Your Statistical Toolbelt
in SPSS & JMP

Stephanie L. Dickinson

Senior Biostatistician & Consulting Manager
Biostatistics Consulting Center

Indiana University, School of Public Health

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Introductions

- **Social Science Research Commons** --- ssrc.indiana.edu

- **Research Analytics**, UITS RT --- https://pti.iu.edu/centers/rt/visualization-analytics.html#ra

- **Biostatistics Consulting Center**, School of Public Health --- biostats.indiana.edu

- **Indiana Statistical Consulting Center**, COAS --- iscc.indiana.edu

- **Center for Survey Research** --- csr.indiana.edu

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Software run-down

- **IBM SPSS** – easy "point & click", good for most "off the shelf" analyses

- **STATA** – syntax w/ "point & click", political science, sociology,…

- **SAS** – syntax-based, industry standard, public health,…

- **JMP** – "point & click", good mix of stats and graphs – good for exploring data

- **R** – free & flexible (but less documented and maintained)

- **MATLAB** – powerful numerical computing, matrix manipulations

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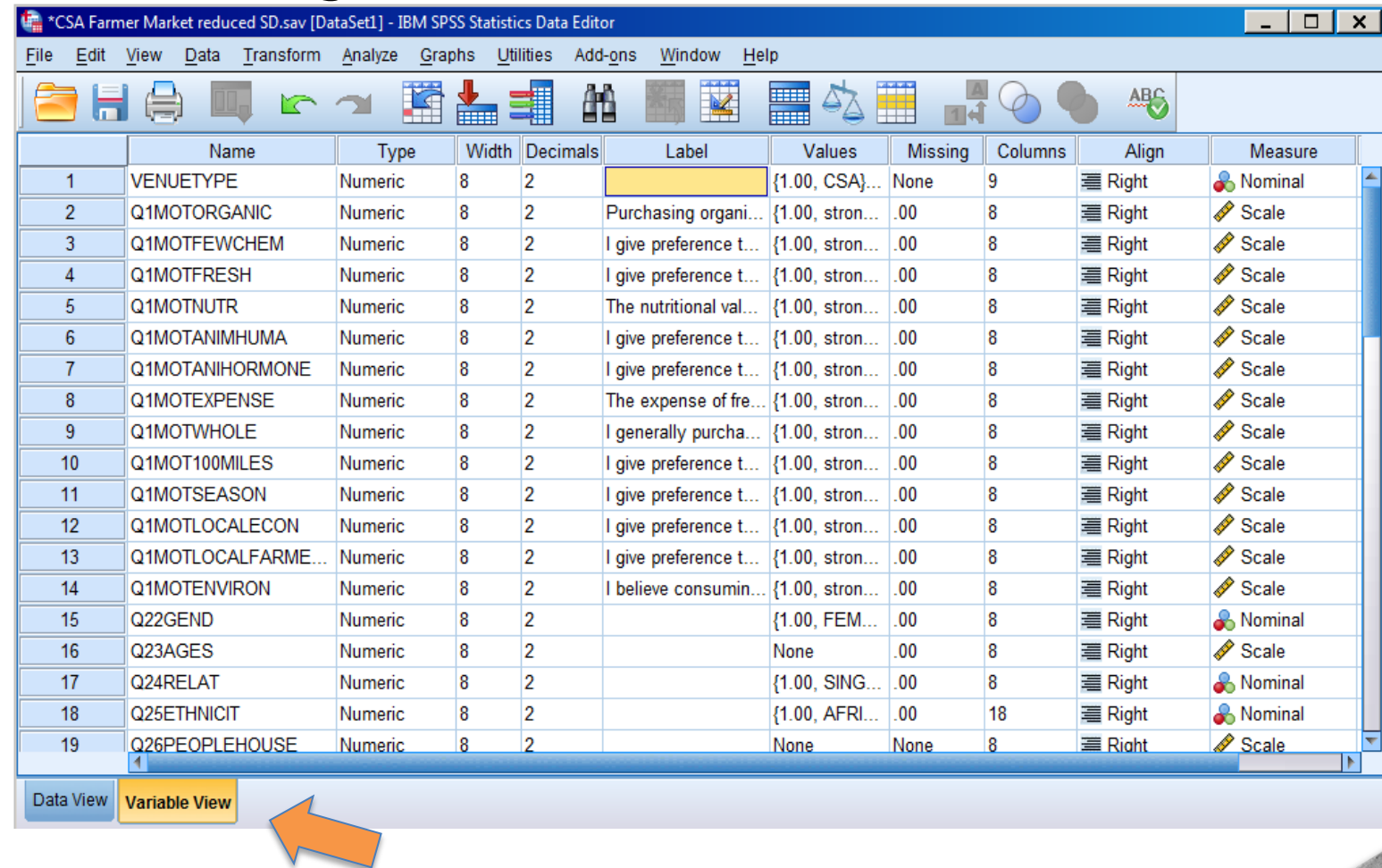# Software Acquisition

- **Purchase** SPSS ($100) or JMP ($50) from Research Analytics --- https://kb.iu.edu/d/bfhv

- **IUanyWare.iu.edu**
  - Free software, streaming online

- **cloudstorage.iu.edu**
  - Box.iu.edu
  - Dropbox
  - File server

Getting started with IBM SPSS

- **Data View**

- Columns are 'Variables'

- Rows are subjects, or 'Observations'
  - o (Usually one row per subject…)

CSA Farmer Market reduced SD.sav [DataSet1] - IBM SPSS Statistics Data Editor

File   Edit   View   Data   Transform   Analyze   Graphs   Utilities   Add-ons   Window   Help

Visible: 27 of 27 Variables

	VENUETYPE	Q1MOTORGANIC	Q1MOTFEWCHEM	Q1MOTFRESH	Q1MOTNU...	Q1MOTANIMHUMA	Q1MOTANIHORMONE	Q1MOTEXPENSE	Q1MOTWHOLE	Q1MOT100MLES	Q1MOTSON
1	2.00	4.00	.	4.00	4.00	5.00	5.00	4.00	4.00	4.00	
2	2.00	4.00	5.00	4.00	5.00	5.00	5.00	4.00	4.00	4.00	
3	1.00	5.00	5.00	4.00	5.00	5.00	5.00	2.00	5.00	4.00	
4	1.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	5.00	
5	2.00	4.00	4.00	5.00	4.00	5.00	4.00	3.00	2.00	2.00	
6	1.00	4.00	5.00	4.00	4.00	5.00	5.00	1.00	4.00	4.00	
7	3.00	3.00	3.00	4.00	2.00	3.00	4.00	2.00	2.00	3.00	
8	1.00	4.00	4.00	4.00	5.00	4.00	4.00	1.00	5.00	5.00	
9	2.00	5.00	5.00	5.00	5.00	5.00	5.00	1.00	4.00	5.00	
10	2.00	4.00	2.00	4.00	4.00	.00	2.00	4.00	3.00	3.00	
11	2.00	4.00	5.00	5.00	4.00	5.00	5.00	4.00	4.00	5.00	
12	1.00	4.00	5.00	4.00	4.00	5.00	4.00	2.00	5.00	3.00	
13	1.00	4.00	3.00	3.00	4.00	3.00	4.00	3.00	4.00	4.00	

Data View   Variable View

IBM SPSS Statistics Processor is ready

Getting started with SPSS

- **Variable View**

- Type (Numeric, String)

- Label

- Values

- Missing

- Measure (Nominal, Scale, Ordinal)

Getting started with JMP

Data Types (Measures)

Data Types		Example
Continuous/ Interval/ Scale		Test scores Height, weight, age Response Time <Percent, proportions >, <Counts> <Likert-type items>
Ordinal		Education: Bachelor, Masters, PhD. Likert-type items
Categorical: Nominal (≥2) Binary (2 levels)		Treatment Group (A,B,C) Sex: Male/female, Yes/no, right/wrong, 0/1.

Example Data: Local Food in Indiana

Comparing consumers (n=302) who purchase food 1 of 3 places in their motivations towards local food.

- Farmer's Markets,
- CSA's, or
- Neither,

Shoppers were surveyed at the Farmer's Market, CSA members, and public.

Thank you to James Farmer (SPH) for sharing his data.

Example Data: Local Food in Indiana

1. Please indicate your level of agreement for the following statements on a scale from **S**trongly **D**isagree (SD), **D**isagree (D), Neutral (N), **A**gree (A), to **S**trongly **A**gree (SA).

	1 SD	2 D	3 N	4 A	5 SA
Purchasing organically grown food is very important to me. ← **Q1MOTORGANIC**					
I give preference to foods that are grown with few chemical applications. ← **Q1FEWCHEM**					
I give preference to foods that were picked just a few days before my purchase. ← **Q1MOTFRESH**					
Over half of the foods/groceries I purchase are fresh produce.					
The nutritional value of a food is an important part of my purchasing decisions.					
I give preference to animal products that have been derived in a humane manner.					
I give preference to animal products that are free from growth hormones.					
The expense of fresh local produce deters me from purchasing it as often as I would like.					
I generally purchase whole foods, rather than processed foods. ← **Q1MOTWHOLE**					
I give preference to purchasing foods that come from within 100 miles of my location.					
I give preference to eating foods that are in season, for example, tomatoes in July-October.					
I give preference to food purchase decisions that support the local economy.					
I give preference to food purchase decisions that support local farmers.					
I believe consuming food produced locally is better for the environment.					

Research Questions

What are the differences in Food Preferences & Motivations for Local Food between people who purchase produce through a CSA, at the Farmer's Market, or neither?

– And what are the differences by Gender?

- **Outcome Measures (DV):** Food Preferences
  – Individual items? (Purchasing Organically Grown Food (Q1MOTORGANIC), etc)
  – Composite scores
    - "Organic, Whole, Humane" = Mean of items 1, 2, 4, 5, 6, 8
    - "Fresh, Local, In Season" = Mean of items 3, 9-13
- **Predictor Variables (IV):**
  - Venue Type (CSA, Farmer's Market, neither)
  - Sex (Male, Female)

Data Cleaning and Preparation

- Missing data?
  - How is it coded?
- Invalid data?
- Outliers?

- **Prepare data for analysis**
  - Calculate new variables
  - Recodes
- **Codebook**
  - Formats/Values
- **Syntax**

The MAJORITY of your time will be cleaning, coding, and planning! Don't short-change it!

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Creating New Variables

- Calculate new variables which are **Summary scores**

☐ Transform > Compute Variable

- "Organic, Whole, Humane"
  ORGWHOLHUM = Mean of items 1,2,4,5,6,8
- "Fresh, Local, In Season"
  FRSHLOCAL = Mean of items 3,9-13

- ORGWHOLHUM & FRSHLOCAL are then added at the end of the dataset

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Creating New Variables

JMP

- Calculate new variables which are **Summary scores**

❑ Cols > New Column

- Column Name: ORGWHOLHUM
- Column Properties > Formula > Mean
- Select items 1,2,4,5,6,8
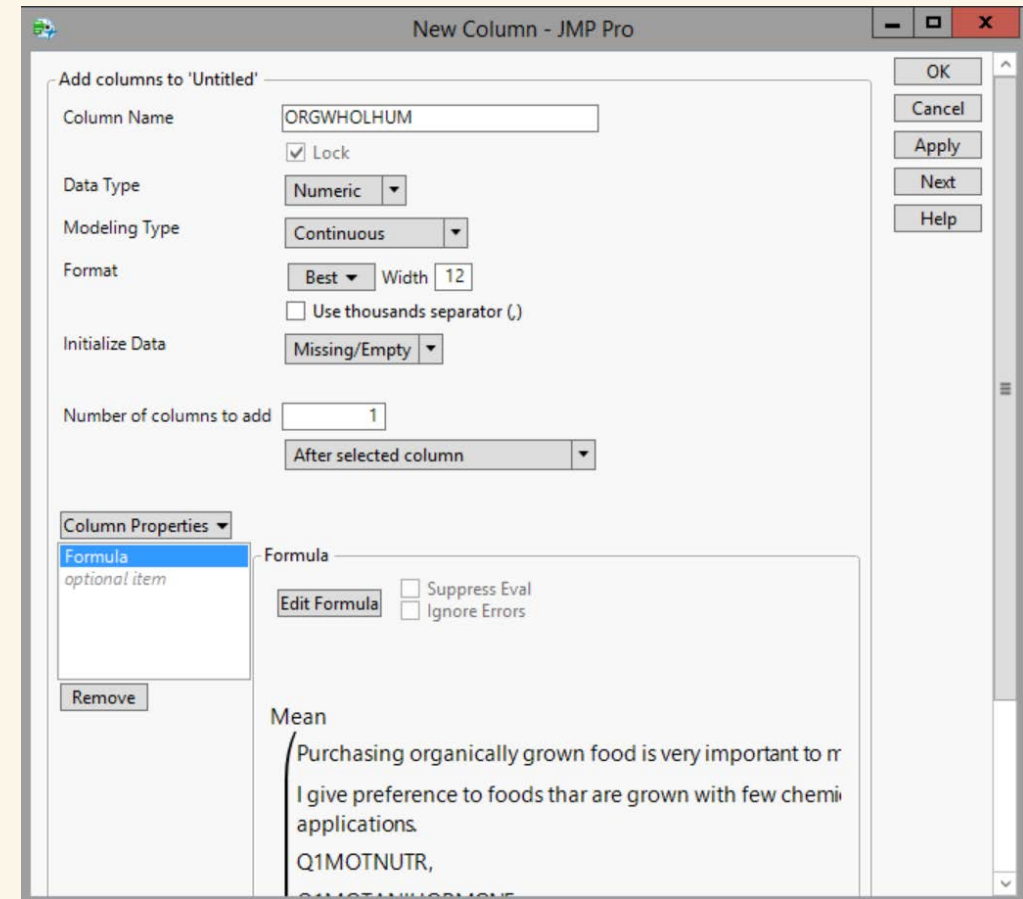
Preference for Whole Foods? (Yes/No)

- **Recodes**
- ☐ Transform > Recode into Different Variables. Select 'Q1MOTWHOLE' as Numeric Variable, and Name Output variable 'WHOLE01'.
  Select 'Old and New Values'.
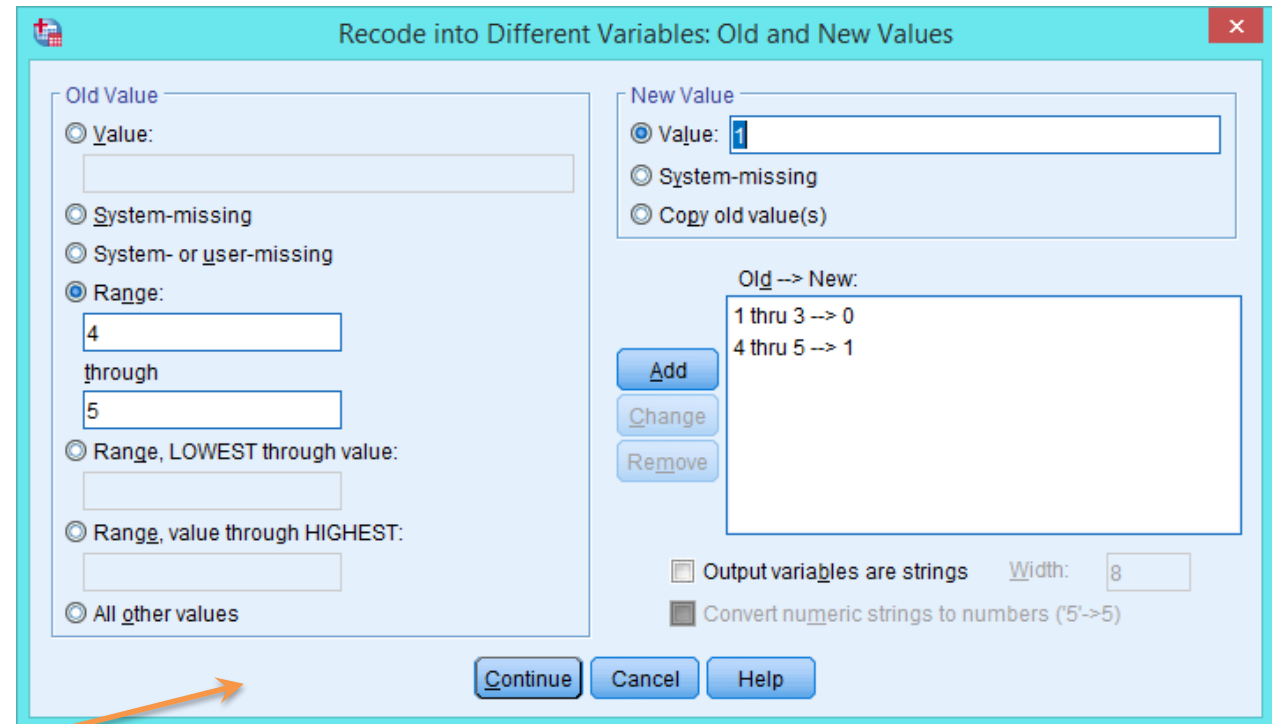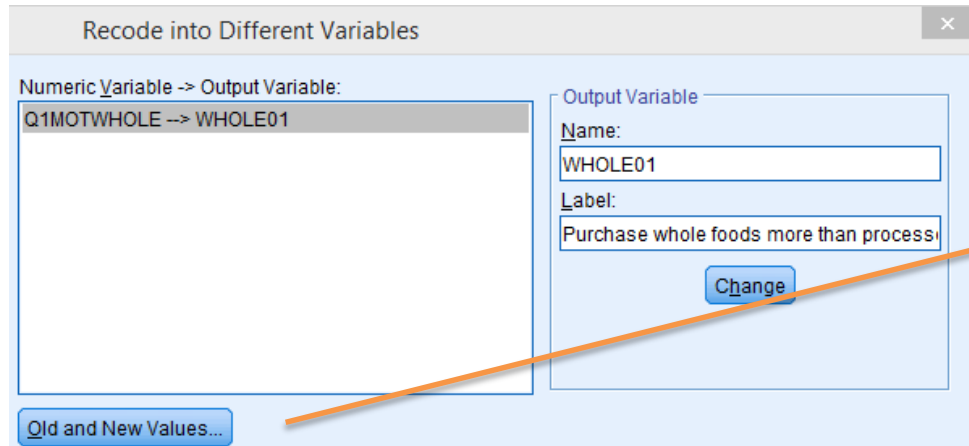
WHOLE01=1 for Yes (Q1MOTWHOLE 4-5),
WHOLE01=0 for No (Q1MOTWHOLE 1-3)

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Data Recodes

- **Recodes**
- ❑ First select column to Recode.
- ❑ Cols > Recode.
- ❑ Done > New Column
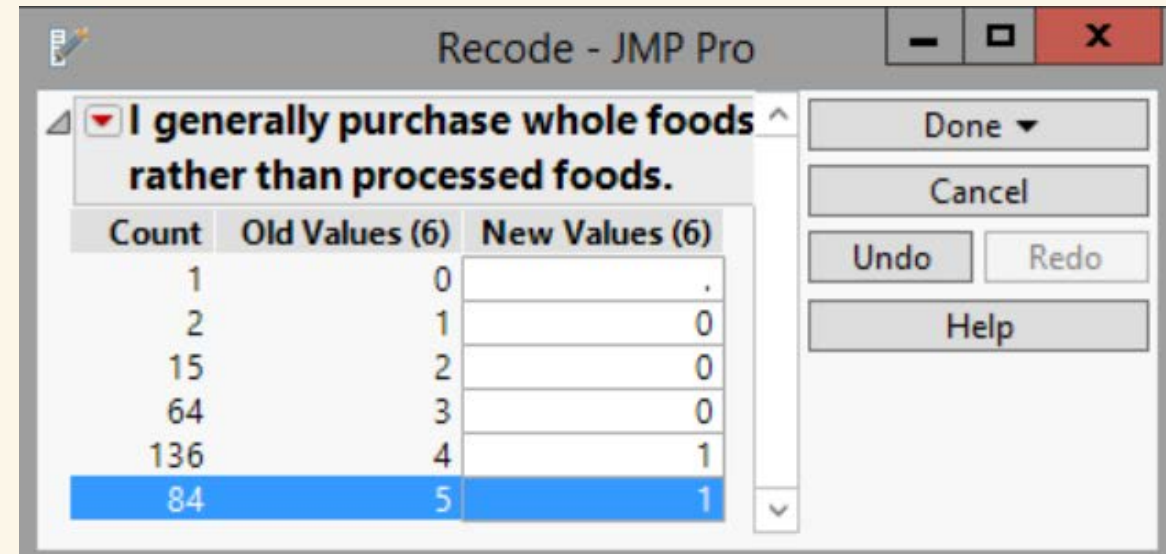
=1 for Yes (Q1MOTWHOLE 4-5),
=0 for No (Q1MOTWHOLE 1-3)

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Data Types (Measures)

- **Q1MOTORGANIC** (etc) → *Scale*
  - 1 to 5 discreet (Strongly Disagree to Strongly Agree)
  - (Note that this is technically *Ordinal* but we will treat as linear *Scale.*)
- **ORGWHOLHUM & FRSHLOCAL** → *Scale*
  - 1 to 5 scale (Mean of discreet items)
- **VENUETYPE** → *Nominal*
  - 1=CSA
  - 2=Farmer's Market
  - 3=Neither
- **SEX** → *Nominal*
  - 1=Female
  - 2=Male

Overview of Basic Analyses

		Descriptive Stats & Plots	Inferential Stats (Significance tests)	
Univariate (1 at a time)	1 Scale Variable	Mean, Med, Min, Max, Std. Dev., Histogram		1
	1 Nominal Variable	Frequency, Percent, Bar chart		2
Bivariate Association (1 on 1)	2 Scale Variables	Scatterplot	Correlation	3
	2 Nominal Variables	Cross-tab	Chi-square Test	4
	1 Scale Variable w/ 1 Nominal Variable (Comparing Groups)	Means by Subgroup, Box-plots	T-test (Compare 2 groups), ANOVA (Compare 3+ groups)	5 6
Multiple variables	Scale variable as response with multiple predictors		Linear Regression, GLM	7
	Nominal variable as response with multiple predictors		Logistic Regression	8

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Descriptive Stats

Summarizing Scale variables

- **Histograms**
- ❑ Graphs > Legacy > Histogram > Select 'Q1MOTORGANIC' as Variable

- **Descriptive Stats** (Mean, SD, Med, Min, Max)
- ❑ Analyze > Descriptive Stats > Descriptives > Select 'Q1MOTORGANIC' as Variable

Mean = 3.92
Std. Dev. = 1.00
N = 299

Purchasing organically grown food is very important to me
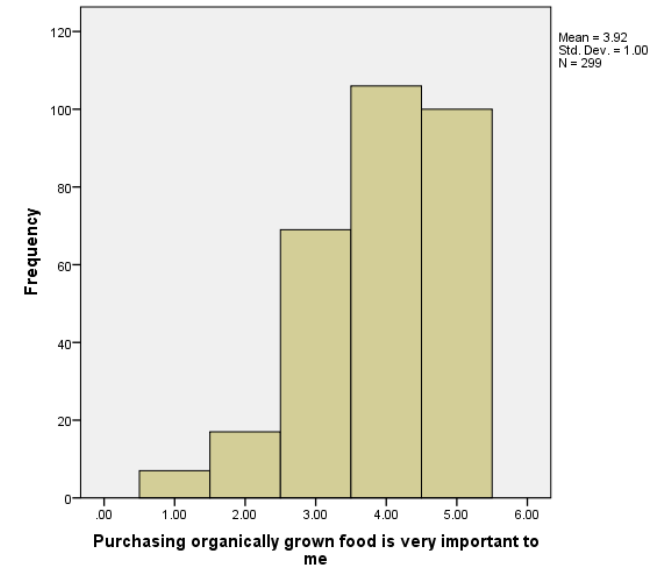
	N	Minimum	Maximum	Mean	Std. Deviation
Purchasing organically grown food is very important to me	299	1.00	5.00	3.9197	1.00012
I give preference to foods that are grown with few chemical applications.	299	1.00	5.00	4.1538	.92490

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Descriptive Stats

Summarizing Scale variables

- **Histogram & Descriptive Stats**
  (Mean, SD, Med, Min, Max)
- ❏ Analyze > Distribution > 'Q1MOTORGANIC'
  as Y, Columns

- *Note: We first have to specify that the variables
  are Continuous in JMP.*
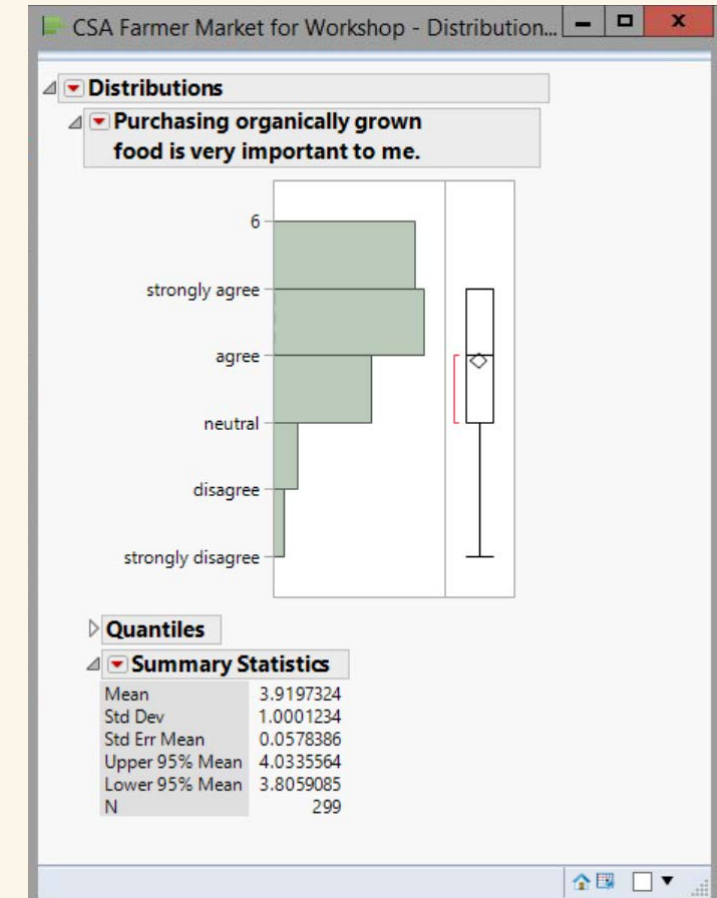
Frequencies

Summarizing Nominal variables

- **Bar Graph**
- ❑ Graphs > Legacy > Bar > Simple > Select 'VENUE' (or 'SEX') as Category Axis

- **Frequency table** (n, %)
- ❑ Analyze > Descriptive Stats > Frequencies > Select 'VENUE' as Variable
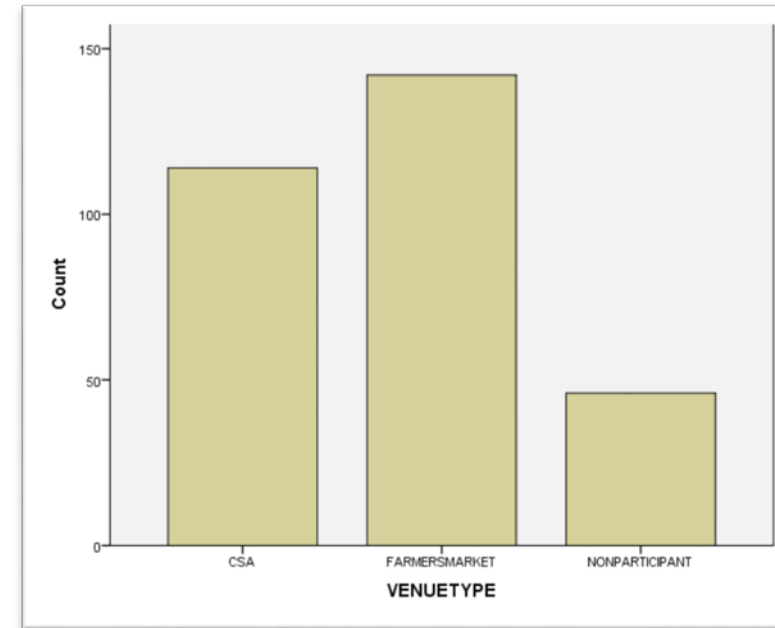
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	CSA	114	37.7	37.7	37.7
	FARMERSMARKET	142	47.0	47.0	84.8
	NONPARTICIPANT	46	15.2	15.2	100.0
	Total	302	100.0	100.0	

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② **JMP**

Summarizing Nominal variables

- **Bar graph & Frequency table**
  n (%)
- ❑ Analyze > Distribution > 'VENUETYPE'
  as Y, Columns

- *Note: This procedure is identical to the procedure for Descriptive Means, SD, but JMP knew this was a Nominal variable instead of Continuous*
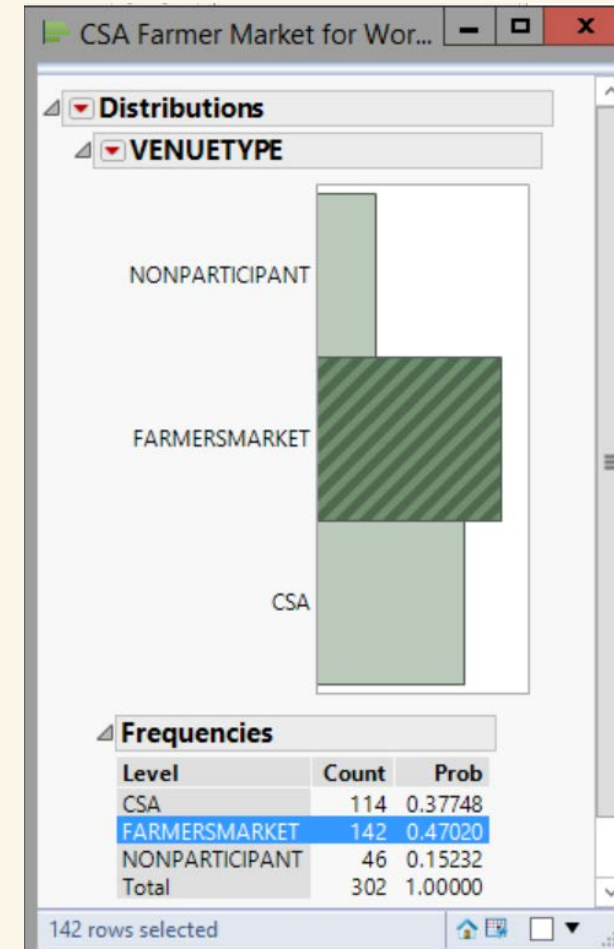
Relationship between 2 Scale variables

- **Scatterplot**
- ❑ Graphs > Legacy > Scatter > Simple > Select 'Q1MOTORGANIC' as Y Axis and 'Q1MOTFEWCHEM' as X Axis.
  (Note: Use syntax to "jitter" the points)

- **Correlation**
- ❑ Analyze > Correlate > Bivariate > Select 'Q1MOTORGANIC' and 'Q1MOTFEWCHEM' as Variables
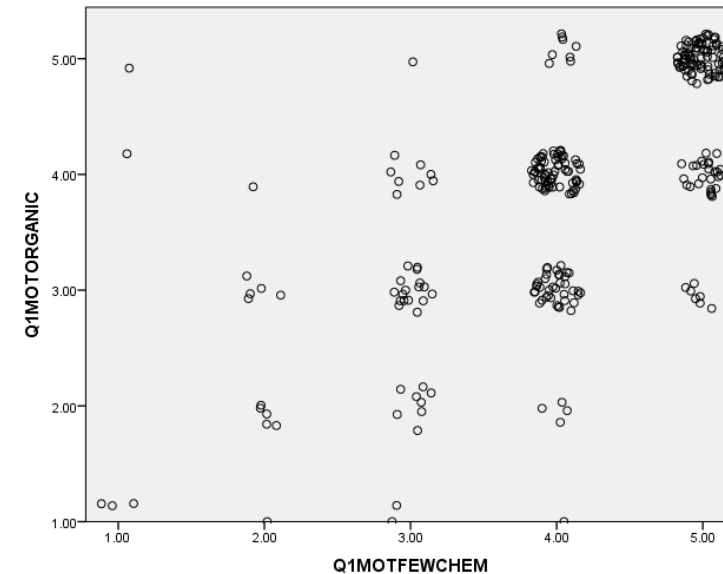
Correlations

		Q1MOTORGANIC	Q1MOTFEWCHEM
Q1MOTORGANIC	Pearson Correlation	1	.685**
	Sig. (2-tailed)		.000
	N	299	296
Q1MOTFEWCHEM	Pearson Correlation	.685**	1
	Sig. (2-tailed)	.000	
	N	296	299

**. Correlation is significant at the 0.01 level (2-tailed).

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JMP ③

Relationship between 2 Scale variables

- **Scatterplot**
- ❑ Analyze > Fit Y by X
- ❑ Or use Graph > Graph builder to "jitter" the points (on *ordinal* data)

- **Correlation**
- ❑ Analyze > Fit Y by X > Red Arrow > Density Ellipse

SPSS
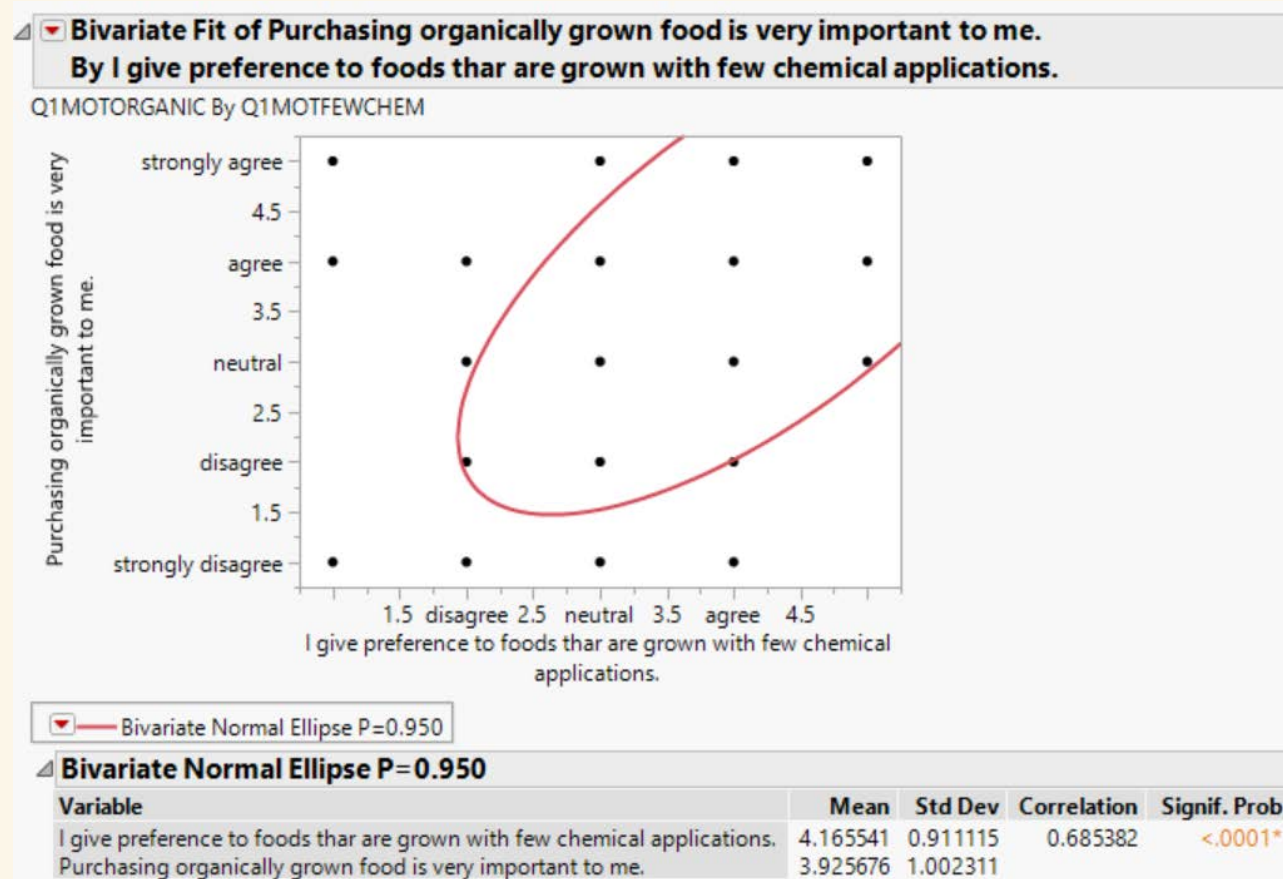
Chi-square

Relationship between 2 Nominal variables

- **Stacked Bar Chart**
- ❏ Graphs > Legacy > Bar > Stacked > Select 'VENUE' as Category Axis and 'Q22Gend' to Define Clusters

- **Crosstab w/ Chi-square test**
- ❏ Analyze > Descriptive > Crosstab > Select 'VENUETYPE' as Rows and 'Q22Gend' Columns
  Statistics button > Select Chi-square.
  Cells button > Select Row %
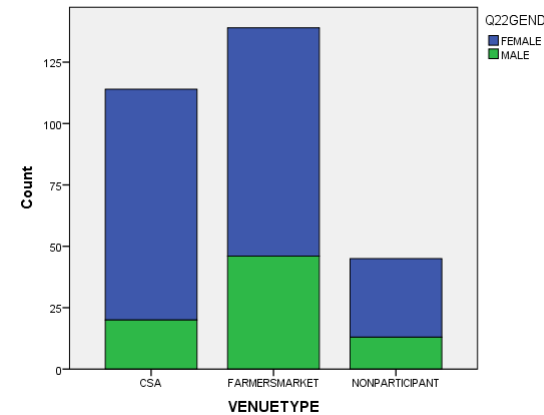
			Q22GEND		
			FEMALE	MALE	Total
VENUETYPE	CSA	Count	94	20	114
		% within VENUETYPE	82.5%	17.5%	100.0%
	FARMERSMARKET	Count	93	46	139
		% within VENUETYPE	66.9%	33.1%	100.0%
	NONPARTICIPANT	Count	32	13	45
		% within VENUETYPE	71.1%	28.9%	100.0%
Total		Count	219	79	298
		% within VENUETYPE	73.5%	26.5%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.927[a]	2	.019

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(4) JMP

Relationship between 2 Nominal variables

- **Crosstab w/ Chi-square test**
- ❑ Analyze > Fit Y by X > Select 'VENUE' as X and 'Q22Gend' as Y
- **Mosaic plot**
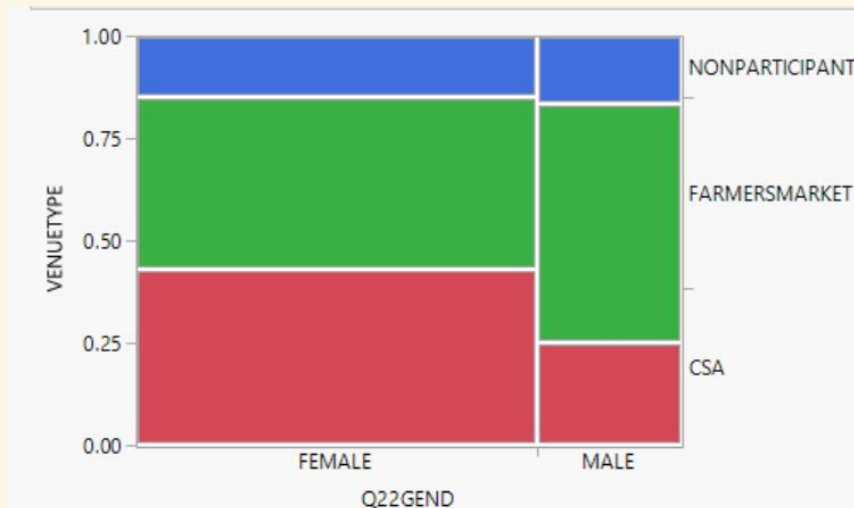
Contingency Table

			VENUETYPE		
Count Total % Col % Row %		CSA	FARME RSMAR KET	NONPA RTICIPA NT	Total
Q22GEND	FEMALE	94 31.54 82.46 42.92	93 31.21 66.91 42.47	32 10.74 71.11 14.61	219 73.49
	MALE	20 6.71 17.54 25.32	46 15.44 33.09 58.23	13 4.36 28.89 16.46	79 26.51
	Total	114 38.26	139 46.64	45 15.10	298

Tests

N	DF	-LogLike	RSquare (U)
298	2	4.1039606	0.0137

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	8.208	0.0165*
Pearson	7.927	0.0190*

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T-Test : Comparing 2 Groups

1 Scale Var. w/ 1 Nominal Var. (2 levels)

- **Box-plot**
- ❑ Graphs > Legacy > Boxplot > Simple > Select 'Q1MOTWHOLE' as Variable and 'Q22Gend' as Category Axis

- **T-test**
- ❑ Analyze > Compare Means > Independent Samples T-test > Select 'Q1MOTWHOLE' as Test Variable and 'Q22Gend' as Grouping Variable. Define Groups – levels 1 & 2
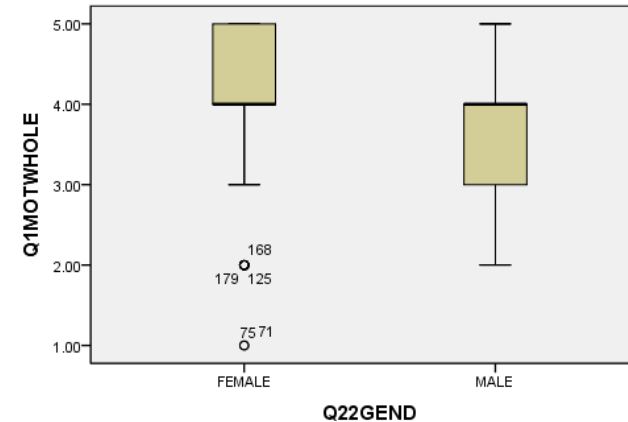
Group Statistics

	Q22GEND	N	Mean	Std. Deviation	Std. Error Mean
Q1MOTWHOLE	FEMALE	218	4.0321	.87140	.05902
	MALE	79	3.6962	.80630	.09072

Independent Samples Test

		Levene's Test for Equality of Variances				
		F	Sig.	t	df	Sig. (2-tailed)
Q1MOTWHOLE	Equal variances assumed	.035	.852	2.993	295	.003
	Equal variances not assumed			3.104	148.444	.002

T-Test : Comparing 2 Groups

1 Scale Var. w/ 1 Nominal Var. (2 levels)

- **Box-plot**
- ❑ Analyze > Fit Y by X > Select 'Q1MOTWHOLE' as Y and 'Q22Gend' as X
- ❑ Red arrow > Display options > Box-plot

- **T-test**
- ❑ Red arrow > t-test
- ❑ Or Means/ANOVA/Pooled t
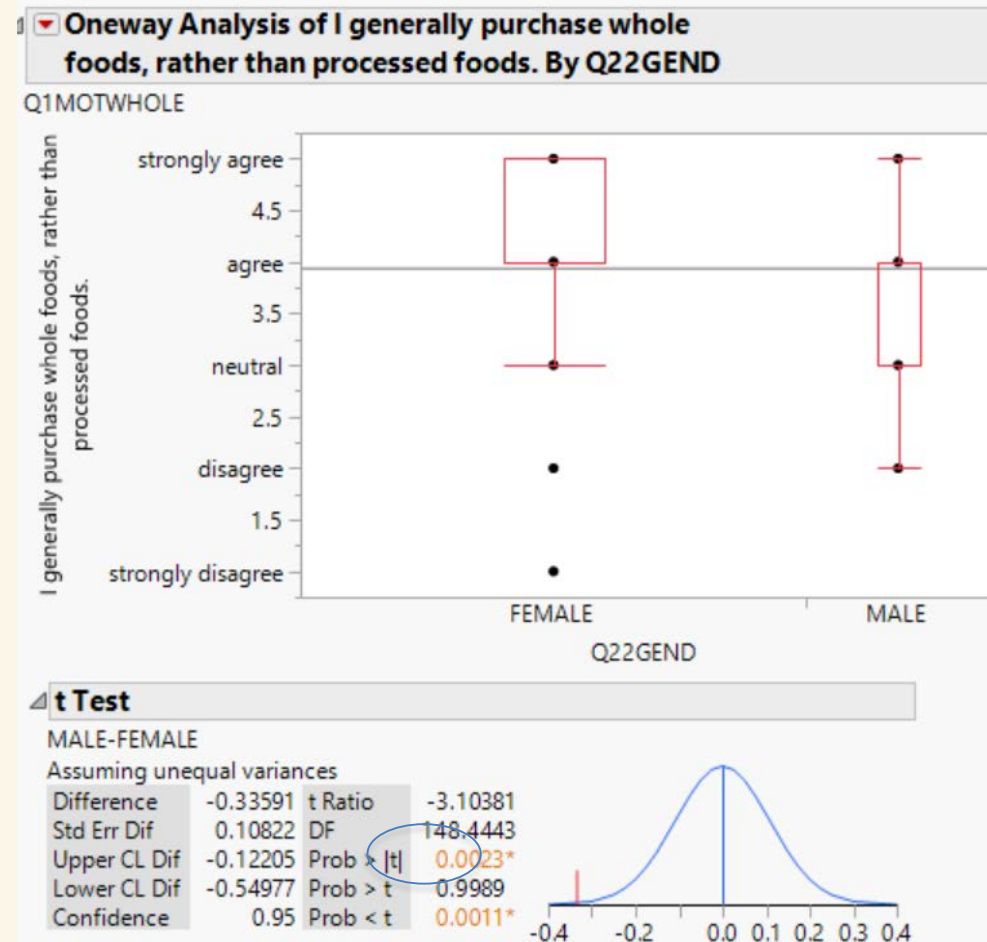
◢Oneway Analysis of I generally purchase whole foods, rather than processed foods. By Q22GEND

t Test

MALE-FEMALE

Assuming unequal variances

Difference	-0.33591	t Ratio	-3.10381
Std Err Dif	0.10822	DF	148.4443
Upper CL Dif	-0.12205	Prob > |t|	0.0023*
Lower CL Dif	-0.54977	Prob > t	0.9989
Confidence	0.95	Prob < t	0.0011*

SPSS — ANOVA : Comparing 3+ Groups

1 Scale Var. w/ 1 Nominal Var. (3+ levels)

- **Box-plot**
- ❑ Graphs > Legacy > Boxplot > Simple > Select 'Q1MOTWHOLE' as Variable and 'VENUETYPE' as Category Axis

- **ANOVA**
- ❑ Analyze > Compare Means > One-way ANOVA , or…
- ❑ Analyze > General Linear Model > Univariate > Select 'Q1MOTWHOLE' as Dependent and 'VENUETYPE' as Fixed Factor. Also button for 'Post Hoc…' > 'VENUETYPE'> 'Tukey'.
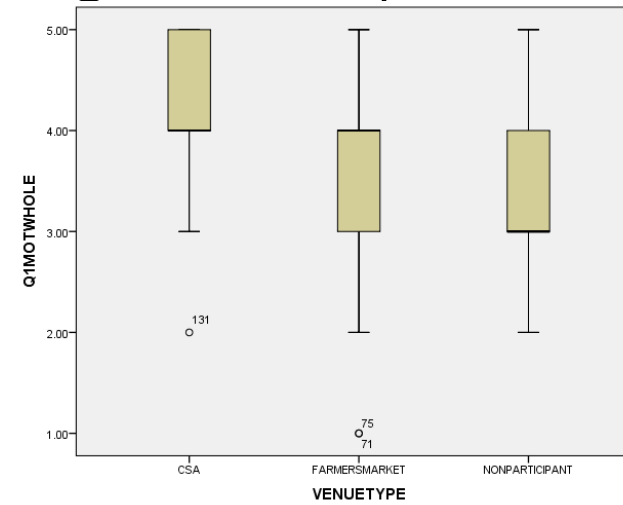
Tests of Between-Subjects Effects

Dependent Variable: Q1MOTWHOLE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	28.012^a	2	14.006	21.172	.000
Intercept	3535.455	1	3535.455	5344.327	.000
VENUETYPE	28.012	2	14.006	21.172	.000
Error	197.137	298	.662		
Total	4914.000	301			
Corrected Total	225.150	300			

ANOVA : Comparing 3+ Groups

1 Scale Var. w/ 1 Nominal Var. (3+ levels)

- **Box-plot**
- ❑ Analyze > Fit Y by X > Select 'Q1MOTWHOLE' as Y and 'VENUETYPE' as X
- ❑ Red arrow > Display options > Box-plot

- **ANOVA**
- ❑ Red arrow > Means/ANOVA

Oneway Analysis of I generally purchase whole foods, rather than processed foods.
Q1MOTWHOLE

Oneway Anova

▷ **Summary of Fit**

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
VENUETYPE	2	28.01232	14.0062	21.1722	<.0001*
Error	298	197.13719	0.6615		
C. Total	300	225.14950			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
CSA	114	4.28070	0.07618	4.1308	4.4306
FARMERSMARKET	141	3.85816	0.06850	3.7234	3.9930
NONPARTICIPANT	46	3.39130	0.11992	3.1553	3.6273

Linear Regression/ GLM

1 Scale Var. w/ Multiple predictors

- **GLM, Factorial ANOVA, ANCOVA**
- ❑ Analyze > General Linear Model > Univariate. Select 'Q1MOTWHOLE' as DV.
  - ▪ Nominal vars are "Fixed Factors"
  - ▪ Scale vars are "Covariates"

- **Linear Regression**
- ❑ Analyze > Regression > Linear. Select 'Q1MOTWHOLE' as DV.
- ❑ All IV's must be Scale or Binary "dummies" (0/1)

Tests of Between-Subjects Effects

Dependent Variable: Q1MOTWHOLE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	32.290[a]	5	6.458	9.905	.000
Intercept	2555.977	1	2555.977	3920.113	.000
VENUETYPE	13.872	2	6.936	10.638	.000
Q22GEND	2.247	1	2.247	3.446	.064
VENUETYPE * Q22GEND	.856	2	.428	.656	.520
Error	189.737	291	.652		
Total	4839.000	297			
Corrected Total	222.027	296			

Coefficients[a]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	4.202	.180		23.352	.000
	Q23AGES	-.005	.003	-.088	-1.505	.133

a. Dependent Variable: Q1MOTWHOLE

JMP

Linear Regression/ GLM

1 Scale Var. w/ Multiple predictors

- **Linear (Least Squares) Regression**
- ❑ Analyze > Fit Model > Select 'Q1MOTWHOLE' as Y.
- ❑ Select Q22GEND and VENUETYPE as "Model Effects"

◿ **Parameter Estimates**

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	3.7803211	0.058275	64.87	<.0001*
Q22GEND[FEMALE]	0.1283697	0.053696	2.39	0.0174*
VENUETYPE[CSA]	0.4170529	0.068994	6.04	<.0001*
VENUETYPE[FARMERSMARKET]	0.0174687	0.066239	0.26	0.7922

◿ **Effect Tests**

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Q22GEND	1	1	3.717766	5.7154	0.0174*
VENUETYPE	2	2	24.891559	19.1330	<.0001*

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Logistic Regression

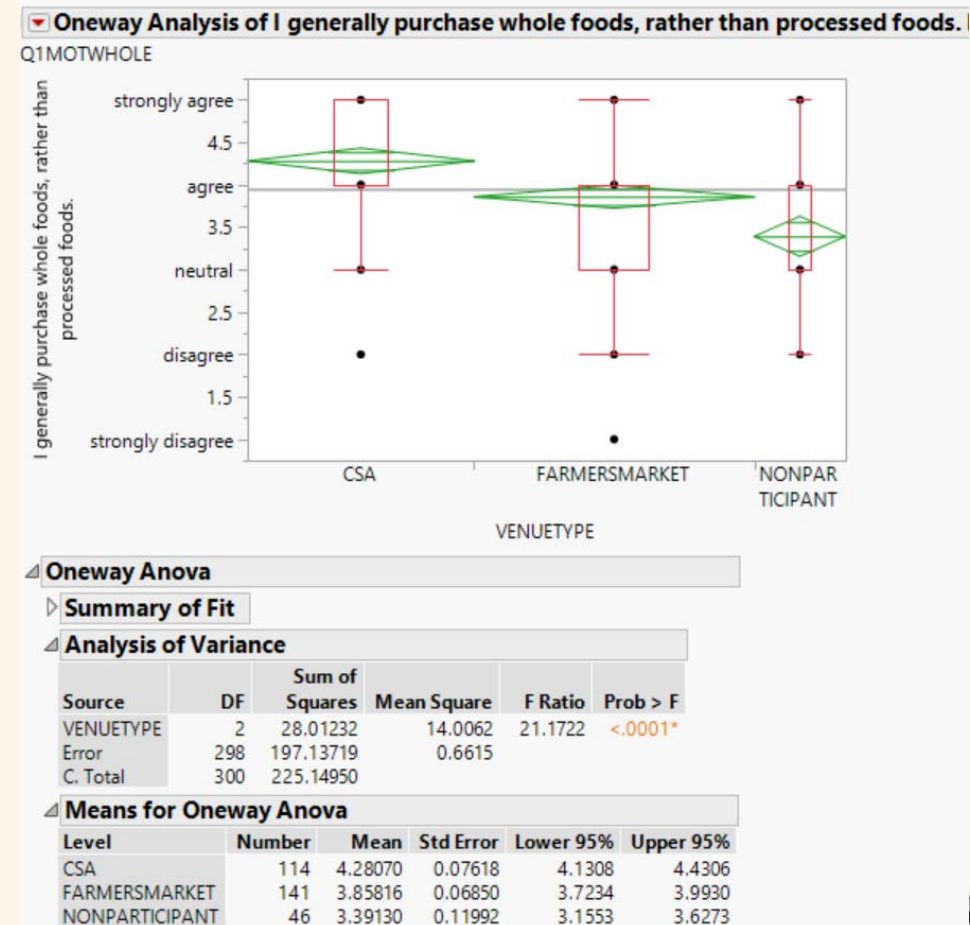## 1 Nominal Var. w/ Multiple predictors

- **Logistic Regression**
- ☐ Analyze > Regression > Binary Logistic. Select 'WHOLE01' as DV. Put IV's as Covariates, and use 'Categorical' button to identify Nominal vars.

- ➢ 'Purchase Whole foods vs Processed?' WHOLE01=1 for Yes (Q1MOTWHOLE 4-5), WHOLE01=0 for No (Q1MOTWHOLE 1-3)
- ➢ Someone who uses a CSA has 7.1 times the odds of saying they purchase Whole Foods compared to Nonparticipant.

Categorical Variables Codings

			Parameter coding	
		Frequency	(1)	(2)
VENUETYPE	CSA	114	1.000	.000
	FARMERSMARKET	135	.000	1.000
	NONPARTICIPANT	44	.000	.000
Q22GEND	FEMALE	214	1.000	
	MALE	79	.000	

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	VENUETYPE			21.531	2	.000	
	VENUETYPE(1)	1.965	.424	21.467	1	.000	7.134
	VENUETYPE(2)	.992	.363	7.476	1	.006	2.698
	Q23AGES	.002	.009	.049	1	.825	1.002
	Q22GEND(1)	.361	.303	1.421	1	.233	1.435
	Constant	-.466	.642	.526	1	.468	.628

a. Variable(s) entered on step 1: VENUETYPE, Q23AGES, Q22GEND.

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Logistic Regression

1 Nominal Var. w/ Multiple predictors

- **Logistic Regression**
- ❑ Analyze > Fit Model > Select 'WHOLE01' as Y. Change "Target" from 0 to 1 > Run.
- ❑ Select Q22GEND and VENUETYPE as "Model Effects"
- ❑ Red Arrow > Odds Ratios

➢ Someone who uses a CSA has 6.7 times the odds of saying they purchase Whole Foods compared to Nonparticipant.

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	0.81367525	0.1624552	25.09	<.0001*
VENUETYPE[CSA]	0.96931035	0.2200949	19.40	<.0001*
VENUETYPE[FARMERSMARKET]	-0.0388048	0.1851821	0.04	0.8340
Q22GEND[FEMALE]	0.17012524	0.1496355	1.29	0.2556

For log odds of Yes (4-5)/No (1-3)

▷ **Covariance of Estimates**

Effect Likelihood Ratio Tests

Source	Nparm	DF	L-R ChiSquare	Prob>ChiSq
VENUETYPE	2	2	23.8294932	<.0001*
Q22GEND	1	1	1.27632037	0.2586

Odds Ratios

For Purchase whole foods more than processed (Yes=1, No=0)
odds of Yes (4-5) versus No (1-3)

Odds Ratios for VENUETYPE

Level1	/Level2	Odds Ratio	Prob>Chisq	Lower 95%	Upper 95%
FARMERSMARKET	CSA	0.3649061	0.0027*	0.1886347	0.7058961
NONPARTICIPANT	CSA	0.1495962	<.0001*	0.0671769	0.3331353
NONPARTICIPANT	FARMERSMARKET	0.4099579	0.0115*	0.2053554	0.8184128
CSA	FARMERSMARKET	2.7404307	0.0027*	1.4166391	5.301252
CSA	NONPARTICIPANT	6.6846639	<.0001*	3.0017829	14.886063
FARMERSMARKET	NONPARTICIPANT	2.4392749	0.0115*	1.2218772	4.8696071

Syntax

Save syntax from the Output window to Paste into a Syntax window to re-run later.

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THANK YOU!

Stephanie L. Dickinson

Senior Biostatistician

Biostatistics Consulting Center

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