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Estimating the environmental footprint of food products from packaging data

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Software

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Summary

Food consumption represents an important part of our ecological footprint and therefore an interesting way to reduce it (Sala et al., 2019). In order to help consumers to make more informed food consumption choices, several ecolabelling initiatives have been developed recently by institutional and private actors (ADEME, 2020a). Most of these initiatives use a single environmental impact value for a given product type. This default value is constructed from a recipe (i.e. proportion of ingredients), a processing chain, and a supply chain that is considered an "average" scenario.This approach appears to be frugal in terms of data, but it is obviously limited. It does not allow for differentiation of products within a category. The software we have developed aims to fill this gap.It estimates the most likely impact for each product individually, based on the information on the packaging (ordered list of ingredients and nutritional composition) and the environmental impacts of the agricultural production of the ingredients.

Statement of need

The algorithm used by this program is based on a Monte-Carlo approach to estimate the impact of a product. Its principle is to pick random possible recipes of the product and compute their impact until the geometric mean of the impacts of all sampled recipes stabilizes within a given confidence interval. The sampling of possible recipes is made as accurate as possible by using a nonlinear optimization solver (Gamrath et al., 2020), and Optimization-Based Bound Tightening to deduce the ranges of possible values of the mass of each ingredient respecting the nutritional constraints of the system.

This program features a class based implementation of the impact estimation algorithm that can be integrated in Python projects. It also integrates a reporting tool to create HTML and PDF impact estimation reports of a product. To be functional, this program has been interfaced to the Open Food Facts database (Open Food Facts, n.d.) providing packaging information. It uses data from the Ciqual (ANSES, 2020) and FCEN (Santé Canada, 2015) nutritional databases, and the Agribalyse (ADEME, 2020b) environmental impact database. All these data are freely available and fit to a French context, but it could be easily adapted to other data sources.

```
from impacts_estimation import estimate_impacts
from openfoodfacts import get_product
from reporting import ProductImpactReport
```

```
product = get_product(barcode='3175681790285')['product']

impact_categories = ['EF single score',
                     'Climate change']
impact_categories = ['EF single score', 'Climate change']
impact_estimation_result = estimate_impacts(product=product,
                                            impact_names=impact_categories)

for impact_category in impact_categories:
    print(f"{impact_category}: "
          f"{impact_estimation_result['impact_geom_means'][impact_category]:.4} "
          f"{impact_estimation_result['impacts_units'][impact_category]}")
# EF single score: 0.07872 mPt
# Climate change: 0.7816 kg CO2 eq


# Generating an impact estimation report
reporter = ProductImpactReport(product=product)

reporter.to_html()
```


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