

## Exam II – Take Home

### Reference Ranges for Senior Subjects

The data for your project comes from a nutritional study conducted at Youngstown State University during 1997-1998. One hundred seventy eight subjects completed the study in which the researchers investigated levels of calcium, inorganic phosphorous and alkaline phosphatase in subjects age 65 or higher. The research study wanted to determine if reference ranges established for the general population applied to subjects in this age range. Researchers also wanted to discover if a difference existed for men and women.

The data appears in the data file **ranges1.xls** which is available at <http://csuohio.edu/holcombj/mth147/exam2.htm> Note that some variables may not be used for this assignment, but may be used for the take-home Final Examination.

Variable guide:

<b>age</b>	Age in years
<b>sex</b>	1=male, 2=female
<b>alkphos</b>	Alkaline Phosphatase in IU/L (International Units Per Liter)
<b>ca</b>	Calcium (mg/dL)
<b>iphos</b>	Inorganic Phosphorus mg/dL
<b>agegroup</b>	1=65-69, 2=70-74, 3=75-79, 4=80-84, 5=85 or over
<b>lowca</b>	0=no, 1=yes, for calcium lower than 9 mg/dL
<b>lowphos</b>	0=no, 1=yes, for phosphorus level lower than 3.0
<b>highalp</b>	0=no, 1=yes, for alkaline phosphatase higher than 115
<b>over80</b>	0=no, 1=yes (subject is 80 or higher)

The Medical Laboratory Reviewer established reference range levels for the general population for calcium and inorganic phosphorus (among others). For calcium that range was 9.0-10.5 mg/dL. Thus the variable **lowca** is an indicator variable to show if the subject was below the level of 9.0. The reference range for inorganic phosphorus is 3.0-4.5. Thus **lowphos** indicates whether the subject was below 3.0. A study by Jernigan established a reference range of 30-115 for alkaline phosphatase. The variable **highalp** indicates whether a subject had a value higher than 115.

Begin your report by providing a summary of the discrete variables of **sex**, **agerange**, and **lowca**. (raw numbers and percents). Also perform a summary analysis of **age** and **ca** (create a 5 number summary and histogram). Describe the shape of the histograms and determine if the mean or the median is the better measure of center.

Create a 2x2 contingency table of **sex** vs. **lowca**. Let A be the event of being a man, B be the event of being a woman, C the event of not having low calcium (**lowca=0**) and D be the event of having low calcium (**lowca=1**). Determine the following:

1.  $P(C)$
2.  $P(D)$
3.  $P(A \cap D)$
4.  $P(B \cap D)$
5.  $P(B \cup C)$
6.  $P(D|A)$
7.  $P(D|B)$

Were mature women or men more likely to have low calcium levels? How did you decide? Was this surprising?

Treating being male as a risk factor and having low calcium as the disease, calculate the relative risk for low calcium comparing men to women. Interpret its meaning.

Calculate the probability of low calcium given the subject was 80 or over. Calculate the probability of low calcium given the subject was 65-79. Which is higher?

If calcium levels are normally distributed and 9.0-10.5 represents a range of plus or minus 2 standard deviations from the mean – what percent should we expect to be below 9.0? Looking at your answer to the probability of having low calcium [ $P(D)$ ], do you feel that perhaps the reference range of 9.0-10.5 is not accurate? Were any of your results above surprising? Why or why not. Make sure this paragraph is at least 5 sentences.

Answers for Test

**Sex**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	91	51.1	51.1	51.1
	Female	87	48.9	48.9	100.0
	Total	178	100.0	100.0	

**AGEGROUP**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	56	31.5	31.5	31.5
	2.00	70	39.3	39.3	70.8
	3.00	38	21.3	21.3	92.1
	4.00	11	6.2	6.2	98.3
	5.00	3	1.7	1.7	100.0
	Total	178	100.0	100.0	

**LOWCA**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	145	81.5	81.5	81.5
	Yes	33	18.5	18.5	100.0
	Total	178	100.0	100.0	