

**Psych 315, Winter 2021, Homework 5**

Due Friday, February 5th by 5pm.

Name \_\_\_\_\_ ID \_\_\_\_\_

Section [AA] (Natalie), [AB] (Natalie), [AC] (Ryan), [AD] (Ryan), [AE] (Kelly), [AE] (Kelly)

**Problem 1** Suppose you flip a fair coin 20 times.

**a)** Use the Excel spreadsheet table B (or table B cumulative) to find the probability of obtaining 13 or more heads.

**b)** Use R's function 'binom.test' to find the same answer. Hint: there are lots of examples in the binomial distribution tutorial. You can just write the proper command below

**c)** Use the normal approximation to find the mean and standard deviation of the number of heads you'd expect from 20 coin flips.

**d)** What is the probability of obtaining 13 or more heads out of 20 flips based on this normal approximation? (hint: use table A to find  $\Pr(X > 12.5)$ ). Do you get a similar key as for problem 1a?

**Problem 2** Suppose the probability of funding for any grant that you send to NIH is 10%. To increase the probability of getting funded, you submit 5 separate grant proposals. What is the probability that at least 1 will get funded? You can either use the table or R.

**Problem 3** Suppose the population body mass index (BMI) for U.S. men has a mean of  $\mu_x = 24$  and a standard deviation of  $\sigma_x = 2.25$ . Suppose also that this population is normally distributed.

**a)** What is the probability that a **single sample** will be greater than 24.5?

**b)** Consider what happens when you take 100 samples from this distribution and calculate the mean. This mean is sampled from its own distribution - the 'sampling distribution of the mean'. What is the approximate shape of this sampling distribution of the mean?

c) What is the expected mean of this sampling distribution of the mean ( $\mu_{\bar{x}}$ )?

d) What is the expected standard deviation of this sampling distribution ( $\sigma_{\bar{x}}$ )?

e) What is the probability that a mean of 100 samples will be greater than 24.5?

f) Why is the answer to part (a) bigger than for part (e)?

g) Answer problems a-d for a sample size of 25 (instead of 100).

h) Why is it more likely for the mean to exceed 24.5 for a sample size of 25 than for a sample size of 100?

**Problem 4** Suppose a professor gives a multiple choice exam. The exam has 30 problems each with 5 possible choices. Suppose also that the professor accidentally gives the exam in the Hungarian language and nobody in the class speaks Hungarian. The students guess randomly on each problem.

a) What is the probability that a given student will get 8 or more problems correct? (Hint: use the normal approximation to the binomial)

b) Suppose that the mean score for the 50 students in the class is 6.75 correct answers. If the students are guessing, what is the probability that the class will get a mean of 6.75 or higher?

c) Do you think the students were really guessing? Why or why not?