1.0 Comparing Distributions

After several assignments computing routine values from maps, we are at last ready to take on an analytical task. To save you time, I have downloaded from the FEMA web site the DFIRM (Digital Flood Insurance Risk Map) file for the Goleta quad. From this map, I have selected only the 100 year and 200 year flood risk zones, shown as lighter and heavy red lines on the map. In the background is the old edition of the Goleta quad.
for reference, and not that I have included a 500 meter grid, but on NAD83 and UTM. Your mission, should you choose to accept it, is to answer this question:

Are schools in the Goleta area at risk for flooding?

## 2.0 Getting Started

Unlike in the previous assignments, there will be very little in terms of direct guidance here. I do suggest that you review Chapter 12 in the textbook, and the notes for the lecture on “Applications of Feature Measurements.” I will at least mention the steps to take, and give a few hints. Write your answers on a separate sheet of paper. You will find that neatness really pays off when doing these sorts of calculations, so be neat!

### 2.1 Select Your Quadrats

The 500m grid is convenient, but may be too coarse or fine for the task. You should think carefully about:

- How much area to include in your map. I suggest a rectangle or square.
- What size cell to use. Note that you could use groups of 4 cells for 1km-square, 16 for 2km-square etc.

### 2.2 Locate the schools

The version of the Goleta quad on the map is out of date. Your own copy of the quad shows the schools pretty well. Note that it is on a different projection and grid! Perhaps there is a better source of information about schools, such as a phone book. Anyway, what is a school? Is UCSB a school?

### 2.3 Do the counts

The example in class used high/low or binary maps. One layer is easy, how many schools are in each cell. Or you could label the cells school/no school. The flood risk map is a bit more complex. What level of flood risk should you use? Code the cells with at risk/not at risk. Your result should be two maps like in figure 12.10 on page 192 of your text. Next step is to combine.

### 2.4 Combine and Unravel the Map into Quadrats

Now you can go cell by cell combining the two maps. Label the cells, and count them off into four classes, as in the following table. Probably no need for the intermediate table (like Table 12.7 on page 193) but it may help to keep your numbers accurate.
In the cells, fill in the numbers of quadrats in that class combination from your study area. Now you are ready to test the hypothesis, that is, answer the question:

Are schools in the Goleta area at risk for flooding?

2.5 Chi-squared

To help compute chi-squared, make another table just like the one for observed frequencies. This one, however, is for expected frequencies. Study how to compute these on page 192 of the text, or review my lecture slides. Hint: You need the quadrat totals to work these out.

When you have calculated Chi-squared, look up its value (you have three degrees of freedom for a 2 x 2 table). Is your value of chi-squared significant enough to answer the question? Hint, the NULL hypothesis is that there is no relation between the distribution of schools and flood risk. A large chi-squared allows you to REJECT this, and ACCEPT the ALTERNATIVE hypothesis.

2.6 Yule’s Q

Going back to your first 2 x 2, you will find Q much easier to calculate. What does it say about the question? Does its assertion agree with the conclusion from Chi-squared?

3.0 The Payoff

Well, what is your answer to the question? Can Goleta’s parents sleep soundly in their beds, knowing their schools are safe?

Are you confident in your answer? What could you have done differently to improve the result?
Table of Chi-squared values

<table>
<thead>
<tr>
<th>χ²</th>
<th>0.995</th>
<th>0.990</th>
<th>0.975</th>
<th>0.950</th>
<th>0.900</th>
<th>0.800</th>
<th>0.500</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.832</td>
<td>0.710</td>
<td>0.692</td>
<td>0.700</td>
<td>0.738</td>
<td>0.765</td>
<td>0.832</td>
</tr>
<tr>
<td>2</td>
<td>0.975</td>
<td>0.872</td>
<td>0.831</td>
<td>0.866</td>
<td>0.900</td>
<td>0.941</td>
<td>0.975</td>
</tr>
<tr>
<td>3</td>
<td>0.991</td>
<td>0.892</td>
<td>0.846</td>
<td>0.869</td>
<td>0.894</td>
<td>0.920</td>
<td>0.991</td>
</tr>
<tr>
<td>4</td>
<td>0.994</td>
<td>0.906</td>
<td>0.857</td>
<td>0.870</td>
<td>0.885</td>
<td>0.900</td>
<td>0.994</td>
</tr>
<tr>
<td>5</td>
<td>0.996</td>
<td>0.911</td>
<td>0.860</td>
<td>0.872</td>
<td>0.887</td>
<td>0.899</td>
<td>0.996</td>
</tr>
<tr>
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<td>0.913</td>
<td>0.861</td>
<td>0.873</td>
<td>0.887</td>
<td>0.900</td>
<td>0.997</td>
</tr>
<tr>
<td>7</td>
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<td>0.914</td>
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</tbody>
</table>