Practice Questions for Exam 2 Answers

Formulas for the test

mean = np

Standard deviation = $\sqrt{np(1-p)}$

$z = \frac{x - \mu}{\sigma} \quad \frac{1}{\sqrt{n}}$

Sampling Distributions

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample means</td>
<td>$\mu$</td>
<td>$\frac{\sigma}{\sqrt{n}}$</td>
</tr>
<tr>
<td>Sample proportions</td>
<td>$p$</td>
<td>$\sqrt{\frac{p(1-p)}{n}}$</td>
</tr>
</tbody>
</table>
1. A baseball enthusiast believes pitchers who strike out a lot of batters also walk a lot of batters. He reached this conclusion by going to the library and examining the records of all major-league pitchers between 1990 and 1995. What type of study is his decision based on?

a. An observational study

b. An experimental study

2. A study is designed to determine whether grades in a statistics course could be improved by offering special review material. The 250 students enrolled in a large introductory statistics class are also enrolled in one of the 20 lab sections. The 20 lab sections are randomly divided into 2 groups of 10 lab sections each. The students in the first set of 10 lab sections are given extra review material during the last 15 minutes of each weekly lab session. The students in the remaining 10 lab sections receive the regular lesson material, without the extra review material. The grades of the students who reviewed weekly were higher, on average, than the students who did not review every week. What type of study is this?

a. An observational study

b. An experiment, but not a double-blind experiment

c. A double-blind experiment

3. The head of the quality control department at the publishing company is studying the effect of type of glue (brands A, B and C) and type of binding (paperback and hardback) on the strength of the bookbinding for 180 books. They decide to try each possible combination.

a. What is/are the factor(s) in this study? type of glue type of binding

b. What is/are the level(s)? A,B,C, paperback, hardback

c. How many possible treatments are there? 6 possible treatments

\[
\begin{align*}
&\text{A} \quad \text{p} \\
&\text{B} \quad \text{p} \\
&\text{C} \quad \text{p} \\
&\text{h} \\
&\text{h} \\
&\text{h}
\end{align*}
\]
d. What are the treatments?

\[ Ap, Ah, Bp, Bh, Cp, Ch \]

e. What are the experimental units?

180 books

f. What are the number of replications?

\[
\frac{\text{total number of items}}{\text{number of treatments}} = \frac{180}{6} = 30
\]

4. The department of Animal Regulations released information on pet ownership for the population consisting of all households in a particular county. Let the random variable \( X = \) number of licensed dogs per household. The distribution for \( X \) is given below

<table>
<thead>
<tr>
<th>Value of X</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>0.52</td>
<td>0.22</td>
<td>0.13</td>
<td>?</td>
<td>0.03</td>
<td>0.01</td>
</tr>
</tbody>
</table>

a. What is the probability for \( X = 3 \)?

\[
1 - .52 - .22 - .13 - .03 - .01 = .09
\]

b. What is the probability that a randomly selected household from this community owns at least one licensed dog?

\[
0.22 + 0.13 + 0.09 + 0.03 + 0.01 = 0.48
\]

c. What is the average number of licensed dogs per household in this county?

\[
0(0.52) + 1(0.22) + 2(0.13) + 3(0.09) + 4(0.03) + 5(0.01) = 0.92
\]
5. Suppose that a college determines the following distribution for \( X = \) number of courses taken by a full-time student this semester.

<table>
<thead>
<tr>
<th>Value of X</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>0.07</td>
<td>?</td>
<td>0.25</td>
<td>0.28</td>
</tr>
</tbody>
</table>

a. What is \( P( X = 4) \)?

\[
1 - 0.07 - 0.25 - 0.28 = 0.4
\]

b. What is the average number of courses full-time students at this college take this semester?

\[
3(0.07) + 4(0.4) + 5(0.25) + 6(0.28) = 4.74
\]

c. What is \( P( X < 7 ) \)?

\[
P( X < 7 ) = 1 \quad (all \ values \ are \ less \ than \ 7 )
\]

d. What is \( P( X > 4.74 ) \)?

\[
P( X > 4.74 ) = 0.25 + 0.28 = 0.53
\]
6. The Biology Department plans to recruit a new faculty member. Data collected by a different university on the 410 possible candidates is available. The Biology Department is debating to put a requirement of 10 years of teaching experience in the job description. The available data on the candidates is shown below.

<table>
<thead>
<tr>
<th>Experience</th>
<th>Less than 10 years</th>
<th>10 or more years</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>178</td>
<td>112</td>
<td>290</td>
</tr>
<tr>
<td>Female</td>
<td>99</td>
<td>21</td>
<td>120</td>
</tr>
<tr>
<td>Total</td>
<td>277</td>
<td>133</td>
<td>410</td>
</tr>
</tbody>
</table>

(a) What is the probability that a candidate has less than 10 years of experience?

\[
\frac{277}{410}
\]

(b) What is the conditional probability that a female candidate has less than 10 years of experience?

\[
\frac{99}{120}
\]

(c) What is the conditional probability than a male candidate has less than 10 years of experience?

\[
\frac{178}{290}
\]

(d) What is the conditional probability that someone has 10 or more years of experience given that they are male?

\[
\frac{112}{290}
\]

(e) What is the conditional probability that someone is a male given that they have less than 10 years of experience?

\[
\frac{178}{277}
\]

(f) What is the conditional probability that someone is female given that they have 10 or more years of experience?

\[
\frac{21}{133}
\]
7. The proportion of students who own a cell phone on college campuses across the country has increased tremendously over the past few years. It is estimated that approximately 90% of students now own a cell phone. 15 students are to be selected at random from a very large university. Assume that the proportion of students who own a cell phone at this university is the same as nationwide. Let X = the number of students in the sample of 15 who own a cell phone.

a. What is the appropriate distribution for X?  \( X \sim \text{Binomial} \ (n = 15, p = .90) \)

b. List the four criteria for X to have a binomial distribution and discuss whether or not it has a Binomial Distribution

- 15 trials (a set number of trails)
- Trails are independent because the sample is randomly selected
- 2 outcomes – cell phone or no cell phone
- \( p = 0.90 \)

c. What is the probability that 14 of the 15 students own a cell phone? 0.3432 (use artofstat.com)

d. What is the probability that 13 students own a cell phone? 0.2669 (use artofstat.com)
e. Calculate the probability that 13 or more students own a cell phone.

\[ P(X \geq 13) = P(13) + P(14) + P(15) = 0.2669 + 0.3432 + 0.2059 = 0.816 \]

(Use artofstat.com to find each of these values.)

f. On average, how many students will own a cell phone in simple random samples of 15 students?

\[ \text{Mean} = np = 15(0.9) = 13.5 \]

g. What is the standard deviation of the number of students who own a cell phone in simple random samples of 15 students?

\[ \sqrt{15(0.9)(1 - 0.9)} = 1.16 \]

8. For the following descriptions, list experimental units (or subjects), factors, levels, treatments, and response variables.

1. Veterinarians are interested in finding out which brands of dog food cause dogs to gain the most weight. Sixteen dogs younger than 5 and sixteen dogs older than 5 are selected and given either Science Diet, Pedigree, Alpo, or Purina.

**Factors:** age, brand

**Levels:** greater than 5, less than 5; SD, Pe, A, Pu

**Treatments**

\[ \begin{array}{c}
SD > 5 \\
Pe > 5A, > 5Pu
\end{array} \]

\[ \begin{array}{c}
< 5SD, < 5Pe, < 5Pu
\end{array} \]
2. A forester wants to know which of three types of tree (palm, pine, oak) does best resisting hurricane force winds. He selects 10 pieces of wood from each type of tree and subjects it to hurricane force winds. He then records the level of damage for each type of wood on a scale from 1 to 10.

Factors: type of tree  
Levels: palm, pine, oak  
Treatments: palm, pine, oak

Response variable: level of damage on a scale of 1 to 10

3. A corporate manager is interested in finding the best way to improve productivity. He wants to see if reading a book or not or attending a seminar or not has the most impact on productivity. He assigns the treatments to 8 branches of his company.

Factors: book  seminar  
Levels: read a book, didn’t read a book; attended seminar, didn’t attend seminar  
Treatments:
book and seminar, book and no seminar, no book seminar, no book and no seminar

Response Variable: productivity

4. Doctors are interested in determining whether fitness level (low, average, high) and age (20’s, 30’s, 40’s, 50’s) impact time to recovery after knee surgery. 40 people of various ages and fitness levels are evaluated for time to recovery.

Factors: fitness level  age  
Levels: low average high  20 30 40 50

Response variable: weight
treatments:

Lo20, Lo30, Lo40, Lo50, Av20, Av30, Av40, Av50, Hi20, Hi30, Hi40, Hi50

response variable: time to recovery

9. Read the following descriptions, and tell what source of bias(es) each represents (undercoverage, non-response, response bias, or poor wording of questions).

1. A mail survey is conducted to determine what percentage of Americans are vegetarian or vegan. 15% of households respond.

   Non-response

2. We would like to have an estimate of the percentage of people that participate in illegal drugs. We call 3,500 households. In the study, no one says that they do illegal drugs.

   Response bias

3. How many Americans are supportive of welfare programs? To find the answer, we will ask “Given the failure of welfare in the US, do you feel welfare programs should be eliminated?”

   poor wording in a question

   How can this question be reworded so as not to cause bias?

   Should the welfare program be continued or eliminated?

4. To find out what college seniors plan to do after they graduate, you take sample from upper level honors courses.

   undercoverage

10. For each of the experiments described below, list the probability model, including the sample space and probabilities for each event in the sample space.

1. You have a jar containing 5 red marbles, 3 blue marbles, and 3 green marbles.

   a) Draw one marble and record its color.

   \[ S: \{\text{red, green, blue}\} \quad P(\text{red}) = \frac{5}{11} \quad P(\text{green}) = \frac{3}{11} \quad P(\text{blue}) = \frac{3}{11} \]
b) Draw a marble and record whether or not it is red.

\[ S: \{\text{red, not red}\} \quad P(\text{red}) = \frac{5}{11} \quad P(\text{not red}) = \frac{6}{11} \]

2. You have two coins.

a) Flip the two coins and look at the outcomes.

\[ S: \{\text{HH, HT, TH, TT}\} \quad P(\text{HH}) = \frac{1}{4} \quad P(\text{HT}) = \frac{1}{4} \quad P(\text{TH}) = \frac{1}{4} \quad P(\text{TT}) = \frac{1}{4} \]

b) Flip the two coins and record the number of heads.

\[ S: \{0, 1, 2\} \quad P(0) = \frac{1}{4} \quad P(1) = \frac{1}{2} \quad P(2) = \frac{1}{4} \]

11. Using the same jar of marbles as above (5 red, 3 blue, 3 green), answer the following questions.

a) What is the probability that a randomly selected marble is blue? \[ \frac{3}{11} \]

b) What is the probability that a randomly selected marble is yellow? \[ 0 \]

c) What is the probability that a randomly selected marble is either red or blue?

\[ \frac{5}{11} + \frac{3}{11} = \frac{8}{11} \]

12. The following table gives ages of murder victims in the United States in the 1990's. In America, the probability that a randomly selected murder victim is in a certain age group is given below.

<table>
<thead>
<tr>
<th>Age of Victims</th>
<th>10 years or under</th>
<th>11-20</th>
<th>21-40</th>
<th>41 or older</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>.025</td>
<td>.225</td>
<td>?</td>
<td>.175</td>
</tr>
</tbody>
</table>

a) What is the probability that a randomly selected victim was between 21 and 40 years old?

\[ 1 - .025 - .225 - .175 = .575 \]

b) What is the probability that a randomly selected victim was less than 21?

\[ .025 + .225 = .25 \]
c) What is the probability that a randomly selected victim was either in the oldest age group or the youngest age group?

\[ .175 + .025 = .20 \]

d) What is the probability that two randomly selected murder victims are both 10 or younger? (The two victims are selected independently of each other.)

\[ (.025)(.025) = 0.000625 \text{ or } almost \text{ zero} \]

13. The General Social Survey (GSS) is a national survey conducted annually by UC-Berkeley covering a wide variety of topics. One of the questions asked and the results are listed below.

How much do you agree or disagree with each of the following statement? It is right to use animals for medical testing if it might save human lives.

<table>
<thead>
<tr>
<th>Response</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>neutral</th>
<th>Agree</th>
<th>strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>.066</td>
<td>.138</td>
<td>.164</td>
<td>.497</td>
<td>.135</td>
</tr>
</tbody>
</table>

a) What is the probability that a randomly selected person agrees or strongly agrees?

\[ .497 + .135 = .632 \]

b) What is the probability that 2 randomly selected people all disagree? (Assume independence).

\[ (.138)(.138) = 0.019 \]

c) What is the probability that a person does not feel neutral about this question?

\[ 1 - .164 = .836 \]

14. A certain breed of dog has a lifespan that follows a roughly normal distribution with mean 13.0 years and standard deviation of 1.23 years. (Remember to write the computer code, draw the picture and write a description.)

a) What proportion of dogs lives longer than 14.23 years? (List the distribution, the population mean and the population standard deviation. Draw a picture, show the calculator code and write a sentence explaining the answer.)

Normal with mean equal to 13.0 years and standard deviation equal to 1.23 years

Answer = .1587

15.87% of dogs live longer than 14.23 years.
b) What proportion will live between 11.5 and 14.5 years? (List the distribution, the population mean and the population standard deviation. Draw a picture, show the calculator code and write a sentence explaining the answer.)

**Normal with mean equal to 13.0 years and standard deviation equal to 1.23 years**

*Answer = .7774 77.74% of dogs will live between 11.5 and 14.5 years.*
c) What proportion will live less than 10 years? (List the distribution, the population mean and the population standard deviation. Draw a picture, show the calculator code and write a sentence explaining the answer.)

Normal with mean equal to 13.0 years and standard deviation equal to 1.23 years

Answer = 0.0074

0.74% of dogs will live less than 10 years.

15. The Graduate Record Examinations (GRE) are widely used to help predict the performance of applicants to graduate schools. The psychology department at a university finds that the scores of its applicants on the quantitative GRE are approximately normal with mean \( \mu = 544 \) and standard deviation \( \sigma = 103 \). Let \( X \) = score on the quantitative GRE.

a.) \( P( X > 700) \) (List the distribution, the population mean and the population standard deviation. Draw a picture, show the calculator code and write a sentence explaining the answer.)

Normal with mean equal to 544 points and standard deviation equal to 103 points

Answer = 0.0649

6.49% of students score greater than 700 points on the GRE
b.) $P(X < 500)$ (List the distribution, the population mean and the population standard deviation. Draw a picture, show the calculator code and write a sentence explaining the answer.)

**Normal with mean equal to 544 points and standard deviation equal to 103 points**

*Answer = 0.3346*

33.46% of students score less than 500 points on the GRE
c.) \( P(500 < X < 800) \) (List the distribution, the population mean and the population standard deviation. Draw a picture, show the calculator code and write a sentence explaining the answer.)

**Normal with mean equal to 544 points and standard deviation equal to 103 points**

*Answer = 0.6589*

65.89% of students score between 500 and 800 on the GRE

[The Normal Distribution](image)

\[ P(500 < X < 800) = 65.89\% \]

---

d.) What is the score of the person that has 90% of the class score less than him? (List the distribution, the population mean and the population standard deviation. Draw a picture, show the calculator code and write a sentence explaining the answer.)

**Normal with mean equal to 544 points and standard deviation equal to 103 points**

*Answer = 676.00*

A person who scores a 676 has 90% of the class score less than him.
e. What is the score of the person that has 20% of the class score less than him? (List the distribution, the population mean and the population standard deviation. Draw a picture, show the calculator code and write a sentence explaining the answer.)

*Normal with mean equal to 544 points and standard deviation equal to 103 points*

*Answer = 457.31*

A person who scores a 457.31 has 20% of the class score less than him.
f. What is the score of the person that has 25% of the class score more than him? (List the distribution, the population mean and the population standard deviation. Draw a picture, show the calculator code and write a sentence explaining the answer.)

*Normal with mean equal to 544 points and standard deviation equal to 103 points*
*Answer = 613.47*

A person who scores a 613.47 has 25% of the class score more than him.

---

**The Normal Distribution**

![Diagram of normal distribution]

---

g. What is the score of the 88th percentile? (List the distribution, the population mean and the population standard deviation. Draw a picture, show the calculator code and write a sentence explaining the answer.)

*Normal with mean equal to 544 points and standard deviation equal to 103 points*
*Answer = 665.0*

The eighty eight percentile score is 665.0
h. Find the 1st and 3rd quartiles. (List the distribution, the population mean and the population standard deviation. Draw a picture, show the calculator code and write a sentence explaining the answer.)

*Normal with mean equal to 544 points and standard deviation equal to 103 points*
*1st quartile: 474.53*
*3rd quartile: 613.47*

The first quartile score is 474.53 and the third quartile score is 613.47
16. Jake an eighth grader from Dayton, Florida took a standardized test. The standardized test was distributed normally with mean 605 and standard deviation 97. Jake scored 432. Lily-also an eighth grader – from Moore, SC took a different standardized test. This test was also normally distributed with a mean of 25 and a standard deviation of 5.3. Lily scored a 37.

a) What is the z-score for Jake? \[ z = \frac{432 - 605}{97} = -1.78 \]

b.) What is the z-score for Lily? \[ z = \frac{37 - 25}{5.3} = 2.26 \]

c.) Who scored better? Why? Lily is 2.26 standard deviations above the mean and Jake is 1.78 standard deviations below the mean.

17. A poll of 20 voters is taken in a very large city. Suppose that the voters were chosen randomly and that their responses were confidential. The purpose is to determine X, the number in favor of a certain candidate for mayor. Suppose that 60% of all the city’s voters favor this candidate. (Suppose that the voters were chosen randomly and that their answer were confidential.)

a) What is the distribution of X?

\[ X \sim \text{Binomial} (n = 20, p = 0.6) \]
b) List the four criteria for X to have a binomial distribution and discuss whether or not it has a Binomial Distribution.

- **20 trials**
- **Independent**
- **p = 0.6**
- **2 outcomes (for or against candidate)** → Yes, it is binomial(n=20, p = 0.6)

c) What is the mean of X?

\[ \text{Mean} = np = 20(0.6) = 12 \]

d) What is the standard deviation of X?

\[ \text{stdev} = \sqrt{np(1-p)} = \sqrt{20(0.6)(1-0.6)} = 2.19 \]

e) What is the sample space?

\[ S: \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20\} \]

f) Find the probability that X=10.

**Answer:** \[ P(X=10) = 0.1171 \] or about 11.71%
g) Find the probability that $X$ less than or equal to 10.

$P(X \leq 10) = 0.2447$

(Use the web app for the binomial and select the type of probability as lower tail.)
h) What is the probability that $X$ is less than or equal to 5?

$$P(X \leq 5) = 0.0016$$

i) What is the probability that $X$ is 5?

$$P(X = 5) = 0.0013$$
j) What is the probability that $X$ is less than 10?

\[ P(X < 10) = P(X \leq 9) = 0.1275 \]
18. Would most wives marry the same man again if given a chance? According to a poll of 608 married women conducted by *Ladies Home Journal* (June 1988), 80% would, in fact, marry their current husbands. Assume the women in the sample were randomly selected from among all married women in the United States. Does the number $X$ in the sample who would marry their husbands again possess a binomial probability distribution? Explain.

- 608 women (trial)
- 2 outcomes (yes or no)
- Independent, because randomly selected
- $p = 0.8$

$X \sim \text{binomial} (p=0.8, n=608)$

19. Consider the following probability distributions. In each case state whether it is a valid probability distribution or not and give reasons.

a).

<table>
<thead>
<tr>
<th>$X$</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>0.01</td>
<td>0.24</td>
<td>0.7</td>
<td>0.06</td>
<td>-0.01</td>
</tr>
</tbody>
</table>

*Not a valid probability distribution because of the negative. All probabilities must be between 0 and 1.*

b)

<table>
<thead>
<tr>
<th>$X$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>0.34</td>
<td>0.21</td>
<td>0.05</td>
<td>0.3</td>
<td>0.2</td>
</tr>
</tbody>
</table>

*Yes, all probabilities are between 0 and 1. Probabilities must sum up to 1. $0.34 + 0.21 + 0.05 + 0.3 + 0.2 = 1.1$, therefore this is not a valid probabilities distribution.*
20. Here is the assignment of probabilities that describe the age (in years) and the sex of a randomly selected American college student:

<table>
<thead>
<tr>
<th>Age</th>
<th>14-17</th>
<th>18-24</th>
<th>25-34</th>
<th>≥ 35</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>150</td>
<td>159</td>
<td>78</td>
<td>3</td>
<td>390</td>
</tr>
<tr>
<td>Female</td>
<td>160</td>
<td>200</td>
<td>45</td>
<td>2</td>
<td>407</td>
</tr>
<tr>
<td>Total</td>
<td>310</td>
<td>359</td>
<td>123</td>
<td>5</td>
<td>797</td>
</tr>
</tbody>
</table>

(underlined word is the given, bold word is the special)

a. What is the probability that the student is a female?

\[ \frac{407}{797} \]

b. What is the conditional probability that the student is a female given the student is at least 35 years old?

\[ \frac{2}{5} \]

c. What is the probability that a male student is between 18 to 24 years old?

\[ \frac{159}{390} \]

d. What is the probability that a 18-24 year old is male?

\[ \frac{159}{359} \]
21. Suppose that the heights of women are normally distributed with a mean of 65 inches and a standard deviation of 3 inches.

a) Write this distribution using the notation above. \( X \sim N (65, 3) \)
   X has a normal distribution with a mean equal to 65 and a standard deviation equal to 3.

b) Draw a graph of this distribution with the mean and change of curvature points correctly located.

![Graph showing normal distribution with mean 65 and standard deviation 3.]

\[ \begin{align*}
56 & \quad 59 \quad 62 \quad 65 \quad 68 \quad 71 \quad 74 \\
\text{68\%} & \quad \text{95\%} \quad \text{99.7\%} \\
\end{align*} \]

c) What percent of women are between 59 and 71 inches tall? 95%

e.) What percent of women are between 62 and 68 inches tall? 68%

f.) What percent of women are between 56 and 74 inches tall? 99.7%

g.) What is the name of the Rule that tells you this? Empirical Rule

22. Determine whether the following examples are simple random samples, convenience samples, or volunteer samples.

a.) ABC.com posted a question on their website asking viewers to say if they approved or disapproved of the State of the Union address by the President. 33% said that they approved. Volunteer sample

b.) A news reporter stood outside of Tigert (the University of Florida’s administration building) and asked all of those that exited if they thought that tuition should be increased. 100% said that tuition should be increased. Convenience sample

c.) A researcher took the University of Florida phone book and chose 60 students to call using a random selection method that a computer program provided. The researcher then called each of these students. 17% of the students said that tuition should be increased. Simple random sample
23. Answer the following short questions.

a. What is the shape of the normal distribution?  
   *Bell/symmetric*

b. What does a negative z-score tell you?  
   *That the score is below the mean*

c. What does a positive z-score tell you?  
   *That the score is above the mean*

d. What is the symbol for the mean of the Normal distribution?  
   *µ*

e. What is the symbol for the standard deviation of the Normal distribution?  
   *σ*

f. A political scientist is asking 4000 randomly selected participants if they approve of 
   president’s performance in the past 100 days, yes or no. What is the margin of error?

\[
\frac{1}{\sqrt{n}} = \frac{1}{\sqrt{4000}} = 0.0158
\]

11 0.0158 4000

= n

g. What is the mean and the standard deviation of the Standard Normal Distribution?

   **Mean = 0 and Standard Deviation = 1**

h. IQ scores are normally distributed with a mean of 100 and a standard deviation of 16. 
   What is the z-score for someone who has a 90 for an IQ score?

\[
z = \frac{x - \mu}{\sigma} = \frac{90 - 100}{16} = -0.625
\]
24. The population proportion of Americans that plan on voting in the next election for mayor is 0.422. You randomly select 55 adults and ask them whether or not plan on voting in the next election for mayor.

i) Is this problem about the sample mean or about the sample proportion?  

sample proportion

ii) Check the conditions for the sampling distribution.

\[ n = 55 \quad np \geq 15 \quad 55(0.422) = 23.21 \]
\[ p = 0.422 \quad n(1-p) \geq 15 \quad 55(1-0.422) = 31.79 \]

Since both conditions are met we can write the sampling distribution

iii) What is the sampling distribution of the statistic?

\[ \hat{p} \text{ has a Normal distribution with mean equal to 0.422 and standard error equal to } \sqrt{\frac{(0.422)(1-0.422)}{55}} \]

iv) Can we answer probability questions for this problem?  

yes

25. The population proportion of Americans that are members of a religious organization is 0.61. You take a random sample of 50 adults and ask them whether or not they are members of a religious organization.

i) Is this problem about the sample mean or about the sample proportion?  

sample proportion

ii) Check the conditions for the sampling distribution.

\[ n = 50 \quad np \geq 15 \quad 50(0.61) = 30.5 \]
\[ p = 0.61 \quad n(1-p) \geq 15 \quad 50(1-0.61) = 19.5 \]

Since both conditions are met we can write the sampling distribution

iii) What is the sampling distribution of the statistic?

\[ \hat{p} \text{ has a Normal distribution with mean equal to 0.61 and standard error equal to } \sqrt{\frac{(0.61)(1-0.61)}{50}} \]

iv) Can we answer probability questions for this problem?  

yes
26. According to research, baby birth weights in the United States follow a normal distribution with mean 3250g and standard deviation 550g. Someone selects 20 random babies and measured their birth weights in grams.
   i) Is this problem about the sample mean or about the sample proportion?
      sample mean
   
   ii) Check the conditions for the sampling distribution.

   n > 30 or X is normally distributed

   Conditions are met since it states that it is normally distributed in the problem.

   iii) What is the sampling distribution of the statistic?
      \( \bar{x} \) has a Normal distribution with mean equal to 3250 and standard error equal to \( \frac{550}{\sqrt{20}} \)

   iv) Can we answer probability questions for this problem? yes

27. According to research, 5.5% of Americans report that they had a peanut allergy. You take a survey of 20 people and ask them a similar question.

   i) Is this problem about the sample mean or about the sample proportion?
      sample proportion

   ii) Check the conditions for the sampling distribution.

   \( n = 20 \) \hspace{1cm} np \geq 15 \hspace{1cm} 20(0.055) = 1.1 \hspace{1cm} ( \text{not greater than 15})
   \( p = 0.055 \) \hspace{1cm} n(1-p) \geq 15 \hspace{1cm} 20(1-0.055) = 18.9

   Conditions are not met, therefore the distribution is unknown

   iii) What is the sampling distribution of the statistic? Unknown

   iv) Can we answer probability questions for this problem? No
28. Average amount of sleep received by adults is 7.2 with a standard deviation of 2. You take a random sample of 120 adults.
   i) Is this problem about the sample mean or about the sample proportion?

   sample mean

   ii) Check the conditions for the sampling distribution.

   n > 30 or X is normally distributed

   Conditions are met since the sample size, n = 120, which is greater than 30.

   iii) What is the sampling distribution of the statistic?

   \( \bar{x} \) has a Normal distribution with mean equal to 7.2 and standard error equal to \( \frac{2}{\sqrt{120}} \)

   iv) Can we answer probability questions for this problem? **yes**

29. Dietary intake in America is said to have a mean of 2000 kcal with a standard deviation of 220 kcal. A randomly selected sample of 25 Americans is taken.

   i) Is this problem about the sample mean or about the sample proportion?

   sample mean

   ii) Check the conditions for the sampling distribution.

   n > 30 or X is normally distributed

   25 < 30 condition not met

   Does not say that X is normally distributed

   Neither conditions are met; therefore the sampling distribution is unknown

   iii) What is the sampling distribution of the statistic? **Unknown**

   iv) Can we answer probability questions for this problem? **No**
30. Out of all Americans, 77.7% agree that you should plan for retirement. A random sample of 250 Americans is taken and they are asked the same question. What is the probability that the sample proportion is greater than 0.85?

i) Is this problem about the sample mean or about the sample proportion?

Sample proportion

ii) The conditions are met. What is the sampling distribution of the statistic? 

\[ \hat{p} \] has a Normal distribution with mean equal to 0.777 and 

standard error equal to 

\[ \sqrt{\frac{(0.777)(1-0.777)}{250}} \]

iii) Answer the question posed. Draw the graph and give an interpretation.

\[ \sqrt{\frac{0.777(1-0.777)}{250}} = 0.02633 \]

Answer = .002782 0.2782% of samples have a sample proportion greater than 0.85

31. For all Americans, 19% of Americans have not had any alcohol in the past 12 months. A random sample of 2000 people was taken and asked if they had not had any alcohol in the past 12 months. What is the probability that the sample proportion is greater than 0.20?

i) Is this problem about the sample mean or about the sample proportion?
ii) The conditions are met. What is the sampling distribution of the statistic?

\[ \hat{p} \text{ has a Normal distribution with mean equal to } 0.19 \text{ and standard error equal to } \sqrt{\frac{(0.19)(1-0.19)}{2000}} \]

iii) Answer the question posed. Draw the graph and give an interpretation.

\[ \sqrt{\frac{(0.19)(1-0.19)}{2000}} = 0.008772 \]

Answer =0.1271

12.71\% of samples have sample proportions greater than 0.20.

32. For all Americans, the average amount of time they watch tv per day is 2.9 hours. The standard deviation is 1.2. If you select 40 people, what is the probability that the sample mean tv watch time is greater than 3.2 hours?

i) Is this problem about the sample mean or about the sample proportion?

sample mean

ii) The conditions are met. What is the sampling distribution of the statistic?

\[ \bar{x} \text{ has a Normal distribution with mean equal to } 2.9 \text{ and} \]
standard error equal to $\frac{1.2}{\sqrt{40}}$

iii) Answer the question posed.

$$\frac{1.2}{\sqrt{40}} = 0.1897$$

Answer = 0.0569

5.69% of samples have sample means greater than 3.2 hours.

33. For all Americans, the average amount of time spent exercising per day is 0.9 hours. The standard deviation is 0.8. If you select 40 people, what is the probability that the sample mean time that they spend exercising is less than 0.5 hours per day?

i) Is this problem about the sample mean or about the sample proportion?

sample mean

ii) The conditions are met. What is the sampling distribution of the statistic?

$\bar{x}$ has a Normal distribution with mean equal to 0.9 and standard error equal to $\frac{0.8}{\sqrt{40}}$

iii) Answer the question posed. Draw the graph and give an interpretation.
\[
\frac{0.8}{\sqrt{40}} = 0.1265
\]

Answer = almost zero = 0.0008

0.08% of samples will have a sample mean less than 0.5 hours.

The Normal Distribution

Normal Distribution with \( \mu = 0.9 \) and \( \sigma = 0.1265 \)

\[ P(X < 0.5) = 0.08\% \]