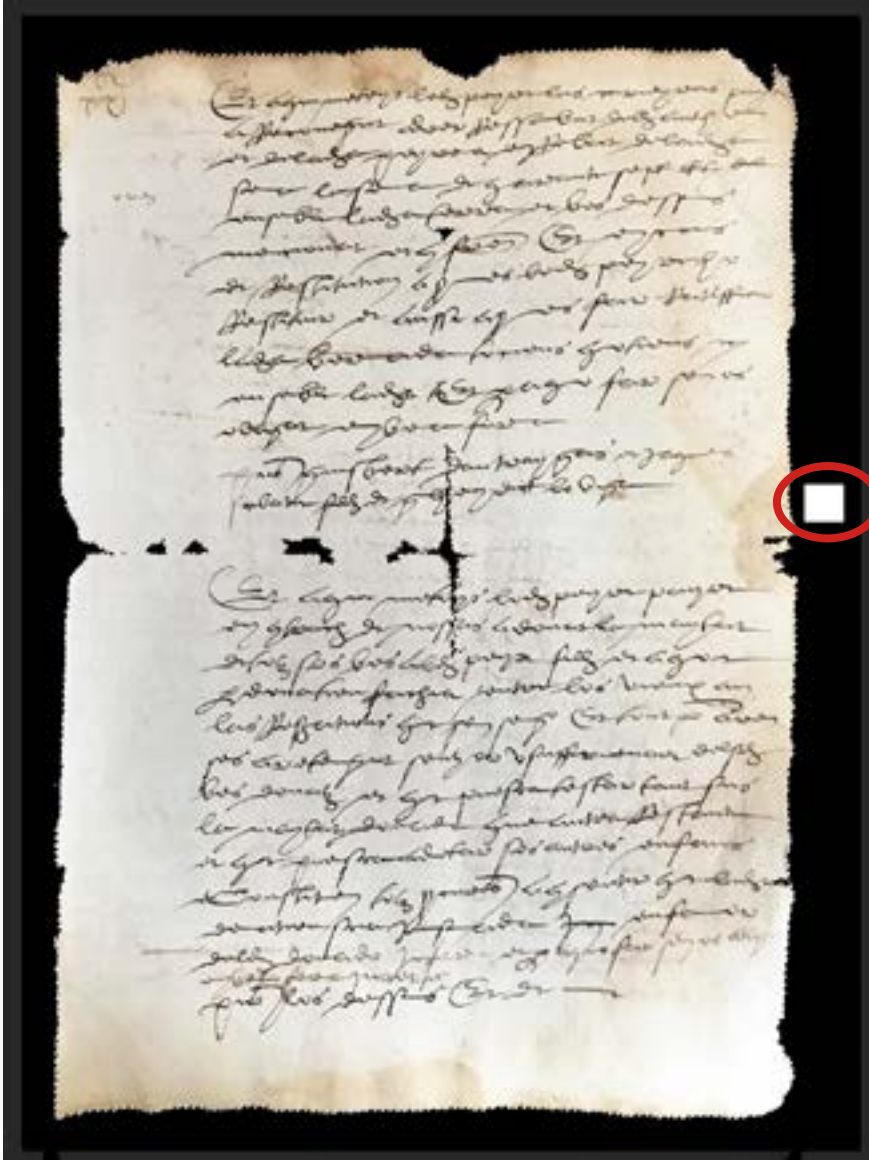


Determinate Hand Papermaking

IV

Calculating the Square Centimeters of an Irregular Sheet



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Calculate sq. cm.

To find the weight (gsm) of a document, we must first determine its size in square centimeters (sq cm). If the document is irregular, with holes and missing parts, discovering the sq cm can be challenging for even the most dedicated mathematician. This Photoshop technique greatly simplifies the process.

The steps:

1. With a digital camera or smartphone, photograph the document on a black background; be sure to include a 1 cm square piece of white paper in the border. (See example at right)



2. Open the photo in Photoshop.

3. Select the document: use the **Magic Wand** tool to select the black area surrounding the document and any black showing through holes in the document.*



Next, add to the selection the 1 cm white square using the **Marquee** tool. (To do this, hold down the Shift key while you drag a square around the 1 cm white square.)

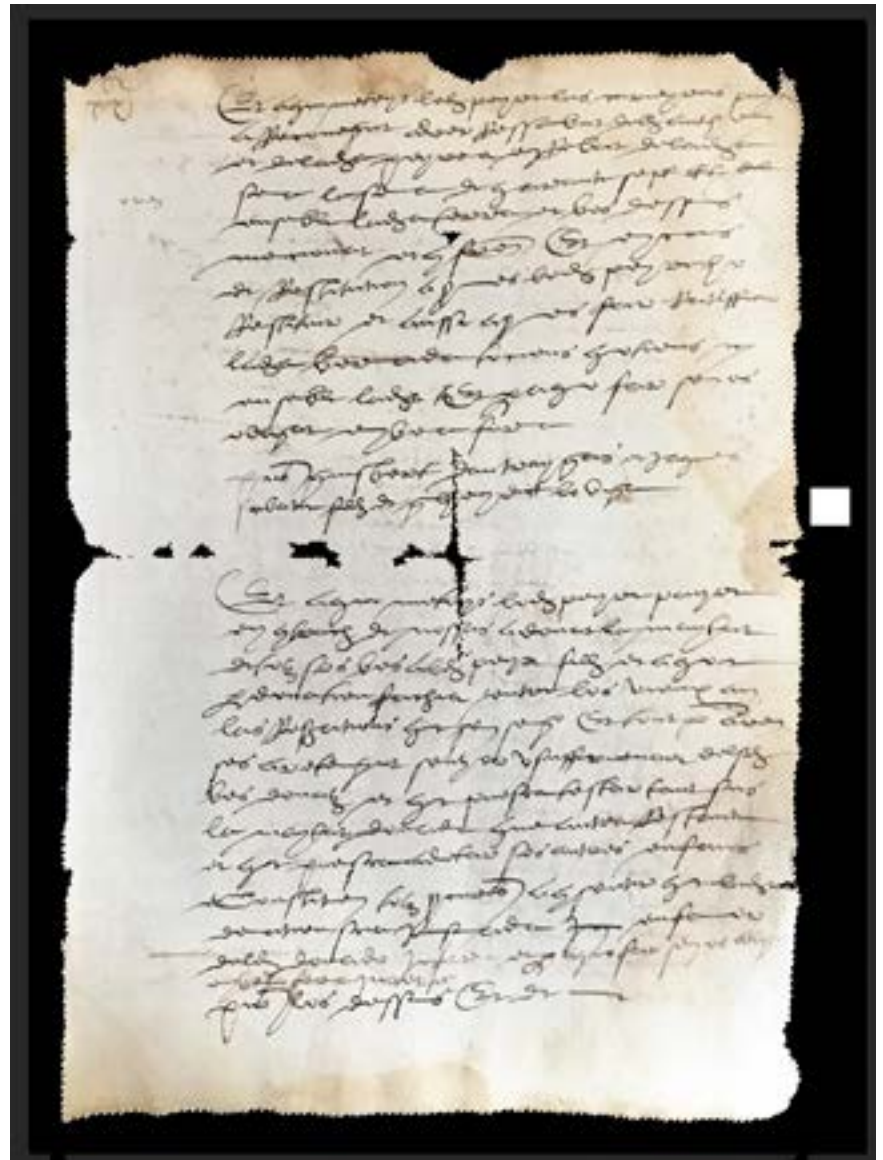


4. From the main menu, choose **Selection/Inverse** to invert the selection so that only the document is selected.

At this point, a marquee (“marching ants”) should be moving around the perimeter of the document – holes and all.

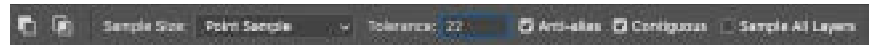
5. Next, open the **Histogram** palette (from the main menu, choose “**Window**” and note if there is a check mark before

Finding the square centimeters of an irregular sheet



iPhone 7 photograph of a document on a black background with a 1 cm square piece of white paper in the border. Note marching ants (marquee) dots around the document but not the 1 cm square (Step 3).

*Magic Wand Palette Settings:

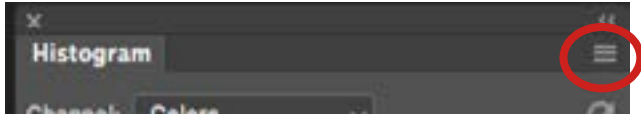




Photoshop’s Magic Wand selects pixels based on tone and color. With Anti-alias and Contiguous checked, choose a tolerance that selects all the black while not selecting into the document. Increasing or lowering the tolerance will make the wand choose a larger or smaller range of values. Click areas while holding down the Shift key to add to a selection; click areas while holding down the Option key to remove from a selection. Command+D deselects all. Alternately, if the black is sufficiently different than anything in the document, uncheck Contiguous and all blacks will be selected with one click.

Histogram; if not, click on **Histogram** and the Histogram palette window will appear).



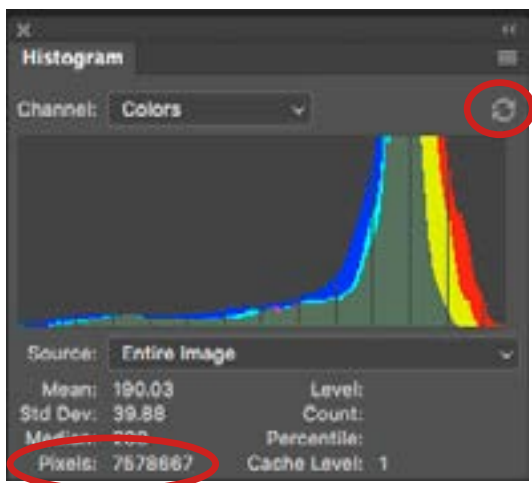
6. Click the pull-down menu of the Histogram palette and click on Show Statistics, expanding the palette.



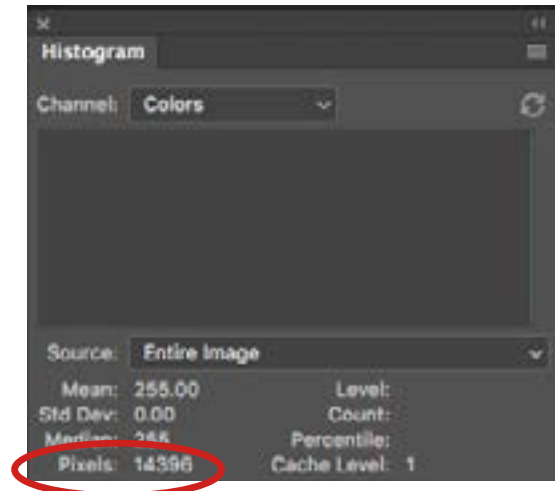
7. If an exclamation mark is visible in the upper right hand corner of the **Histogram** window,  this indicates that the pixel count is not accurate and the **Refresh** button  must be clicked to get an accurate pixel count. This step is critical.



Take notice and write down the accurate pixel count; in this case, pixels = 7,578,667 (below):



8. Next, deselect the document (Control+D on Windows or Command+D on a Mac). Now select the 1 cm square using the **Marquee** tool or the **Magic Wand** tool and note the pixel count:



In this case, the 1cm white square = 14,396 pixels.

9. Divide the number of document pixels by the number of pixels in the white sq cm to find sq cm for the document.

In this example:

Document pixels to sq cm calculation:

$$7,578,667 \div 14,396 = 526.66 \text{ sq cm}$$

Now we have the square centimeters of the document. For the formula we also need to measure the mass of the document. For this I use a balance beam. The mass of the document is 3.1 grams.

Now the accurate weight (gsm) can be discovered:



$$(\text{mass} \div \text{area} \times 10,000 = \text{gsm})$$

$$3.1 \text{ g} \div 526.66 \text{ sq cm} \times 10,000 = 58.86 \text{ gsm}$$

Series links:

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- No. III: [Calculating paper weight with a smartphone app](#)
- No. IV: [Finding the surface area of an irregular sheet](#)
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