INGA LÖSNINGAR ERHÅLLNA!

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Examination in Statistical Image Analysis, May 28, 2014

Course code Chalmers: TMS016, Gothenburg University: MSA300

Written examination May 28, 2014, 8.30–12.30.

Literature and notes may be brought for this written examination. Neither pocket calculators, nor computers are allowed at this examination. In the written examination there are two pages and two problems. You are supposed to answer both problems, and in the judgement they have the same weight. Answers may be given in English or Swedish.

Problem 1.

Figure 1 shows four images of parts of cow hides (cow skins) with scratches and veins. Scratches imply that a hide has a decreased value, while veins, which are blood vessels, are natural parts of the hides. One wishes to find an image analysis method that can discriminate between scratches and veins.

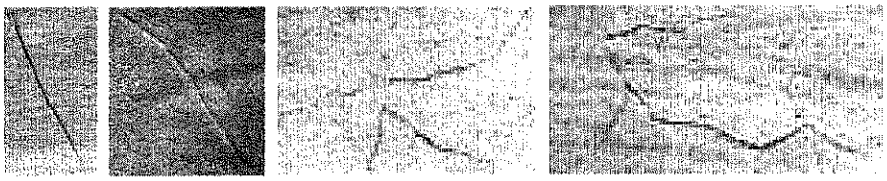

Figure 1: Four images af parts of cow hides showing scratches (the two images to the left) and veins (the two images to the right).

a) Describe a method that can identify structures that consist of either scratches or veins in images such as those shown in Figure 1.

b) Suppose that you have a set of 50 images of scratches and 50 images of veins similar to those shown in Figure 1. Suggest a set of suitable features that might be useful in discriminating between scratches and veins. Suggest also a statistical model for the joint distribution of a set of such features for the dataset.

c) Describe how you could select a suitable optimal subset of features for discriminating between scratches and veins using the dataset described in **b)**.

Problem 2.

Figure 2 shows results from an experiment with $16 \times 24 = 384$ colonies of yeast mutants grown under normal conditions (left) and in a nutrition solution with arsenic added (right). It is the same mutant grown in corresponding positions on both plates, for instance in the top left spot in both images. The object is to compare spot areas of corresponding colonies.

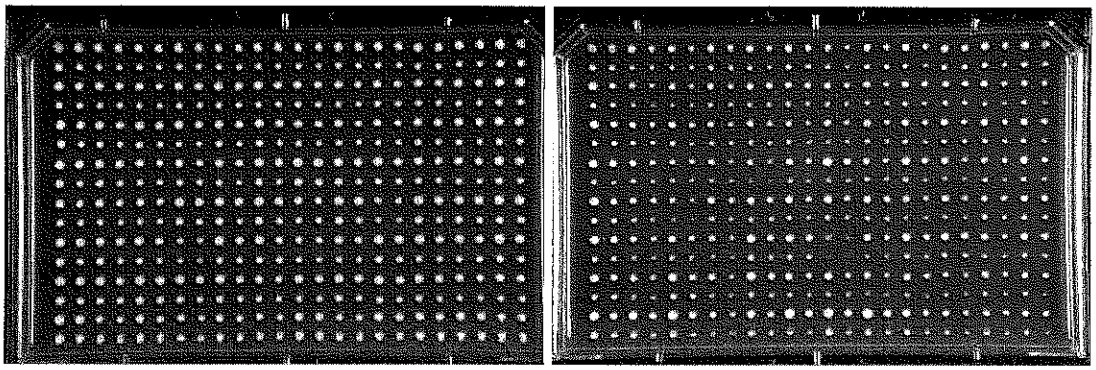

Figure 2: Images of two plates showing size of yeast colonies grown under normal conditions (left) and with arsenic added (right).

a) Suggest a method for computing the spot area of the 384 yeast colonies in each plate.

b) There are actually 96 different mutants studied in this experiment and each mutant is grown in a group of four positions in the following way: It is the same mutant in
row 1, column 1; row 1, column 2; row 2, column 1; row 2, column 2
and similarly in
row 1, column 3; row 1, column 4; row 2, column 3; row 2, column 4
and so on.

Further, in each group of four colonies for the same mutant the concentration decreases in the order shown above. (Check for yourself by looking at the images that this seems reasonable.) How it decreases is not precisely known, but it can be assumed that it is the same start amount (before growth) for the colonies in corresponding positions in the two plates.

Suggest a suitable statistical model (or several models) for estimating the effect of arsenic on the growth of each of the 96 mutants. Assume that the growth of each colony is described by the corresponding spot area.