

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:

Item	Area Harvested	Yield	Production
0111	18496174	0	0
23110	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.

Item	Area Harvested	Yield	Production
0111	18496174	3	0
23110	NA	NA	18652048

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

Item	Area Harvested	Yield	Production
0111	18496174	3	54418808
23110	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	135717	176724	0	0	0	0	0	0	0	0
Breakfast cereals	NA	308048	455645	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	135717	176724	NA	0	0	0	0	0	0	0
Breakfast cereals	NA	308048	455645	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	NA	0	0	0	0	0	0
Wheat flour	18652048	341529	572794	NA	18539484	0	0	0	0	0	0
Bulgur	NA	135717	176724	NA	3684	0	0	0	0	0	0
Breakfast cereals	NA	308048	455645	NA	98131	0	0	0	0	0	0
Wheat starch	NA	624947	224528	NA	NA	0	0	0	0	0	0
Wheat bran	NA	258937	2343712	NA	NA	0	0	0	0	0	0

Losses

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Wheat	54418808	1999076	32789894	-230630	NA	0	560306	0	0	0	0
Wheat flour	18652048	341529	572794	NA	18539484	0	NA	0	0	0	0
Bulgur	NA	135717	176724	NA	3684	0	NA	0	0	0	0
Breakfast cereals	NA	308048	455645	NA	98131	0	NA	0	0	0	0
Wheat starch	NA	624947	224528	NA	NA	0	NA	0	0	0	0

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

Seed

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Wheat	54418808	1999076	32789894	-230630	NA	0	560306	1929614	0	0	0
Wheat flour	18652048	341529	572794	NA	18539484	0	NA	NA	0	0	0
Bulgur	NA	135717	176724	NA	3684	0	NA	NA	0	0	0
Breakfast cereals	NA	308048	455645	NA	98131	0	NA	NA	0	0	0
Wheat starch	NA	624947	224528	NA	NA	0	NA	NA	0	0	0
Wheat bran	NA	258937	2343712	NA	NA	0	NA	NA	0	0	0

Industrial Utilization

Work in progress...

Tourist Consumption

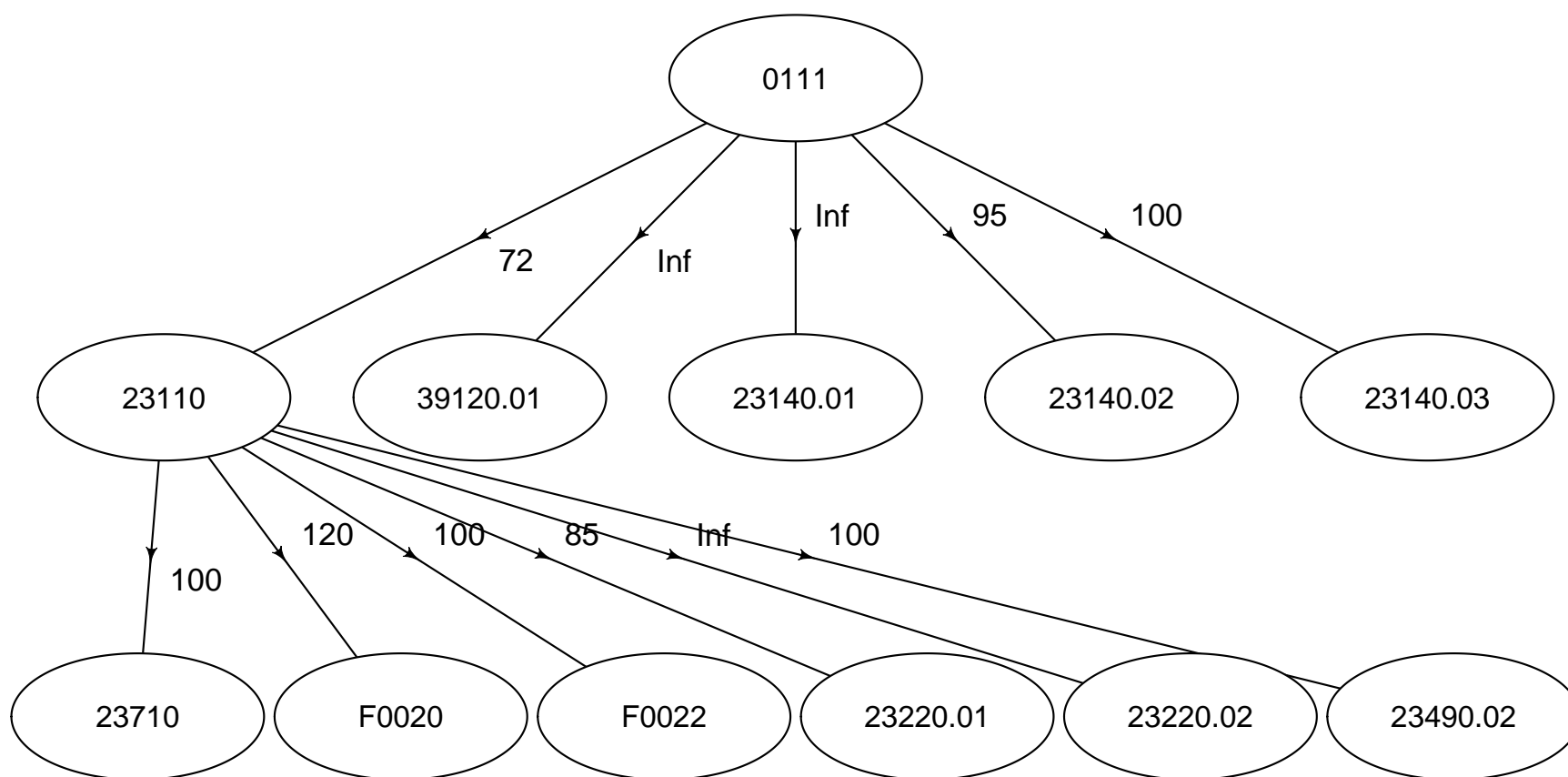
The tourist consumption estimation approach uses tourist data from the WTO as well as last year's consumption patterns to estimate the impact of tourism on local consumption. Note that tourist consumption can be negative; as an extreme example consider a case where many nationals travel abroad but no 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.

Standardization Approach 1 We first standardize all commodities up or down the commodity tree to the first processing level equivalent. We do this element-by-element, and thus we represent trade and food consumption of derived products in their first-processing level equivalent (which seems very natural/reasonable). However, we also do this for the primary product: we translate production of wheat into production of flour/bran/germ; stock changes of wheat into stock changes of flour/bran/germ; etc. For all elements except production, this standardization is additive (i.e. the imports of flour are added to the standardized imports of wheat, bread, etc. to get the total standardized imports of flour). For production, this should not

occur as you never truly have “production” of processed products. However, if production of a processed product is reported, that means that the standardized primary product must provide for this production and thus we update the shares to give us the correct amount here. Thus, our table is updated as follows:

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Wheat flour	18652048	1026712	11811531	-79048	18539484	0	192045	661375	0	0	0
Bulgur	5417628	334734	3441100	-22960	3684	0	55781	192101	0	0	0
Breakfast cereals	22810383	1145988	14199975	-96672	98131	0	234860	808824	0	0	0
Wheat bran	0	258937	2343712	0	0	0	0	0	0	0	0

Problem: Flour, in this case, receives a very low share because the production of wheat is so high and so much is exported. Thus, we shouldn’t be standardizing production in this way but rather the food from wheat should flow into the production of flour and other derived products.

Standardization Approach 2 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	NA	0	560306	1929614	0	0	0
Wheat flour	18652048	341529	572794	NA	18539484	0	NA	NA	0	0	0
Bulgur	NA	135717	176724	NA	3684	0	NA	NA	0	0	0
Breakfast cereals	NA	308048	455645	NA	98131	0	NA	NA	0	0	0
Wheat starch	NA	624947	224528	NA	NA	0	NA	NA	0	0	0
Wheat bran	NA	258937	2343712	NA	NA	0	NA	NA	0	0	0

We then standardize the food values up to Wheat to get an estimate for food for the primary commodity:

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Wheat	54418808	1999076	32789894	-230630	25851292	0	560306	1929614	0	0	0
Wheat flour	18652048	341529	572794	NA	18539484	0	NA	NA	0	0	0
Bulgur	NA	135717	176724	NA	3684	0	NA	NA	0	0	0
Breakfast cereals	NA	308048	455645	NA	98131	0	NA	NA	0	0	0
Wheat starch	NA	624947	224528	NA	NA	0	NA	NA	0	0	0
Wheat bran	NA	258937	2343712	NA	NA	0	NA	NA	0	0	0

Now, we balance the primary product:

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Wheat	54418808	1999076	32789894	-2023667	24954774	0	-336213	1033096	0	0	0
Wheat flour	18652048	341529	572794	NA	18539484	0	NA	NA	0	0	0
Bulgur	NA	135717	176724	NA	3684	0	NA	NA	0	0	0
Breakfast cereals	NA	308048	455645	NA	98131	0	NA	NA	0	0	0
Wheat starch	NA	624947	224528	NA	NA	0	NA	NA	0	0	0
Wheat bran	NA	258937	2343712	NA	NA	0	NA	NA	0	0	0

This updated value for food can now be allocated to the production of children commodities (via multiplication of the shares and extraction rates).

Problem: At this point, the amount allocated to wheat food is not enough to cover official flour production. We could attempt to bound the distribution of food at the minimum amount to create the flour production, but in this case the optimum would be on that boundary and so we'd have no wheat to allocate to the other commodities. This will then cause other problems if those commodities have higher exports/food than imports.

Question: How do we pass the food element into production in the subelements?

Standardization Approach 3 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	NA	0	560306	1929614	0	0	0
Wheat flour	18652048	341529	572794	NA	18539484	0	NA	NA	0	0	0
Bulgur	NA	135717	176724	NA	3684	0	NA	NA	0	0	0
Breakfast cereals	NA	308048	455645	NA	98131	0	NA	NA	0	0	0
Wheat starch	NA	624947	224528	NA	NA	0	NA	NA	0	0	0
Wheat bran	NA	258937	2343712	NA	NA	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	NA	0	560306	1929614	0	0	0
Wheat flour	18652048	341529	572794	NA	18539484	0	NA	NA	0	0	0
Bulgur	44691	135717	176724	NA	3684	0	NA	NA	0	0	0

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Breakfast cereals	245728	308048	455645	NA	98131	0	NA	NA	0	0	0
Wheat starch	0	624947	224528	NA	NA	0	NA	NA	0	0	0
Wheat bran	2084775	258937	2343712	NA	NA	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	25905622	0
Bulgur	44691	11173	47043	11761
Breakfast cereals	245728	61432	245728	61432
Wheat bran	2084775	521194	9476252	2369063

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 52 thousand kilograms (the square-root of the sum of the squares of the first three standard deviations). Thus, we now have the following table:

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Wheat	54418808	1999076	32789894	-230630	26198393	0	560306	1929614	0	0	0
Wheat flour	18652048	341529	572794	NA	18539484	0	NA	NA	0	0	0
Bulgur	44691	135717	176724	NA	3684	0	NA	NA	0	0	0
Breakfast cereals	245728	308048	455645	NA	98131	0	NA	NA	0	0	0
Wheat starch	0	624947	224528	NA	NA	0	NA	NA	0	0	0
Wheat bran	2084775	258937	2343712	NA	NA	0	NA	NA	0	0	0

Now, we balance this table, and find that the food value is adjusted down slightly:

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Wheat	54418808	1999076	32789894	-2838664	26150096	0	77336	239222	0	0	0
Wheat flour	18652048	341529	572794	NA	18539484	0	NA	NA	0	0	0
Bulgur	44691	135717	176724	NA	3684	0	NA	NA	0	0	0

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Breakfast cereals	245728	308048	455645	NA	98131	0	NA	NA	0	0	0
Wheat starch	0	624947	224528	NA	NA	0	NA	NA	0	0	0
Wheat bran	2084775	258937	2343712	NA	NA	0	NA	NA	0	0	0

Now, Food gets adjusted in the balance, and this adjustment proportionally flows down to all the children according to their variability. 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.

Problem: How do we allocate the excess when processing back down? Should this excess be directly allocated to food/feed (depending on the commodity)? Or maybe we do a balance at the SUA level and allocate a little to trade as well, if trade is not official?

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

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Meat of cattle	11921102	63429	33424	0	0	0	0	0	0	0	0
Meat of cattle boneless	0	93126	179197	0	0	0	0	0	0	0	0
Bovine meat	0	NA	NA	0	0	0	0	0	0	0	0
Extracts of meat	0	NA	NA	0	0	0	0	0	0	0	0
Butcher fat	0	19637	267121	0	0	0	0	0	0	0	0

Production

Trade

Stock Changes

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Meat of cattle	11921102	63429	33424	-1431	0	0	0	0	0	0	0
Meat of cattle boneless	0	93126	179197	NA	0	0	0	0	0	0	0
Bovine meat	0	NA	NA	NA	0	0	0	0	0	0	0
Extracts of meat	0	NA	NA	NA	0	0	0	0	0	0	0
Butcher fat	0	19637	267121	NA	0	0	0	0	0	0	0

Food

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Meat of cattle	11921102	63429	33424	-1431	NA	0	0	0	0	0	0
Meat of cattle boneless	0	93126	179197	NA	7793721	0	0	0	0	0	0
Bovine meat	0	NA	NA	NA	98	0	0	0	0	0	0
Extracts of meat	0	NA	NA	NA	949	0	0	0	0	0	0
Butcher fat	0	19637	267121	NA	NA	0	0	0	0	0	0

Losses

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Meat of cattle	11921102	63429	33424	-1431	NA	0	22766	0	0	0	0
Meat of cattle boneless	0	93126	179197	NA	7793721	0	NA	0	0	0	0
Bovine meat	0	NA	NA	NA	98	0	NA	0	0	0	0
Extracts of meat	0	NA	NA	NA	949	0	NA	0	0	0	0
Butcher fat	0	19637	267121	NA	NA	0	NA	0	0	0	0

Seed

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Meat of cattle	11921102	63429	33424	-1431	NA	0	22766	NA	0	0	0
Meat of cattle boneless	0	93126	179197	NA	7793721	0	NA	NA	0	0	0
Bovine meat	0	NA	NA	NA	98	0	NA	NA	0	0	0
Extracts of meat	0	NA	NA	NA	949	0	NA	NA	0	0	0
Butcher fat	0	19637	267121	NA	NA	0	NA	NA	0	0	0

Industrial Utilization

Work in progress...

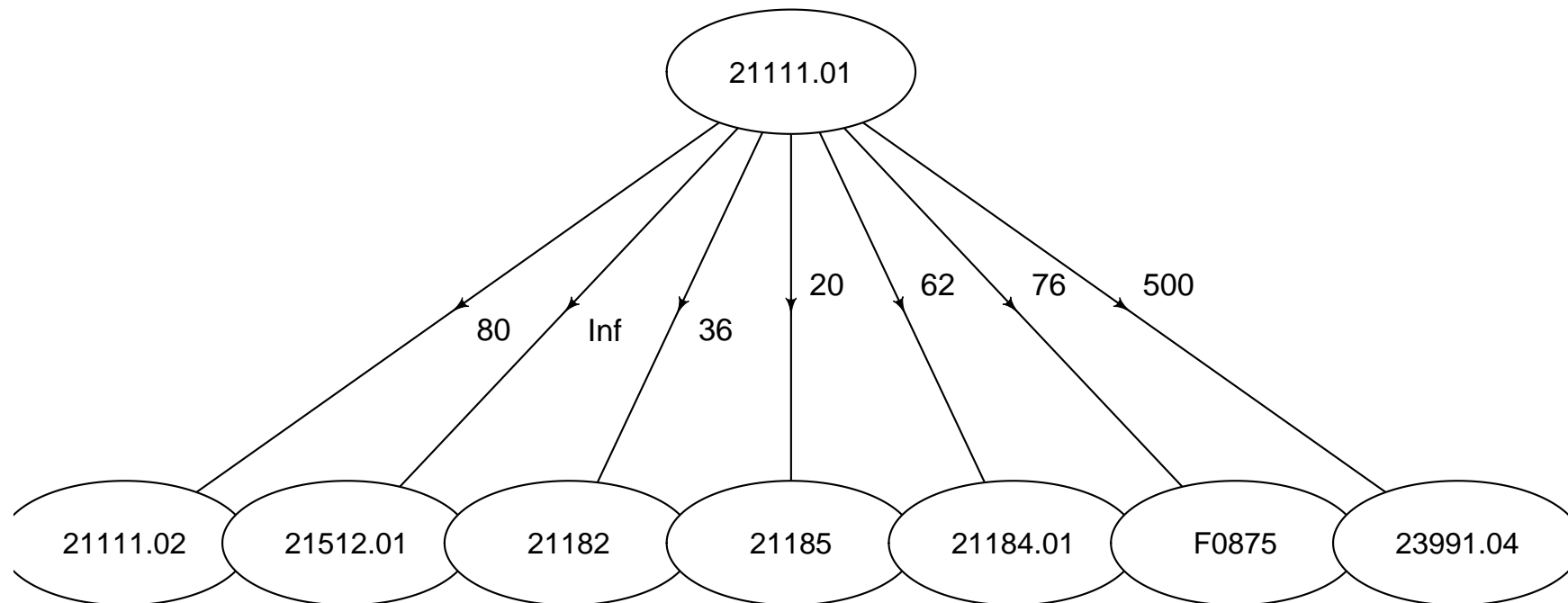
Tourist Consumption

Work in progress...

Residual Other Uses

Work in progress...

Standardization



Feed

Balancing

Palm Oil

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Palm oil	0	NA	NA	0	0	0	0	0	0	0	0
Oil of Palm	0	NA	NA	0	0	0	0	0	0	0	0
Margarine	3714000	NA	NA	0	0	0	0	0	0	0	0
Fatty acids	0	NA	NA	0	0	0	0	0	0	0	0
Animal or vegetable fats	0	NA	NA	0	0	0	0	0	0	0	0
Fat preparations n.e.	194125	NA	NA	0	0	0	0	0	0	0	0
Hydrogenated oils	0	NA	NA	0	0	0	0	0	0	0	0

Production

Trade

Stock Changes

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Palm oil	0	NA	NA	NA	0	0	0	0	0	0	0
Oil of Palm	0	NA	NA	NA	0	0	0	0	0	0	0
Margarine	3714000	NA	NA	3866	0	0	0	0	0	0	0
Fatty acids	0	NA	NA	0	0	0	0	0	0	0	0
Animal or vegetable fats	0	NA	NA	NA	0	0	0	0	0	0	0
Fat preparations n.e.	194125	NA	NA	NA	0	0	0	0	0	0	0
Hydrogenated oils	0	NA	NA	NA	0	0	0	0	0	0	0

Food

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Palm oil	0	NA	NA	NA	0	0	0	0	0	0	0

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Oil of Palm	0	NA	NA	NA	15000	0	0	0	0	0	0
Margarine	3714000	NA	NA	3866	3729905	0	0	0	0	0	0
Fatty acids	0	NA	NA	0	NA	0	0	0	0	0	0
Animal or vegetable fats	0	NA	NA	NA	NA	0	0	0	0	0	0
Fat preparations n.e.	194125	NA	NA	NA	175439	0	0	0	0	0	0
Hydrogenated oils	0	NA	NA	NA	NA	0	0	0	0	0	0

Losses

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Palm oil	0	NA	NA	NA	0	0	NA	0	0	0	0
Oil of Palm	0	NA	NA	NA	15000	0	NA	0	0	0	0
Margarine	3714000	NA	NA	3866	3729905	0	NA	0	0	0	0
Fatty acids	0	NA	NA	0	NA	0	NA	0	0	0	0
Animal or vegetable fats	0	NA	NA	NA	NA	0	NA	0	0	0	0
Fat preparations n.e.	194125	NA	NA	NA	175439	0	NA	0	0	0	0
Hydrogenated oils	0	NA	NA	NA	NA	0	NA	0	0	0	0

Seed

Name	Production	Imports	Exports	StockChange	Food	Feed	Waste	Seed	Industrial	Tourist	Residual
Palm oil	0	NA	NA	NA	0	0	NA	NA	0	0	0
Oil of Palm	0	NA	NA	NA	15000	0	NA	NA	0	0	0
Margarine	3714000	NA	NA	3866	3729905	0	NA	NA	0	0	0
Fatty acids	0	NA	NA	0	NA	0	NA	NA	0	0	0
Animal or vegetable fats	0	NA	NA	NA	NA	0	NA	NA	0	0	0
Fat preparations n.e.	194125	NA	NA	NA	175439	0	NA	NA	0	0	0
Hydrogenated oils	0	NA	NA	NA	NA	0	NA	NA	0	0	0

Industrial Utilization

Work in progress...

Tourist Consumption

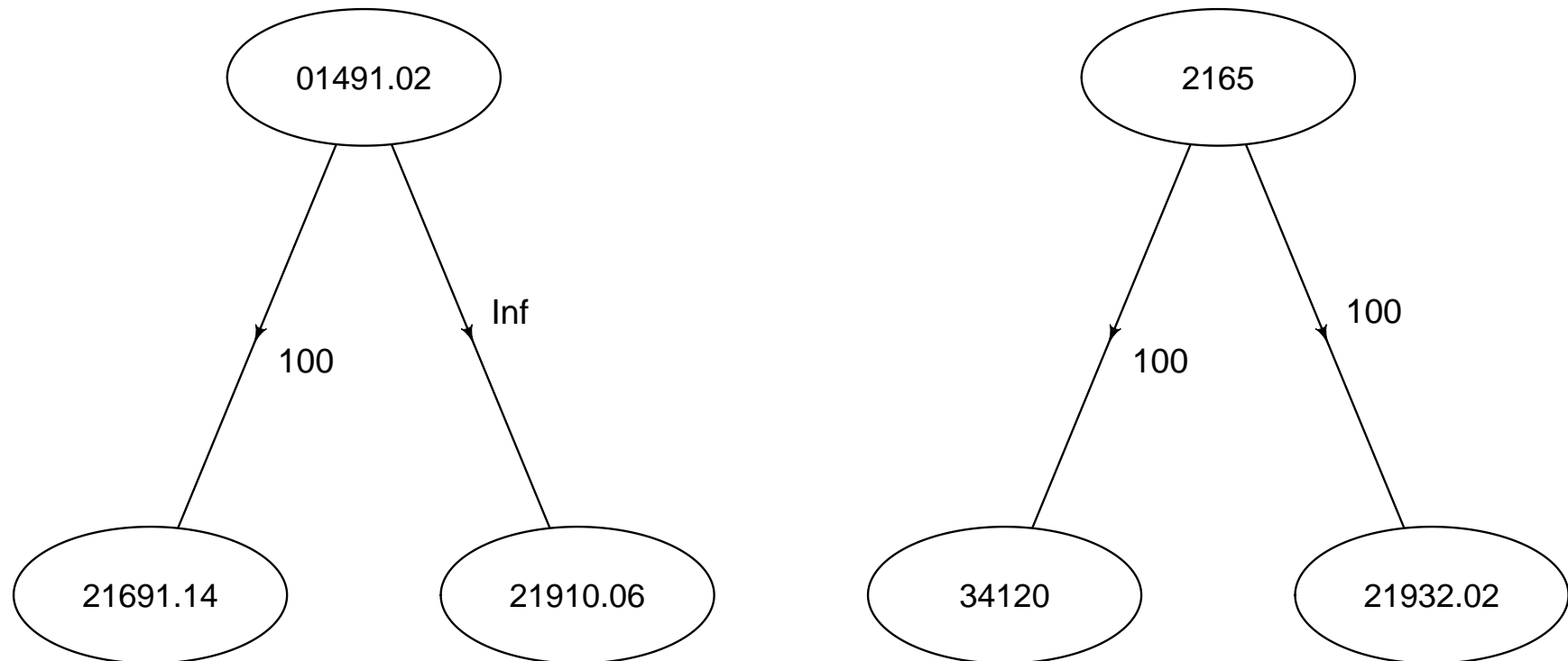
Work in progress...

Residual Other Uses

Work in progress...

Standardization

NOTE (Josh): This commodity tree looks like two separate trees. But, the two parent nodes can actually be processed into many of the same children. I'm not sure what the logic was for historically rolling up some of the children into one of the parents and some of the children into the other parent, but that would presumably need to be reviewed/revised.



Feed

Balancing