1. The COMP3208 students vote on which restaurants rank highest on tripadvisor (note this is from the 2014/15 cohort, so the rankings are slightly different to the ones used in class):

Cowherds > Crown > Stile > Kohinoor
Cowherds > Crown > Stile > Kohinoor
Cowherds > Crown > Stile > Kohinoor
Kohinoor > Cowherds > Stile > Crown
Kohinoor > Cowherds > Stile > Crown
Kohinoor > Crown > Stile > Cowherds
Kohinoor > Crown > Stile > Cowherds
Crown > Cowherds > Stile > Kohinoor
Crown > Stile > Cowherds > Kohinoor
Kohinoor > Cowherds > Crown > Stile
Stile > Cowherds > Crown > Kohinoor
Stile > Crown > Cowherds > Kohinoor

Work out the aggregated ranking using each of the following voting rules:

(a) Majority
(b) Copeland
(c) Borda

2. Three students, Alice, Bob and Charlie, want to decide on what take-away dinner to order and decide to vote. They submit their preferences as votes:

<table>
<thead>
<tr>
<th>Student</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alice</td>
<td>Indian &gt; Chinese &gt; Pizza</td>
</tr>
<tr>
<td>Bob</td>
<td>Chinese &gt; Pizza &gt; Indian</td>
</tr>
<tr>
<td>Charlie</td>
<td>Pizza &gt; Indian &gt; Chinese</td>
</tr>
</tbody>
</table>

(a) Is there a Condorcet winner? Explain your answer.
(b) Alice, Bob and Charlie consider using each of the voting rules from Question 1, but realise there is a problem. What is that problem?
(c) To get around this problem, Alice proposes a new voting system: a sequential tournament. First, the students use a majority vote to decide between Pizza or Chinese. Then, a second vote is taken to decide between the winner (Pizza or Chinese) and Indian. What meal do the students choose now?
(d) What is the problem with the proposed tournament procedure above?
3. Consider the following rankings:

\[ A \succ B \succ C \succ D \succ E \]
\[ E \succ B \succ A \succ C \succ D \]

(a) What are the Spearman's Footrule and Kendall-tau distances between these two rankings?

(b) Give a ranking that maximises the Kendall-tau distance to the first ranking.

4. The undergraduate students of Southampton are asked to rank their favourite locations in the city. These are the results:

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>42%</td>
<td>Common (\succ) Highfield Campus (\succ) Portswood (\succ) Bedford Place</td>
</tr>
<tr>
<td>26%</td>
<td>Highfield Campus (\succ) Portswood (\succ) Bedford Place (\succ) Common</td>
</tr>
<tr>
<td>15%</td>
<td>Portswood (\succ) Bedford Place (\succ) Highfield Campus (\succ) Common</td>
</tr>
<tr>
<td>17%</td>
<td>Bedford Place (\succ) Portswood (\succ) Highfield Campus (\succ) Common</td>
</tr>
</tbody>
</table>

(a) Is there a Condorcet winner?

(b) What is the aggregated ranking using Copeland?

(c) What is the aggregated ranking using Borda?

5. Consider the following votes:

\[ A \succ B \succ C \]
\[ A \succ B \succ C \]
\[ C \succ B \succ A \]
\[ C \succ B \succ A \]
\[ B \succ A \succ C \]

(a) What are the solutions for Footrule optimal, and for the Kemeny rule?

(b) Are these two voting rules Condorcet consistent?