WARNING- THIS HW IS TWO PAGES.

1. (0 points) What is your name? Write it clearly. Staple your HW. When is the first midterm? When is the final? IF YOU CAN"T MAKE THE FIRST MIDTERM (which is at night) LET ME KNOW BY Feb 10 SO WE CAN MAKE OTHER ARRANGEMENTS.

2. (60 points) For this problem a cake is $[0, 1]$ and a valuation is the area under a piecewise constant function. For example, Alice's valuation might be

   Let $f(x)$ be the following function ($f$ is NOT the valuation but will be used to define it).

$$f(x) = \begin{cases} 1/4 & \text{if } 0 \leq x \leq 2/3 \\ 15/6 & \text{if } 2/3 < x \leq 1 \end{cases} \tag{1}$$

$$V(a, b) = \int_a^b f(x)dx$$

   (Do not let the $\int_a^b$ scare you. This is just the area under the function $f(x)$ between $a$ and $b$ which is easy to figure out since $f$ is piecewise constant.)

   For the first two parts of this problem assume that Alice and Bob do Cut and Choose with Alice doing the cutting. A *scenario* is a valuation for Alice and a valuation for Bob.

   (a) Give a scenario where if Alice does Cut and Choose honestly Bob gets at least 3/4. (Alice will, of course, get 1/2.) Draw the functions and shade in what Alice gets and what Bob gets.

   (b) Give a scenario where, if Alice knows Bob's tastes, she can cut in such a way that she gets at least 3/4 and Bob gets $\leq .51$ (a little more than .5). Draw the functions and shade in what Alice gets and what Bob gets.

   (c) Give a scenario where the equitable cut-and-choose protocol, with $\epsilon = \frac{1}{10}$, ends up with both Alice and Bob having at least $\frac{3}{4}$.

   THERE IS A PROBLEM ON THE NEXT PAGE

3. (40 points) Assume that Alice, Bob, and Carol value goods as follows:

| Item | Alice | Bob | Carol |
|---|---|---|---|
| PICASSO | 20 | 40 | 30 |
| CAR | 20 | 30 | 30 |
| HOUSE | 20 | 20 | 30 |
| MILLION | 20 | 10 | 5 |
| ISLAND | 20 | 0 | 5 |

(a) Execute the 3-player AW protocol. State clearly who gets what in the end.

(b) How much does Alice think Bob has?

(c) How much does Alice think Carol has?

(d) How much does Bob think Alice has?

(e) How much does Bob think Carol has?

(f) How much does Carol think Alice has?

(g) How much does Carol think Bob has?

(h) Is the division Envy Free?