Math 150, Spring 2023
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WU # 14
Tuesday, 3/21/23

Your Name: _____

Names of people you worked with: _____

Task: Consider an experiment where the goal is to understand the melt rate of a chocolate chip as a function of time. That is, at a particular time t, what proportion of chocolate chips will have melted?

$$\begin{aligned} S(t) &= P(T > t) = \text{ probability of surviving until after time } t \\ \hat{S}(t)_E &= m(t)/n = \text{ proportion alive at time } t \\ \hat{S}(45)_E &= \frac{\text{number of chips that have not melted after 45 seconds}}{\text{total number of chips in the sample}} \end{aligned}$$

The data you collect is the following. Note that the "+" indicates a censored observation. That is, you know the chip was unmelted at the time, but you have since lost track of the observational unit.

Student	1	2	3	4	5	6	7
Time	35^+	30	60^+	45	25	55	30^+

At $t = 45$ seconds, calculate the proportion of chips which are still unmelted using the following strategies:

1. Assume that the censoring is the same as melted. Find $\hat{S}(t)_E$.
2. Why does your estimate of $S(t)$ seem wrong?
3. Assume that the censored observations contain no information and remove them. Find $\hat{S}(t)_E$.
4. Why does your estimate of $S(t)$ seem wrong?

Solution:

1. Assume that the censoring is the same as melted. Find $\hat{S}(t)_E$.

$$\hat{S}(t)_E = \hat{S}(45)_E = \frac{2}{7} = 0.286$$

2. Why does your estimate of $S(t)$ seem wrong?

   Because we know that the first chip was unmelted at 35 seconds, so maybe it was also unmelted at 45 seconds! We aren't using all of the information we have. $\hat{S}(t)_E$ will under-estimate $S(t)$.

3. Assume that the censored observations contain no information and remove them. Find $\hat{S}(t)_E$.

$$\hat{S}(t)_E = \hat{S}(45)_E = \frac{1}{4} = 0.25$$

4. Why does your estimate of $S(t)$ seem wrong?

   Because we know that the 3rd chip was unmelted at 60 seconds, so it was definitely unmelted at 45 seconds! We aren't using all of the information we have. $\hat{S}(t)_E$ will have lower power to estimate $S(t)$.