MATH 120: Quiz 1 - 1/24/2019

No reference materials permitted except calculator.

(I) The 2-way table shows the distribution of rank of university faculty at all U.S. medical schools by sex in 2016 (Data source: Association of American Medical Colleges):

	Faculty Rank			
	Assistant professor	Associate professor	Professor	**Total**
Female	36,498	12,589	8,708	57,795
Male	43,561	21,991	28,634	94,186
Total	80,059	34,580	37,342	151,981

Compute marginal and conditional distributions, and determine whether these data indicate an association between rank and sex. Write a short paragraph summarizing your findings. [You may omit graphing, but must show all computational details.]

(II) In the previous question, the sample contains a much larger number of males than females. How does that affect your conclusion about association?

Solution

(I) The table below shows the marginal distribution of sex, together with its conditional distributions for each faculty rank. In other words, percentages are computed column-wise.

	Faculty Rank			
	Assistant professor	Associate professor	Professor	**Total**
Female	$\frac{36,498}{80,059} = 0.456$	$\frac{12,589}{34,580} = 0.364$	$\frac{8,708}{37,342} = 0.233$	$\frac{57,795}{151,981} = 0.38$
Male	$\frac{43,561}{80,059} = 0.544$	$\frac{21,991}{34,580} = 0.636$	$\frac{28,634}{37,342} = 0.767$	$\frac{94,186}{151,981} = 0.62$

According to these data, there is an association between faculty rank and sex. As seen in the table, the conditional distribution of sex is different for different ranks. We see that the proportion of female faculty decreases as rank increases. The reverse is true of males. Females comprise only 23.3% of the "Professor" rank, whereas they make up 45.6% of the "Assistant professor" rank. Another indication of association between sex and rank is that the conditional distributions differ appreciably from the marginal distribution.

(II) The larger number of males makes no difference to the conclusion, since we looked at proportions (or percents) instead of raw counts. Thus, our conclusion remains the same: According to these data, there is an association between faculty rank and sex.

Grading: Total points possible = 6.

5 pt for (I): 2pt = correctly compute a full set of conditional distributions
1pt = compute correct marginal distribution
1pt = show all calculation steps
1pt = reasonable statement summarizing findings

1 pt for (II): No partial credit. Answer must clearly say it makes no difference.

Just for reference, if the marginal and conditional distributions are computed row-wise, here is what we get

	Faculty Rank		
	Assistant professor	Associate professor	Professor
Female	$\frac{36{,}498}{57{,}795} = 0.632$	$\frac{12{,}589}{57{,}795} = 0.218$	$\frac{8{,}708}{57{,}795} = 0.151$
Male	$\frac{43{,}561}{94{,}186} = 0.462$	$\frac{21{,}991}{94{,}186} = 0.233$	$\frac{28{,}634}{94{,}186} = 0.304$
Marginal distribution	$\frac{80{,}059}{151{,}981} = 0.527$	$\frac{34{,}580}{151{,}981} = 0.228$	$\frac{37{,}342}{151{,}981} = 0.246$

Conclusion remains the same: The conditional distribution of faculty ranks differs by sex. Only 15.1% of the females are at the rank of Professor, while a much larger percent of males (30.4%) are at that same rank. Thus, there is an association.