REVIEW PROBLEMS

1. Statistics is used in research
   A. to make rational inferences
   B. to quantify uncertainty
   C. to summarize the results of experiments
   D. all of the above
   E. none of the above

2. The following are steps in the scientific method – the never-ending circle of refining our knowledge about the universe:
   (a) test a hypothesis by experiment
   (b) formulate a hypothesis
   (c) retain or reject a hypothesis
   (d) observe

   The order of these steps should be
   A. dcba
   B. cbda
   C. adbc
   D. abcd
   E. dbac

3. You wish to conduct a clinical trial to compare two drugs in the treatment of a disease, and decide to enlist the help of a statistician. What is the best time to initiate contact with the statistician?
   A. Before you have decided which two drug regimens to use, so that the statistician can help decide on what is medically appropriate
   B. After you have decided on what drug regimens to use, but before you decide on the sample of patients to receive them, so that the statistician can help design the trial
C. After you have decided on the sample of patients, but before you actually conduct the trial, so that the statistician can help organize the data
D. After the data have been collected, but before analyzing the data, so that the statistician can be responsible for the data analysis
E. After the data are analyzed, but before the results are submitted for publication, so that the statistician can verify that an appropriate statistical analysis has been performed

4. The logic of inductive reasoning is an aspect of statistics that is used
A. to prove mathematical theorems
B. to make rational inferences about what happens in general
C. to deduce specific results from general laws
D. all of the above
E. none of the above

5. A physician develops a diagnostic test that is positive for 95% of the patients who have the disease and for 10% of the patients who do not have the disease. Of the patients tested, 20% have the disease. If the patient’s test is positive, the probability a patient has the disease is approximately
A. 0.10
B. 0.30
C. 0.50
D. 0.70
E. 0.90

6. A 99% confidence interval implies that
A. the probability the given interval contains the true parameter is 0.99
B. the probability that 99% of the observations are in the interval is 0.99
C. on average, 99 out of 100 similarly constructed intervals would contain the true parameter
D. the probability the given interval does not contain the true parameter is 0.99
E. there is a 1% chance the hypothesis is false

7. An investigator collects diastolic blood pressure levels on a group of patients. He divides his scale of measurement into intervals of 5 mmHg (70–74, 75–79, 80–84 mmHg, etc.). The investigator counts the number of patients with diastolic blood pressures in each interval. If the investigator were to plot the frequency of blood pressure levels in each interval, he would probably choose the following type of graph:
A. histogram
B. scatter diagram
C. regression line
D. bar graph
E. correlation coefficient

8. The figure below depicts a distribution that is
   A. symmetric
   B. unimodal
   C. leptokurtic
   D. positively skewed
   E. negatively skewed

![Distribution Figure]

9. An investigator states that the correlation between two variables is not statistically significant ($r = 0.07$). Which of the following conclusions is appropriate?
   A. 0.07 should be quoted as the significance level.
   B. 0.07 indicates a strong linear association between the two variables.
   C. For every unit of change in one variable, the other variable increases by 0.07 units.
   D. High values of one variable tend to be associated with low values of the other variable.
   E. Any association between the two variables does not appear to be linear.

10. Serum cholesterol levels in a group of young adults were found to be approximately normally distributed with mean 170 mg/dl and standard deviation 8 mg/dl. Which of the following intervals includes approximately 95% of serum cholesterol levels in this group?
    A. 160–180 mg/dl
    B. 162–178 mg/dl
    C. 150–190 mg/dl
    D. 154–186 mg/dl
    E. 140–200 mg/dl

11. The standard deviation of a population is about 25. The standard error of the mean of a random sample of nine observations is about
    A. 3
    B. 8
    C. 75
12. A difference is declared significant at the 5% significance level. This implies that
   A. the difference is significant at the 1% level
   B. there is a 95% probability that the difference is attributable to sampling variability
   C. the difference is significant at the 10% level
   D. the probability is 95% that the true difference is greater than zero
   E. there is a 5% probability that there is no difference

13. An estimator that on average gives the same value as the parameter being estimated is said to be
   A. minimum variance
   B. maximum likelihood
   C. efficient
   D. unbiased
   E. symmetric

14. An investigator compares two treatments, A and B, and finds that the difference in responses for these treatments is not statistically significant ($p = 0.25$). This implies that
   A. the difference could well have occurred by chance alone
   B. the probability the treatments are different in their effectiveness is 0.25
   C. the probability the treatments are equally effective is 0.25
   D. one of the treatments is 25% more effective than the other
   E. the difference in success rates using the two treatments is 25%

15. A patient checks her diastolic blood pressure at home and finds her average blood pressure for a 2-week period to be 84 mmHg. Assume her blood pressure to be normally distributed with a standard deviation $\sigma = 5$ mmHg. A nurse checks the patient’s diastolic blood pressure in the clinic and finds a value of 110 mmHg. The clinic reading is apparently
   A. not atypical of her distribution of blood pressures
   B. consistent with normotensive diastolic blood pressure
   C. below the 95th percentile for this patient
   D. extremely high for this patient
   E. none of the above

16. ‘$p$-values’ are reported often in the medical literature, yet their meaning is not always understood. The $p$-value is
A. the power of the test  
B. the probability of getting a result as extreme or more extreme than the one observed if the null hypothesis is false  
C. the probability the null hypothesis is true  
D. the probability of making a type II error  
E. the probability of getting a result as extreme or more extreme than the one observed if the null hypothesis is true

17. An investigator found drug A to be more effective than drug B in reducing blood pressure \( (p = 0.02) \). A review of the literature revealed two other studies reported similar results, one finding \( p = 0.03 \) and the other \( p = 0.01 \). The probability that all three results could have occurred by chance when in fact there was no difference between the drugs is

A. 0.000006
B. 0.06
C. 0.94
D. 0.000094
E. 0.04

18. A type II error

A. is often made when the \( p \)-value is small  
B. is always made when the \( p \)-value is large  
C. can only be made if the null hypothesis is true  
D. can only be made if the null hypothesis is false  
E. none of the above

19. An investigator wishes to test the hypothesis that the variance of serum cholesterol levels in a group of school children is 20 (mg/dl)\(^2\). Since the serum cholesterol levels in these children appear to be normally distributed, the appropriate statistical distribution to use in evaluating the test statistic is the

A. normal distribution  
B. \( t \)-distribution  
C. \( F \)-distribution  
D. binomial distribution  
E. chi-square distribution

20. Below are five tables giving the frequency of the presence of symptoms among 200 patients with a particular disease and 200 patients without that disease. The rows and columns are: \( D \) = disease present; \( \bar{D} \) = disease absent; \( S \) = symptoms present; and \( \bar{S} \) = symptoms absent. Which table presents results that would be
expected to yield the smallest chi-square value for testing the hypothesis that the proportion of patients with symptoms present is the same whether or not disease is present?

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21. The diastolic blood pressures of a random sample of 25 men are measured. The sample mean is found to be 85 mmHg, the standard deviation 5 mmHg. What are the approximate 95% confidence limits for the mean diastolic blood pressure of the population sampled?

A. 85 ± 1 mmHg
B. 85 ± 2 mmHg
C. 85 ± 5 mmHg
D. 85 ± 10 mmHg
E. 85 ± 15 mmHg

22. Finding a \( p \)-value in significance testing begins with the basic assumption that

A. well-trained observers record the data
B. modern computing facilities are available
C. the null hypothesis is true
D. the sample size is at least 30
E. the data are recorded on an interval scale
23. A researcher wishes to study the mean effects of four treatments, say A, B, C, and D, on triglyceride levels. He randomly assigns 40 patients to the four groups – 10 patients to each group. He administers the treatments for 2 months and then measures the triglyceride level of each patient. His statistical hypothesis is that the mean triglyceride level is the same in each of the four groups. He knows from a plot of the data that, in these patients, log triglyceride levels are approximately normally distributed. The investigator should take logs of his data and use the following to test his hypothesis:

A. $F$-test
B. $\chi^2$-test
C. two-sample $t$-test
D. paired $t$-test
E. none of the above

24. Which of the following is a statistic?

A. the population standard deviation of height
B. the mean of a binomial distribution
C. the mean of a normal distribution
D. the population variance of height
E. the mean height of a sample of 10 men

25. The power of a test is the probability of

A. accepting a true hypothesis
B. rejecting a true hypothesis
C. accepting a false hypothesis
D. rejecting a false hypothesis

26. On developing a likelihood ratio test of a null hypothesis where we need to estimate one or more parameters in addition to those explicitly involved in this null hypothesis, the additional parameters are called

A. Bayes factors
B. Critical values
C. Nuisance parameters
D. Empirical influences
E. Principle components

27. The probability an operation is a success is $\frac{3}{4}$. The operation is performed on each of three patients. The probability that at least one of the operations is a failure is

A. $\frac{1}{64}$
B. $\frac{63}{64}$
REVIEW PROBLEMS

C. \(\frac{27}{64}\)
D. \(\frac{37}{64}\)
E. \(\frac{48}{64}\)

28. Assume the risk of developing stomach cancer during one’s life is 1 in 50, whereas that of developing skin cancer is 1 in 25. Further assume that these events are independent. The risk of developing stomach cancer for a man who already has skin cancer is

A. \(\frac{1}{50}\)
B. \(\frac{1}{25}\)
C. \(\frac{3}{50}\)
D. \(\frac{1}{1250}\)
E. about 1 in 1.5 million

29. A distribution has a long tail to the right, so that it is not symmetric. We say the distribution is

A. abnormal
B. positively skewed
C. negatively skewed
D. bell shaped
E. bimodal

30. Sometimes a one-tail test is used to determine significance level, and sometimes a two-tail test is used. The two-tail test is used for situations in which we know \(a\ priori\) that

A. two samples are involved
B. both treatments will either increase or decrease the response
C. a paired \(t\)-test is appropriate
D. any true difference could be in either direction
E. two proportions are unequal

31. In a study of stomach cancer, patients who had the disease were matched with patients without cancer (controls) by age, sex, and social class. The frequency of alcohol consumption was then compared. What type of study was this?

A. clinical trial
B. prospective
C. experimental
D. sample survey
E. retrospective

32. A physician wishes to evaluate the effectiveness of three treatments, A, B, and C, with regard to time until relief of a headache. He decides to study 60 patients with chronic headache problems by giving 20 patients treatment A, 20
patients B, and 20 patients C, and observing them until they are relieved of their headaches. The physician randomly assigns A, B, or C to the 60 patients, using the restriction that 20 patients receive each treatment, but no other restriction. The design of this study is

A. double-blind
B. changeover
C. completely randomized
D. Latin square
E. randomized blocks

33. Advantages of using the double-blind procedure in clinical trials include

A. to increase the power of the trial
B. to reduce observer variability in recording data
C. to prevent biased observation of the outcome of a treatment
D. to eliminate chances of a disproportionate number of poor-risk patients in one of the groups
E. to allow for multiple comparisons

34. For a sample of \( n \) observations, we calculate the sample mean and then the deviation of each observation from the mean. These deviations are summed, and the result is divided by \( n-1 \); the result is

A. zero
B. the sample mean
C. the standard error of the mean
D. the sample standard deviation
E. the sample variance

35. Three new cases of a certain disease occurred during the month of July. If 500 persons were at risk during July, then the

A. prevalence was 3 per 1000 persons
B. incidence was 3 per 1000 persons
C. prevalence was 6 per 1000 persons
D. incidence was 6 per 1000 persons
E. odds ratio was 3:1

36. A group of patients was examined during a routine screening for elevated blood pressure. Twenty patients were told they had high blood pressure. A drug was prescribed for these patients, and they were asked to return for re-examination 1 week later. At the second examination it was determined that the mean blood pressure for these patients was 10 mmHg lower than on the initial screening. It was claimed that the drug was responsible for the decrease. However, at least part, if not all, of the decrease would be expected to be due to a phenomenon known as
A. observer bias
B. double blinding
C. random allocation
D. false-negative testing
E. regression toward the mean

37. A physician conducted a sample survey of residents who graduated from a medical school during the last 5 years. The sample design was structured so that a random 10% of the graduates from each of the five classes were interviewed. The design can be described as a

A. simple random sample
B. stratified random sample
C. systematic random sample
D. two-stage random sample
E. random cluster sample

38. A control patient of the same age, race, and sex was found for each member of a group of 25 test patients. The control patients were given a standard drug and the test patients were given a new drug to determine whether the new drug increased the number of hours slept during one night of observation. An appropriate test for the hypothesis of interest is the

A. binomial test
B. paired $t$-test
C. two-sample $t$-test
D. $F$-test
E. chi-square test

39. An investigator studies the effect of a drug for lowering serum cholesterol levels. Patients are randomly assigned to either an active treatment group or a placebo group. The patients’ cholesterol levels are then observed for 1 year while they take one of the treatments daily. This investigation can be described as a

A. historical prospective study
B. case–control study
C. clinical trial
D. retrospective study
E. robust study

40. The incidence of a certain disease among smokers was found to be 20 per 100,000 per year, while among nonsmokers it was found to be 5 per 100,000 per year. This implies that

A. the risk of developing the disease is four times greater among smokers than among nonsmokers
B. smokers require four times as many hospital beds as nonsmokers with the disease
C. the prevalence of smoking was four times as great among diseased persons as compared to nondiseased persons
D. the risk of developing the disease appears to be unrelated to smoking
E. a clinical trial is needed to estimate the risk of developing the disease

41. In experimental studies, known sources of extraneous variability in the outcome variable are best controlled by using
   A. randomization
   B. completely randomized designs
   C. randomized block designs
   D. sample surveys
   E. double-blind procedures

42. Investigator A claims his results are statistically significant at the 5% level. Investigator B argues that significance should be announced only if the results are statistically significant at the 1% level. From this we can conclude
   A. it will be more difficult for investigator A to reject statistical null hypotheses if he always works at the 5% level (compared with investigator B)
   B. it will be less difficult for investigator A to reject statistical null hypotheses if he always works at the 5% level (compared with investigator B)
   C. if investigator A has significant results at the 5% level, they will also be significant at the 1% level
   D. if investigator A has significant results at the 5% level, they will never be significant at the 1% level
   E. none of the above

43. The duration of disease A is longer than that of disease B. They both have the same incidence. The prevalence of disease A would then be expected to be
   A. the same as that of disease B
   B. less than that of disease B
   C. greater than that of disease B
   D. less than the incidence of the disease
   E. greater than the incidence of the disease

44. Two laboratory methods for determining triglyceride levels are being compared. Method A has a coefficient of variation of 8%, while method B has a coefficient of variation of 3%. This implies that
   A. method B is less precise than method A
   B. the distribution of method B is less skewed than that of method A
   C. method B is less apt to produce false positives
D. method B is easier to carry out than method A
E. there is less bias in method A than in method B

45. Suppose the regression equation for predicting $y$ from $x$ is given by $y = 10 + 3x$. Then all the following are true except

A. the intercept is 10
B. the correlation between $x$ and $y$ is negative
C. the slope of the regression line is positive
D. the predicted value of $y$ for $x = 4$ is 22
E. $y$ increases as $x$ increases

46. An estimator that has optimal properties when certain assumptions are true but also performs well when the assumptions are false is said to be

A. efficient
B. unbiased
C. unique
D. maximum likelihood
E. robust

47. A researcher carries out an analysis of variance on a set of data and finds a statistically significant interaction between two factors of interest. A similar analysis, performed after taking logarithms of the observed data and carried out on these transformed data, did not result in a statistically significant interaction. The analysis of the transformed data is the preferred analysis because, on the transformed scale,

A. the effects of the two factors are additive
B. the residual errors are uniformly distributed
C. the residual errors are not independent
D. the residual errors have variances proportional to the magnitude of the difference between the means for the individual factors
E. none of the above

48. An analysis of variance was carried out to compare the mean diastolic blood pressure in four groups of patients. This resulted in the finding that the variability among groups was not significantly greater than that within groups. A closer study of the data revealed, however, that the age distribution was not the same in the four groups. An analysis of covariance was therefore performed, with age as the covariate, and then statistically significant differences were found among the groups. The most likely explanation for this disparity in the results of the two analyses is

A. the residual errors are not independent
B. nonparametric tests are more powerful than their parametric counterparts
C. more precise comparisons among the groups are possible when the obscuring effect of age is accounted for
D. \( p \)-values are easier to obtain using the analysis of covariance procedure
E. none of the above

49. The main purpose of discriminant analysis is
   A. to adjust for concomitant variables
   B. to remove the obscuring effects of interaction terms
   C. to explain linear relationships with covariates
   D. to compare categorical data
   E. to classify individuals into categories

50. The estimated probabilities of survival for the first, second, and third years after surgery in a group of experimental patients were found to be 0.80, 0.67, and 0.52, respectively, while those for a control group were found to be 0.76, 0.59, and 0.37. The difference between the two survival profiles was found to be statistically significant. Based on these data, the most appropriate conclusion is that
   A. the experimental group appears to have a better survival profile
   B. the control group appears to have a better survival profile
   C. the survival profiles are about the same
   D. a regression analysis is needed to compare the two groups
   E. incidence rates are required to compare the two groups

51. All of the following are based on statistical data except
   A. smoking increases the risk of lung cancer
   B. wearing seat belts increases the chance of survival in automobile accidents
   C. the chance a newborn baby is female is slightly less than 50%
   D. the sun will rise tomorrow
   E. \( \pi \) is the ratio of the circumference of a circle to its diameter

52. In determining the difference in genetic expression between tumor and non-tumor cells at a large number of loci, one might expect no difference in expression for about half the loci and a flat uniform distribution of differences for the other half. This spike and slab model for expression data is an example of
   A. a prior distribution
   B. a uniform prior Bayesian model
   C. a binomial model
   D. a discriminant model
   E. a logistic regression model