Introduction to Statistics for the Social Sciences (SBS200) Fall, 2015 - Dr. Delaney Study Guide - Exam 3

Readings: OpenStax - Chapters 1 – 11 + 13 & Appendix D & E (online) Plous - Chapters 2, 3, and 4 Chapter 2: Cognitive Dissonance, Chapter 3: Memory and Hindsight Bias, Chapter 4: Context Dependence

Still important ideas

Contrast the measurement of observable actions (and/or characteristics) with the theoretical constructs associated with those measurements

- Be able to identify examples of measurements versus constructs
- Describe what is meant by operational definitions
- Describe what is meant by validity versus reliability in measuring a construct
- Provide an example of a measure that has high reliability and low validity?
- Provide an example of a measure that has low reliability and high validity?
- Describe the "target" example of reliability and validity

Contrast a dependent versus independent variable? - be able to identify them in an example A study with a single independent variable would be associated with a univariate data set

- while a study with two variables (as in a correlation) would be associated with a bivariate data set
- a study with more than two variables would be associated with a multivariate data set

What are control (placebo) versus experimental (treatment) variables? - be able to identify them in an example. What is a within versus between participant design? - also known as within and between subject designs? What is random assignment - what's it good for?

What is random sampling - what's it good for?

Compare and contrast random sampling and random assignment

Populations versus samples - be able to define and identify examples of each

- Define and contrast a statistic with a parameter
- Sample data
- Population data
- Sample mean (x)
- Population mean (μ)

Describe what is meant by a placebo

Contrast the double-blind procedure with the single-blind procedure Review the structure for organizing a memo

Contrast inferential statistics with descriptive statistics

Be able to identify each from a description of a study

Describe how quasi-experimental designs are especially vulnerable to

- selection bias (when participants are not randomly assigned to groups)
 - especially from subject variables like gender, or political party

- selection attrition (when some participants drop out of the study and create a bias in the sample)

Describe why we can talk about causation in 'true' experiments, but only relationships in correlational studies

Define continuous versus discrete variables

Define categorical versus numerical data

- These are also known as qualitative versus quantitative data 8
- Be able to identify each from examples
- Contrast verbal and coded labels of categorical data
- Remember, that just because someone might code male = 1 and female = 2, this does not make "gender" a quantitative variable
- Describe what is meant by a binary variable

Levels of measurement: be able to identify each from an example - Nominal, Ordinal, Interval, and Ratio

5 Principles of questionnaire construction Describe time series versus cross-sectional comparisons Describe the "Likert Scales"

Describe surveys and what the goal of a survey would be Contrast a census with a sample and contrast a population with a sample

- Review situations where sample or census might be preferred
- Describe how a sample can be representative versus biased

- Define random selection and random assignment relative to sampling for administering survey Describe the five reasons to sample as described by the

Define a sampling frame

- How might a "sampling frame" be different from a "target population"

Describe why larger samples can be preferable to smaller samples

- Describe why a higher response rate percentage is better than a smaller response rate
- Describe why response rate is so important for a sample to remain unbiased

Define and contrast probability sampling with non-probability sampling Describe these sampling techniques

- simple random sampling (this is a probability sampling technique)
 - what is a random numbers table good for?
 - how would you find a random number using excel
- systematic random sampling (this is a probability sampling technique)
- stratified random sampling (this is a probability sampling technique)
 proportional and disproportional stratified random sampling
- cluster sampling (this is a probability sampling technique)
- convenience sampling (this is a non-probability sampling technique)
- snowball sampling (this is a non-probability sampling technique)
- judgment sampling (this is a non-probability sampling technique

Describe what is meant by sampling error

Describing Data Visually

Describe a frequency distribution

Describe the guidelines for constructing frequency distributions described in lecture

- mutually exclusive classes
- collectively exhaustive classes
- equal size intervals

Describe how raw data can be organized and presented in a dot plot

Describe what is meant by cumulative frequencies (be able to calculate them)

Describe what is meant by relative frequencies and cumulative relative frequencies (be able to calculate) Describe a frequency histogram and a cumulative frequency histogram

Describe a frequency polygon and a cumulative frequency ogive

Describe the different shapes of frequency histograms and be able to interpret examples

- skewed left, skewed right (negatively or positively skewed)
- bimodal skewed left, bimodal skewed right
- skewed left with outliers, skewed right with outliers
- symmetric, multimodal symmetric, symmetric with outliers
- how does the skew of the distribution affect the order of the mean, median and mode

Describe a Bar chart, Pareto chart, stacked bar chart, pie chart, simple line chart and be able to interpret one and when it should be used

Define a correlation: Describe and be able to interpret scatterplots

- strong positive pattern, strong negative, weak positive, weak negative, zero pattern, curvilinear pattern Describe the relationship between the strength and direction of the correlation coefficient Direction of correlation (positive, negative)

- Be able to identify a positive correlation from a correlation coefficient, a verbal description of the data, a scatterplot, or raw data
- Be able to generate examples of both negative and positive correlations

Strength of correlation (0 - +1.0 or 0 - -1.0)

- Be able to identify (or estimate) the strength of a correlation from a correlation coefficient, a scatterplot, or raw data

Correlation vs causation (when does a correlation imply, or provide evidence for causation?) Describe linear vs curvilinear relationship -

 Be able to identify a linear or curvilinear relationship from raw data, a verbal description of data, or a scatterplot

Distributions

Describe the dot plot display and frequency distributions and how they represents central tendency and dispersion and shape

Define and contrast these three characteristics of distributions: central tendency (measure of location), dispersion (measure of variability), and shape

Describe what it means to say that the "Mean is a measure of 'position', (it lives on one location of the curve) and than the standard deviation is a distance score of the spread of the distribution

- Describe the definitional formula for the standard deviation?
- Describe the relationship between sample size and standard error
 - as n goes up, df goes up, and variability goes down
 - describe why larger samples can be preferable to smaller samples
- How does this fit with the "Law of Large Numbers" (Gilbert Reading)



Describe the empirical rule for the normal curve

Normal distribution

Describe what is meant by a z-score and how area under the curve relates to a particular z-score What is the probability that a score will fall above a z of 0 (50%)

What is the probability that a score will fall between -1 and +1 standard deviation of the mean? - 68% What is the probability that a score will fall between -1 or +1 standard deviation of the mean? - 34% - notice, z = 1

What is the probability that a score will fall between -2 and +2 standard deviation of the mean? - 95% What is the probability that a score will fall between -1 or +1 standard deviation of the mean? - 47.5% - notice, z = 2

What is the probability that a score will fall between -3 and +3 standard deviation of the mean? - 99.7% What is the probability that a score will fall between -1 or +1 standard deviation of the mean? - 49.85% - notice, z = 3

Convert z scores to x scores

raw score = mean + (z score)(standard deviation)

Convert x scores to z scores (consider how the formula vary between samples and population) z score = raw score – mean / Standard deviation

Finding z scores from raw scores

Finding z scores from probabilities (or area, percent, percentiles, or proportion of curve)

Finding raw scores from z scores

Finding raw scores from probabilities (or area, percent, percentiles or proportion of curve)

Finding probabilities from z scores

Finding probabilities from raw scores

How are the following related: Area under the curve, percent, probability, and proportion of the curve Convert a raw score (x) to a percentile rank using the normal curve

Convert a percentile rank to a raw score (x) using the normal curve

Convert an x to a percentile ranking using the normal curve

Be able to use the z-table in our text

Given an example of a distribution with a specific standard deviation, be able to estimate

- the score for a z = 0, z = 1, or z = 2 (from worksheet)

- the standard deviation (from worksheet)

Contrast positively skewed and negatively skewed distributions and how that affects the order of the mean, median and mode *Remember, regardless of the skew, the median is always the middle score* Describe bimodal distribution

Given an example of a distribution with a mean and specific standard deviation

Define the characteristics of the normal curve

- Measured on continuous scale

Note: when range is large we often treat a discrete variable as continuous (exam scores for example) Measure of central tendency or "location"

Shape

- Possess clear central tendency
- Have only one peak (unimodal)
- Exhibit tapering tails
- Be symmetric around the mean (equal tails)

- Be bell-shaped

Domain

- theoretical and practical range in terms of standard deviations (or z scores)

Measures of Central Tendency

- What are the three measures of "location" or measures of "central tendency?
- Mode: most commonly occurring score also tallest point on normal distribution
- Median: middle score also the midpoint score: (remember also the 50th percentile)
- Describe procedure for finding quartiles
- Describe how box plots use medians, quartiles, maximum and minimum scores Note: just plots the minimum score, maximum score and first three quartiles
- Mean: average score also balance point of distribution
 - define what is meant by a "trimmed mean"
 - define what is meant by a weighted mean

In a normal distribution mean = median = mode

In a positively skewed distribution mean > median > mode In a negatively skewed distribution mean < median < mode *Note: the mean is most influenced by extremely large or extremely small scores* - which measure of central tendency is most affected by outliers

Probability

Describe what is meant by a "probability"

Describe and provide examples for the three approaches to probability

- Empirical
- Classical
- Subjective

Describe the "Law of Large Numbers"

Describe

- Probability of an event must lie within an interval of 0 and 1
- Probabilities of all simple events must sum to 1
- Complement Rule
- Union of Two Events
- Intersection of Two Events (Joint Probability)
- Mutually Exclusive Events
- Collectively Exhaustive
- Conditional Probabilities

Each measure of central tendency is useful for which type of data (nominal, ordinal, interval and ratio) Measures of variability (dispersion)

- range: smallest score subtracted from the largest score
- note range makes no reference to scores between the largest and smallest scores
- variance: standard deviation squared
- standard deviation: typical amount observations deviate on either side of their mean
- $\Sigma(x \bar{x}) = 0$ also $\Sigma(x \mu) = 0$
- Describe the definitional formula for the population standard deviation (and variance)
- Describe the definitional formula for the sample standard deviation (and variance)
- Describe a "deviation score"
- memorize the standard deviation and variance (definitional) formula for samples and populations
- how is definitional formula different from the calculation formula for the standard deviation (be able to calculate standard deviation using calculation formula)
- how are the formula for standard deviations for samples different than for population
- how are standard deviation formula different from variance formulas
- describe what is meant by a deviation score
- what would happen if we took the average of the deviation scores (without taking the square or absolute values of each deviation)?
- describe the "mean deviation" it uses the absolute values of the deviation scores
- what does it mean to say that the standard deviation is calculated relative to the mean
- be able to calculate standard deviation and variance from a set of scores
- be able to estimate it from a normal distribution when given an example deviation
- Note: standard deviation can also be estimated by range / 6

Describe what it means to say that the "Mean is a measure of 'position', (it lives on one location of the curve) and than the standard deviation is a distance score of the spread of the distribution

Provide examples of distributions that have the same mean but different variability and provide examples of distributions that have the same variability but different means (from worksheets in class) Describe what is meant by

- "not unusual scores" (z of less than 2), "unusual scores" (z between 2 up to 3), "outliers" (z between 3 up to 4) and "extreme outliers" (z of 4 and above)

Contrast inferential statistics with descriptive statistics - Be able to identify each from a description of a study

Describe why we can talk about causation in 'true' experiments, but only "relationships" in correlational studies True experiments use random assignment that allows us to consider causal relationships, unlike quasi

experiments

Describe the Central Limit Theorem

Describe the three propositions derived from the central limit theorem

- Proposition 1: If sample size (n) is large enough, the mean of the sampling distribution will approach the mean of the population
- Proposition 2: If sample size (*n*) is large enough, the sampling distribution of means will be approximately normal, regardless of the shape of the population
- Proposition 3: The standard deviation of the sampling distribution equals the standard deviation of the
 population divided by the square root of the sample size. As n increases standard error of the men
 (SEM) decreases.

Describe the sampling distribution of sample means

- what does this mean?
- how is this distribution formed? What is each point of data really mean in this distribution?
- how is this different from a population distribution of raw scores?
- how is the standard deviation different from the standard error of the mean (how are they similar?)
- what is the formula for standard error of the mean?
- why is the standard error of the mean nearly always smaller than the standard deviation of the population?

Describe what is meant by a point estimate, and an interval estimate – what are they for? Contrast point estimates with confidence intervals

- Point estimates are a more specific estimation, but less likely to be exactly right
- Confidence intervals provide a range of scores, but is more likely to include the population parameter
- Describe the factors will affect the size of a confidence interval

(especially variability, sample size and confidence level)

Standard error of the mean

Confidence Intervals with z scores

Why do we care about the middle 95% of the curve?

- confidence intervals
- usual versus unusual scores
- hypothesis testing
- Be able to calculate a confidence interval
- for a z score distribution and for a t score distribution
- for different confidence intervals (80%, 90%, 95%, 99%)
- be able to find the critical t score on the t-table to create the confidence interval
- review different ways of interpreting confidence intervals (from lecture)
- how can we make our confidence interval smaller?
- decrease level of confidence
- decrease variability
 - Remember, variability can be decreased through
 - 1) an increase in sample size and
 - 2) improvement of reliability of assessment tools and careful data collection techniques
 - our Melvin/Mark worksheet discussed this too



Connecting intentions of the researchers (when designing the studies) with experimental methodologies, and appropriate statistical analyses and graphs

Be able to identify each of these 7 methodologies from a description of a study

- 1. Confidence intervals Using distributions to estimate means
- t-test (2-means)
 Please note: t-tests <u>always</u> compares two means, there is one IV and one DV typically is a bar graph
- 3. One-way ANOVA (note: ANOVA stands for "analysis of variance") Please note: one-way ANOVA usually compares more than two means, there is one IV and one DV You may see either a bar graph representation or a line graph
- 4. Two-way ANOVA
 - Please note: two-way ANOVA usually compares more than two means, there are two IVs and one DV You may see either a bar graph representation or more likely, a line graph
- 5. Correlational methodologies

(Please note: correlation uses two quantitative variables that must be interval/ratio numeric scale – uses scatterplot)

6. Simple and multiple regression

Uses correlations to predict values on one variable based on values for the other variable – uses scatterplot)

7. Chi Square

Allows hypothesis testing for nominal data (just counting how many in each category)

- also define and contrast these methodologies in terms of type of DV and IV
- contrast quasi with true experiments (has to do with random assignment)
- identify the DV and IV and whether it is a between or within participant design
- also identify the most appropriate type of graph for each

Contrast inferential statistics with descriptive statistics

Be able to identify each from a description of a study

Describe why we can talk about causation in 'true' experiments, but only "relationships" in quasi or correlational studies. True experiments use random assignment that allows us to consider causal relationships, unlike quasi experiments

Define categorical versus numerical data

- These are also known as qualitative versus quantitative data

- Be able to identify each from examples

Levels of measurement: be able to identify each from an example - Nominal, Ordinal, Interval, Ratio

Hypothesis tests

Describe what is meant by hypothesis testing Describe generally what is meant by a null hypothesis, and contrast it with the alternative hypothesis

Describe what is meant by "we assume weird (or rare) things just don't happen"

Describe what is meant by a "critical z" or "critical t" or "critical value" or "critical statistic" Describe the relationship between the observed z and critical z - which has to be bigger for significance? Describe the relationship between the observed t and critical t - which has to be bigger for significance? - which has to be bigger to reach significance, or to reject the null, or to claim $p < \alpha$ (for example p < 0.05) Describe how "not rejecting the null hypothesis" is different from "accepting the null hypothesis" Describe why an observed z-score, t-score or an F-score that is less than one could never be significant

If the observed z falls beyond the critical z in the distribution (curve):

- then it is so rare, we conclude it must be from some other distribution
- decision considers effect size and variability
- then we reject the null hypothesis we have a significant result
- then we reject the null hypothesis
- $p < \alpha$ (for example p < 0.05)
- then we have support for our alternative hypothesis

If the observed z falls within the critical z in the distribution (curve):

- then we know it is a common score and is likely to be part of this null distribution, we conclude it must be from this distribution (either because the effect size is too small or because the variability is to big)
- then we do not reject the null hypothesis
- *p* is not less than α (for example p > 0.05) *p* is n.s.
- then we do not have support for our alternative hypothesis

The t-test - Remember, the numerator of our test statistics (z, and t) estimate the difference between groups (between means) while the denominators estimate the within group variability

How are single sample t-tests and independent 2-samples t-test similar and how are they different?

- How do the formulas compare and contrast
- How are they used differently?
- How do the differ in terms of information you have about the population
- How do they differ in terms of the degrees of freedom?

What is pooled variance - when is it used?

5 steps for hypothesis testing used for z tests and t-tests

- 1. identify research problem, describe null and alternative hypotheses,
- 2. identify decision rule, (alpha, d.f., critical value how do we find critical values?)

3. Calculations

- be able to calculate standard deviations and t-test scores (as we did in homework and worksheet)

- 4. make decision,
 - when do you reject the null hypothesis?
 - what does that mean relative to the alternative hypothesis?
 - what is our assumption about rare and common outcomes?
- 5. conclusion

Generally the numerator of our test statistics (z, t, and F) estimates the difference between groups (between means) while the denominators estimate the within group variability.

Describe generally what is meant by a null hypothesis, and contrast it with the alternative hypothesis Describe what is meant by a "critical z", "critical t", "critical r", "critical F" or "critical statistic" Describe the relationship between the observed statistic and the critical statistic z

- which has to be bigger to reach significance, or to reject the null, or to claim $p < \alpha$ (for example p < 0.05) In lecture and homeworks we discussed summary statements that include both descriptive statistics and inferential like the example presented here. Review how this statement reflects the output of the statistical analyses of excel.

Be familiar with summary statements like this one for t-tests

The mean test score for participants who completed the big meal was 24, while the mean test score for participants who completed the small meal was 21. A t-test was completed and there appears to be no significant difference in the test scores as a function of the size of the meal, t(4) = 1.964; n.s.

The p-value method is also useful: The smaller the p value the stronger the evidence for rejecting the null hypothesis. Be able to use excel output and summary tables to determine levels of significance

Hypothesis testing with z, t scores - describe the logic of when we reject the null hypothesis What is the relationship between the observed statistic (also known as test statistic) and critical statistic Compare and contrast the z, and t distributions – *when do you use each?*

- describe what is meant by degrees of freedom (d.f.) for t scores
- describe how the t-distributions change as sample size increases

Level of significance (alpha = α)

- What is it and how do we determine our alpha level?
- Be able to draw where it is on a distribution
- Be able to interpret summary analysis tables
- Be able to interpret excel output for the t statistic

(see example of t-test output in homework worksheets and at the end of this study guide)

- Be able to find the critical statistic for z, and t from a table and from the excel printout for different levels of alpha

- Be able to find means, df, p values, observed versus critical t
- Please review examples from your homework assignments
- Be able to find the critical z for different levels of alpha and 1 vs 2 tailed tests
 - What happens to our critical statistic when alpha gets larger?

- What happens to our critical statistic when we move from 2-tailed to 1-tailed test?

Remember, it is not possible to reject the null (find significant difference) if the results of the 1-tailed test is in the unpredicted direction. This is the gamble made when we use a 1-tailed test

- What is meant by conventional levels of significance? (- the common ones .05, .01 and .001)
- Statistical significance versus practical importance

Please contrast "significance" meaning important or relevant with "significance" meaning statistically different (or statistically reliable)

- Describe how the variance of the distribution effects the likelihood of rejecting the null hypothesis
 - larger variance makes it harder to reject (effect size has to be bigger) than a smaller variance
 - describe the relationship between effect size, variance, and sample size
- Region of rejection what is it? what does that mean?
- Be able to draw where it is on a distribution
- If we want to reject the null we want our z (or t) to be as big as possible and our p to be as little as possible

1 vs 2 tailed tests: how do we decide when to use each

- One vs two tailed tests what are the pros and cons of each
- If our results are opposite of our predictions we will NEVER reject the null (or find a significant difference) (For example, if we test whether "men are taller than women" (1-tailed test), but then find that women are taller than men, we would be unable to find a significant difference regardless of the size of the effect (size of the difference)
- how does it affect our critical values for an alpha of 0.05?
- how do we construct the hypothesis for a one versus two-tailed test

Remember, it is not possible to reject the null (find significant difference) if the results of the 1-tailed test is in the unpredicted direction. This is the gamble made when we use a 1-tailed test

Type I vs Type II errors

- Be able to define them and be able to identify each type of error from a situation
- Which is false alarm, which is miss?
- What determines which is worse? consider criminal trial versus drug testing versus fire in the house
- How is alpha related to Type I error?
- How is beta related to Type II error
- Please note: power of a test is sometimes called "sensitivity"

Analogy between hypothesis tests and confidence intervals

"The two-tailed hypothesis test at the 5 percent level of significance ($\alpha = .05$) is exactly equivalent to asking whether the 95% confidence interval for the mean includes the hypothesized mean..."

ANOVA - Analysis of Variance

How is ANOVA similar to and different from t-tests 5 steps for hypothesis testing Be able to calculate an F ratio and complete an ANOVA table Degrees of freedom within Degrees of freedom between Degrees of freedom total

Mean squares within

Mean squares between

F Ratio - know formula by heart F = MS_{between}/ MS_{within}

- notice which is the numerator and which is denominator

Be able to construct an ANOVA table and interpret an excel ANOVA output

- Note: Sum of Squares "SS" will be provided

- be able to "fill in" missing values on the ANOVA table

Describe Total Variation = Treatment Variation + Random Variation

This is the same thing as Total variance = Between variance + Within Variance

Explain why and how variances are used to answer questions about means

Variability within groups (be able to draw a picture)

- note also called within-groups variance

Variability between groups (be able to draw a picture)

- note also called among-groups or treatment variability

Random error how is it related to MS within and within group variability (they are the same thing)

Be able to perform a single factor ANOVA and interpret results

Be able to find critical values for F

What would an observed F of 1 (or less) suggest? – *it would suggest that it is not a significant finding* How are one-way vs two-way ANOVAs similar and different

Define one-way ANOVA and two-way ANOVA

Be able to identify the two independent variables, and the dependent variable in a two-way anova

Plous text - Chapters 2, 3, & 4

Cognitive dissonance (Chapter 2)

Describe the "Parable of cognitive dissonance" - (Plous, page 22)

Describe the experiment by Festinger and Carlsmith (1959) - (Plous, page 23)

- describe why this is so counter-intuitive

Describe what is meant by pre-decisional dissonance in consumer behavior (Doob et al, 1969) (Plous, page 26 and 27)

Describe what is meant by post-decisional dissonance in voting behavior (Frenkel & Doob, 1976)

Please review the conclusions (page 29) especially the quote from Aronson (1972) and Plous's statement:

"It is well known that changes in attitude can lead to changes in behavior, but research on cognitive dissonance shows that changes in attitude can also follow changes in behavior" (Plous, page 30)

Memory and hindsight biases (Chapter 3)

Describe the experiment by Loftus and Palmer (1974) - (Plous, page 33) Describe the experiment by Bransford and Franks (1974) - (Plous, page 33-34) Describe what is meant by hindsight bias, and how it might be reduced

Context dependence (Chapter 4)

Describe what is meant by the contrast effect (Plous, page 38) When is it most likely to occur (Plous, page 41) Describe the primacy effect in impression formation Plous,page 42) Describe what is meant by the "halo effect"

	t-Test: Two-Sample Assuming Equal Variances		
		Big Meal	Small Meal
	Mean	24	21
	Variance	2.25	3
	Observations	9	9
	Pooled Variance	2.625	
	Hypothesized Mean Difference	0	
	df	16	
)	t Stat	3.927922024	
L	P(T<=t) one-tail	0.000600513	
2	t Critical one-tail	1.745883669	
8	P(T<=t) two-tail	0.001201026	
1	t Critical two-tail	2.119905285	

t Critical two-tall					2.11	9905	285	
		Groups						
	Mastery		Combined					
	Mean	SD	Mean	SD	И	df	т	Sig.
Mastery-Oriented	32.7895	4.4043	33.4737	4.3508	38	36	482	.633
Performance-Oriented	25.1053	5.3634	30.8947	6.1904	38	36	-3.081	.004*
*D> 05								

Table V Results of t-tests on individual constructs Male Female Constructs mean (SD) mean (SD) Significant ANCOVA results Advantages to individuals Quality of life 3.49 (0.63) 3.31 (0.66) 2.34 0.020 Advantages to organizations Productivity/overheads 3.65 (0.49) 3.43 (0.52) 3 64 0.000 Insignificant ANCOVA results Advantages to individuals Relationship with family 3.56 (0.63) 3.42 (0.53) 1.85 0.066 Commuting costs 4.29 (0.70) 4.31 (0.55) -0.160.870 Productivity 3.82 (0.62) 3.82 (0.59) -0.02 0.984 Disadvantages to individuals 3.51 (0.70) 3.47 (0.63) 0.50 0.617 Career development 2.99 (0.70) 3.62 (0.62) 0.99 0.84 Home-work interface 3.08 (0.70) 0.325 0.400 Workspace 3.68 (0.67) Impact on others 2.80 (0.63) 2.71 (0.60) 1.21 0.074 Advantages to organizations Staff recruitment/leave/turnover 3.52 (0.63) 3.50 (0.60) 0.28 0.782 Disadvantages to organizations 3.43 (0.66) 3.31 (0.69) Supervision/evaluation 1.54 0.081 Technical/equipment 3.75 (0.64) 3.73 (0.64) 0.25 0.805

	A	В	C	D	E	F	G	Н
1	Anova: Single Factor						· · · · · · · · · · · · · · · · · · ·	
2								
3	SUMMARY							
4	Groups	Count	Sum	Average	Variance			
5	Troop 1	5	50	10	6.5			1
6	Troop 2	5	60	12	2.5			
7	Troop 3	5	70	14	13			
8								
9								
10	ANOVA							
11	Source of Variation	SS	df	MS	F	P-value	F crit	
12	Between Groups	40	2	20	2.72727272727	0.105593264	3.885290312	
13	Within Groups	88	12	7.333333333				
14	10							
15	Total	128	14					
16								

d15f_sbs200_study3.docx

Note: Lecture notes can be found at http://courses.eller.arizona.edu/mgmt/delaney/