College Prep Stats
Review for Quiz (9.2 ~ 9.3)

Use a significance level of α = 0.05. Keep 4 decimal places.

Task #1 **Identify the null hypothesis, alternative hypothesis, test statistic, P-value, short conclusion about the null hypothesis, and a final conclusion written in a clear and easy to understand way that addresses the original claim.**

Task #2 **Calculations for Confidence Intervals of the difference of the two population variables.**

1. Among 2739 female atom bomb survivors, 1397 developed thyroid diseases. Among 1352 male atom bomb survivors, 436 developed thyroid diseases. Performa a hypothesis test for the claim that the female survivors and male survivors have different rates of thyroid diseases.

$H_0: \quad p_1 = p_2$ $\qquad$ $H_1: \quad p_1 \neq p_2$ **(original claim)**

$$z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\overline{p}\overline{q}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} = \frac{\frac{1397}{2739} - \frac{436}{1352}}{\sqrt{0.44806 \cdot 0.55194\left(\frac{1}{2739} + \frac{1}{1352}\right)}} = 11.3471$$

P-value ≈ 0 < 0.05

Reject H_0

There is sufficient evidence to support the claim that the female survivors and male survivors have different rates of thyroid diseases.

95% C. I. for $p_1 - p_2$ is (0.15639, 0.21872)

2. In one trip of the Royal Caribbean cruise ship *Freedom of the Seas*, 338 of the 3823 passengers became ill with a Norovirus. At about the same time, 276 of the 1652 passengers on the *Queen Elizabeth II* cruise ship became ill with a Norovirus. Treat the sample results as simple random samples from large populations, perform a hypothesis test for the claim that the rate of Norovirus illness on the *Freedom of the Seas* is less than the rate on the *Queen Elizabeth II*. Based on the result, does it appear that when a Norovirus outbreak occurs on a cruise ship, the proportion of infected passengers can vary considerably?

$H_0: \quad p_1 = p_2$ $\qquad\qquad$ $H_1: \quad p_1 < p_2$ **(original claim)**

$$z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\overline{p}\overline{q}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} = \frac{\frac{338}{3823} - \frac{276}{1652}}{\sqrt{0.11215 \cdot 0.88785\left(\frac{1}{3823} + \frac{1}{1652}\right)}} = -8.4663$$

P-value = 0 < 0.05

Reject H_0

There is sufficient evidence to support the claim that the rate of Norovirus illness on the *Freedom of the Seas* is less than the rate on the *Queen Elizabeth II*. Based on the result, it appear that when a Norovirus outbreak occurs on a cruise ship, the proportion of infected passengers can vary considerably.

95% C. I. for $p_1 - p_2$ is (-0.0988, -0.0585)

3. A simple random sample of 38 four-cylinder cars is obtained, and the braking distances are measured. The mean braking distance is 137.5 ft and the standard deviation is 5.8 ft. A simple random sample of 32 six-cylinder cars is obtained and the braking distances have a mean of 140.3 ft with a standard deviation of 9.7 ft. Perform a hypothesis test for the claim that the mean braking distance of four-cylinder cars is less than the mean braking distance of six-cylinder cars.

$H_0: \quad \mu_1 = \mu_2$ $\qquad\qquad$ $H_1: \quad \mu_1 < \mu_2$ **(original claim)**

$$t = \frac{\overline{x}_1 - \overline{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{137.5 - 140.3}{\sqrt{\frac{5.8^2}{38} + \frac{9.7^2}{32}}} = -1.4316$$

P-value = 0.0793 > 0.05

Fail to reject H_0

There is not sufficient sample evidence to support the claim that the mean braking distance of four-cylinder cars is less than the mean braking distance of six-cylinder cars.

95% C. I. for $\mu_1 - \mu_2$ is (-6.731, 1.131)

4. Scientists collect a simple random sample of 25 menthol cigarettes and 25 nonmenthol cigarettes. Both samples consist of cigarettes that are filtered, 100 mm long, and non-light. The menthol cigarettes have a mean nicotine amount of 0.87 mg and a standard deviation of 0.24 mg. The nonmenthol cigarettes have a mean nicotine amount of 0.92 mg and a standard deviation of 0.25 mg. Conduct a hypothesis test for the claim that menthol cigarettes and nonmenthol cigarettes have same amounts of nicotine. Assume that the nicotine amount in cigarettes is normally distributed. Does menthol appear to have an effect on the nicotine content?

$H_0: \quad \mu_1 = \mu_2$ **(original claim)** $\qquad H_1: \quad \mu_1 \neq \mu_2$

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{0.87 - 0.92}{\sqrt{\frac{0.24^2}{25} + \frac{0.25^2}{25}}} = -0.7214$$

P-value = 0.4742 > 0.05

Fail to reject H_0

There is not sufficient evidence to warrant rejection of the claim that menthol cigarettes and nonmenthol cigarettes have same amounts of nicotine.

95% C. I. for $\mu_1 - \mu_2$ is (-0.1894, 0.08936)