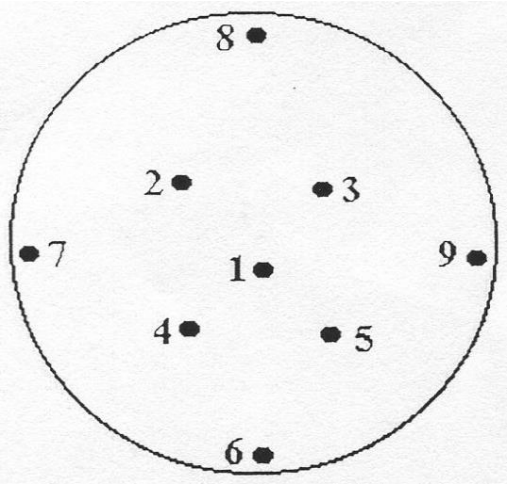
Hand-in date: April 15, 2014

Assignment #1: Thickness measure of wafers

Objective: As part of quality control, one silicon wafer was sampled from each tray of wafers after a CVD (chemical vapor deposition) step of semiconductor manufacturing. Successive samples from 184 trays were taken and the thickness of a layer was measured at 9 locations on the wafer. These locations, illustrated in the figure (right), were consistently used for each wafer in every tray. One desires to have wafers with uniform and constant thickness within a given specification.



Use the data set "wafer.xls" with the nine thickness measurements made on 184 wafers manufactured.

You shall answer the following: Make a PCA of this table to find out

- **a.** How many components there are in the data, and the presence of outliers, etc?
- **b.** After removing outliers, can one interpret the first two most important components?
- **c.** Are there any clear groups? Can they be interpreted?
- **d.** Do you see any trends? And can you interpret them?
- **e.** Can you explain the large variability of the first component t1, i.e. the average thickness?

General Hints

1. Build a PCA model using all observations. Use autofit.
2. Pinpoint some outliers in the data and identify why they are outliers. Exclude these outliers and rebuild the model.
3. What % of the total variation is explained by the first PC? - by the second and the third?
4. Make a bar plot of the first loading vector (p_1) and explain what this tells you about the nature of the variation in the first PC score (t_1). Plot this first PC (t_1) vs. time order (NUM vs t_1). Does it show any unusual behavior?
5. Redo question 4 for the second PC.
6. Based on your PCA model, can you suggest where you might start to try to reduce variability in this manufacturing process?