slide 1
### Housekeeping

**Contact details**

<table>
<thead>
<tr>
<th>Name</th>
<th>Office</th>
<th>Email</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steffen Klaere</td>
<td>303.219</td>
<td>s.klaere</td>
<td>10:00–12:00, Thu</td>
</tr>
<tr>
<td>Alan Lee</td>
<td>303.265</td>
<td>aj.lee</td>
<td>10:30–12:00, Tue–Thu</td>
</tr>
</tbody>
</table>

**Class representatives**

<table>
<thead>
<tr>
<th>Name</th>
<th>Course</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wanshan (Serena) Liang</td>
<td>330</td>
<td>wlia884</td>
</tr>
<tr>
<td>Jun Ma</td>
<td>762</td>
<td>jma077</td>
</tr>
</tbody>
</table>

- Assignment 1 is due August 7
- Lecturer evaluation before mid-semester break
Coplots: syntax

\[
\text{plot}(y \sim x|z \ast w)
\]

- \text{plot} is the plot type, either \text{xyplot}, \text{dotplot} or \text{bwplot}
- \text{x} and \text{y} are the relationship variables
- \text{z} and \text{w} are the \text{conditioning variables, optional.}
Suppose we have two conditioning variables, \( Z \) and \( W \).

- No problem if both are categorical.
- If one or both are continuous variables, we turn them into categorical variables by using subranges, e.g.,
  - Turn ages into 10 year age groups
  - Turn marks into grades
In each of the 8 cells of the table, we can draw a graph that illustrates the relationship between $x$ and $y$ for individuals having that age and gender.

Type of graph will depend on variable type of $x$ and $y$

<table>
<thead>
<tr>
<th>Both continuous</th>
<th>scatterplot</th>
</tr>
</thead>
<tbody>
<tr>
<td>One continuous</td>
<td>boxplots, dotplots, etc</td>
</tr>
<tr>
<td>Both categorical</td>
<td>mosaic plots</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-17</td>
<td></td>
</tr>
<tr>
<td>18-24</td>
<td></td>
</tr>
<tr>
<td>25-49</td>
<td></td>
</tr>
<tr>
<td>50+</td>
<td></td>
</tr>
</tbody>
</table>
x and y continuous: xyplot
x categorical, y continuous: dotplot

dotplot(y ~ x | gender * age)
$x$ categorical, $y$ continuous: bwplot
$x$ categorical, $y$ categorical: mosaicplot
x categorical, y categorical: mosaicplot
In summary

- The conditioning variables determine the layout of the cells
- The $x/y$ variables determine the kind of graph to draw in each cell
In a study on athletes at the Australian Institute of Sport, various physical measurements were made.

In this example we look at the relationship between body fat and BMI, and how it differs between athletes of either gender playing different sports.

\[
\text{BMI} = \frac{\text{weight (kg)}}{(\text{height (m)})^2}
\]
Body fat vs. BMI conditioned on Gender and Sport
In a study of engine emissions, a test engine was run under different conditions and the amount of nitrogen oxide (NOx) emitted was measured.

The conditions involved different settings of the compression ratio \( C \), and the equivalence ratio, \( E \), (related to fuel/air mixture).
E vs. NOx given C

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E vs. NOx given C

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In an experiment to test the strength of different yarns, lengths of yarn are repeatedly stressed until they break (cycles to failure). It is desired to see how this variable is related to the length of the yarn samples, the amplitude and the load (two variables related to the amount of stress). The experiment involved using 3 amplitudes, 3 lengths and 3 loads, for a total of $27 = 3 \times 3 \times 3$ different experimental conditions. (Coursebook p.9)
Testing procedure

Cycles to failure: number of pushes before yarn breaks.

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Yarn length vs. yarn cycles

Yarn length vs. yarn cycles
Conclusions

- For longer lengths, the cycles to failure are higher. (less likely to break)
- High loads reduce the cycles to failure. (more likely to break)
- High amplitudes reduce the cycles to failure. (more likely to break)
- Most likely to break when load and amplitude are high and length is low.