I. **Pre-class material** Either read the indicated textbook sections OR watch the indicated video.

(a) **Sections to Read** (All content from Blitzstein and Hwang's *Introduction to Probability* unless otherwise noted). A digital copy of the textbook is available for free via the authors' website.

- 7.4
- 7.7 (just the part on Multinomial)

(b) **Videos to Watch** (All videos from Blitzstein's Math 110 YouTube channel, unless otherwise noted)

- Lecture 20: Multinomial and Cauchy (from 8:00 to 28:00)
- Lecture 21: Covariance and Correlation (from 33:00 to end)
- Read Section 7.7 (just the part on Multinomial)

II. **Objectives** (By the end of the day's class, students should be able to do the following:)

- Define the multinomial distribution via a story model and calculate the corresponding joint PMF.
- Compute the marginal and conditional distributions for the multinomial distribution, as well as the covariance of coordinates of the multinomial vector.
- Sample from a multinomial distribution in R

III. **Reflection Questions** (Submit answers on Gradescope `https://www.gradescope.com/courses/425901`)

1) The multinomial distribution $\text{Mult}_k(n, \mathbf{p})$ is usually only discussed in the case when $k \geq 2$. But the definition of the multinomial can still be used in the case when $k = 1$. Suppose $X \sim \text{Mult}_1(10, p)$. What must be the value of p? What is another name for the distribution of X in this case?

2) In your own words, explain why it isn't surprising that the covariance of components in a Multinomial vector are negatively correlated.

3) Suppose (X_1, X_2, X_3) are $\text{Mult}_3(10, \mathbf{p})$ where $\mathbf{p} = (\frac{1}{2}, \frac{1}{3}, \frac{1}{6})$.

i. What is the marginal distribution of X_1? Give the name of the distribution, as well as the values of the associated parameters.

ii. What is the conditional distribution of (X_1, X_2) given $X_3 = 0$? Give the name of the distribution, as well as the values of the associated parameters.

iii. What is the conditional **marginal** distribution of X_1, given $X_3 = 0$. That is, what is the conditional PMF $P(X_1 = k|X_3 = 0)$? Give the name of the distribution, as well as the values of the associated parameters.

IV. **Additional Feedback** Are there any topics you would like further clarification about? Do you have any additional questions based on the readings / videos? *If not, you may leave this section blank.*