**Midterm 2 - STAT 301**
**Spring 2018**

**Name**:

**UIN**:

**Signature**:

**Version C**:

1. Do not open this test until told to do so.
2. This is a closed book examination, However you may use the cheat sheet provided to you, the $t$ and $z$ tables. You should have no other printed or written material with you on the exam. But scrap paper is allowed.
3. You have 60 minutes to work on this exam. There are **18** multiple choice questions.
4. On the scantron please state the version of exam that you have.
5. You may use a calculator in the exam.
6. If there is no correct answer or if multiple answers are correct, select the **best** answer.
7. Unless stated otherwise, do all tests at the 5% level.
8. If you are unsure of what a question is asking for, do not hesitate to ask the instructor or course assistant for clarification (however we are limited in the amount of help we can offer).
9. Please only give one answer per question (the one that is closest to the solution).
10. Good Luck!!!

(1-3) Suppose the weight of **healthy** hens are normally distributed with mean **6** pounds and standard deviation one pound (both the population mean and population standard deviation are **known**).

(1) Calculate the proportion of healthy hens which are **greater** than 7 pounds.

(A) 1% (B) 99% (C) 0.84% (D) 84.1% (E) 15.9%

(2) What is the population mean and population standard error of the average weight (sample mean) of 10 healthy hens?

(A) $\mu = 6$, se $= \frac{1}{10}$ (B) $\mu = 6$ and se $= 1$ (C) $\mu = 6$ and se $= \frac{1}{\sqrt{10}}$

(D) $\mu = \frac{6}{\sqrt{10}}$, se $= \frac{1}{\sqrt{10}}$ (E) $\mu$ is unknown and se is unknown.

(3) Calculate the chance that the sample mean of **10** healthy hens is **less** than 5 pounds.

(A) 3.16% (B) 96.84% (C) 99.9% (D) 0.08% (E) 15.9%.

(4) A farmer has a coop and is monitoring her hens. The average weight of 10 hens in her coop is less than 5 pounds. The farmer calculates the chance that the average weight of 10 hens is less than 5 pounds when the mean weight of a healthy hen is **6** pounds. This chance is **0.07**%. Based on this probability what can we say about her hens?

(A) The probability that the average weight of 10 healthy hens is less than **5** pounds is quite small, which suggests her hens may **not** be healthy.

(B) The probability that the average weight of 10 healthy hens is less than **5** pounds is quite small, which suggests her hens are **very healthy**.

(C) The farmer's hens **are healthy** and lie inside the 80% confidence interval.

(D) The farmer's hens are extremely unhealthy (E) The farmer must be sick too.

(5) A nutritionist wants to know the mean weight of a 10 year old. He will collect a random sample, and construct a 95% confidence interval for the mean weight. The Margin of Error should be no more than **1** pound. Suppose the **standard deviation** for the weight of a 10 year is believed to be in the interval $[5, 10]$.

What is the minimum sample size required to ensure the margin of error is no more than **1** pound?

(A) 385 (B) 262 (C) 96 (D) 4 (E) 484

(6) Compare the margin of error of a 99% confidence interval with the margin of error of a 80% confidence interval (both constructed using the same data). Which statement(s) is correct?

(A) The 80% confidence interval is **wider** than the 99% confidence interval.

(B) The 80% confidence interval is about **half** the length of a 99% confidence interval.

(C) The 80% confidence interval is about **80%** the length of the 99% confidence interval.

(D) The 80% confidence interval is about **two thirds** the length of the 99% confidence interval.

(E) (A) and (C).

(7) The margin of error of a 95% confidence interval is **6**. By how much should one change the sample size such that the margin of error reduces to **2**?

(A) The sample size should be **3** times larger.

(B) The sample size should be **1/3** smaller.

(C) The sample size should be **9** times larger.

(D) The sample size should be **4** times larger.

(E) It is not possible to say without additional information.

(8) Given the 95% confidence interval $[20, 30]$ what is the sample mean and the margin of error?

(A) $\bar{x} = 25$, MoE $= 10$ (B) $\bar{x} = 25$, MoE $= 5$ (C) $\bar{x} = 20$, MoE$= 10$

(D) $\bar{x} = 30$, MoE$= -10$ (E) $\bar{x} = 50$, MoE $= 5$.

(9) Construct a 95% confidence interval for the mean amount of sugar in a bowl of cereal using the following summary statistics

**Summary statistics:**

| Column | n | Mean | Variance | Std. dev. | Std. err. |
|---|---|---|---|---|---|
| sugars | 76 | 7.0263158 | 19.172632 | 4.3786564 | 0.50226633 |

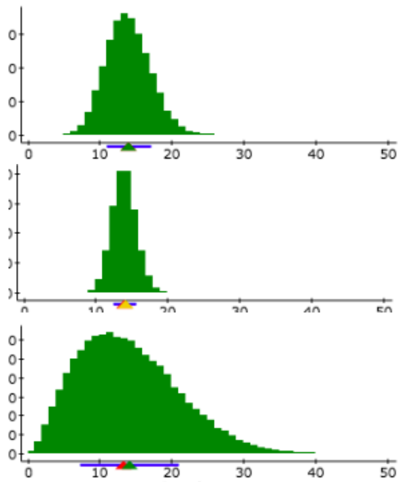
Below are the critical values for a t-distribution with 75df.

| probability | 0.3 | 0.15 | 0.10 | 0.05 | 0.025 | 0.01 | 0.005 |
|---|---|---|---|---|---|---|---|
| $t^*$ | 0.52 | 1.09 | 1.28 | 1.66 | 1.99 | 2.37 | 2.64 |

(A) [6.17, 7.83] (B) [0, 15.6] (C) [18.17, 19.83] (D) [18.05, 19.9] (E) [6.01, 8.02]

(10) The distribution of the sample means (data drawn from the same population) for various sample sizes are plotted below.

The **top** plot we call **Plot 1**. The **middle** plot we call **Plot 2**. The **bottom** plot we call **Plot 3**.



Match the sample sizes ($n = 3, 15$ and $50$) to the plots.

| | Plot 1 | Plot 2 | Plot 3 |
|---|---|---|---|
| A | 3 | 15 | 50 |
| B | 15 | 50 | 3 |
| C | 15 | 3 | 50 |
| D | 50 | 15 | 3 |
| E | 50 | 3 | 15 |

(11) Which statement(s) is true?

(A) The central limit theorem states that as the sample size grows the **data** becomes more normal.

(B) The central limit theorem states that as the sample size grows the **sample mean** becomes more normal.

(C) The t-distribution **corrects** for the lack of normality of the data.

(D) [A] and [B]     (E) [A], [B] and [C].

(12-13) A company is interested in the opinion that students have about their product. The students can rate the product from **1** to **5**.

(12) A random sample of **four** students were asked to rate the product. They gave the ratings $\mathbf{4, 5, 5, 5}$. The sample mean is **4.75** and **sample** standard deviation is **0.5**. Using the t-distribution construct a **99%** confidence interval for the mean rating for the product.

(A) [3.29, 6.21]   (B) [1.83, 7.67]   (C) [1.83, 5]   (D) [3.29, 5]   (E) [2.47, 7.02]

(13) The QQplots in Figure 1 (next page) are of the distribution of ratings that students give a product and its sample mean (based on 4 students). Using these plots, what can one say about the reliability of the 99% confidence interval constructed in Question 12.

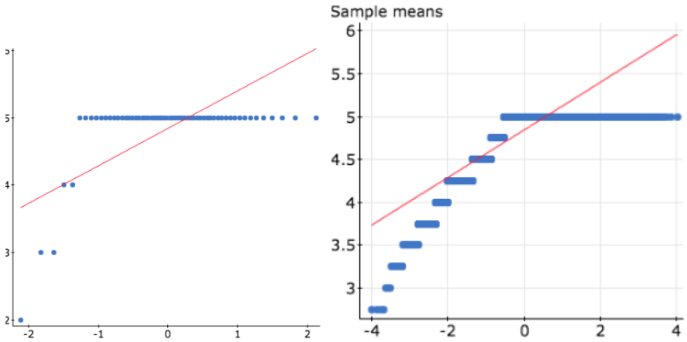



Figure 1: Left: Distribution of product ratings Right: Distribution of sample mean.

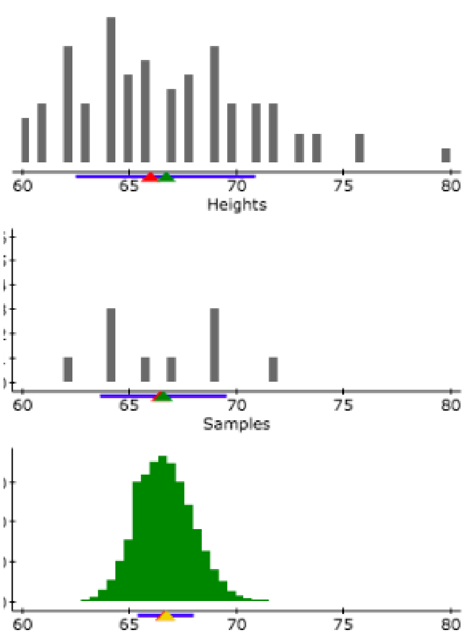
(A) The distribution of the sample mean is far from normally distributed.

(B) We **do not** have 99% confidence in the interval.

(C) We **do** have 99% confidence in the interval.

(D) [A] and [B]  (E) [A] and [C].

(14) Below are plots and the measures of center and spread of:




**Population**

| | |
|---|---|
| Mean | 66.7125 |
| Median | 66 |
| Unadjusted Std. dev. | 4.1958 |

**Samples**

| | |
|---|---|
| Sample size | 10 |
| Mean | 66.6 |
| Median | 66.5 |
| Std. dev. | 2.9732 |

**Sample means**

| | |
|---|---|
| # of Samples | 61000 |
| Mean | 66.7167 |
| Median | 66.7 |
| Std. dev. | 1.3259 |

(**1**) The heights of a population (of students)

(**2**) A sample 10 students from the population and

(**3**) The distribution of the sample mean (based on size 10).

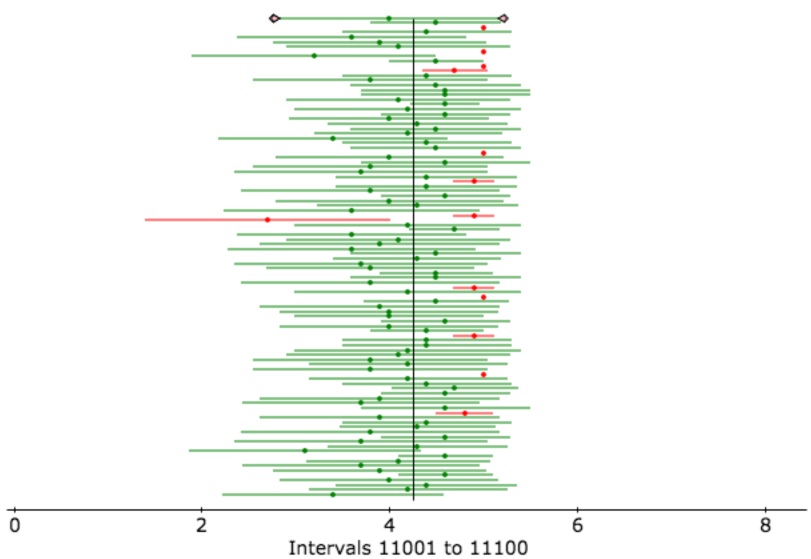
Match the numbers with the measure of spread.

| | Standard deviation | Sample standard deviation | Standard error |
|---|---|---|---|
| A | 4.2 | 4.2 | 0.42 |
| B | 4.2 | 2.97 | 1.32 |
| C | 2.97 | 2.97 | 1.32 |
| D | 1.32 | 2.97 | 1.32 |
| E | 2.97 | 4.32 | 0.42 |

(15) To check whether a 95% confidence interval had the stated level of confidence the following application (using the t-distribution) in statcrunch was run. Which statement(s) is correct?

**Confidence intervals a mean: Data (μ=4.253, σ=1.37) Type=T**
**Sample size=10**

| CI Level | Containing μ | Total | Proportion |
|---|---|---|---|
| 0.95 | 9565 | 11100 | 0.8617 |




(A) Each horizontal line corresponds to one confidence interval.

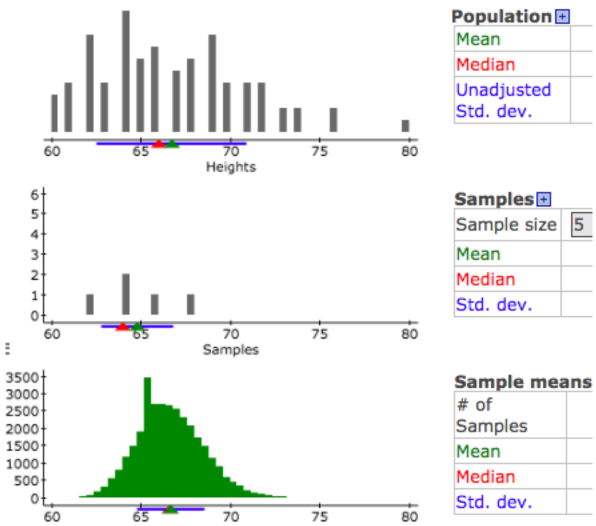
(B) 86.17% of the intervals contain the population mean, so the true level of confidence is below the stated 95%.

(C) The sample mean is close to normally distributed.

(D) [A] and [B] [E] (A), (B) and (C)

(16) 5 students are randomly sampled, their sample mean is **64.8** inches.

To understand the distribution of the sample means we use the sampling distribution applet in Statcrunch. Which statement(s) are correct?




(A) **64.8** is a number drawn from the histogram in the top plot.

(B) **64.8** is a number drawn from the histogram in the middle plot.

(C) **64.8** is a number drawn from the histogram in the bottom plot.

(D) The distribution of the sample mean based on 5 is highly left skewed.

(E) [A] and [D].

(17) The t-value of a t-distribution with 8df is **-1.8**. What is the area to the **right** of **-1.8**?

(A) Between 5-10% (B) Between 90-95% (C) Between 2.5-5%

(D) 68% (E) 11%.

(18) Previously the mean yearly mileage of a vehicle was 4000 miles. I want to see whether the mean yearly mileage has **changed** after the price change. What is the hypothesis of interest?

(A) $H_0 : \mu < 4000$ vs $H_A : \mu \geq 4000$ (B) $H_0 : \mu > 4000$ vs $H_A : \mu \leq 4000$

(C) $H_0 : \mu \leq 4000$ vs $H_A : \mu > 4000$ (D) $H_0 : \mu = 4000$ vs $H_A : \mu \neq 4000$

(E) $H_0 : \mu \neq 4000$ vs $H_A : \mu = 4000$.