Christmas boxes

Laboratory of Customer and Business Analytics
University of Trento - AA 2019/2020
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Agenda

→ Survey design

→ Descriptive analysis

→ Multinomial Logit model

→ Willingness to pay

→ Mixed MNL model

→ Individual level variables

→ Simulating preference shares

→ Conclusions and future development

Survey design

- **Binomial** variables:
  - *Dolce: Pandoro - Panettone*
  - *Bottiglia: Spumante - Passito*
  - *Boolean variables:*
    - *Grana*
    - *Cioccolatini*
    - *Miele*
    - *Salame*
    - *Torrone*
- **Multinomial** variables:
  - *Prezzo: 10 - 13 - 16 - 20*
- **Individual level** variables:
  - *Età*
  - *Genere*
  - *Occupazione*
  - *Provincia di residenza*
  - *Destinatario*
  - *Team*

8 variables
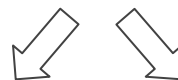
18 levels

512 profiles

Fractional design:

- easy to administer
- orthogonal

Mix-and-match method

3 alternatives for question

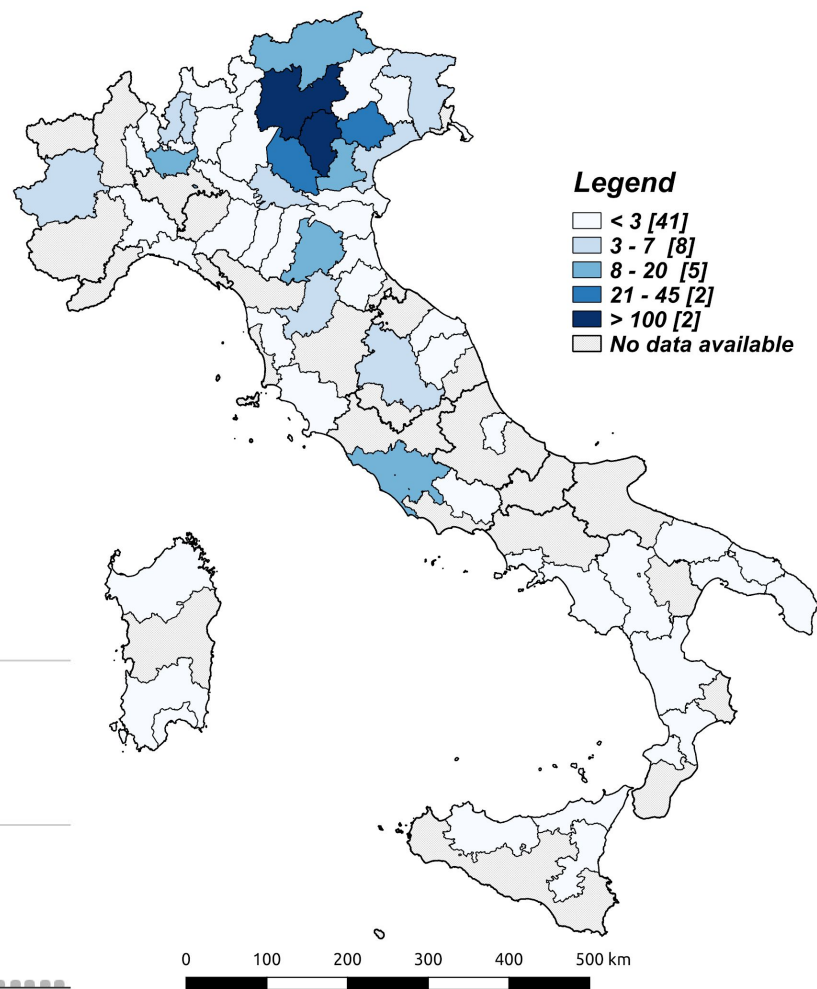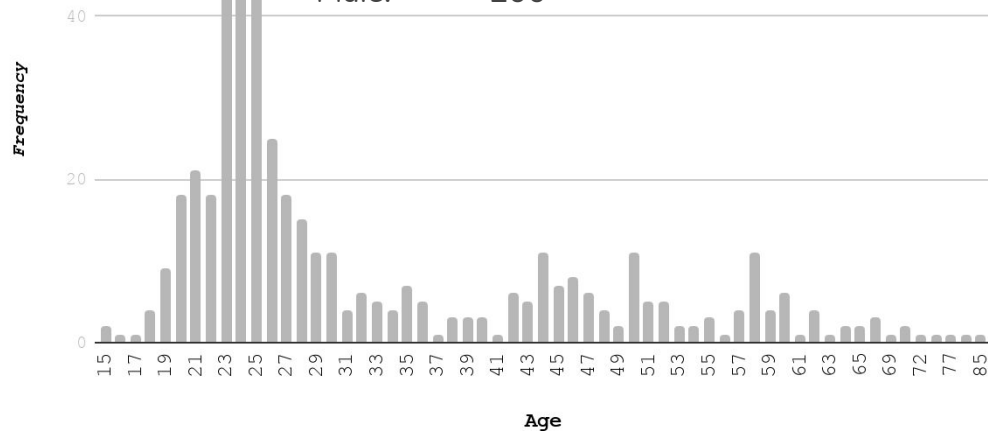2 blocks with 8 questions each

Descriptive analysis

Age

Min.:	15
Median:	26
Mean:	32.62
Max.:	85

Gender

Female:	274
Male:	200

Province

TN:	115
VI:	115
TV:	42
VR:	37
BO:	20
BZ:	16
(Other):	129

Legend
- *< 3 [41]*
- *3 - 7 [8]*
- *8 - 20 [5]*
- *21 - 45 [2]*
- *> 100 [2]*
- *No data available*

4

Descriptive analysis

- Individual level variables:
    - **Employment**:
      - Lavoratore: 229
      - Studente: 192
      - Pensionato: 20
      - Disoccupato: 5
      - Altro: 28
    - **Receiver**:
      - Parente: 197
      - Famiglia del partner: 132
      - Amico: 74
      - Collega: 71
    - **Team preference**:
      - Pandoro: 272
      - Panettone: 202

- Frequency of the chosen attributes:

Dolce	Pandoro	→	2010,	Panettone	→	1782
Bottiglia	Passito	→	1880,	Spumante	→	1912
Salame	Sì	→	2021,	No	→	1771
Torrone	Sì	→	2008,	No	→	1784
Cioccolatini	Sì	→	2155,	No	→	1637
Miele	Sì	→	2178,	No	→	1614
Grana	Sì	→	2287,	No	→	1505
Prezzo	10 → 1074, 13 → 1025, 16 → 976, 20 → 717					

Multinomial Logit model

Fixed effects model with one intercept for each alternative.

Coefficients :	Estimate	Std. Error	z-value	Pr(>|z|)	
2:(intercept)	0.217	0.042	5.175	2.3e-07	***
3:(intercept)	0.094	0.044	2.153	0.031	*
panettone	-0.149	0.048	-3.144	0.002	**
spumante	0.036	0.049	0.738	0.460	
salame	0.201	0.046	4.386	1.2e-05	***
torrone	0.242	0.047	5.130	2.9e-07	***
cioccolatini	0.475	0.044	10.872	< 2.2e-16	***
miele	0.393	0.041	9.597	< 2.2e-16	***
grana	0.582	0.045	13.072	< 2.2e-16	***
€ 13	0.045	0.065	0.695	0.487	
€ 16	-0.109	0.067	-1.642	0.101	
€ 20	-0.502	0.064	-7.904	2.7e-15	***

(baseline for binary variables is FALSE)

Multinomial Logit model

Likelihood Ratio Test performed to compare the models' goodness of fit.

```
Likelihood ratio test:
Model 1: scelta ~   dolce + bottiglia + salame + torrone
                    + cioccolatini + miele + grana + prezzo | -1
Model 2: scelta ~   dolce + bottiglia + salame + torrone
                    + cioccolatini + miele + grana + prezzo
    #Df    LogLik  Df   Chisq    Pr(>Chisq)
1   10     -3850.5
2   12     -3836.8  2   27.386   1.13e-06 ***
```

Willingness to pay

Product	Willingness to pay(€)
Grana	- 10.33
Cioccolatini	- 8.46
Miele	- 7.28
Torrone	- 4.94
Salame	- 3.99
Panettone (in respect to Pandoro)	+ 2.35
Spumante (in respect to Passito)	- 0.93

Mixed MNL model

Dealing with respondents heterogeneity. A mixed MNL model with covariances among random effects set to zero.

```
Random coefficients:
                Min.      1st Qu.    Median      Mean       3rd Qu.    Max.
panettone      -Inf      -1.148     -0.224     -0.224      0.701      Inf
spumante       -Inf      -0.355      0.069      0.069      0.494      Inf
salame         -Inf      -0.369      0.271      0.271      0.910      Inf
torrone        -Inf       0.069      0.374      0.374      0.678      Inf
cioccolatini   -Inf       0.430      0.538      0.538      0.646      Inf
miele          -Inf       0.150      0.551      0.551      0.952      Inf
grana          -Inf       0.403      0.756      0.756      1.109      Inf
€ 13           -Inf      -0.020      0.029      0.029      0.078      Inf
€ 16           -Inf      -0.515     -0.253     -0.253      0.010      Inf
€ 20           -Inf      -1.212     -0.726     -0.726     -0.239      Inf
(baseline for binary variables is FALSE)


Likelihood ratio test: Model 1 (fixed MNL) vs Model 2  (mixed MNL)

   #Df    LogLik    Df   Chisq     Pr(>Chisq)
1   10    -3850.5
2   20    -3660.3   10   380.36   < 2.2e-16 ***
```
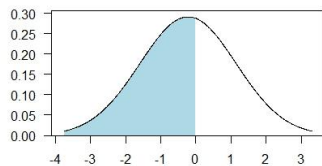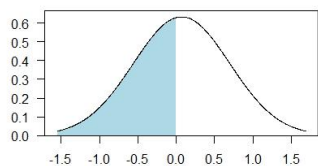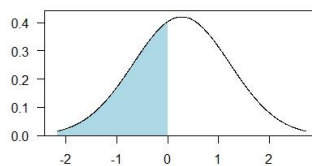
Mixed MNL model

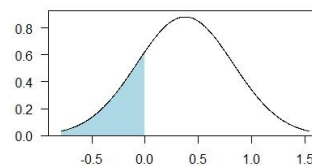Distribution of dolcepanettone : 56 % of 0

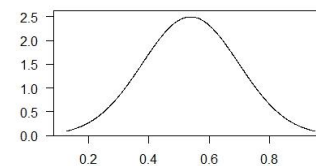Distribution of bottigliaspumante : 46 % of 0
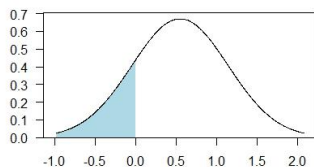
Distribution of salameTRUE : 39 % of 0
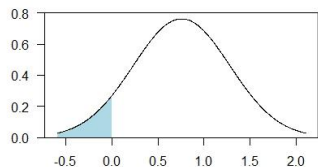
Distribution of torroneTRUE : 20 % of 0

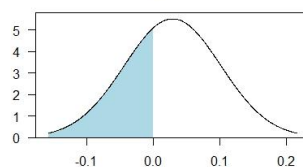Distribution of cioccolatiniTRUE : 0 % of 0

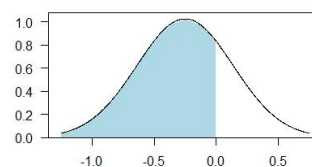Distribution of mieleTRUE : 18 % of 0
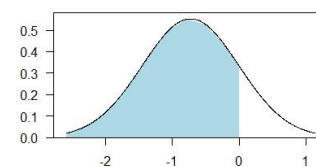
Distribution of granaTRUE : 7 % of 0

Distribution of prezzo13 : 35 % of 0

Distribution of prezzo16 : 74 % of 0

Distribution of prezzo20 : 84 % of 0

Mixed MNL model

A mixed MNL model with correlated random effects. The correlation matrix of the random effects:

	panettone	spumante	salame	torrone	cioccolat.	miele	grana	€ 13	€ 16	€ 20
panettone	1.000	−0.488	0.111	0.004	0.179	−0.107	−0.031	−0.230	0.306	0.217
spumante	−0.488	1.000	0.052	−0.207	**−0.771**	−0.147	0.081	0.243	−0.341	−0.234
salame	0.111	0.052	1.000	0.346	0.074	0.153	0.329	0.095	−0.248	0.064
torrone	0.004	−0.207	0.346	1.000	**0.745**	−0.472	0.201	−0.002	−0.237	0.004
cioccolat.	0.179	**−0.771**	0.074	**0.745**	1.000	−0.104	0.144	−0.199	0.046	0.099
miele	−0.107	−0.147	0.153	−0.472	−0.104	1.000	**0.556**	−0.248	−0.062	−0.156
grana	−0.031	0.081	0.329	0.201	0.144	**0.556**	1.000	−0.291	−0.443	−0.365
€ 13	−0.230	0.243	0.095	−0.002	−0.199	−0.248	−0.291	1.000	**0.600**	**0.762**
€ 16	0.306	−0.341	−0.248	−0.237	0.046	−0.062	−0.443	**0.600**	1.000	**0.907**
€ 20	0.217	−0.234	0.064	0.004	0.099	−0.156	−0.365	**0.762**	**0.907**	1.000

(baseline for binary variables is FALSE)

Likelihood ratio test: Model 1 (uncorrelated mixed MNL) vs Model 2 (fully correlated mixed MNL)

```
  #Df   LogLik   Df  Chisq   Pr(>Chisq)
1  20   -3660.3
2  65   -3563.0  45  194.74  < 2.2e-16 ***
```

Individual level variables

Introduction of respondent information as individual level variables in the MNL model.
Variables included in the model:

- gender
- age divided into 4 classes
- occupation
- recipient of the christmas box
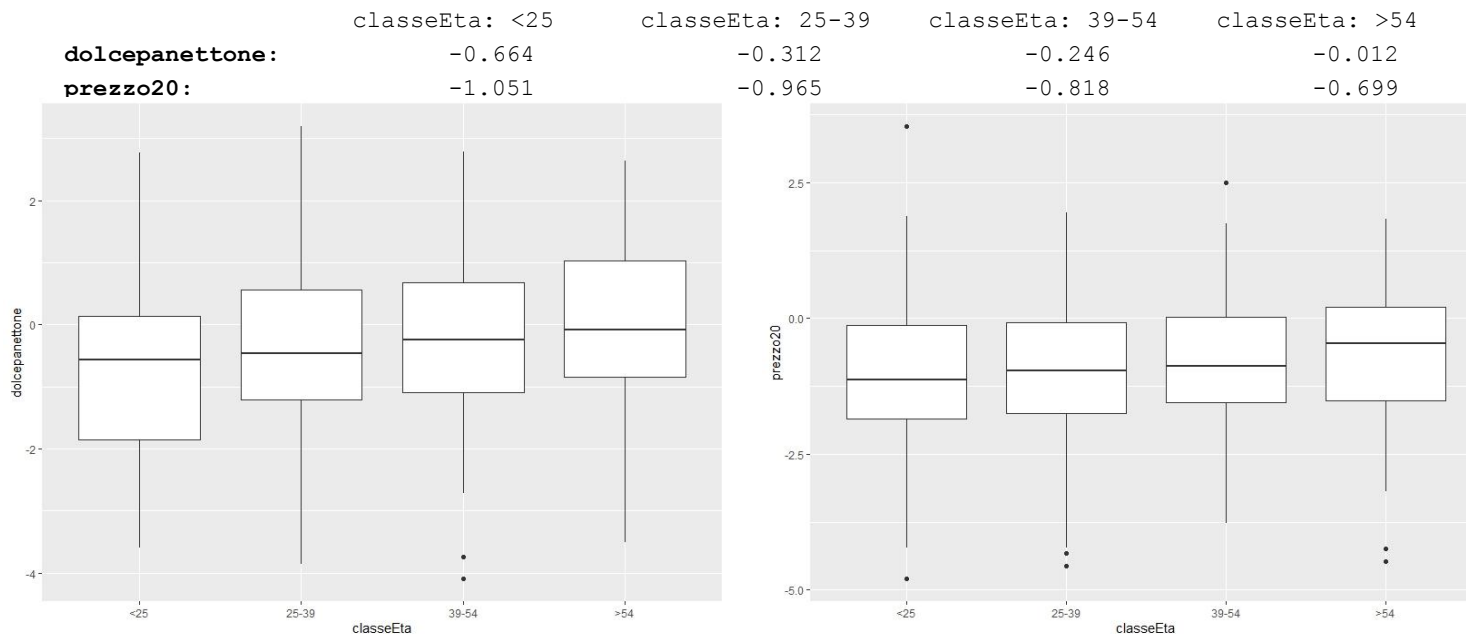
```
Likelihood ratio test:
Model 1: scelta ~ dolce + bottiglia + salame + torrone + cioccolatini + miele + grana + prezzo | -1
Model 2: scelta ~ dolce + bottiglia + salame + torrone + cioccolatini + miele + grana + prezzo
                | dolce * classeEta + bottiglia * classeEta + salame * classeEta
                + torrone * classeEta + cioccolatini * classeEta + miele * classeEta
                + grana * classeEta + prezzo * classeEta
        #Df    LogLik      Df    Chisq Pr(>Chisq)
1       10     -3850.5
2       125    -3720.1     115   260.83      2.461e-13 ***
```

Individual level variables

Explaining respondent heterogeneity with their individual level characteristics, associating them to the random coefficients of the mixed MNL model.

|	classeEta: <25	classeEta: 25-39	classeEta: 39-54	classeEta: >54
dolcepanettone:	-0.664	-0.312	-0.246	-0.012
prezzo20:	-1.051	-0.965	-0.818	-0.699

Preference share simulation under the fixed effects MNL model

	share	2.5%	97.5%	dolce	bottiglia	salame	torrone	cioccolat.	miele	grana	prezzo
364	0.163	0.145	0.192	panettone	spumante	FALSE	TRUE	FALSE	TRUE	TRUE	16
7	0.077	0.066	0.091	pandoro	spumante	TRUE	FALSE	FALSE	FALSE	FALSE	10
209	0.175	0.149	0.207	pandoro	passito	FALSE	FALSE	TRUE	FALSE	TRUE	13
226	0.141	0.125	0.162	panettone	passito	FALSE	FALSE	FALSE	TRUE	TRUE	13
302	0.109	0.094	0.125	panettone	passito	TRUE	TRUE	FALSE	TRUE	FALSE	16
343	0.196	0.173	0.213	pandoro	spumante	TRUE	FALSE	TRUE	FALSE	TRUE	16
445	0.137	0.116	0.152	pandoro	passito	TRUE	TRUE	TRUE	TRUE	FALSE	20

	share	2.5%	97.5%	dolce	bottiglia	salame	torrone	cioccolat.	miele	grana	prezzo
371	0.220	0.201	0.241	pandoro	spumante	FALSE	FALSE	TRUE	TRUE	TRUE	16
7	0.072	0.060	0.084	pandoro	spumante	TRUE	FALSE	FALSE	FALSE	FALSE	10
209	0.163	0.143	0.184	pandoro	passito	FALSE	FALSE	TRUE	FALSE	TRUE	13
226	0.131	0.116	0.151	panettone	passito	FALSE	FALSE	FALSE	TRUE	TRUE	13
302	0.102	0.087	0.117	panettone	passito	TRUE	TRUE	FALSE	TRUE	FALSE	16
343	0.183	0.163	0.203	pandoro	spumante	TRUE	FALSE	TRUE	FALSE	TRUE	16
445	0.128	0.112	0.143	pandoro	passito	TRUE	TRUE	TRUE	TRUE	FALSE	20

Sensitivity chart:
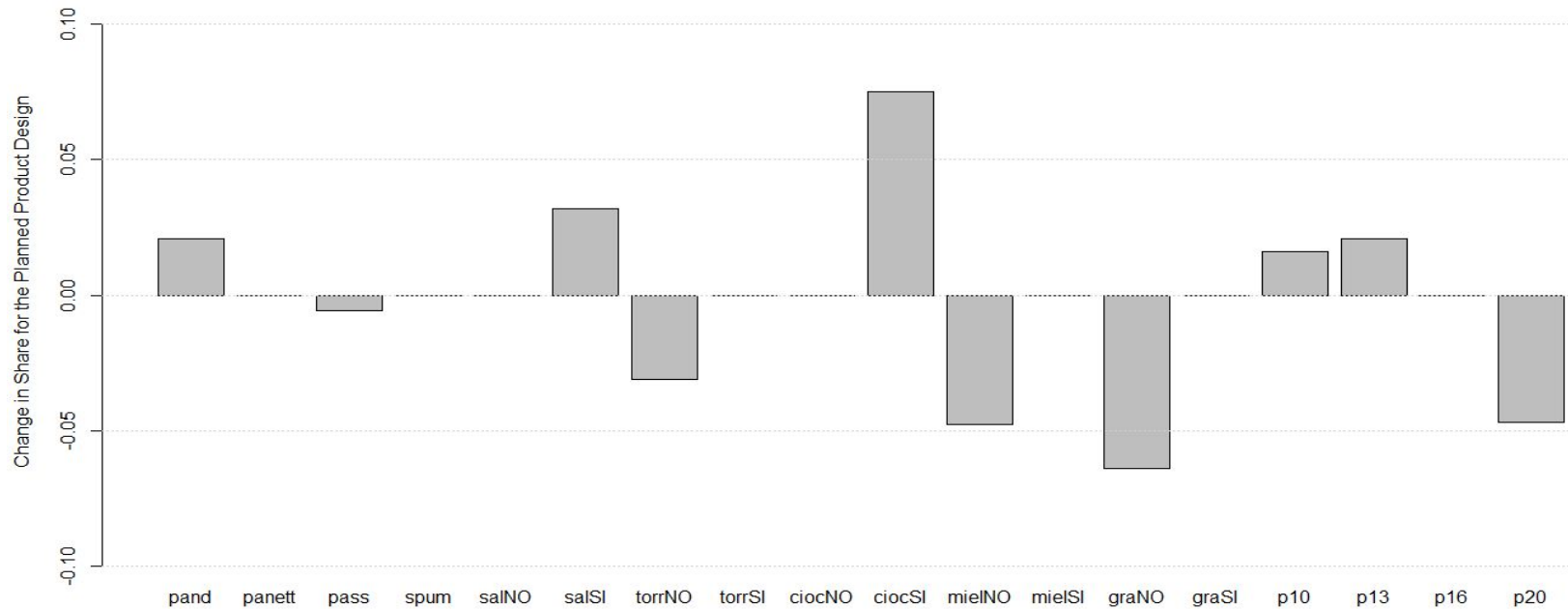
Preference share simulation under the Mixed MNL model

	colMeans(shares)	dolce	bottiglia	salame	torrone	cioccolat.	miele	grana	prezzo
364	0.171	panettone	spumante	FALSE	TRUE	FALSE	TRUE	TRUE	16
7	0.092	pandoro	spumante	TRUE	FALSE	FALSE	FALSE	FALSE	10
209	0.194	pandoro	passito	FALSE	FALSE	TRUE	FALSE	TRUE	13
226	0.144	panettone	passito	FALSE	FALSE	FALSE	TRUE	TRUE	13
302	0.123	panettone	passito	TRUE	TRUE	FALSE	TRUE	FALSE	16
343	0.135	pandoro	spumante	TRUE	FALSE	TRUE	FALSE	TRUE	16
445	0.140	pandoro	passito	TRUE	TRUE	TRUE	TRUE	FALSE	20

	colMeans(shares)	dolce	bottiglia	salame	torrone	cioccolat.	miele	grana	prezzo
371	0.197	pandoro	spumante	FALSE	FALSE	TRUE	TRUE	TRUE	16
7	0.086	pandoro	spumante	TRUE	FALSE	FALSE	FALSE	FALSE	10
209	0.169	pandoro	passito	FALSE	FALSE	TRUE	FALSE	TRUE	13
226	0.154	panettone	passito	FALSE	FALSE	FALSE	TRUE	TRUE	13
302	0.144	panettone	passito	TRUE	TRUE	FALSE	TRUE	FALSE	16
343	0.120	pandoro	spumante	TRUE	FALSE	TRUE	FALSE	TRUE	16
445	0.130	pandoro	passito	TRUE	TRUE	TRUE	TRUE	FALSE	20

Future development

➔ Survey design evaluation

➔ IIA assumption - robust modeling

➔ Preference share vs. Market share

Thank you!