SAMPLE LAB EXAM 4

Case Study 1 (15 marks): Use 252sampleexam4a.sav to answer questions 1 – 15.

Discrimination against the Handicapped: Do people with physical disabilities have a more difficult time obtaining employment? One potential factor confronting people having a handicap may be a bias by employers during the employment interview. A study was designed to examine whether different types of physical handicaps produce different empathy by raters and to examine whether interviewer evaluations are affected by the type of handicap of the person being interviewed.

The paper, "Interviewers' Decisions Related to Applicant Handicap Type And Rater Empathy," *Human Performance*, 1990, 3: 157 – 171, describes a study that examines these issues.

The researchers videotaped five simulated job interviews for a computer sales position, with actors representing the interviewer and the applicant (the same actors were used in all interviews). Further, a set script (questions and answers) was the same for each video. The script was intended to explore the qualification of the applicant. The only difference between the interviews was the physical disability that the applicant displayed, but they were all depicted as permanent disabilities. The five disabilities were labeled: none (control), hard of hearing, crutches, wheelchair, leg amputee.

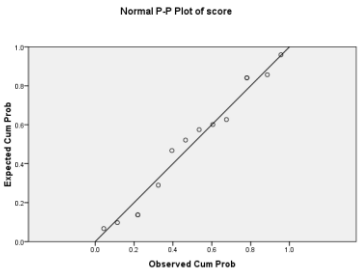
Seventy undergraduate students were selected to participate in the study. For each of the five videotapes, 14 students were randomly assigned to view the tapes. After viewing the tape, the participant rated the applicant on a 10-point scale that assessed the rater's evaluation of the applicant's qualifications. Do individuals rate qualifications differently according to a candidate's handicap? If so, which handicaps produce the different evaluations?

The data file contains the following variables:

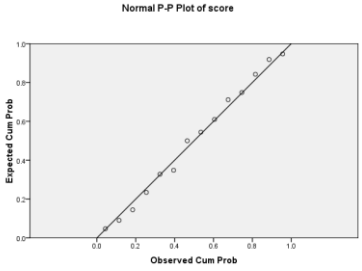
score: the qualification score (out of 10)
handicap: the type of handicap, (1 = none, 2 = hard of hearing, 3 = crutches, 4 = wheelchair, 5 = leg amputee)
handicap2: the type of handicap with all mobility handicaps grouped (1 = none, 2 = hard of hearing, 3 = mobility (crutches, wheelchair, and leg amputee))

1. One of the plots below is the normal probability plot of standardized residuals of score for the control group (no handicap). Which plot is it?

a)



b)



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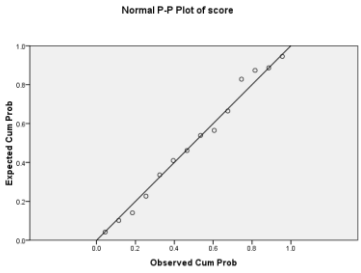

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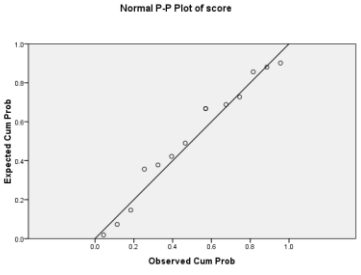

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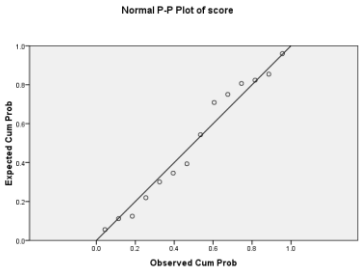

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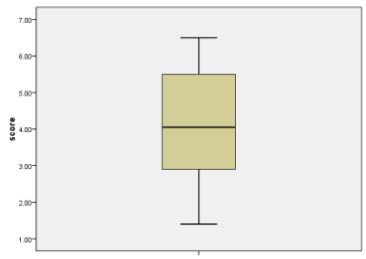
2. One of the plots below is the boxplot of scores for the hearing group. Which plot is it?

a)



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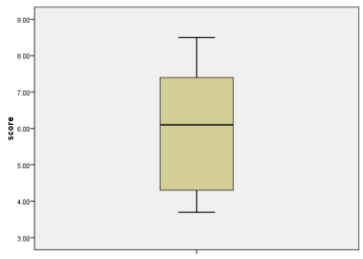

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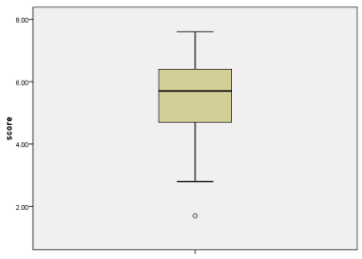
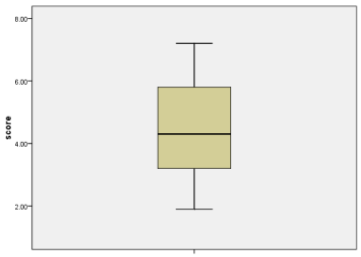


d)



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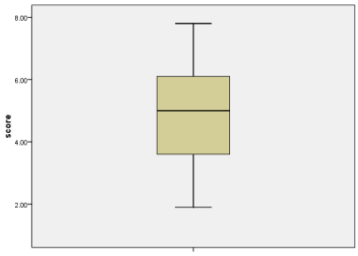


3. The sample variance of scores for the five handicap groups are, respectively:
   a) 0.479, 0.424, 0.396, 0.410, 0.467
   b) 1.793, 1.586, 1.482, 1.533, 1.748
   c) 2.666, 2.666, 2.666, 2.666, 2.666
   d) 3.216, 2.515, 2.196, 2.349. 3.056
   e) 0.230, 0.180, 0.157, 0.168, 0.218

4. Consider a One-Factor Model for average score with handicap type as the explanatory variable. What is the best estimate for the common standard deviation of the five groups?
   a) 1.719 b) 2.666 c) 1.633 d) 0.205 e) 1.628

5. Consider a One-Factor Model on score with handicap type as the explanatory variable. In the test for any mean differences, what are the extra sum-of-squared residuals and degrees of freedom that compare the model under the null hypothesis to the model under the alternative hypothesis?
   a) 173.321 and 65
   b) 30.521 and 4
   c) 142.800 and 61
   d) 203.843 and 69
   e) 0 and 70

6. Consider a One-Factor Model on score with handicap type as the explanatory variable. In the test for any mean differences, what is the distribution of the test statistic under the null hypothesis?
   a) F(5, 69) b) F(5, 65) c) F(4, 70) d) F(4, 69) e) F(4, 65)

7. Consider the following contrast: the mean score for the groups with no handicap minus the mean score for the groups with some handicap. What is the estimate for this contrast?
   a) -0.0357 b) -14.8429 c) -0.1428 d) -3.7107 e) -0.0714

8. Suppose you want to compare the mean score for the control group to the mean score for the mobility handicap groups (crutches, wheelchair, and amputee). What is the standard error of the estimated mean difference?
   a) 0.5416 b) 1.5118 c) 0.7559 d) 0.5039 e) 4.5354

9. What is the p-value for the test to determine if the average score is higher for those with no handicap vs. those with a hearing impairment?
   a) 0.448 b) 0.224 c) 0.896 d) 0.468 e) 0.234

10. According to the Bonferroni method with family-wise confidence level of 95%
    a) There are no significant differences.
    b) There is exactly one significant difference.
    c) There are exactly two significant differences.
    d) There are more than two significant differences, but not all are significantly different.
    e) All groups are significantly different.

Are there any significant differences in mean scores between the three mobility groups? In order to answer this question, you will compare the model with all groups potentially different to a model where all the mobility groups are the same (still potentially different from the control group and the hearing group). The variable *handicap2* is coded for the model where all the mobility handicaps are the same.

11. What is the reduction in sum-of-squared residuals by fitting the full five-mean model vs. the reduced three-mean model?
    a) 0
    b) 25.707
    c) 30.521
    d) 4.815
    e) 199.028

12. What is the test statistic for the test defined above?
    a) 2.862 b) 4.326 c) 0.810 d) 4.821 e) 3.214

13. Regardless of your results above, consider the three-mean model for this question. The magnitude of the test statistic for the test to determine if there is a difference in mean score between the hearing and mobility groups is:
    a) 1.347
    b) 1.284
    c) 0.810
    d) 1.271
    e) 4.821

Consider only the crutches group and the wheelchair group for questions 14 – 15. That is, **ignore** the data for the other three groups and answer questions 14 – 15 by considering this a **two independent sample** problem.

14. What is the standard error of the difference in mean scores between the crutches group and the wheelchair group?
    a) 0.5697 b) 0.0136 c) 0.5416 d) 0.6172 e) 0.4028

15. What is the distribution of the test statistic for the test to determine if the average score for the crutches group is higher than the average score the wheelchair group?
    a) t(68) b) t(26) c) F(2, 26) d) t(28) e) t(13)

Case Study 2 (15 marks): Use 252sampleexam4b.sav to answer questions 16 – 30.

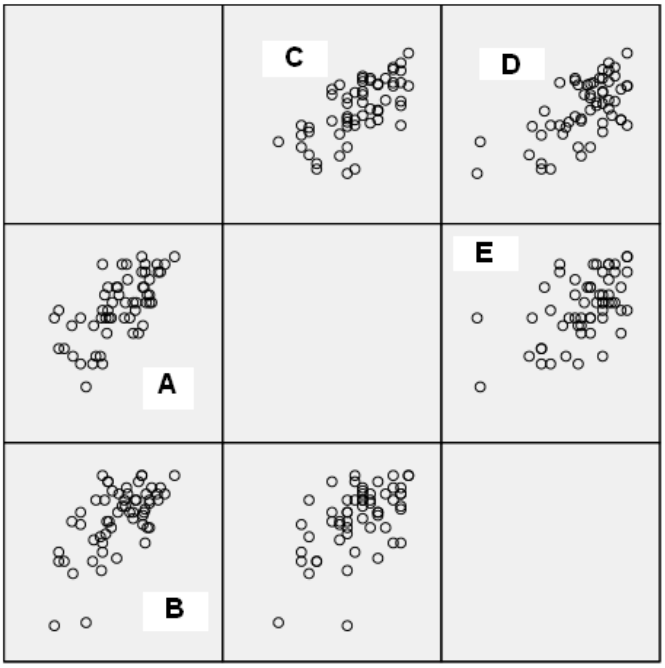
What factors can be used to predict how Stat 252 students will perform on their final exam? Here we will explore the linear association for final exam score (out of 65) given midterm score (out of 30), lab exam score (out of 30), and faculty (classified as Arts, Sciences, and Other). The sample consists of 57 randomly selected Stat 252 students from the last two years.

Column	Variable Name	Description of Variable
1	*final*	final exam score out of 65
2	*midterm*	midterm score out of 30
3	*labexam*	lab exam score out of 30
4	*midlab*	interaction variable between *midterm* and *labexam*
5	*faculty*	faculty (0 = Other, 1 = Sciences, 2 = Arts)
6	*science*	indicator variable for science (0 = not in sciences, 1 = in sciences)
7	*arts*	indicator variable for arts (0 = not in arts, 1 = in arts)

NOTE: If hand calculation is necessary to answer a question, round regression coefficients to 3 decimal places.

16. The scatterplot of final exam score vs. midterm score is:

a) A b) B c) C d) D e) E



Consider a regression model for average final exam score given midterm score. Use model 1 to answer questions 17 – 21.

Model 1: $\mu(final \mid midterm) = \beta_0 + \beta_1 midterm$

To make sure you have to correct output, the linear correlation between final exam score and midterm score should be 0.631.

17. Fit the simple linear regression model for model 1 defined above. The estimated regression equation is:
    a) 1.324 + 6.168midterm
    b) 1.570 + 0.260midterm
    c) 1.324 + 1.570midterm
    d) 6.168 + 0.260midterm
    e) 0.620 + 1.570midterm

18. The percentage of variation in final score that is explained by midterm score is:
a) 39.8 % b) 10.5 % c) 38.7% d) 63.1 % e) 36.37 %

19. In the F-test for any linear significance, the sum-of-squared residuals for the model under the null hypothesis and the model under the alternative hypothesis are, respectively:
a) 4020.680 and 6080.355
b) 10101.035 and 4020.680
c) 6080.355 and 10101.035
d) 6080.035 and 4020.680
e) 10101.035 and 6080.355

20. In the F-test for any linear significance, the distribution of the test statistic under the null hypothesis is:
a) F(1, 56) b) F(1, 55) c) F(2, 55) d) F(1, 57) e) F(2, 56)

21. What is the estimated effect on average final exam score for two additional points on the midterm?
a) 12.336 b) 2.648 c) 1.570 d) 0.520 e) 3.140

You decide to include lab exam score and the interaction between midterm and lab exam score in your model. "You've" defined the model below (model 2). Use model 2 to answer questions 22 – 24.

Model 2: $\mu(final \mid midterm, labexam) = \beta_0 + \beta_1 midterm + \beta_2 labexam + \beta_3 midlab$

To make sure you have the correct output, the test statistic for the test of any linear significance is 21.579.

22. What is the estimated average final exam score for individuals that scored 100% on both the midterm and lab exam?
a) 595.838 b) 4.188 c) 56.895 d) 65.000 e) 53.710

23. Does it appear that the effect of labexam score on final exam score depends on an individual's midterm score?
a) With a test statistic of 21.579 and a p-value close to zero, yes.
b) With a test statistic of 1.254 and a p-value of 0.215, no.
c) With a test statistic of 0.401 and a p-value of 0.690, no.
d) With a test statistic of -0.316 and a p-value of 0.753, no.
e) With a test statistic of 0.092 and a p-value of 0.927, no.

24. Which statement best describes the model?
a) No factors appear to be significant.
b) Some factors appear to be significant.
c) All factors appear to be significant.
d) We can accurately predict the final exam scores for 55% of the individuals.
e) This model is unreliable, because there is too much interaction between midterm score and labexam score.

Consider the following model (model 3) and answer questions 25 – 27.

Model 3: $\mu(final \mid midterm, FACULTY) = \beta_0 + \beta_1 midterm + \beta_2 sciences + \beta_3 arts$

To make sure you have the correct output, the sum-of-squared residuals for the model under the alternative hypothesis for the test to determine if model 3 has any linear significance is 5848.450.

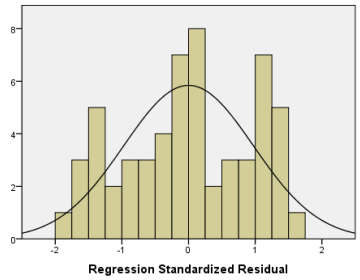
25. A 95% prediction interval for the final exam score of a student in education that scored 24 on their midterm is:
a) (21.27. 65.52) b) (35.11, 48.47) c) (16.89, 59.66)

d) (36.66. 50.13) e) (19.69, 63.90)

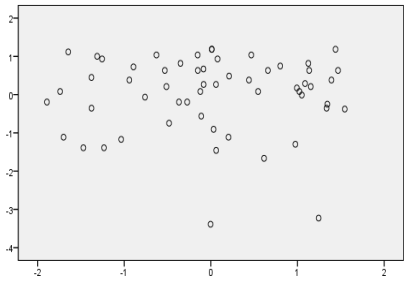
26. Does it appear that, after accounting for midterm score, students from other faculties perform better on the final exam than students from the faculty of science? The p-value for the test to answer this question is:
a) 0.250 b) 0.183 c) 0.499 d) 0.092 e) 0.000

27. In order to verify the validity of the constant variance assumption, which plot is most appropriate?

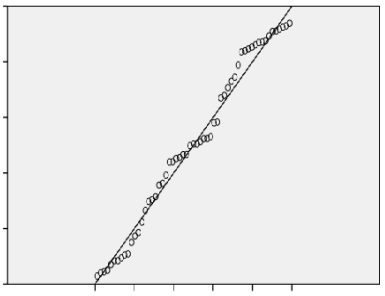
a)



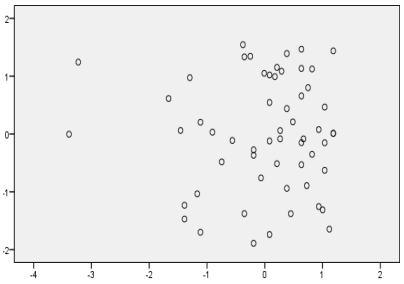
b)



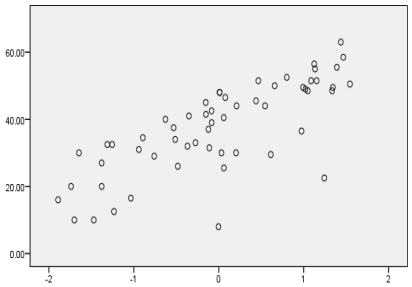
c)



d)



e)



For questions 28 – 30, you will have to consider and compare two models from the three models defined above (not necessarily the same two models in each question).

28. Does labexam score have any effect on average final exam score, after accounting for midterm score? The difference in sum-of-squared residuals between the reduced and full models is:
a) 1533.344 b) 5554.025 c) 231.905 d) 4020.680 e) 4547.011

29. Does labexam score have any effect on average final exam score, after accounting for midterm score? The test statistic used to answer this question is:
a) 6.937 b) 1.051 c) 1.254 d) 8.936 e) 21.579

30. Does it appear that faculty type has any effect on average final exam score, after accounting for midterm score? The sum-of-squares residuals for the model under the null and alternative hypothesis for this test are respectively:
a) 6080.355 and 5848.450
b) 4020.680 and 4252.586
c) 10101.035 and 6080.355
d) 10101.035 and 5848.450
e) 6080.355 and 4547.011