Texas State University  
School of Criminal Justice  
Ph.D. Comprehensive Exam for Statistics  
October 7, 2013  
9:00 a.m. – 11:00 a.m.

DIRECTIONS: Choose Option One or Option Two.  
Save two electronic copies of your answer (one with just your ID number assigned to you,  
the other with your ID number and name). Email both copies to Cybele Hinson  
<ch56@txstate.edu>. Print out and turn in a hard copy as well with both your ID number  
and name on it.

Option 1:  
Background and Motivation

Whether the American justice system delivers more severe punishments to minorities (and those  
with a lower socioeconomic status) is a topic that has been widely studied. Some argue that the  
severity of the offense explains racial disparities in the harshness of punishments. Others argue  
that racial bias and discrimination explain the disparity. This exam is focused on whether the  
quality of the defendant’s lawyer matters differently for sentence length when a defendant is a  
minority.

Estimate an ordinary least squares multiple regression model to test the following hypothesis:

The quality of the defense attorney reduces the length of a criminal sentence, but only when the  
defendant is minority. The premise here is that because minorities have higher baseline sentences  
in the first place, the quality of the defense counsel can operate as an equalizer.

Hold constant the potentially confounding effects of: (1) severity of the alleged crime; (2)  
whether the defendant retained private legal counsel; (3) age of the defendant; and (4) sex of the  
defendant.

You may use a calculator.  
You will be assessed based on your responses to the following items:

1. Using the data file described below, use SPSS to estimate a multivariate ordinary least  
   squares regression equation with length of criminal sentence in weeks the dependent  
   variable. The primary independent variables are the defendant’s minority status, the  
   quality of the defendant’s legal counsel, and the statistical interaction (i.e., the product  
   term) of the defendant’s ethnic minority status and quality of defense counsel. The  
   secondary variables (that is, the control variables) are: severity of the alleged crime,  
   having a private defense lawyer, age, and sex.

2. Interpret the model-fit statistics associated with the model you estimated.
3. Based on the model you estimated, interpret (a) the y-intercept; and (b) the slopes (i.e., the coefficients) for the primary independent variables; and (c) their tests of statistical significance. Assume that all continuous variables have been centered on their means.

4. What is the effect of the quality of the defense attorney on sentence length for minority defendants?
   A. -12.345
   B. -12.054
   C. -0.291
   D. 24.845

5. Assume that the standard error for the effect of quality of the defense attorney is the same for both minority and non-minority defendants. Report (1) the numeric value of the t statistic for this effect given a minority defendant; and (2) whether this effect is statistically significant at the .05 level of statistical significance.

6. Based on your answers to questions 3-5, explain whether and how the results support (or reject) the motivating hypothesis.

7. Examine measures of outlying and non-outlying influence, and discuss whether levels of influence seem problematic for the model you estimated. If evidence for problems exists, do not attempt to address problems with additional analysis.
The data file contains data from 450 individual respondents. The variables relevant to the exam are named and described below.

### Data File Contents for Exam

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Variable Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>sentence</td>
<td>A continuous measure for sentence length in weeks. Higher values indicate longer sentences. Refer to units of this variable as points (or weeks) on a length of sentence scale.</td>
</tr>
<tr>
<td>quality</td>
<td>A mean-centered and continuous measure of the quality of the defendant’s counsel. Higher values indicate a higher quality defense attorney. Refer to units on this scale as points on the quality of the defense attorney scale.</td>
</tr>
</tbody>
</table>
| minority      | A dummy-coded variable for minority status of the defendant.  
0 = not minority  
1 = minority |
| product       | The product-term for the statistical interaction between the quality of the defendant’s legal counsel and the defendant’s minority status (that is, product = quality \times minority). |
| crime         | A mean-centered and continuous measure for severity of the alleged crime. Higher values indicate more severe or serious crime. Refer to units of this variable as points on the crime severity scale. |
| prlawyer      | A dummy-coded variable for whether the defendant retained private legal counsel.  
0 = did not retain private legal counsel  
1 = retained private legal counsel |
| age           | A mean-centered and continuous measure for the defendant’s age in years. Higher values indicate older defendant. Refer to units of this variable as years of age. |
| male          | A dummy-coded variable for sex of respondent.  
0 = not female  
1 = female |

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**End of Option 1**
Option 2:  
Background and Motivation

Whether the American justice system delivers more severe punishments to minorities (and those with a lower socioeconomic status) is a topic that has been widely studied. Some argue that the severity of the offense explains racial disparities in the harshness of punishments. Others argue that racial bias and discrimination explain the disparity. This exam is focused on whether independent variables play different roles, or matter differently when a defendant is a minority.

The investigator has split the sample into minority defendants and non-minority defendants. The investigator then estimated a standard linear regression model for minority defendants and another model for non-minority defendants. The investigator is interested in whether the effects of the independent variables operate differently across minority status.

The dependent variable is length of criminal sentence, and the primary independent variable is the quality of the defense attorney. The investigator argues that the quality of defense counsel reduces the length of a criminal sentence, but only when the defendant is minority. The premise here is that because minorities have higher baseline sentences in the first place, the quality of the defense counsel should operate as an equalizer.

Other variables of interest are: (1) the severity of the alleged crime; (2) whether the defendant retained private legal counsel as opposed to a public defender; (3) whether the defendant has known prior defenses (4) the age of the defendant; and (5) the sex of the defendant.

You may use a calculator.  
You will be assessed based on your responses to the following items:

1. Based on results in the non-minority subsample, interpret the estimate and the test of statistical significance for the effect of quality of defense lawyer on sentence length.

2. Based on results in the minority subsample, interpret the estimate and the test of statistical significance for the effect of quality of defense lawyer on sentence length.

3. With regard to the quality of the defense lawyer, do the results in the table support the hypothesis?

4. Based on the results, what is the approximate effect of minority status on the effect of the quality of the defense lawyer on sentence length? Report the actual numeric value.
5. Although the author is primarily interested in the effect of defense-lawyer quality, there is a more general argument: when investigating variability in length of criminal sentences, a different process unfolds when the defendant is minority. Discuss whether the reported model-fit statistics are consistent with the investigator’s hypothesis?

6. Assume the investigator had estimated only one model using the entire sample (as opposed to dividing the sample). Although these results are not presented, discuss whether the effect of age would be statistically significant.
Table for statistics exam, option 2

Ordinary least squares model explaining length of criminal sentence

By minority status of defendant

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sample</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Non-minority</td>
<td>Minority</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Effect</td>
<td>t</td>
<td>Effect</td>
<td>t</td>
</tr>
<tr>
<td>Quality of defense counsel</td>
<td></td>
<td>-1.13</td>
<td>-0.44</td>
<td>-11.89*</td>
<td>-3.12</td>
</tr>
<tr>
<td>Severity of charged offense</td>
<td>4.81</td>
<td>1.74</td>
<td></td>
<td>3.43</td>
<td>1.70</td>
</tr>
<tr>
<td>Private legal counsel</td>
<td>-10.41</td>
<td>-0.47</td>
<td></td>
<td>-30.77</td>
<td>-1.15</td>
</tr>
<tr>
<td>Prior offenses</td>
<td>-0.13</td>
<td>-0.41</td>
<td></td>
<td>0.68</td>
<td>1.75</td>
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<tr>
<td>Age</td>
<td>-3.80</td>
<td>-1.44</td>
<td></td>
<td>10.17*</td>
<td>2.98</td>
</tr>
<tr>
<td>Male</td>
<td>17.98</td>
<td>1.27</td>
<td></td>
<td>4.47</td>
<td>0.30</td>
</tr>
<tr>
<td>Constant</td>
<td>82.22</td>
<td>1.67</td>
<td></td>
<td>-141.54*</td>
<td>-2.24</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model Statistics</th>
<th></th>
<th>Model Statistics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>213</td>
<td>N</td>
<td>237</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.0369</td>
<td>$R^2$</td>
<td>0.1109</td>
</tr>
<tr>
<td>Root MSE</td>
<td>72.053</td>
<td>Root MSE</td>
<td>99.001</td>
</tr>
<tr>
<td>$F_{6,206}$</td>
<td>1.31</td>
<td>$F_{6,230}$</td>
<td>4.78*</td>
</tr>
</tbody>
</table>

* $p < .05$

a A continuous variable.

b A dummy-coded variable where zero indicates absence of characteristic.

End of Option 2