1. Elena and Kaz are going to share a frozen hoagie. There are four components in the frozen hoagie - the ice cream flavors are mint chip and vanilla, the cookie flavors are fudge brownie and snickerdoodle. Elena (E) and Kaz (K) have the following values for the components:

<table>
<thead>
<tr>
<th></th>
<th>Mint</th>
<th>Van</th>
<th>Fudge</th>
<th>Snick</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>.3</td>
<td>.1</td>
<td>.1</td>
<td>.5</td>
</tr>
<tr>
<td>K</td>
<td>.2</td>
<td>.2</td>
<td>.5</td>
<td>.1</td>
</tr>
</tbody>
</table>

(a) Compute the E to K valuation ratios and fill them out in the table above. (4 pts)

(b) Circle which of the cuts below is a threshold division. Note that S_E goes to E and S_K goes to K, and same for T_E, T_K. In the space below right, you should draw and label the graph we discussed in class to justify your answer for partial credit. (3 pts)

The S_ES_K-cut on the left is NOT a threshold division. The T_ET_K-cut on the right is indeed a threshold division.

For the cut on the left (the S_ES_K-cut): to have a threshold division, giving all the Snickerdoodle to Kaz would force everything to the right of a threshold line at R ≥ 5 to be given to Kaz, but this is not the case! For example, Vanilla is given to Elena. By the same logic, giving Vanilla to Elena forces a threshold of R ≤ 1/2, and that all of the Snickerdoodle and Mint Chip must be given to Elena. Since that did NOT happen in this S_ES_K-cut, we conclude the cut is NOT a threshold cut.

For the cut on the right (the T_ET_K-cut): Splitting the Mint Chip between E and K forces a threshold line to appear exactly at R = 3/2, passing over the Mint. Then everything to the right goes to Kaz: that's the Vanilla and Fudge Brownie. And everything on the left must go to Elena, which is just the Snickerdoodle. Since that is exactly what the T_ET_K-cut does, we conclude that the cut is a threshold division.

2. Choose and prove ONE of the following claims: (3 pts)

(a) A pareto-optimal, equitable division is fair.

(b) Suppose there are N = 4 players dividing a cake. If a division is unfair to one player, then that player has envy.
(a) Ch 16 sols
(b) Ch 16 sols see day 2 (page 2)