

The Nutri-Score model

Brice Mayag

Université Paris Dauphine
LAMSADE
FRANCE





INFORMATIONS NUTRITIONNELLES			
Valeurs nutritionnelles moyennes pour :	100 g	1 barre (25 g)	
Average nutritional information for:	100 g	1 bar (25 g)	
Énergie / Energy (kJ)	1436	359	
Énergie / 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	4,8 g	1,2 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	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
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

- 1 About the Nutri-Score label
 - The history
 - The algorithm
- 2 An equivalent simple model and some limits of Nutri-Score
- 3 About Yuka Score
- 4 Conclusion

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; Manger 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 nutritional 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

Nutritional score = Negative points – Positive points

Nutritional score of **a** = **7** – **10** = **-3**

Step 3: Nutri-Score label

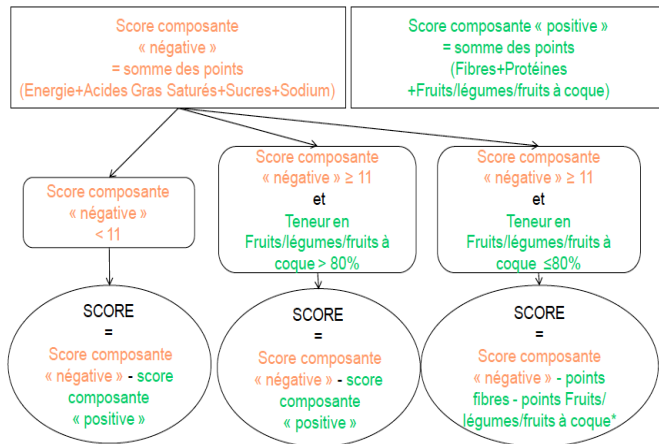
POINTS SOLID FOOD	POINTS BEVERAGES	NUTRI-SCORE
-15 to -1	Water	A B C D E
0 to 2	≤ 1	A B C D E
3 to 10	2 to 5	A B C D E
11 to 18	6 to 9	A B C D E
19 to 40	10 to 40	A B C D E

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

Nutri-Score's algorithm

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
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
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

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

- 1 About the Nutri-Score label
 - The history
 - The algorithm
- 2 An equivalent simple model and some limits of Nutri-Score
- 3 About Yuka Score
- 4 Conclusion

Which food is healthy?

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
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

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

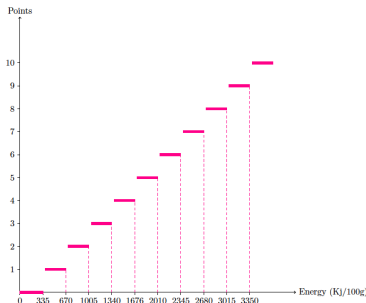


Figure: Scale of Nutri-Score

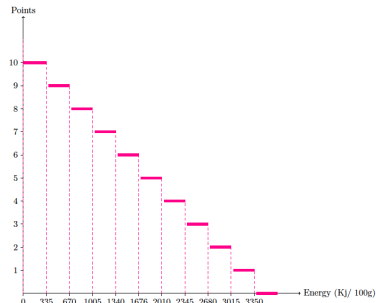


Figure: Our marginal utility function

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

Marginal utility functions for the criteria to be maximized

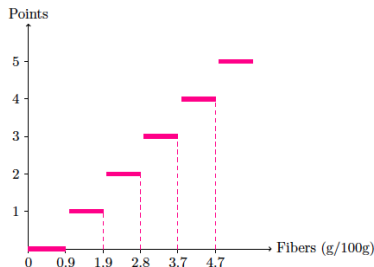


Figure: Scale of Nutri-Score

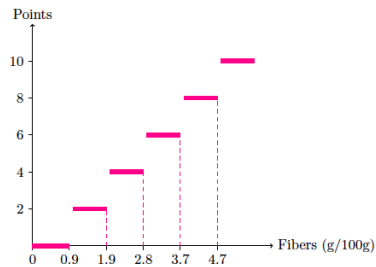


Figure: Our marginal utility function

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



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

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

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	$u_{fr}(a) = 0$

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

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
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
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

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

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

Consequences

- 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

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

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

Consequences

- The criteria are independent:

Are “Energy”, “Sugar”, “Protein”, “Fibers” independent ?

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

The Nutri-Score is equivalent to a weighted sum model

Consequences

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
Energy (kJ)	1700	1400	1700	1400
Sugar (g)	10	10	10	10
Saturated fatty acids (g)	9	9	9	9
Sodium (mg)	2	2	2	2
Proteins (g)	8	6	8	6
Fibers (g)	11	11	1	1
Fruits/vegetables (%)	0	0	0	0

We cannot have $a \succ b$ and $d \succ c$

Discussions with Chantal Julia of Nutri-Score Team

De Chantal JULIA <julia@eren.smbh.univ-paris13.fr> ☆
Sujet: Re: Demande de rencontre pour discussion scientifique au sujet du Nutri-score
Pour Moi ☆

Le 19/02/2020 à 16:16, Brice MAYAG a écrit :

Merci beaucoup pour votre prompte réponse, ainsi que du document.
Je propose de venir vous rencontrer le Mardi 3 Mars matin à 10h. Est-ce correct pour vous?

Bien cordialement,
Brice Mayag

Le 19/02/2020 à 16:07, Chantal Julia a écrit :

Bonjour

Merci beaucoup pour votre intérêt pour cet outil d'évaluation de la qualité nutritionnelle. Nous se

“Move Along, There is Nothing to See Here” ?

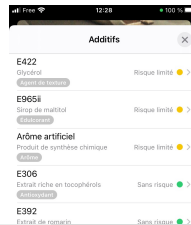
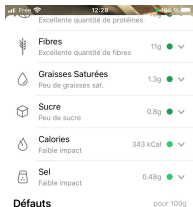
Le Nutri-Score, tant dans sa construction que sa validation, repose sur des bases scientifiques très solides (avec plus de 30 publications scientifiques dans des revues internationales à comité de lecture) démontrant son efficacité et sa supériorité par rapport à tous les autres systèmes de logo nutritionnel (qui n'ont pas un dossier scientifique aussi convaincant).

From <https://nutriscore.blog/2019/04/20/incomprehensions-et-fake-news-concernant-nutri-score-comment-essayer-de-stabiliser>

Plan

- 1 About the Nutri-Score label
 - The history
 - The algorithm
- 2 An equivalent simple model and some limits of Nutri-Score
- 3 About Yuka Score**
- 4 Conclusion

Yuka mobile application



Yuka Score

An aggregation function of 3 criteria ?

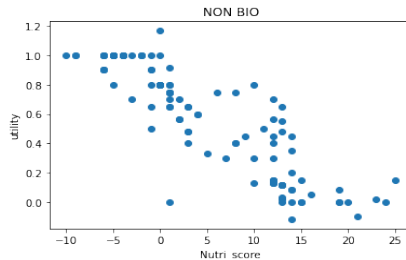
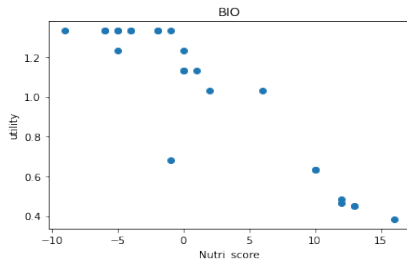
- Nutri-Score (60% of the score)
- Presence of additives (30% of the score)
- Organic dimension: Bio or not Bio (10% of the score)

No additional information about Yuka's algorithm.

Yuka Score

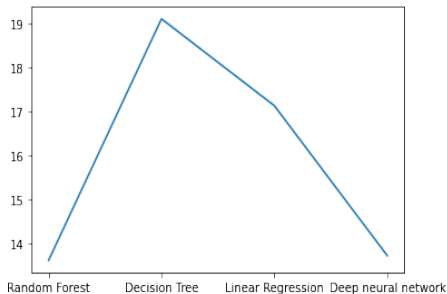
Yuka Score is not an additive model !

product_name	nutrition-score-fr_100g	additives_n	Bio	Score Yuka
Les évasions Poulet Satay et son riz	0	1	non	84
Purée aux brocolis	0	1	non	94
Poulet Saucisses Volailles	11	5	non	23
Rôti de porc	11	3	non	9



Yuka Score

Yuka Score is not an additive model !



A “black box” algorithm

Plan

- 1 About the Nutri-Score label
 - The history
 - The algorithm
- 2 An equivalent simple model and some limits of Nutri-Score
- 3 About Yuka Score
- 4 Conclusion

I have a dream . . .



- Everybody should always cook with fresh products
- Everybody should learn about positive and negative nutrients
- Avoid non transparent algorithms
- Life is beautiful, but short and unpredictable. Enjoy every moment.