

**Rutgers-Camden Doctoral Program in Public Affairs/Community
Development**

**Topics, Sample Questions, and Suggested Readings for the
Comprehensive Methods Examination**

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I. Logic of Social Inquiry and Research Design

A. List of Topics

Approaches to Social Science Research

- Positivism
- Post-Positivism
- Critical Theory
- Interpretivism
- Correlation vs. causation
- Logic of causal inference

Measurement Issues

- Types of data
- Validity
- Reliability
- Index and scale construction

Sampling Techniques

- Simple Random sampling
- Stratified Sampling
- Multi-Stage Cluster Sampling

Survey Research

- Questionnaire Construction
- Survey Administration

Research design

- Experiments
- Quasi-Experiments
- Natural Experiments
- Qualitative Methods
 - Ethnography
 - Participant observation
 - Case studies
 - Principles of field work
 - Structured interviews
- Quantitative methods
 - Difference in differences
 - Interrupted time series
 - Regression discontinuity
 - Instrumental variables
 - Propensity score matching
 - Statistical power
 - Significance vs. importance

Ethics in research

B. Sample Questions

1. The publication of Theda Skocpol's *States and Social Revolutions* initiated a heated debate within the social sciences about not only her theory of the state but also her methodology. For some, her research demonstrated all of the pitfalls of small-N comparative analysis. Describe Skocpol's research design. What are the weaknesses of her research design? Explain. What are the strengths of her research design? Explain. Does her research design solve the *fundamental problem of causal inference*? Why or why not?

2. Social scientists are often admonished to distinguish facts from values in order to frame testable empirical theories or hypotheses. Public policy analysis depends on social scientific inquiry to formulate responses to socio-economic problems, but is explicitly concerned with values or normative issues (i.e., fairness, efficiency, etc.) Select a specific public policy problem of interest to you (e.g., affordable housing, urban crime, childhood obesity, unemployment) and explain the role that facts and values respectively, would play in an analysis of the problem.

3. Does playing violent video games at home cause boys to become more violent and aggressive in school? This question concerns many parents and educators. Assume you have just received a grant to conduct a study of this question. For a previous study, you collected data on a simple random sample of 200 ten year old boys in the Richardson Independent School District (RISD), including data on the boy's demographics, their leisure activities including time spent playing violent video games, and disciplinary infractions at school. However, most of the boys in the previous study did not play violent video games at that time and video games were not the focus of the previous study. The boys are now 16, and you suspect many more of them now play these games and play them for longer periods. Your grant will allow you to go back and reinterview the boys as well as collect additional data from the school. Since the boys' families previously consented to participation, you assume they will continue to participate. RISD has agreed to participate as well.
 - a) State your research hypothesis, and the appropriate null hypothesis.
 - b) What research design will you employ?
 - c) What is your dependent variable?
 - d) What is your main independent variable?
 - e) What additional independent variables do you intend to control if any?
 - f) What additional data will you have to collect to implement your design?

- g) What specific statistical tests will you conduct relevant to your research hypothesis?
 - h) What is the main threat to internal validity in this design? List only one. Explain.
 - i) What is the main threat to external validity in this design? List only one. Explain.
 - j) Fifteen boys in the original sample have transferred out of the district. You do not have the funding to track them and the new school districts are unlikely to cooperate. Does this present any problems for your study? If so, what are they?
4. In *White Logic, White Methods*, sociologists Tukufu Zuberi and Eduardo Bonilla-Silva offer a series of startling claims about the relationship between race and social science research. For example, they write: “Not only are Whites a dominant population, the dominant perspective in sociology has been defined by a view of reality that privileges Whites in the United States and Europe...[S]ociology has been—and still is—a White-led and White-dominated field and, therefore, it should not surprise anyone that the logic of analysis and methods used to investigate racial matters reflect this social fact.” Do you find this argument compelling? Why or why not? Given the logic of statistical methods (e.g. the linear model), under what conditions (if any) does race shape applications of this method? Under what conditions (if any), can this method escape the racial dynamics of the society in which it is applied?
 5. In his seminal work, *The Structure of Scientific Revolutions*, Thomas Kuhn characterized the common understand of science, including social science, as “the constellation of facts, theories and methods collected in current texts,” and scientific development as, “the piecemeal process by which these items have been added, singly and in combination, to the ever growing stockpile that constitutes scientific technique and knowledge.” Kuhn, of course, argues that this model of science as an incremental progression is flawed. Explain Kuhn’s critique of this historiographic model. In discussing his alternative view of paradigmatic shifts be sure to offer examples from the social as well as the natural sciences. Select a policy or approach to community development and illustrate how Kuhn’s theory, rather than the incremental progression model, applies to your case.
 6. The rational choice approach has assumed a prominent position within the social sciences. While some scholars have welcomed this development, others have fiercely opposed it. In *Pathologies of Rational Choice*, political scientists Donald Green and Ian Shapiro write: “We contend that much of the fanfare with which the rational choice approach has been heralded in political science must be seen as premature once the question is asked: What has this literature contributed to our

- understanding of politics? We do not dispute that theoretical models of immense and increasing sophistication have been produced by practitioners of rational choice theory, but in our view the case has yet to be made that these models have advanced our understanding of how politics works in the real world.” Do you find this argument compelling? Why or why not? Outline and discuss the foundational propositions of this theoretical approach. Then, drawing upon the work of two different interpretivist scholars, formulate a critique of the rational choice approach.
7. Cross-national comparisons can be a fruitful method of analysis. They can also present significant analytical, conceptual, and measurement challenges. Select a specific public policy problem of interest to you (for example, affordable housing, urban crime, childhood obesity, or unemployment) and formulate a specific research question related to that problem. Then outline and discuss the benefits and drawbacks of a large-N, cross-national design that attempts to answer that question.
 8. Recently, three prominent scholars at Harvard University received intense criticism for approving a dissertation that found that the “average IQ of immigrants in the United States is substantially lower than that of the white native population” and argued that the lower intelligence of immigrants should be considered when drafting immigration policy.
 - (a) What are the advantages and disadvantages of using IQ as a measure in social scientific studies?
 - (b) How would positivists evaluate this measure?
 - (c) How would interpretivists evaluate this measure?
 9. Karl Popper and Thomas Kuhn offer two different perspectives on the development of scientific knowledge. Briefly outline the logic of those frameworks. Identify specific issues on which the two frameworks disagree and issues on which they agree, if any.

10. The City of Philadelphia observed that one of the most common causes of auto accidents is drivers who run red lights. Philadelphia has data on traffic accidents over many years, coded by location. In an attempt to reduce accidents, Philadelphia installed red light cameras at some of the most accident-prone intersections. The cameras take pictures of red light violators and a ticket is sent to the registered owner of the vehicle. The City expects a reduction in accidents over time, as more people learn about the cameras by getting tickets or by hearing about the program from others who did. The city has given you their monthly accident data going back to 1990, coded by location, as well as the date of red light camera installations and the number of tickets per month at each location.
- (a) State the City's hypothesis and the appropriate null hypothesis.
 - (b) What analytic strategy will you use to test the City's hypothesis?
 - (c) What is your dependent variable? What is your main independent variable?
 - (d) What additional independent variables do you intend to control if any? (Assume you have the variables you need in the dataset.)
 - (e) What is the main threat to internal validity in this design? List only one. Explain.

11. In seeking to bridge the gap between the positivist and interpretive traditions in qualitative research, Professor Ann Chih Lin argues that:

The usual juxtaposition of qualitative research against quantitative research makes it easy to miss the fact that qualitative research itself encompasses at least two traditions: positivist and interpretivist. Positivist work seeks to identify qualitative data with propositions that can then be tested or identified in other cases, while interpretive work seeks to combine those data into systems of belief whose manifestations are special to a case...I argue that discovering causal relationships is the province of positivist research, while discovering causal mechanisms is the province of interpretivists. *Policy Studies Journal*, Vol. 26, No 1, 1998 (162-80)

- (a) How does a *positivist* view of research differ from an *interpretivist* view? Please consider the difference from an ontological perspective (the nature of reality), an epistemological perspective (the nature of knowledge), and a methodological perspective (appropriate research methods).
- (b) What are the advantages and disadvantages of interpretivism and positivism, respectively?
- (c) Is Lin's attempt to define interpretivism and positivism as complementary rather than fundamentally in conflict persuasive?

12. At a recent policy conference, researchers presented a study examining the effect of SAT preparation courses on SAT scores. The researchers collected data on twenty 11th grade students in a local high school. Each student filled out a survey that asked them two questions: 1. Did you take a SAT preparation course? 2. What was your SAT score? Using this data, they found high school students who took SAT preparation courses had lower SAT scores relative to high school students who did not take a SAT preparation courses. Answer the following questions:
- Do you believe this study's findings? If not, what are some potential research design questions you would ask this researcher and why?
 - What is the difference between correlation and causation? Can you prove causation?
 - If you were this researcher, how would you design this study to estimate the causal impact of SAT preparation courses on SAT scores?
13. Ernie Van Moore, the Mayor of Income Falls knows that cities across the U.S. have different minimum wages and after reviewing this variation, he introduced an ordinance to raise the minimum wage in Income Falls from \$7.80 to \$12.00 per hour. In a city council hearing, the head of Income Fall's Chamber of Commerce, Hiram Cheap, complains that an increase in the local minimum wage will actually decrease employment by raising the price of labor. In response, Mayor Van Moore cites a study by the Department of Commerce demonstrating that the last increase in the federal minimum wage showed no statistically significant impact on national employment rates. On learning of this controversy, the Mayor's Director of Research, Marge Inovera, explains to Ernie that using the Department of Commerce study to draw conclusions about Income Falls would be an "ecological fallacy."
- Using the example above (i.e., drawing conclusions about the relationship between local minimum wages and employment in Income Falls' from the national Commerce Department study), explain the problem of an ecological fallacy.
 - How might Marge design a more valid study to test the employment effects of an increase in Income Falls' minimum wage?
14. "Alternative sentencing programs," such as *drug courts*, offer a way to reduce mass incarceration. In the drug court model, one or two judges control all non-violent drug cases in a jurisdiction and, working with in collaboration with defendants, prosecutors, probation officers and nonprofits, devise a program of supervision instead of a prison sentence.

An ABD student interested in explaining the factors that lead a community to establish drug courts proposes a dissertation in which she will examine four municipalities that have adopted the drug court model. Based on her literature review, she hypothesizes that the critical independent variable in deciding to adopt the drug court model is the number of community organizations that focus on public safety as an issue. To control for other influences, she selects four cities of comparable size, demography, and crime rates, all located in the same state. Her dissertation advisor, a disciple of the King, Keohane, and Verba approach to qualitative analysis, agrees that she has identified an interesting question and formulated a solid hypothesis, but rejects her research design.

- (a) Identify and explain the flaw the advisor sees in her research design.
- (b) How do you think her dissertation advisor would recommend she fix the flaw? Again, frame your discussion in terms of the specific hypothesis about creating drug courts.

C. Suggested Readings

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II. Quantitative Methods I & II

A. List of topics for Research Methods Exam

Descriptive Statistics

- Levels of measurement (types of variables)
- Types of data (cross-sectional, longitudinal, cohort, panel)
- Measures of central tendency
- Measures of dispersion
- Correlation

Probability

- Basic rules of probability
- Random Variables
- Probability distributions
- The normal distribution

Inferential Statistics

- Sampling theory
- Sampling distributions and the properties of estimators
- Confidence Intervals and hypothesis tests, including z, t, F, and χ^2 tests as appropriate, for:
 - Means and proportions
 - Difference of two means and difference of two proportions
 - Difference in variances
 - Association between variables
 - Goodness of fit

Linear Regression Analysis

- Regression models (bivariate and multiple)
 - Estimation by Ordinary Least Squares (OLS)
 - Hypothesis testing (single and joint hypotheses)
 - Use of indicator variables (aka dummy variables)
 - Varying intercepts
 - Varying slopes
 - Interactions
- Alternative functional forms
 - Logarithmic functions forms
 - Quadratic and polynomial functional forms
 - Piece-wise linear models
- Specification Errors
 - Omitted variable bias
 - Incorrect functional form
 - Errors in variables
- Deviations from OLS assumptions and corrections
 - Heteroskedasticity
 - Autocorrelation
 - Endogeneity
- Panel data analysis

- Fixed effects
- Random effects
- Instrumental variables

B. Sample Questions:

i) Descriptive and Inferential Statistics

1. Five hundred students apply for a certain scholarship. Each student receives a rating based on their financial aid, references, personal essays, and so on. The ratings are normally distributed with a mean score of 50 and a standard deviation of 15.
 - a) How many students received ratings higher than 70?
 - b) How many students had ratings between 40 and 60?
 - c) One student's z score was -1.33; what was his rating?

2. A recent New York Times/CBS News survey of 688 persons found that 352 approved of President Obama's handling of the economy. The sample included 356 women, of whom 196 approved, and 332 men, of whom 156 approved.
 - a) What is the 95 percent confidence interval for the proportion of the population that approves of President Obama's handling of the economy?
 - b) What is the 90 percent confidence interval for the *difference* between men and women in the proportion who favor President Obama's handling of the economy?

3. From the New York Times, November 21, 2002, p. 1:

Scientists are reporting today that they have created the first vaccine that appears able to prevent cervical cancer. The vaccine works by making people immune to a sexually transmitted virus that causes many cases of the disease. The vaccine is experimental and will not be available to the public for several years. A successful vaccine could sharply reduce rates of cervical cancer, which affects 470,000 women a year worldwide and kills 225,000. In the United States, there are 13,000 cases a year and 4,100 deaths. In a study of 2,392 young women, half of them vaccinated and half given placebo shots, the vaccine was 100 percent effective. Followed for 17 to 27 months, no vaccinated women developed infections or precancerous growths from the virus, whereas 41 non-vaccinated women did become infected, including 9 with precancerous cervical growths.

Based on the information in the paragraph above, test the hypothesis that the new vaccine is effective in preventing the infections associated with cervical cancer.

4. The Social Security Disability program pays benefits to former workers who are no longer able to work due to a physical or mental disability. The hard part is deciding who is disabled enough to qualify for the program. Many people who apply for benefits are denied, and they have a right to appeal. The appeals are randomly assigned to one of several judges, who reviews the case and makes a decision. Overall, 70 percent of the appeals are denied, so the applicant does not receive any benefits. The table below shows the record on appeals for 2001. Since the cases are randomly assigned and the judges are supposed to use the same standards, there isn't supposed to be any systematic difference between the judges in terms of their decisions. Test the hypothesis that the outcome of the case is related to the judge to whom the case is assigned.

Outcome of Appeal		Judge			
		Anderson	Bennett	Cramer	Davis
Approved		19	13	17	19
Denied		20	43	41	28

5. In the 1970s, experiments were conducted to determine whether an income subsidy would lead to increased rent expenditures. Summary statistics for one of the experimental groups is shown below. "Rent1" is the rent of the households before the subsidy began. "Rent2" is the rent of those households 1 year after the subsidy began. "Diff" is the difference between rent1 and rent2 for each household. There were 362 total households in the study. Test the hypothesis that the amount households spent on rent increased. Can we conclude that the subsidy was the cause of the increase? Explain your answer.

Variable	Obs	Mean	Std. Err.	Std. Dev.
rent1	362	116.88	3.32	63.22
rent2	362	126.01	3.76	71.59
diff	362	9.13	2.05	39.02

6. Two students made two different mistakes in the final exam for descriptive and inferential statistics class. Student A used t-test for one sample mean test for a sample of more than 100; student B used a Z-test for one sample mean test for a sample of less than 10. We do not know the underlying distribution of the variable in question. Which mistake is more serious? Or maybe both are serious? Explain.
7. Why, when we test hypotheses, do we always test them in terms of population parameters, not in terms of the sample statistics? There are at least two serious reasons.

8. Is there something wrong with this statement, or is it correct? Explain.

“When you increase your sample size, your test statistic is going up in absolute value and your p value is going up as well, hence your results are more statistically significant.”

9. A researcher wants to figure out the effectiveness of a flu vaccine. The vaccine was provided free of charge in a two-shot sequence over a period of two weeks to those wishing to avail themselves of it. Some people received the two-shot sequence, some appeared only for the first shot, and others received neither. Do the data present sufficient evidence to indicate dependence between vaccine classification and the occurrence or nonoccurrence of flu?

	no vaccine	one shot	two shots	total
flu	24	9	13	46
no flu	289	100	565	954
total	313	109	578	1000

10. A city manager is trying to determine if her new personnel procedures are decreasing the time it takes to hire an employee. She takes a sample shown below, and calculates the average time to hire an employee in days before and after implementing the new procedures. Help her decide.

bureau	before	after
a	36	32
b	49	45
c	55	12
d	70	10
e	44	24

11. During the Senate impeachment hearings of President Bill Clinton in 1999, the *Dallas Morning News* published a letter to the editor from David Read of Grand Prairie that read as follows:

I’m sick and tired of listening and reading news commentary on some poll that shows that *the American people* are tired of the Senate hearings and that two-thirds of the public want Mr. Clinton to remain in office. STOP SAYING THAT! It’s not true and any intelligent person who knows anything about how phone surveys are taken knows that. The only statement that could be honestly reported would be one which stated that “two-thirds of the people polled” expressed a certain opinion. Let’s leave the American people out of this poll spin.

Please write a response to Mr. Read. Specifically comment on whether the underlined statement is true or false and explain your reasoning.

12. In *Differences that Matter* (Ithaca NY: Cornell, 2006), Dan Zuberi interviews low-wage hotel workers in Seattle and Vancouver to assess the importance of different social policies in the U.S. and Canada. One of the largest differences, at least at the time of the study, is that Canada had a universal health insurance program in place, whereas the U.S. did not and therefore many low wage workers were uninsured. Of the 39 workers Zuberi interviewed in Seattle, he reports that 67 percent saw a doctor regularly. Of the 38 workers he interviewed in Vancouver, he states that 85 percent saw a doctor regularly.
- What is the 95 percent confidence interval for the difference in the proportion that sees a doctor regularly?
 - Test the hypothesis that low-wage workers in Vancouver are more likely to see a doctor regularly than in Seattle at the 0.05 level of significance.
13. A recent CNN survey asked registered voters their opinions about government spending on education and government spending on public safety. For each, should it increase, or should it decrease?

<u>Education Spending</u>	<u>Public Safety Spending</u>		Total
	Increase	Decrease	
Increase			292
Decrease			73
Total	330	35	365

Answer the following questions:

- Assuming that “being in favor of an increase in public safety spending” and “being in favor of an increase in education spending” are entirely independent events, fill in the missing values in Table 1.
- Test whether there is a difference in the population proportions favoring public safety and education spending and discuss the results of the test.
- Construct a 95% confidence interval for the difference of proportions. Interpret.

14. Table 2 presents survey data on college students' cigarette and alcohol usage in Baltimore, MD.

Table II-2: College Student Cigarette and Alcohol Usage

		<u>Cigarette Use</u>	
		Yes	No
<u>Alcohol Use</u>	Yes	1,449	500
	No	46	281

- (a) Calculate the probabilities of cigarette use conditional on alcohol use and explain their meaning.
- (b) Test whether cigarette use and alcohol use are statistically independent. State your conclusion based on the test.
15. Renski et al. (1999) studied the impact of speed limit increases on crash injury severity using data from North Carolina. They analyzed crashes on specific road segments before and after the speed limits were raised when the nationwide 55 mph speed limit was removed. The results are shown in Table 3 below.

Table II-3: Accident Injury Severity after Speed Limit Increase

<u>Injury Classification</u>	<u>Before</u>	<u>After</u>
No injury	80	66
Class C (least severe)	24	41
Class B (moderate)	11	18
Class A (most severe)	3	2

Source: Renski, Henry, Asad Khattak, and Forrest Council. "Effect of speed limit increases on crash injury severity: analysis of single-vehicle crashes on North Carolina interstate highways." *Transportation Research Record: Journal of the Transportation Research Board* 1665 (1999): 100-108.

- (a) Is there a relationship between the speed limits and injuries?
- (b) Do you consider this analysis to be internally valid? Why or why not?
16. A city has a problem with unpaid real estate taxes. The city uses two different bill collection services for recovering unpaid taxes. Cases are randomly assigned to one service or the other as they reach a status of 90 days past due. Based on a sample of 50 cases for each collector, Service A recovered \$540 per \$1,000 owed with a standard deviation of \$120. Service B recovered \$560 per \$1,000 owed with a standard deviation of \$150. Assume the amounts collected for both services were approximately normally distributed.

- (a) Which service is more likely to collect 50 percent of the taxes owed in any given case?
- (b) What is the 95 percent confidence interval for the difference in collections between Service A and Service B?

ii) Regression Analysis

1. Persico et al. (2004) investigate the relationship between height and wages in the U.S. and Britain. They have measures of both adult and teen height in inches, age, number of siblings, parental education, and dummy variables indicating whether the parents are in skilled or professional occupations. Table 3 presents several regression models in which the dependent variable is the natural logarithm of the hourly wage for white male workers.

- a) Which coefficients in Model 6 are significant at the 0.05 level of significance? Show the tests.
- b) Discuss the exact interpretation of the significant coefficients in Model 6.
- c) Based on Model 5, what is the predicted wage for a 25 year old man who is 6 feet tall?
- d) Are the four parental schooling and occupation variables in Model 6 jointly significant at the 0.05 level of significance?
- e) On explanation for the wage premium for height is that employers discriminate in favor of taller people. Models 7 and 8 add teen height to the previous models. What conclusion do you draw from these models about the role of height in wage determination?

TABLE 3
OLS ESTIMATES $\ln(\text{Wage})$ EQUATION FOR ADULT, WHITE MALE WORKERS, NCDS AND NLSY

COVARIATE	BRITAIN: NCDS (N= 1,772)				UNITED STATES: NLSY (N=1,577)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Adult height (inches)	.027 (.0053)	.022 (.0052)	.004 (.0074)	.005 (.0073)	.025 (.0062)	.018 (.0060)	.002 (.0096)	-.004 (.0091)
Youth height (inches)			.026 (.0066)	.021 (.0066)			.027 (.0095)	.026 (.0090)
Age028 (.0066)	.027 (.0065)	.024 (.0067)	.023 (.0065)
Mother's years of schooling		.016 (.0104)		.016 (.0104)		.025 (.0092)		.023 (.0092)
Mother skilled/professional		-.080 (.0357)		-.074 (.0356)		.019 (.0608)		.024 (.0606)
Father's years of schooling		.008 (.0086)		.007 (.0087)		.030 (.0065)		.030 (.0065)
Father skilled/professional		.135 (.0467)		.130 (.0465)		.050 (.0459)		.052 (.0458)
Number of siblings		-.033 (.0084)		-.029 (.0084)		-.023 (.0077)		-.023 (.0077)
Adjusted R^2	.032	.047	.037	.049	.031	.092	.034	.094
Fstatistic (K, N - K - 1)	9.99	10.25	11.47	10.97	9.86	15.52	8.82	14.31

NOTE.—Standard errors robust to heteroskedasticity are in parentheses. See the note to table 2. The sample consists only of white male, full-time workers. Each specification includes controls for region and a constant term (results omitted).

2. Many argue that when metropolitan areas experience high levels of suburbanization, central cities become economically and socially isolated. In turn, economic and social isolation has long been suspected to increase crime. Thus, suburbanization may indirectly increase crime. To test the hypothesis, a researcher regressed metropolitan crime rates on a standard set of demographic factors and four indicators of suburbanization. Descriptive statistics are shown below, and regression models are shown on the next page.
- a) What is the predicted violent crime rate for the average metropolitan area? Either show your calculations or explain your reasoning.
 - b) Other things equal, how does the predicted violent crime rate in a metropolitan area with 500,000 residents compare to one with 400,000 residents?
 - c) Are the suburbanization indicators jointly significant at the 0.05 level of significance?
 - d) Which of the suburbanization indicators has the largest effect on the violent crime rate?
 - e) Crime in the central city may encourage people to move to the suburbs. If this is true, does it pose a problem for the analysis? If so, what should the authors do?

Table 1: Descriptive Statistics

<u>Variable</u>	<u>Obs</u>	<u>Mean</u>	<u>Std. Dev.</u>
Violent Crime Rate	318	438.78	236.73
Population (log)	318	12.77	1.05
Mean Household Income	318	41.03	7.97
% Non-Hispanic Black	318	0.11	0.11
% Hispanic	318	0.10	0.15
% 13-17	318	0.07	0.01
% 18-24, not in college	318	0.05	0.01
% 65 or older	318	0.13	0.03
Density Gradient	318	-0.19	0.11
Population Density	318	423.31	944.48
% in Central Cities	318	0.42	0.19
Mean Travel Time	318	22.45	3.64

Table 2: Regression Results for Metropolitan Violent Crime Rate

	<u>Model 1</u>	<u>Model 2</u>
Constant	312.197 (245.645)	134.380 (272.748)
Demographic Characteristics		
Population (log)	51.741 (9.746)	49.547 (12.757)
Mean Household Income	-7.587 (1.591)	-7.627 (1.672)
% Non-Hispanic Black	1176.275 (110.334)	1129.772 (123.317)
% Hispanic	714.524 (71.197)	657.073 (78.050)
% Age 13-17	-3810.414 (1676.789)	-3899.739 (1765.286)
% Age 18-24*	-3236.698 (1194.783)	-3640.026 (1186.957)
% Age 65+	78.001 (444.801)	343.789 (455.680)
Suburbanization Indicators		
Density Gradient		96.963 (175.200)
Population Density		-0.025 (0.008)
% in Central City		199.581 (64.777)
Mean Travel Time		6.905 (4.218)
F	57.8	39.98
R ²	0.5662	0.5835
Root MSE	153.07	151.05
N	318	318

Standard errors in parentheses

*Excluding college students

3. The Women, Infants, and Children (WIC) program provides prenatal nutrition to low-income mothers. The goal of the program is to increase the health of newborn children. One of the most important indicators of infant health is birth weight. Low birth weight babies suffer from many more physical problems and often require very expensive care. The regression shown in Table 1 regresses birth weight (in grams) on an indicator variable for the WIC program and a number of control variables.
- Based on Model 4, what is the predicted birth weight for a male child, not part of a multiple birth, who is the first birth to an unmarried mother who is on WIC, age 16, with 12 years of education?
 - What is the effect of the WIC program according to the different models? Are the estimated effects statistically significant? Why do they vary so much? Which estimate do you think is the best?
 - Explain the meaning of the three age coefficients in Model 4.
 - Are the mother's characteristics in Model 4 jointly significant at the 0.05 level? Show the test and explain the result.
 - The variance inflation factors (VIF) and the Breusch-Pagan tests for model 5 are shown below. What do you conclude based on this information?

Variable	VIF	1/VIF
age	58.42	0.017118
age2	58.05	0.017227
wic	2.40	0.417382
educ	2.18	0.459359
married	1.52	0.656909
prev	1.01	0.991445
male	1.01	0.992124
multi	1.00	0.995546
Mean VIF	15.70	

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
 Ho: Constant variance
 Variables: fitted values of bw
 chi2(1) = 0.00
 Prob > chi2 = 0.9964

Table 1: Models of Birth Weight (Grams) of Children Born to Low Income, WIC Eligible Mothers

	Model 1	Model 2	Model 3	Model 4	Model 5	
Constant	3395 (16)	3367 (18)	3071 (115)	3078 (104)	2571 (209)	
WIC (Yes=1, No=0)	-64 (24)	-71 (22)	84 (34)	80 (31)	83 (31)	
<u>Child Characteristics</u>						
Male		118 (22)		99 (20)	99 (20)	
Multiple Birth		-763 (59)		-781 (54)	-783 (54)	
<u>Mother Characteristics</u>						
Age of Mother (Base: <18 years)						
18-19 years			9 (57)	-10 (52)		
20-34 years			76 (44)	75 (40)		
35+ years			-54 (80)	0 (73)		
Unmarried (yes=1, no=0)			176 (27)	192 (25)	191 (24)	
Previous Births (number)			-153 (16)	-147 (14)	-145 (14)	
Education (years)			19 (9)	16 (8)	13 (8)	
Age (years)					44 (15)	
Age squared					-0.76 (.29)	
	r2	0.007	0.173	0.142	0.305	0.308
	N	977	977	977	977	977

Note: Standard errors in parentheses.

4. In conducting regression analyses, researchers have a seemingly limitless tool bag of specification tricks. Variables can be transformed and interacted in a variety of ways. Suppose you have a dependent variable Y , several continuous independent variables X_2 through X_4 , and a “dummy variable,” i.e. a binary independent variable D , coded as 1 if the observation is a member of a specific group and 0 otherwise. In what circumstances would you employ each of the specifications listed below? Also discuss how the interpretation of each model would differ from a standard linear model, i.e. $Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 D_i + u_i$

- (a) A “log-lin” model:

$$\ln(Y)_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 D_i + u_i$$

- (b) A “log-log” specification for the relationship between Y and X_2 :

$$\ln(Y)_i = \beta_1 + \beta_2 \ln(X_{2i}) + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 D_i + u_i$$

- (c) A quadratic specification for the effect of X_3 .

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 D_i + \beta_6 X_{3i}^2 + u_i$$

- (d) A model that includes an interaction between X_4 and D .

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 D_i + \beta_6 D_i X_{4i} + u_i$$

- (e) A piece-wise linear specification for the effect of X_2 , where C is dummy indicating that X_2 is above a specified value (X_2^*).

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 D_i + \beta_6 C_i (X_{2i} - X_2^*) + u_i$$

5. In an effort to understand the racial and ethnic gaps in student achievement, a researcher administered a word recognition test to a sample of kindergarten children. All of the children were between 5 and 6 years old. (The mean age in the sample was 66 months.) In Model I, the researcher regressed the word recognition score (converted to a z score) on indicator variables for race/ethnicity and gender, and a quadratic specification for age in months. This model establishes the baseline gaps between the groups and between genders, conditional on age. In Model II, the researcher controlled for several variables that measure the socio-economic status of the child's family (family income and parents' education levels). Finally, in Model III, the researcher controlled for the mean test score in the child's school to test for neighborhood, school, and peer effects. The word recognition score, the socio-economic variables, and school mean scores have been converted to z scores; in other words, these variables have means of 0 and variances of 1. The results of the regressions are presented in Table 1 on the following page.

- (a) Based on Model III, what is the predicted test score for a white male child who has average values on all other characteristics?
- (b) Based on Model I, what is the marginal effect of age on word recognition score for a 60 month old child? How does that effect change as the child ages?
- (c) Only one of the socioeconomic variables is even borderline significant. If you had the raw data, what steps would you take to test for multicollinearity? If multicollinearity is present, what would you do about it?
- (d) Test the hypothesis that family socioeconomic status helps to explain word recognition score at the 0.01 level of significance.
- (e) Discuss what these results tell you about the direct and indirect effects of race, ethnicity, and gender on achievement among students.

Table 1: Ordinary Least Squares Regression of Word Recognition Scores

	Model I	Model II	Model III
Constant	-8.019 ***	-8.917 ***	-8.125 ***
Black	-0.376 ***	-0.191 **	0.009
Hispanic	-0.110 **	0.015 *	-0.006
Asian	0.349 ***	0.139 **	0.033 *
Indian	-0.323 ***	-0.043 *	-0.056 *
Age (months)	0.199 ***	0.211 ***	0.197 ***
Age squared	-0.001 **	-0.001 ***	-0.001 ***
Male	-0.468 ***	-0.228 ***	-0.192 **
Family Income		0.158 *	0.109 *
Father's Education		0.045	0.020
Mother's Education		0.055	0.027
School Mean Score			0.211 ***
R ²	0.171	0.256	0.270
N	597	597	597

Significance Level: *p<0.10, **p<0.05, ***p<0.01

6. In a widely cited article, Bruce Western explores the effect of incarceration on men's wages using a longitudinal panel from the National Longitudinal Survey of Youth (NLSY). His OLS regression models for the log of wages are shown below in Table 4.
- Based on Model 1, how does previous incarceration affect wage, controlling for the other variables in the model?
 - Based on Model 1, what is the predicted wage for a previously incarcerated man, not currently incarcerated, who is 25 years old with 10 years of education?
 - Explain how to interpret the coefficient on "Log age" in Model 1.
 - Western states that "the fixed effects models (Models 2, 3, and 4) remove large differences in work experience between never-incarcerated and pre-incarcerated men as a confounding source of variation." Explain what this means and how it affects your interpretation of the "Was incarcerated" coefficient in Model 2 compared to Model 1.
 - Model 3 adds year and an education by year interaction. Test the hypothesis that these two variables are jointly significant with 99 percent confidence.

Table 4. Unstandardized Coefficients from the Regression of Log Hourly Wages on Incarceration, Main Effects Model: NLSY Men, 1983 to 1998

Independent Variable	Model 1	Model 2	Model 3	Model 4
Intercept	1.04** (.02)	.71** (.05)	2.23** (.09)	2.23** (.14)
Was incarcerated (<i>P</i>)	-.07** (.01)	-.19** (.02)	-.16** (.02)	-.16** (.02)
Now incarcerated (<i>C</i>)	-.23** (.02)	-.24** (.02)	-.23** (.02)	-.23** (.02)
Log age (<i>A</i>)	.42** (.02)	.50** (.02)	2.27** (.13)	2.05** (.21)
Education (<i>E</i>) × 10	.43** (.01)	.65** (.03)	-.05 (.05)	-.15 (.08)
Year (<i>t</i>)	—	—	-.11** (.01)	-.10** (.01)
(Education × year) × 100	—	—	.41** (.02)	.38** (.03)
Fixed effects	No	Yes	Yes	Yes
Sample	Full	Full	Full	At-risk
R ²	.34	.61	.62	.60
Number of observations	47,616	51,424	51,424	18,923
Number of respondents	4,953	5,438	5,438	2,092

Note: Standard errors are in parentheses. Model 1 includes controls for juvenile contact with the criminal justice system, cognitive ability, race, and ethnicity. All models control for work experience, enrollment status, drug use, marital status, union membership, industry, and region. The full sample includes all respondents. The at-risk subsample includes respondents who report crime, delinquency or any incarceration. Results for control variables are reported in Appendix A.

p* < .05 *p* < .01 (two-tailed tests)

Source: Western, Bruce. "The impact of incarceration on wage mobility and inequality." *American Sociological Review* (2002): 526-546.

C. Suggested Readings

- Joshua D. Angrist and Jorn-Steffen Pischke. *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton, NJ: Princeton University Press, 2009.
- Damodar N. Gujarati and Dawn C. Porter, *Basic Econometrics*, 5th edition.
- Paul A. Jargowsky and Rebecca Yang, *Descriptive and Inferential Statistics*.
- Paul A. Jargowsky, *Using the F Statistic to Test Hypotheses*.
- Paul A. Jargowsky, *Omitted Variable Bias*.
- Kennedy, Peter. 2003. *A Guide to Econometrics*. MIT press.
- Gary King, "How Not to Lie with Statistics: Avoiding Common Mistakes in Quantitative Political Science" *American Journal of Political Science* 30 (1986): 666-687.
- William Mendenhall, Robert J. Beaver, and Barbara M. Beaver, *Introduction to Probability and Statistics*, 14th edition.
- R. Lyman Ott and Micheal T. Longnecker, *An Introduction to Statistical Methods and Data Analysis*, 6th ed.
- Larry Schroeder, David L. Sjoquist, Paula E. Stephan, *Understanding Regression Analysis: An Introductory Guide*. Thousand Oaks, CA: Sage Publications, Inc., 1986.
- James H. Stock and Mark W. Watson, *Introduction to Econometrics*, 3rd edition.