Questions 1-10. Each question has 4 choices. Circle only one answer. **(10 points)**

1. Let x be a continuous random varaible and c be any real value. Which of the following is **false**?
   A. $P(x = c) = 0$
   B. $P(x \le c) = P(x < c)$
   C. $P(x > c) = 1 - P(x < c)$
   D. $P(x \ge c) = P(x \le -c)$

3. The central limit theorem requires that the sample size n has to be large. What is the suggested value of n?
   A. At least 20
   B. At least 30
   C. At least 40
   D. At least 50

5. Which statement is true about p and $\hat{p}$?
   A. $p = 1$
   B. $p < \hat{p}$
   C. $p + \hat{p} = 1$
   D. p is a parameter

6. The width of a confidence interval will be:
   A. Narrower for 98% confidence than for 90% confidence.
   B. Wider for a sample size of 64 than for a sample size of 36.
   C. Wider for a 99% confidence than for 95% confidence.
   D. Narrower for sample size of 25 than for a sample size of 36.

7. Assume that the sample size n is large and a 95% confidence interval for the population mean is 10 ± 1.5. What is a point estimate of the population mean?
   A. 1.5
   B. 3
   C. 5
   D. 10

8. Suppose that a left-tailed test of a statistical hypothesis testing has the p-value equaled 0.004. Which statement is **true**?
   A. Reject the null hypothesis only when the significance level $\alpha > 0.004$.
   B. Reject the null hypothesis only when the significance level $\alpha < 0.004$.
   C. Reject the null hypothesis only when the significance level $\alpha > 0.002$.
   D. Reject the null hypothesis only when the significance level $\alpha < 0.002$.

Use the following information for Questions 9-10:

A consumer protection group is concerned that a ketchup manufacturer is filling its 20-ounce family size containers with less than 20 ounces of ketchup. The group purchases 12 family-size bottles of this ketchup, weighs the contents of all bottles and finds that the mean weight is $\bar{x} = 19.9$ ounces and the standard deviation $s = 0.22$ ounces. Assume that the weight follows a normal distribution.

9. To test the protection group's suspicion, the null and alternate hypotheses are
   A. $H_0 : \bar{x} = 20$ vs. $H_a : \bar{x} \ne 20$
   B. $H_0 : \mu = 20$ vs. $H_a : \mu < 20$
   C. $H_0 : \mu = 20$ vs. $H_a : \mu \ne 20$
   D. $H_0 : \mu = 20$ vs. $H_a : \mu > 20$

10. For a test with 0.05 level of significance, what is (are) the critical value(s)?
   A. -1.645
   B. 1.645
   C. -1.796
   D. 1.796

13. Thais eat an average of 10 kg. of bananas per person every year. Suppose that the weight of bananas consumed has an unknown distribution with population standard deviation of 3 kg.

a) What can be said about the sampling distribution of $\bar{x}$? (1 point)

The sampling dist of $\bar{x}$ is approximately normal provided that n is large.

b) For a random sample of $n = 64$ Thais, what is the probability that the sample mean weight of banana consumed is between 9 and 11? (2 points)

$$P(9 \le \bar{x} \le 11) = P\left(\frac{9-10}{3/\sqrt{64}} \le \frac{\bar{x}-\mu}{\sigma/\sqrt{n}} \le \frac{11-10}{3/\sqrt{64}}\right)$$

$$= P(-2.67 \le Z \le 2.67)$$

$$= 0.9962 - 0.0038$$

$$= 0.9924$$

14. A major metropolitan newspaper selected a simple random sample of 1,600 readers from their list of 100,000 subscribers. They asked whether the paper should increase its coverage of local news. Forty percent of the sample wanted more local news. Find a 99% confidence interval for the proportion of readers who would like more coverage of local news? (2 points)

$$\hat{p} \pm z_{0.005}\sqrt{\frac{\hat{p}\hat{q}}{n}}$$

$$= 0.4 \pm 2.57\sqrt{\frac{0.4(0.6)}{1600}}$$

2.58
2.575

$$\cong 0.4 \pm 0.0315$$

15. A random sample of 35 men has an average pulse rate of 70 and a standard deviation of 8, while a random sample of 40 women has an average pulse rate of 73 and a standard deviation of 10.

a) Find a point estimate of the difference in average pulse rates between men and women. (1 point)

-3 or 3.

b) Construct a 95% confidence interval for the difference between the averages of pulse rates between men and women. (2 points)

men

$$\bar{x}_1 - \bar{x}_2 \pm z_{0.025}\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

$$= 70 - 73 \pm 1.96\sqrt{\frac{64}{35} + \frac{100}{40}}$$

$$= -3 \pm 4.0778$$

OR $[-7.0778,\ 1.0778]$

c) Based on Part (b), do men and women have a difference in the average pulse rates? Justify your answer. (1 point)

No, there is no difference, because 0 falls in the interval above.

16. A newspaper conducted an online survey of 200 adults who smoked and 300 adults who did not. The question asked was: "Should the tax on cigarettes be raised to pay for health care reform?" The results of the survey are:

	Sample size	Number of adults saying "yes"
Smokers (1)	200	90
Non-smokers (2)	300	150

Let p_1 and p_2 be proportions of smokers and non-smokers who said yes, respectively. At $\alpha = 0.05$ level of significance, perform the test $H_0 : p_1 - p_2 = 0$ vs. $H_a : p_1 - p_2 \neq 0$. What is the conclusion of the test? (6 points)

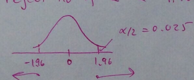
Test Statistics : $Z = \dfrac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}\hat{q}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$

$\frac{240}{500} = 0.48$

$= \dfrac{0.45 - 0.5}{\sqrt{0.48(0.52)\left(\frac{1}{200} + \frac{1}{300}\right)}}$

$\simeq 1.096$

At $\alpha = 0.05$, reject H_0 if $Z \leq -1.96$ or $Z \geq 1.96$



Do not reject H_0 at $\alpha = 0.05$

Thus, there is no difference in proportions of males and of females who said yes to raising tax.

17. The general manager of a chain of fast food chicken restaurants wants to determine how effective their promotional campaigns are. In these campaigns "20% off" coupons are widely distributed. These coupons are only valid for one week. To examine their effectiveness, the executive records the daily gross sales (in \$100s) in one restaurant during the campaign and during the week after the campaign ends. The data are shown below.
Can the manager conclude that sales increase during the campaign?
→ **Perform a hypothesis test at 0.1 significance level.**

(*Make sure that the null and alternative hypotheses are stated and the test procedure is shown.*) (6 points)

Day	Sales During Campaign	Sales After Campaign	During – After
Sunday	52	49	3
Tuesday	42	35	7
Wednesday	50	50	0
Thursday	55	51	4
Friday	60	58	2
Saturday	65	66	-1

$\bar{d} = \frac{15}{6} = 2.5$

$s_d^2 = \dfrac{\sum d_i^2 - \frac{(\sum d_i)^2}{n}}{n-1} = \dfrac{79 - \frac{15^2}{6}}{5} = 8.3$

$H_0: \mu_d - \mu_a = 0$ vs. $H_0: \mu_d - \mu_a > 0$

Test Statistic : $t = \dfrac{\bar{d}}{s_d/\sqrt{n}}$

$= \dfrac{2.5}{\sqrt{8.3}/\sqrt{6}} \simeq 2.125$

At $\alpha = 0.1$, H_0 will be rejected if $t > t_{0.1,5}$

$t > 1.476$

Conclusion : Reject H_0 at $\alpha = 0.1$

Thus, coupons campaign help increasing the sales.