University of Toronto Scarborough
STAB22 Final Examination

December 2007

This examination is multiple choice. Ensure that you have a Scantron answer sheet and a #2 pencil, and complete the Scantron sheet according to the instructions (otherwise your exam may not be marked).

For this examination, you are allowed two letter-sized sheet of notes (both sides), handwritten and prepared by you, a non-programmable, non-communicating calculator, and writing implements.

If your answer is not included in the alternatives given, mark the answer that is most nearly correct from those alternatives.

If you need paper for rough work, use the back of the sheets of this question paper. The question paper will be collected at the end of the examination, but any writing on it will not be read or marked.

This examination has 23 numbered pages; before you start, check to see that you have all the pages.

1. One part of the stock market is called the "over-the-counter market". One way of measuring activity in a stock market is by the percentage of outstanding shares traded. On a particular day, the results for 40 shares were as shown in the stemplot below:

```
Stem-and-leaf of C1  N  = 40
Leaf Unit = 1.0

(22)  0  22222222223333333333
 18   0  444444455555
 6    0  66777
 1    0
 1    1
 1    1
 1    1
 1    1
 1    1
 1    2
 1    2  2
```

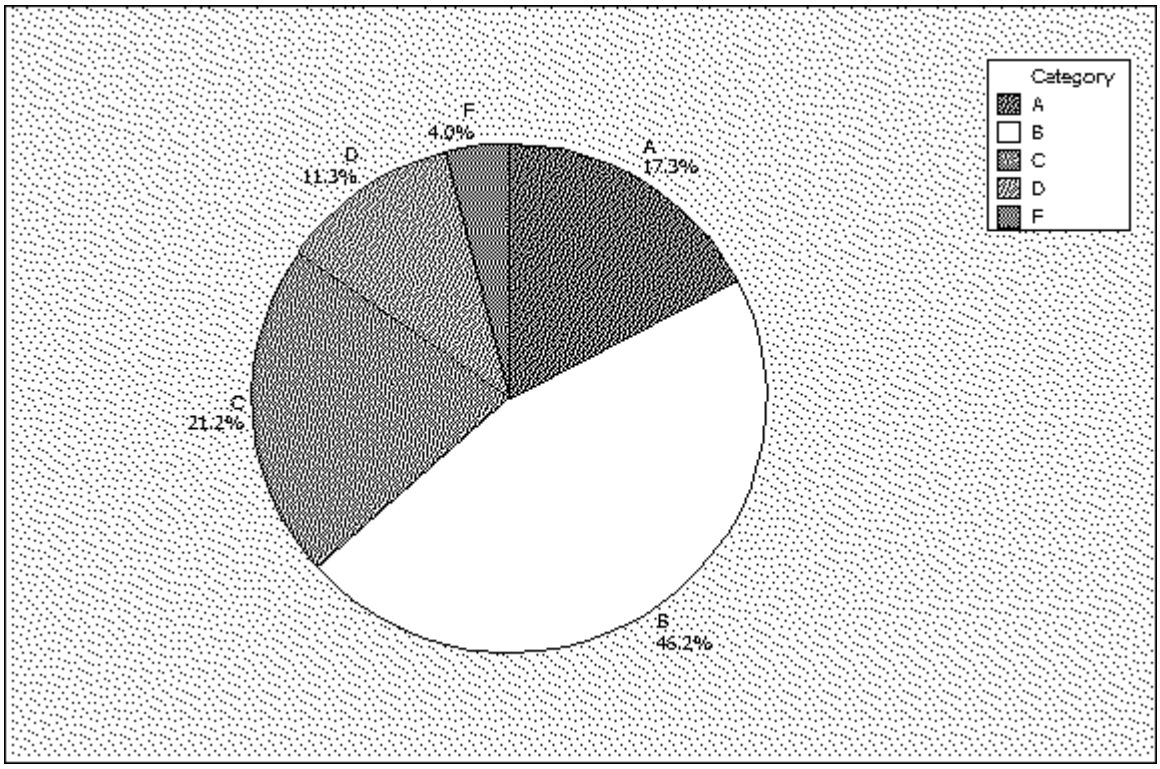
   What is the median of this distribution?

   (a) * 3
   (b) 0.3
   (c) 30
   (d) 2.2
   (e) 6

2. In the data of Question 1, how do the mean and median compare?

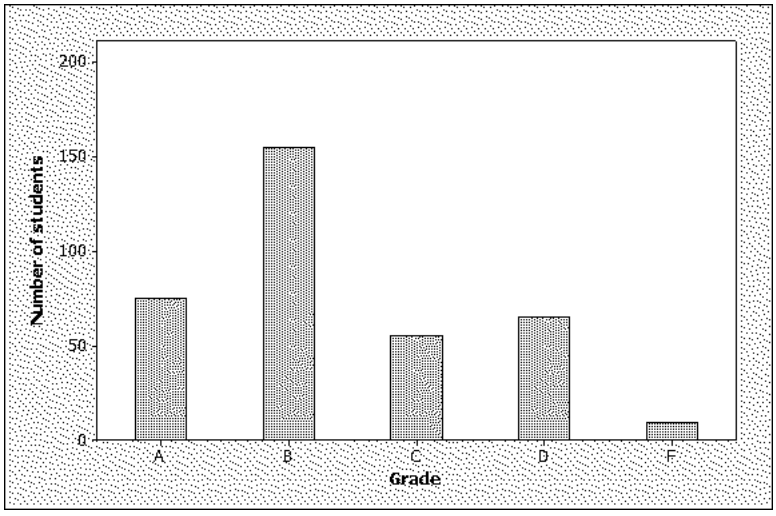
   (a) * The mean is bigger than the median
   (b) The median is bigger than the mean
   (c) The mean and median are about the same
   (d) It is impossible to compare the mean and median from this information.

3. The pie chart below displays the distribution of grades in a statistics course. Note that in this course, the performance of the students is graded into one of the five grades, A, B, C, D and F.

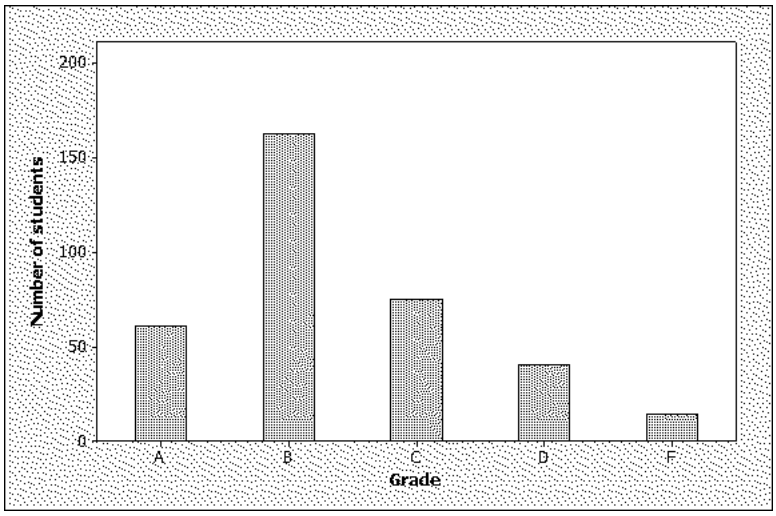


One (and only one) of the five bar charts blow was constructed from the same data set used to create the above pie chart. Which of the following bar charts represents the same data as the pie chart above?

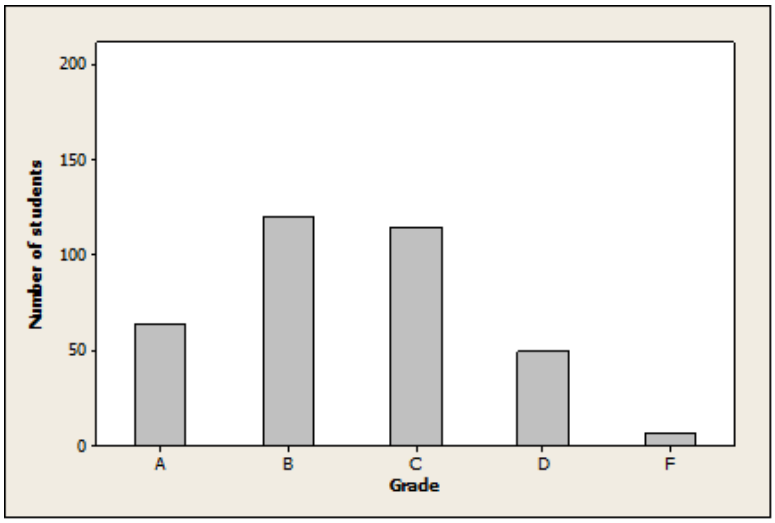
(a) This bar chart:



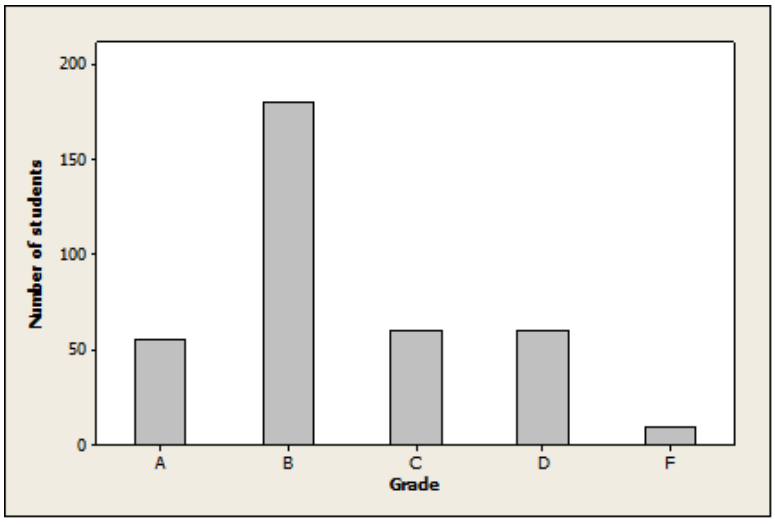
(b) * This bar chart:



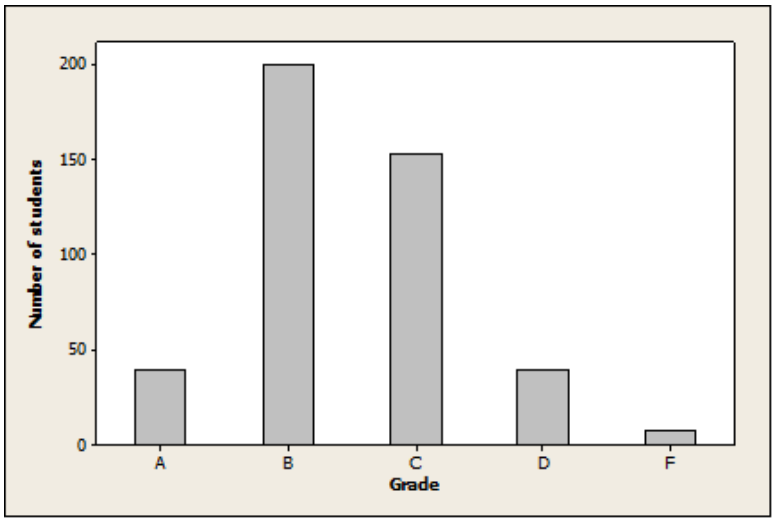
(c) This bar chart:



(d) This bar chart:



(e) This bar chart:



4. The MINITAB output below gives the stemplot of the GPAs of a group of 78 students in a class.

```
Stem-and-Leaf Display: GPA

Stem-and-leaf of GPA  N  = 78
Leaf Unit = 0.10


 1     0   5
 2     1   7
 3     2   4
 7     3   4689
 11    4   0678
 15    5   0259
 22    6   0001249
(22)   7   1122344555566668888999
 34    8   001111223378899
 19    9   011133445555679
 4     10  1577
```

This class actually had 82 students, but the GPAs of four of them were not available at the time, the above stemplot was constructed. Later, it was found out that the GPAs of these four students are 5.9, 7.1, 10.5, and 9.1.

Which of the following numbers is the closest to the interquartile range (i.e. IQR) of the GPAs of all 82 students?

(a) 2.0

(b) 2.3

(c) 2.6

(d) * 2.9

(e) 3.2

5. There are five children aged 3, 3, 4, 5 and 5 years in a room. If another 4-year-old child enters the room, what will happen to the mean and standard deviation of the ages of the children in the room?

   (a) The mean will stay the same but the standard deviation will increase.

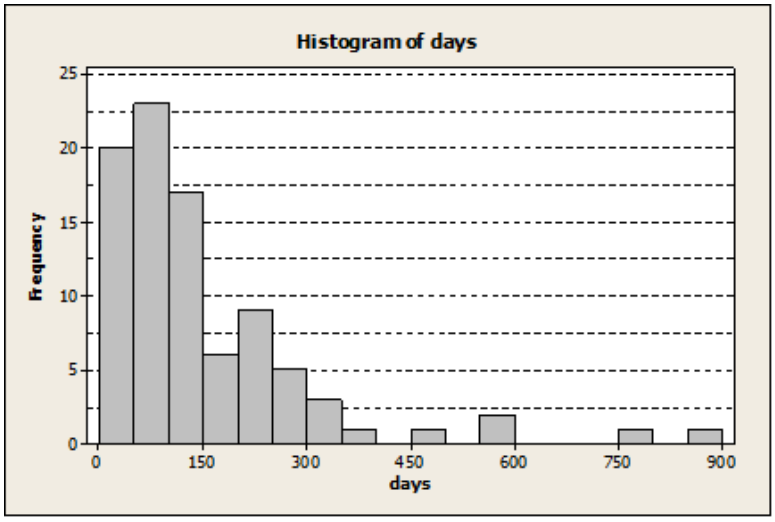
   (b) * The mean will stay the same but the standard deviation will decrease.

   (c) The mean and standard deviation will both stay the same.

   (d) The mean and standard deviation will both decrease.

   (e) The mean and standard deviation will both increase.

6. The histogram given below shows the distribution of survival times in days of 89 guinea pigs after they were injected with an experimental substance in a medical experiment.



   Which of the following statements regarding the median survival time is true?

   (a) The median survival time is less than 50 days.

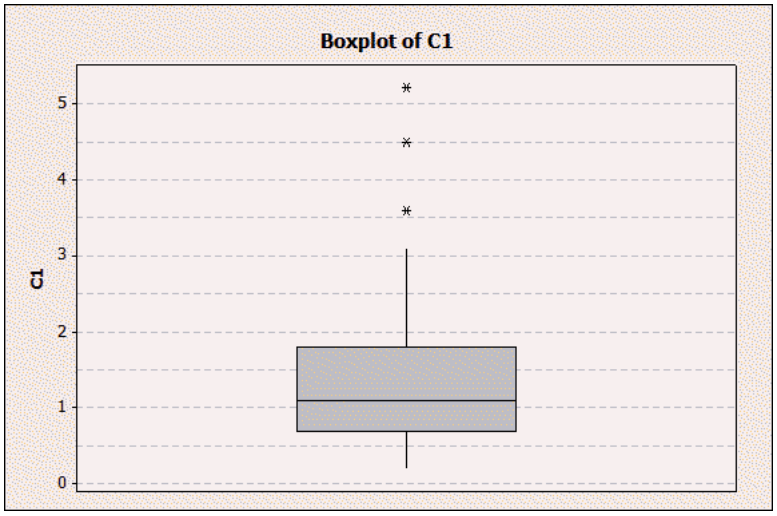
   (b) The median survival time is greater than 50 days but less than (or equal to) 95 days

   (c) * The median survival time is greater than 95 days but less than (or equal to) 155 days

   (d) The median survival time is greater than 155 days but less than (or equal to) 300 days

   (e) The median survival time is greater than 300 days

7. A supermarket chain studied the times required to service customers. The values, in minutes, are shown in the boxplot below.



What is the inter-quartile range of service times?

(a) * 1.1 minutes
(b) 0.4 minutes
(c) 0.7 minutes
(d) 3 minutes
(e) greater than 5 minutes

8. Gasoline use for compact cars sold in the United States has a normal distribution with mean 32 miles per gallon, and SD 5 miles per gallon. What proportion of compact cars obtain 40 miles per gallon or higher?

(a) * 0.05
(b) 0.95
(c) 0.15
(d) 0.85
(e) 0.30

9. Consider again the situation of Question 8. When gasoline is scarce, there is a competitive advantage in developing a car that has better (higher) miles per gallon than 90% of the current compact car market. What must the gasoline consumption (in miles per gallon) be for this new car?

(a) * 38.4
(b) 25.6
(c) 32.0

(d) 35.2

(e) 28.8

10. The time it takes (for any student) to complete a STAB22 final exam is a random variable having a normal distribution with mean 160 minutes and standard deviation 15 minutes. Anne, Bob, Clara and Dave are four friends writing this exam. What is the probability that at least one of them will complete the exam in less than 145 minutes? (Assume that their completion times are independent.)

(a) Less than 0.01

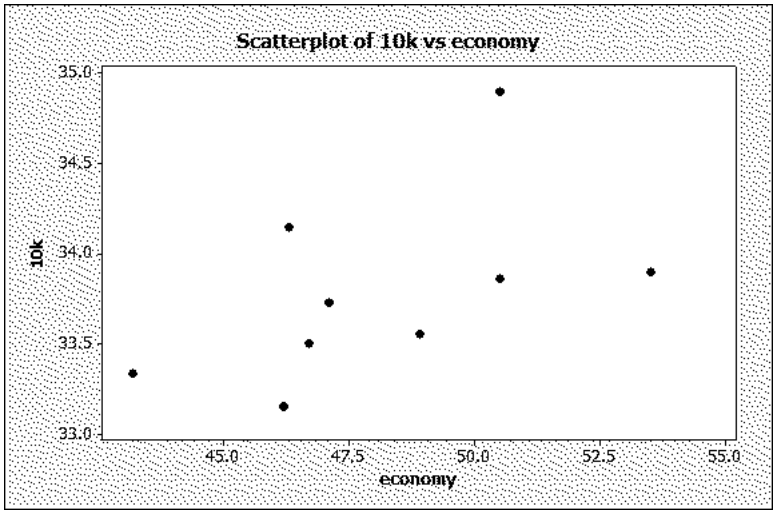
(b) Between 0.01 and 0.35

(c) Between 0.35 and 0.45

(d) * Between 0.45 and 0.55

(e) Greater than 0.55

11. The "running economy" of a runner is the oxygen consumption when that runner runs at a standardized speed. It is believed that a runner's finishing time in a 10 km race will be related to the running economy. A scatterplot of running economy and 10 km finishing time is shown below.



It is proposed to fit a straight line to these data. Which comment below is most appropriate?

(a) * The relationship is not very strong, but it appears roughly linear.

(b) A straight line describes this relationship very well, and the correlation will be very high.

(c) The relationship is clearly curved, and so fitting a straight line is a bad idea.

(d) This residual plot clearly does not show a random pattern, and therefore a straight line should not be used for these data.

(e) We cannot use regression techniques because of the outliers.

12. In the situation described in Question 11, you are asked to predict the finish time for a runner with running economy 40. What is your reaction to this request?

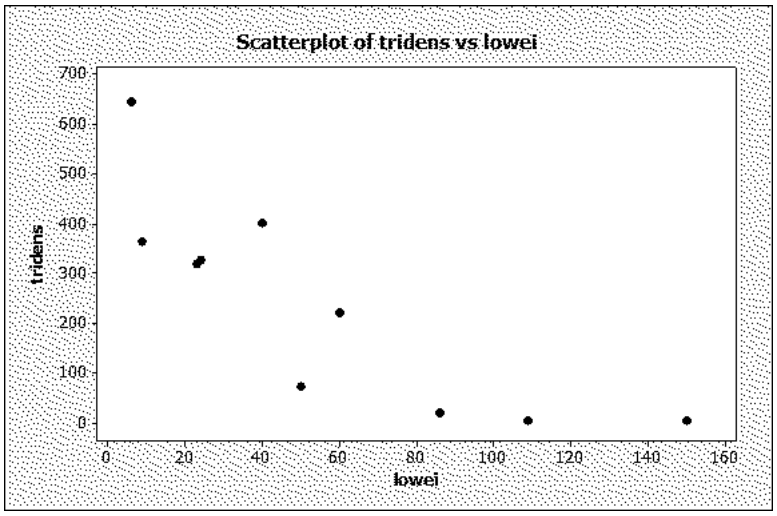
    (a) * A running economy value of 40 is very untypical for these data, and so the finishing time may not be predicted accurately.

    (b) Because a straight line describes the data, it is appropriate to use the regression equation to do this prediction.

    (c) The average finishing time is 33.8 minutes, and so this is our best guess at the finishing time for this runner.

    (d) A straight line is not appropriate here, so we cannot produce a prediction at all.

13. A study was made of the infestation of a certain type of lobster by two different types of barnacle, "tridens" and "lowei". It is believed that these two types of barnacle compete for space on the surface of the lobster. A sample of 10 lobsters is taken, and the number of barnacles of each type on each lobster is counted. A scatterplot of the results is shown below.



    What can you say about the correlation between the number of tridens and the number of lowei?

    (a) * It is definitely negative.

    (b) It is definitely positive.

    (c) It is close to zero.

    (d) It is close to $+1$.

    (e) It is close to -1.

14. Wood scientists are interested in replacing solid-wood building material by less expensive products made from wood flakes. The following Minitab outputs were obtained from a study of the relationship between the length (in inches) and the strength (in pounds per square inch) of beams made from wood flakes.

```
Descriptive Statistics: Length, Strength

Variable   N  N*   Mean  SE Mean  StDev  Minimum     Q1  Median      Q3
Length    10   0  9.500    0.957  3.028    5.000  6.750   9.500  12.250
Strength  10   0  291.3     22.5   71.2    234.0  242.8   251.5   343.3

Regression Analysis: Strength versus Length

The regression equation is
Strength = 488 - 20.7 Length


Predictor     Coef  SE Coef      T      P
Constant    488.38    38.85  12.57  0.000
Length     -20.745    3.914  -5.30  0.001
```

Which of the following numbers is the closest to the value of the correlation between the length and strength?

(a) 0.8

(b) –0.6

(c) –0.7

(d) –0.8

(e) * –0.9

15. In the study of the relationship between the length and the strength in Question 14 above, if we change the units of length to centimeters and the units of strength to kilograms per square centimeter, what will be the slope of the least squares regression line for predicting strength (in kilograms per square centimeter) from length (in cm)? Choose the closest answer from the alternatives below.

    (Assume 1 inch = 2.54 cm 1 pound per square inch = 0.07 kg per square centimeter)

    (a) *–0.5

    (b) –1.5

    (c) –8.0

    (d) –20.7

    (e) –53.2

16. A study was carried out to assess the effects of sleep deprivation on subjects' ability to perform simple tasks. Each subject was deprived of a pre-determined amount of sleep between 8 and 24 hours, and then given a standard set of addition problems to solve; the number of errors was recorded. A regression was carried out to predict the number of errors from the number of hours of sleep deprivation, as shown below.

```
The regression equation is
errors = 3.00 + 0.475 hours


Predictor    Coef  SE Coef     T      P
Constant    3.000    2.127  1.41  0.196
hours      0.4750   0.1253  3.79  0.005
```

What is the predicted number of errors for a subject who is deprived of 20 hours of sleep?

(a) * 12.5 errors

(b) 3.0 errors

(c) 20.0 errors

(d) 8.0 errors

(e) cannot predict because we are extrapolating

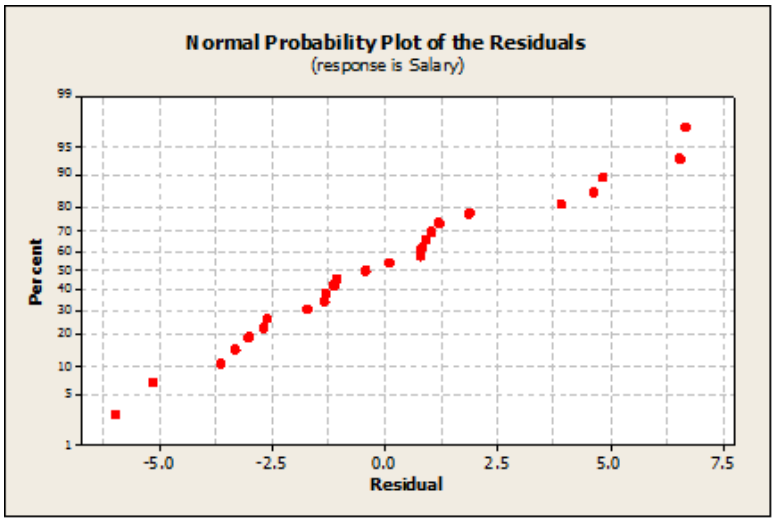
17. The following MINITAB output was obtained from a study of the relationship between the salary (in thousands of dollars) and length of service (in years) based on a random sample of 25 employees from a large firm.

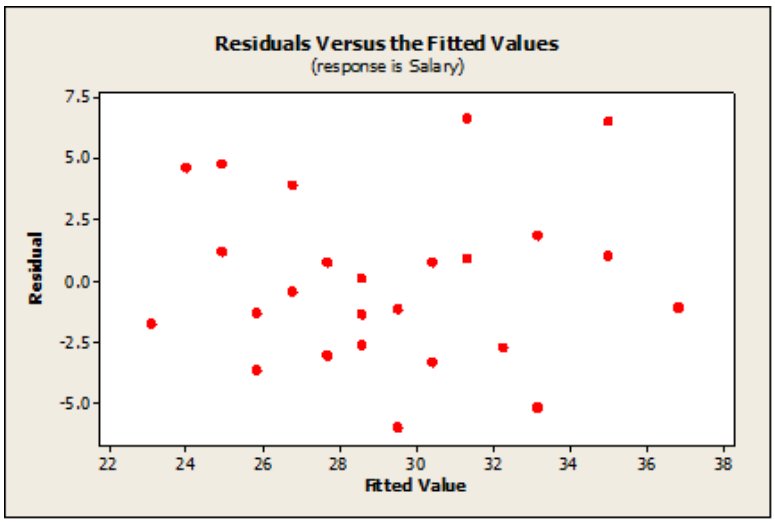
```
Regression Analysis: Salary versus Length

The regression equation is
Salary = 20.3 + 0.915 Length


Predictor    Coef  SE Coef      T      P
Constant   20.332    1.851  10.98  0.000
Length     0.9153   0.1767   5.18  0.000


S = 3.44985   R-Sq = 53.8%   R-Sq(adj) = 51.8%
```





Based on the above, which one of the following statements is true?

(a) The above regression model explains more than 75% of the variability in salaries of these employees.

(b) The distribution of residuals is left skewed.

(c) The residual plots above, clearly indicates the need for a higher order model

(d) * The absolute value of the residual for an observation in this sample with Length = 16 and Salary = 41, is greater than 5.0

(e) The correlation between Length and Salary is 0.538

18. Using the information in Question 17 above, if the average length of service of the 25 employees is 9.72 years, what is the average salary of these 25 employees?

(a) it will be less than \$21 000

(b) * it will be greater than \$21 000 but less than \$31 000

(c) it will be greater than \$31 000 but less than \$41 000

(d) it will be greater than \$41 000

(e) it cannot be determined from the information given.

19. The regression analysis in Question 17 above is based on 25 observations. The residuals for these 25 observations were calculated (not shown in the output). The sum of 20 of these values (i.e. 20 residuals) was -6.08. What will be the sum of the remaining 5 residuals? (You may assume that the answer is not exactly equal to any of $-10, -5, 0, 5$ or 10.)

    (a) between -10 and -5

    (b) between -5 and 0

    (c) between 0 and 5

    (d) * between 5 and 10

    (e) none of the above intervals contain this value

20. A plot is made of the residuals from a regression against the explanatory variables. In order for you to conclude that the regression is satisfactory, what are you looking for on the residual plot?

    (a) * no pattern at all

    (b) a straight-line pattern

    (c) some pattern, but not necessarily a straight line

    (d) no outliers

21. A residual plot was made as described in Question 20. In the residual plot, which of the following would indicate that a straight-line relationship is not satisfactory in the regression?

    - * a curved pattern
    - no pattern at all
    - a "fan-out" pattern with larger values of the explanatory variable going with large positive or large negative residuals
    - some pattern not given above

22. An researcher believes that a certain meditation technique lowers people's anxiety level. The researcher collects a random sample of subjects and divides them, at random, into two groups. The subjects in group 1 are taught how to meditate, and are given frequent practice in meditating. The subjects in group 2 spent an equivalent amount of time in quiet relaxation. At the end of the study, all the subjects are given a standard test of their anxiety, and the subjects in group 1 had a statistically significantly lower anxiety level. What do you conclude from this study?

(a) * This experiment provides convincing evidence that meditation causes lower anxiety.

(b) This observational study suggests that meditation is associated with lower anxiety, but does not offer convincing evidence.

(c) This study offers anecdotal evidence only, and so is no proof of anything.

(d) Group 2 in this study was unnecessary, because quiet relaxation is obviously associated with lower anxiety.

23. A survey is taken on a healthcare issue, where opinion is likely to be different between young and old people. A simple random sample is taken of young people and a separate simple random sample is taken of older people, and the responses to the survey question are combined. It is desired to make a confidence interval for the proportion of all people who agree with the statement made in the survey. Is it possible to use the methods of this course to construct the confidence interval?

    (a) * No, because this is a stratified sample, and our methods only apply to simple random samples.

    (b) Yes, because random samples were taken.

    (c) Yes, because the samples don't have to be random for our methods to be used.

    (d) No, because a systematic sample is used here, and our methods only apply to simple random samples.

    (e) No, because simple random samples were used here, and our methods apply to some other kind of sampling.

24. A multiple-choice exam consists of 30 multiple-choice questions. Each question has five possible responses, of which only one is the correct answer. Each correct response carries 5 marks and each incorrect response loses 1 mark (scores a negative mark). A question that is left unanswered automatically scores 0 marks. (Subtracting marks for incorrect responses is known as a "correction for guessing" and is designed to discourage test takers from choosing answers at random.). A totally unprepared student answers all 30 questions by just selecting one of the five answers at random. Find the mean of his total score on this exam. Choose the closest answer from the options below.

    (a) * 6

    (b) 0

    (c) 3

    (d) 12

    (e) -3

    (KB: I did some serious editing here. (i) having integer numbers of points for correct and wrong answers makes the calculation a lot less prone to error; (ii) the question is difficult enough just figuring out the mean, and with two numbers, "closest" isn't meaningful.)

25. What is the probability that the observed value of a binomial random variable with 5 trials and success probability 0.8 will be 4 or more?

    (a) * 0.74
    (b) 0.26
    (c) 0.007
    (d) 0.90
    (e) 0.41

26. What is the approximate probability that the observed value of a binomial random variable with 500 trials and success probability 0.7 will be between 340 and 365?

    (a) *0.76
    (b) 0.24
    (c) 0.16
    (d) 0.93
    (e) 0.50

27. In a certain large population, the annual income of individuals has a normal distribution with mean \$45 000 and standard deviation \$10 000. If we select a random sample of 100 individuals from this population, what is the approximate probability that there will be more than 20 individuals with annual income below \$35 000? Choose the closest answer from the alternatives below.

    (a) * 0.1
    (b) 0.2
    (c) 0.3
    (d) 0.4
    (e) 0.5

28. A type of paper used for packaging has a mean strength of 25 pounds per square inch and a SD of strength of 2 pounds per square inch. A sample of 10 pieces of paper of this type is taken. What is the probability that the sample mean strength will be 24 pounds per square inch or less?

    (a) * 0.06
    (b) 0.31
    (c) 0.69
    (d) 0.94
    (e) close to 1

29. You have measured the systolic blood pressure of a random sample of 25 employees of a company. A 95% confidence interval for the mean systolic blood pressure of the employees of the company is computed to be $(122, 138)$. Which of the following statements gives a valid interpretation of this interval?

    (a) 95% of the employees in the sample have a systolic blood pressure between 122 and 138.

    (b) 95% of the employees in the company have a systolic blood pressure between 122 and 138.

    (c) * If the sampling procedure were repeated a large number of times, then approximately 95% of the resulting confidence intervals would contain the mean systolic blood pressure for employees in the company.

    (d) If the sampling procedure were repeated a large number of times, then approximately 95% of the sample means would be between 122 and 138.

    (e) The probability that the sample mean falls between 122 and 138 is equal to 0.95.

30. A study with 25 observations gives a sample mean of 60. In case 1, the population SD is known to be 10, while in case 2 the population SD is not known, and the sample SD is used instead. How will the 90% confidence interval calculated in case 1 differ from the 90% confidence interval calculated in case 2?

    (a) * The confidence interval calculated in case 2 is likely to be longer.

    (b) The confidence interval calculated in case 2 is likely to be shorter.

    (c) The two confidence intervals will be identical.

    (d) We cannot calculate the confidence interval in case 2 because there is no SD given.

31. In order to estimate the proportion of defective items produced by a production process, a quality inspector decides to take five independent samples, each of 25 items produced by this production process and report a 90% confidence interval for each sample. We know that some of these intervals may contain the value of the true population proportion (p) and some may not. What is the probability that at least three of these five intervals will contain the value of the true population proportion? Choose the closest answer from the options given below.

    (a) 0.10

    (b) 0.50

    (c) 0.90

    (d) 0.95

    (e) * 0.99

    (KB: this question seems difficult for the purposes of being difficult, and for no other purpose. It makes more sense to ask for the prob. of all five intervals containing p, or something like that, which could be answered without making the connection with the binomial distribution.)

32. The pH is a measure of acidity. A substance with a pH below 7.0 is acid, and a substance with a pH above 7.0 is alkaline. According to fishing experts, the best water for catching bass (a type of fish) has a pH of between 7.5 and 7.9, but you suspect that acid rain has lowered the pH in a popular fishing spot below 7.5. You take a random sample of 30 water specimens from this fishing spot, and obtain a sample mean of 7.3. The population SD is assumed to be 0.2. What is the P-value for your significance test?

    (a) * close to 0
    (b) 0.16
    (c) 0.84
    (d) close to 1
    (e) 0.50

33. A researcher (A) is testing the null hypothesis that $\mu = 20$ against the alternative that $\mu \neq 20$, using $\alpha = 0.05$. Researcher A obtains a sample mean of 18, and a P-value of 0.08. Another researcher (B) says that the alternative hypothesis should have been $\mu > 20$. Using the same data as for researcher A, what does researcher B conclude?

    (a) * The P-value is very large (greater than 0.50), so the null hypothesis should not be rejected.
    (b) The P-value of 0.08 is greater than 0.05, so the null hypothesis should not be rejected.
    (c) The P-value for researcher B should be 0.04, and so researcher B will reject the null hypothesis.

34. The statistical technique called "analysis of variance" (not taught in this course) is used to compare the means of more than two populations. Suppose there are six populations, and a significance test is done to assess differences between every possible pair of population means. One of the 15 tests gives a P-value less than 0.05. What do you conclude?

    (a) * The observed difference could have occurred by chance, and so there is no evidence of any differences in population means.
    (b) Because the P-value was less than 0.05, we are entitled to conclude that the two populations compared have significantly different means.
    (c) We need to learn about "analysis of variance" to make an appropriate conclusion here.

35. The 90%, 95%, and 99% confidence intervals for a population mean μ, calculated from tthe same sample, are: $(68.4860, 91.5140)$, $(66.2803, 93.7197)$, and $(61.9692, 98.0308)$ respectively. What can you say about the p-value for testing $H_0 : \mu = 95$ against $H_a : \mu \neq 95$ using this sample?

(a) It is less than 0.01

(b) * It is between 0.01 and 0.10

(c) It is between 0.10 and 0.20

(d) It is between 0.20 and 0.30

(e) It is greater than 0.30

(KB: value in (e) changed to 0.30 for clarity. Would it be a good idea to change the correct answer to "between 0.01 and 0.05", avoiding the "trick" of having to take one extra step of thought to get to the right answer?)

36. Which is the most appropriate definition of the power of a test of significance?

(a) * The probability of rejecting the null hypothesis when it is false.

(b) The probability of rejecting the null hypothesis when it is true.

(c) The probability of failing to reject the null hypothesis when it is false.

(d) The probability of failing to reject the null hypothesis when it is true.

37. A hypothesis test is to be carried out at $\alpha = 0.05$, for a population whose SD is 12. Use the output below to decide how big a sample is needed to bring the type II error probability below 0.2.

```
Power and Sample Size

1-Sample Z Test

Testing mean = null (versus not = null)
Calculating power for mean = null + difference
Alpha = 0.05  Assumed standard deviation = 12

            Sample  Target
Difference    Size   Power  Actual Power
         5      29     0.6      0.611752
         5      36     0.7      0.705418
         5      46     0.8      0.806758
         5      61     0.9      0.902220
```

(a) 29

(b) 36

(c) * 46

(d) 61

38. The MINITAB output given below shows the power of the Z-test for testing the null hypothesis $\mu = 200$ against the alternative hypothesis $\mu < 200$, for various values of the true mean μ and for various sample sizes. The population from which the samples were selected, is normally distributed with standard deviation 10 (i.e. $\sigma = 10$).

```
Power and Sample Size

1-Sample Z Test

Testing mean = null (versus < null)
Calculating power for mean = null + difference
Alpha = 0.05  Assumed standard deviation = 10


            Sample
Difference    Size     Power
        -2      10  0.155674
        -5      10  0.474599
        -5      20  0.722812
         2      10  0.011384
         2      20  0.005554
```

The five statements below are based on the above information. Four of them are correct, and one is incorrect. Mark the INCORRECT statement. You may assume that all tests below are at level $\alpha = 0.05$.

(a) If the value of the true mean is 196 (i.e. $\mu = 196$), then the power of the Z-test for testing the null hypothesis $\mu = 200$ against the alternative hypothesis $\mu < 200$, based on a sample of size 15, will be greater than 0.10.

(b) If the value of the true mean is 198 (i.e. $\mu = 198$), then the power of the Z-test for testing the null hypothesis $\mu = 200$ against the alternative hypothesis $\mu < 200$, based on a sample of size 20, will be greater than 0.10.

(c) * If the value of the true mean is 195 (i.e. $\mu = 195$), then the probability of a Type II error of the Z-test for testing the null hypothesis $\mu = 200$ against the alternative hypothesis $\mu < 200$, based on a sample of size 20, will be greater than 0.40.

(d) If the value of the true mean is 195 (i.e. $\mu = 195$), then the power of the Z-test for testing the null hypothesis $\mu = 200$ against the alternative hypothesis $\mu < 200$, based on a sample of size 17, will be between 0.40 and 0.75.

(e) If the value of the true mean is 199 (i.e. $\mu = 199$), then the probability of a Type II error of the Z-test for testing the null hypothesis $\mu = 200$ against the alternative hypothesis $\mu < 200$, based on a sample of size 9, will be greater than 0.80.

(KB: I don't like these "pick out the incorrect one" questions, so I tried to make the wording in the question as clear as possible. I don't want to be accused of making the exam difficult by using "tricks".)

39. The total amount of vegetation held by the earth's forests is called the "biomass". A random sample of 11 one-square-metre plots was taken in Canada's northern forests; the sample mean biomass was 4.2 kilograms per square metre, and the sample standard deviation was 1.5 kilograms per square metre. What is the upper limit of a 95% confidence interval for the mean biomass (kilograms per square metre) in all of Canada's northern forests?

    (a) * 5.2

    (b) 5.1

    (c) 4.2

    (d) 4.7

    (e) 5.4

40. A two-sample test is to be used to compare two population means, with the population SDs unknown. The sample sizes are 10 and 13. For the test shown in class and calculated by hand, what is the appropriate degrees of freedom?

    (a) * 9

    (b) 12

    (c) 21

    (d) 13

    (e) we don't need degrees of freedom because the normal distribution can be used.

41. In a study of the nicotine content of cigarettes, a random sample of 31 cigarettes of a certain brand was tested for nicotine content (in milligrams). The MINITAB output below gives the 90% confidence interval for the mean nicotine content. (Note: In order to make this question nontrivial, some values in this MINITAB output have been deleted.). Assume that the data satisfy all assumptions required for the t-procedures.

```
One-Sample T

 N     Mean    StDev   SE Mean         90% CI
31  deleted  deleted   deleted  (14.2465, 15.9535)
```

    What can you say about the P-value of the test of the null hypothesis that $\mu = 16$ against the alternative hypothesis that $\mu > 16$, based on the same sample?

    (a) it is less than 0.05

(b) it is between 0.05 and 0.10

(c) it is between 0.10 and 0.90

(d) * it is greater than 0.90

(e) the P-value cannot be determined with the information provided

(KB: I think this question might be viewed as a "trick" because not only is the test one-sided, but the sample mean is the "wrong side". If the alternative were two-sided, it would be simply a matter of deciding whether 16 is inside the interval, and all the other information could be given without giving anything away.)

42. Using the information in Question 41 above, calculate a 99% confidence interval for the mean nicotine content. Choose the closest answer from the alternatives below.

(a) (14.6, 15.6)

(b) * (13.7, 16.5)

(c) (14.1, 16.1)

(d) (13.3, 16.9)

(e) (13.4, 16.8)

(KB: the danger here is that someone who cannot do the previous question won't have a clue about this one either.)

43. An experiment was conducted to compare the mean number of tapeworms in the stomachs of lambs that had been treated for worms, against the mean number in those that were untreated. A sample of 80 worm-infected lambs was randomly divided into two groups (each of 40 lambs). One of these groups was injected with the drug and the other group was left untreated. After a 6-month period, worm counts were recorded. A student in a basic statistics course (i. e. an inexperienced analyst) analyzed these data. Some MINITAB output from the student's analysis is given below. Even though the analysis may not perfect, the output has enough information to answer our questions. Assume that the data satisfy all assumptions required for the t-procedures. Below, the data from the treated and untreated samples are denoted by Treated and Untreated respectively..

```
One-Sample T: Treated

Variable   N     Mean    StDev  SE Mean        95% CI
Treated   40  34.1903  10.8656   1.7180  (30.7153, 37.6653)


Two-Sample T-Test and CI: Treated, Untreated

Difference = mu (Treated) - mu (Untreated)
```

```
Estimate for difference:  -7.06250
95% lower bound for difference:  -11.69503
T-Test of difference = 0 (vs >): T-Value = -2.54  P-Value = 0.993  DF = 73
```

If we were interested in testing the null hypothesis that the population mean worm counts are equal for the treated and untreated groups, against the alternative that the means are different, what can we say about the P-value for this test?

(a) less than 0.01.

(b) * between 0.01 and 0.02.

(c) between 0.02 and 0.05.

(d) between 0.05 and 0.10.

(e) greater than 0.10.

44. Using the information in Question 43 above, which one of the following statements is true?

(a) The mean number of tapeworms in the sample of untreated lambs, is greater than 43.

(b) If the distribution of the data were slightly nonnormal, then the t-procedures cannot be used to analyze these data.

(c) The value of the t-statistic for testing the null hypothesis that the population means are equal, against the alternative that they are not, is -5.08.

(d) If we calculate a 95% confidence interval for the population mean worm count for treated lambs, using the same data given above, but assuming that population standard deviation of the number of tapeworms in treated lambs is known and is equal to $\sigma = 10.8656$ (and so using a Z-interval instead of a t-interval), then its margin of error will be greater than 4.00.

(e) * None of the above four statements (a)-(d) is true.

45. Policy analysts believe that the proportion of Americans holding two or more jobs has increased since 1991, the last year for which complete records are available. In 1991, the proportion was 0.054. A recent survey of 850 employed Americans found that 53 of them, 6.24%, held two or more jobs. What is the test statistic for testing the policy analysts' belief?

(a) * 1.08

(b) 1.01

(c) 0.03

(d) 0.74

(e) -0.56

46. Suppose that, in the scenario of question 45, the P-value turns out to be 0.14. Using $\alpha = 0.01$, what should the policy analysts conclude about the proportion of Americans holding two or more jobs?

    (a) * there is no evidence that the proportion has increased

    (b) there is no evidence that the proportion has changed

    (c) there is evidence that the proportion has increased

    (d) there is evidence that the proportion has changed

    (e) there is evidence that the proportion has decreased

47. A study compared the fatality rates of heart attack victims who were given beta-blockers with those who were not given beta-blockers. (The fatality rate is the number of patients who die divided by the total number of patients, times 100%. A lower fatality rate is better.)

    For 879 patients given beta-blockers, the fatality rate was 9%, and for 1906 patients who were not given beta-blockers, the fatality rate was 27%. Assuming the patients to be random samples from their populations, calculate a 99% confidence interval for the difference between fatality rates for heart attack patients given beta-blockers and heart attack patients not given beta-blockers (the difference taken in that order). What is the upper limit of this confidence interval?

    (a) * -0.14

    (b) 0.22

    (c) -0.16

    (d) 0.20

    (e) -0.18