Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Math 275 **Final Exam Part II** Due: December 17, 2019

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Sleep Apnea is a sleep disorder in which breathing is briefly and repeatedly interrupted during sleep. The "apnea" in sleep apnea refers to a breathing pause that lasts at least ten seconds. Obstructive sleep apnea syndrome (OSAS) occurs when the muscles in the back of the throat fail to keep the airway open, despite efforts to breathe. OSA can cause fragmented sleep and low blood oxygen levels. For people with OSA, the combination of disturbed sleep and oxygen starvation may lead to hypertension, heart disease and mood and memory problems.

One of the most common methods used to diagnose sleep apnea is Polysomnography, also called a sleep study, which may require an overnight stay at a sleep center. The sleep study monitors a variety of functions during sleep including sleep state, breathing patterns, brain waves, muscle activity, heart rate, blood oxygen levels, and other vital signs. This test is used both to diagnose sleep apnea and to determine its severity.

More than 18 million American adults have sleep apnea. As OSAS presents a large public health problem, there has been an ongoing search towards simpler measures to screen patients that may have OSA. Obesity is one of the risk factors. A clinical study examined the correlation of waist-to-height ratio, an indicator of central obesity, with presence and severity of OSAS.

The ***OSASdataFinalExam.xlsx*** file contains apnea-hypopnea index (AHI) values, waist circumferences, heights, body mass-index (BMI) and demographic characteristics of 437 OSAS patients and 72 healthy individuals.

The Apnea-hypopnea index (AHI) is calculated by dividing the number of apnea events by the number of hours of sleep. Patients with an AHI value of equal to or greater than 5 were diagnosed as having OSAS. Among them, further classification was made as mild (5≤ AHI ≤ 15), moderate (15 < AHI < 30), and severe (AHI ≥ 30) OSAS. Participants with AHI < 5 were considered as the control group.

**Answer the following questions only using R, save your script (or rmd) file and submit it with your answers.**

**1. a)** Create a new variable in R for the waist-to-height ratio (waist circumference / height) from the dataset and define it as WtoH for statistical analysis.

**b)** Create new categories in R for the severity of OSAS, based on the above information, name them as mildOSAS, moderateOSAS, and severeOSAS.

**2.** Fill in the blanks of the following sentences.

**a)** There were \_\_\_\_ cases in the study. The mean age was \_\_\_\_\_\_ (with sd=\_\_\_, min=\_\_\_, max=\_\_\_). Of these cases, 437 (\_\_\_%) were diagnosed with OSAS and 72 (\_\_\_%) were not. Two hundred and eight (\_\_\_%) of the patients had severe, \_\_\_ (\_\_\_%) had moderate, and \_\_\_ (\_\_\_%) had mild OSAS.

**b)** The mean age of patients with OSAS (mean ± sd = \_\_\_\_\_±\_\_\_\_\_) was significantly higher than those without OSAS (mean ± sd = \_\_\_\_\_±\_\_\_\_\_) (p-value \_\_\_\_\_, Welch t-test).

**3.** Fill in the blanks of the following sentences and table.

**a)** One hundred fifty (\_\_\_%) of the participants were female and \_\_\_ were male. Of the patients with OSAS, \_\_\_ were female (\_\_\_%) and \_\_\_ were male (\_\_\_%). There were \_\_\_ females and \_\_\_ male participants who were not diagnosed with OSAS.

**b)**

|  |  |  |
| --- | --- | --- |
|  | OSAS Patients | Control Group |
| Female |  |  |
| Male |  |  |

Table 1. Number of female and male cases in patient and control groups.

**c)** There was an association between sex and incidence of OSAS (p-value\_\_\_\_\_\_, Chi-square test). It means that, the incidence of OSAS among males (90%) is higher than that in females (\_\_\_%) (p-value \_\_\_\_\_, two-sample proportion test).

**4.** Calculate the 95% confidence interval for the mean of the following parameters for the population of OSAS patients and healthy people; and mild, moderate and severe OSAS patients. Fill in the following table.

waist circumference (defined as WAIST),

body mass-index (defined as BMI),

waist-to-height ratio (your new variable WtoH)

|  |  |  |  |
| --- | --- | --- | --- |
|  | BMI | Waist Circumference | Waist-to-Height Ratio |
| Control |  |  |  |
| OSAS |  |  |  |
| Mild OSAS |  |  |  |
| Moderate OSAS |  |  |  |
| Severe OSAS |  |  |  |

Table 2. 95% confidence interval for the mean of the populations.

**5.** Make a side-by-side boxplot for the BMI of the Control, Mild OSAS, Moderate OSAS, and Severe OSAS groups.

**6. a)** Calculate the summary statistics (Mean ± SD, Median, Min, and Max) of Waist-to Height Ratio for females and males separately in the patient and control groups. Fill in the following table.

**b)** Make an overlapping histogram for the Waist-to Height Ratio of the patient and control groups for females.

**c)** Make an overlapping histogram for the Waist-to Height Ratio of the patient and control groups for males.

**d)** Is there any statistical evidence that the mean waist-to-height ratio is higher in OSAS patients than healthy people for both females and males? Before using a hypothesis test, check its assumptions. If the assumptions do not satisfy, then use a nonparametric test. Write the p-values in the table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | OSAS Patients | Control Group | p-value |
| Females | Mean ± SD |  |  |  |
| Median |  |  |  |
| Min - Max |  |  |  |
| Males | Mean ± SD |  |  |  |
| Median |  |  |  |
| Min - Max |  |  |  |

Table 3. Summary statistics of Waist-to Height Ratio for females and males separately in the patient and control groups. The p-values were obtained from the \_\_\_\_\_\_\_\_\_\_\_\_ Test.

**7.** In adults, a BMI value above 30 kg/m2 is considered obese. Is there any significant evidence that the mean BMI of severeOSAS patients is above 30 kg/m2? Don’t forget to check the assumptions of the statistical test you will use.