6. **(5 points)** `local/Library/UBC/STAT/STAT302/HW08/HW08-01.pg`

The time (in minutes) between arrivals of customers to a post office is to be modelled by the Exponential distribution with mean 0.55. Please give your answers to two decimal places.

Part a)

What is the probability that the time between consecutive customers is less than 15 seconds?

___

Part b)

Find the probability that the time between consecutive customers is between ten and fifteen seconds.

___

Part c)

Given that the time between consecutive customers arriving is greater than ten seconds, what is the chance that it is greater than fifteen seconds?

___

Solution: *(Instructor solution preview: show the student solution after due date.)*

Part a)

For $X \sim Exp(0.55)$, in general the cumulative distribution function is

$F(x) = 1 - e^{-x/0.55}$,

for $x > 0$. The probability can be found via

$F(1/4) = 1 - e^{-1/(4\times 0.55)} = 0.37$.

In R, we use

pexp(0.25,1/0.55)

Part b)
The probability is

$$P(1/6 < X < 1/4) = P(X < 1/4) - P(X < 1/6).$$

The first probability was found in part (a), and the second is

$F(1/6) = 1 - e^{-1/(6\times 0.55)}$.

The difference $F(1/4) - F(1/6)$ can be worked out in R using pexp(1/4,1/0.55)-pexp(1/6,1/0.55). The probability is 0.10..

Part c)
Since $P(X > x) = e^{-x/0.55}$, we have

$$P(X > \tfrac{1}{4} | X > \tfrac{1}{6}) = \tfrac{P(\{X>1/4\}\cap\{X>1/6\})}{P(X>1/6)} = \tfrac{P(X>1/4)}{P(X>1/6)} = e^{-1/(4\times 0.55)} e^{1/(6\times 0.55)} = 0.86$$

(or more directly by the lack of memory property).
Correct Answers:

- `0.37`
- `0.1`
- `0.86`

---

15. **(5 points)** `local/Library/CollegeOfIdaho/setStatistics_Ch19InferencePropn/19Stats_07_InferencePropn.pg`
Kim wants to determine a 90 percent confidence interval for the true proportion p of high school students in the area who attend their home basketball games. Out of n randomly selected students she finds that that exactly half attend their home basketball games. About how large would n have to be to get a margin of error less than 0.04 for p?
$n \approx$ ______
Solution: *(Instructor solution preview: show the student solution after due date.)*
The margin of error of a confidence interval for the population proportion is given by

$$z_{\alpha/2}\sqrt{\frac{p(1-p)}{n}}$$

where $p = 1/2$, $1-\alpha = 0.9$ and $z_{\alpha/2} = \Phi^{-1}(1-\alpha/2)$. The condition on the margin of error reads

$$z_{\alpha/2}\sqrt{\frac{p(1-p)}{n}} \leq 0.04$$

and solving for thesample size n gives the condition

$$n \geq (\Phi^{-1}(1-\alpha/2)/0.04)^2 p(1-p) = (\Phi^{-1}(1-(1-0.9)/2)/0.04)^2 \times \frac{1}{2}(1-\frac{1}{2}).$$

The numerical value can be computed with the R command (qnorm(1-(1-0.9)/2)/0.04)**2*1/2*(1-1/2) and n is the smallest integer larger or equal to this value.

Correct Answers:

- `423`

---

12. **(5 points)** `local/Library/ASU-topics/setStat/di4.pg`

A variable of a population has a mean of $\mu = 100$ and a standard deviation of $\sigma = 35$.

a. The sampling distribution of the sample mean for samples of size 49 is approximately normally distributed with mean ____ and standard deviation ____.

b. For part (a) to be true, what assumption did you make about the distribution of the variable under consideration?

- A. Normal distribution.
- B. Uniform distribution.
- C. No assumption was made.

c. Is the statement in part (a) still true if the sample size is 16 instead of 49? Why or why not?

- A. No. Because the distribution of the variable under consideration is not specified, a sample size of at least 30 is needed for part (a) to be true.
- B. Yes, the sampling distribution of the sample mean is always normal.
- C. No, the sampling distribution of the sample mean is never normal for sample size less than 30.

Solution: *(Instructor solution preview: show the student solution after due date.)*

Part i) Proposition 5.1 tells us that $E\overline{X}) = \mu = 100$ and $Var(\overline{X}) = \sigma^2/n = 35^2/49$.

Part ii) No particular assumption about the distribution is needed (because of the central limit theorem). One just uses linearity of expectation and independence.

Part iii) The sample is too small to use the central limit theorem. Since no distribution of the random variables has been given the distribution of the sample mean cannot be worked out.

Correct Answers:

- `100`
- `5`
- `C`
- `A`

---

3. **(5 points)** `Library/Rochester/setProbability8BinomialDist/ur_pb_8_8.pg`

A man claims to have extrasensory perception (ESP). As a test, a fair coin is flipped 26 times, and the man is asked to predict the outcome in advance. He gets 21 out of 26 correct. What is the probability that he would have done at least this well if he had no ESP?

Probability = ________

Solution: *(Instructor solution preview: show the student solution after due date.)*

SOLUTION

Let X be the random variable that gives the number of correct guesses the ma n would make without ESP. Then X is a binomial random variable with paramet ers $n = 26$ and $p = 0.5$ (since that is the probability of successfully g uessing whether a fair coin will land on heads or tails. Hence the probability he would do at least as well without ESP is

$$P(X \geq 21) = \sum_{i=21}^{26} \binom{26}{i} (0.5)^i (0.5)^{n-i} = (0.5)^{26} \sum_{i=21}^{26} \binom{26}{i} \approx 0.00124696.$$

Correct Answers:

- `0.00124695897102356`

---

10. (5 points) `Library/NewHampshire/NECAP/grade8/gr8-2005/n8-2005-9s.pg`

the table below shows the number of books the Jefferson Middle school students read each month for nine months.

Month	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Number of Books	293	280	266	280	289	279	275	296	271

If the students read only 101 books for the month of June, which measure of central tendency will have the greatest change?

- A. The median will have the greatest change.
- B. The mode will have the greatest change.
- C. The mean will have the greatest change.
- D. All measures will have an equal change.

Solution: *(Instructor solution preview: show the student solution after due date.)*

Solution

The mode (the number that occurs most frequently) is 280 and will not change
The median (the central number) is 280 and will change to 279.5 (the average of 280 and 279),
Since the mean (the average of the numbers) is about 280 and we add 101 which is about 180 less than the mean, and there are now 10 values, the mean will decrease by approximately $180/10 = 18$.

Correct Answers:

- `C`

---

2. (5 points) `local/Library/Rochester/setStatistics1Data/ur_stt_1_2.pg`

Determine whether the following examples are discrete or continuous data sets. Write "DISCRETE" for discrete and "CONTINUOUS" for continuous. (without quotations)

(a) The number of voters who vote Democratic.
answer: ________

(b) The length of time it takes to fill up your gas tank.
answer: ________

(c) The number of errors found on a student's research paper.
answer: ________

(d) The number of customers waiting in line at the grocery store.
answer: ________

Solution: *(Instructor solution preview: show the student solution after due date.)*

The following are discrete random variables (in fact integers)
The number of voters who vote Democratic.
The number of students applying to graduate schools.
The number of errors found on a student's research paper.
The number of customers waiting in line at the grocery store.

The following are continuous random variables (as they can take in principle any real value)
The length of time it takes to fill up your gas tank.
The length of time needed for a student to complete a homework assignment.
The temperature in any given location.
The distance travelled by a city bus each day.

Correct Answers:

- DISCRETE
- CONTINUOUS
- DISCRETE
- DISCRETE

---

4. **(5 points)** local/Library/Rochester/setProbability9PoissonDist/ur_pb_9_1.pg

Given that X is a random variable having a Poisson(λ) distribution, compute the following:

(a) $P(X = 6)$ when $\lambda = 5.5$
$P(X = 6) =$ _____

(b) $P(X \le 2)$ when $\lambda = 1$
$P(X \le 2) =$ _____

(c) $P(X > 3)$ when $\lambda = 1$
$P(X > 3) =$ _____

(d) $P(X < 3)$ when $\lambda = 5.5$
$P(X < 3) =$ _____

Solution: *(Instructor solution preview: show the student solution after due date.)*
R commands to evaluate the expressions

Part a) dpois(6,5.5)
Part b) ppois(2,1)
Part c) 1-ppois(3,1)
Part d) ppois(3-1,5.5)

Correct Answers:

- 0.157117293756442
- 0.919698602928606
- 0.0189881568761537
- 0.0883764323567855

---

14. **(5 points)** local/Library/UBC/STAT/STAT203/hw11/hw11-q03.pg

Rock band The Rolling Stones have played scores of concerts in the last twenty years. For 30 randomly selected Rolling Stones concerts, the mean gross earnings is 2.96 million dollars.

Part a) Assuming a population standard deviation gross earnings of 0.45 million dollars, obtain a 99% confidence interval for the mean gross earnings of all Rolling Stones concerts (in millions). Please carry at least three decimal places in intermediate steps. Give your answer to the nearest 3 decimal places.

Confidence interval: (_____,_____).

Part b)

Which of the following is the correct interpretation for your answer in part (a)?

- A. We can be 99% confident that the mean gross earnings for this sample of 30 Rolling Stones concerts lies in the interval
- B. If we repeat the study many times, 99% of the calculated confidence intervals will contain the mean gross earning of all Rolling Stones concerts.

- C. There is a 99% chance that the mean gross earnings of all Rolling Stones concerts lies in the interval
- D. None of the above

Solution: *(Instructor solution preview: show the student solution after due date.)*

Part a)
The confidence interval for the sample mean is given by

$$[\bar{x} - \sigma z_{\alpha/2}/\sqrt{n}, \bar{x} + \sigma z_{\alpha/2}/\sqrt{n}]$$

where $\bar{x} = 2.96$ is the sample mean, $n = 30$ the sample size, $\sigma = 0.45$ the standard deviation, and $1 - \alpha = 0.99$ the level of confidence. The z score is given by $z_{\alpha/2} = \Phi^{-1}(1 - \alpha/2)$. The interval endpoints can be computed with the R commands 2.96-0.45*qnorm(1-0.01/2)/sqrt(30) and 2.96+0.45*qnorm(1-0.01/2)/sqrt(30).

Part b) If we calculate the confidence interval for all possible random samples then 99% of those intervals will contain the true mean gross earning.

Correct Answers:

- `2.74836`
- `3.17164`
- `B`

---

5. **(5 points)** `local/Library/UBC/STAT/STAT200/hw05/hw05-q04.pg`

You and your friend carpool to school. Your friend has promised that he will come pick you up at your place at 8am, but he is always late(!) The amount of time he is late (in minutes) is a Uniform random variable between 3 and 15 minutes.

Which of the following statements is/are true? CHECK ALL THAT APPLY.

- A. The standard deviation of the amount of time that your friend is late is 3.46 minutes.
- B. It is less likely that your friend is late for more than 14 minutes than he is late for less than 4 minutes.
- C. The mean amount of time that your friend is late is 9 minutes.
- D. None of the above

Solution: *(Instructor solution preview: show the student solution after due date.)*

Denote by X a continuous random variable which obeys a uniform distribution $X \sim U(3, 15)$.

The expectation reads

$$E(X) = \int_3^{15} x/(15-3)dx = \frac{1}{2}\frac{15^2 - 3^2}{15-3} = \frac{1}{2}(15+3).$$

To compute the variance observe that

$$E(X^2) = \int_3^{1} 5x^2/(15-3)dx = \frac{1}{3}\frac{15^3 - 3^3}{15-3} = \frac{1}{3}(15^2 + 3 \times 15 + 3^2)$$

so that

$$Var(X) = E(X^2) - (E(X))^2 = \frac{1}{2}(15^2 + 3^2) - \frac{1}{6}3 \times 15 = \frac{(15-3)^2}{12}$$

Hence the standard deviation is given by

$$\sigma = \sqrt{\frac{(15-3)^2}{12}}$$

Finally $P(X > 14) = P(X < 4)$.

Correct Answers:

- `AC`

A type II error

- A. is the rejection of a true null hypothesis.
- B. arises when the true null hypothesis is not rejected.
- C. arises when the false null hypothesis is not rejected.
- D. is the rejection of a false null hypothesis.

Solution: *(Instructor solution preview: show the student solution after due date.)*
A type II error occurs when we do not reject a null hypothesis that was false.
Correct Answers:

- `C`

---

17. **(5 points)** `local/Library/CollegeOfIdaho/setStatistics_Ch14InferenceIntro/14Stats_07_InferenceIntro.pg`
For each problem, select the best response.
(a) In testing hypotheses, which of the following would be strong evidence against the null hypothesis?

- A. Obtaining data with a large P -value.
- B. Using a large level of significance.
- C. Obtaining data with a small P -value.
- D. Using a small level of significance.

(b) The P -value of a test of a null hypothesis is

- A. the probability, assuming the null hypothesis is true, that the test statistic will take a value at least as extreme as that actually observed.
- B. the probability, assuming the null hypothesis is false, that the test statistic will take a value at least as extreme as that actually observed.
- C. the probability the null hypothesis is false.
- D. the probability the null hypothesis is true.

(c) In formulating hypotheses for a statistical test of significance, the null hypothesis is often

- A. the probability of observing the data you actually obtained
- B. a statement of ”no effect” or ”no difference”.
- C. a statement that the data are all 0.
- D. 0.05

Solution: *(Instructor solution preview: show the student solution after due date.)*

The level of significance is part of the test design but does not provide any evidence. A small P value gives evidence against the null hypothesis.
The P value is the probability that the test statistic will take a value at least as extreme as that actually observed, assuming that the null hypothesis is true (and that is the reason why small P values are evidence against the null hypothesis).
A null hypothesis is a statement, e.g., that a parameter change had no effect or did not make any difference, or that a parameter has a certain value.
Correct Answers:

- `C`
- `A`
- `B`

13. **(5 points)** `local/Library/UVA-Stat/setStat212-Homework08/stat212-HW08-06.pg`

A statistics practitioner took a random sample of 57 observations from a population whose standard deviation is 30 and computed the sample mean to be 109.

Note: For each confidence interval, enter your answer in the form (LCL, UCL). You must include the parentheses and the comma between the confidence limits.

A. Estimate the population mean with 95% confidence.

Confidence Interval = ________

B. Estimate the population mean with 90% confidence.

Confidence Interval = ________

C. Estimate the population mean with 99% confidence.

Confidence Interval = ________

Solution: *(Instructor solution preview: show the student solution after due date.)*

The confidence interval for the sample mean at $1-\alpha$ level of confidence is given by

$$\left[\bar{x}-\sigma z_{\alpha/2}/\sqrt{n}, \bar{x}+\sigma z_{\alpha/2}/\sqrt{n}\right]$$

where $\bar{x}=109$ is the sample mean, $n=57$ the sample size, and $\sigma=30$ the standard deviation. The z score is given by $z_{\alpha/2}=\Phi^{-1}(1-\alpha/2)$.

Part A) For a 95% confidence interval we have $\alpha=0.05$ and the interval endpoints can be computed with the R commands 109-30*qnorm(1-0.05/2)/sqrt(57) and 109+30*qnorm(1-0.05/2)/sqrt(57).

Part B) For a 90% confidence interval we have $\alpha=0.1$ and the interval endpoints can be computed with the R commands 109-30*qnorm(1-0.1/2)/sqrt(57) and 109+30*qnorm(1-0.1/2)/sqrt(57).

Part C) For a 99% confidence interval we have $\alpha=0.01$ and the interval endpoints can be computed with the R commands 109-30*qnorm(1-0.01/2)/sqrt(57) and 109+30*qnorm(1-0.01/2)/sqrt(57).

Correct Answers:

- `(101.211897609925,116.788102390075)`
- `(102.464015045221,115.535984954779)`
- `(98.7646841394306,119.235315860569)`

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18. **(5 points)** `local/Library/CollegeOfIdaho/setStatistics_Ch14InferenceIntro/14Stats_08_InferenceIntro.pg`

For each statement, select the correct null hypothesis, H_0, and alternative hypothesis, H_a, in symbolic form.

(a) A certain type of hummingbird is known to have an average weight of 4.55 grams. A researcher wonders if hummingbirds (of this same type) living in the Grand Canyon differ in weight from the population as a whole. The researcher finds a sample of 30 such hummingbirds from the Grand Canyon and calculates their average weight to be 3.75 grams.

- A. $H_0: \mu = 4.55, \quad H_a: \mu \neq 4.55$
- B. $H_0: \mu = 4.55, \quad H_a: \mu < 4.55$
- C. $H_0: \bar{x} = 4.55, \quad H_a: \bar{x} < 4.55$
- D. $H_0: \bar{x} = 3.75, \quad H_a: \bar{x} > 3.75$
- E. $H_0: \mu = 3.75, \quad H_a: \mu \neq 3.75$
- F. $H_0: \mu < 4.55, \quad H_a: \mu = 4.55$

(b) According to the Merck Veterinary Manual, the average resting heart rate for a certain type of sheep dog is 115 beats per minute (bpm). A Montana farmer notices his aging sheep dog has been acting more lethargic than usual and wonders if her heart rate is slowing. He measures her heart rate on 15 occasions and finds a sample mean heart rate of 118.2 bpm.

- A. $H_0: \bar{x} = 115, \quad H_a: \bar{x} > 115$

- B. $H_0 : \mu = 115, \quad H_a : \mu \neq 115$
- C. $H_0 : \mu = 118.2, \quad H_a : \mu < 118.2$
- D. $H_0 : \mu = 115, \quad H_a : \mu < 115$
- E. $H_0 : \bar{x} = 118.2, \quad H_a : \bar{x} \neq 118.2$
- F. $H_0 : \mu = 115, \quad H_a : \mu > 115$

(c) The mean height of *all* adult American males is 69 inches (5 ft 9 in). A researcher wonders if *young* American males between the ages of 18 and 21 tend to be taller than 69 inches. A random sample of 100 young American males ages 18 to 21 yielded a sample mean of 71 inches.

- A. $H_0 : \mu = 71, \quad H_a : \mu < 71$
- B. $H_0 : \bar{x} = 69, \quad H_a : \bar{x} > 69$
- C. $H_0 : \mu = 69, \quad H_a : \mu \neq 69$
- D. $H_0 : \bar{x} = 71, \quad H_a : \bar{x} < 71$
- E. $H_0 : \mu > 69, \quad H_a : \mu < 69$
- F. $H_0 : \mu = 69 \ , \quad H_a : \mu > 69$

Solution: *(Instructor solution preview: show the student solution after due date.)*

The researcher wants to test whether the average weight of hummingbirds differs from 4.55 grams. Hence the null hypothesis $\mu = 4.55$ will be tested against the alternative $\mu \neq 4.55$.

The farmer wants to test whether their dog's heart rate is slowing down, i.e. whether it is lower than expected. Hence they test the null hypothesis $\mu = 115$ against the alternative $\mu < 115$.

The researcher wants to test whether the height of young males exceed the mean height of all males. Hence they test the null hypothesis $\mu = 69$ against the alternative $\mu > 69$.

Correct Answers:

- `A`
- `D`
- `F`

What type of variable is "*monthly rainfall in Vancouver* "?

- A. categorical
- B. quantitative
- C. none of the above

Solution: *(Instructor solution preview: show the student solution after due date.)*
The monthly rainfall is quantitative, as the quantity is measured by a number.

Correct Answers:

- `B`

---

19. **(5 points)** `local/Library/UBC/STAT/STAT200/hw08/hw08-q04.pg`

Prof. Johnson conducts a hypothesis test on whether the proportion of all UBC students who bike to school (denoted as p) equals 30%. Specifically, Prof.Johnson has $H_0 : p = 0.3$ versus $H_A : p \neq 0.3$. He obtains a P-value of 0.01. On the other hand, Prof. Smith would like to test if there is sufficient evidence to support that p is greater than 0.3 at the 10% significance level. Based on Prof. Johnson's result, will the null hypothesis of Prof. Smith's test be rejected?

- A. Yes.
- B. No.
- C. There is insufficient information to tell.

Solution: *(Instructor solution preview: show the student solution after due date.)*
The test performed by Prof. Johnson has been a two-sided test. For the new design the alternative hypothesis has changed and a right-tailed test is needed. The result of this test cannot be deduced from the two-sided test (see the expressions in section 7d of the lecture notes).
Correct Answers:

- `C`

---

20. **(5 points)** `local/Library/ASU-topics/setStat/kolossa33.pg`

In each part, we have given the significance level and the P-value for a hypothesis test. For each case determine if the null hypothesis should be rejected. Write ”reject” or ”do not reject” (without quotations).
(a) $\alpha = 0.06, P = 0.001$
answer: ________

(b) $\alpha = 0.01, P = 0.06$
answer: ________

(c) $\alpha = 0.07, P = 0.06$
answer: ________
Solution: *(Instructor solution preview: show the student solution after due date.)*
One rejects the null hypothesis at significance level α if $P < \alpha$.
Correct Answers:

- `reject`
- `do not reject`
- `reject`

---

11. **(5 points)** `local/Library/UBC/STAT/STAT200/hw06/hw06-q07a.pg`
The weights of cans of Ocean brand tuna are supposed to have a net weight of 6 ounces. The manufacturer tells you that the net weight is actually a Normal random variable with a mean of 5.95 ounces and a standard deviation of 0.2 ounces. Suppose that you draw a random sample of 42 cans.
Part i) Suppose the number of cans drawn is doubled. How will the standard deviation of sample mean weight change?

- A. It will decrease by a factor of 2.
- B. It will increase by a factor of 2.
- C. It will decrease by a factor of $\sqrt{2}$.
- D. It will increase by a factor of $\sqrt{2}$.
- E. It will remain unchanged.

Part ii) Suppose the number of cans drawn is doubled. How will the mean of the sample mean weight change?

- A. It will increase by a factor of 2.
- B. It will increase by a factor of $\sqrt{2}$.
- C. It will decrease by a factor of 2.
- D. It will decrease by a factor of $\sqrt{2}$.
- E. It will remain unchanged.

Part iii) Consider the statement: ’The distribution of the mean weight of the sampled cans of Ocean brand tuna is Normal.’

- A. It is a correct statement, and it is a result of the Central Limit Theorem.
- B. It is a correct statement, but it is not a result of the Central Limit Theorem.
- C. It is an incorrect statement. The distribution of the mean weight of the sample is not Normal.

Solution: *(Instructor solution preview: show the student solution after due date.)*

Part i) Proposition 5.1 tells us that $Var(\overline{X}) = \sigma^2/n$. That means if we double the sample size then the standard deviation of the sample mean decreases by a factor of $\sqrt{2}$.

Part ii) Proposition 5.1 tells us that $E(\overline{X}) = \mu$, i.e., the expectation of the sample mean does not change if the sample size changes.

Part iii) The sample is small, hence the central limit theorem does not apply. Since each weight is actually a Normal random variable proposition 3.2 tells us that the sample mean is a normal random variable as well.

Correct Answers:

- `C`
- `E`
- `B`

---

8. (5 points) `local/Library/Rochester/setProbability12NormApproxBinom/ur_pb_12_1.pg`

Use normal approximation to estimate the probability of getting less than 50 girls in 100 births. Assume that boys and girls are equally likely.

_____

Solution: *(Instructor solution preview: show the student solution after due date.)*

Solution for one of the random selections:

Use normal approximation to estimate the probability of getting less than 50 girls in 100 births. Assume that boys and girls are equally likely.

Denote by X_k independent Bernoulli(1/2) trials and introduce the random variable

$$X = X_1 + X_2 + \ldots + X_{100}$$

counting the number of girls in 100 births. Obviously $E(X) = 100 \times 1/2$ and $Var(X) = 100 \times 1/4$.

Denote by W a normal random variable with expectation $E(W) = E(X) = 100 \times 1/2$ and variance $Var(W) = Var(X) = 100 \times 1/4)$. The normal approximation means

$$P(X < 50) = P(X \leq 49) \approx P(W \leq 49.5)$$

The remaining expression can be evaluated using standardisation

$$P(W \leq 49.5) = P(Z \leq (49.5 - 100 \times 1/2)/\sqrt{100 \times 1/4})$$

and the numerical value can be obtained with the R command pnorm((49.5-100/2)/sqrt(100/4)).

Correct Answers:

- `0.4601721617361`

---

7. (5 points) `local/Library/UVA-Stat/setStat212-Homework07/stat212-HW07-09.pg`

The number of pizzas consumed per month by university students is normally distributed with a mean of 9 and a standard deviation of 3.

A. What proportion of students consume more than 12 pizzas per month?

Probability = _______

B. What is the probability that in a random sample of size 9, a total of more than 99 pizzas are consumed? (Hint: What is the mean number and the variance of pizzas consumed by the sample of 9 students?)

Probability = _______

Solution: *(Instructor solution preview: show the student solution after due date.)*

Part a) Denote by X a normal random variable with expectation 9 and standard deviation 3 (i.e. the number of pizzas consumed). Using standardisation we have

$$P(X > 12) = 1 - P(X \leq 12) = P(Z \leq (12-9)/3)$$

The numerical value can be computed with the R command 1-pnorm((12-9)/3).

Part b) Denote by

$$Y = X_1 + X_2 + \ldots + X_9$$

the random variable which counts the number of pizzas consumed by the sample of 9 (where $X_k \sim N(,3^2)$). When using linearity of expectation and independence we have $E(Y) = 9 \times 9$ and $Var(X) = 9 \times 3^2$). Using standardisation we have

$$P(Y > 99) = 1 - P(Y \leq 99) = P(Z \leq (99 - 9 \times 9)/(\sqrt{9} \times 3))$$

The numerical value can be computed with the R command 1-pnorm((99-9*9)/(sqrt(9)*3)).

Correct Answers:

- `0.158655252944872`
- `0.0227501309615918`

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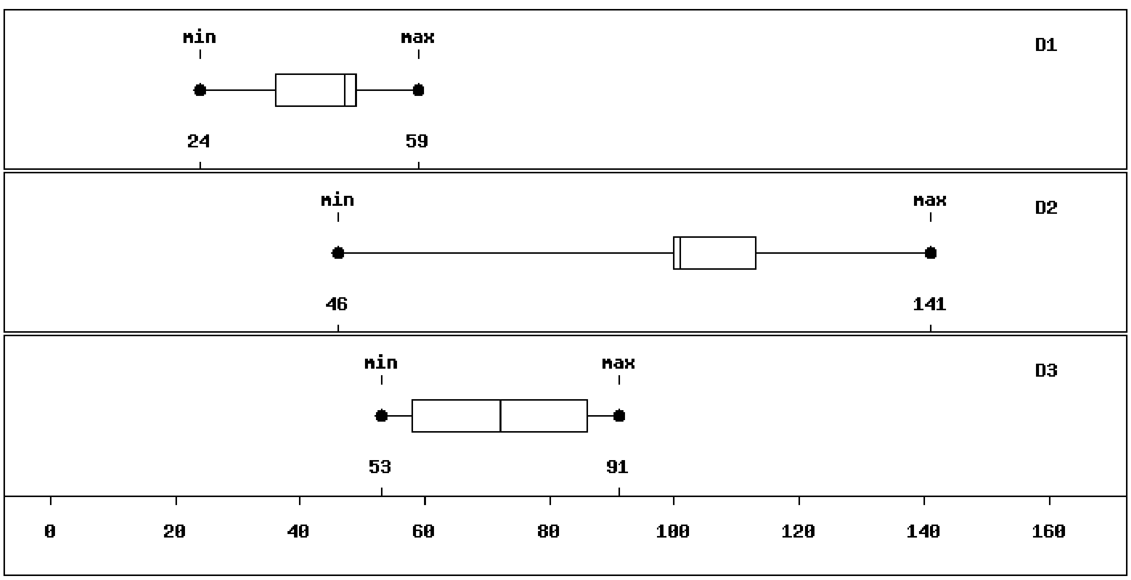
9. **(5 points)** `local/Library/NAU/setStatistics/boxplot_problem.pg`



Which of the following are true?

- A. The data in D3 is skewed right.
- B. The median value for D1 is less than the median value for D3 .
- C. Three quarters of the data values for D2 are greater than the median value for D1 .
- D. At least a quarter of the data values in D2 are less than all of the data values in D3 .
- E. At least three quarters of the data values in D1 are less than all of the data values in D2 .
- F. At least a quarter of the data values for D3 are less than the median value for D2 .

Correct Answers:

- `BCF`