The Importance and Economic Value of Meat Characteristics in Pork Consumption

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OUTLINE

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II. Experimental Data

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I. Questions

(i) What are the effects of meat characteristics on the consumer sensory attribute rankings?

(ii) What are the possible tradeoffs between different meat characteristics that will leave a sensory attribute ranking unaffected?

(iii) What are the effects of meat characteristics, in addition to price, on the likelihood that the meat will be purchased?

(iv) What are the possible tradeoffs between different meat characteristics and price that will not change the likelihood of purchasing the product?

(v) What is the economic value of changing a characteristic?

NPPC's Quality Lean Growth Modeling Project

- Over 1800 hogs, 6 genetic types, 4 diets, 3 slaughter weights
- Taste panels in Boston, Denver, Chicago
- 6-8 session per day with up to 10 consumers per session
- Each consumer evaluated 12 samples: 4 loin chops, 4 inside ham chop, 4 chicken breast
- Each sample had combination of three meat cuts
- Each cut = 1.25 cm cube with internal temperature of 70 degrees celcius
- Each consumer received two samples per cut
- Meats evaluated based on juiciness, tenderness, and flavor with 5 point Likert scale

II. Experimental Data

Questions asked consumers (Dependent Variables)

3. Please rate the **juiciness** of the piece of meat you just tried on a scale from 1 to 5, where "1" means "Strongly Disliked" the juiciness and "5" means "Strongly Liked" the juiciness.

Strongly Disliked **Strongly Liked**

0 1 2 3 4

4. Suppose the piece of meat you just tasted were available in your local supermarket. The price per pound is *x*. Thinking about the ***taste*** and ***price*** of the meat you just tasted, how likely would you be to but it .

Very Unlikely **Very Likely**

0 1 2 3 4

Explanatory Variables:

Shear Drip Percent Fat Ph Level Cook time

Cook Temperature

Prices ($/lb.):

Loin cuts $1.99, $2.47, $3.49, $4.24, and $4.99

Ham cuts $1.61, $2.22, $2.80, $3.43, and $4.04

Demographic Information

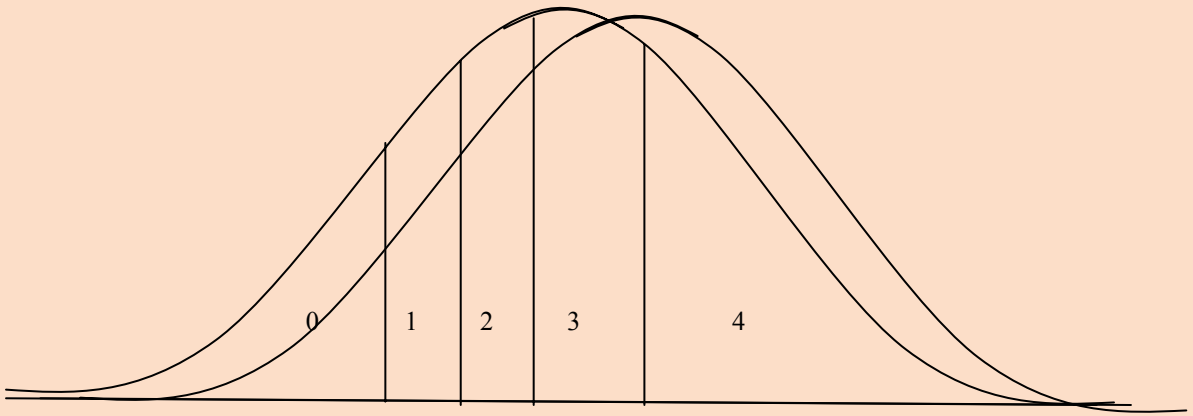
age health problem

education gender

income ethnicity

household number married children number

Probability of Liking/Buying



Ordered Probit

(2.1) $\text{Prob}(y = 0) = \Phi(-X\beta)$

(2.2) $\text{Prob}(y = 1) = [\Phi(\mu_1 - X\beta) - \Phi(-X\beta)]$

(2.3) $\text{Prob}(y = 2) = [\Phi(\mu_2 - X\beta) - \Phi(\mu_1 - X\beta)]$

(2.4) $\text{Prob}(y = 3) = [\Phi(\mu_3 - X\beta) - \Phi(\mu_2 - X\beta)]$

(2.5) $\text{Prob}(y = 4) = 1 - \Phi(\mu_3 - X\beta),$

Analytical Technique for Questions i *and* iii.

(i) What are the effects of the meat characteristics on the sensory attribute rankings?

(iii) What are the effects of the meat characteristics, in addition to price, on the likelihood that the meat will be purchased?

$$(3.1) \qquad ME(y=0) = \frac{\partial \Pr ob(y=0)}{\partial x_i} = -\phi(X\beta)\beta_i$$

$$(3.2) \qquad ME(y=1) = \frac{\partial \Pr ob(y=1)}{\partial x_i} = [\phi(-X\beta) - \phi(\mu_1 - X\beta)]\beta_i$$

Questions ii *and* iv

(ii) What are the possible tradeoffs between different meat characteristics that will leave the sensory attribute ranking unaffected?

(iv) What are the possible tradeoffs between different meat characteristics and price that will not change the likelihood of purchasing the product?

(4) Prob(y = a category) = $P(x_1, x_2)$.

$\Rightarrow$ d Prob(y = a category) = (marginal effect for x_1) $\times$ dx_1

+ (marginal effect for x_2) $\times$ dx_2.

0 = (marginal effect for x_1) $\times$ dx_1

+ (marginal effect for x_2) $\times$ dx_2.

$\Rightarrow$ $dx_1/dx_2 = -$ [(marginal effect for x_2)/ (marginal effect for x_1)]

$\Rightarrow$ $dx_1/dx_2 = -(\beta_2 / \beta_1)$.

Question v

(v) What is the economic value of changing a characteristic?

Sales revenue

(6) $R = p \times q(c, d, s, p)$

Marginal sales revenue for a characteristic

$MR_i = \partial R / \partial c_i = p \times \partial q / \partial c_i$

Present setting requires a little more work

$E(R) = p \times E(q)$

Assume a purchase is only made when the consumer checks the "very likely" response.

A little boring math leads to the result

$$E(MR_i) = p \times \partial \text{Prob(very likely)} / \partial c_i$$

$$= p \times \text{marginal effect of } c_i$$

Table 2. Sample of Summary Statistics for Loin

Variable	Mean	Std. Dev.
Juiciness	3.38	1.15
Tenderness	3.35	1.08
Flavor	3.32	1.05
Buy	2.96	1.34
Age	46.43	14.29
Income	50989	22821
No. Children	0.83	1.17
Married	0.71	0.45
Shear	6.26	1.93
Drip	0.02	0.02
Percent fat	2.59	1.34
Ph level	5.84	0.39
Cook time	12.23	5.03
Cook temperature	8.02	5.93
Price	3.51	1.05

N = 1102

Table 7. Sample Summary Statistics for Ham

Variable	Mean	Std. Dev.
Juiciness	3.38	1.14
Tenderness	3.25	1.13
Flavor	3.28	1.07
Buy	2.88	1.37
Age	46.58	13.81
Income	51121	22931
No. Children	0.85	1.20
Married	0.71	0.45
Shear	6.31	1.79
Drip	0.02	0.02
Percent fat	5.47	4.71
Ph level	5.76	0.26
Cook time	13.36	4.54
Cook temperature	8.38	3.52
Price	2.84	0.84

N = 1028

Table 12. Summary of Statistically Significant Variables

	Juiciness		Tenderness		Flavor		Buy	
	Loin	Ham	Loin	Ham	Loin	Ham	Loin	Ham
Juiciness	–	–	x	x	x	x	–	–
Tenderness	x	x	–	–	x	x	–	–
Flavor	x	x	x	x	–	–	–	–
Buy	–	–	–	–	–	–	–	–
Age					x			x
Income				x				
No. Children					x			
Married			x				x	

Table 12. Summary of Statistically Significant Variables

	Juiciness		Tenderness		Flavor		Buy	
	Loin	Ham	Loin	Ham	Loin	Ham	Loin	Ham
Shear			x	x			x	x
Drip	x		x		x	x	x	x
Percent Fat		x						
Ph level		x		x				x
Cook Time	x							x
Cook Temp					x			
Price	–	–	–	–	–	–	x	x

– not included in model. x - statistically significant in model

Table 4. Order Probit for Loin - Tenderness

			Marginal Effect			
Variable	**Estimate**	**P-Value**	**Low**	**P-Value**	**High**	**P-Value**
Juiciness	0.692	0.000	-0.007	0.000	0.065	0.000
Flavor	0.515	0.000	-0.005	0.000	0.049	0.000
Age	-0.002	0.438	0.000	0.453	0.000	0.437
Income	0.000	0.596	0.000	0.603	0.000	0.595
No. household	-0.031	0.555	0.000	0.562	-0.003	0.554
No. children	0.062	0.285	-0.001	0.307	0.006	0.288
Married	-0.348	0.000	0.004	0.005	-0.033	0.002
Shear	-0.074	0.000	0.001	0.003	-0.007	0.001
Drip	2.754	0.107	-0.028	0.123	0.260	0.125
Percent fat	0.016	0.564	0.000	0.567	0.002	0.566
Ph level	0.141	0.150	-0.001	0.162	0.013	0.169
Cook time	-0.009	0.223	0.000	0.230	-0.001	0.240
Cook temperature	-0.007	0.551	0.000	0.555	-0.001	0.552

Table 6. Order Probit for Loin - Buy

			Marginal Effects			
Variable	**Estimate**	**P-Value**	**Low**	**P-Value**	**High**	**P-Value**
Age	0.003	.232	-0.001	0.233	0.001	0.232
Income	0.000	.800	0.000	0.800	0.000	0.800
No. children	-0.006	.905	0.002	0.905	-0.001	0.905
Married	-0.155	.099	0.039	0.100	-0.034	0.100
Shear	-0.066	.000	0.017	0.000	-0.014	0.000
Drip	-4.431	.006	1.105	0.006	-0.967	0.006
Percent fat	-0.001	.965	0.000	0.965	0.000	0.965
Ph level	0.034	.734	-0.008	0.734	0.007	0.734
Cook time	-0.001	.874	0.000	0.874	0.000	0.874
Cook temperature	0.001	.827	0.000	0.827	0.000	0.827
Price	-0.354	.000	0.088	0.000	-0.077	0.000

Loin Buy Significant Marginal Rate of Substitution

Marginal rate of substitution	Value
Shear/Price	– 5.4
Drip/Price	– .08

Loin Buy Significant Marginal Revenue

Shear

$3.52 × -.014=-$.05

Drip

$3.52 × -.967=-$3.40

Table 9. Order Probit for Ham - Tenderness

			Marginal Effects			
Variable	**Estimate**	**P-Value**	**Low**	**P-Value**	**High**	**P-Value**
Juiciness	0.714	0.000	-0.015	0.000	0.068	0.000
Flavor	0.468	0.000	-0.010	0.000	0.044	0.000
Age	0.002	0.437	0.000	0.437	0.000	0.444
Income	0.000	0.004	0.000	0.015	0.000	0.008
No. children	0.027	0.682	-0.001	0.685	0.003	0.682
Married	-0.129	0.244	0.003	0.236	-0.012	0.266
Shear	-0.068	0.002	0.001	0.004	-0.006	0.008
Drip	0.319	0.866	-0.007	0.867	0.030	0.866
Percent fat	0.002	0.809	0.000	0.809	0.000	0.809
Ph level	0.290	0.053	-0.006	0.069	0.027	0.067
Cook time	-0.001	0.869	0.000	0.869	0.000	0.869
Cook temperature	0.004	0.757	0.000	0.756	0.000	0.759

Table 11. Order Probit for Ham - Buy

			Marginal Effects			
Variable	Estimate	P-Value	Low	P-Value	High	P-Value
Age	0.008	.013	-0.002	0.014	0.002	0.014
Income	0.000	.952	0.000	0.952	0.000	0.952
No. children	0.076	.196	-0.021	0.195	0.018	0.198
Shear	-0.060	.003	0.016	0.002	-0.014	0.003
Drip	-2.901	.075	0.792	0.075	-0.672	0.078
Percent fat	0.009	.380	-0.003	0.379	0.002	0.383
Ph level	0.312	.029	-0.085	0.030	0.072	0.029
Cook time	-0.014	.054	0.004	0.054	-0.003	0.056
Cook temperature	0.017	.183	-0.005	0.183	0.004	0.184
Price	-0.402	.000	0.110	0.000	-0.093	0.000

Ham Buy Significant Marginal Rate of Substitution

Marginal rate of substitution	Value
Shear/Price	– .15
Drip/Price	– 7.22
Ph level/Price	.77
Cook Time/Price	–.04

Ham Buy Significant Marginal Revenue

Shear

$2.84 × -.014=-$.04

Ph Level

$2.84 × .072=$.20

Drip

$2.84 × -.672=-$1.91

Cook Time

$2.84 × -.003=-$.01

V. Conclusions

- Sensory attributes are in general significant
- Shear and drip most important characteristics
- No real pattern for demographics
- Most MRS very small with exception of Drip/Price
- Drip has the largest impact on marginal revenue