



# 2-D Measurement Tools

The 2D sampling options in Measure allow users to derive measurements from interactively defined rectilinear or elliptical regions or from objects that exist on a specific slice. Measurement options available include spatial context measurements as well as signal value measurements, including Max/Min, mean, standard deviation, area, volume, 2D shape characteristics and more.

2D measurements include measurements tools that can be used with or without object maps, these include; rectangular region of interest sampling, oval region of interest sampling, free trace region of interest sampling, and entire image sampling. The remaining three 2-D sampling options can only be used with an object map, these are; selected regions, selected object, and enabled object.

The 2-D tab provides access to the following measurement tools:

- Sample 2-D Rectangle
- Sample 2-D Oval
- Sample 2-D Closed Trace
- Selected Region
- Selected Object
- Enabled Object
- Entire Image

## Sample 2-D Rectangle

The Sample 2-D Rectangle tool enables the drawing of a rectangle on the displayed image to define a region. To define a rectangular region left click on the image and then drag the cursor until the desired size and shape rectangle has been define. The following sampling options are available.

**Sample Options:** Provides users with access to the following 2-D Rectangle sampling options:

- **Name:** Allows users to assign a name to the selected rectangle when reported to the log file.
- **Persistent:** When selected prevents previously defined rectangles for being cleared from the image.
- **Clear:** Clears all rectangles from the image.

**Stats to View:** The stats to view area allows users to enable and disable measurements and information reported to the stats log.



## Sample 2-D Rectangle Options (continued)

### Stats to View (continued):

- **General:** Allows users to report general image data parameters in the stats log file. See General under Sample Point(s) > Stats to View for a full description of available options.
- **DICOM Info:** Allows users to report DICOM tag information if the data is in the DICOM format. See DICOM Info under Sample Point(s) > Stats to View above for a full description.
- **Size Intensity:** Allows users to report an array of size intensity information and measurements. The following options are available:
  - **Orient:** Reports the orientation the region was defined in.
  - **Name:** Reports the name entered in the Sample Options area for the region.
  - **Slice:** Reports the slice the region was defined on.
  - **Maximum:** Reports the maximum voxel intensity in the region.
  - **Max Location:** Reports the location of the voxel with the maximum intensity value.
  - **Minimum:** Reports the minimum voxel intensity in the region.
  - **Min Location:** Reports the location of the voxel with the minimum intensity value.
  - **Number of Voxels:** Reports the number of voxels in the defined region.
  - **Area:** Reports the area of the region using the formula:  $\text{Area} = \text{number of voxels} \times \text{voxel width} \times \text{voxel height}$
  - **Volume:** Reports the volume of the region using the formula:  $\text{Volume} = \text{number of voxels} \times \text{voxel width} \times \text{voxel height} \times \text{voxel depth}$
  - **Mean:** Reports the mean intensity value of the voxels sampled in the region.
  - **St. Dev:** Reports the standard deviation of the sampled voxels.
  - **Sum:** Reports the sum of the intensity values of the sampled voxels.
  - **Entropy:** Reports the Shannon entropy of the sampled voxels.

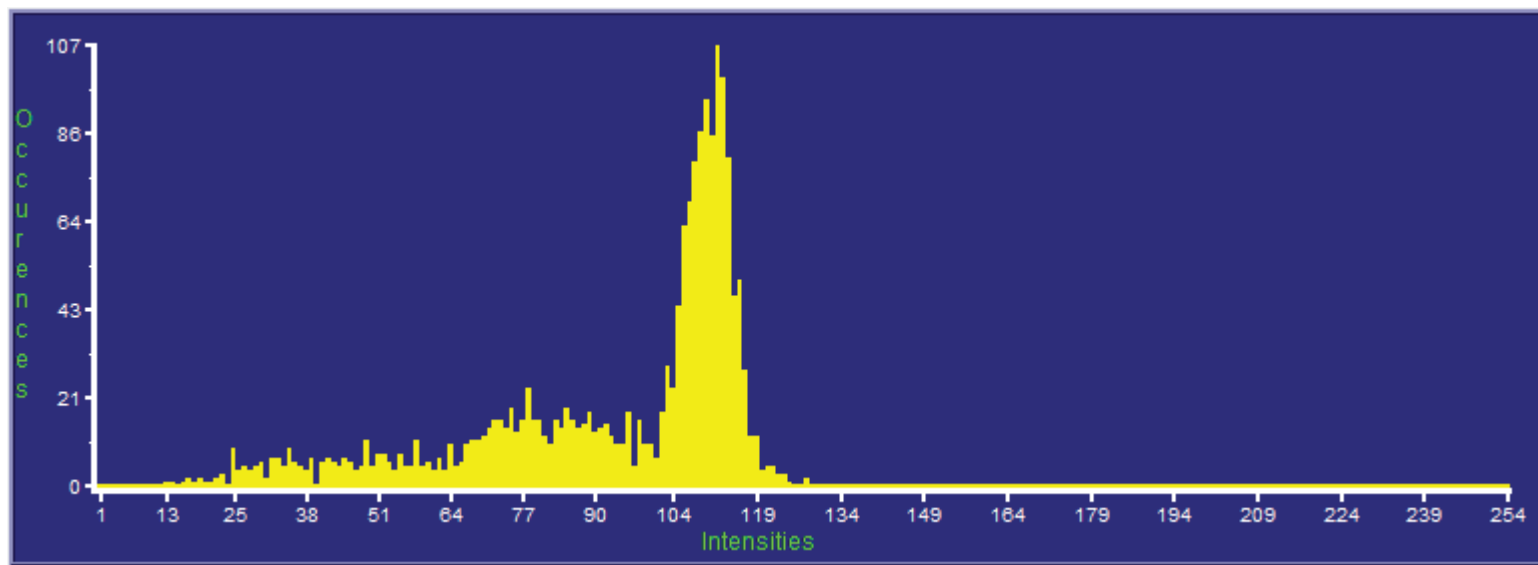


## Sample 2-D Rectangle Options (continued)

### Stats to View > Size Intensity (continued):

- **Histogram:** The histogram option reports plots the histogram of the region (intensities vs. occurrence) and reports relevant histogram information including:
  - **Orient:** Reports the orientation the region was defined in.
  - **Slice:** Reports the slice number the region was defined on.
  - **Object:** Reports the object or region name.
  - **Intensity:** Reports all intensity values in the region.
  - **Count:** Reports the count of the intensity in the region
  - **Histogram Mode:** Reports the Histogram Mode value.
  - **Histogram Median:** Reports the Histogram Median value.

Histogram						
Orient	Slice	Object	Intensity	Count	Histogram Mode	Histogram Median
Axial	136	Brain	1.00	0	112.00	104.00
Axial	136	Brain	2.00	0		
Axial	136	Brain	3.00	0		
Axial	136	Brain	4.00	0		
Axial	136	Brain	5.00	0		
Axial	136	Brain	6.00	0		
Axial	136	Brain	7.00	0		
Axial	136	Brain	8.00	0		
Axial	136	Brain	9.00	0		
Axial	136	Brain	10.00	0		
Axial	136	Brain	11.00	0		
Axial	136	Brain	12.00	0		
Axial	136	Brain	13.00	0		
Axial	136	Brain	14.00	0		
Axial	136	Brain	15.00	0		





## Sample 2-D Rectangle Options (continued)

### Stats to View > Size Intensity (continued):

- **Boundary Coordinates:** Reports the boundary (perimeter) coordinates of the region. Measurements include the following:
  - **Index:** Boundary pixel reference number.
  - **X:** Reports the X position of the boundary coordinate.
  - **Y:** Reports the Y position of the boundary coordinate.
  - **Slice:** Reports the slice position of the boundary coordinate.
  - **Orient:** Reports the orientation the sampled region is defined in.
  - **Value:** Reports the greyscale value of the boundary coordinate.
  - **Object:** Reports selected or enabled object when an object map is loaded.
  - **Border:** Reports border thickness when an object map is loaded.
- **Region Pixels:** Reports information on all pixels that make up the defined region, measurements include:
  - **Index:** Region pixel reference number.
  - **X:** Reports the X position of the pixel.
  - **Y:** Reports the Y position of the pixel.
  - **Slice:** Reports the slice position of the pixel.
  - **Orient:** Reports the orientation the sampled region is defined in.
  - **Value:** Reports the greyscale value of the pixel.
  - **Object:** Reports selected or enabled object when an object map is loaded.

Boundary Coordinates							
Index	X	Y	Slice	Orient	Value	Object	Border
1	79	10	136	Axial	45	Skin	1
2	80	11	136	Axial	89	Skin	1
3	81	11	136	Axial	87	Skin	1
4	82	11	136	Axial	88	Skin	1
5	83	11	136	Axial	89	Skin	1
6	84	11	136	Axial	83	Skin	1
7	85	11	136	Axial	82	Skin	1
8	86	10	136	Axial	45	Skin	1
9	87	10	136	Axial	55	Skin	1
10	88	10	136	Axial	63	Skin	1
11	89	10	136	Axial	65	Skin	1
12	90	10	136	Axial	67	Skin	1
13	91	10	136	Axial	71	Skin	1
14	92	10	136	Axial	73	Skin	1
15	93	10	136	Axial	70	Skin	1

Region Pixels							
Index	X	Y	Slice	Orient	Value	Object	
1	79	25	136	Axial	62	Brain	
2	80	25	136	Axial	73	Brain	
3	81	25	136	Axial	79	Brain	
4	82	25	136	Axial	82	Brain	
5	83	25	136	Axial	78	Brain	
6	84	25	136	Axial	63	Brain	
7	89	25	136	Axial	53	Brain	
8	90	25	136	Axial	78	Brain	
9	91	25	136	Axial	105	Brain	
10	94	25	136	Axial	95	Brain	
11	95	25	136	Axial	77	Brain	
12	96	25	136	Axial	53	Brain	



## Sample 2-D Rectangle Options (continued)

### Stats to View (continued):

- **Sample Range:** Allows users to sample voxels within the defined region based on a minimum and maximum intensity range. The following options are available.
  - **Sample Range Slider:** The sample range slider allows users to define a minimum and maximum sample range based on the image histogram. Only voxels that meet the specified criteria will be sampled.
  - **Range Min:** Set the minimum for the sampling range.
  - **Range Max:** Set the maximum for the sampling range.
  - **< Sample Min:** Reports the number of voxels with an intensity value less than the specified minimum range value.
  - **> Sample Max:** Reports the number of voxels with an intensity value greater than the specified maximum range value.
  - **>= SMin & <= SMax:** Reports the number of voxels with an intensity value equal to or greater than the sample minimum and equal to or less than the sample maximum.
  - **Mean in Range:** Reports the mean intensity value of the voxels within the specified minimum and maximum sampling range.
  - **STD in Range:** Reports the standard deviation of the sampled voxels.
  - **Sum in Range:** Reports the sum of the intensity values of the sampled voxels within the defined range.
  - **Area in Range:** Reports the area of the sampled voxels within the defined range.
  - **Volume in Range:** Reports the volume of the sampled voxels within the defined range.
  - **Brightness Area Product:** Reports the Brightness Area Product for the sampled voxels. The value is calculated from the formula:  $(\text{Mean in Range} - \text{Min}) * \text{No. Pixels In Range}$ .
- **2-D Shape:** All 2-D shape measurements assume the input image data will have square pixels and are in units of linear pixel-sides or square pixels as appropriate. The following options are available.
  - **MER Angle Resolution:** MER (Minimum Enclosing Rectangle) specifies the angle resolution to be used when searching for the Minimum Enclosing Rectangle.
  - **Perimeter:** Reports the perimeter of the region in pixel-sides and in calibrated voxel units.



## Sample 2-D Rectangle Options (continued)

### Stats to View > 2-D Shape (continued):

- **MER Angle:** Reports the angle of rotation in one-degree increments, at which the sides of the minimum enclosing Rectangle is parallel to the X and Y axes.
- **MER Area:** Reports the minimum enclosing rectangle.
- **MER Aspect Ratio:** Reports the short side of the minimum enclosing rectangle to the long side.
- **MER Coordinates:** Reports the coordinates of the four corners of the MER.
- **Rectangular Fit Factor:** Reports the ratio of the area of the region to the area of the minimum enclosing rectangle.
- **Circularity:** Reports the ratio of the perimeter squared of the region to the area of the region,  $(P^2/A)$ . This parameter takes on a minimum value of  $4\pi$  for a circle.
- **Circ./(4\*Pi):** Reports the circularity value divided by  $4\pi$ . This value should be 1 for a perfect circle.
- **Centroid:** Reports the center gravity for the region.
- **Surface Voxels:** For use with the rendered image only. Reports the total number of voxels counted on the surface of the defined region.
- **Surface Faces:** For use with the rendered image only. Reports the total number of exposed faces for all surface voxels.
- **Planar Area:** For use with the rendered image only. Reports the count of 2-D pixels in the user defined area.
- **Surface Area:** For use with the rendered image only. Reports an estimate of the structures surface area within the defined region, computed by examining each surface voxel found via the tracking algorithm and assigning a surface area component for each voxel based on its non-surface neighbors.



## Making 2D Rectangular Measurements using Sample 2-D Rectangle

Download the MRI\_3D\_Head.avw data set from [analyzedirect.com/data](http://analyzedirect.com/data) to follow along.

- Open Input/Output and load MRI\_3D\_Head.avw into Analyze. Select MRI\_3D\_Head and open Measure.
- Select File > Load Object Map and load the MRI\_3D\_Head.obj file. Select the 2D Sample Type [1] and choose Sample 2-D Rectangle(s) [2].
- In the Stats to View area check all required measurements [3] in the stats review area.
- Define a rectangle on the current axial slice [4].
- Selected measurements will be reported for the region in the stats review area [5]. Click Log Stats to return the stats to a log file that can be saved out of Analyze as a .csv file.
- Note, to move the rectangle, place the cursor in the center of the rectangle. When the cursor updates its shape [6] move the rectangle up, down, left, or right.

