Statistics

CREDIT HOURS 3
LEVEL LOWER

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Before You Choose This UExcel Exam

Uses for the Examination

- Excelsior College, the test developer, recommends granting three (3) semester hours of lower-level undergraduate credit to students who receive a letter grade of C or higher on this examination.
- Other colleges and universities also recognize this exam as a basis for granting credit or advanced standing.
- Individual institutions set their own policies for the amount of credit awarded and the minimum acceptable grade.

Exam-takers who have applied to Excelsior College should ask their academic advisor where this exam fits within their degree program.

Exam-takers not enrolled in an Excelsior College degree program should check with the institution from which they wish to receive credit to determine whether credit will be granted and/or to find out the minimum grade required for credit. Those who intend to enroll at Excelsior College should ask an admissions counselor where this exam fits within their intended degree program.

Examination Length and Scoring

The examination consists of approximately 72 questions, most of which are multiple choice; for samples of all the item types on this exam, see the sample items in the back of this guide. Some items are unscored, pretest items. The pretest items are embedded throughout the exam and are indistinguishable from the scored items. You will have two (2) hours to complete the examination. Your score will be reported as a letter grade.

UExcel Exam Resources

Excelsior College Bookstore

The Excelsior College Bookstore offers recommended textbooks and other resources to help you prepare for UExcel exams.

The bookstore is available online at (login required): www.excelsior.edu/bookstore

UExcel Practice Exams

The official UExcel practice exams are highly recommended as part of your study plan. Once you register for your UExcel exam, you are eligible to purchase the corresponding practice exam, which can be taken using any computer with a supported Web browser. Each practice exam includes two forms that you may take within a 180-day period.

Excelsior College Library

Enrolled Excelsior College students can access millions of authoritative resources online through the Excelsior College Library. Created through our partnership with the Sheridan Libraries of The Johns Hopkins University, the library provides access to journal articles, books, websites, databases, reference services, and many other resources. Special library
pages relate to the nursing degree exams and other selected exams. To access it, visit www.excelsior.edu/library (login is required).

Our library provides:

- 24/7 availability
- The world’s most current authoritative resources
- Help and support from staff librarians

**Online Tutoring**

Excelsior College offers online tutoring through SMARTTHINKING™ to connect with tutors who have been trained in a variety of academic subjects. To access SMARTTHINKING, go to www.excelsior.edu/smarthinking. Once there, you may download a copy of the SMARTTHINKING Student Handbook as a PDF.

**Preparing for UExcel Exams**

**Take Charge of Your Own Learning**

At Excelsior College, independent, self-directed study supported by resources we help you find is not a new concept. We have always stressed to exam takers that they are acting as their own teacher, and that they should spend as much time studying for an exam as they would spend in a classroom and on homework for a corresponding college course in the same subject area.

Begin by studying the content outline contained in this content guide, at its most detailed level. You will see exactly which topics are covered, and where chapters on those topics can be found in the Recommended Resources. You will see exactly where you might need to augment your knowledge or change your approach.

The content outline, along with the Learning Outcomes for this exam and recommended textbooks, will serve as your primary resources.

**How Long Will It Take Me to Study?**

A UExcel exam enables you to show that you've learned material comparable to one or more 15-week college-level courses. As an independent learner, you should study and review as much as you would for a college course. For a 3-credit course in a subject they don’t know, most students would be expected to study nine hours per week for 15 weeks, for a total of 135 hours.

**Study Tips**

Become an active user of the resource materials. Aim for understanding rather than memorization. The more active you are when you study, the more likely you will be to retain, understand, and apply the information.

The following techniques are generally considered to be active learning:

- **preview or survey** each chapter
- **highlight or underline text** you believe is important
- **write questions or comments** in the margins
- **practice re-stating content** in your own words
- **relate what you are reading** to the chapter title, section headings, and other organizing elements of the textbook
- **find ways to engage** your eyes, your ears, and your muscles, as well as your brain, in your studies
- **study with a partner or a small group** (if you are an enrolled student, search for partners on MyExcelsior Community)
- **prepare your review notes** as flashcards or create recordings that you can use while commuting or exercising

When you feel confident that you understand a content area, review what you have learned. Take a second look at the material to evaluate your understanding. If you have a study partner, the two of you can review by explaining the content to each other or writing test questions for each other to answer. Review questions from textbook chapters may be helpful for partner or individual study, as well.

**Using UExcel Practice Exams**

We recommend taking the first form of the practice exam when you begin studying, to see how much you already know. After taking the first practice exam, check your performance on each question and find out why your answer was right or wrong. This feedback will help you improve your knowledge of the subject and identify areas of weakness that you should address before taking the exam. Take the second form of the
Preparing for This Exam

Prior Knowledge
A basic knowledge of algebra is assumed.

Using the Content Outline
Each content area in the outline includes (1) the recommended minimum hours of study to devote to that content area and (2) the most important sections of the recommended resources for that area. These annotations are not intended to be comprehensive. You may need to refer to other chapters in the recommended textbooks. Chapter numbers and titles may differ in other editions.

This content outline contains examples of the types of information you should study. Although these examples are numerous, do not assume that everything on the exam will come from these examples. Conversely, do not expect that every detail you study will appear on the exam. Any exam is only a broad sample of all the questions that could be asked about the subject matter.

Using the Sample Questions and Rationales
Each content guide provides sample questions to illustrate those typically found on the exam. These questions are intended to give you an idea of the level of knowledge expected and the way questions are typically phrased. The sample questions do not sample the entire content of the exam and are not intended to serve as an entire practice test.

Recommended Resources for the UExcel Exam in Statistics
The resources and materials listed below were used by the examination development committee to verify all the questions on the exam. Excelsior College recommends you use these resources as the most appropriate information when ordering textbooks from the college's bookstore (see page...
You should allow ample time to obtain resources and to study sufficiently before taking the exam, so plan appropriately and systematically.

A word about textbook editions: Textbook editions listed in the UExcel content guides may not be the same as those listed in the bookstore. Textbook editions may not exactly match up in terms of table of contents and organization, depending upon the edition. However, our team of exam developers checks exam content against every new textbook edition to verify that all subject areas tested in the exam are still adequately available in the study materials. If needed, exam developers will list supplemental resources to ensure that all topics in the exam are still sufficiently covered. Public libraries may have the textbooks you need, or may be able to obtain them for you through interlibrary loan to reduce textbook costs. You may also consider financial aid, if you qualify, to further help defray the steep cost of textbooks. A section on OER has been included in this guide to help you locate additional resources to augment your study.

Textbooks

The following textbook was used by the examination development committee to verify all questions on the exam. These study materials may be purchased from the Excelsior College Bookstore.


NOTE: We recommend that during your study, you perform all calculations using a basic, 8-function calculator, so that you will be well prepared to do similar calculations using the online calculator at the Pearson testing center.

Reducing Textbook Costs

Many students know it is less expensive to buy a used textbook, and buying a previous edition is also an option. The Excelsior College bookstore includes a buyback feature and a used book marketplace, as well as the ability to rent digital versions of textbooks for as long as students need them. Students are encouraged to explore these and the many other opportunities available online to help defray textbook costs.

A Word About Open Educational Resources

Open educational resources (OER) are educational materials available for study at no cost on the Web. Some OER are available for anyone to access any time. Others, such as Massive Open Online Courses (MOOCs), require sign-up and are only available during certain windows. Please note that some MOOC providers offer certificates of completion or other products or services for a fee. No MOOC or other OER is a complete substitute for the content guide and officially Recommended Resources listed here in this content guide. However, by definition, MOOCs are essentially free of charge and include access to a main body of learning materials that may help you in your learning.

Being an independent learner preparing for credit by exam, you may not need any of the fee-based options that are offered elsewhere online. But if you are looking for a coherent academic course for self-study, lectures on specific topics, or audio or visual materials that fit your learning style better than print materials alone, a MOOC or other type of OER may be your answer. Keep in mind that none of these OER were designed by Excelsior, nor are they guaranteed to match the exam content outlines completely. They are simply another tool available in your study kit.

We highly encourage using the Recommended Resources. In the content outline, you will see that the topics in the exam are referenced to specific portions of recommended textbooks. Using OER alone will not ensure you’ve completely covered the content in the exam, or it may not cover some topics in sufficient-enough depth without the use of the formal, recommended textbooks.

If the OER course you choose does not include a textbook for reference and you do not have significant practical theory-based experience in the field of study, use a college textbook to ensure adequate preparation for the exam, and use the exam’s content outline as a guide.

Combined with comparable college textbooks, OER provides you with a variety of choices in knowledge sources and learning experiences, to enhance your understanding of the subject matter.
Choosing Open Educational Resources

Most sites for university-based OER can be searched through www.ocwconsortium.org and/or www.oercommons.org.

Sites that specialize in Web courses designed by college professors under contract with the website sponsor, rather than in Web versions of existing college courses, include:

- www.education-portal.com
- www.opencourselibrary.org (abbreviated as OCL)

We have included specific courses that cover material for one or more UExcel® exams from the sites in the listings above. It's worth checking these sites frequently to see if new courses have been added that may be more appropriate or may cover an exam topic not currently listed.

In addition, sites like Khan Academy (www.khanacademy.com) and iTunes U feature relatively brief lessons on very specific topics rather than full courses. Full courses are also available on iTunes U (http://www.apple.com/education/ipad/itunes-u/).

We have chosen a few courses and collections for this listing.

Other Online Resources

This section of the OER Guide is provided to allow learners to independently search for resources. Send an e-mail to OER@excelsior.edu if you have questions about a resource’s credibility.

Open Online Textbooks

Boundless open textbooks
- https://www.boundless.com/open-textbooks/

BookBoon

Flatworld Knowledge
- http://catalog.flatworldknowledge.com/#our-catalog

College Readiness

Khan Academy
- http://www.khanacademy.org/

Hippocampus
- http://www.hippocampus.org/

Open Course Library

Study Aids

Education Portal
- http://education-portal.com/

Khan Academy
- http://www.khanacademy.org/

Annenberg Learner
- http://www.learner.org/

OpenCourseWare

OER Commons
- http://www.oercommons.org/

Open Course Library
- http://www.opencourselibrary.org/
## General Description of the Examination

The UExcel Statistics examination is based on material typically taught in a one-semester introductory course in statistics. It measures knowledge and understanding of the fundamental concepts of descriptive and inferential statistics, and the meaning and application of basic statistical ideas.

Those beginning to study for this exam should have a basic knowledge of algebra.

## Learning Outcomes

After you have successfully worked your way through the recommended study materials, you should be able to demonstrate the following learning outcomes:

1. Explore, organize, and describe data.
2. Perform standard statistical calculations.
3. Analyze and interpret several types of data.
4. Use graphical and numerical summaries.
5. Apply standard statistical inference procedures.
6. Draw valid conclusions from your analysis of data.
### Content Outline

The content outline describes the various areas of the test, similar to the way a syllabus outlines a course. To fully prepare requires self-direction and discipline. Study involves careful reading, reflection, and systematic review.

The major content areas on the Statistics examination, the percent of the examination, and the hours to devote to each content area are listed below.

<table>
<thead>
<tr>
<th>Content Area</th>
<th>Percent of the Examination</th>
<th>Hours of Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Overview of Statistics</td>
<td>5%</td>
<td>7</td>
</tr>
<tr>
<td>II. Summarizing, Organizing, and Describing Data</td>
<td>20%</td>
<td>27</td>
</tr>
<tr>
<td>III. Regression and Correlation</td>
<td>10%</td>
<td>14</td>
</tr>
<tr>
<td>IV. Basic Probability Theory</td>
<td>10%</td>
<td>14</td>
</tr>
<tr>
<td>V. Probability Distributions</td>
<td>10%</td>
<td>14</td>
</tr>
<tr>
<td>VI. Sampling</td>
<td>10%</td>
<td>14</td>
</tr>
<tr>
<td>VII. Statistical Estimation</td>
<td>15%</td>
<td>20</td>
</tr>
<tr>
<td>VIII. Hypothesis Testing</td>
<td>20%</td>
<td>27</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Occasionally, examples will be listed for a content topic to help clarify that topic. However, the content of the examination is not limited to the specific examples given.

### I. Overview of Statistics

**5 PERCENT OF EXAM | 7 HOURS OF STUDY**

A. Descriptive vs. inferential statistics  
(populations–samples, parameters–statistics)

B. Uses and misuses of statistics

C. Counting and measuring
   1. Measurement scales (nominal, ordinal, interval, ratio)

### II. Summarizing, Organizing, and Describing Data

**20 PERCENT OF EXAM | 27 HOURS OF STUDY**

A. Measures of central tendency
   1. Mean (population and sample)
   2. Median
   3. Mode

D. Collection of data (random samples, probability samples, samples of convenience)
B. Measures of variation
1. Range
2. Variance (population and sample)
3. Standard deviation (population and sample)
4. Interquartile range

C. Organizing data
1. Ordering or ranking
2. Distributions
   a. Frequency
   b. Relative frequency
   c. Cumulative frequency
3. Pictorial displays (quantitative, qualitative)
   a. Histogram
   b. Frequency polygon
   c. Box-and-whisker plot
   d. Stem-and-leaf display

D. Measures of relative position
1. Rank
2. Quartiles
3. Percentiles
4. Standardized scores (z-scores)

E. Interpreting descriptive measures
1. Symmetry and skewness
2. Comparative characteristics of measures of central tendency
3. Unimodal vs. bimodal distributions
4. Coding data/effects of adding and multiplying by constants
5. Effects of outliers on descriptive measures

III. Regression and Correlation

10 percent of exam | 14 hours of study

A. Scatterplots/diagrams
B. Least squares regression line
   1. Calculation of coefficients
   2. Prediction
C. Correlation coefficient $r$ and coefficient of determination ($R^2$) — calculation and interpretation

IV. Basic Probability Theory

10 percent of exam | 14 hours of study

A. Possibilities and probabilities
   1. Counting principles
      a. Basic counting rule — multiplication principle
      b. Permutations
      c. Combinations
   2. Sample spaces
   3. Events
      a. Mutually exclusive
      b. Union, intersection, complement
   4. The concept of a probability
      a. Relative frequency
      b. Theoretical (classical) probability
      c. Conditional probability

B. Rules of probability
   1. Complement rule
   2. Addition rules
      a. Mutually exclusive events
      b. Non-mutually exclusive events
   3. Multiplication rules
      a. Independent events
      b. Dependent events
V. Probability Distributions

10 PERCENT OF EXAM | 14 HOURS OF STUDY

A. Discrete random variables and their distributions
   1. Basic concepts
      a. Probability distributions and probability functions
      b. Mean (expected value)
      c. Variance and standard deviation
   2. Binomial distributions
      a. Properties of a binomial experiment
      b. Parameters of binomial distributions \((n, p)\)
      c. Calculation of binomial probabilities
         1) Formula
         2) Use of table
      d. Mean and standard deviation
      e. Related word problems

B. Continuous random variables and their distributions
   1. Basic concepts
      a. Probability as area under the curve
      b. Interpretation of mean and standard deviation
   2. Normal distributions
      a. Properties of the normal curve
      b. Parameters of the normal distribution — mean \((\mu)\) and standard deviation \((\sigma)\)
      c. Standard normal distributions
      d. Use of table of areas for standard normal distribution
      e. Standardized units (standardized scores, z-scores)
      f. Use of area tables to solve general normal distribution problems
      g. Normal approximation of binomial distribution (using continuity correction)

VI. Sampling

10 PERCENT OF EXAM | 14 HOURS OF STUDY

A. Simple random sampling
   1. Concept of a random sample
   2. Obtaining a simple random sample

B. Sampling distribution of the sample means
   1. Shape of sampling distribution
   2. Expected value (mean) of the sample mean
   3. Standard deviation (standard error) and variance of the sample mean
   4. Probabilities based on sampling distribution
   5. Central limit theorem and applications

C. Other sampling schemes (for example: stratified, cluster, systematic)

VII. Statistical Estimation

15 PERCENT OF EXAM | 20 HOURS OF STUDY

A. Estimation of a single population mean
   1. Large sample or sample with known variance (using \(z\)-statistic)
      a. Point estimation
      b. Interval estimation (confidence intervals)
   2. Small sample from normal populations (using \(t\)-statistic)
      a. Point estimation
      b. Student’s \(t\) distribution
      c. Interval estimation (confidence intervals)

B. Estimation of population proportions
   using the normal approximation (for large samples, only)
1. Point estimate (sample proportion)
2. Mean and standard deviation of sample proportion
3. Interval estimation (confidence intervals)

C. Estimation of the difference between two population means (for large samples, only)
   1. Matched pairs (dependent samples)
      a. Point estimate
      b. Confidence interval
   2. Large independent samples or samples with known variances
      a. Point estimate
      b. Confidence interval
   3. Small independent samples from normal distributions with equal variances
      a. Point estimate
      b. Confidence interval

D. Estimation of the difference between two population proportions (for large samples, only)
   1. Point estimate of difference
   2. Mean and standard deviation of differences of proportions
   3. Interval estimate of differences of proportions

VIII. Hypothesis Testing

A. Testing hypotheses for a single population mean
   1. Formulating hypotheses (null vs. alternative)
      a. Large sample case (using z test)
      b. Small sample case (using t test)
   2. Decisions based on P-values or critical values
   3. Type I and Type II errors

B. Testing hypotheses for population proportions (for large samples, only)
   1. Formulating hypotheses (null vs. alternative)
   2. Decisions based on P-values or critical values
   3. Type I and Type II errors

C. Testing hypotheses for the difference between two population means
   1. Large independent samples or samples with known population variances (z test)
   2. Small independent samples from normal distributions with unknown, but assumed equal variance (t test)
   3. Matched-pairs samples (t test)

D. Testing hypotheses for the difference between two population proportions (for large samples, only)

E. Chi-square tests
   1. Goodness of fit
   2. Independence in two-way contingency tables
The sample questions give you an idea of the level of knowledge expected in the exam and how questions are typically phrased. They are not representative of the entire content of the exam and are not intended to serve as a practice test.

Rationales for the questions can be found on pages 15-18 of this guide. In that section, the correct answer is identified and each answer is explained. The number in parentheses at the beginning of each rationale refers to the corresponding section of the content outline. For any questions you answer incorrectly, return to that section of the content outline for further study.

You will be provided with an erasable white board to use during your exam. During your exam, tables of necessary formulas will be available for your reference and you will have access to a basic 8-function calculator on the computer. The calculator button is in the top left hand corner of the page as each question is presented and the tables and formulas are in the Help button located in the lower left hand corner as each question is presented. A list of the formulas is printed at the back of this content guide along with a picture of the calculator that will be available for your use during the exam.

1. What is the mean of the set of data below?
   1, 1, 2, 2, 2, 4, 6, 7, 9, 10, 11
   1) 5
   2) 2
   3) 6
   4) 4

2. A random sample of 5 test scores has a mean of 82 points on a scale of 0 – 100, with a variance of zero. What is the range of these test scores?
   1) 0
   2) 50
   3) 82
   4) 100

3. A stem-and-leaf display of a set of data is shown below:
   2  345
   3  0112
   4  12555789
   5  11235
   6  235
   7  02
   Leaf Unit = 1.0
   What is the median of the data set?
   1) 45
   2) 45.5
   3) 47
   4) 49

4. A set of scores has a mean of 70 and a standard deviation of 4. Which score has a standardized score of –2.5?
   1) 55
   2) 60
   3) 65
   4) 80

5. If the number $k$ were added to each value in a set of data, which measure would remain unchanged?
   1) mean
   2) median
   3) mode
   4) range
6. Which of the following scatterplots would have a correlation coefficient closest to zero?

1)  
2)  
3)  
4)  

7. Given the regression equation \( y = -3 + 0.5x \), which is true?

1) The value of \( y \) increases 1 unit for every 2 units of increase in \( x \).
2) The value of \( y \) increases 2 units for every 1 unit of increase in \( x \).
3) The value of \( y \) is 3 units less than \( x \).
4) The correlation between \( x \) and \( y \) is negative.

8. Base your answer to this question on the scatter diagram below:

If the regression line \( \hat{y} = 3 - 0.5x \) fits the points on the scatter diagram perfectly, what is the value of the correlation coefficient \( r \)?

1) 1
2) -1
3) 0.5
4) -0.5

9. How many different radio station call letter combinations could there be if the first letter must be a W or a K and the whole station name must have three letters?

1) 54
2) 676
3) 1352
4) 17,576

10. Assume that events A and B are mutually exclusive, with \( P(A) = .4 \) and \( P(B) = .5 \). What is \( P(A \text{ or } B) \)?

1) 0
2) .2
3) .7
4) .9

11. Which of the following is a probability distribution for a discrete random variable?

1) \[
\begin{array}{c|c}
    x & P(x) \\
    \hline
    0 & 0.6 \\
    1 & 0.6 \\
    2 & -0.2 \\
\end{array}
\]

2) \[
\begin{array}{c|c}
    x & P(x) \\
    \hline
    0 & 0.7 \\
    1 & -0.2 \\
    2 & -0.1 \\
\end{array}
\]

3) \[
\begin{array}{c|c}
    x & P(x) \\
    \hline
    0 & 0.1 \\
    1 & 0.3 \\
    2 & 0.6 \\
\end{array}
\]

4) \[
\begin{array}{c|c}
    x & P(x) \\
    \hline
    0 & 0.3 \\
    1 & 0.3 \\
    2 & 0.3 \\
\end{array}
\]

12. What are the mean (\( \mu \)) and standard deviation (\( \sigma \)) of a binomial distribution where \( n = 60 \) and \( p = 1/6 \)?

1) \( \mu = 10 \) and \( \sigma = 2.89 \)
2) \( \mu = 10 \) and \( \sigma = 8.33 \)
3) \( \mu = 30 \) and \( \sigma = 3.87 \)
4) \( \mu = 30 \) and \( \sigma = 15 \)

13. Assume that the grades of individuals taking a proficiency examination are distributed normally with an average score of 75 and a standard deviation of 5. The minimum passing grade on the examination is 70. What is the approximate proportion of individuals who fail the examination?

1) .16
2) .34
3) .68
4) .84
14. Which is an accurate statement with regard to a simple random sample?
   1) The population is divided into stratified groups.
   2) The sample consists of every \( n \)th subject.
   3) The sample uses only subjects that have been screened for common traits.
   4) Samples of the same size have the same probability of being selected.

15. Given a normally distributed population with a mean of 72 and a standard deviation of 12, what is the standard error for the distribution of sample means for samples of size 36?
   1) 12
   2) 2
   3) 36
   4) 72

16. To get a sample of size 20 from the Fortune 500 companies, a statistician began by choosing a random integer (which turned out to be 16) from among the integers 1 to 25. The sample consisted of the companies with the following rankings:

   16 41 66 91 116 141 166 191 216 241
   266 291 316 341 366 391 416 441 466 491

   Which sampling scheme was used?
   1) cluster
   2) simple random
   3) stratified
   4) systematic

17. A change in which value would move the midpoint of the confidence interval for the population mean?
   1) sample size
   2) sample mean
   3) sample standard deviation
   4) confidence level

18. Which of the following pairs of procedures would increase the length of a confidence interval for the population mean? (Assume \( \sigma \) remains constant.)
   1) increasing the confidence level and decreasing the sample size
   2) decreasing the confidence level and increasing the sample size
   3) increasing both the confidence level and sample size
   4) decreasing both the confidence level and sample size

19. A random sample of size 5 from a normal distribution, whose mean and variance are unknown, yields a sample mean of 27.75 and a sample variance of 16. Which of the following is closest to a 95% confidence interval for the true mean?
   1) 27.75 ± 3.51
   2) 27.75 ± 4.60
   3) 27.75 ± 4.97
   4) 27.75 ± 14.02

20. A college’s past experience is that 46% of students accepted for admission will actually enroll at the college. It is assumed that the students act independently and that the 46% probability of acceptance still holds. If 5490 students are accepted, what is a 99% confidence interval for the number who will enroll?
   1) (2430, 2620)
   2) (2453, 2597)
   3) (2465, 2585)
   4) (0.443, 0.477)

21. In testing the hypotheses \( H_0: \mu = \mu_0 \) and \( H_a: \mu \neq \mu_0 \) based on a sample of size \( n = 36 \), assume that the population standard deviation is known and the value of the test statistic is \( z = 1.71 \). What is the approximate \( P \)-value?
   1) .044
   2) .050
   3) .087
   4) .100
22. A group of researchers plan to test the null hypothesis $H_0: \mu_1 - \mu_2 = 0$ by drawing independent samples of size $n = 15$ and $n = 12$, respectively, from two normally distributed populations. The population variances are unknown, but are assumed to be equal. Which statement best describes part of the test procedures?

1) Use test statistic $t$ and the pooled variance calculated from the sample variances.

2) Use test statistic $t$ but not the pooled variance calculated from the sample variances.

3) Use test statistic $z$ and the pooled variance calculated from the sample variances.

4) Use test statistic $z$ but not the pooled variance calculated from the sample variances.

23. An insurance company that currently sells only automobile insurance is planning to introduce homeowners insurance to its customers. The management has indicated that they will introduce homeowners insurance if more than 40% of their current customers indicate that they will purchase the new insurance. A random sample of 500 customers was used to test $H_a: p > .40$. The value of the test statistic was computed to be 2.8. Let $\alpha$ be the significance level. What is the appropriate conclusion?

At $\alpha = 0.05$,

1) there is sufficient evidence to conclude that homeowners insurance should not be introduced.

2) there is insufficient evidence to conclude that homeowners insurance should be introduced.

3) there is sufficient evidence to conclude that homeowners insurance should be introduced.

4) there is insufficient evidence to conclude that more than 80% of current customers will purchase homeowners insurance.

24. A researcher developed a method to treat stomach ulcers. The researcher found that 47% of patients in the treatment group (sample size = 82) were cured, and that 38% of patients in the control group (sample size = 78) were cured. Let $P_1$ = the proportion cured in the population of those taking treatment. Let $P_2$ = the proportion cured in the population represented by the control group. The $z$ test for $H_0: p_1 = p_2$ is closest to which value?

1) 0.7

2) 1.15

3) 1.6

4) 2.53

25. A researcher wishes to know if there is a relationship between gender and a person’s preference of color in an automobile. Male and female customers at a car dealership are shown a particular model of car in each of four colors and are asked to state their preference. Which would be the most appropriate test to determine whether men and women have different preferences?

1) chi-square test for goodness of fit

2) chi-square test for independence of effects

3) two-sample $t$ test for comparing means

4) $z$ test for comparing means
1. (IIA1)  
*1. The mean is the sum of the set of values (1 + 1 + 2 + ... + 11 = 55) divided by the number of values (11): 55/11 = 5  
2. 2 is the mode of the data set.  
3. 6 is not the mean.  
4. 4 is the median of the data set.

2. (IIB1)  
*1. Since the variance is zero, there is no variation. All the values are the same (all the test scores are 82), so the range is zero.  
2. 50 is the midpoint of the test scale.  
3. 82 is the mean of the test scores.  
4. 100 is the range of the test scale.

3. (IIC3d)  
1. 45 is the 12th ranked measure; therefore, it is not the median. 45 is the mode of the set of data.  
2. 45.5 is not the 13th ranked observation; therefore, it is not the median.  
*3. The rank of the median is \( \frac{n+1}{2} = \frac{25+1}{2} = 13 \)  
The median is the 13th ranked observation.  
The 13th ranked observation is 47.  
4. 49 is not the 13th ranked observation; therefore, it is not the median.

4. (IID4)  
1. The standardized score of 55 is \( \frac{55-70}{4} = -3.75 \)  
*2. The formula for the standardized score is \( z = \frac{x - \mu}{\sigma} \)  
The standard score of 60 is \( \frac{60-70}{4} = -2.5 \)  
3. The standard score of 65 is \( \frac{65-70}{4} = -1.25 \)  
4. The standard score of 80 is \( \frac{80-70}{4} = 2.5 \)

5. (IIE4) Assuming that \( k \cdot 0 \),  
1. the mean will be increased by \( k/n \) if \( k \) is positive.  
2. the median will change as every number is shifted by \( k \) units.  
3. the mode will change because every value in the data set is changed.  
*4. the range will remain unchanged. The lowest and highest observations will change by the same amount, so the difference will remain the same.

6. (IIIA,C)  
1. This scatterplot shows a weak positive relationship; therefore, the correlation coefficient is a small positive number, but is not closest to zero.  
2. This scatterplot shows a strong positive relationship; therefore, the correlation coefficient is a positive number close to one.  
3. This scatterplot shows a strong negative relationship; therefore, the correlation coefficient is a negative number close to -1.  
*4. This scatterplot shows a random pattern relationship; therefore, the correlation coefficient is a number closest to zero. *correct answer
7.(IIIB)
1. Because the slope = \( m = 0.5 \), for each two-unit increase in \( x \) there is a one-unit increase in \( y \).
2. Here, \( x \) and \( y \) are incorrectly reversed.
3. The value of \( y \) is actually 3 units less than \( 0.5x \).
4. The correlation between \( x \) and \( y \) is positive because the slope of the regression line is positive.

8.(IIIC)
1. The slope of the regression line is negative, so the correlation must be negative.
2. The slope is negative and all points fit the line perfectly. This is a perfect negative linear relationship; correlation coefficient \( r = -1 \).
3. When the points fit the line perfectly, the correlation can only be 1.00 or -1.00.
4. See 3).

9.(IVA1a)
1. \( 54 = (2)(3)(3)(3) \) which does not represent the number of any three-letter combinations.
2. \( 676 = (1)(26)(26) \) which represents the number of three-letter combinations where the first letter is W only or R only.
3. \( 1352 = (2)(26)(26) \) which represents the number of three-letter combinations where the first letter must be a W or a K.
4. \( 17,576 = (26)(26)(26) \) which represents the number of any three-letter combinations.

10.(IVB2a)
1. \( 0 = P(A \text{ and } B) \).
2. If \( A \) and \( B \) are independent, then \( P(A \text{ and } B) = P(A)P(B) = (.4)(.5) = .2 \).
3. If \( A \) and \( B \) are independent, then \( P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) = .7 \).
4. Since \( A \) and \( B \) are mutually exclusive, then \( P(A \text{ or } B) = P(A) + P(B) = .4 + .5 = .9 \).

11.(VA1a)
1. This is not a probability distribution because it has a negative entry.
2. This is not a probability distribution because it has two negative entries.
3. A probability distribution must satisfy these rules: \( P(x) \) can only be between 0 and 1 inclusive, and the sum of the \( P(x) \) values must be equal to 1. This distribution satisfies both rules.
4. This is not a probability distribution because the sum of \( P(x) \) values is not 1.

12.(VA2d)
1. \[ np = 60 \cdot \frac{1}{6} = 10 \]; \[ \sigma = \sqrt{np(1 - p)} = \sqrt{60 \cdot \frac{1}{6} \cdot \frac{5}{6}} = \sqrt{8.33} = 2.89 \]
2. \[ np = 60 \cdot \frac{1}{6} = 10 \]; \[ 8.33 = (2.89)^2 \] is the variance
3. 30 and 3.87 are the mean and standard deviation of a binomial distribution with \( n = 60 \) and \( p = 60 \) and \( p = \text{fi} \).
4. 30 and 15 are the mean and variance of a binomial distribution with \( n = 60 \), and \( p = \text{fi} \).

13.(VB2f)
1. \( P(\text{fail}) = P(x < 70) = P(z < \frac{70 - 75}{8.33}) = P(z < -1) = .1587 = .16 \)
2. .34 = \( P(70 < x < 75) \)
3. .68 = \( P(70 < x < 80) \)
4. .84 = \( P(x > 70) = P(\text{pass}) \)

14.(VIA2)
1. When the population is divided into stratified groups, it is a stratified sample.
2. When the sample consists of every \( n \)th subject, it is a systematic sample.
3. When the sample uses only subjects that have been screened for common traits, it is a judgment or nonprobabilistic sample.
4. When samples of the same size have the same probability of being selected, it is a simple random sample. Each set of \( n \) units has an equal chance of being selected.

*correct answer
15. (VIB3)
1. 12 is the standard deviation of the population.
2. The standard error of the sample means is
   \[ \frac{s}{\sqrt{n}} = \frac{12}{\sqrt{36}} = 2 \]
3. 36 is the sample size.
4. 72 is the mean of the population.

16. (VIC)
1. Cluster sampling is based on the random selection of clusters of elements from a population.
2. In simple random sampling, every possible sample of a given size has the same chance of being selected.
3. In stratified random sampling, first the population is divided into strata, then a random sample is selected from each stratum.
4. This is a classic case of systematic sampling. The first item (#16) is randomly chosen. Then items are chosen at fixed intervals (every 25th).

17. (VIIA)
1. A change of sample size will change the length of the confidence interval for the population mean.
2. A change of sample mean will change the midpoint of the confidence interval for the population mean.
3. A change of sample standard deviation will change the length of the confidence interval for the population mean.
4. A change of confidence level will change the length of the confidence interval for the population mean.

18. (VIIA1)
1. Increasing the confidence level and decreasing the sample size will increase the length of the confidence interval.
2. Decreasing the confidence level and increasing the sample size will decrease the length of the confidence interval.
3. Increasing both the confidence level and the sample size may increase or decrease the length of the confidence interval.
4. Decreasing both the confidence level and the sample size may increase or decrease the length of the confidence interval.

19. (VIIA2c) Use \( t \) because sample size is small.
1. \[ 27.75 \pm 3.51 = \bar{x} \pm z_{0.025} \frac{s}{\sqrt{n}} \]
2. \[ 27.75 \pm 4.60 = \bar{x} \pm z_{0.025} \frac{s}{\sqrt{n}} \]
3. \[ n = 5, \bar{x} = 27.75, s^2 = 16 \]
   The 95% confidence interval for the true mean is \( \bar{x} \pm t_{4,0.025} \frac{s}{\sqrt{n}} = 27.75 \pm 2.776 \frac{4}{\sqrt{5}} \)
   \[ = 27.75 \pm 4.97 \]
4. \[ 27.75 \pm 14.02 = \bar{x} \pm t_{4,0.025} \frac{s^2}{\sqrt{n}} \]

20. (VIIB3)
1. \( (2430, 2620) = (2525 - 95, 2525 + 95) \)
   The number of students enrolled is a binomial distribution with \( n = 5490, p = .46 \), which is approximately normally distributed with mean \( np = 2525 \) and standard deviation \( \sqrt{np(1 - p)} = 37 \).
   Therefore, a 99% confidence interval for the number of students who will enroll is \( 2525 \pm (z_{0.005})(37) = 2525 \pm (2.57)(37) = 2525 \pm 95. \)
2. \( (2453, 2597) = (2525 - 72, 2525 + 72) = 2525 \pm (z_{0.005})(37) \)
3. \( (2453, 2585) = (2525 - 60, 2525 + 60) = 2525 \pm (z_{0.005})(37) \)
4. \( (0.443, 0.477) = \frac{2430}{5490} \frac{2620}{5490} \) is the 99% confidence interval for the proportion of students who enroll.
21. (VIIIA2)
1. \(0.044 = P(z > 1.71)\). This is the \(P\)-value of a one-sided test.
2. \(0.05 = P(z < -1.645)\) or \(P(z > 1.645)\). This is the \(P\)-value of a one-sided test when \(z = 1.645\).
3. \(0.087 = 2(1 - 0.9564) = 2P(z > 1.71)\). This is the \(P\)-value of the test.
4. \(0.10 = 2P(z > 1.645)\). This is the \(P\)-value of a two-sided test when \(z = 1.645\).

22. (VIIIC2)
1. Since the population variances are unknown but are assumed to be equal, test statistic \(t\) and pooled variance calculated from the sample variances should be used.
2. This test procedure is only for normal populations with unknown and unequal variances.
3. This test procedure is only for large sample sizes and populations with unknown and equal variances.
4. This test procedure is only for large sample sizes and populations with unknown and unequal variances.

23. (VIIIB2)
1. This conclusion means accept \(H_0\).
2. This conclusion means do not accept \(H_a\).
3. This conclusion means accept \(H_a\). The critical value \(z_a = z_{0.5} = 1.645\). \(z = 2.8 > 1.645\).
   Therefore, we reject \(H_0\) and accept \(H_a\).
4. This conclusion means do not claim \(p > .80\).

24. (VIIIID)
1) 0.7 is not closest to 1.15.
2) \[\hat{p}_1 = 0.47, \hat{p}_2 = 0.38, \hat{p} = \frac{(0.47)(82) + (0.38)(78)}{82 + 78} = \frac{39 + 30}{160} = 0.43\]
   Therefore, the observed value for the \(z\) test is
   \[\frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}(1 - \hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} = \frac{0.47 - 0.38}{\sqrt{0.43 \cdot 0.57 \left(\frac{1}{82} + \frac{1}{78}\right)}}\]
3) 1.6 is not closest to 1.15.
4) 2.53 is not closest to 1.15.

25. (VIIIE2)
1) The chi-square test for goodness of fit is used to determine whether observed data fit a theoretical distribution.
2) The chi-square test for independence of effects is most appropriate. "Men and women have different preferences" suggests a test of independence.
3) Means are not being compared.
4) See 3).

*correct answer
Formula Information

Formulas

The formulas and tables listed below will be provided for your use during the examination. You will also have access to a standard calculator, as shown below.

To use the formulas and table during your computer-delivered examination, click the Help button in the lower left corner of any question screen, and select the appropriate tab.

1. Mean
2. Variance
3. Standard deviation
4. Formula for converting to standardized units
5. Number of permutations of \( n \) objects taken \( r \) at a time
6. Number of combinations of \( n \) objects taken \( r \) at a time
7. Complement rule
8. General addition rule
9. Addition rule for mutually exclusive (disjoint) events
10. General multiplication rule
11. Multiplication rule for independent events
12. Mean of a discrete random variable
13. Variance of a discrete random variable
14. Binomial distribution
15. Mean (expected value) and standard deviation of a binomial distribution
16. Standard error of the mean
17. Large-sample level C confidence interval for \( \mu \)
18. Level C confidence interval for \( p \)
19. Level C confidence interval for \( \mu_1 - \mu_2 \) if both populations are normal with equal unknown variances (independent samples)
20. Level C confidence interval for \( p_1 - p_2 \) if both sample sizes are large
21. Level C confidence interval for \( \mu_1 - \mu_2 \) for matched pairs samples
22. Variance of difference of two independent means \( X_1 - X_2 \)
23. Large-sample level C confidence interval for difference of two means
24. Test statistic for test concerning mean with known variance
25. Test statistic for small-sample test concerning mean of normal population with unknown variance
26. Test statistic for large independent sample test concerning \( (\mu_1 - \mu_2) \) difference of two means
27. Test statistic for small independent sample test concerning \( (\mu_1 - \mu_2) \) difference of two means of two normal populations with equal variance
28. Statistic for large-sample test concerning \( (p_1 - p_2) \) difference of two proportions of two populations
29. Chi-square statistic for test of goodness of fit
30. Coefficients of least squares line \( \hat{y} = a + bx \)
31. Computing formula for linear correlation coefficient

Tables

Table I Standard Normal Probabilities
Table II \( t \) Distribution Critical Values
Table III Chi-square Critical Values
ARTICLE FIVE
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• arrive at the test site rested and prepared to concentrate for an extended period
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• be prepared for possible variations in temperature at the test center due to weather changes or energy conservation measures
• bring your ID, but otherwise, don’t weigh yourself down with belongings that will have to be kept in a locker during the test.

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