The Nutri-Score label

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CÉRÉALES FOURRÉES
Nestlé
Nesquik
Céréales
+20%
SMACKS
CHOCAPIC

INFORMATIONS NUTRITIONNELLES		
Valeurs nutritionnelles moyennes pour : / Average nutritional information for:	100 g / 100 g	1 barre (25 g) / 1 bar (25 g)
Energie / Energy (kJ)	1436	359
Energie / Energy (kcal)	343	86
Matières grasses / Fat	10 g	2,6 g
dont acides gras saturés / of which saturates	1,3 g	0,3 g
Glucides / Carbohydrate	48 g	12 g
dont sucres / of which sugars	0,8 g	0,2 g
dont polyols / of which polyols	23 g	5,8 g
Fibres alimentaires / Fibre	11 g	2,7 g
Protéines / Protein	18 g	4,5 g
Sel / Salt	0,48 g	0,12 g

Which food is healthy?

Figure: Food *a*

Figure: Food *b*

Figure: Food *c*

Figure: Food *d*

Which food is healthy?

Nutritional information	a	b	c	d
Energy (kJ)	1435	565	1615	1552
Sugar (g)	0.8	7.5	15	1
Saturated fatty acids (g)	1.3	0.7	0.3	0.2
Sodium (mg)	192	4	360	300
Proteins (g)	18	3.7	8.3	8
Fibers (g)	11	2	5.2	5
Fruits/vegetables (%)	4	54	0	0

Many indicators elaborated

Figure: Nova classification (2010)

Figure: Siga index

Figure: Eco-score (2021)

Figure: Nutri-score

Figure: Yuka

Plan

The history of French Nutri-Score

Figure: ANSES Report (March 2015 - 100 pages)

The history of French Nutri-Score

- A "simple" nutritional rating system known as the 5-Colour Nutrition label (A to E)
- Inspired from the work of Rayner et al. (2009): *The UK Ofcom Nutrient Profiling Model*
- Based on the work of Pr. Serge Hercberg - Univ. Paris 13 (2014)
  - Nutritional epidemiologist
  - Chairman of the Steering Committee of the French Nutrition and Health Program, PNNS (2001-)
  - Programme National Nutrition Santé created in 2001 (Manger-Bouger; Marger 5 fruits et légumes ...)
- ANSES Report (March 2015)
- Validated and recommended by the French government (March 2017)
- Recommended in Belgium, Spain, Germany, the Netherlands, ...

Nutri-Score's algorithm

Step 1: Calculate points for each nutrional information

Points	Energy (kJ)	Sugar (g)	Saturated fatty acids (g)	Sodium (mg)
0	≤ 335	≤ 4,5	≤ 1	≤ 90
1	> 335	> 4,5	> 1	> 90
2	> 670	> 9	> 2	> 180
3	>1005	> 13,5	> 3	> 270
4	> 1340	> 18	> 4	> 360
5	> 1675	> 22,5	> 5	> 450
6	> 2010	> 27	> 6	> 540
7	> 2345	> 31	> 7	> 630
8	> 2680	> 36	> 8	> 720
9	> 3015	> 40	> 9	> 810
10	> 3350	> 45	> 10	> 900

Points	Fruit, vegetables (%)	Fibers (g)	Proteins (g)
0	≤ 40	≤ 0,9	≤ 1,6
1	> 40	> 0,9	> 1,6
2	> 60	> 1,9	> 3,2
3	-	> 2,8	> 4,8
4	-	> 3,7	> 6,4
5	> 80	> 4,7	> 8,0

Positive points : 10

Nutritional information	Value (per 100 g)	Points
Proteins (g)	18	**5** / 5
Fibers (g)	11	**5** / 5
Fruits/vegetables (%)	4	**0** / 5

Negative points : 7

Nutritional information	Value (per 100 g)	Points
Energy (kJ)	1435	**4** / 10
Sugar (g)	0.8	**0** / 10
Saturated fatty acids (g)	1.3	**1** / 10
Sodium (mg)	192	**2** / 10

Step 2: Nutri-Score calculation

$$\text{Nutritional score} = \text{Negative points} - \text{Positive points}$$

Nutritional score of $a = 7 - 10 = -3$

Step 3: Nutri-Score label

POINTS SOLID FOOD	POINTS BEVERAGES	NUTRI-SCORE
-15 to -1	Water	A
0 to 2	≤ 1	B
3 to 10	2 to 5	C
11 to 18	6 to 9	D
19 to 40	10 to 40	E

Nutri-Score label of a = **A**

Nutri-Score's algorithm

	a	b	c	d
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Fibers (g)	11	2	5.2	5
Fruits/vegetables (%)	4	54	0	0
Negative Points	7	2	10	7
Positive Points	10	5	10	9
Nutritional score	-3	-3	0	-2
Nutri-Score label	A	A	B	A

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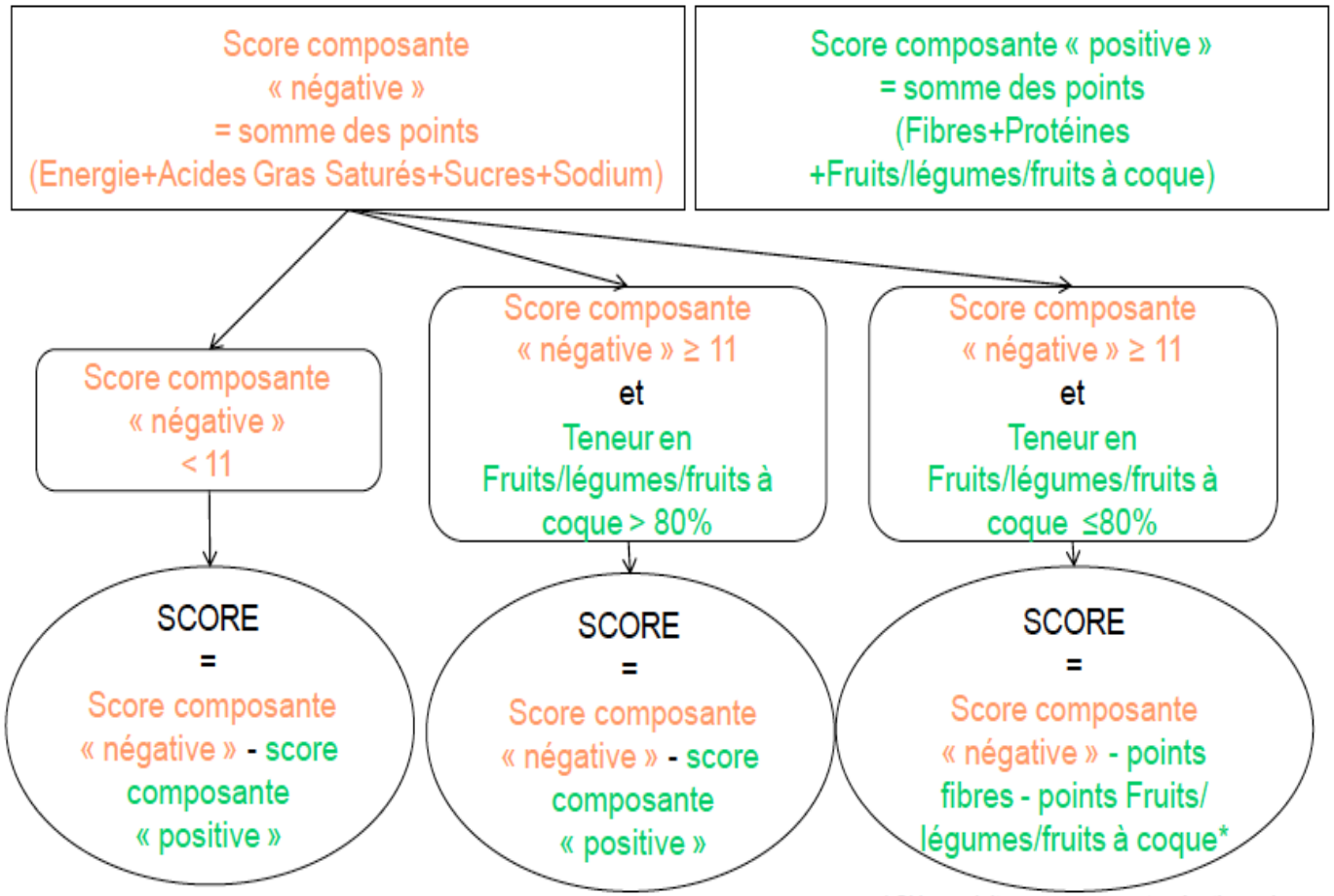
More precisely . . .



* Si le produit a sa composante négative qui comporte un score ≥ 11 et n'est pas composé de plus de 80% de fruits/légumes/fruits à coque, alors les protéines ne sont plus prises en compte dans le calcul du score nutritionnel

Plan

Which food is healthy?

	a	b	c	d
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Nutri-Score viewed as a MCDA problem

N is a set of nutritional information and X is a set of foods

- 4 criteria to be minimized (negative nutrients)
  1. Energy (kJ)
  2. Sugar (g)
  3. Saturated fatty acids (g)
  4. Sodium (mg)
- 3 criteria to be maximized (positive nutrients)
  1. Proteins (g)
  2. Fibers (g)
  3. Fruits/vegetables (%)

Marginal utility functions for the criteria to be minimized

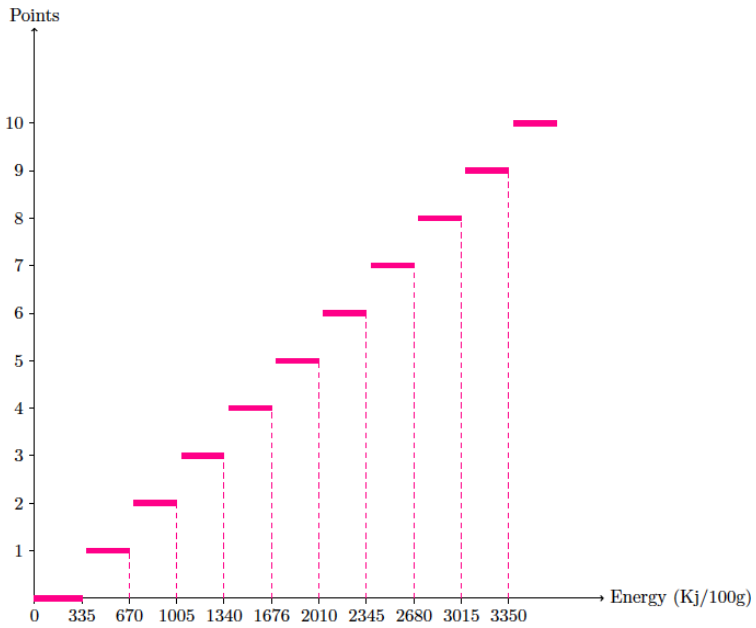

Figure: Scale of Nutri-Score

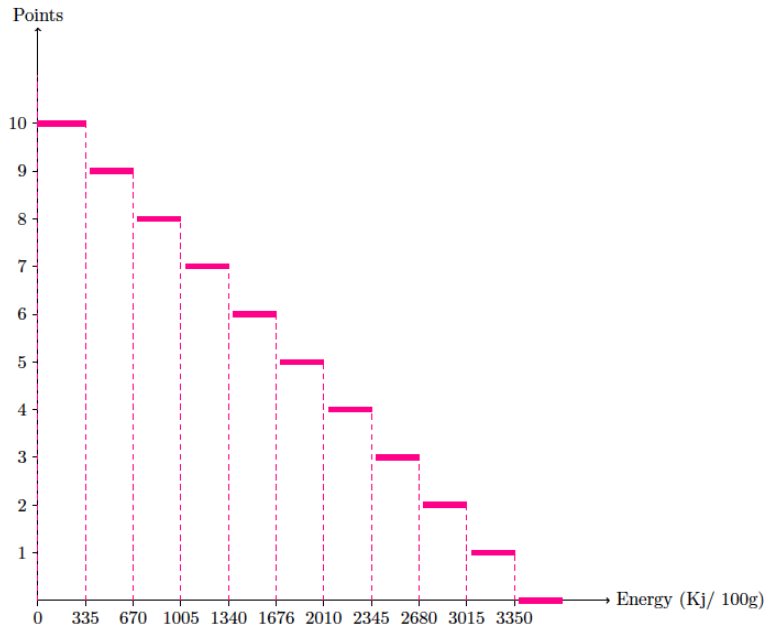

Figure: Our marginal utility function

$$u_i(x_i) = 10 - \text{ points given by the Nutri-Score}$$

Marginal utility functions for the criteria to be maximized

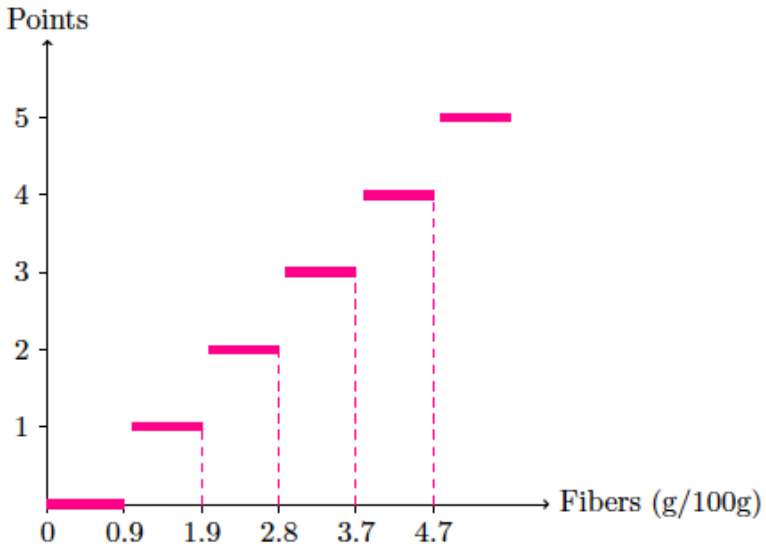

Figure: Scale of Nutri-Score

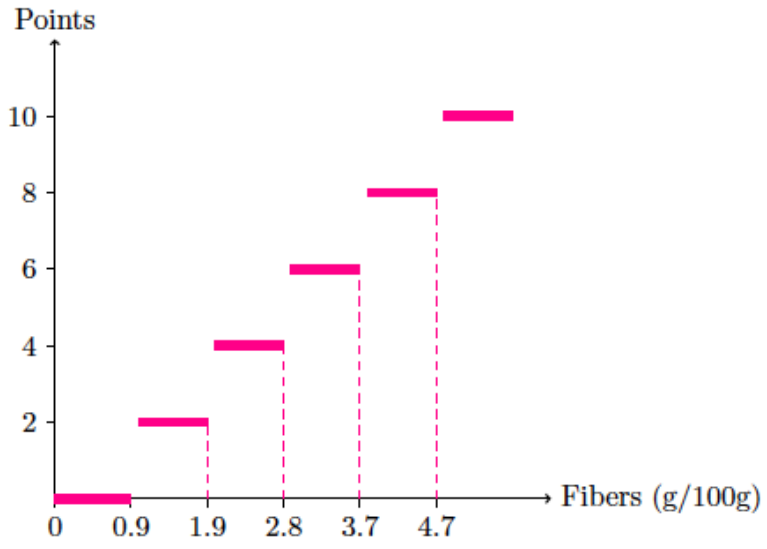

Figure: Our marginal utility function

$$u_i(x_i) = 2 \times \text{ points given by the Nutri-Score}$$

Example

Nutritional information	Value (per 100 g)	Points	Marg. uti. func.
Energy (kJ)	1435	**4** / 10	$u_{en}(a) = 6$
Sugar (g)	0.8	**0** / 10	$u_{su}(a) = 10$
Saturated fatty acids (g)	1.3	**1** / 10	$u_{sa}(a) = 9$
Sodium (mg)	192	**2** / 10	$u_{so}(a) = 8$
Proteins (g)	18	**5** / 5	$u_{pr}(a) = 10$
Fibers (g)	11	**5** / 5	$u_{fi}(a) = 10$
Fruits/vegetables (%)	4	**0** / 5	$u_{fr}(a) = 0$

Our additive model

$$\mathbf{F}(\mathbf{x_{en}}, \mathbf{x_{su}}, \mathbf{x_{sa}}, \mathbf{x_{so}}, \mathbf{x_{pr}}, \mathbf{x_{fi}}, \mathbf{x_{fr}}) = \mathbf{x_{en}} + \mathbf{x_{su}} + \mathbf{x_{sa}} + \mathbf{x_{so}} + \frac{1}{2}(\mathbf{x_{pr}} + \mathbf{x_{fi}} + \mathbf{x_{fr}})$$

Example

Nutritional information	Value (per 100 g)	Points	Marg. uti. func.
Energy (kJ)	1435	**4** / 10	$u_{en}(a) = 6$
Sugar (g)	0.8	**0** / 10	$u_{su}(a) = 10$
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Proteins (g)	18	**5** / 5	$u_{pr}(a) = 10$
Fibers (g)	11	**5** / 5	$u_{fi}(a) = 10$
Fruits/vegetables (%)	4	**0** / 5	$u_{fr}(a) = 0$

$$F(a) = 6 + 10 + 9 + 8 + \frac{1}{2}(10 + 10 + 0) = 43$$

	a	b	c	d
Energy (kJ)	1435	565	1615	1552
Sugar (g)	0.8	7.5	15	1
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Sodium (mg)	192	4	360	300
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Fibers (g)	11	2	5.2	5
Fruits/vegetables (%)	4	54	0	0
Negative Points	7	2	10	7
Positive Points	10	5	10	9
Nutritional score	-3	-3	0	-2
Nutri-Score label	A	A	B	A
Our additive model	43	43	40	42

The Nutri-Score is equivalent to a weighted sum model

$$\mathbf{F}(\mathbf{x_{en}}, \mathbf{x_{su}}, \mathbf{x_{sa}}, \mathbf{x_{so}}, \mathbf{x_{pr}}, \mathbf{x_{fi}}, \mathbf{x_{fr}}) = \mathbf{x_{en}} + \mathbf{x_{su}} + \mathbf{x_{sa}} + \mathbf{x_{so}} + \frac{1}{2}(\mathbf{x_{pr}} + \mathbf{x_{fi}} + \mathbf{x_{fr}})$$

$$\text{Nutri-Score}(x) = 40 - F(x)$$

Consequences

- Nutri-Score allows compensation between criteria
- The normalization of scale is needed
- The criteria are independent.

The Nutri-Score is equivalent to a weighted sum model

$$\mathbf{F}(x_{en}, x_{su}, x_{sa}, x_{so}, x_{pr}, x_{fi}, x_{fr}) = x_{en} + x_{su} + x_{sa} + x_{so} + \frac{1}{2}(x_{pr} + x_{fi} + x_{fr})$$

$$\text{Nutri-Score}(x) = 40 - F(x)$$

Consequences

- The criteria are independent:

  Are "Energy" , "Sugar", "Protein", "Fibers" independent ?

$$\begin{aligned}\text{Energy} = \quad & (9 \times \text{ fat}) + (7 \times \text{ alcohol}) + (4 \times \text{ protein}) \\ & + (4 \times \text{ sugar}) + (2.4 \times \text{ organic acids}) \\ & + (2.4 \times \text{ polyols}) + (2 \times \text{ fibers})\end{aligned}$$