

In almost all numeric problems, I have given the answers to four significant digits. If your answer is slightly different from one of mine, consider that to be roundoff error and mark the closely matching one. If your answer differs from the closest one of mine by more than one percent (meaning the ratio of yours to mine is less than 0.99 or greater than 1.01), then mark “J) None of the preceding”. Unless otherwise specified, hypothesis tests are non-directional (two-sided). Note that the upper tails of chi-square and F statistics automatically give two-sided tests. Unless otherwise specified, all confidence intervals are 95%. In problems involving the binomial distribution, if conditions are met for the normal approximation to the binomial, the approximation should be used; otherwise, use exact binomial calculations. Based on our two referenda, the first 25 questions are strictly computational, while the last five, extra-credit, problems, require some memory of having read the book, having worked the homework problems and/or having paid attention in class. Of the 25 computational problems, the first 15 should be recognizable as homework problems assigned since the last examination, while the next 10 are homework problems from before then.

1. Shown are the winning times (in minutes) for men and women in the New York City Marathon between 1991 and 1998.

Year	1991	1992	1993	1994	1995	1996	1997	1998
Men	129.5	129.5	130.1	131.4	131.0	129.9	128.2	128.8
Women	147.5	144.7	146.4	147.6	148.1	148.3	148.7	145.9

Assuming that performances in the Big Apple resemble performances elsewhere, we can think of these data as a sample of performance in marathon competitions. Create a 50% confidence interval for the mean difference in winning times for male and female marathon competitors and report its length.

A) 0.7843 B) 0.8202 C) 0.8561 D) 0.8920 E) 0.9279 F) 0.9638 G) 0.9997 H) 1.0356 I) 1.0715 J) None of the preceding

2. A subtle form of racial discrimination in housing is racial steering. Racial steering occurs when real estate agents show prospective buyers or renters only homes in neighborhoods already dominated by that family’s race. This violates the Fair Housing Act of 1968. According to an article in *Chance* magazine Vol. 14, no. 2 [2001], tenants at a large apartment complex recently filed a lawsuit alleging racial steering. The complex is divided into two parts, Section A and Section B. The plaintiffs claimed that white potential renters were steered to Section A, while African Americans were steered to Section B. The table below displays [fictitious] data that show the locations of recently rented apartments. Do you think there is evidence of racial steering? Calculate the P-value for the two-sided test of the null hypothesis.

	White	Black
Section A	87	18
Section B	83	24
Total	170	42

A) 0.2490 B) 0.2703 C) 0.2916 D) 0.3129 E) 0.3342 F) 0.3555 G) 0.3768 H) 0.3981 I) 0.4914 J) None of the preceding

3. Two human traits controlled by a single gene are the ability to roll one's tongue and whether one's ear lobes are free or attached to the neck. Genetic theory says that people will have neither, one, or both of these traits in the ratio 1:3:3:9 (1—attached, noncurling; 3—attached, curling; 3—free, noncurling; 9—free, curling). An Introductory Biology class collected the data shown below. Are they consistent with the genetic theory? Test the appropriate hypothesis and state the P-value.

	Trait			
	Attached, noncurling	Attached, curling	Free, noncurling	Free, curling
Count	10	32	41	69

A) 0.02770 B) 0.2983 C) 0.03196 D) 0.03409 E) 0.03622 F) 0.03835 G) 0.04048 H) 0.04261 I) 0.04474 J) None of the preceding

4. Does your IQ depend on the size of your brain? A group of five female college students took a test that measured their verbal IQs and also underwent an MRI scan to measure the size of their brains (in 1000s of pixels). The regression analysis is shown below, and the assumptions for inference were satisfied.

Dependent variable is: IQ_Verbal

R-squared = 6.71%

Variable	Coefficient	SE(Coefficient)
Intercept	37.6995	169.01
Size	0.086180	0.1856

Test an appropriate hypothesis about the association between brain size and IQ. Give the two-sided P-value for this test.

A) 0.4451 B) 0.4778 C) 0.5105 D) 0.5432 E) 0.5759 F) 0.6086 G) 0.6413 H) 0.6740 I) 0.7067 J) None of the preceding

5. Given the data below, calculate a 95% confidence interval for the mean % *body fat* found in people with 40-inch waists:

Waist (in.):	32	36	38	33	39	40	41	35	38	38
Body Fat (%):	6	21	15	6	22	31	32	21	25	30

Report the length of this confidence interval.

A) 10.05 B) 10.58 C) 11.11 D) 11.64 E) 12.17 F) 12.70 G) 13.23 H) 13.76 I) 14.29 J) None of the preceding

6. Given the data below, calculate a 50% prediction interval for the % *body fat* of an individual who weighs 210 pounds:

Weight (lb):	175	181	200	159	196	192	205	173	187	188
Body Fat (%):	6	21	15	6	22	31	32	21	25	30

Report the length of this prediction interval.

A) 10.68 B) 11.19 C) 11.70 D) 12.21 E) 12.72 F) 13.23 G) 13.74 H) 14.25 I) 14.76 J) None of the preceding

7. A figure skater tried various approaches to her Salchow jump in a designed experiment using four different places for her focus (arms, free leg, midsection, and take-off leg). She tried each jump 7 times in random order, using two of her skating partners to judge the jumps on a scale from 0 to 6. After collecting the data and analyzing the results, she reports that the F-ratio is 3.92. Assuming the conditions for ANOVA are satisfied, what is the P-value?
 A) 0.01556 B) 0.01685 C) 0.01814 D) 0.01943 E) 0.02072 F) 0.02201 G) 0.02330 H) 0.02459 I) 0.02588 J) None of the preceding

8. An experiment to determine the effect of several methods of preparing cultures for use in commercial yogurt was conducted by a food science research group. Four batches of yogurt were prepared using each of three methods: traditional, ultrafiltration, and reverse osmosis. A trained expert then tasted each of the 12 samples, presented in random order, and judged them on a scale from 1 to 10. A partially completed Analysis of Variance table of the data is shown below. Complete the table and report the P-value of the F-ratio.

Source	Sum of Squares	Degrees of Freedom	Mean Square	F-ratio
Treatment	18.23			
Residual	10.97			
Total				

A) 0.01048 B) 0.01221 C) 0.01394 D) 0.01567 E) 0.01740 F) 0.01913 G) 0.02086 H) 0.02259 I) 0.02432 J) None of the preceding

9. A pharmaceutical company tested three formulations of a pain relief medicine for migraine headache sufferers. For the experiment 9 volunteers were selected and 3 were randomly assigned to each of three drug formulations. The subjects were instructed to take the drug during their next migraine headache episode and to report their pain on a scale of 1 = no pain to 10 = extreme pain 30 minutes after taking the drug. Their pain levels are given below:

<u>Drug A</u>	<u>Drug B</u>	<u>Drug C</u>
1	1	6
2	3	8
3	5	10

After performing the analysis of variance, calculate the Bonferroni-corrected P-value for a two-sided test of Drug A versus Drug C (among the set of all pairwise comparisons).

A) 0.01296 B) 0.01627 C) 0.01958 D) 0.02289 E) 0.02620 F) 0.02951 G) 0.03282 H) 0.03613 I) 0.03944 J) None of the preceding

10. A student runs a two-factor experiment to test how microwave power and temperature affect popping. She chooses 3 levels of *power* (*low*, *medium*, and *high*) and 3 *times* (*3 minutes*, *4 minutes*, and *5 minutes*), running one bag at each condition. She counts the number of uncooked kernels as the response variable. After collecting her data and analyzing the results, the student reports that the F-ratio for *power* is 11.56 and the F-ratio for *time* is 7.36. What is the P-value for *time*?

A) 0.04221 B) 0.04566 C) 0.04911 D) 0.05256 E) 0.05601 F) 0.05946 G) 0.06291 H) 0.06636 I) 0.06981 J) None of the preceding

11. Building on the cup experiment of Chapter 4, a student selects one type of container and designs an experiment to see whether the type of *liquid* stored and the outside *environment* affect the ability of a cup to maintain temperature. He randomly chooses an experimental condition and runs each twice:

<u>Liquid</u>	<u>Environment</u>	<u>Change in Temperature</u>
Water	Room	13
Water	Room	15
Water	Outside	33
Water	Outside	35
Coffee	Room	11
Coffee	Room	13
Coffee	Outside	28
Coffee	Outside	30

Find the P-value for the test of the null hypothesis that the interaction between *liquid* and *environment* is zero.

A) 0.1498 B) 0.1595 C) 0.1692 D) 0.1789 E) 0.1886 F) 0.1983 G) 0.2080 H) 0.2177 I) 0.2274 J) None of the preceding

12. A large section of Stat 101 was asked to fill out a survey on grade point average and SAT scores. A regression was run to find out how well Math and Verbal SAT scores could predict performance as measured by GPA. The regression was run on a computer package with the following output:

Response: GPA

	Coefficient	Std Error	t-ratio	Prob > t
Constant	0.598342	0.219374	2.727	0.006955
SAT Verbal	0.001574	0.000342	4.602	7.454E-6
SAT Math	0.001843	0.000473	3.896	1.335E-4

From this, what is the predicted GPA of a student with an SAT Verbal score of 580 and an SAT Math score of 610?

A) 2.012 B) 2.101 C) 2.190 D) 2.279 E) 2.368 F) 2.457 G) 2.546 H) 2.635 I) 2.724 J) None of the preceding

13. We saw in Chapter 8 that the calorie content of a breakfast cereal is linearly associated with its sugar content. Is that the whole story? Here's the output of a regression model that regresses calories for each serving on its *protein(g)*, *fat(g)*, *carbohydrate(g)*, and *sugars(g)* content:

	<i>Df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>
Regression	4	16017.38	4004.346	140.71
Residual	45	1280.617	28.45815	
Total	49	17298		

	<i>Coefficient</i>	<i>SE(Coeff)</i>	<i>t-ratio</i>	<i>P-value</i>
Intercept	3.66866	5.56588	0.65913	0.513169
Protein	3.46656	0.86449	4.00994	0.000226
Fat	8.66252	0.74515	11.62517	3.79E-15
Carbo	4.05226	0.22048	18.37915	1.51E-22
Sugars	3.78753	0.25361	14.93442	4.72E-19

Do you think this model would do a reasonably good job at predicting calories? To find out, calculate the value of R-squared.

A) 68.87% B) 72.26% C) 75.65% D) 79.04% E) 82.43% F) 85.82% G) 89.21% H) 92.60% I) 95.99% J) None of the preceding

14. In March 2002, Consumer Reports listed the rate of return for several large cap mutual funds over the previous 3-year and 5-year periods. Some of these rates of return are shown below. ("Large cap" refers to companies worth over \$10 billion.) Create a 95% confidence interval for the difference in rate of return for the 3-year and 5-year periods covered by these data. Report the length of that confidence interval.

<u>Fund name</u>	<u>3-year</u>	<u>5-year</u>
Ameristock	7.9	17.1
Credit Suisse Strategic Value	5.5	11.5
Excelsior Value	13.1	16.4
ICAP Discretionary Equity	6.6	11.4
Neuberger Berman Focus	9.8	13.2
Pelican	7.7	12.1
Vanguard Equity Income	3.5	11.3

A) 2.307 B) 2.537 C) 2.767 D) 2.997 E) 3.227 F) 3.457 G) 3.687 H) 3.917 I) 4.147 J) None of the preceding

15. A study of pregnant women examined the association between the woman's education level and the occurrence of unplanned pregnancies, producing these data:

	<u>Education Level</u>		
	<u><3 yr HS</u>	<u>3+yr HS</u>	<u>Some college</u>
Number of pregnancies	118	121	48
% unplanned	66.1	55.4	43.8

Do these data provide evidence of an association between family planning and education level? Calculate the appropriate statistic and report its P-value.

- A) 0.01380 B) 0.01699 C) 0.02018 D) 0.02337 E) 0.02656 F) 0.02975 G) 0.03294 H) 0.03613 I) 0.03932
J) None of the preceding

16. A survey of autos parked in student and staff lots at a large university classified the brands by country of origin, as seen in the table.

	Student	Staff
American	324	223
European	105	129
Asian	237	197

What percent of the European cars were owned by students?

- A) 24.92% B) 28.91% C) 32.90% D) 36.89% E) 40.88% F) 44.87% G) 48.86% H) 52.85% I) 56.84% J) None of the preceding

17. A class of fourth graders takes a diagnostic reading test, and the scores are reported by reading grade level. The five-number summaries for the 18 boys and 11 girls are shown:

Boys:	1.9	3.7	4.5	5.1	6.0
Girls:	1.3	3.1	4.2	5.3	5.8

Find the interquartile ranges for the boys and the girls and subtract the smaller from the larger.

A) 0.4 B) 0.5 C) 0.6 D) 0.7 E) 0.8 F) 0.9 G) 1.0 H) 1.1 I) 1.2 J) None of the preceding

18. A class of fourth graders takes a diagnostic reading test, and the scores are reported by reading grade level. The five-number summaries for the 18 boys and 11 girls are shown:

Boys:	1.9	3.7	4.5	5.1	6.0
Girls:	1.3	3.1	4.2	5.3	5.8

If the overall mean reading score for the boys was 4.7 and the mean reading score for the girls was 4.25, what is the overall mean for the class?

A) 3.753 B) 3.850 C) 3.947 D) 4.044 E) 4.141 F) 4.238 G) 4.335 H) 4.432 I) 4.529 J) None of the preceding

19. A student scores 95 on the first exam in a chemistry course. Assume the correlation between exams 1 and 2 is 0.6, and that both exams have means of 70 and standard deviations of 13. According to regression, the student should not expect to do as well as 95 on the second exam. What score should the student expect?
A) 77 B) 79 C) 81 D) 83 E) 85 F) 87 G) 89 H) 91 I) 93 J) None of the preceding

20. The Masterfoods company says that before the introduction of purple, yellow candies made up 20% of their plain M&M's, red another 20%, and orange, blue, and green each made up 10%. The rest were brown. If you pick three M&M's in a row from this distribution of colors, what is the probability that the third one is the first one that's brown?
A) 0.1094 B) 0.1141 C) 0.1188 D) 0.1235 E) 0.1282 F) 0.1329 G) 0.1376 H) 0.1423 I) 0.1470 J) None of the preceding

21. Census reports for a city indicate that 59% of residents classify themselves as Christian, 14% as Jewish, and 12% as members of other religions (Muslims, Buddhists, etc.). The remaining residents classify themselves as nonreligious. A polling organization seeking information about public opinions wants to be sure to talk with people holding a variety of religious views, and makes random phone calls. Among the first four people they call, what is the probability they reach at least one person who is nonreligious?

A) 0.3121 B) 0.3358 C) 0.3595 D) 0.3832 E) 0.4069 F) 0.4306 G) 0.4543 H) 0.4780 I) 0.5017 J) None of the preceding

22. A junk box in your room contains a dozen old batteries, six of which are totally dead. You start picking batteries one at a time and testing them. Find the probability that at least one of the first two works.

A) 0.3623 B) 0.4136 C) 0.4649 D) 0.5162 E) 0.5675 F) 0.6188 G) 0.6701 H) 0.7214 I) 0.7727 J) None of the preceding

23. In 2001 a national vital statistics report indicated that 3% of all births produced twins. Data from a large city hospital found only 8 sets of twins born to 568 teenage girls. Does this suggest that mothers under 20 may be less likely to have twins? Perform a one-sided test of the appropriate null hypothesis and report its P-value.
A) 0.01009 B) 0.01109 C) 0.01209 D) 0.01309 E) 0.01409 F) 0.01509 G) 0.01609 H) 0.01709 I) 0.01809 J) None of the preceding

24. A basketball player with a poor foul-shot record practices intensively during the off-season. He tells the coach he has raised his proficiency from 57% to 85%. Dubious, the coach asks him to take 10 shots and is surprised when the player hits 9 out of 10. If the player really can hit 85% now, and it takes at least 9 out of 10 successful shots to convince the coach, what's the power of the test?
A) 0.5149 B) 0.5443 C) 0.5737 D) 0.6031 E) 0.6325 F) 0.6619 G) 0.6913 H) 0.7207 I) 0.7501 J) None of the preceding

25. Several programs attempt to address the shortage of qualified teachers by placing uncertified instructors in schools with acute needs—often in inner cities. A study compared students taught by certified teachers with others taught by undercertified teachers within the same schools. Reading scores of the students of certified teachers averaged 35.62 points with standard deviation 8.31. The scores of students instructed by undercertified teachers had mean 32.48 with standard deviation 8.43 points, on the same test. There were 54 students in each group. Is there evidence of a difference in scores between the two types of teachers? Calculate the P-value using a two-sided alternative hypothesis. (Ignore the possible lack of independence induced by the clustering of students within teachers.)
A) 0.04783 B) 0.05390 C) 0.05997 D) 0.06604 E) 0.07211 F) 0.07818 G) 0.08425 H) 0.09032 I) 0.09639 J) None of the preceding

26. The regression example involving global warming came from what location?
A) Antarctica
B) New York City
C) Ithaca, New York
D) Nenana, Alaska
E) Mauna Loa, Hawaii
F) Tel Aviv, Israel
G) Bangalore, India
H) Crater Lake, Oregon
I) Niagara Falls
J) Hudson's Bay, Canada

27. I once offered a grade of A in Math 320 for the first class member to find any kind of non-random and/or non-uniform behavior of what? (So far, no one has claimed the prize.)

- A) Digits of e
- B) Digits of $\ln 2$
- C) Digits of Feigenbaum's constant
- D) Digits of the square root of 2
- E) Digits of π
- F) Digits within the RAND tables
- G) Digits generated by Excel's random number generator
- H) Digits generated by the TI-83 random number generator
- I) Last two digits of every phone number in the White Pages
- J) Last two digits of every phone number in the Yellow Pages

28. When we covered Chapter 31, "Multiple Regression Wisdom," I showed you how to perform a one-factor ANOVA test for equality of means via multiple regression. What did I use to do this?

- A) Sines
- B) Cosines
- C) Tangents
- D) Satterthwaite's df
- E) Wavelet transform
- F) Discrete cosine transform
- G) Cooley-Tukey FFT
- H) Bayes's Rule
- I) Inverse hyperbolic tangent
- J) Indicator variables

29. The TI-83 LinRegTTest does not report a standard error of slope $SE(b)$. However, it is easy to calculate $SE(b)$ from the numbers the calculator does display. Suppose LinRegTTest shows the following information:

t = 2.16489
p = .082675
df = 5
a = 9.00384
b = .554032
s = 1.93711
 $r^2 = .48383$
r = .69558

Use this information to find $SE(b)$.

A) 0.1369 B) 0.1607 C) 0.1845 D) 0.2083 E) 0.2321 F) 0.2559 G) 0.2797 H) 0.3035 I) 0.3273 J) None of the preceding

30. What statistical method did a recent Wash U MBA graduate have to learn before he would be hired by Household Finance Corporation?

- A) Bayes's Rule
- B) Logistic Regression
- C) Survival Analysis
- D) Analysis of Variance
- E) Satterthwaite's Method
- F) Exact Binomial Tests
- G) Poisson Processes
- H) Stochastic Processes
- I) Quality Control
- J) Randomized Block Designs

