Janine Yanes - Stat 490, HW 1

1.
    a. The experimental factor is the brand of soy sauce: the control is the existing (original) brand and the treatment is the new, more expensive brand.
    b. The experimental units are the 50 individuals being fed fried rice.
    c. An appropriate outcome variable would be the individuals' satisfaction with the fried rice. This could be measured by asking the individuals to rate the rice on a scale of 1 to 10 (10 being completely satisfied and 1 being completely unsatisfied).
    d. Yes, SUTVA is reasonable in this experiment: there is only one form of the active treatment and one form of the control treatment for each unit, and interference between units can be removed/limited.
    On that note, I would make the units individual people (rather than groups), since eating with other people could affect/distract from the experience of eating the rice, therefore affecting the units' satisfaction.
    e. To avoid possible SUTVA violations, the individuals being fed should be isolated, since one person's opinion on/reaction to the food could influence others. Furthermore, everyone eating from the same portion should be served at roughly the same time. Otherwise, there could be a difference in freshness between servings, causing multiple forms for the treatments (e.g. "fresh" and "less fresh").

2.
    a. 4 factors are now under consideration: soy sauce brand (qualitative), rice brand (qualitative), soy sauce amount (quantitative), and rice-to-water ratio (quantitative).
    b. The factors "soy sauce brand" and "rice brand" both have two levels: "existing brand" (0) and "new brand" (1). I would make the quantitative (other) factors have 3 levels: their original value, a lesser amount, and a greater amount. That way, we could know what kind of change is needed (if any) to improve satisfaction, a decrease or increase.
    For example, levels that could be chosen are 0.25, 0.5, and 0.75 for the soy sauce amount and 1:3, 1:2, and 1:1 for the rice-to-water ratio. A less extreme range could lead to an indistinguishable difference between levels, while a greater increase/decrease could be too drastic, resulting in a decrease in satisfaction even though a more moderate change could have led to an increase (not to mention that too much or too little water when cooking rice could lead to it being undercooked or overcooked).

c. The potential outcome for unit i would be written as $Y_i(F_1, F_2, F_3, F_4)$, with F_1 being a binary indicator of soy sauce brand, F_2 being a binary indicate of rice brand, F_3 being the soy sauce amount, and F_4 being the rice-to-water ratio. For example, with the levels proposed in part b), $Y_i(0, 0, 0.5, 1{:}2)$ would be the outcome for the unit i that was given the original (control) levels for all of the factors. The rice-to-water ratio could also be written as a number for greater consistency (1:2 → 0.333).

3.

a. The experimental units are the 20 individuals typing the manuscript.
b. A natural estimand would be the average treatment effect (the difference between the mean typing speed of those with keyboard *A* and the mean typing speed of those with keyboard *B*).
   Since the participants will only type the manuscript once, we assume that they will only use one keyboard. Therefore, we would be unable to use alternative estimands such as the median treatment effect, since that would require each participant to use both keyboards in order to find the treatment effect (difference in speed between keyboards) for each unit.
c. There is no clear reason for one keyboard to be assigned more units, so each keyboard should be assigned the same amount (10 people).
   i. I would use completely randomized assignment: units are randomly allocated to either use keyboard *A* or *B*, with 10 people for each keyboard. Based on the given information, the participants are roughly identical, so any difference in outcome between groups should be due to the keyboards.
   ii. I would randomly allocate 5 people from each sex to either use keyboard *A* or *B*. Complete randomization should be avoided: if all units of one sex were assigned to the same group, we wouldn't know if any difference in outcome between groups was due to the keyboards or due to sex.
   iii. According to the table, the average typing speed is 25 WPM for females and 25.1 for males. Since there is no significant difference in typing speed between sexes, there is no need to consider sex while assigning units. However, there is a significant range of typing speeds, with the slowest unit (individual 18) having half the WPM of the fastest (individual 2). Complete randomization could assign all of the fastest typers to one keyboard; if the average WPM was higher for that group, we would be unable to say it was solely due to the keyboard. Therefore, I would randomly assign the units in pairs: the fastest typer would be paired with the slowest, the second-fastest with the second-slowest, and so on. Then, the pairs would be randomly allocated (5 pairs for each keyboard). This ensures a fairly equal typing speed between groups.

d. Randomly assign 10 units to use keyboard *A*, the rest use keyboard *B*
   i. 10 people to *A* → ${}_{20}C_{10}$ = 184756 possible randomizations
   ii. 5 from each sex to *A* → ${}_{10}C_5$ * ${}_{10}C_5$ = 63504 possible randomizations
   iii. 5 pairs to *A* → ${}_{10}C_5$ = 252 possible randomizations