IEooc_Application3_Exercise1: Consumption Taxation of CO_2-intensive Materials

Goal: *Systems understanding of material markets, material content of merchandise groups, error propagation, Monte-Carlo-Simulation*

In the reading material 2-4 of Application part 3 the principle of excise tax of material intensive consumer goods is described. In addition, the principles of error analysis, error propagation, and the Monte-Carlo-Simulation method for numerical error and sensitivity analysis were introduced in Methodology part 2. This exercise will help you to understand the error analysis methodology through an application to one example of material consumption and trade.

The excel table 'IEooc_Application3_Exercise1_IoC_Data.xlsx' contains data from the EU ProdCom data base for the production, import and export of 100 important merchandise groups for the EU28 in 2012 (column A and B). The data is provided in monetary flows (MEUR, column E-G) and mass flows (kt, column H-J). Further the degree of processing is also provided (column C) while products marked '3' are final products, which are not further processed but added as capital goods. In addition to this, approximate material content for each product is also given (column L-O). CO_2- bench marks as well as CO_2 prices are also provided (column R).

Table 1: Color coding of error margins.

Color coding for uncertainty of material content estimates		
Color display	**Color code (RGB)**	**Range**
	(216,228,188)	0, +/-0
	(196,215,155)	≠ 0, +/-0
	(112,048,160)	+/- 5 pp
	(000,112,192)	+/- 7 pp
	(000,176,240)	+/- 10 pp
	(000,176,080)	+/-15 pp
	(146,208,080)	+/- 20 pp
	(255,255,000)	+/- 33 %
	(255,192,000)	+/- 50 %
	(255,000,000)	+/- 100 %
	(192,000,000)	+ 200 / -100 %

Task:

1) Draft the system definition for the production, trade and consumption of a random merchandise group! Name all processes, flows and stocks! Which ones of your processes provide a balanced equation for the product flows for the merchandise chosen and which ones don't? Why or why not?

2) Why are all production related excise taxes for steel (or any other material) counted more than once when applying simple addition of all charges across commodity groups?

3) Determine the quantity of steel flowing into the final consumption inventories for all 100 merchandise groups (commodity group 3)

4) For all 4 materials, determine total CO_2 taxes and fees final consumers in the EU 28 must pay. Only consider the merchandise groups that eventually flow into the consumer inventories (commodity group 3)!

5) For which merchandise group are the fees (fee/kg per EUR/g) highest for import?

6) Calculate the error propagation for the relative tax/fee (change of price) for steel contained in a manufactured good!
   a. Present your results as formulas. Consider the production flow of any random merchandise group.
   b. Determine the numerical value for the absolute and relative maximal error for the prices change of steel for the EU28 production volume group , 29102230 ', , Motor vehicles with a petrol engine > 1500 cm^3

7) Conduct a Monte-Carlo-Simulation of the relative change of price for steel tax based on the EU28 production volume , 29102230 ', , Motor vehicles with a petrol engine > 1500 cm^3 (minimum 1000 MC cycles)
   a. Assume all data is distributed normally!
   b. Assume all data is distributed uniformly!

   Assess your results using histograms. Determine mean and standard deviation relative to change of price distribution. How does the mean value compare to the mean value calculated in task 4? How reasonable are the assumptions about the distribution of the random values?

Assume following parameters for the error ranges for the uncertain variables. The absolute values are for task 7a, the standard deviations for task 7b.
- ProdCom absolute value: +/- 10 %, standard deviation: 10 % of mean value
- ProdCom absolute mass: +/- 10 %, standard deviation: 10 % of mean value.
- Absolute material content: see color code in excel table and table 1. Standard deviation 1/3 of mean value.
- CO_2 threshold and CO_2 price: no deviation since fixed parameters/assumptions

List of helpful excel functions:
+ Sum
+ SumIf / SumIfS
+ Rand
+ Norm.Inv
+ Max
+ Average
+ Stdev