Food Balance Sheets

Wheat

For this example, we'll first consider the commodity tree for wheat. We start off with an empty table:

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
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
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 production, we must also consider yield and area harvested data as yield is defined as production divided by area harvested (and thus with any two elements the third is uniquely defined). Suppose we have the following official data:

Name	Area Harvested	Yield	Production
Wheat	18496174	0	0
Wheat flour	NA	NA	18652048

In this case, the production value 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.

Name	Area Harvested	Yield	Production
Wheat	18496174	2.942166	0
Wheat flour	NA	NA	18652048

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

Name	Area Harvested	Yield	Production
Wheat	18496174	2.942166	54418808
Wheat flour	NA	NA	18652048

Now, we fill in the table with our production values. Production is only imputed for primary products, and so in this case no additional values are filled in.

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Wheat	**54418808**	0	0	0	0	0	0	0	0	0	0
Wheat flour	**18652048**	0	0	0	0	0	0	0	0	0	0
Bulgur	**NA**	0	0	0	0	0	0	0	0	0	0
Breakfast cereals	**NA**	0	0	0	0	0	0	0	0	0	0
Wheat starch	**NA**	0	0	0	0	0	0	0	0	0	0
Wheat bran	**NA**	0	0	0	0	0	0	0	0	0	0

Trade

For the next example, we'll show how the imputation, mirroring and balancing works. In this case, we just take the country totals and insert into this table.

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Wheat	54418808	**1999076**	**32789894**	0	0	0	0	0	0	0	0
Wheat flour	18652048	**341529**	**572794**	0	0	0	0	0	0	0	0
Bulgur	NA	**282485**	**191273**	0	0	0	0	0	0	0	0
Breakfast cereals	NA	**161280**	**441097**	0	0	0	0	0	0	0	0
Wheat starch	NA	**624947**	**224528**	0	0	0	0	0	0	0	0
Wheat bran	NA	**258937**	**2343712**	0	0	0	0	0	0	0	0

NOTE (Josh): The trade figures I quote here are based on the US data, but not exactly. We have HS6 trade data, and I can map that to CPC. However, some HS6 codes map to many CPC codes. My understanding is that the historical approach has been to not use split factors and to simply map the quantity straight into one of the CPC codes. For this simple example, I map the HS data to CPC and randomly split it.

Stock Changes

We now estimate the stock changes. Note that for most products, we assume that countries do not hold stocks. Generally, stocks will only be held for primary level products, and not even all of these products. The numbers below represent the estimated stock changes (by the stock imputation methodology described previously) for the example country we're considering.

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Wheat	54418808	1999076	32789894	**-230630**	0	0	0	0	0	0	0
Wheat flour	18652048	341529	572794	**NA**	0	0	0	0	0	0	0
Bulgur	NA	282485	191273	**NA**	0	0	0	0	0	0	0
Breakfast cereals	NA	161280	441097	**NA**	0	0	0	0	0	0	0
Wheat starch	NA	624947	224528	**NA**	0	0	0	0	0	0	0
Wheat bran	NA	258937	2343712	**NA**	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 some commodities (such as wheat) are assumed to not be eaten as such. We impute food consumption numbers for the example country and update the FBS table below.

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Wheat	54418808	1999076	32789894	-230630	0	0	0	0	0	0	0
Wheat flour	18652048	341529	572794	NA	**18539484**	0	0	0	0	0	0
Bulgur	NA	282485	191273	NA	**3684**	0	0	0	0	0	0
Breakfast cereals	NA	161280	441097	NA	**98131**	0	0	0	0	0	0
Wheat starch	NA	624947	224528	NA	0	0	0	0	0	0	0
Wheat bran	NA	258937	2343712	NA	0	0	0	0	0	0	0

Losses

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Wheat	54418808	1999076	32789894	-230630	0	0	**560306**	0	0	0	0
Wheat flour	18652048	341529	572794	NA	18539484	0	**NA**	0	0	0	0
Bulgur	NA	282485	191273	NA	3684	0	**NA**	0	0	0	0
Breakfast cereals	NA	161280	441097	NA	98131	0	**NA**	0	0	0	0
Wheat starch	NA	624947	224528	NA	0	0	**NA**	0	0	0	0

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Wheat bran	NA	258937	2343712	NA	0	0	**NA**	0	0	0	0

```
## Warning: Standard error for loss data is currently just 20% of loss value,
## it is not estimated in any way.
```

Seed

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Wheat	54418808	1999076	32789894	-230630	0	0	560306	**1929614**	0	0	0
Wheat flour	18652048	341529	572794	NA	18539484	0	NA	**NA**	0	0	0
Bulgur	NA	282485	191273	NA	3684	0	NA	**NA**	0	0	0
Breakfast cereals	NA	161280	441097	NA	98131	0	NA	**NA**	0	0	0
Wheat starch	NA	624947	224528	NA	0	0	NA	**NA**	0	0	0
Wheat bran	NA	258937	2343712	NA	0	0	NA	**NA**	0	0	0

```
## Warning: Standard error for seed data is currently just 20% of seed value,
## it is not estimated in any way.
```

Industrial Utilization

Work in progress...

Tourist Consumption

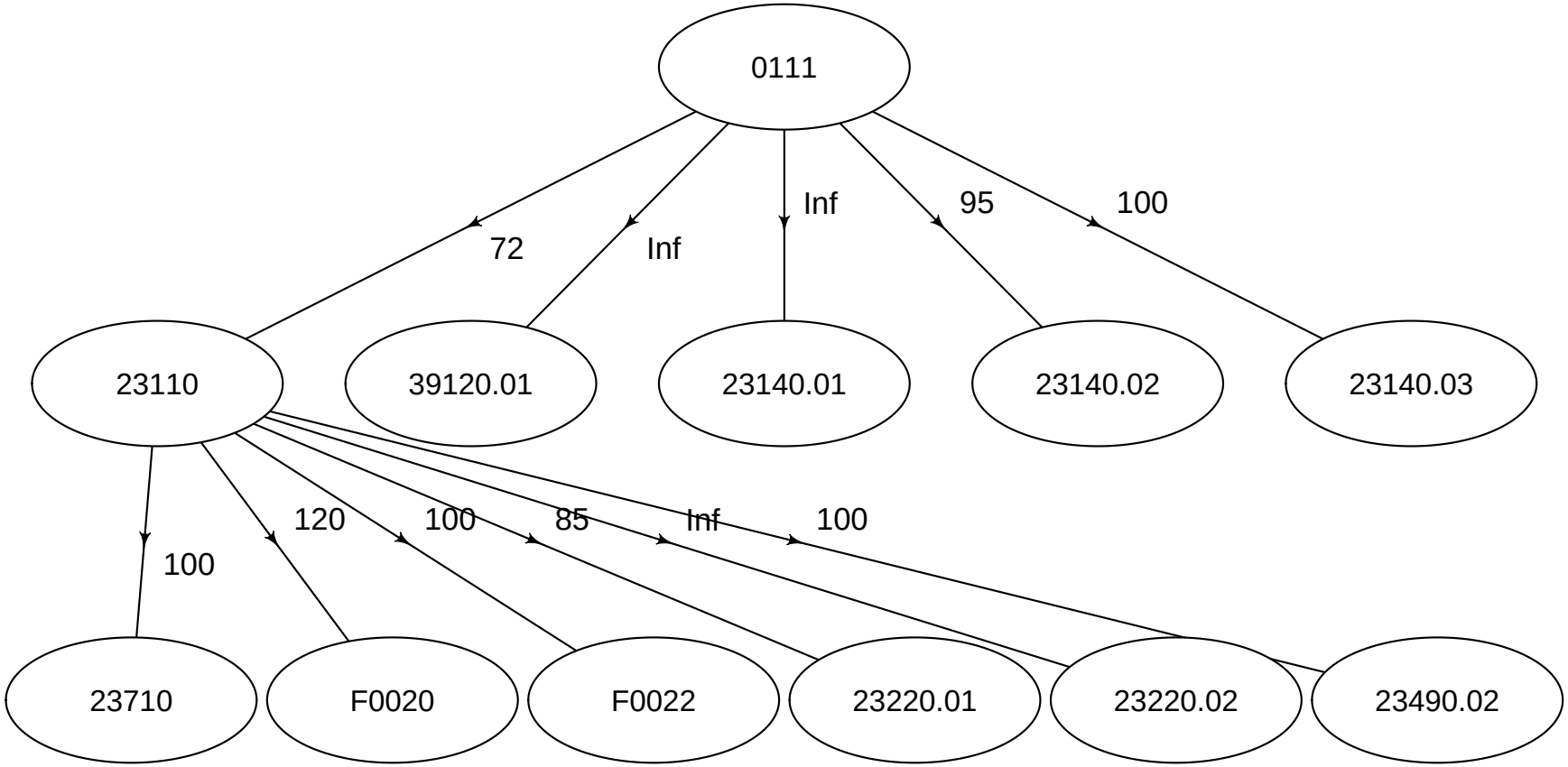
The tourist consumption estimation approach uses tourist data from the WTO as well as last year's consumption patterns to estimate the impact of tourism on local consumption. Note that tourist consumption can be negative; as an extreme example consider a case where many nationals travel abroad but no tourists enter. In this case, that country will certainly have a negative "tourist consumption" because more calories will be assumed abroad than locally.

Residual Other Uses

Work in progress...

Standardization

Now, suppose we have the following commodity tree:



NOTE (Josh): This commodity tree above is derived based on the FCL commodity tree. It will likely need to be updated, but for now I just simply map the FCL elements to their corresponding CPC codes.

NOTE (Josh): At this point, we should also compute calories/proteins/fats.

NOTE (Josh): Need to keep track of the standard deviations as well so that we can balance at the end.

We first start with the pre-standardized table:

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Wheat	54418808	1999076	32789894	-230630	0	0	560306	1929614	0	0	0
Wheat flour	18652048	341529	572794	NA	18539484	0	NA	NA	0	0	0
Bulgur	NA	282485	191273	NA	3684	0	NA	NA	0	0	0
Breakfast cereals	NA	161280	441097	NA	98131	0	NA	NA	0	0	0
Wheat starch	NA	624947	224528	NA	0	0	NA	NA	0	0	0
Wheat bran	NA	258937	2343712	NA	0	0	NA	NA	0	0	0

We then 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	Feed	Waste	Seed	Industrial	Tourist	Residual
Wheat	54418808	1999076	32789894	-230630	0	0	560306	1929614	0	0	0
Wheat flour	18652048	341529	572794	NA	18539484	0	NA	NA	0	0	0
Bulgur	**0**	282485	191273	NA	3684	0	NA	NA	0	0	0
Breakfast cereals	**377948**	161280	441097	NA	98131	0	NA	NA	0	0	0
Wheat starch	**0**	624947	224528	NA	0	0	NA	NA	0	0	0
Wheat bran	**2084775**	258937	2343712	NA	0	0	NA	NA	0	0	0

Since wheat starch is produced from wheat flour, we would first need to ensure the wheat flour food can cover any deficits of wheat starch. However, since wheat starch imports exceed exports plus food, we don't have to worry about this requirement. Instead, we can just standardize all the first processed level products back to food of wheat.

Name	Production (processed)	SD(Production)	Wheat Equivalent	SD(Wheat Equivalent)
Wheat flour	18652048.0	0.0000	25905622.2	0.0000
Bulgur	0.0	884.1955	0.0	930.7321
Breakfast cereals	377947.6	1480.5188	377947.6	1480.5188
Wheat bran	2084775.4	0.0000	9476252.0	0.0000

Now, we wish to compute the distribution for food for wheat. The main requirement is in the wheat flour, and it should be noted that the 9 million kilogram requirement for wheat bran will automatically be satisfied if the 26 million kilogram requirement for wheat flour is satisfied (as they are by-products). Thus, the food element for wheat has a mean of 26,198 thousand kilograms (the sum of the first three) and a standard deviation of 63 thousand kilograms (the square-root of the sum of the squares of the first three standard deviations). Thus, we now have the following table:

Now, we must balance this table. To do this, we need to extract the computed **standard deviations (is this the word we're using???)** of each

element. The table below shows the expected value and estimated **standard deviation** for each of the elements for wheat:

Variable	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Mean	54418808	1999076	32789894	-230630.14	26283777.077	0	560305.7	1929614.0	0	0	0
Standard Dev.	2720940	0	0	89854.23	1724.453	0	112061.1	385922.8	0	0	0

Note that in this case, the standard deviation for food is very small; this is because it's mostly determined by the production of wheat flour, and this value is an official figure.

ADD BALANCING HERE (and delete the little R chunk below which sets food manually)

Now, when balancing, we find that food is adjusted down slightly. This adjustment to food of wheat implies that the production of children commodities must also be updated (and hence their food values as well).

We can now update the production numbers for each of the first level primary elements. Note that 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:

Additionally, we must enforce consistent shares/extraction rates across grouped commodities (for example, flour/bran/germ) and so when flowing back down we will create excess production of some of the by-products.

Feed

Feed allocation must be done at this phase in order to ensure that we have reduced the feed demand by the corresponding amounts of feed products (i.e. wheat bran, wheat germ, etc.).

Balancing

Cattle Meat

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## Warning in rm(cattleData): object 'cattleData' not found
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Palm Oil

```
## Warning in rm(palmData): object 'palmData' not found
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