

Health Studies 315

Epidemiology and Clinical Investigation

Notes on the 1996 Examinations

Ronald Thisted

In 1996, there were two one-hour in-class exams. Because the order in which topics are covered varies from year to year, the material on the 1996 midterm may not have been covered in class by the date of this year's midterm. Similarly, some topics discussed before this year's midterm may be represented by questions on the 1996 second exam.

The 1996 exams are provided to help you focus your studies for this year's exams. The answers to the 1996 exams are purposely not distributed.

Some of the questions on these exams are well tested and have been improved over the years; others were new in 1996. Questions which turned out to be ambiguous, or to have multiple answers will be revised before they are used again. These questions were omitted from the grading in 1996.

This year's exam will consist of a mix of questions from the 1966 exam, new questions, and some questions from earlier years. At least 50% of the questions will be "recycled" questions.

Examination 1
Epidemiology and Clinical Investigation

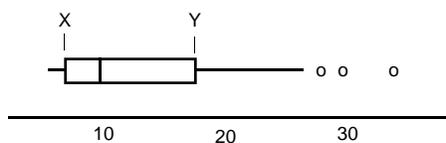
Name _____

Instructions

1. This is a 50-minute timed exam. Do not begin until you are told to do so.
2. All questions are multiple choice. Your score is based on the number of *correct* answers you supply. No points are deducted for incorrect answers, so it is to your advantage to give an answer to each question.
3. Only answers recorded on the answer sheet will count. Be sure to put your name on the answer sheet!
4. **DO NOT WRITE IN THE AREA AT THE BOTTOM OF THE ANSWER SHEET, EXCEPT AS INSTRUCTED BELOW.**
5. If you feel that a question is ambiguous, or that none of the answers are correct, take the following steps:
 - (a) Make the best choice you can from the possible answers, and put this answer on the answer sheet for the question.
 - (b) Circle the corresponding *question number* on the answer sheet.
 - (c) *Indicate the nature of the problem in the area labelled “Guilty with an explanation” at the bottom of the answer sheet. Describe the best alternative answer you can. Clearly indicate the question number you are referring to.*
6. You may use the following materials:
 - Electronic calculator
 - Writing implements
7. When the exam is over, submit the answer sheet. You should keep the test booklet.

Questions 1–2 refer to a placebo-controlled study of the effects of Vitamin A in treating children with measles.

- The investigators report a relative risk of death of 0.2. This means that
 - Children receiving vitamin A were one-fifth as likely to die from measles than children receiving placebo
 - The chance of dying from measles without Vitamin A is approximately 20%
 - The chance of the null hypothesis being true is approximately 20%
 - One-fifth of the children who died received Vitamin A, and the other four-fifths received placebo
- The investigators reported a 95% confidence interval for the relative risk of death as 0.05–0.94.
 - Because the interval doesn't contain the value 0, we can be confident that children not taking vitamin A are at greater risk of death than those taking vitamin A.
 - Because the interval doesn't contain the value 0, there is no convincing evidence that children not taking vitamin A are at greater risk of death than those taking vitamin A.
 - Because the interval doesn't contain the value 1, we can be confident that children not taking vitamin A are at greater risk of death than those taking vitamin A.
 - None of the above statements is correct



- In the figure above, the region between points X and Y represents
 - A 95% confidence interval for the mean
 - A 95% confidence interval for the median
 - The middle 50% of the data
 - The observed range
 - The mean \pm 2 SD
- According to the threshold model for clinical decision, the zone in which testing is appropriate will be widest for
 - High-information, high-risk tests
 - High-information, low-risk tests
 - Low-information, high-risk tests
 - Low-information, low-risk tests

5. According to the Evidence-Based Medicine Working Group, which of the following conditions would produce greatest confidence in the validity of an article on treatment?

- Treatments were allocated randomly, and both patients and investigators were blinded as to treatment.
- Diagnostic tests were applied in a representative patient sample, and an independently judged "gold standard" was used.
- Patients were randomly allocated to treatment, and all randomized patients were accounted for at the end of the study.
- One of the treatments is a placebo control, and each patient is used as his or her own control.

Tests for Pheochromocytoma

Test	Sensi- tivity	Speci- ficity
VMA excretion	81	97
Metanephrine excretion	83	95
Abdominal CT	92	80

- Pheochromocytoma is a potentially fatal disease that occurs in 14 per 10,000 hypertensive patients. A patient presents with labile hypertension. Of the tests above, which is the most useful for ruling out a diagnosis of pheochromocytoma?
 - VMA excretion
 - Metanephrine excretion
 - Abdominal CT scan
 - Information inadequate to determine

7. In a randomized study comparing treatments A and B, what is the reason for "double blinding"?

- To reduce selection bias
- To insure that outcomes are assessed in the same way in each group
- To improve the generalizability of the results
- None of the above is correct

8. The term "sensitivity," when applied to a medical test for a disease,

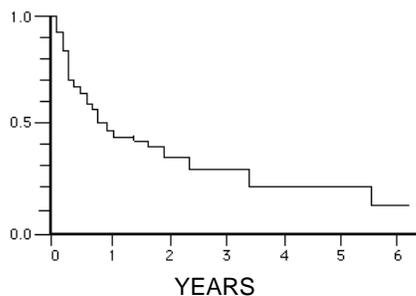
- Does not depend on the prevalence of disease in the population
- Depends only on disease prevalence in the population in which the test is used
- Is a function of both the test and the prevalence of the disease
- Can be calculated from the specificity of the test
- None of the above is correct

9. Approximately 10% of all surgical residents become seropositive for hepatitis B during their residency. Two new residents want to know the probability that neither of them will contract hepatitis B during their residency. This probability is closest to

- (a) 18%
- (b) 20%
- (c) 80%
- (d) 81%
- (e) None of the above is correct

10. Which of the following statements is correct about an analysis based on the intention-to-treat principle in a randomized clinical trial?

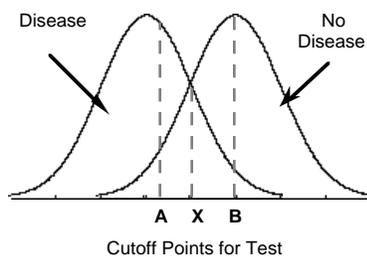
- (a) It assesses the effectiveness of a particular policy of treatment, rather than the treatment effect itself
- (b) It is the analysis most likely to be correct
- (c) It is the analysis that is the most ethical analysis
- (d) It is unlikely to have clinical relevance when the compliance rate on one of the treatment arms is low



11. The survival curve above indicates that one-fourth of the patients die within

- (a) 6 months
- (b) 10 months
- (c) 2 years
- (d) 3 years

The following questions refer to the figure below representing the distribution of a diagnostic test in two populations.



- (a) Point A
- (b) Point B
- (c) Point X
- (d) Cannot determine point

- 12. Cutoff point with greatest specificity
- 13. Cutoff point with least sensitivity
- 14. Cutoff point with highest false positive rate
- 15. Cutoff point with greatest positive predictive value

16. Of the following criteria, which would be considered *most* important for the validity of the results from a clinical trial?

- (a) Similarity of groups at the start of treatment
- (b) Patients and clinicians "blinded" to treatment
- (c) Randomized assignment of patients to treatment
- (d) Assessment of cost-benefit ratios
- (e) Prior approval of the Institutional Review Board

17. A study on the effects of smoking on bone density in elderly women reports, "For every 10 pack-years of smoking, the bone density of the twin who smoked more heavily was 2.0 percent lower at the lumbar spine ($P=0.01$)." Which of the following statements is most nearly correct?

- (a) The probability that tobacco use affects bone density is 0.01.
- (b) The probability that tobacco use does not affect bone density is 0.01.
- (c) There is a one-percent chance that the null hypothesis is true.
- (d) It is unlikely that random variability caused the lower bone density in heavy smokers.

18. Which of the following statements is correct about an analysis based on the intention-to-treat principle in a randomized clinical trial?

- (a) It assesses the effectiveness of a particular policy of treatment, rather than the treatment effect itself
- (b) It is the analysis most likely to be correct
- (c) It is the analysis that is the most ethical analysis
- (d) It is unlikely to have clinical relevance when the compliance rate on one of the treatment arms is low

19. When comparing randomized control trials (RCT) to cohort studies, which of the following is *not* generally true?

- (a) Both are prospective
- (b) Biases are more likely to arise in assessing outcomes than in assessing exposures
- (c) The RCT is less likely to encounter confounding variables
- (d) The RCT is likely to be more generalizable than the cohort study

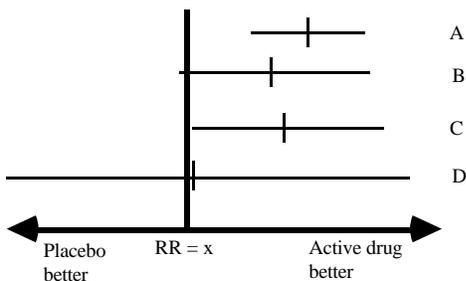
20. Which of the following is true of a case-control study?

- (a) Good for studying causes of rare events
- (b) Generally less expensive than other studies
- (c) Retrospective
- (d) All of the above are true
- (e) None of the above are true

21. The best design for studying exposure-harm relationships when the exposure occurs long before the outcome is a(n)

- (a) Animal model
- (b) Case study
- (c) Case-control study
- (d) Cohort study
- (e) Randomized control trial

In the following questions, the horizontal lines represent 95% confidence intervals (for a relative risk, in this case) obtained from four randomized studies of the same drug. The dark vertical line represents no difference between treatments.



22. Which studies would report a p-value less than 0.05 favoring the active drug?

- (a) A only
- (b) A and C only
- (c) B and D only
- (d) A, B, C, and D
- (e) Cannot determine from information given

23. Which study had the greatest number of patients enrolled?

- (a) A (b) B (c) C (d) D
- (e) Cannot determine from information given

24. All four investigators agree to report 90% confidence intervals instead of 95% confidence intervals. Which studies would have confidence intervals that cross the dark vertical line?

- (a) A only
- (b) A and C only
- (c) A, B, and C only
- (d) A, B, C, and D
- (e) Cannot determine from information given

25. The value for "x" in the figure is

- (a) 0.0
- (b) 0.5
- (c) 1.0
- (d) Ho
- (e) Not determined

A randomized trial compared a treatment (Z) to placebo (P) in mild asthmatics. The primary outcome was an exacerbation of asthma. The results in 1000 patients were

	No exacerbation	1 exacerbation	
Z	124	8 (6 %)	132
P	114	21 (16 %)	135
Total	238	29 (12 %)	267

26. The absolute risk reduction associated with Z is closest to

- (a) 63% (b) 38% (c) 10% (d) 6% (e) 4%

27. The odds of experiencing at least one exacerbation on treatment Z is

- (a) $124/132 = 0.94$
- (b) $124/ 8 = 15.5$
- (c) $8/29 = 0.28$
- (d) $8/124 = 0.06$
- (e) None of the above

28. The relative risk of exacerbation (comparing Z to P) is

- (a) $(124 \times 21) / (114 \times 8) = 2.86$
- (b) $(8 \times 114) / (124 \times 21) = 0.35$
- (c) $(8 / 124) / (21 / 114) = 0.35$
- (d) $(8 / 132) / (21 / 135) = 0.39$
- (e) Cannot be determined

29. The number of patients needed to treat with Z to avoid one exacerbation is closest to

- (a) 1/6 (b) 6 (c) 10 (d) 16 (e) 25

30. Which of the following changes in the Zileuton study would contribute most to confidence in the validity of the reported study results?

- (a) Report breakdown by treatment group for patients who withdrew from the study
- (b) Reduce the placebo run-in period
- (c) Explain the randomization in greater detail
- (d) Use a more representative patient population

31. A randomized study compares rate of cardiac death for two treatments. A smaller proportion of patients on treatment A had a cardiac death than did patients receiving B. In the main comparison, the investigators report " $p > 0.05$ ". You can conclude that

- (a) The two drugs are equivalent
- (b) The null hypothesis is rejected
- (c) There is strong evidence that treatment A is superior to B
- (d) At least five percent of the deaths in the study can be attributed to chance
- (e) None of the above

32. Drug A is expected to be better than placebo, but a well-conducted study finds that there is no (statistically) significant difference between the two. Which of the following could account for this result?

- (a) Drug A is no more effective than placebo
- (b) The study did not have enough power to detect the superiority of Drug A
- (c) An unfortunate randomization put too many people with favorable outcomes into the placebo group
- (d) More than one of the above
- (e) None of the above

33. Which of the following most critically influences the performance of a screening test (such as Hemocult)?

- (a) Test sensitivity
- (b) Test specificity
- (c) Test's positive predictive value
- (d) Test's negative predictive value

Hemocult is approximately 25% sensitive and 95% specific for detecting colorectal carcinomas in the screening context.

34. When a Hemocult test is positive, by what factor are the odds of having cancer multiplied?

- (a) 1.27 (b) 3.8 (c) 4 (d) 5 (e) 20

35. The factor referred to above is called

- (a) The odds ratio
- (b) The relative risk
- (c) The likelihood ratio
- (d) The odds factor
- (e) The confidence level

36. When Hemocult is used for screening, what fraction of rectal carcinomas will go *undetected*?

- (a) 5 %
- (b) 25 %
- (c) 75 %
- (d) 95 %
- (e) None of the above, or can't determine

37. For a particular patient, you calculate that the predictive odds that this patient has Crohn's disease following a positive test result is 9. The positive predictive value of the test in this context is

- (a) 0.99
- (b) 0.90
- (c) 0.88
- (d) Cannot be determined

38. Which of the following characteristics of a diagnostic test is *not* affected by the prevalence of the disease being tested for?

- (a) Prior odds
- (b) Likelihood ratio
- (c) Positive predictive odds
- (d) Positive predictive value
- (e) Negative predictive odds

Examination 2
Epidemiology and Clinical Investigation

Name _____

Instructions

1. This exam is over at 3:15 pm. You may begin at any time.
2. All questions are multiple choice. Your score is based on the number of *correct* answers you supply. No points are deducted for incorrect answers, so it is to your advantage to give an answer to each question.
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6. You may use the following materials:
 - Electronic calculator
 - Writing implements
7. When the exam is over, submit the answer sheet. You should keep the test booklet.

1. Over the past decade, screening methods for detecting early prostate cancer have improved. More early cancers are being found, and the average survival time from diagnosis of prostate cancer until death is increasing.

- (a) This shows that prostate screening has been effective in reducing mortality
- (b) Screening at 6-month intervals instead of 12-month intervals would detect more curable tumors and thus improve survival
- (c) Randomized studies have shown that untreated patients do as well as treated patients, so that screening has no benefit
- (d) Survival from time of diagnosis may have increased without any reduction in cancer mortality due to lead-time bias

2. The prior probability that a patient has disease H is low. Which of the following reasons, if any, are legitimate for *not* ordering a screening test for this patient?

- (a) The patient can be harmed (physically and/or financially) by following up on false positive tests
- (b) In this situation, the majority of positive tests are false positives
- (c) Most positive test results are ignored when the prior probability of disease was low, and there is a risk of later legal action from not following up a positive test
- (d) All of the above are legitimate reasons for not ordering a test
- (e) None of the above are legitimate reasons for not ordering a test

3. The 1980 crude mortality rate in the US male population was 977 per 100,000. This is an example of

- (a) A probability
- (b) An incidence
- (c) A prevalence
- (d) A standardized mortality ratio
- (e) None of the above is correct

4. Approximately 15% of all surgical residents become seropositive for hepatitis B during their residency. Two new residents want to know the probability that neither of them will contract hepatitis B during their residency. This probability is closest to

- (a) 81%
- (b) 73%
- (c) 70%
- (d) 30%
- (e) 2.3%

Questions 5–7 concern the following study. In a study to determine whether prostate specific antigen (PSA) was useful as a screening assay for prostate cancer, Catalona *et al* examined PSA levels after controlling for other predictors such as age, findings on digital rectal examination, and ultrasound findings. Catalona *et al* provided the following table.

Table 4. Accuracy of Rectal Examination, Serum PSA Measurement, and Ultrasonography in Detecting Prostate Cancer on First Biopsy in 300 Men in the Comparison Group

Measure	Rectal Examination	Ultra-sonography <i>percent</i>	Serum PSA
Sensitivity	86	92	79
Specificity	44	27	59
Positive Predictive Value	33	28	40
Negative predictive value	91	91	89
Overall accuracy	58	43	64

5. For ultrasonography, what fraction of *the positive test results* were false positives (men who did not have cancer)?

- (a) 91%
- (b) 73%
- (c) 72%
- (d) 8%
- (e) Cannot determine from information given

6. For which test is a *positive* finding most informative?

- (a) Rectal examination
- (b) Ultrasound
- (c) PSA
- (d) Cannot determine from information given

7. For which test is a *negative* finding most informative?

- (a) Rectal examination
- (b) Ultrasound
- (c) PSA
- (d) Rectal exam and ultrasound are equivalent, and each is more informative than PSA.
- (e) Cannot determine from information given

8. Which of the following terms best describes the fraction of infants who do not survive from birth to one month of age:

- (a) Infant mortality rate
- (b) Neonatal mortality rate
- (c) Perinatal mortality rate
- (d) Sudden death rate

Questions 9–12 refer to the following abstract from a recent issue of *JAMA*.¹

Objective—To estimate the prevalence of substance abuse among US physicians.

Design—A mailed, anonymous, self-report survey.

Participants—A national sample of 9600 physicians, randomly selected from the American Medical Association master file. Demographic characteristics of respondents closely reflected those of the US physician population.

Main Outcome Measures—Subjects' self-reported use of 13 substances in their lifetime, the past year, and the past month; reasons for use; self-admitted substance abuse or dependence; and whether treatment was received.

9. This study is an example of a

- (a) Cohort study
- (b) Case-control study
- (c) Cross-sectional study
- (d) Case series
- (e) None of these.

10. “Younger physicians had higher rates of illicit drug use in the past year than older physicians ($p < 0.05$).” From this statement it follows that

- (a) The probability that younger physicians use illicit drugs more often than older physicians is 95%.
- (b) The probability that younger physicians use illicit drugs more often than older physicians is <5%.
- (c) There is a 5% probability that younger and older physicians use illicit drugs equally often.
- (d) The observed difference in rates of drug use between older and younger physicians cannot plausibly be attributed to chance.
- (e) None of the above are correct.

Table 5.—Estimated Prevalence of Marijuana Use in Past Year by Male Physicians

Age	Use, %	SE
25-34	10.3	1.2
35-44	7.5	0.7
45-54	2.1	0.5
55	0.5	0.2

11. Table 5 shows that as age in this sample increases, prevalence of marijuana use appears to decline. Of the following tests, which would be most appropriate for assessing this trend?

- (a) χ^2 test
- (b) linear regression
- (c) survival analysis
- (d) logistic regression

12. You hypothesize that as individual physicians grow older, they tend to use marijuana less frequently. You also note that the trend in Table 5 is highly statistically significant.

- (a) This study strongly confirms your hypothesis
- (b) This study's results are consistent with the hypothesis, but a randomized clinical trial could confirm your hypothesis
- (c) This study's results are consistent with the hypothesis, but a prospective cohort study could confirm your hypothesis
- (d) Because the findings in Table 5 may not be clinically significant, this study does not provide much evidence for your hypothesis.
- (e) None of the above

13. Men with rapidly progressing prostate tumors are likely to have their cancer detected by their physicians as a result of seeking care for their symptoms, while men with slowly growing tumors are more likely to be detected through general screening programs for asymptomatic men. Thus, the screening program will appear to be beneficial because those detected by screening will survive longer. This is an example of

- (a) The healthy-worker phenomenon
- (b) Volunteer effect
- (c) Lead-time bias
- (d) Length-time bias

14. The methods and potential biases of meta-analysis are closest to which of the following

- (a) Case-control studies
- (b) Randomized clinical trials
- (c) Cohort studies, with some elements of multi-center clinical trials
- (d) Multi-center clinical trials, with some elements of retrospective trials
- (e) Expert review papers

¹ Hughes PH, Brandenburg N, Baldwin DC, Storr CL, Williams KM, Anthony JC, Sheehan, DV. Prevalence of substance use among US physicians. *JAMA* 1992; 267: 2333-2339.

15. A formal decision analysis often includes a "sensitivity analysis." The purpose of the sensitivity analysis is to

- (a) Assess the positive predictive value of the decision model
- (b) Study the difficulty of obtaining reliable utilities from patients to use in a decision tree
- (c) Evaluate the sensitivity and specificity of the resulting decisions
- (d) Assess the extent to which conclusions depend on the assumptions used in the decision model
- (e) None of the above

The following table is taken from a study of the effects of gender on outcome of PTCA². The table was constructed using multiple logistic regression.

Independent predictors of In-Hospital Mortality Following 2963 PTCA procedures in patients without a history of myocardial infarction within the preceding 7 days

Variable	OR (95% CI)†	P
Presence of cardiac failure	6.04 (2.86-12.76)	<.001
Prior myocardial infarction	2.66 (1.30-5.52)	.007
Multivessel disease	3.59 (1.23-10.50)	.02
Proximal LAD stenosis 70%*	2.03 (1.04-3.93)	.03
Female gender	2.21 (1.14-4.30)	.02

† OR indicates odds ratio, and CI confidence interval

* LAD indicates left anterior descending coronary artery

16. Which statement is *not* correct?

- (a) Women are 2.2 times more likely to die after PTCA than men, even after taking account of the other risk factors in the table
- (b) Presence of cardiac failure is the most important risk factor, because its p-value is the smallest
- (c) Presence of cardiac failure is the most important risk factor, because its odds ratio is the largest
- (d) The added risk associated with having multivessel disease could be as small as a factor of 1.23 or as large as a factor of 10.5

17. The purpose of doing multiple logistic regression in this setting is

- (a) To reduce the chances of error by taking account of the effects of all possible risk factors
- (b) To get a clearer picture of the effects of gender by first taking account of the effects of other risk factors
- (c) To obtain smaller p-values, and hence more statistically significant results
- (d) To obtain more accurate estimates of the effects of the various risk factors

18. Relative to a man with none of the risk factors represented in the table, by approximately how much are the odds of dying increased for a woman in cardiac failure with a history of myocardial infarction?

- (a) 6
- (b) 9
- (c) 16
- (d) 36

19. Consider a decision analysis to help a patient with prostate cancer consider alternatives for treatment. The costs assigned to the possible outcomes should

- (a) Reflect economic costs to the patient only, and should not incorporate other costs
- (b) Reflect the combined monetary costs to the patient, physician, and hospital
- (c) Incorporate the relative value the patient assigns to the various complications
- (d) Depend upon the physician's best assessment of the patient's financial situation.

20. A married 39 year old male has been your patient for three years. He presents with a rash on his trunk and arms. Your tentative diagnosis is pityriasis rosea, but you know that secondary syphilis is similar in appearance. Your next step should be:

- (a) Order a test to rule out syphilis
- (b) Treat the rash symptomatically
- (c) Obtain the patient's recent sexual history
- (d) File a report with the Board of Health, since syphilis is a reportable disease

21. Survivors of myocardial infarction now have daily aspirin prescribed to reduce the risk of another MI. This is an example of

- (a) Population-based medicine
- (b) Primary prevention
- (c) Secondary prevention
- (d) A clinical trial

² Bell MR, Holmes DR Jr, Berger PB, Garratt KN, Bailey KR, Gersh BJ. The changing in-hospital mortality of women undergoing percutaneous transluminal coronary angioplasty. *JAMA* 1993; 269: 2091-2095.

22. The annual incidence of a disease is 36 per thousand. The point prevalence is 18 per thousand. The annual mortality from this disease is 3 per thousand. The average duration of this disease is

- (a) 3 years
- (b) 2 years
- (c) 6 months
- (d) 3 months
- (e) 1 month

The following table is taken from a study of serum α -fetoprotein during pregnancy, in which volunteers in their 14th through 20th week of gestation were studied.

Predictor	Coef	Std Error	t-ratio	p-value
Constant	0.260	0.038	6.84	<0.001
gestage	0.072	0.002	36.0	<0.001

$s = 0.244$ $n = 3648$ $R^2 = 0.10$

23. The estimated mean AFP level for women measured in the 18th week of gestation is closest to

- (a) 0.260
- (b) 0.342
- (c) 1.56
- (d) 4.75

24. Which factors are the most important criteria for assessing the methodological rigor of an article on diagnosis?

- (a) Patients were randomly allocated to diagnostic test, and all randomized patients were accounted for at the end of the study.
- (b) Diagnostic tests were applied in a representative patient sample, and an independently judged "gold standard" was used.
- (c) Positive and negative predictive values are reported, and tests were read blindly
- (d) A fixed protocol specified in advance was used to ascertain which patients were positive and which negative.

25. Which of the following factors is *least* important for assessing the methodological rigor of an article on decision analysis?

- (a) Utilities reflect different point of view
- (b) The decision studied is clinically important
- (c) The decision process is faithfully modelled
- (d) Valid evidence is used to obtain probabilities used in the analysis

26. A multiple regression study reports an R-squared value of 0.50. This means that

- (a) The predictors account for 25% of the variability seen in the response
- (b) The predictors account for 50% of the variability seen in the response
- (c) The predictors account for about 70% of the variability seen in the response
- (d) The chance that the null hypothesis is true is 50%
- (e) None of the above is correct.

27. In a multiple regression analysis, which of the following is the best summary of the extent to which the response variable can be estimated using the predictor variables?

- (a) the t-statistic
- (b) the p-value
- (c) the slope
- (d) the R-squared value
- (e) the constant term

28. Which of the following potential sources of bias is *most* likely to occur in a meta-analysis?

- (a) Misclassification bias
- (b) Verification bias
- (c) Selection bias
- (d) Surveillance bias

29. Censored data are most likely to arise in

- (a) A case-control study of risk
- (b) A long-term prospective study of prognosis
- (c) A study of diagnostic test accuracy
- (d) A clinical trial comparing two analgesics
- (e) Dr. Vuselich's "clamp-and-run" study

30. Patients exposed to a certain risk factor X were compared to unexposed patients with respect to death rates, with the following results:

	Died	N	Per 1000
Exposed to X	1036	3178	32.6
Not exposed	854	3810	22.4

The attributable risk fraction for the exposed is closest to

- (a) 0.03
- (b) 0.31
- (c) 0.33
- (d) 0.59
- (e) 0.69

Questions 31–36 refer to the table below.

The following table is taken from a study of factors associated with operative mortality from cholecystectomy³.

Factors independently associated with operative mortality, 1990–1992.

Characteristic	Unadjusted OR (95% CI)†	Adjusted OR (95% CI)†
Male sex (vs female)	2.3 (1.7–3.1)	1.5 (1.1–2.1)
Marital status (vs widowed)		
Married	0.2 (0.1–0.3)	0.6 (0.4–0.8)
Single	0.15 (0.09–0.3)	0.4 (0.2–0.7)
Insurance (vs private)		
Medicare	12.6 (7–21)	2.2 (1.0–5.0)
Medicaid	3.5 (1.6–7.7)	2.7 (1.6–4.5)
HMO	1.1 (0.4–2.6)	1.1 (0.4–2.6)
Emergency (vs other)	10.3 (6.7–16)	3.2 (2.0–5.1)
Laparoscopic (vs open)	0.13 (0.06–0.2)	0.22 (0.13–0.4)
Coexistent Dx:		
Hypertension	0.4 (0.2–0.7)	0.4 (0.2–0.7)
Acute MI	50 (25–100)	14 (7–28)
Arrhythmia	8.3 (5.9–11)	7.4 (1.5–3.7)
Pneumonia	11 (6–70)	5.2 (3.2–8.3)
Kidney disease	25 (17–50)	8.8 (5.2–15)
Cancer	14 (9.1–70)	5.2 (3.2–8.3)
Cerebrovasc.	10 (4.8–20)	3.0 (1.4–6.3)
Age (yrs)	—	1.008* (1.004–1.011)

† OR indicates odds ratio, and CI confidence interval

* Denotes the odds of death per year of increased age

31. Which of the following statistical methods is most appropriate for constructing the last column of the table from the raw data?

- (a) Simple logistic regression
- (b) Multiple logistic regression
- (c) Proportional hazards regression
- (d) Multiple linear regression

32. Relative to a woman with none of the other risk factors represented in the table, by approximately how much are the odds of dying increased for a man with cancer having an open procedure?

- (a) 1.5
- (b) 2.3
- (c) 6.7
- (d) 7.8
- (e) None of the above

33. Which statement is correct?

- (a) Men are 2.3 times more likely to die after cholecystectomy than women, even after taking account of the other risk factors in the table
- (b) Occurrence of a myocardial infarction is the most important risk factor, because its adjusted odds ratio is the largest
- (c) Presence of arrhythmia is the most important risk factor, because its odds ratio is large and least affected by adjustment
- (d) The additional risk associated with having pneumonia could be as small as a factor of 6 or as large as a factor of 70

34. After accounting for other risk factors, the odds of dying after laparoscopic surgery are approximately

- (a) About the same as for open surgery
- (b) About one-fifth as great as for open surgery
- (c) 20% greater than the odds of dying after open surgery
- (d) 20% smaller than the odds of dying after open surgery
- (e) None of the above

35. The unadjusted odds ratio for Medicare patients (relative to private patients) is 12.6, while the adjusted figure is 2.2. The best explanation for this observation is that

- (a) Fewer Medicare patients had laparoscopic procedures
- (b) The investigators made a computational error, since 2.2 is outside the 95% confidence interval
- (c) Medicare patients are older than private patients, and older patients are at greater risk
- (d) Medicare patients are more likely to have hypertension, and are thus at increased risk

36. The phenomenon described in the preceding question is an example of

- (a) Systematic error
- (b) Selection bias
- (c) Confounding
- (d) None of the above

³ Steiner CA, et al. Surgical rates and operative mortality for open and laparoscopic cholecystectomy in Maryland. *N Engl J Med* 1994; 330: 403–408.