U. S. ARMY

PEACEKEEPING & STABILITY OPERATIONS INSTITUTE

PKSOI

CARLISLE BARRACKS, PA

PKSOI PAPERS

A Reference Guide for Interpreting Statistics and Creating Survey Questions

Hai Do and Karen Finkenbinder

U.S. ARMY WAR COLLEGE PRESS
Prudens Futuri
Carlisle Barracks, PA

PKSOI PAPER

A Reference Guide for Interpreting Statistics and Creating Survey Questions

Hai H. Do
Karen Finkenbinder

April 2013

*****

Comments pertaining to this report are invited and should be forwarded to: Director, Peacekeeping and Stability Operations Institute, U.S. Army War College, 22 Ashburn Drive, Carlisle, PA 17013-5054.

*****

All Peacekeeping and Stability Operations Institute (PKSOI) publications are available on the PKSOI homepage for electronic dissemination. Hard copies of this report also may be ordered while copies last from our homepage. PKSOI's homepage address is: *https://pksoi.army.mil*

*****

The Peacekeeping and Stability Operations Institute publishes a quarterly journal to update the peace and stability operations community on the research of our analysts, recent and forthcoming publications and upcoming conferences sponsored by PKSOI. Each quarterly journal has a specific theme related to peace and stability operations and a commentary by the Director of PKSOI entitled *The Director's Corner*. If you are interested in receiving this journal, please subscribe on our homepage at *http://pksoi.army.mil/subscription.cfm.*

*****

ISBN: 978-0-9894393-0-5

FOREWORD

The genesis of this guide started at a meeting between PKSOI and the Department of Distance Education (DDE) at the Army War College (AWC). During this meeting, a discussion occurred in which we all realized that neither the resident nor distance courses of study require a statistics or research methods course. However, as part of the directed study we were discussing, we were finding that some students were quite interested in using statistics and survey questions. Further, we began to reflect back on our own student advising experiences and noted that a simple guide, to be used as a refresher or quick study, would be very helpful.

I volunteered to help put such a guide together and recruited Hai Do to assist. Hai was a graduate intern at PKSOI and had repeatedly demonstrated his skill with statistics and crafting survey questions. We, mostly Hai, have created a guide that is user friendly. Though originally designed to assist with the directed study project, we decided to offer it to anyone that can make use of it; because, frankly, we could not find anything as concise and complete elsewhere.

The guide is designed for one that is not enamored with statistics but needs to know enough to accurately interpret an academic article or other statistical information. Further, it includes a brief "how to" section on designing survey questions. For some, this information will be just a review; for others, it will be new information. Regardless of which camp you are in, we hope you find it useful.

Karen J. Finkenbinder, Ph.D. (ABD)
Chief, Research & Publications
The Peacekeeping and Stability
Operations Institute

ABOUT THE AUTHORS

HAI DO lives in Philadelphia, Pennsylvania. He received his Bachelor's Degree in History and Political Science at the University of Pittsburgh and his Master's Degree in Public and International Affairs from the Graduate School of Public and International Affairs. He interned at PKSOI and is currently working as a consultant. He enjoys writing and wargaming.

KAREN FINKENBINDER is the Chief of Research and Publications at the Peacekeeping and Stability Operations Institute. She spent a career in civilian policing before moving into academia. As one of a myriad of duties, she developed the PKSOI internship program and has seen it grow from a handful of students to the large program it is today.

LIST OF COMMON STATISTICAL SYMBOLS

μ population mean
σ population standard deviation
$\sum$ summation of all numbers
P probability
! factorial (i.e. 5! = 5 x 4 x 3 x 2 x 1)
EV expected value
$\bar{X}$ sample mean
s sample standard deviation
n size of the sample
N size of the population
α population regression y-intercept
β population regression slope/coefficient
a sample regression y-intercept
b sample regression slope/coefficient
$\hat{Y}$ predicted value of Y/dependent variable
e error
s.e. standard error
r^2 coefficient of determination in bivariate regression
R^2 multiple coefficient of determination in multivariate regression
Adj. R^2 adjusted R^2 (coefficient of determination adjusted for variables with little or no explanatory power
Z standard normal score
t *t*-distribution score

INTRODUCTION

Figures often beguile me, particularly when I have the arranging of them myself; in which case the remark attributed to Disraeli would often apply with justice and force: "There are three kinds of lies: lies, damned lies and statistics." Mark Twain

That is often the case – statistics are either loved or hated. Most of the people that love statistics are also those that are naturally inclined toward mathematics – and frankly, that is not most of Americans. In fact, recent studies show that only about 32 per cent of American high school students are "math proficient." Other countries have much higher math proficiency rates. [1] So why is this important? Because these math proficiency rates do not stop in high school – they carry over to one's professional life. Let's face it - if you do not feel comfortable in math you probably selected a college major that does not require much of it. We are not talking about basic math, such as addition and subtraction, the kinds of things you can do with a calculator and understand the concepts behind it (1 plus 1 really does equal 2). No, we are talking about advanced math competencies, the knowledge that is required to understand statistics. This requires the dreaded algebra!

Many professionals just avoid it. And they are embarrassed to admit that they do not understand it.[2]

1. Peterson, P., C. Lastra-Anadon, E. Hanushek, and L. Woesserman, "Are U.S. Students Ready to Compete?" *Education Next*, Fall 2011, Volume 11, No. 4. Harvard Kennedy School,

2. Which is why we do not take too seriously self-reports of math competencies among professionals. Though doubtful that the non-math proficient 68-70% all enter professional careers after high school graduation, it is likely that a portion do.

The problems occur when they are promoted to positions that really do require the ability to understand statistics because if they do not "get it" – they may unwittingly be sold a bill of goods by someone that does understand it. Or, as is the case in graduate education, they are put into a position of having to read and understand academic articles replete with statistical information. In academic articles, we are usually looking at some kind of real-world phenomena, one in which someone has collected a plethora of data and then drawn conclusions from it. Knowing how to read and interpret this data helps us understand the conclusions and decide if they pass muster. We become informed consumers, the bane of every snake oil salesman hiding behind creatively interpreted statistics.

Case in point[3]: A manager at a state data center is advised to analyze information regarding the elderly. The state's governor was insistent that he wanted to justify a program. In order to get the number of "elderly" required to prove the program's success, the data center manager had to define "elderly" as those 47 years of age or older! Like a good statistician, she defined "elderly" in the footnotes of the report. But, if the policy makers did not know to look for the definition of elderly, they would have missed this essential fact – the program was not doing what it purported to do – at least not for the population most of us consider elderly.[4]

Unfortunately, this is not an isolated case. This guide is designed to help those that are uncomfortable with statistics and research methods. This discomfort may be because it was never learned or though once

3. The state and governor will remain nameless; however, this is an actual case.

4. Funny, the closer one gets to these ages, the less "elderly" they become.

known, is now forgotten. They need a primer to recognize red flags and judge quality. This guide will do that. Like anything involving statistics – if this isn't your thing, your eyes may glaze over (EGO); however, stay with us. There are examples and you can apply them to any article with statistics. It is great if you can master these but if not, just keep this guide handy so when such opportunities do arise, you can use this guide as a "cheat sheet." There is a glossary of terms and symbols at Appendix A. And we included a short set of problems. Answers are located in Appendix B.

We have also included a short primer to creating survey questions. Whether a professional creating a survey for the workplace or a graduate student creating a survey as part of a research project, we hope this information is helpful. Just a caution – when conducting survey research in an academic or operational environment – an Institutional Review Board (IRB) may be required.[5] When in doubt, ask! Sadly, in the past, in the name of research, people have been abused – physically and psychologically. And though we may think our surveys won't do that – it is best to have professional oversight. Please accept this guide with our best wishes.[6]

---

5. Institutional review boards are ethics committees designed to approve, monitor and review research involving humans. They conduct a risk-benefit analysis and its priority is to protect people from physical or psychological harm. The Department of Health and Human Services (Office for Human Research Protections) regulations empower IRBs. Within the Department of Defense, DoD Directive 3216.02 covers IRBs. Additionally, each military educational institution has additional complementary requirements. If you are a student, check with your faculty advisors. They will direct you to the proper office.

6. If you do decide that you want to master statistics, a staff member highly recommends the Inter-university Consortium for Political and Social Research (ICPSR) Summer Program at the

Section 1
Basic Things to Know in Statistics

A. Sample vs. Population

a. A **population** is the total set of items that the observers are concerned about. For example, a population would be all the people who live in Pittsburgh, Pennsylvania.[7]

b. A **sample** is a subset of the population.[8]

c. A random sample of the population means that every unit to be selected for the research study has a *known* probability of being selected.[9] Larger samples (n>120) are more representative of the population being studied.[10]

B. Random selection ≠ random assignment

a. **Random assignment**: a person selected for a study is randomly assigned to a different program or treatment to guard against selection biases.[11]

University of Michigan, Ann Arbor. It was created by a group of member universities and is recognized, world-wide, as the preeminent forum for basic and advanced training (a similar program is conducted in England each summer by a UK university). ICPSR runs two 4-week sessions each summer and the fees are modest. Housing can be found through UMICH Intercooperative Council (Housing Coop).

7. Meier, Kenneth J., Jeffrey L. Brudney, and John Bohte. *Applied Statistics for Public & Nonprofit Administration.* 7th. Thomson Wadsworth, 2009: 173

8. Ibid.

9. Langbein, Laura, and Claire L. Felbinger. *Public Program Evaluation: A Statistical Guide.* Armonk, New York: M.E. Sharpe, 2006: 35

10. Langbein, 36

11. Langbein, 76

C. Measures of Central Tendency

- **a. Mean**: the average of a set of numbers.
  - **i. Outlier**: an extreme value that has a disproportionate effect on the mean and may affect how well the mean represents the data.
- **b. Median**: the middle observation in a set of numbers when the observations are ranked in order of magnitude; i.e.—1, 2, 3, 4, 5 where 3 is the median.
  - i. In an even number of observations, no middle number may exist. Use the formula (N + 1) ÷ 2, where N is the total number of observations.[12] For example, (6 + 1) ÷ 2 = 3.5, so the median will be halfway between the third and fourth items; add these items and then divide by 2 to get the median.
- **c. Mode**: the data value that occurs most often in a set of observations; i.e.—1, 2, 3, 3, 4, 5 where 3 is the mode.

D. Levels of Measurement

- **a. Interval**: the most precise level. Measurements are taken in common standards (*numbers*); for example, *tons* of garbage, *number* of deaths, response times in *minutes*, etc.[13]
- **b. Ordinal**: observations that lack an agreed-upon standard or metric, such as "*more*" or "*less*" of a given characteristic in a ranking order.[14] For example, measuring satisfaction on a scale of 1 to 5, from "Very Dissatisfied" to "Very Satisfied."

---

12. Meier, 80
13. Meier, 23
14. Meier, 23

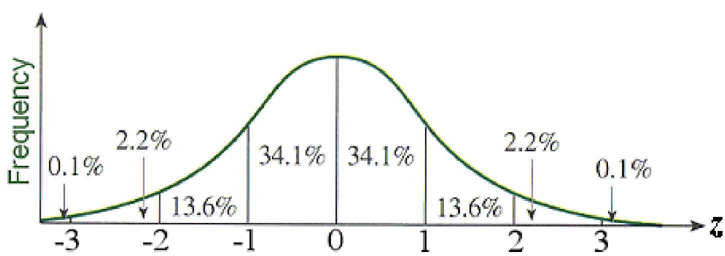
c. **Nominal**: measurements that lack any sense of scale or magnitude, such as sex, race, religion, employed/unemployed, etc.[15]

E. **Range:** the difference between the smallest and largest value in a distribution of data.

F. The Normal Curve, Standard Deviation, and *Z* Scores

a. **Normal Curve** (sometimes referred to as the **Normal Distribution**): a classic bell-shaped curve or distribution indicating that observations at or close to the mean occur with highest probability, and that the probability of occurrence progressively decreases as observations deviate from the mean.[16]

i. Example of a Normal Distribution Table[17]



b. Standard deviation: a measure of dispersion (how much the data does or does not cluster near the mean); the square root of the average squared deviation from the mean.[18]

15. Meier, 24
16. Meier, 538
17. Image Source: http://hawaii.hawaii.edu/math/Courses/Math100/Chapter4/Notes/Lesson434.htm
18. Meier, 97

i. See the Normal Distribution Table. Numbers along the x-axis (horizontal line) are the number of standard deviations from the mean. 68.26% of all values lie within *one* standard deviation of the mean; 95.44% of all values lie within *two* standard deviations; and 99.72% of all values lie within *three* standard deviations.

ii. Example of using deviations: The mean (μ) of a set of values is 5, and the standard deviation (σ) is calculated to be 3.

1. At 1 standard deviation from the mean, 68.26% of all values would fall between 2 and 8. This is calculated by $\mu + x\sigma$ and $\mu - x\sigma$, where x is the number of standard deviations from the mean. So, for *one* standard deviation, it would be 5 + (*1*)3 = 8, and 5 – (*1*)3 = 2.
2. For 2 standard deviations, 95.44% of all values are between -1 and 11.
3. For 3 standard deviations, 99.72% of all values are found between -4 and 14.

c. **Z score**: the number of standard deviations a score of interest lies from the mean on the normal distribution.[19]

i. Refer to the table in Appendix A. A Z score of 1.21 means that a score of interest would have a probability of .8869 (88.69%) of occurring; alternatively, the score ranked in the 89th percentile.

19. Meier, 134

G. **Hypothesis:** a statement about the world that can be either true or false.

  a. **Null hypothesis**: a hypothesis stating that nothing happened in an observed event.

  b. **Research hypothesis**: the opposite of the null hypothesis, stating that something *did* occur in an observed event.

  c. Example:

    i. **Research**: If the government institutes cost-cutting measures, costs will go down.

    ii. **Null**: If the government institutes cost-cutting measures, costs will *not* go down.

H. **T-distribution or t-test:** a statistical test that enables researchers to determine the probability of drawing a random sample with a particular mean and standard deviation from a known or hypothesized population. See Appendix B for a table of t scores.

  a. **One-tailed test**: a significance test in which the hypothesis specifies a direction (increase or decrease in effect) and, therefore, only uses one tail of the normal curve or some other probability distribution.

  b. **Two-tailed test**: a significance test in which the hypothesis does not specify a direction and, therefore, only uses both tails of a probability distribution.

I. **Regression Analysis terms**

  a. **Regression**: a statistical technique used to describe the relationship between two variables based on the principle of minimizing errors in prediction.[20]

---

20. Meier, 540

b. **Regression coefficient**: the weight assigned to independent variables in a regression (the beta or slope).[21]

c. **Multiple regression**: an interval-level statistical technique that uses several independent variables to predict or explain one dependent variable based on minimizing squared error.[22]

21. Meier, 540
22. Meier, 538

Section 2
Short Guidelines to Interpreting Statistics

A. Identify the dependent variable (DV): what the author is trying to predict, or to explain or account for changes or variation in.[23] Sometimes called the *criterion*.[24] There are several ways in which authors present or denote the dependent variable.

a. In the text of the article itself, the dependent variable is usually written as "*Y* (the dependent variable) is affected by *X* (the independent variable)" or "increasing *X* will have an impact on *Y*."

b. Most authors will have the dependent variable somewhere in the title of the table.

<u>Example A</u>[25]

Dependent Variable

Data for Four Bureaucrats				
Case	Race	Sex	Time Wasted on Job (minutes)	Attitude towards Job
Bureaucrat 1	White	Female	62	Dislike
Bureaucrat 2	White	Male	43	Neutral
Bureaucrat 3	African American	Male	91	Like
Bureaucrat 4	Hispanic	Male	107	Like

In this table, the dependent variable is the character of the Bureaucrats, affected by Race, Sex, etc.

c. The dependent variable will also be in the table itself, usually in "columns."

23. Meier, 36
24. Ibid.
25. Ibid.

Example B[26]

Dependent Variable

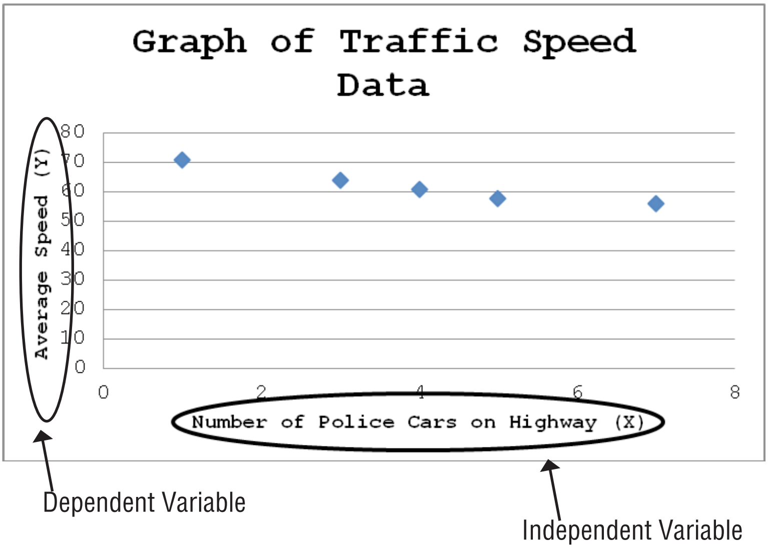
Table 2 Regressions to Explain Public Service Motivation

	Public Service Motivation	
Independent variables	B (std. error)	Beta
Education	1.093 (.398)	.172***
Professional identification	1.913 (.527)	.230****
Group culture	.332 (.288)	.079
Developmental culture	.117 (.260)	.023
Hierarchical culture	–.009 (.273)	–.002
Rational culture	–.237 (.264)	–.057
Red tape	–.431 (.147)	–.207***
Reform orientation	.088 (.039)	.145**
Hierarchical authority	.378 (.137)	.193***
Length of organizational membership	–058 (.025)	–.148*
Age	.029 (.040)	.049
Income	.347 (.330)	.069
Gender (Female)	.543 (.519)	.065

d. On graphical charts (such as Time Series or Scatter Plots), the dependent variable will be written on the Y-axis (vertical), while the independent variable will be on the X-axis (horizontal).

26. Moynihan, Donald P., and Sanjay K. Pandey. "The Role of Organizations in Fostering Public Service Motivation." *Public Service Review*, January/February 2007: 46

<u>Example C</u>[27] of a Scatter Plot graph



B. **Identify Independent Variables (IVs):** the predictors of the dependent variable. Sometimes referred to as *explanatory, predictor,* or *causal* variables.[28] These are usually listed as "rows" in a table.

a. The relevant statistics about each of these independent variables are usually provided in the same row as the variable's name.

27. Meier, 322
28. Meier, 36

Example D[29]

Table 2 Regressions to Explain Public Service Motivation

	Public Service Motivation	
Independent variables	B (std. error)	Beta
Education	1.093 (.398)	.172***
Professional identification	1.913 (.527)	.230****
Group culture	.332 (.288)	.079
Developmental culture	.117 (.260)	.023
Hierarchical culture	−.009 (.273)	−.002
Rational culture	−.237 (.264)	−.057
Red tape	−.431 (.147)	−.207***
Reform orientation	.088 (.039)	.145**
Hierarchical authority	.378 (.137)	.193***
Length of organizational membership	−058 (.025)	−.148*
Age	.029 (.040)	.049
Income	.347 (.330)	.069
Gender (Female)	.543 (.519)	.065

C. **Find the *statistically significant* relationships between independent variables and the dependent variable.**

a. The usual standard for statistical significance in social science is less than a 5% chance that a relationship this strong would be observed by coincidence, where no real relationship existed.[30] This is called the **alpha**, usually written as "an alpha of .05." Some authors use alphas as

29. Moynihan, 46

30. Tarleton State University. "A Guide to Interpreting Statistics." *Tarleton State University.* October 7, 2007. www.tarleton.edu/~jdixon/StatisticalInterpretation.doc (accessed September 13, 2012): 1

low as .01, .005, and .001. These numbers are the probability of a relationship being generated by random coincidence.[31] Indicators that are higher than .05 (or not statistically significant) are sometimes referred to as *null results*.

b. Look for any one of the following indicators:
   i. *Probability* or *p-value* (like the alpha, should be .05 or less),
   ii. *t score*: if the number of samples is 30 or more, a score of 1.645 or above indicates significance. In samples of less than 30, the value of the t-score will depend of the "degrees of freedom," calculated through n - 1. See Appendix B for degrees of freedom below 30.
   iii. *Z score*: in samples of 30 or more, t scores and z scores are the same. In these cases, a z score of 1.645 indicates significance at the .05 level.[32]
   iv. *Significance level*, or the use of *asterisks* (*) to indicate significance at the .05 level or less.

31. Tarleton State University, 1
32. Meier, 196

Example F[33] with asterisks denoting significant values.

Table 2 Regressions to Explain Public Service Motivation

	Public Service Motivation	
Independent variables	B (std. error)	Beta
Education	1.093 (.398)	.172***
Professional identification	1.913 (.527)	.230****
Group culture	.332 (.288)	.079
Developmental culture	.117 (.260)	.023
Hierarchical culture	–.009 (.273)	–.002
Rational culture	–.237 (.264)	–.057
Red tape	–.431 (.147)	–.207***
Reform orientation	.088 (.039)	.145**
Hierarchical authority	.378 (.137)	.193***
Length of organizational membership	–058 (.025)	–.148*
Age	.029 (.040)	.049
Income	.347 (.330)	.069
Gender (Female)	.543 (.519)	.065

****Statistically significant at .001
***Statistically significant at .005
** Statistically significant at .01
* Statistically significant at .05

D. Now that you know the statistically significant independent variables, check the **direction of the relationship.** You are looking for a number which will be called a *coefficient*, or *beta*, or β. Refer to Example F for the following points.

33. Moynihan, 46

a. If you see numbers in parentheses, ignore them. These are usually standard errors, which are used to calculate the *p-value*. If *p* is already given, then you don't need them.
b. Look for the number without parentheses — that is the coefficient you want.[34] When you are given both β and beta coefficients, pay more attention to the β coefficients; analysts will often use these to write regression equations because they are easier to interpret.[35]
c. In most studies, if the coefficient number is *positive*, then the relationship between the IV and DV is *direct*: increases in the IV increase the value of the DV. If the number is *negative*, then the relationship is *inverse:* increasing the IV decreases the value of the DV.[36]
d. In studies of duration (how long a war lasts, how long before a peace treaty is broken, how long people live, etc.), the coefficient often describes an effect on the "hazard rate."[37] The hazard rate is the likelihood that some process stops (i.e. a war ends, or peace ends). In this case, <u>a hazard rate above 1</u> means a shorter duration.[38] Similarly, a <u>hazard rate below 1</u> means a longer duration. The author will nearly always tell you whether the coefficients represent effects on the dependent variable or hazard ratios, but you might have to glance at the text to see which approach they use.[39]

34. Tarleton State University, 1
35. Meier, 444
36. Tarleton State University, 1
37. Ibid.
38. Ibid.
39. Ibid.

e. Note: If you see "Constant" in the list of independent variables, that is the y-intercept used to write the regression equation. Depending on the model, the regression equation is usually written as $\hat{Y}=\alpha + \beta X$, where $\hat{Y}$ is the predicted variable, α is the y-intercept, X is the independent variable, and β is the coefficient of X.

<u>Example G</u>: a typical SPSS Output Table

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	38.126	2.562		14.880	.000
1	Age	1.567	.087	1.001	18.064	.000
	Percentage Owned	-.492	.036	-.748	-13.492	.000

a. **Dependent Variable**: Fires per Month

The regression equation would be written as $\hat{Y}= 38.13 + 1.57X_1 - .49X_2$, where X_1 is "Age" and X_2 is "Percentage Owned."

E. Now that you know which variables matter and whether each one increases or decreases the dependent variable, you need to determine the importance of the variables. *How well does the model perform?* There is usually some indication of whether knowing all of the independent variables actually helps one predict the value of the dependent variables. There are two main types of information you might see:

a. The chi-square (χ^2) statistic: this is only used in *contingency table analysis* (or *cross-tabulation*), a method to examine relationships between variables measured at the ordinal and nominal levels.[40]

i. The chi-square statistic is used in conjunction with a special distribution table to determine whether any apparent relationship in a sample cross-tabulation is attributable to chance.[41] If it is "larger" than the appropriate minimum value (determined by the author of the study), it means the overall model performs better than chance.

<u>Example H</u>[42]: A Cross–tabulation table of Pay and Shame

Pay * Shame Crosstabulation

Count

		Shame		Total
		Not Shamed	Shamed	
Pay	Not Paid	44	6	50
	Paid	11	39	50
Total		55	45	100

ii. Look for a significance level printed next to the chi-square statistic (usually called the **asymptotic significance**, abbreviated as Asymp. Sig.). This is just like the significance for the IVs, but applies to the entire combination of IVs included in the analysis. Remember, this only tells you how likely it is for ran-

40. Meier, 245
41. Meier, 261
42. Meier, 289, Problem 16.16

dom chance to have produced these results. It does not tell you HOW MUCH better the model is than flipping a coin.[43]

<u>Example I</u>: Chi-square Test of Example H with Asymp. Sig.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	44.000[a]	1	.000		
Continuity Correction[b]	41.374	1	.000		
Likelihood Ratio	48.244	1	.000		

b. **The R-Square (r^2) statistic**: this is a better measure of how well the statistical model performs. Used in bivariate (1 IV and 1 DV) Regression models, it is a measure of "goodness of fit" (accuracy) for the regression line based on the ratio of explained variation to total variation. Explained variation is just the total variation in the dependent variable minus the error of prediction.[44]

i. The R-Square ranges from 0 (the data does not fit the regression line at all) to 1 (the data fits the line perfectly). <u>The higher the number, the better</u>.

ii. An example: the average (modal) civil war ends in government victory.[45] Suppose that you predict that every civil war ends in government victory. You will be right two-thirds

43. Tarleton State University, 1
44. Meier, 338
45. Tarleton State University, 2

of the time. If you use an IV to predict the DV of civil war outcome, then an r^2 of .5 would mean that the IV explained 50% of the variance in civil war outcome, or it is 50% accurate.

iii. Adjusted (or Pseudo) R-Square (R^2) statistic: The same as the "r^2" mentioned above, but applied to Multiple Regression models (more than 1 IV and DV). In multiple regressions, the adjusted R^2 is a more accurate picture of the explanatory power of the model.[46]

1. The adjusted R^2 will occasionally be shortened down to "R^2" in a multiple regression table. Unless indicated otherwise, it is the same as the adjusted R^2.

Example J[47] of R^2 explicitly labeled in a table

Table 2 Regressions to Explain Public Service Motivation

	Public Service Motivation	
Independent variables	B (std. error)	Beta
Education	1.093 (.398)	.172***
Professional identification	1.913 (.527)	.230****
Group culture	.332 (.288)	.079
Developmental culture	.117 (.260)	.023
Hierarchical culture	−.009 (.273)	−.002
Rational culture	−.237 (.264)	−.057
Red tape	−.431 (.147)	−.207***
Reform orientation	.088 (.039)	.145**
Hierarchical authority	.378 (.137)	.193***
Length of organizational membership	−058 (.025)	−.148*
Age	.029 (.040)	.049
Income	.347 (.330)	.069
Gender (Female)	.543 (.519)	.065
N	237	
R^2	.220	
F	7.768	
Significance	.0000002	

46. Meier, 392
47. Moynihan, 46

With an R^2 of.220, the explanatory power of the model is not very high, but conclusions can still be drawn from the significant IVs identified.

c. *Just because a variable is statistically significant does not mean that it has a large effect on the DV*. In order to find out which variables have the largest effect on the DV, there are two choices:

i. Hopefully, the author included a table with the substantive effect of each variable,

ii. <u>If and only if two variables are measured using the exact same scale</u> (i.e. both are measured in dollars, or both are measured in number of people, etc.) then you can compare their coefficients. Larger coefficients have greater effects.[48]

F. (Sometimes) Repeat these steps for each model. Some tables summarize the effects of four or five different combinations of independent variables on the dependent variable.

a. When there are multiple models, look for any IVs that have significant coefficients (of the same sign, i.e. positive or negative) across all models – usually the author is trying to show that no matter which approach he/she used, this variable always seemed to be important.

---

48. Tarleton State University, 2

<u>PROBLEM SETS</u> (Answers located in Appendix C)

1. In the following examples, determine which variable is the dependent variable and which is the independent variable:
   1.1. A police chief believes that increasing expenditures for police will reduce crime.

      Independent variable__________

      Dependent variable_______________

   1.2. A librarian believes that circulation is related to advertising.

      Independent variable__________

      Dependent variable_______________

   1.3. MPA candidates make good summer interns.

      Independent variable__________

      Dependent variable_______________

   1.4. The number of volunteers is affected by the weather.

      Independent variable__________

      Dependent variable_______________

2. In the following table, identify the **significant** independent variables.

Regressions to Explain Public Service Motivation		
	Public Service Motivation	
Independent Variables	B (std. error)	*t*
Education	3**	3.291
Professional Identification	1	1.282
Group Culture	0.5	0.9
Red tape	2*	2.576
Hierarchal authority	1	1.323
Reform orientation	1.5	1.645
N	30	
R2	0.72	

2.1. _________
2.2. _________
2.3. _________

3. Identify the Mean, Median and Mode in the following set of numbers: 64, 31, 65, 27, 31, 40, 33
   3.1. Mean: _______
   3.2. Median: _______
   3.3. Mode: _______

4. In a case study, a variable is shown to have a mean (μ) of 500 and a standard deviation (σ) of 100. Calculate the range of possible scores that lie within:
   4.1. 1 standard deviation of the mean (68.26%): __________
   4.2. 2 standard deviations (95.44%): ___________
   4.3. 3 standard deviations (99.72%): ___________

5. What is the difference between "$\mathbf{r^2}$" and "$\mathbf{R^2}$"?

____

____

____

Section 3
A Short Guide to Creating Survey Questions

A survey collects data on individuals for an analysis on some aspect of a group or area. It is useful for *comparing programs* or for *comparing individual performance* in a special program to individual performance in agencies or administrative units without the special program.[49] High response rates are better than low ones in surveys because there is less of a response bias between those who responded and those who did not.[50]

A. How to get the best response rates to mail surveys (these guidelines can also apply to face-to-face interviews and telephone surveys).

1. Expect to send or do follow-ups to improve response rates. For mail surveys, you may send out the surveys once, wait two weeks, then send out the second wave, wait another two weeks, and then possibly send out a third wave. Expect diminishing returns to each follow-up. How many waves to actually send will depend on yours and others' experience in your situation.[51]
2. Keep surveys short, no more than twenty minutes of the respondent's time. Longer times mean lower response rates.[52]
3. Administer surveys when it is convenient for the respondents, not when it is convenient for you or the researcher.[53]

49. Langbein, 192
50. Langbein, 193
51. Langbein, 196
52. Langbein, 197
53. Ibid.

4. Do not make it more costly for the respondents to cooperate. Do not ask for more than their time.[54]
   a. Include self-addressed stamped envelopes so the respondents can return their answers to you.[55]
5. Inform them, in an introductory letter or statement, why you are doing the survey and why it is important.[56]
6. Begin the survey with questions pertinent to the topic.[57] Leave demographic questions to the end of the survey, making sure to mention that they are for statistical purposes only.

B. Making surveys easy to answer.

1. Use close-ended (multiple choice) response categories instead open-ended opinion questions.[58]

<u>Example of an open-ended opinion question:</u>

What changes should the school board make in its policies regarding the placement of computers in elementary schools?

The above question is too vague and hard to answer.

---

54. Langbein, 197
55. Ibid.
56. Ibid.
57. Ibid.
58. Langbein, 198

Example of a close-ended question:

Should the school board increase or decrease its spending on computers for elementary school classrooms?

1. Increase a lot
2. Increase
3. Neither increase or decrease
4. Decrease
5. Decrease a lot

2. Use mutually-exclusive categories.[59]

Consider the following example:

How many hours did you spend at the office last week?

1. None
2. 1-8
3. 8-16
4. 16-24
5. 24-32
6. 32 or over

Respondents will have trouble answering “8,” “16,” “24,” and “32” because they repeat themselves. It is best to use mutually-exclusive categories such as “1-7, 8-15, 16-24, 25-32, 33 or over” to get clear information.

3. Avoid double- (or triple- or quadruple-) barreled questions and responses.[60]

---

59. Langbein , 201
60. Langbein, 201

My subordinate performed his/her tasks carefully, impartially, thoroughly, and on time.

1. Agree strongly
2. Agree
3. Neither agree or disagree
4. Disagree
5. Strongly disagree

This is a quadruple-barreled question, with four questions being asked in one. It is recommended to just break the above example into four separate items, one for each adverb.

4. Avoid vague responses categories when more precise categories are readily available.[61]

For example, consider the following ways of responding to the same question:

How often did you file reports to headquarters during the past month?

1. Never
2. Rarely
3. Occasionally
4. Regularly

VERSUS

1. Not at all
2. About once a week
3. Two or three times a week
4. About once a day
5. More than once a day

61. Langbein, 202

The second set of responses is far more informative and easier to interpret for the researcher.

5. When asking about age, income, and other numbers, use categories (20-29, 30-39, etc.) when exact numbers are available but not helpful.[62]

6. Avoid leading questions and outside cues.[63]

Do you believe that women, the primary caretakers of children, should be allowed to enlist in the military where their lives will be put in danger?

1. Yes
2. No

The example above is a leading question utilizing social pressure to influence the responder to answer in a certain way.

The state Supreme Court has ruled that spending among school districts must be equal. Do you favor or oppose this ruling?

1. Favor
2. Oppose
3. No opinion

This question is set up to increase the proportion which favors the policy; few people are likely to want to disagree with a state Supreme Court ruling. A more precise (and less leading) version of the question would be:

62. Langbein, 203
63. Ibid.

Would you favor or oppose a law that requires spending among the school districts in the state to be equal on a per capita basis?

1. Favor
2. Oppose
3. No opinion

7. If possible, avoid Agree/Disagree questions.[64]

On average, students in my classroom are more interested in studies during this school year than last year.

1. Agree strongly
2. Agree
3. Neither agree or disagree
4. Disagree
5. Strongly disagree

There are three problems with the set of choices. First, disagreeing with the statement does not indicate what the respondent believes. Second, the responses confuse intensity of opinion with the position of the opinion.[65] Does agreement mean that the respondent thinks that students are *much* more interested in their studies but is not confident of this view? Or does the respondent think that students are *somewhat* interested and is very confident of this assessment? And, third, the set of choices induce bias due to the tendency among many people to just be agreeable.

---

64. Langbein, 204
65. Ibid.

Using bipolar, balanced response categories will resolve all of these problems.[66] For example:

Compared to the last school year, my students' interest in their studies this year has:

Increased a lot				Decreased a lot		
+3	+2	+1	0	-1	-2	-3

References

Langbein, Laura, and Claire L. Felbinger. *Public Program Evaluation: A Statistical Guide.* Armonk, New York: M.E. Sharpe, 2006.

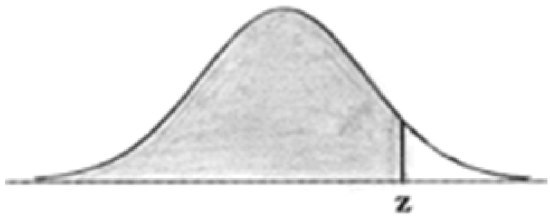
Meier, Kenneth J., Jeffrey L. Brudney, and John Bohte. *Applied Statistics for Public & Nonprofit Administration.* 7th. Thomson Wadsworth, 2009.

Moynihan, Donald P., and Sanjay K. Pandey. "The Role of Organizations in Fostering Public Service Motivation." *Public Service Review*, January/February 2007: 40-53.

Tarleton State University. "A Guide to Interpreting Statistics." *Tarleton State University.* October 7, 2007. www.tarleton.edu/~jdixon/StatisticalInterpretation.doc (accessed September 13, 2012).

66. Langbein, 205

APPENDIX A[67]
Table of the Normal Distribution



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

67. Image Source: http://www.math.unb.ca/~knight/utility/NormTble.htm

APPENDIX B[68]
T DISTRIBUTION SCORES

Tail Probabilities

One Tail		0.10	0.05	0.025	0.01	0.005	0.001	0.0005	
Two Tails		0.20	0.10	0.05	0.02	0.01	0.002	0.001	
D	1	3.078	6.314	12.71	31.82	63.66	318.3	637	1
E	2	1.886	2.920	4.303	6.965	9.925	22.330	31.6	2
G	3	1.638	2.353	3.182	4.541	5.841	10.210	12.92	3
R	4	1.533	2.132	2.776	3.747	4.604	7.173	8.610	4
E	5	1.476	2.015	2.571	3.365	4.032	5.893	6.869	5
E	6	1.440	1.943	2.447	3.143	3.707	5.208	5.959	6
S	7	1.415	1.895	2.365	2.998	3.499	4.785	5.408	7
	8	1.397	1.860	2.306	2.896	3.355	4.501	5.041	8
O	9	1.383	1.833	2.262	2.821	3.250	4.297	4.781	9
F	10	1.372	1.812	2.228	2.764	3.169	4.144	4.587	10
	11	1.363	1.796	2.201	2.718	3.106	4.025	4.437	11
F	12	1.356	1.782	2.179	2.681	3.055	3.930	4.318	12
R	13	1.350	1.771	2.160	2.650	3.012	3.852	4.221	13
E	14	1.345	1.761	2.145	2.624	2.977	3.787	4.140	14
E	15	1.341	1.753	2.131	2.602	2.947	3.733	4.073	15
D	16	1.337	1.746	2.120	2.583	2.921	3.686	4.015	16
O	17	1.333	1.740	2.110	2.567	2.898	3.646	3.965	17
M	18	1.330	1.734	2.101	2.552	2.878	3.610	3.922	18
	19	1.328	1.729	2.093	2.539	2.861	3.579	3.883	19
	20	1.325	1.725	2.086	2.528	2.845	3.552	3.850	20
	21	1.323	1.721	2.080	2.518	2.831	3.527	3.819	21
	22	1.321	1.717	2.074	2.508	2.819	3.505	3.792	22
	23	1.319	1.714	2.069	2.500	2.807	3.485	3.768	23
	24	1.318	1.711	2.064	2.492	2.797	3.467	3.745	24
	25	1.316	1.708	2.060	2.485	2.787	3.450	3.725	25
	26	1.315	1.706	2.056	2.479	2.779	3.435	3.707	26
	27	1.314	1.703	2.052	2.473	2.771	3.421	3.690	27
	28	1.313	1.701	2.048	2.467	2.763	3.408	3.674	28
	29	1.311	1.699	2.045	2.462	2.756	3.396	3.659	29
	30	1.310	1.697	2.042	2.457	2.750	3.385	3.646	30
	∞	1.282	1.645	1.96	2.326	2.576	3.08	3.291	∞
Two Tails		0.20	0.10	0.05	0.02	0.01	0.002	0.001	
One Tail		0.10	0.05	0.025	0.01	0.005	0.001	0.0005	

Tail Probabilities

68. Image Source: http://www.math.unb.ca/~knight/utility/t-table.htm

APPENDIX C
Solutions to Problem Sets from Section 2

1.1. Independent variable: expenditures
Dependent variable: crime

1.2. Independent variable: advertising
Dependent variable: circulation

1.3. Independent variable: MPA candidacy
Dependent variable: good performance

1.4. Independent variable: weather
Dependent variable: number of volunteers

2.1. Education — there are two asterisks and the t score is above 1.645
2.2. Red tape — there is an asterisk and the t score is above 1.645
2.3. Reform orientation —the t score is above 1.645

3.1. Mean: 41.57
3.2. Median: 33
3.3. Mode: 31

4.1. 68.26% of all possible scores lie between 400 and 600.
4.2. 95.44% of all possible scores lie between 300 and 700.
4.3. 99.72% of all possible scores lie between 200 and 800.

4. "r^2" is used for bivariate regression models, while "R^2" is used in multiple regression models.

U.S. ARMY WAR COLLEGE
Prudens Futuri
Carlisle Barracks, PA

U.S. ARMY WAR COLLEGE
SSI
STRATEGIC STUDIES INSTITUTE

CENTER for STRATEGIC LEADERSHIP and DEVELOPMENT
CSLD
U.S. ARMY WAR COLLEGE

PKSOI

PARAMETERS

U.S. Army War College
SLDR
Senior Leader Development and Resiliency

SCHOOL OF STRATEGIC LANDPOWER
U.S. ARMY WAR COLLEGE

UNITED STATES ARMY HERITAGE AND EDUCATION CENTER

FOR THIS AND OTHER PUBLICATIONS, VISIT US AT
http://www.carlisle.army.mil/

This Publication

PKSOI Website

USAWC Website

ISBN: 978-0-9894393-0-5