UNT
UNIVERSITY OF NORTH TEXAS

An Overview of Correspondence Analysis (CA)

UNT
UNIVERSITY OF NORTH TEXAS

Key Characteristics of CA

1. Exploratory Data Analysis Technique
2. Examines Association Between Rows/Columns of Contingency Tables
3. Extension of the Chi-Square Test of Independence
4. Produces Graphical Display of Most Significant Associations in a Table

UNT
UNIVERSITY OF NORTH TEXAS

Contingency/Crosstabulation Table

		PELL Eligibility		
		PELL-Eligible	Non-PELL	**Total**
College	Enginr	1,103	2,478	3,581
	Lib Arts	3,290	5,189	8,479
	Total	4,393	7,667	12,060

UNT
UNIVERSITY OF NORTH TEXAS

Chi-Square Test of Independence

1. For Use with Categorical Data
2. Compares Observed & Expected Frequencies
3. Can Be Used to Examine Proportions Among Various Classes/Groups

UNT
UNIVERSITY OF NORTH TEXAS

Chi-Square Statistic

χ^2 = **Sum of…**

$$\frac{\textbf{(Observed Frequency – Expected Frequency)}^2}{\textbf{Expected Frequency}}$$

UNT
UNIVERSITY OF NORTH TEXAS

Observed/Expected Frequencies

		PELL Eligibility		
		PELL-Eligible	Non-PELL	**Total**
College	Enginr	1,103/1,304	2,478/2,277	3,581
	Lib Arts	3,290/3,089	5,189/5,390	8,479
	Total	4,393	7,667	12,060

UNT
UNIVERSITY OF NORTH TEXAS

Table Proportions

		PELL Eligibility		
		PELL-Eligible	Non-PELL	**Total**
College	Enginr	31%	69%	3,581
	Lib Arts	39%	61%	8,479
	Total	4,393 (36%)	7,667 (64%)	12,060

UNT
UNIVERSITY OF NORTH TEXAS

Extended Contingency Table (modified data)

		PELL Eligibility			
		PELL-Eligible	Non-PELL FAFSA	Non-PELL No FAFSA	**Total**
College	Enginr	1,103	1,611	867	3,581
	Lib Arts	3,290	4,151	1,038	8,479
	Music	241	900	422	1,563
	Science	1,473	1,617	727	3,817
	Total	6,107	8,040	3,293	17,440

UNT
UNIVERSITY OF NORTH TEXAS

Extended Contingency Table (modified data)

		PELL Eligibility			
		PELL-Eligible	Non-PELL FAFSA	Non-PELL No FAFSA	**Total**
College	Enginr	31%	45%	24%	3,581
	Lib Arts	39%	49%	12%	8,479
	Music	15%	58%	27%	1,563
	Science	39%	42%	19%	3,817
	Total	6,107(35%)	8,040(47%)	3,293(18%)	17,440

UNT
UNIVERSITY OF NORTH TEXAS

CA Example: Graduate Survey

		Net Promoter Group			
		Detractor	Passive	Promoter	**Total**
College	Business	33	119	182	334
	Enginr	55	81	67	203
	Lib Arts	55	179	255	489
	Music	8	25	45	78
	Science	50	79	76	205
	Total	201	483	625	1,309

UNT
UNIVERSITY OF NORTH TEXAS

CA Building Blocks: Row & Column Profiles

1. Row Profile Example (Business)

- *Cell One (Business/Detractor)* - 33/334 = 0.0988
- *Cell Two (Business/Passive)* - 119/334 = 0.3563
- *Cell Three (Business/Promoter)* - 182/334 = 0.5449

2. Column Profile Example (Detractor)

- *Cell One (Detractor/Business)* - 33/201 = 0.1642
- *Cell Two (Detractor/Enginr)* - 55/201 = 0.2736
- *Cell Three (Detractor/Lib Arts)* - 55/201 = 0.2736
- *Cell Four (Detractor/Music)* - 8/201 = 0.0398
- *Cell Five (Detractor/Science)* - 50/201 = 0.2488

UNT
UNIVERSITY OF NORTH TEXAS

CA Building Blocks: Row Profile Table

		Net Promoter Group			
		Detractor	Passive	Promoter	**Total**
College	Business	0.0988	0.3563	0.5449	1
	Enginr	0.2709	0.3990	0.3300	1
	Lib Arts	0.1125	0.3661	0.5215	1
	Music	0.1026	0.3205	0.5769	1
	Science	0.2439	0.3854	0.3707	1
	Average	0.1536	0.3690	0.4775	1

UNT
UNIVERSITY OF NORTH TEXAS

CA Building Blocks: Column Profile Table

		Net Promoter Group			
		Detractor	Passive	Promoter	**Average**
	Business	0.1642	0.2464	0.2912	0.2552
	Enginr	0.2736	0.1677	0.1072	0.1551
College	Lib Arts	0.2736	0.3706	0.4080	0.3736
	Music	0.0398	0.0518	0.0720	0.0596
	Science	0.2488	0.1636	0.1216	0.1566
	Total	1	1	1	1

UNT
UNIVERSITY OF NORTH TEXAS

CA Building Blocks: Row Profile Table

Dist.=(.0988-.1536)^2/.1536

Wgt.=334/1,309

		Net Promoter Group			
		Detractor	Passive	Promoter	**Total**
College	Business	0.0988	0.3563	0.5449	334
	Engineer	0.2709	0.3990	0.3300	203
	Lib Arts	0.1125	0.3661	0.5215	489
	Music	0.1026	0.3205	0.5769	78
	Science	0.2439	0.3854	0.3707	205
	Average	0.1536	0.3690	0.4775	1,309

UNT
UNIVERSITY OF NORTH TEXAS

CA Building Blocks: Weighted Chi-Square Distance

Total Inertia

Net Promoter Group

χ^2=Total Inertia x N

College	Detractor	Passive	Promoter	Total
Business	0.0050	0.0001	0.0024	0.0075
Enginr	0.0139	0.0004	0.0071	0.0214
Lib Arts	0.0041	0.0000	0.0015	0.0056
Music	0.0010	0.0004	0.0012	0.0026
Science	0.0083	0.0001	0.0037	0.0121
Total	0.0323	0.0010	0.0159	**0.0492**

UNT
UNIVERSITY OF NORTH TEXAS

CA Building Blocks: Singular Value Decomposition (SVD)

1. Breakdown of Table of Inertia Contributions Into Three Component Matrices

2. Each Singular Value Associated With:
   - a dimension/axis (perpendicular to all other dimensions)
   - an eigenvalue (*singular value*^{2}*=eigenvalue*)

3. Each eigenvalue explains/accounts for a proportion of total inertia

4. Results of SVD Used to Map Row/Column Values Onto Dimensions/Graph Space

UNT
UNIVERSITY OF NORTH TEXAS

SAS Code

Pre-Aggregated Count Data

```
proc corresp data=corresp_ex dimens=2 out=coord;
var Detractor Passive Promoter;
id College;
run;
```

Raw Data

```
proc corresp data=corresp_ex dimens=2 out=coord;
tables College,Q7_NPS_Group;
run;
```

UNT
UNIVERSITY OF NORTH TEXAS

R Code

Package ca (Pre-Aggregated Counts)

```
# Correspondence Analysis
library(ca)
mytable <- with(mydata, table(A,B)) # create a 2 way table
prop.table(mytable, 1) # row percentages
prop.table(mytable, 2) # column percentages
fit <- ca(mytable)
print(fit) # basic results
summary(fit) # extended results
plot(fit) # symmetric map
plot(fit, mass = TRUE, contrib = "absolute", map =
  "rowgreen", arrows = c(FALSE, TRUE)) # asymmetric map
```

UNT
UNIVERSITY OF NORTH TEXAS

CA Results/Output

Inertia and Chi-Square Decomposition

Singular Value	Principal Inertia	Chi-Square	Percent	Cumulative Percent
0.22119	0.04893	64.0451	99.23	99.23
0.01944	0.00038	0.4948	0.77	100.00
	0.04930	64.5399	100.00	

Degrees of Freedom = 8

UNT
UNIVERSITY OF NORTH TEXAS

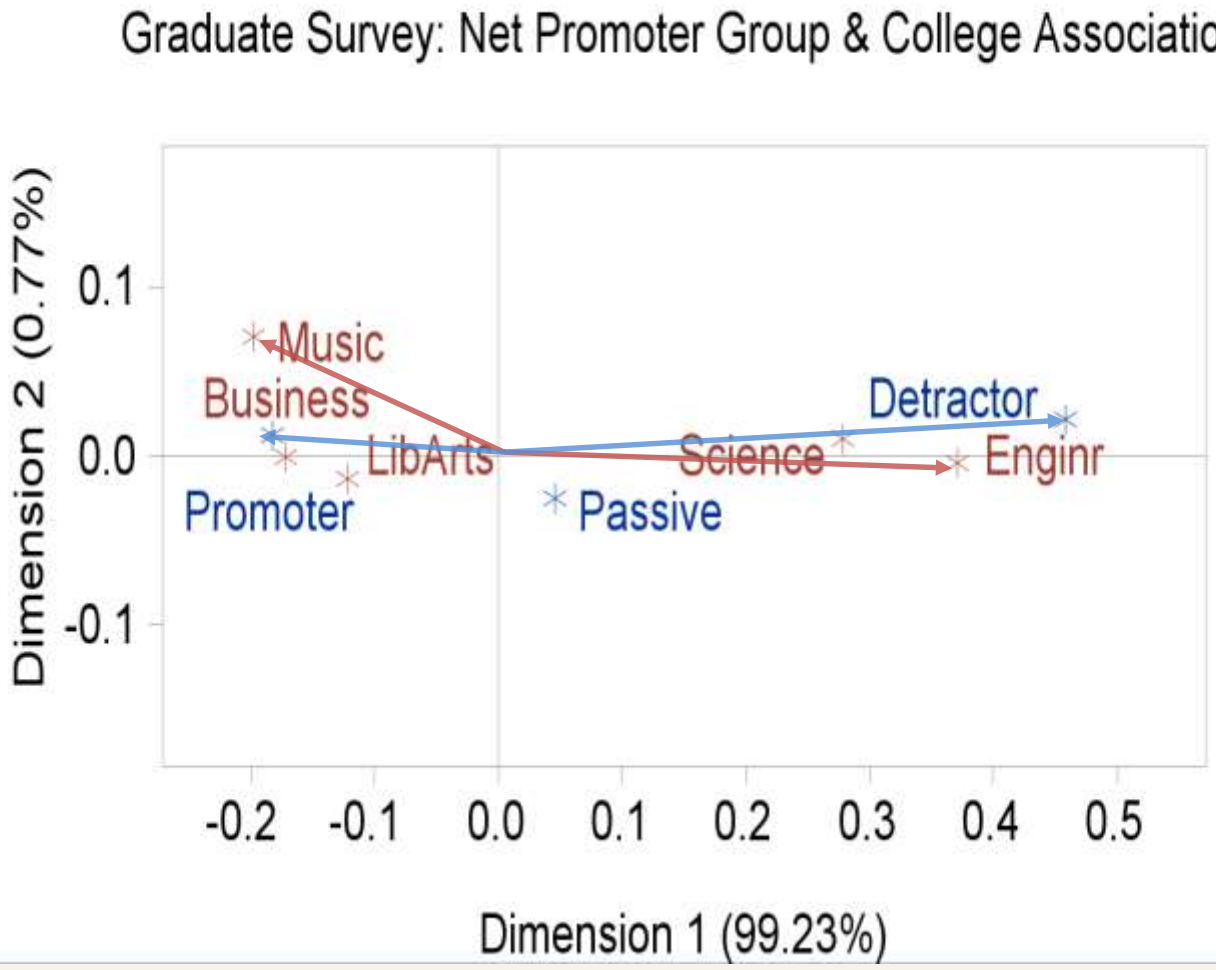
CA Results/Output

Row Coordinates		
	Dim1	Dim2
Enginr	0.3710	-0.0041
LibArts	-0.1220	-0.0132
Music	-0.1977	0.0703
Science	0.2787	0.0099
Business	-0.1717	-0.0006

Column Coordinates		
	Dim1	Dim2
Detractor	0.4584	0.0215
Passive	0.0454	-0.0251
Promoter	-0.1825	0.0125

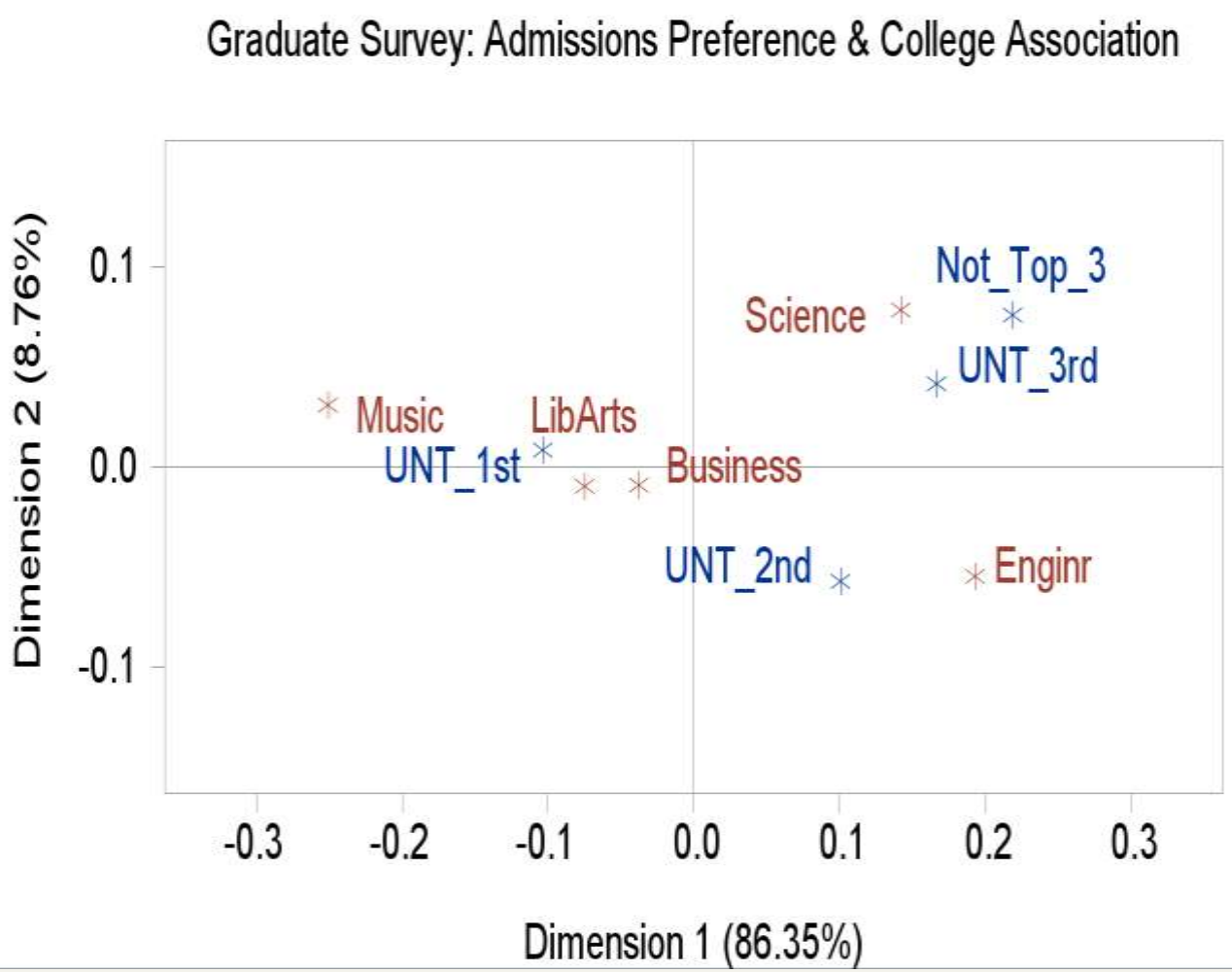
UNT
UNIVERSITY OF NORTH TEXAS

CA Results/Output



UNT
UNIVERSITY OF NORTH TEXAS

CA Results/Output



UNT
UNIVERSITY OF NORTH TEXAS

Thank You

Contact Information: rion.mcdonald@unt.edu