

1 Exam Directions From Canvas Assignments

1.1 Final Exam Directions

Students must use Respondus Monitor with LockDown Browser, with a webcam on the relevant area for the duration of this exam. Before beginning the exam, the webcam should be placed at a location at which the entire work area can be seen, including the student's face and hands, at all times. No electronic devices other than a calculator should be brought into the testing environment; this includes smart watches. Communication of any kind with another person during this exam will be considered a violation of the academic integrity policy.

Once the webcam for Respondus Monitor is on, but before beginning the exam, students must clearly show their blank pages to the webcam, front and back.

This exam will consist of two sections: the Multiple Choice (MC) and Free Response (FR) sections.

MC Section: This Canvas assignment will include all MC questions, and they will be graded automatically in this assignment.

FR Section: It will appear as a single question on this exam; that question will include a list of all of the FR questions. You must write your work and answers on paper, and then scan all pages and upload them together as a single pdf (via an app such as Adobe Scan or CamScanner: NOT simply a phone picture) to the "Final Exam pdf Upload" Canvas assignment (the assignment after this one on Canvas). This portion must be uploaded within 15 minutes of finishing the exam. Before logging off of this Respondus Monitor, you must hold up all sheets with your written work to the webcam so they can be read on the video. You also need to follow the directions given in the FR section during the exam. The FR portion will be graded by the grading team, and your score will be entered manually into this assignment.

Failure to follow any of the above guidelines will result in you losing 2 points on the exam (which is the final Free Response Question). Significant failure to follow these guidelines may result in the exam not being accepted and you being granted a score of zero for the exam.

Before beginning this exam, make sure that you have the following:

- tablet/laptop/similar device with Respondus Monitor and LockDown Browser (NOT a smartphone);
- a webcam in, or capable of being integrated into, the device in #1 (you will need to show your face, your picture ID, and your testing environment to begin the exam);
- device capable of scanning (with Adobe Scan or CamScanner), saving, and uploading pdf files (no other file type);
- sufficient internet connection;
- an approved calculator (TI-83, TI-84, or "Plus" versions of these);
- pencil and paper.

This exam is made available a little early and a little late on Canvas so that you have sufficient time to read these directions and perform the RM/LDB checks. However, note the time limit once you start the exam.

In the event of technical difficulties, contact your instructor immediately. You should continue to complete the exam if possible.

1.2 FR Directions

There are 6 (content-carrying) free response questions, each with multiple parts. Show all necessary work on your handwritten page (which you will scan and upload as a pdf).

Verify that the answers carry the appropriate units. Partial credit may be given for work towards the correct solution. However, if answers are shown without necessary work, you may receive little or no credit for the correct answer.

Free Response Questions: [Image Embedded]

Type your free response answers (ANSWERS ONLY) into the answer area for this question, marked with the question number. For example, your response should be formatted something like this:

#1) (a) your answer

(b) your answer

(c) your answer

#2) etc. ...

If your answer involves a chart, table, or diagram, type the appropriate word (e.g. "diagram") as your answer to this question.

Write your work and answers on a sheet of paper (remember to always include appropriate units, including % and \$ symbols when appropriate). Round answers to two decimal places unless otherwise instructed. When finished the exam, but before logging off of Respondus Monitor, show all of the pages of your work/answers to FR questions to the webcam so that they can be clearly read. Then log off of Respondus Monitor, scan the pages to create a single pdf, and upload the scanned pdf to the corresponding "Final Exam pdf Upload" assignment.

1.3 Final Exam pdf Upload Directions

Upload, as a single pdf, your handwritten work and answers to the Free Response section of the exam here.

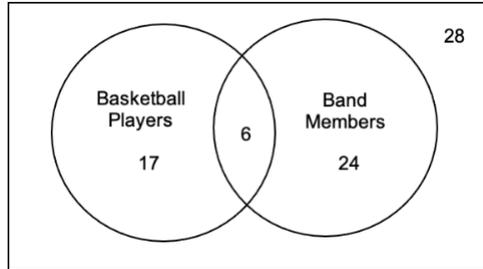
After uploading, confirm that your upload has completed by downloading it again to make sure it is readable. A late upload or one that cannot be read/downloaded will result in a deduction of 10 points, and it might not be accepted at all at the instructor's discretion.

Your upload is due within 15 minutes of the exam ending. Failure to follow this policy may result in your exam responses not being accepted and you being given a score of zero for the Free Response portion of the exam.

Points earned on the free response section will be manually added to the Exam assignment on Canvas, not to this assignment.

2 MC: 2 points each, 60 points total. Correct answer is option (a).

1. The Venn Diagram below represents the number of students who play basketball or play an instrument in the band. How many students do not play in the band?



- (a) 45
(b) 28
(c) 17
(d) 51
(e) 24
2. Is the following argument valid? Is it sound?
- P: All fruit is red.
P: Blueberries are fruit.
C: Blueberries are red.
- (a) The argument is valid but is not sound.
(b) The argument is both valid and sound.
(c) The argument is neither valid nor sound.
(d) The argument is not valid but is sound.
3. You have 2 different options to rent a truck to help you move. The first rental truck has a storage area of 10 feet by 8 feet and costs \$45. The second rental truck has a storage area of 3 meters by 3 meters and costs \$40. Which truck is cheaper per square foot?
- (a) The second rental truck is cheaper per square foot.
(b) The first rental truck is cheaper per square foot.
(c) Both rental trucks cost the same per square foot.
(d) There is not enough information to answer this question.

4. Jocelyn went for a bike ride, and their smart watch said 750 calories were burned during the 30-minute ride. What was Jocelyn's power for the bike ride in watts? Round to the nearest whole number.
- (a) 1,743 Watts
 - (b) 104,600 Watts
 - (c) 2 Watts
 - (d) 313,800 Watts
 - (e) 52,300 Watts
5. A company profited \$4,500 from selling a new product on their website. 72% of their overall profit was from this new product. What was their total profit for all products? Round to the nearest whole number.
- (a) \$6,250
 - (b) \$3,240
 - (c) \$2,616
 - (d) \$7,740
6. In 2018, there were 90.3 million households in the U.S. that subscribed to cable TV. In 2020, there were only 82.9 million households in the U.S. that subscribed to cable TV. Find the relative change in the number of U.S. households subscribing to cable TV over this timeframe.
- (a) -8.2%
 - (b) 8.2%
 - (c) -8.9%
 - (d) 8.9%
 - (e) -9.2%
7. You are measuring 4 cups of water to cook pasta. The absolute error in a glass measuring cup is -0.25 cups, and it can be read to the nearest $\frac{1}{8}$ th of a cup. A plastic measuring cup has an absolute error of 0.33 cups, and it can be read to the nearest $\frac{1}{5}$ th of a cup. Which measuring cup is more accurate, and which measuring cup is more precise?
- (a) The glass measuring cup is more accurate and more precise than the plastic measuring cup.
 - (b) The plastic measuring cup is more accurate and more precise than the glass measuring cup.
 - (c) The glass measuring cup is more accurate, but the plastic measuring cup is more precise.
 - (d) The glass measuring cup is more precise, but the plastic measuring cup is more accurate.
8. Find the overall inflation rate from 1984 to 2004.
- (a) 81.81%
 - (b) 44.99%
 - (c) -81.81%
 - (d) -44.99%
 - (e) 1.82%

9. Which of the following is false about compound interest is false?
- (a) Interest is paid only on the principal, and not the accumulated interest.
 - (b) Compounding more than once per year results in an APY greater than the APR.
 - (c) Continuous compounding will never reach an infinite amount of money.
 - (d) After one year, an account earning compound interest will earn more interest than an account earning simple interest (with all else being equal).
10. Jocelyn deposited \$100 a month for 25 years into an IRA. The IRA now contains \$125,000. How much interest did Jocelyn earn in interest on this IRA?
- (a) \$95,000
 - (b) \$30,000
 - (c) \$125,000
 - (d) \$155,000
11. An initial investment of \$3,000 grew to \$5,000 in 4 years. What was the annual return over the life of this investment?
- (a) 13.62%
 - (b) 16.67%
 - (c) 66.67%
 - (d) 3.41%
12. Davida is looking for a new car. She can afford monthly payments of \$375, and the bank offers her a 4-year loan at 6.1% APR. Calculate the maximum amount she can afford to borrow. Round to the nearest whole number.
- (a) \$15,936
 - (b) \$59,032
 - (c) \$18,000
 - (d) \$8,824
 - (e) \$20,328
13. Consider a home mortgage of \$225,000 with a fixed APR of 3.8% compounded monthly for 30 years. Calculate the monthly payment, rounded to the nearest penny.
- (a) \$1,048.40
 - (b) \$625.00
 - (c) \$2,146.12
 - (d) \$335.90
 - (e) \$4,147.66

14. Moira and Johnny are married and file taxes jointly. Their taxable income is \$75,000. They also have a tax credit of \$800 for installing solar panels on the motel they own. Compute their total income tax.
- (a) \$7,805
 (b) \$8,435
 (c) \$3,405
 (d) \$8,605
 (e) \$10,175
15. Gordon and Talitha are both in the 35% tax bracket. Assume Gordon makes an additional \$500 contribution to a tax-deductible charity, and Talitha qualifies for an additional \$500 tax credit. Whose tax bill will be reduced the most?
- (a) Talitha
 (b) Gordon
 (c) Their tax bills will be reduced by the same amount.
 (d) There is not enough information to answer this question.
16. Use the following voting preference schedule to determine the winner by the Condorcet method (pairwise comparisons).

<i>1st</i>	A	C	A	B
<i>2nd</i>	B	A	C	C
<i>3rd</i>	C	B	B	A
Total	15	20	5	11

- (a) There is no clear winner
 (b) A wins
 (c) B wins
 (d) C wins
17. Use the following voting preference schedule to determine the winner by the single (top-two) runoff method.

<i>1st</i>	A	C	A	B
<i>2nd</i>	B	A	C	C
<i>3rd</i>	C	B	B	A
Total	15	20	5	11

- (a) C wins
 (b) A wins
 (c) B wins
 (d) There is no clear winner

18. In a poll of 1000 elementary school children nationwide, 788 of those surveyed stated they preferred chicken nuggets for lunch. What is the population parameter?
- (a) % of US elementary school children who prefer chicken nuggets for lunch
 - (b) 78.8%
 - (c) All US elementary school children
 - (d) 1000 elementary school children surveyed
19. Which of the following regarding a pie chart is true?
- (a) It highlights relative frequency for qualitative data.
 - (b) It highlights relative frequency for quantitative data.
 - (c) It highlights frequency for qualitative data.
 - (d) It highlights frequency for quantitative data.
20. The number of schools in a county tends to be higher for counties with more residents. Identify the direction of the correlation and the most likely reason for it.
- (a) Positive correlation; having more residents in a county causes the need for schools to increase.
 - (b) Positive correlation; the correlation is a coincidence.
 - (c) Negative correlation; the correlation is caused by a third underlying variable.
 - (d) Negative correlation; having more residents in a county causes the need for schools to increase.
 - (e) Negative correlation; the correlation is a coincidence.
21. Which of the following is not a characteristic of the shape of a distribution?
- (a) Mean
 - (b) Symmetry
 - (c) Skewness
 - (d) Number of Modes
22. The heights of newborn babies is normally distributed with mean 19 inches and standard deviation 1.3 inches. What percentage of newborns are born taller than 22.25 inches?
- (a) 0.62%
 - (b) 99.38%
 - (c) 6.68%
 - (d) 93.32%
23. Suppose we roll two dice, giving the following sample space. Find $P(3 \leq \text{sum} < 5)$, where “sum” is the sum of the two dice rolled.

| $1^{st}, 2^{nd}$ |
|------------------|------------------|------------------|------------------|------------------|------------------|
| 1, 1 | 2, 1 | 3, 1 | 4, 1 | 5, 1 | 6, 1 |
| 1, 2 | 2, 2 | 3, 2 | 4, 2 | 5, 2 | 6, 2 |
| 1, 3 | 2, 3 | 3, 3 | 4, 3 | 5, 3 | 6, 3 |
| 1, 4 | 2, 4 | 3, 4 | 4, 4 | 5, 4 | 6, 4 |
| 1, 5 | 2, 5 | 3, 5 | 4, 5 | 5, 5 | 6, 5 |
| 1, 6 | 2, 6 | 3, 6 | 4, 6 | 5, 6 | 6, 6 |

- (a) $\frac{5}{36}$
(b) $\frac{9}{36}$
(c) $\frac{3}{36}$
(d) $\frac{4}{36}$
24. A bag of candy has 4 chocolates, 4 caramels, and 6 sour candies. If you draw 2 candies, eating the first one after it is drawn, what is the probability of drawing 2 caramels?
- (a) 0.066
(b) 0.088
(c) 0.082
(d) 0.516
(e) 0.061
25. You pay \$1 to play a game to raise money for a charity. You roll a 5-sided die, with the sides numbered 1 through 5. If an even number comes up, you win \$2. If an odd number comes up, you win \$0. What is the expected value of playing this game?
- (a) -\$0.20
(b) \$0.20
(c) \$0.60
(d) -\$0.60
(e) -\$1.00
26. For a certain password, the first 3 symbols must be a numeral (0-9), with repetition allowed, and the last 5 symbols must be a lowercase letter from the alphabet (a-z), repetition not allowed. How many possible passwords are there?
- (a) $10^3 \times_{26} P_5$
(b) $10^3 \times 26^5$
(c) ${}_{10}P_3 \times 26^5$
(d) ${}_{10}P_3 \times_{26} P_5$
(e) $10^3 \times_{10} C_3$
27. In the Olympic trials for the 100-meter dash, 10 people compete to make the team, but only 4 finalists can make the team. How many different teams are possible?
- (a) 210
(b) 5,040
(c) 10,000
(d) 715
(e) 840

28. Suppose a study of 5000 people with a certain brain characteristic are studied to see if this characteristic causes dementia. A test determining whether or not a participant has dementia is 95% accurate. We know that 12% of people with this characteristic actually have dementia. Of the people with dementia, how many were correctly identified by the test?
- (a) 570 people
 - (b) 600 people
 - (c) 4750 people
 - (d) 4400 people
 - (e) 30 people
29. Suppose a study of 5000 people with a certain brain characteristic are studied to see if this characteristic causes dementia. A test determining whether or not a participant has dementia is 95% accurate. We know that 12% of people with this characteristic actually have dementia. Of the people that the test identified as not having dementia, what percentage were false negatives?
- (a) 0.71%
 - (b) 5%
 - (c) 88%
 - (d) 7.1%
 - (e) 72%
30. Two treatments are being compared to see which is better at breaking up kidney stones. In trial 1, Treatment A was used on 150 subjects and had a success rate of 16%, while Treatment B was used on 140 subjects and had a success rate of 18%. In trial 2, Treatment A was used on 90 subjects and had a success rate of 78%, while Treatment B was used on 430 subjects and had a success rate of 75%. Choose the following statement about this scenario which is true.
- (a) The overall success rate of Treatment A is 39.25%; the overall success rate of Treatment B is 61%; this data does not exhibit Simpson's Paradox.
 - (b) The overall success rate of Treatment A is 39.25%; the overall success rate of Treatment B is 61%; this data exhibits Simpson's Paradox.
 - (c) The overall success rate of Treatment A is 47%; the overall success rate of Treatment B is 46.5%; this data does not exhibit Simpson's Paradox.
 - (d) The overall success rate of Treatment A is 47%; the overall success rate of Treatment B is 46.5%; this data exhibits Simpson's Paradox.

3 FR: Points as marked, 40 points total.

1. Consider the argument given below. Assume all premises are true.

P: There are power tools that have a battery.

P: My new saw (**X**) is not a power tool.

C: My new saw does not have a battery.

- (a) (1 point) Rephrase the first premise in standard form: “Some S are P.”

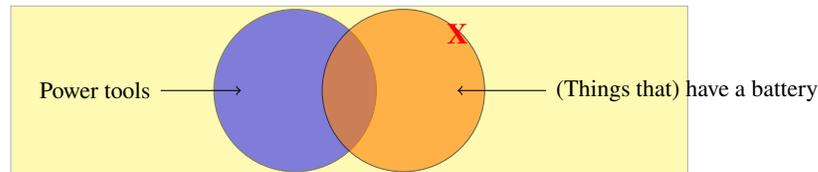
Answer:

Some power tools are things/objects/tools that have a battery.

1 point for appropriate rephrasing (with reasonable leniency).

- (b) (3 points) Is the argument valid? Support your answer with a Venn diagram, and explain.

Answer:



No, this argument is not valid. X could be in the “battery” circle or outside of it (optional: so, the conclusion does not follow logically from the premises).

1 point for correct diagram.

1 point for correct yes/no answer, following diagram.

1 point for correct explanation.

- (c) (2 points) Is the argument sound? Explain your answer.

Answer:

No, the argument is not sound because it is not valid.

1 point for correct yes/no answer, following prior work.

1 point for correct explanation.

2. Solve the following unit analysis problems.

- (a) (2 points) Convert 31°C to $^{\circ}\text{F}$. Give your answer to the nearest tenth.

Answer:

$$F = 1.8(31) + 32 = 87.8^{\circ}\text{F}$$

1 point for use of correct formula.

0.5 point for values in correct places.

0.5 point for correct computation and answer with units.

- (b) (2 points) Swimming one lap of a pool burns about 6 calories. If you swim 120 laps in an hour, what is your average power output, in watts? Give your answer to the nearest hundredth.

Answer:

$$\frac{120 \text{ laps}}{1 \text{ hr}} \times \frac{6 \text{ cal}}{1 \text{ lap}} \times \frac{4184 \text{ j}}{1 \text{ cal}} \times \frac{1 \text{ hr}}{60 \text{ min}} \times \frac{1 \text{ min}}{60 \text{ sec}} = 836.8 \text{ j/sec} = 836.8 \text{ watts}$$

1 point for use of correct conversion factors (equivalent formulations are acceptable).

1 point for correct computation and answer with units.

- (c) (2 points) A certain container has 5 pounds of sugar in it. If one chocolate chip cookie contains 9 grams of sugar, how many chocolate chip cookies can be made from the sugar in this container? Round to the nearest whole cookie.

Answer:

$$\frac{1 \text{ cookie}}{9 \text{ g}} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ kg}}{2.2046 \text{ lb}} \times \frac{5 \text{ lbs}}{1 \text{ container}} \approx 252 \text{ cookies}$$

1 point for use of correct conversion factors (equivalent formulations are acceptable).

1 point for correct computation and answer with units.

3. Suppose your grandmother had \$50 in 1985 that she kept as a gift for you to be delivered in 2015.
- (a) (2 points) If she bought a savings bond for \$50 in 1985 earning simple interest at a rate of 7.5%, how much would the savings bond be worth after 30 years?

Answer:

$$A = P + (P \times APR \times Y) = 50 + (50 \times 0.075 \times 30) = \$162.50$$

1 point for use of correct formula.
0.5 point for values in correct places.
0.5 point for correct computation and answer.

- (b) (3 points) Suppose instead that your grandmother locked the \$50 in a safe in 1985 that was not accessed until 2015. What was the purchasing power of \$50 in 1985 in terms of 2015 dollars?

Answer:

$$\frac{CPI_{2015}}{CPI_{1985}} = \frac{\$_{2015}}{\$_{1985}} \Rightarrow \frac{237}{107.6} = \frac{x}{\$50} \Rightarrow x = \$50 \times \frac{237}{107.6} = \$110.13$$

1 point for use of correct formula (or equivalent formulation).
1 point for correct values in correct places.
1 point for correct computation and answer.

- (c) (2 points) Which choice earns the most money: purchasing a savings bond or locking the \$50 in a safe for 30 years? Explain.

Answer:

The savings bond is the better choice because it is worth \$162.50 in 2015, which is more than what the \$50 is worth in 2015.

1 point for correct answer, following work.
1 point for correct explanation, following work.

4. The Nutty Novelties peanut butter company is testing a new flavor. They asked 350 Pennsylvanians to sample the new flavor and respond whether they liked it or not. Of the 350 participants, 190 responded that they liked the new flavor.

- (a) (1 point) Identify the population.

Answer:

All Pennsylvanians

1 point for correct answer. No partial credit possible.

- (b) (1 point) Identify the population parameter.

Answer:

% of Pennsylvanians who like the new flavor.

1 point for correct answer. No partial credit possible.

- (c) (1 point) Identify the sample.

Answer:

The 350 participants

1 point for correct answer. No partial credit possible.

- (d) (1 point) Identify the sample statistic. Round to the nearest hundredth.

Answer:

$$\frac{190}{350} \times 100\% = 54.29\%$$

0.5 point for correct values used.

0.5 point for correct computation and answer.

- (e) (2 points) Find the confidence interval for the population parameter. Round to the nearest hundredth of a percent.

Answer:

$$MOE = \frac{1}{\sqrt{350}} \times 100\% = 5.35\%$$

$$CI = [54.29\% - 5.35\%, 54.29 + 5.35\%] = [48.94\%, 59.64\%]$$

0.5 point for correct values used in MOE computation.

0.5 point for correct computation and answer of MOE.

0.5 point for correct values used in CI computation.

0.5 point for correct computation and answer of CI.

- (f) (1 point) Can you claim that a majority of Pennsylvanians would enjoy the new flavor? Explain your answer.

Answer:

No, the confidence interval contains values less than 50%, so it is possible that fewer than a majority of Pennsylvanians would enjoy the flavor. Thus we cannot make that claim.

0.5 point for correct answer, following work.

0.5 point for correct explanation, following work.

5. Systolic blood pressure in adults follows a normal distribution with mean 112mmHg and standard deviation 10mmHg.

(a) (2 points) Suppose Louise's blood pressure is 127mmHg. Find Louise's percentile.

Answer:

$$z = \frac{127 - 112}{10} = 1.5 \Rightarrow 93.32\%$$

0.5 point for use of correct formula.
 0.5 point for values in correct places.
 0.5 point for correct z -score.
 0.5 point for correct percentile, following work.

- (b) (2 points) In a sample of 1000 adults, how many would you expect to have blood pressure between 87mmHg and 122mmHg? Round to the nearest whole number.

Answer:

$$\begin{aligned} z_1 &= \frac{87 - 112}{10} = -2.5 \Rightarrow 0.62\% \\ z_2 &= \frac{122 - 112}{10} = 1 \Rightarrow 84.13\% \text{ (or } 84\%) \\ \Rightarrow 84.13 - 0.62\% &= 83.51\% \Rightarrow 1000(0.8351) = 835.1 \approx 835 \text{ adults} \\ \text{or } 84 - 0.62\% &= 83.38\% \Rightarrow 1000(0.8338) = 833.8 \approx 834 \text{ adults} \end{aligned}$$

0.5 point each for percentile computations.
 0.5 point for finding percentage between the two z -scores.
 0.5 point for correct final answer.

- (c) (2 points) If someone is in the 6.68th percentile, what is their blood pressure?

Answer:

$$\begin{aligned} 6.68\% &\Rightarrow z = -1.5 \\ z &= \frac{x - \mu}{\sigma} \Rightarrow -1.5 = \frac{x - 112}{10} \Rightarrow x = -1.5(10) + 112 = 97 \text{ mmHg} \end{aligned}$$

0.5 point each for correct z -score.
 1 point for correct computation and value for x (any equivalent formulation is acceptable).
 0.5 point for correct final answer.
 -0.25 point for missing unit in final answer.

6. In the card game Blackjack, a Blackjack occurs when you are dealt an ace and either a 10, jack, queen or king. Assume we are using a standard 52-card deck for this problem.

- (a) (2 points) What is the probability of being dealt a 10, jack, queen, or king as your first card? Give your answer as a reduced fraction.

Answer:

OR probability, non-overlapping (mutually exclusive)

$$P(\text{dealt a 10, J, Q, or K}) = \frac{4}{52} + \frac{4}{52} + \frac{4}{52} + \frac{4}{52} = \frac{16}{52} = \frac{4}{13}$$

0.25 point each for correct probabilities of 10, J, Q, and K.

0.5 point for correct computation and value.

0.5 point for correct reduction of fraction for final answer.

Note: It is not necessary to write "OR probability, non-overlapping (mutually exclusive)."

- (b) (2 points) What is the probability of being dealt an ace given that you already were dealt a card that was a 10, jack, queen, or king? Give your answer as a reduced fraction.

Answer:

Conditional probability

$$P(\text{dealt an ace given 10, J, Q, or K}) = \frac{4}{51}$$

1 point for correct numerator.

1 point for correct denominator.

Note: It is not necessary to write "Conditional probability."

- (c) (2 points) What is the probability of being dealt a Blackjack in the following order: first a 10, jack, queen or king, and then an ace? Assume the first card that is dealt is not returned to the deck. Give your answer as a decimal rounded to the thousandths.

Answer:

AND probability, dependent

$$P(\text{dealt a Blackjack}) = \frac{4}{13} \times \frac{4}{51} = 0.024$$

0.5 point for correct first factor, following work.

0.5 point for correct second factor, following work.

0.5 point for multiplying.

0.5 point for correct final answer.

Note: It is not necessary to write "AND probability, dependent."

7. (2 points) Follow all testing protocol directions (hold up blank paper to the webcam at the beginning of the exam; show your work to the webcam before submitting; etc.).

Each violation worth 1 or 2 points at discretion of grader, for a maximum of 2 points.

Grading notes for entire FR section:

Minor deductions are the discretion of the grader; deductions can come in increments of 0.25.

If a problem needs the use of an answer from a previous part, then correct work using incorrect previous answers still earns credit.

Formulas

- **Absolute Change** = new value - old value
- **Relative Change** = $\frac{\text{new value} - \text{old value}}{\text{old value}} \times 100\%$
- **Index Number:** $\frac{\text{compared value}}{\text{reference value}} \times 100$
- **CPI:** $\text{Price in } \$_y = (\text{Price in } \$_x) \times \left(\frac{CPI_y}{CPI_x}\right)$ or $\frac{CPI_y}{CPI_x} = \frac{\text{Price in } \$_y}{\text{Price in } \$_x}$
- **Rate of Inflation:** $\frac{CPI_{New} - CPI_{Old}}{CPI_{Old}} \times 100\%$

TABLE 3.4 Average Annual Consumer Price Index (1982–1984 = 100)

Year	CPI	Year	CPI	Year	CPI	Year	CPI
1977	60.6	1987	113.6	1997	160.5	2007	207.3
1978	65.2	1988	118.3	1998	163.0	2008	215.3
1979	72.6	1989	124.0	1999	166.6	2009	214.5
1980	82.4	1990	130.7	2000	172.2	2010	218.1
1981	90.9	1991	136.2	2001	177.1	2011	224.9
1982	96.5	1992	140.3	2002	179.9	2012	229.6
1983	99.6	1993	144.5	2003	184.0	2013	233.0
1984	103.9	1994	148.2	2004	188.9	2014	236.7
1985	107.6	1995	152.4	2005	195.3	2015	237.0
1986	109.6	1996	156.9	2006	201.6	2016	240.0

- **Simple Interest:** $A = P + (P \times APR \times Y)$

- **Compound Interest:** $A = P \left(1 + \frac{APR}{n}\right)^{(nY)}$ $P = \frac{A}{\left(1 + \frac{APR}{n}\right)^{(nY)}}$

$$A = P \times e^{(APR \times Y)} \quad P = \frac{A}{e^{(APR \times Y)}}$$

- **APY = Total Return:** $\frac{A - P}{P} \times 100\%$

- **Savings Plans:** $A = PMT \times \left[\frac{\left(1 + \frac{APR}{n}\right)^{(nY)} - 1}{\left(\frac{APR}{n}\right)} \right]$ $PMT = \frac{A}{\left[\frac{\left(1 + \frac{APR}{n}\right)^{(nY)} - 1}{\left(\frac{APR}{n}\right)} \right]}$

- **Annual Return:** $\left[\left(\frac{A}{P}\right)^{\left(\frac{1}{Y}\right)} - 1 \right] \times 100\%$

- **Installment Loans:** $PMT = \frac{P \times \left(\frac{APR}{n}\right)}{\left[1 - \left(1 + \frac{APR}{n}\right)^{(-nY)} \right]}$ $P = \frac{PMT \times \left[1 - \left(1 + \frac{APR}{n}\right)^{(-nY)} \right]}{\left(\frac{APR}{n}\right)}$

- **Gross Income**= Sum of All Income
- **Adjusted Gross Income**= Gross Income – Adjustments to Income
- **Taxable Income**= Adjusted Gross Income – (Deductions and Exemptions)
- **Total Income Tax**= Tax Calculated from Table – Tax Credits
- **Overall Federal Tax Rate**= $\frac{\text{Total Income Tax} + \text{FICA Tax}}{\text{Gross Income}} \times 100\%$

Tax Rate*	Single	Married Filing Jointly	Married Filing Separately	Head of Household
10%	Up to \$9875	Up to \$19,750	Up to \$9875	Up to \$14,100
12%	Up to \$40,125	Up to \$80,250	Up to \$40,125	Up to \$53,700
22%	Up to \$85,525	Up to \$171,050	Up to \$85,525	Up to \$85,500
24%	Up to \$163,300	Up to \$326,600	Up to \$163,300	Up to \$163,300
32%	Up to \$207,350	Up to \$414,700	Up to \$207,350	Up to \$207,350
35%	Up to \$518,400	Up to \$622,050	Up to \$311,025	Up to \$518,400
37%	Above \$518,400	Above \$622,050	Above \$311,025	Above \$518,400
Standard Deduction	\$12,200	\$24,400	\$12,200	\$18,350
Exemption (per person)	\$0	\$0	\$0	\$0

- **Margin of Error Estimate:** $\frac{1}{\sqrt{n}} \times 100\%$
- **Confidence Interval:** [stat – MOE, stat + MOE]
- **Mean** = $\frac{\text{sum of all values}}{\text{total number of values}}$
- **Standard deviation** = $\sqrt{\frac{\text{sum of (deviations from the mean)}^2}{\text{total number of values} - 1}}$
- **Range** = highest value – lowest value
- **z-score = Standard score** = $\frac{\text{data value} - \text{mean}}{\text{standard deviation}} = \frac{x - \mu}{\sigma}$
- **z-score/Percentile table:**

z-score	Percentile	z-score	Percentile	z-score	Percentile	z-score	Percentile
-3.5	0.02	-1.5	6.68	0.5	69.15	2.5	99.38
-3	0.13	-1	15.87	1	84.13	3	99.87
-2.5	0.62	-0.5	30.85	1.5	93.32	3.5	99.98
-2	2.28	0	50.00	2	97.72		

- **Probability Formulas:** $P(A) = \frac{\text{number of ways A can occur}}{\text{total number of possible outcomes}}$

$$P(A) + P(\text{not } A) = 1; \quad P(\text{not } A) = 1 - P(A)$$

$$(\text{Independent:}) P(A \text{ AND } B) = P(A) \times P(B)$$

(Dependent:) $P(A \text{ AND } B) = P(A) \times P(B \text{ given } A)$

(Non-overlapping:) $P(A \text{ OR } B) = P(A) + P(B)$;

(Overlapping:) $P(A \text{ OR } B) = P(A) + P(B) - P(A \text{ AND } B)$

$P(A \text{ at least once}) + P(A \text{ zero times}) = 1$

$P(A \text{ at least once in } n \text{ trials}) = 1 - [P(\text{not } A)]^n$

- **Expected Value** = (value of A) $\times P(A)$ + (value of B) $\times P(B)$ + ...
- **Multiplication Principle:** Number of arrangements = n^r
- **Permutations:** Number of permutations = $\frac{n!}{(n-r)!}$
- **Combinations:** Number of combination = $\frac{n!}{(n-r)!r!}$

		Number Cards									Face Cards			
Colors	Suits	2	3	4	5	6	7	8	9	10	J	Q	K	A
Black	Clubs													
	Spades													
Red	Hearts													
	Diamonds													

Conversion Factors

(revised 8/11/19)

Length				Volume (liquid measure)			
1 in.	2.54 cm			1 tablespoon (T)	3 teaspoons (t)		
1 ft	.3048 m	12 in.		1 fluid oz	2 tbsp (T)	1.8047 in. ³	29.5735 mL
1 yd	.9144 m	36 in.	3 ft	1 cup (c)	8 fl oz		
1 mi	1.6093 km	5280 ft	1760 yds	1 pint (pt)	16 fl oz	28.875 in. ³	
1 nautical mi	1.852 km	6076.1155 ft		1 quart (qt)	2 pts	57.75 in. ³	.9463 L
1 cm	.3937 in.			1 gallon (gal)	4 qts	3.7853 L	
1 m	3.2808 ft	1.0936 yd		1 L	1.0567 qt	.2642 gal	
1 km	.6214 mi			1 ml	1 cm ³		
1 rod	5.5 yds			Volume (dry measure)			
1 fathom	6 ft			1 in. ³	16.3871 cm ³		
1 furlong	40 rods	.125 mi		1 ft ³	1728 in. ³		
Weight				1 yd ³	27 ft ³		
1 lb	16 oz	.4536 kg		1 dry pint	33.6003 in. ³		
1 ton	2000 lbs			1 dry quart	2 dry pts	67.2006 in. ³	
1 kg	2.2046 lb			1 peck	8 dry quarts		
				1 bushel	4 pecks		
Metric Prefixes			Energy and Power		Currency Conversions from US Dollar		
Prefix	Abbrev.	Value	1 watt	1 joule/s	British Pound	.8317 £/\$	1.202 \$/£
micro	μ	10 ⁻⁶ (one millionth)	1 kilowatt-hr	3.6 million joules	European Euro	.8923 €/€	1.121\$/€
milli	m	10 ⁻³ (one thousandth)	1 calorie	4184 joules	Japanese Yen	105.46 ¥/\$.009482 \$/¥
centi	c	10 ⁻² (one hundredth)	1 kilowatt	1000 watts	Canadian Dollar	1.322 C\$/€	.7566 \$/C\$
deci	d	10 ⁻¹ (one tenth)			Mexican Peso	19.42 MexP/\$.05149 \$/MexP
deca	da	10 ¹ (ten)	Celsius/Fahrenheit/Kelvin		Note that these values fluctuate several times per day. Current values are only provided at the beginning of the semester. (Values are rounded to four significant digits.)		
hecto	h	10 ² (hundred)	F = 1.8C + 32				
kilo	k	10 ³ (thousand)	C = $\frac{F - 32}{1.8}$				
mega	M	10 ⁶ (million)	K = C + 273.15				
giga	G	10 ⁹ (billion)	C = K - 273.15				
tera	T	10 ¹² (trillion)					