SECTION II

1. (a) This is an example of *stratified sampling,* where the chapters are strata. The advantage is that the student is ensuring that the final sample will represent the 12 different authors, who may well use different average word lengths.

   (b) This is an example of *cluster sampling,* where for each chapter the three chosen pages are clusters. It is reasonable to assume that each page (cluster) resembles the author's overall pattern. The advantage is that using these clusters is much more practical than trying to sample from among all an author's words.

   (c) This is an example of *systematic sampling,* which is quicker and easier than many other procedures. A possible disadvantage is that if ordering is related to the variable under consideration, this procedure will likely result in an unrepresentative sample. For example, in this study if an author's word length is related to word order in sentences, the student could end up with words of particular lengths.

Scoring

Part (a) is essentially correct for identifying the procedure and giving a correct advantage. Part (a) is partially correct for one of these two elements.

Part (b) is essentially correct for identifying the procedure and giving a correct advantage. Part (b) is partially correct for one of these two elements.

Part (c) is essentially correct for identifying the procedure and giving a correct disadvantage. Part (c) is partially correct for one of these two elements.

4 **Complete Answer**	All three parts essentially correct.
3 **Substantial Answer**	Two parts essentially correct and one part partially correct.
2 **Developing Answer**	Two parts essentially correct OR one part essentially correct and one or two parts partially correct OR all three parts partially correct.
1 **Minimal Answer**	One part essentially correct OR two parts partially correct.

2. (a) The SRS with $n = 50$ is more likely to have a sample proportion greater than 75%. In each case, the sampling distribution of $\hat{p}$ is approximately normal with a mean of .69 and a standard deviation of $\sigma_{\hat{p}} = \sqrt{\frac{pq}{n}} = \sqrt{\frac{(.69)(.31)}{n}} = \frac{.462}{\sqrt{n}}$. Thus the sampling distribution with $n = 50$ will have more variability than the sampling distribution with $n = 100$. Thus the tail area ($\hat{p} > .75$) will be larger for $n = 50$.

(b) The size of the sample, 30, is much too large compared to the size of the population, 95. With a sample size this close to the population size, the necessary assumption of independence does not follow. A commonly accepted condition is that the sample should be no more than 10% of the population.

(c) A normal distribution may be used to approximate a binomial distribution only if the sample size n is not too small. The commonly used condition check is that both np and nq are at least 10. In this case $nq = (20)(1 - .78) = 4.4$.

Scoring

Part (a) is essentially correct for correctly giving $n = 50$ and linking in context to variability in the sampling distributions. Part (a) is partially correct for a correct answer missing comparison of variability in the sampling distributions.

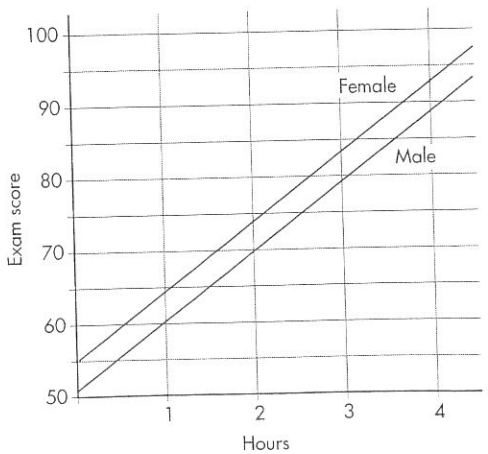
Part (b) is essentially correct for a clear explanation in context. Part (b) is partially correct for saying the sample size is too close to the population size but not linking to this context (sample size 30 and population size 95).

Part (c) is essentially correct for a clear explanation in context. Part (c) is partially correct for saying the sample size is too small but not linking to this context ($nq = 4.4 < 10$).

4 Complete Answer	All three parts essentially correct.
3 Substantial Answer	Two parts essentially correct and one part partially correct.
2 Developing Answer	Two parts essentially correct OR one part essentially correct and one or two parts partially correct OR all three parts partially correct.
1 Minimal Answer	One part essentially correct OR two parts partially correct.

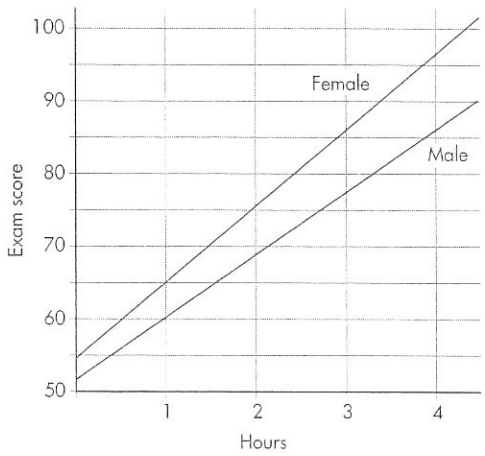
3. (a) The value 50.90 estimates the average score of males who spend 0 hours studying. The value 9.45 estimates the average increase in score for each additional hour study time. For any fixed number of hours study time, the value 4.40 estimates the average number of points that females score higher than males.

(b)



(c) For each additional hour of study time, the scores of males increase an average of 8.5 while those of females increase an average of 10.4. Additional hours of study time appear to benefit females more than males, something that does not show in the original model.

(d)



Scoring

Part (a) is essentially correct for correctly interpreting all three numbers in context and partially correct for correctly interpreting two of the three numbers.

Part (b) is essentially correct for correct graphs, clearly parallel and labeled as to which is which. Part (b) is partially correct for correct parallel graphs but missing labels, or for labeled, parallel graphs with incorrect y-intercepts.

Part (c) is essentially correct for correctly interpreting both slopes and for some comparative statement about additional hours study time appearing to benefit females more than males. Part (c) is partially correct for correctly interpreting both slopes but failing to make a comparative statement, or for making a correct comparative statement without interpreting the slopes.

Part (d) is essentially correct for correct graphs, clearly showing different slopes and labeled as to which is which. Part (d) is partially correct for graphs, clearly showing different slopes but missing labels, or for labeled graphs with different slopes but with incorrect y-intercepts.

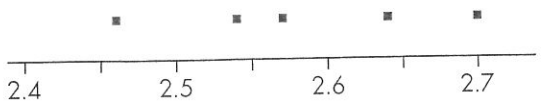
Count partially correct answers as one-half an essentially correct answer.

4 **Complete Answer**	Four essentially correct answers.
3 **Substantial Answer**	Three essentially correct answers.
2 **Developing Answer**	Two essentially correct answers.
1 **Minimal Answer**	One essentially correct answer.

Use a holistic approach to decide a score totaling between two numbers.

4. (a) Name the procedure: This is a one-sample t-interval for the mean.

Check the conditions: We are given that this is a random sample, and a dotplot.



makes the nearly normal condition reasonable.

Mechanics: A calculator readily gives $\bar{x} = 2.582$ and $s = 0.0923$. With $df = 4$, the critical t-scores are ± 2.776. Thus the confidence interval is

$$2.582 \pm 2.776\left(\frac{0.0923}{\sqrt{5}}\right) = 2.582 \pm 0.115.$$

Conclusion in context: We are 95% confident that the mean concentration level for the active ingredient found in this pharmaceutical product is between 2.467 and 2.697 milligrams per milliliter. [On the TI-84, with the data in L1, TInterval readily confirms this result.]

(b) Raising the confidence level would increase the width of the confidence interval.

(c) Since the whole confidence interval (2.467, 2.697) is below the critical 2.7, at the 95% confidence level the mean concentration is at a safe level. However, with 2.697 so close to 2.7, based on the statement in (c), if the confidence level is raised we are no longer confident that the mean concentration is at a safe level.

Scoring

Part (a) has two components. The first component is essentially correct for correctly naming the procedure and checking the conditions, and is partially correct for one of these two. The second component is essentially correct for correct mechanics and a correct conclusion in context, and is partially correct for one of these two.

Part (b) is either essentially correct or incorrect.

Part (c) is essentially correct for a correct conclusion in context for both the 95% interval and for if the confidence is raised, both conclusions referencing the answers from (a) and (b). Part (c) is partially correct for a correct conclusion in context for either of the confidence intervals or for both but with a weak explanation.

Count partially correct answers as one-half an essentially correct answer.

4 **Complete Answer**	Four essentially correct answers.
3 **Substantial Answer**	Three essentially correct answers.
2 **Developing Answer**	Two essentially correct answers.
1 **Minimal Answer**	One essentially correct answer.

Use a holistic approach to decide a score totaling between two numbers.

5. (a) Points A and B both have high leverage; that is, both their x-coordinates are outliers in the x-direction. However, point B is influential (its removal sharply changes the regression line), while point A is not influential (it lies directly on the regression line, so its removal will not change the line).

   (b) Point C lies off the regression line so its residual is much greater than that of point D, whose residual is 0 (point D lies on the regression line). However, the removal of point C will very minimally affect the slope of the regression line, if at all, while the removal of point D dramatically affects the slope of the regression line.

   (c) Removal of either point E or point F minimally affects the regression line, while removal of both has a dramatic effect.

   (d) Removing either point G or point H will definitely affect the regression line (pulling the line toward the remaining of the two points), while removing both will have little, if any, effect on the line.

Scoring

Each of parts (a), (b), (c), and (d) has two components and is scored essentially correct for both components correct and partially correct for one component correct.

Give 1 point for each essentially correct part and $\frac{1}{2}$ point for each partially correct part.

4 Complete Answer	4 points
3 Substantial Answer	3 points
2 Developing Answer	2 points
1 Minimal Answer	1 point

Use a holistic approach to decide a score totaling between two numbers.

6. (a) State the hypotheses: H_0: $\mu_A - \mu_B = 0$ and H_a: $\mu_A - \mu_B \neq 0$
   Identify the test and check conditions: two-sample t-test. It is given that the samples are random. The populations may not be normal, but since $n_A = 390$ and $n_B = 235$ are both large, it is OK to proceed with the t-test.

   Calculate the test statistic t and the P-value: $t = \dfrac{14.08 - 14.51}{\sqrt{\frac{2.93^2}{390} + \frac{3.71^2}{235}}} = -1.51$

   and with $df = 199$, we have $P = 2(.066) = .133$. [Or use $df = 623$. Or a calculator using the given sample statistics gives $t = -1.51$, $df = 408.25$, and $P = .131$. Or a calculator using the sample data gives $t = -1.53$, $df = 408.27$, and $P = .127$.]

   Conclusion in context: With this large a P-value, there is no evidence of a difference in the mean years of schooling between the two communities.

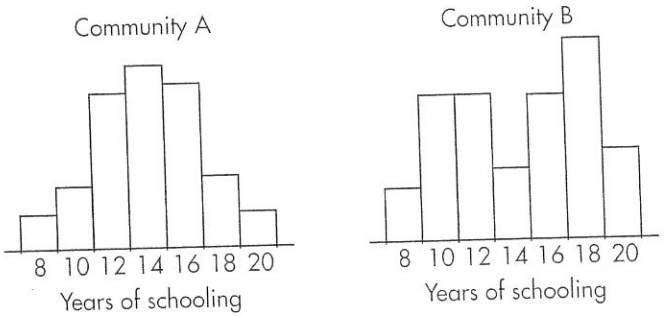
(b) State the hypotheses: H_0: The distribution of years of schooling is the same in the two communities. H_a: The distribution of years of schooling is not the same in the two communities.

Identify the test and check conditions: Chi-square test (of homogeneity). All expected counts are > 5.

Calculate the test statistic and the *P*-value: $\chi^2 = 57.85$ and with $df = (7 - 1)(2 - 1) = 6$, we have $P = .000$.

State the conclusion in context: With this small a *P*-value, there is strong evidence that the distribution of years of schooling is not the same in the two communities.

(c)



Although the two distributions have roughly the same center, their shapes are different. The distribution of years of schooling for Community A is unimodal, symmetric, and bell-shaped, while that of Community B is roughly bimodal with few scores in the center.

Scoring

Part (a) is essentially correct if all four steps for a two-sample *t*-test are correct and partially correct if three steps are correct.

Part (b) is essentially correct if all four steps for a chi-square test (of homogeneity) are correct and partially correct if three steps are correct.

Part (c) is essentially correct for an accurate comparison of the distributions linked to correctly drawn histograms. Part (c) is partially correct if only one of the two parts (comparison and histograms) is correct or if both are correct but there is no linkage.

4 Complete Answer	All three parts essentially correct.
3 Substantial Answer	Two parts essentially correct and one part partially correct.
2 Developing Answer	Two parts essentially correct OR one part essentially correct and one or two parts partially correct OR all three parts partially correct.
1 Minimal Answer	One part essentially correct OR two parts partially correct.