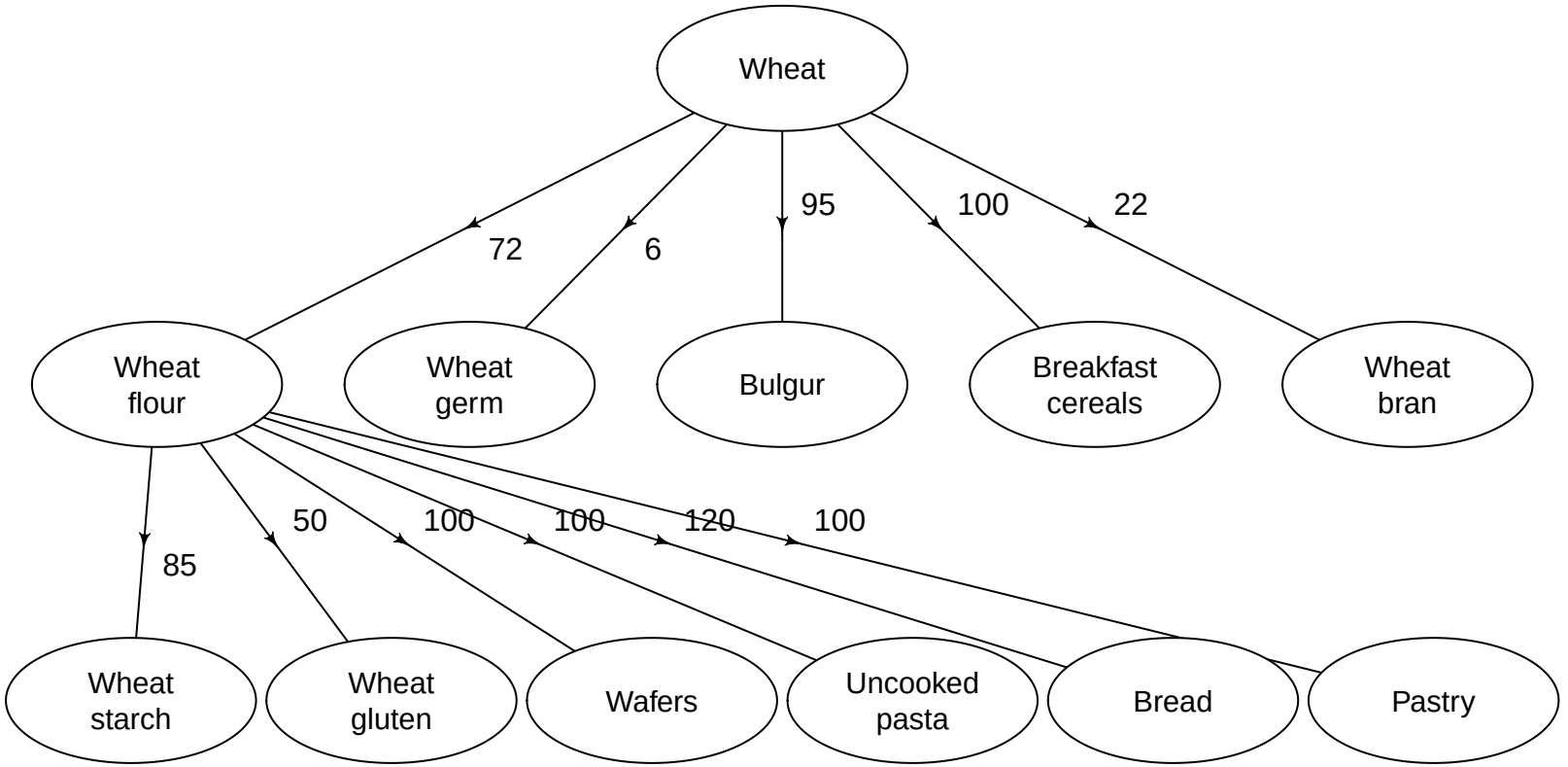
Tourist Consumption

The tourist consumption estimation approach uses tourist data from the World Trade Organization (UNWTO) to compute tourist flows as well as previous year consumption patterns to estimate tourist consumption amounts while tourists are outside their nation. Note that tourist consumption can be negative; as an extreme example consider a case where many nationals travel abroad but no tourists enter. In this case, the country will have a negative "tourist consumption" because more calories will be consumed abroad than locally.

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat	54420000	1999100	32790000	-230600	-	0	4898000	1904200	**65**	-	560300
Wheat flour	18650000	341500	572800	-	18540000	0	-	-	**-29200**	-	-
Bulgur	-	182500	580000	-	3700	0	-	-	**-**	-	-
Breakfast cereals	-	312500	217300	-	98100	0	-	-	**-**	-	-
Wheat starch	-	624900	224500	-	-	0	-	-	**-**	-	-
Wheat bran	-	258900	2343700	-	-	0	3355500	-	**-**	-	-

Standardization and Balancing

Now, suppose we have the following commodity tree:



We first start with the pre-standardized table that we have so far compiled:

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat	54420000	1999100	32790000	-230600	-	0	4898000	1904200	65	-	560300
Wheat flour	18650000	341500	572800	-	18540000	0	-	-	-29200	-	-
Bulgur	-	182500	580000	-	3700	0	-	-	-	-	-
Breakfast cereals	-	312500	217300	-	98100	0	-	-	-	-	-
Wheat starch	-	624900	224500	-	-	0	-	-	-	-	-
Wheat bran	-	258900	2343700	-	-	0	3355500	-	-	-	-

We now compute the required "production" of each of the processed products to satisfy any deficits due to exports or consumption (note that we can allow production to be zero if supply exceeds utilization).

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat	54420000	1999100	32790000	-230600	-	0	4898000	1904200	65	-	560300
Wheat flour	18650000	341500	572800	-	18540000	0	-	-	-29200	-	-
Bulgur	**401200**	182500	580000	-	3700	0	-	-	-	-	-
Breakfast cereals	**2900**	312500	217300	-	98100	0	-	-	-	-	-
Wheat starch	**0**	624900	224500	-	-	0	-	-	-	-	-
Wheat bran	**5440300**	258900	2343700	-	-	0	3355500	-	-	-	-

Since wheat starch is a derived by-product of wheat flour production (as is wheat bran), we would first need to ensure the wheat flour "food to processing" can cover any deficits of wheat starch. However, since wheat starch imports, in this example, exceed exports plus food, we do not have to worry here about this requirement. Therefore, we can now standardize all the processed product quantities back to "food to processing" of wheat. The standardized quantities will, of course, be in their primary commodity (in this case wheat) equivalents. For example, consider that 100 tonnes of a primary commodity produce 50 tonnes of the processed product (a 50% extraction rate). Therefore, these 50 tonnes of processed product will be standardised back as 100 kg of wheat equivalent.

Name	Production (processed)	SD(Production)	Wheat Equivalent	SD(Wheat Equivalent)
Wheat flour	18650000	0	25910000	0
Bulgur	401200	880	422300	930
Breakfast cereals	2900	1500	2900	1500
Wheat bran	5440300	167800	24730000	762600

Now, we wish to compute the distribution for the "food to processing" variable for wheat. Computing the distribution (rather than just a single value) is important for our balancing algorithm: without a distribution, we cannot balance the equation. The main requirement is in the wheat flour and

bran, and it should be noted that the 24 million tonnes requirement for wheat bran will automatically be satisfied if the 26 million tonnes requirement for wheat bran is satisfied (as they are produced together). Thus, the food to processing element for wheat has a mean of 26 million tonnes (the sum of the first three means) and a standard deviation of 1850 million tonnes (the square-root of the sum of the squares of the last three standard deviations). Thus, we now have the following table:

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat	54420000	1999100	32790000	-230600	-	**26330000**	4898000	1904200	65	-	560300
Wheat flour	18650000	341500	572800	-	18540000	0	-	-	-29200	-	-
Bulgur	401200	182500	580000	-	3700	0	-	-	-	-	-
Breakfast cereals	2900	312500	217300	-	98100	0	-	-	-	-	-
Wheat starch	0	624900	224500	-	-	0	-	-	-	-	-
Wheat bran	5440300	258900	2343700	-	-	0	3355500	-	-	-	-

Now, we must balance this table to satisfy the FBS equation of supply equals utilization. To do this, we need to extract the computed standard deviations of each variable. The table below shows the expected value and estimated standard deviation for each of the elements for wheat:

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## 'double' RHS to 'character' to match the column's type; may have truncated
## precision. Either change the target column to 'double' first (by creating
## a new 'double' vector length 21 (nrows of entire table) and assign that;
## i.e. 'replace' column), or coerce RHS to 'character' (e.g. 1L, NA_[real|
## integer]_, as.*, etc) to make your intent clear and for speed. Or, set the
## column type correctly up front when you create the table and stick to it,
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Variable	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Waste	Seed	Industrial	Tourist
Mean	54420000	1999100	32790000	-230600	0	26330000	4898000	560300	1904200	0	65
Standard Dev.	544188	0	0	89854	NA	1749	244900	56031	1129	NA	7

Note that in this case, the standard deviation for food for processing is very small because the flour production is an official figure (and this is the main utilization of wheat). Thus, the "food for processing" element is not adjusted much.

Variable	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Waste	Seed	Industrial	Tourist
Mean	62350000	1999100	32790000	-446800	0	26330000	3292200	476300	1904200	0	65
Standard Dev.	544188	0	0	89854	NA	1749	244900	56031	1129	NA	7

Now, when running the balancing algorithm, we find that "food for processing" is adjusted down slightly. This adjustment to food of wheat implies that the production quantities of derived processed commodities must also be updated (and hence their respective food values as well).

Name	Production (processed)	SD(Production)	Wheat Equivalent	SD(Wheat Equivalent)	Adjustment
Wheat flour	18650000	0	25910000	0	0
Bulgur	401200	880	422300	930	0
Breakfast cereals	2900	1500	2900	1500	0
Wheat bran	5440300	167800	24730000	762600	-80

We can now update the production quantities for each of the derived/processed commodities. As already mentioned, in the process of creating flour, we also create bran and germ. The amount of bran and germ created, in this case, is determined by the amount of flour we need to create (as that was our most stringent requirement). Thus, we have:

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat	62350000	1999100	32790000	-446800	0	26330000	3292200	1904200	65	0	476300
Wheat flour	18650000	341500	572800	-	18540000	0	-	-	-29200	-	-
Wheat germ	**1554300**	**0**	**0**	**0**	**0**	**0**	**1554300**	**0**	**0**	**0**	**0**
Bulgur	**401200**	182500	580000	0	**3700**	0	0	0	0	0	0
Breakfast cereals	**3000**	312500	217300	0	**98200**	0	0	0	0	0	0
Wheat starch	0	624900	224500	-	-	0	-	-	-	-	-
Wheat bran	**5699300**	258900	2343700	0	0	0	**3614500**	0	0	0	0

Now our food balance sheet is nearly completed, except that some commodities haven't been handled yet. In particular, wheat starch has imports exceeding exports and so we have not balanced that commodity yet; also, wheat flour has official production and so we have not modified that commodity either. These unbalanced elements must be updated; and since the production is already fixed (either because it is an official figure or because it is 0) the balancing is very straightforward: the uncertainty will be entirely allocated to food (or, in general, to either food or feed).

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat	62350000	1999100	32790000	-446800	0	26330000	3292200	1904200	65	0	476300
Wheat flour	18650000	341500	572800	-	**18450000**	0	-	-	-29200	-	-
Wheat germ	1554300	0	0	0	0	0	1554300	0	0	0	0
Bulgur	401200	182500	580000	0	3700	0	0	0	0	0	0
Breakfast cereals	3000	312500	217300	0	98200	0	0	0	0	0	0
Wheat starch	0	624900	224500	-	**-**	0	-	-	-	-	-
Wheat bran	5699300	258900	2343700	0	0	0	3614500	0	0	0	0

Now, the final step is to aggregate this full table back into the primary commodity equivalent (in this case wheat). For most elements, this is simple: for example, the final stock change for wheat will simply be the current stock change as there is no stock change for processed products. However, there are three elements that must be handled differently: imports, exports, and food. Note that the final value for wheat equivalent production is simply the current value for wheat production: this is because "production" of flour or bulgur (or any other processed product) is not strictly-speaking the actual production in that the flour or bulgur is acquired from a preceding commodity (whereas production of wheat is truly a production as it is not derived from anything else). Also, food processing will not be standardized as it is more of an accounting variable that specifies how much of a commodity at one level should be processed into a successive different commodity. To standardize trade and food, we can simply aggregate the trade and food of the derived/processed commodities up into their primary equivalent by dividing by the extraction rate. We add these primary equivalents to the current value of trade/food of wheat, and we have our final, primary equivalent trade/food of wheat. Furthermore, feed is not standardized back into primary (wheat) equivalent as it is accounted for **???**.

Name	Production	Imports	Exports	StockChange	Food	Food Processing	Feed	Seed	Tourist	Industrial	Loss
Wheat	62350000	3999200	34780000	-446800	25730000	26330000	3292200	1904200	-40500	0	476300

We can now calculate the calories, fats, and proteins content. First, we apply the calorie/fat/protein content nutritive factor to each individual element. These nutritive factors are obtained from national sources or from international standard tables.

Name	Quantity	Energy	Protein	Fat
Wheat	0.000	1420.937	12.3400	1.86500
Wheat flour	18449983.700	1472.172	11.0475	1.33875
Wheat germ	0.000	NA	NA	NA
Bulgur	3706.173	NA	NA	NA
Breakfast cereals	98189.422	NA	NA	NA
Wheat starch	NA	NA	NA	NA
Wheat bran	0.000	NA	NA	NA

Standardization of nutrients is now a simple last step: all the variables here (i.e. calories, fats, and proteins) are purely additive, so the standardized calories/fats/proteins are simply the sum of the total calories/fats/proteins for each element:

Energy (millions)	Protein (millions)	Fat (millions)
27161.56	203.83	24.7