

# Who likes Nutella ?

Study about chocolate spread's consumption

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The logo for Nutella, featuring the word "nutella" in a bold, lowercase sans-serif font. The "n" is black, and the "utella" is red. A registered trademark symbol (®) is located to the left of the "n".

# Table of contents

- 1 Introduction
- 2 Variables
- 3 Nutella consumers
- 4 Non Nutella consumers
- 5 Conclusion

- 1 Introduction
- 2 Variables
- 3 Nutella consumers
- 4 Non Nutella consumers
- 5 Conclusion

# Table of contents

- 1 Introduction
  - Who likes Nutella?
  - Data set
- 2 Variables
- 3 Nutella consumers
- 4 Non Nutella consumers
- 5 Conclusion

## Objectives of the project

- Why Nutella is the leader on the chocolate spread market ?
- Why do people prefer consuming Nutella over any other chocolate spread ?
- How does this consumption evolve if some characteristics are changed?

# Table of contents

- 1 Introduction
  - Who likes Nutella?
  - Data set
- 2 Variables
- 3 Nutella consumers
- 4 Non Nutella consumers
- 5 Conclusion

## Gathering data

- Google survey (friends, relatives, students at ENAC, confederation of the Junior Enterprises, networks)

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# Gathering data

- Google survey (friends, relatives, students at ENAC, confederation of the Junior Enterprises, networks)
- 328 responses within four days : 4 were rejected :-)
- Separation into two data set (Nutella consumers = 249 / non consumers = 75)

- 1 Introduction
- 2 Variables**
- 3 Nutella consumers
- 4 Non Nutella consumers
- 5 Conclusion

# Table of contents

- 1 Introduction
- 2 Variables
  - Choice of the variables
  - Descriptive analysis
- 3 Nutella consumers
- 4 Non Nutella consumers
- 5 Conclusion

# Variables (1)

Explanatory variables	Details
COCOA FREQUENCY NATIONALITY AGE HEIGHT WEIGHT SEX STATUS	Binary How often do people eat Nutella a month ? Binary in years in centimeters in kilograms Binary Student=0 ; Worker=1 ; Unemployed=2 ; Retired=3

## Variables (2)

MARITAL	Single=0 ; Live-in partnership=1 ; Engaged=2 ; Married=3 ; Divorced=4 ; Widow=5
CHILDREN	
INCOME	in euros
LOCALIZATION	Where do you live ?
TYPE	Nutella=0 ; First price=1 ; Homemade=2 ; Organic=3
R_Taste	Binary
R_Leader	Binary
R_Price	Binary
R_Ads	Binary
R_Design	Binary

## Variables (3)

RNo_Nutrition	Binary
RNo_Price	Binary
RNo_Taste	Binary
RNo_Composition	Binary

Number of variables

$$k = 22$$

# Table of contents

- 1 Introduction
- 2 Variables
  - Choice of the variables
  - Descriptive analysis
- 3 Nutella consumers
- 4 Non Nutella consumers
- 5 Conclusion



# Nutella consumption

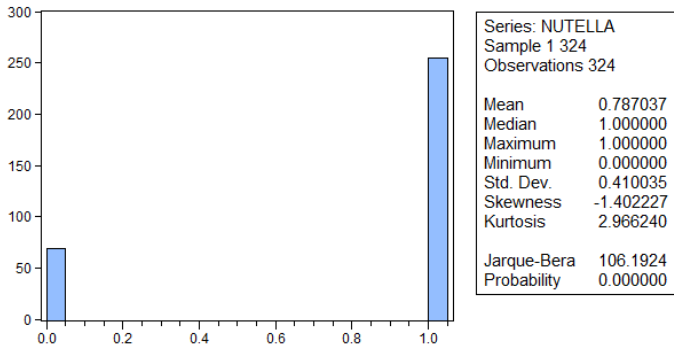


Figure: Histogram NUTELLA

# Income

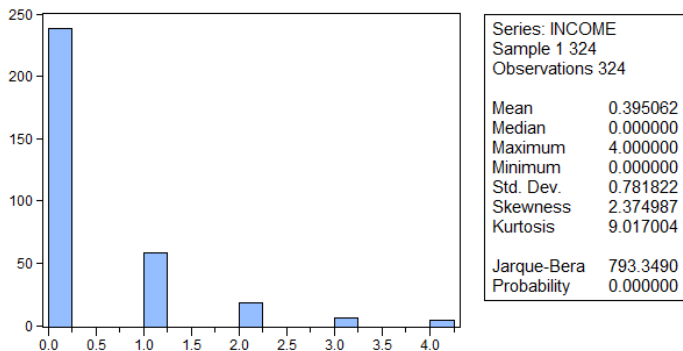


Figure: Histogram INCOME

# Frequency of Nutella consumption

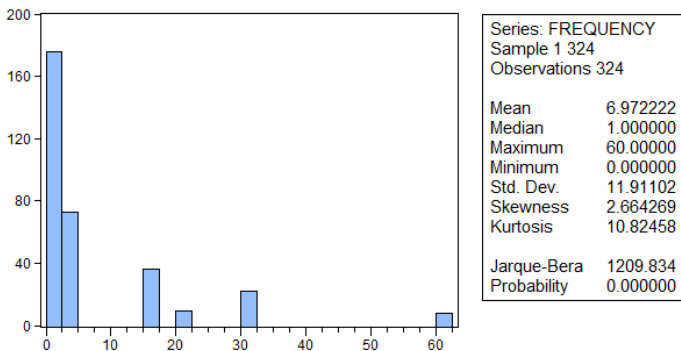


Figure: Histogram FREQUENCY

# Other chocolate spread consumption

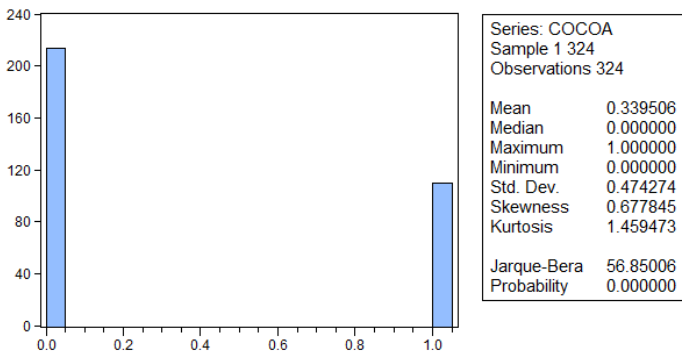


Figure: Histogram COCOA

# Dependent variable

## Choice of Y

For the first group of data :  $Y = \text{FREQUENCY}$

- 1 Introduction
- 2 Variables
- 3 Nutella consumers**
- 4 Non Nutella consumers
- 5 Conclusion

# Table of contents

- 1 Introduction
- 2 Variables
- 3 Nutella consumers**
  - **First complete linear model**
  - Correlation matrix
  - Second model
  - Last model but not least
  - Bonus !
- 4 Non Nutella consumers

# First complete model

	Coefficient	Std. Error	t-Statistic	Prob.
C	7.995020	11.13002	0.718329	0.4733
COCOA	-3.243883	2.334653	-1.389450	0.1660
TYPE	-0.606686	1.261087	-0.481082	0.6309
R_TASTE	-1.603029	4.975020	-0.322216	0.7476
R_PRICE	-3.613439	4.671877	-0.773445	0.4401
R_LEADER	-3.265521	2.523498	-1.294046	0.1969
R_ADS	-1.693534	4.013819	-0.421926	0.6735
R_DESIGN	-3.298490	3.375917	-0.977065	0.3296
MALE	-2.789966	2.517931	-1.108039	0.2690
FRENCH	-0.267589	5.064722	-0.052834	0.9579
AGE	0.218659	0.354664	0.616524	0.5382
HEIGHT	1.926782	1.266041	1.521895	0.1294
WEIGHT	1.051871	1.137466	0.924750	0.3561
STATUS	-0.608960	4.748384	-0.128246	0.8981
MARITAL	1.794473	1.982322	0.905238	0.3663
CHILDREN	-0.493631	4.011230	-0.123062	0.9022
INCOME	-3.768123	2.415082	-1.560247	0.1201
LOCALIZATION	-0.050838	0.035263	-1.441661	0.1508
R-squared	0.072403	Mean dependent var	8.979920	
Adjusted R-squared	0.004138	S.D. dependent var	12.89706	
S.E. of regression	12.87035	Akaike info criterion	8.017273	
Sum squared resid	38264.21	Schwarz criterion	8.271547	
Log likelihood	-980.1505	Hannan-Quinn criter.	8.119622	
F-statistic	1.060620	Durbin-Watson stat	1.793828	
Prob(F-statistic)	0.394040			

Figure: First complete model



# Table of contents

- 1 Introduction
- 2 Variables
- 3 Nutella consumers**
  - First complete linear model
  - Correlation matrix**
  - Second model
  - Last model but not least
  - Bonus !
- 4 Non Nutella consumers

# Correlation matrix

	Correlation																	
	COCOA	TYPE	R_TASTE	R_PRICE	R_LEADER	R_ADS	R_DESIGN	FREQUENCY	MALE	FRENCH	AGE	HEIGHT	WEIGHT	STATUS	MARITAL	CHILDREN	INCOME	LOCALIZATI
COCOA	1.00000	0.624695	-0.180801	0.078284	-0.178700	0.018184	-0.083947	-0.120636	0.013878	-0.03075	0.037175	-0.018526	-0.006375	0.007630	0.016729	0.040422	0.021635	-0.033953
TYPE	0.624695	1.00000	-0.067340	0.150032	-0.125524	-0.055096	-0.060776	-0.097330	-0.005024	-0.039955	0.039773	-0.006125	0.023455	0.020862	0.056845	0.060087	-0.013419	0.068851
R_TASTE	-0.180801	-0.067340	1.00000	-0.305265	-0.005725	-0.488773	-0.003954	0.011810	-0.001904	-0.041512	0.064772	-0.173294	-0.060313	0.074075	0.008653	0.039644	0.077898	-0.151225
R_PRICE	0.078284	0.150032	-0.305265	1.00000	-0.103813	-0.069845	-0.055371	-0.028287	-0.151227	0.034789	-0.059833	-0.023655	-0.063871	-0.052079	-0.021795	-0.033224	-0.065282	-0.034957
R_LEADER	-0.178700	-0.125524	-0.005725	-0.103813	1.00000	0.445000	0.050897	-0.060287	0.082768	0.026113	-0.178996	0.019523	0.089746	-0.140206	-0.057444	-0.062432	-0.161974	0.114553
R_ADS	0.018184	-0.055096	-0.488773	-0.069845	0.445000	1.00000	-0.040360	-0.027016	0.242071	0.058073	-0.056266	0.221505	0.268022	-0.103028	-0.018010	-0.055460	-0.108975	0.084652
R_DESIGN	-0.083947	-0.060776	-0.003954	-0.055371	0.050897	-0.040360	1.00000	0.020032	0.099693	0.046039	-0.065797	0.117231	0.141112	-0.024853	-0.095370	-0.043967	-0.086392	-0.028811
FREQUENCY	-0.120636	-0.097330	0.011810	-0.028287	-0.060287	-0.027016	-0.020032	1.00000	0.029873	-0.002153	-0.000868	0.106787	0.070590	-0.055607	0.003951	0.008829	-0.067053	-0.109416
MALE	0.013878	-0.005024	-0.001904	-0.151227	0.082768	0.242071	0.099693	0.029873	1.00000	0.074913	0.081321	0.036881	0.065620	0.017484	0.058960	0.049806	0.130503	-0.170888
FRENCH	-0.03075	-0.039955	-0.041512	0.034789	0.026113	0.058073	0.046039	-0.002153	0.074913	1.00000	-0.023813	-0.009894	0.003275	-0.035815	-0.049840	0.027624	-0.021438	-0.144750
AGE	0.037175	0.039773	0.064772	-0.059833	-0.178996	-0.056266	-0.065797	-0.000868	0.081321	-0.023813	1.00000	-0.004341	0.170741	0.668324	0.631524	0.831720	0.740438	0.037754
HEIGHT	-0.018526	-0.006375	-0.173294	-0.023655	0.189523	0.221505	0.117231	0.106787	0.036881	-0.009894	-0.004341	1.00000	0.628688	0.056132	-0.024218	-0.033183	0.036584	-0.049599
WEIGHT	-0.006375	0.023455	-0.060313	-0.063871	0.069746	0.268022	0.141112	0.070590	0.065620	0.003275	0.170741	0.628688	1.00000	0.142356	0.099337	0.068526	0.248045	-0.004029
STATUS	0.007630	0.020862	0.074075	-0.052079	-0.140206	-0.103028	-0.024853	-0.056607	0.017484	-0.035815	0.668324	-0.056132	0.142356	1.00000	0.516615	0.488853	0.758857	0.178554
MARITAL	0.016729	0.056845	0.060087	-0.021795	-0.057444	-0.018010	-0.095370	0.003951	0.058960	-0.049840	0.631524	-0.024218	0.099337	0.516615	1.00000	0.615889	0.552619	0.148335
CHILDREN	0.040422	0.060087	0.039644	-0.033224	-0.062432	-0.055460	-0.043967	0.008829	0.049806	0.027624	0.831720	-0.033183	0.068526	0.488853	0.615889	1.00000	0.533424	-0.015144
INCOME	0.021635	-0.013419	0.077898	-0.065282	-0.161974	-0.108975	-0.086392	-0.067053	0.130993	-0.021438	0.740438	0.036584	0.248045	0.758857	0.552619	0.533424	1.00000	0.133610
LOCALIZATI	-0.033953	0.068851	-0.151225	-0.034957	0.114553	0.084652	-0.028811	-0.109416	-0.170888	-0.144750	0.037754	-0.049599	-0.004029	0.178554	0.149335	-0.015144	0.133610	1.00000

Figure: Correlation matrix

## Correlated variables

As expected :

- AGE with STATUS(66%), CHILDREN(83%)...
- HEIGHT with WEIGHT (63%)



# Table of contents

- 1 Introduction
- 2 Variables
- 3 Nutella consumers**
  - First complete linear model
  - Correlation matrix
  - Second model**
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# Simplification

Dependent Variable: FREQUENCY

Method: Least Squares

Date: 04/12/17 Time: 18:41

Sample: 1 255

Included observations: 249

	Coefficient	Std. Error	t-Statistic	Prob.
C	3.300153	6.022624	0.547959	0.5842
R_TASTE	0.096645	3.588830	0.026930	0.9785
R_LEADER	-3.520132	2.078265	-1.693784	0.0916
COCOA	-3.843562	1.788505	-2.149036	0.0326
WEIGHT	1.270738	0.786636	1.615408	0.1075
INCOME	-3.925512	1.928621	-2.035399	0.0429
AGE	0.278096	0.220547	1.260934	0.2085
R-squared	0.043984	Mean dependent var	8.979920	
Adjusted R-squared	0.020281	S.D. dependent var	12.89706	
S.E. of regression	12.76561	Akaike info criterion	7.959097	
Sum squared resid	39436.54	Schwarz criterion	8.057981	
Log likelihood	-983.9076	Hannan-Quinn criter.	7.998900	
F-statistic	1.855622	Durbin-Watson stat	1.779989	
Prob(F-statistic)	0.089165			

## Analysis

$$R^2 = 4,4\%$$

R\_TASTE  
insignificant

Figure: Second model

# Test classical assumptions (1)

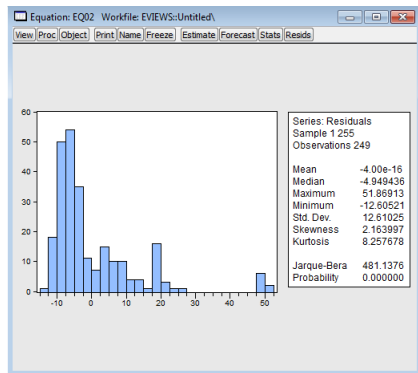


Figure: Normality of the errors

## Analysis

$JB \geq \chi^2(k)$  at 99%

Probability = 0

Reject  $H_0$  : not a normal distribution

## Test classical assumptions (2)

### Analysis

$1/2 * ESS \geq \chi^2(6) = 12.592$   
 at 95%

Reject the null hypothesis :  
 Heteroskedasticity

But

$1/2 * ESS \leq \chi^2(6) = 16.812$   
 at 99%

Dont Reject :  
 Homoskedasticity

#### Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.645709	Prob. F(6,242)	0.1352
Obs*R-squared	9.761576	Prob. Chi-Square(6)	0.1351
Scaled explained SS	33.45952	Prob. Chi-Square(6)	0.0000

#### Test Equation:

Dependent Variable: RESID\*2

Method: Least Squares

Date: 04/12/17 Time: 18:44

Sample: 1 255

Included observations: 249

	Coefficient	Std. Error	t-Statistic	Prob.
C	214.7699	200.1475	1.073058	0.2843
R_TASTE	-96.45978	119.2662	-0.808777	0.4194
R_LEADER	-117.7052	69.06616	-1.704238	0.0896
COCOA	-127.7540	59.43667	-2.149415	0.0326
WEIGHT	48.03162	26.14197	1.837338	0.0674
INCOME	-52.10888	64.09308	-0.813019	0.4170
AGE	1.228515	7.329363	0.167616	0.8670

R-squared	0.039203	Mean dependent var	158.3797
Adjusted R-squared	0.015382	S.D. dependent var	427.5354
S.E. of regression	424.2346	Akaike info criterion	14.96616
Sum squared resid	43553941	Schwarz criterion	15.06504
Log likelihood	-1856.287	Hannan-Quinn criter.	15.00596
F-statistic	1.645709	Durbin-Watson stat	1.813687
Prob(F-statistic)	0.135237		

Figure: Heteroskedasticity test

# Correction of heteroskedasticity

Dependent Variable: FREQUENCY

Method: Least Squares

Date: 04/12/17 Time: 18:45

Sample: 1 255

Included observations: 249

White Heteroskedasticity-Consistent Standard Errors & Covariance

	Coefficient	Std. Error	t-Statistic	Prob.
C	3.300153	7.132899	0.462666	0.6440
R_TASTE	0.096645	4.438722	0.021773	0.9826
R_LEADER	-3.520132	1.803320	-1.952028	0.0521
COCOA	-3.843562	1.702565	-2.257512	0.0249
WEIGHT	1.270738	0.805681	1.577222	0.1161
INCOME	-3.925512	1.906379	-2.059146	0.0406
AGE	0.278096	0.210733	1.319661	0.1882
R-squared	0.043984	Mean dependent var		8.979920
Adjusted R-squared	0.020281	S.D. dependent var		12.89706
S.E. of regression	12.76561	Akaike info criterion		7.959097
Sum squared resid	39436.54	Schwarz criterion		8.057981
Log likelihood	-983.9076	Hannan-Quinn criter.		7.998900
F-statistic	1.855622	Durbin-Watson stat		1.779989
Prob(F-statistic)	0.089165			

Figure: Regression 2 corrected

# Wald test

Wald Test:  
Equation: EQ02

Test Statistic	Value	df	Probability
F-statistic	0.000474	(1, 242)	0.9826
Chi-square	0.000474	1	0.9826

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(2)	0.096645	4.438722

Restrictions are linear in coefficients.

## Analysis

$$H_0 : \beta_1 = 0$$

We do not reject the null

Figure: Test  $\beta_1 = 0$



# Table of contents

- 1 Introduction
- 2 Variables
- 3 Nutella consumers**
  - First complete linear model
  - Correlation matrix
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## Third regression

Dependent Variable: FREQUENCY  
 Method: Least Squares  
 Date: 04/12/17 Time: 19:19  
 Sample: 1 255  
 Included observations: 249

	Coefficient	Std. Error	t-Statistic	Prob.
C	3.394721	4.882807	0.695240	0.4876
R_LEADER	-3.520940	2.073771	-1.697844	0.0908
COCOA	-3.851851	1.758192	-2.190802	0.0294
WEIGHT	1.268974	0.782289	1.622129	0.1061
INCOME	-3.922582	1.921585	-2.041326	0.0423
AGE	0.278183	0.220070	1.264070	0.2074
R-squared	0.043981	Mean dependent var	8.979920	
Adjusted R-squared	0.024310	S.D. dependent var	12.89706	
S.E. of regression	12.73934	Akaike info criterion	7.951068	
Sum squared resid	39436.65	Schwarz criterion	8.035826	
Log likelihood	-983.9080	Hannan-Quinn criter.	7.985184	
F-statistic	2.235796	Durbin-Watson stat	1.780212	
Prob(F-statistic)	0.051449			

### Analysis

Probabilities lower : more significant variables

No change in coefficients

Higher Adjusted- $R^2$  : better model

Figure: Third model

# Test classical assumptions

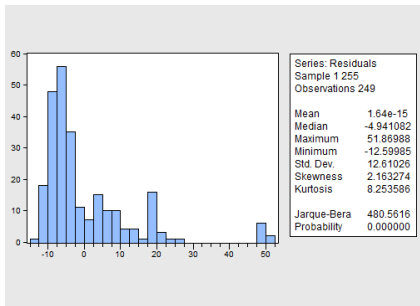


Figure: Normality of the errors 3

## Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.844926	Prob. F(5,243)	0.1048
Obs*R-squared	9.106697	Prob. Chi-Square(5)	0.1049
Scaled explained SS	31.45557	Prob. Chi-Square(5)	0.0000

Test Equation:  
 Dependent Variable: RESID^2  
 Method: Least Squares  
 Date: 04/12/17 Time: 18:52  
 Sample: 1 255  
 Included observations: 249

	Coefficient	Std. Error	t-Statistic	Prob.
C	120.0384	162.4448	0.738949	0.4607
R_LEADER	-116.8119	68.99173	-1.693129	0.0917
COCOA	-119.2990	58.49281	-2.039550	0.0425
WEIGHT	49.79822	26.02576	1.913421	0.0569
INCOME	-55.09983	63.92869	-0.861895	0.3896
AGE	1.153550	7.321432	0.157558	0.8749

R-squared	0.036573	Mean dependent var	158.3801
Adjusted R-squared	0.016749	S.D. dependent var	427.4162
S.E. of regression	423.8216	Akaike info criterion	14.96030
Sum squared resid	43648804	Schwarz criterion	15.04506
Log likelihood	-1856.558	Hannan-Quinn criter.	14.99442
F-statistic	1.844926	Durbin-Watson stat	1.805505
Prob(F-statistic)	0.104778		

Figure: Heteroskedasticity test 3

# Correction of the Heteroskedasticity

Dependent Variable: FREQUENCY

Method: Least Squares

Date: 04/12/17 Time: 18:40

Sample: 1 255

Included observations: 249

White Heteroskedasticity-Consistent Standard Errors & Covariance

	Coefficient	Std. Error	t-Statistic	Prob.
C	3.394721	4.819834	0.704323	0.4819
R_LEADER	-3.520940	1.792109	-1.964691	0.0506
COCOA	-3.851851	1.568373	-2.455954	0.0148
WEIGHT	1.268974	0.796826	1.592536	0.1126
INCOME	-3.922582	1.887965	-2.077677	0.0388
AGE	0.278183	0.210885	1.319125	0.1884
R-squared	0.043981	Mean dependent var		8.979920
Adjusted R-squared	0.024310	S.D. dependent var		12.89706
S.E. of regression	12.73934	Akaike info criterion		7.951068
Sum squared resid	39436.65	Schwarz criterion		8.035826
Log likelihood	-983.9080	Hannan-Quinn criter.		7.985184
F-statistic	2.235796	Durbin-Watson stat		1.780212
Prob(F-statistic)	0.051449			

Figure: Final Regression

# Table of contents

- 1 Introduction
- 2 Variables
- 3 Nutella consumers**
  - First complete linear model
  - Correlation matrix
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- 4 Non Nutella consumers

## Limit of consumption

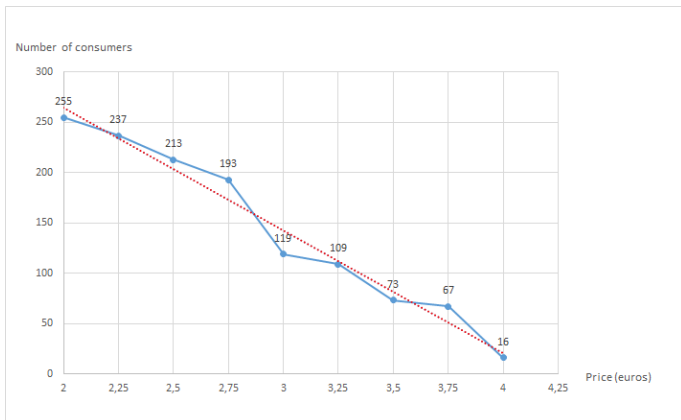


Figure: Demand curve

- 1 Introduction
- 2 Variables
- 3 Nutella consumers
- 4 Non Nutella consumers**
- 5 Conclusion

# Table of contents

- 1 Introduction
- 2 Variables
- 3 Nutella consumers
- 4 Non Nutella consumers**
  - **Modelisation**
  - Classical assumptions
  - White test
- 5 Conclusion



# Dependent variable

## Choice of Y

For the second group of data :  $Y = \text{WEIGHT}$

## Variables

Focus on the variables RNo\_Composition and RNo\_Nutrition

# Regression

Dependent Variable: WEIGHT  
 Method: Least Squares  
 Date: 04/13/17 Time: 10:43  
 Sample (adjusted): 1 49  
 Included observations: 49 after adjustments

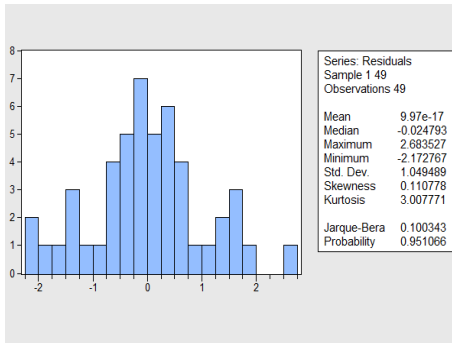
	Coefficient	Std. Error	t-Statistic	Prob.
C	4.520658	0.881096	5.130718	0.0000
RN0_COMPOSITION	-0.412906	0.430119	-0.959981	0.3424
RN0_NUTRITION	0.920058	0.348264	2.641843	0.0115
COCOA	-0.351375	0.371059	-0.946951	0.3490
AGE	-0.035994	0.023807	-1.511913	0.1379
LOCALIZATION	-0.020904	0.006432	-3.249795	0.0022
R-squared	0.354941	Mean dependent var	2.204082	
Adjusted R-squared	0.279934	S.D. dependent var	1.306707	
S.E. of regression	1.108829	Akaike info criterion	3.158763	
Sum squared resid	52.86855	Schwarz criterion	3.390415	
Log likelihood	-71.38970	Hannan-Quinn criter.	3.246652	
F-statistic	4.732105	Durbin-Watson stat	1.099160	
Prob(F-statistic)	0.001566			

Figure: Regression 4

# Table of contents

- 1 Introduction
- 2 Variables
- 3 Nutella consumers
- 4 Non Nutella consumers**
  - Modelisation
  - Classical assumptions**
  - White test
- 5 Conclusion

## Normality of the errors



### Analysis

Probability = 95%

Accept the null hypothesis of a normal distribution

Figure: Normality of the errors 4

# Heteroskedasticity test

## Analysis

$$1/2 * ESS$$

$$\leq \chi^2(5) = 11.070$$

Don't reject the null :

Homoskedasticity

### Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.517233	Prob. F(5,43)	0.2045
Obs*R-squared	7.348295	Prob. Chi-Square(5)	0.1960
Scaled explained SS	5.680878	Prob. Chi-Square(5)	0.3385

Test Equation:

Dependent Variable: RESID\*2

Method: Least Squares

Date: 04/13/17 Time: 10:52

Sample: 1 49

Included observations: 49

	Coefficient	Std. Error	t-Statistic	Prob.
C	2.248051	1.195637	1.880212	0.0669
RN0_COMPOSITION	-0.511378	0.583666	-0.876148	0.3858
RN0_NUTRITION	0.143068	0.472590	0.302731	0.7636
COCOA	0.891563	0.503522	1.770652	0.0837
AGE	-0.013353	0.032306	-0.413335	0.6814
LOCALIZATION	-0.014359	0.008729	-1.645036	0.1073

R-squared	0.149965	Mean dependent var	1.078950
Adjusted R-squared	0.051124	S.D. dependent var	1.544670
S.E. of regression	1.504667	Akaike info criterion	3.769299
Sum squared resid	97.35303	Schwarz criterion	4.000950
Log likelihood	-86.34781	Hannan-Quinn criter.	3.857187
F-statistic	1.517233	Durbin-Watson stat	1.318520
Prob(F-statistic)	0.204523		

Figure: Heteroskedasticity test 4

# Table of contents

- 1 Introduction
- 2 Variables
- 3 Nutella consumers
- 4 Non Nutella consumers**
  - Modelisation
  - Classical assumptions
  - White test**
- 5 Conclusion

# White test

## Heteroskedasticity Test: White

F-statistic	1.340506	Prob. F(17,31)	0.2328
Obs*R-squared	20.75982	Prob. Chi-Square(17)	0.2372
Scaled explained SS	16.04916	Prob. Chi-Square(17)	0.5204

Figure: White test 4

### Analysis

$nR^2 = 20.76 \leq \chi^2(15) = 25.00$  with an error of 5%

$Probability = 24\% \geq 5\%$  : accept  $H_0$

No Heteroskedasticity

- 1 Introduction
- 2 Variables
- 3 Nutella consumers
- 4 Non Nutella consumers
- 5 Conclusion**



# Conclusion

Thank you for listening !

The Nutella logo consists of the word "nutella" in a bold, lowercase, sans-serif font. The "n" is black, and the "utella" is red. A registered trademark symbol (®) is located to the left of the "n".