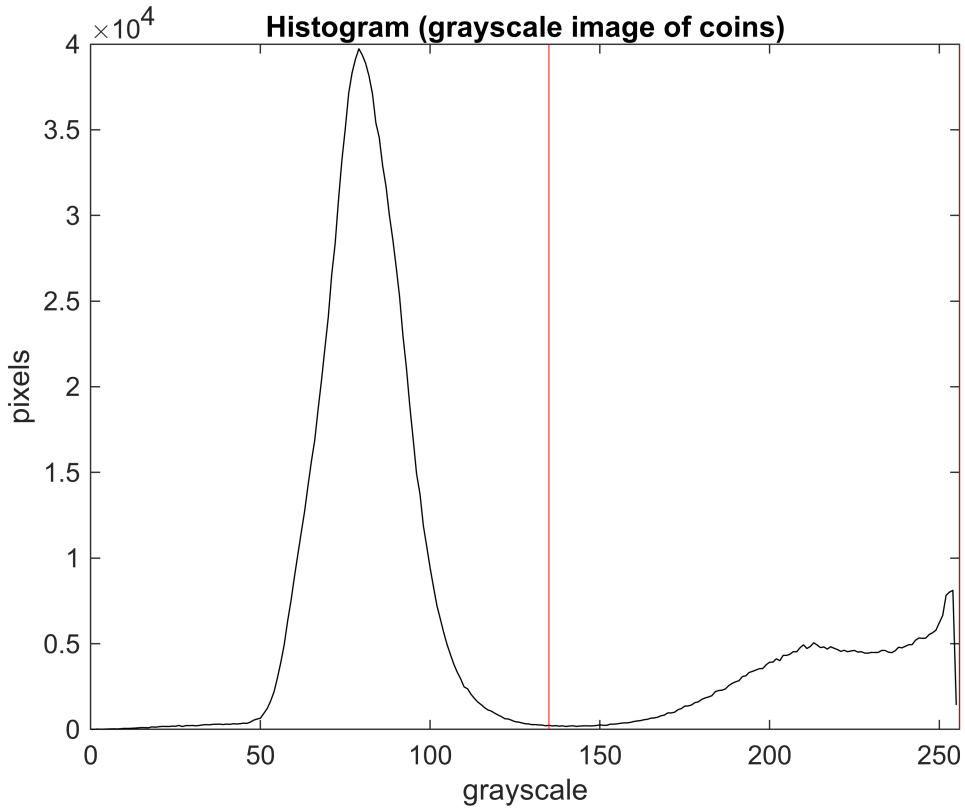
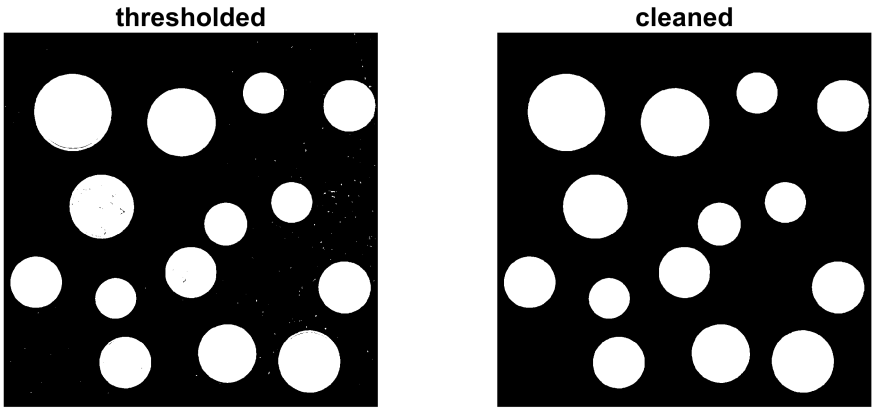
Activity 7: Featured Extraction from Labeled Blobs

01: Different Coins

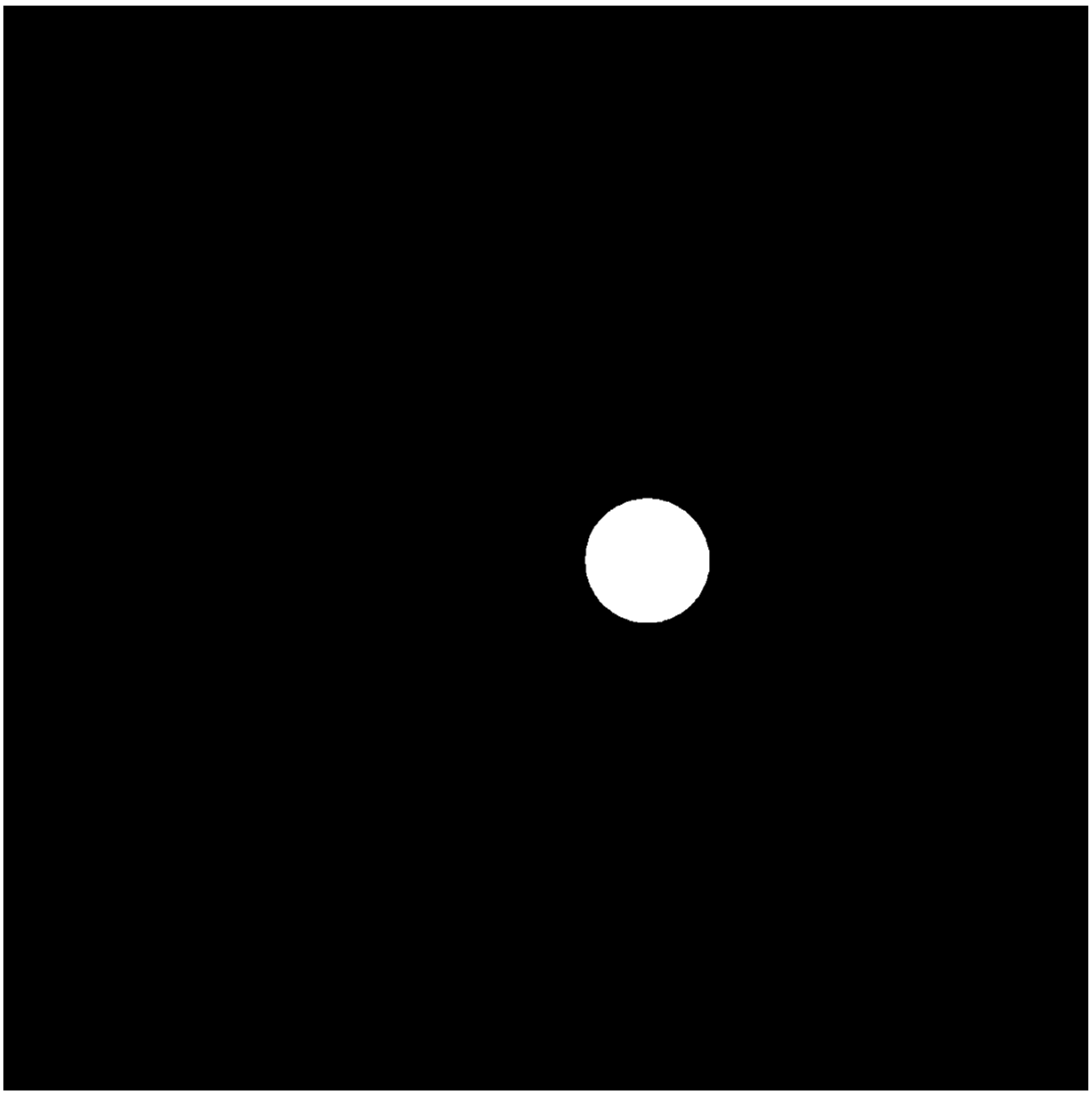
```
%Histogram
clear;close;
I = rgb2gray(imread('coins.jpeg'));
[count, cells] = imhist(I, 256);
plot(cells, count, 'color', 'black'); ylabel('pixels'); xlabel('grayscale'); xlim([0 256]);
hold on; xline(135, 'color', 'red'); xline(256,'color', 'red');
title('Histogram (grayscale image of coins)');
```




```
%Thresholding
clear;close;
subplot(1,2,1); imshow(threshold('coins.jpeg',135,256)); title('thresholded');
subplot(1,2,2); imshow(coinclean('coins.jpeg')); title('cleaned');
```

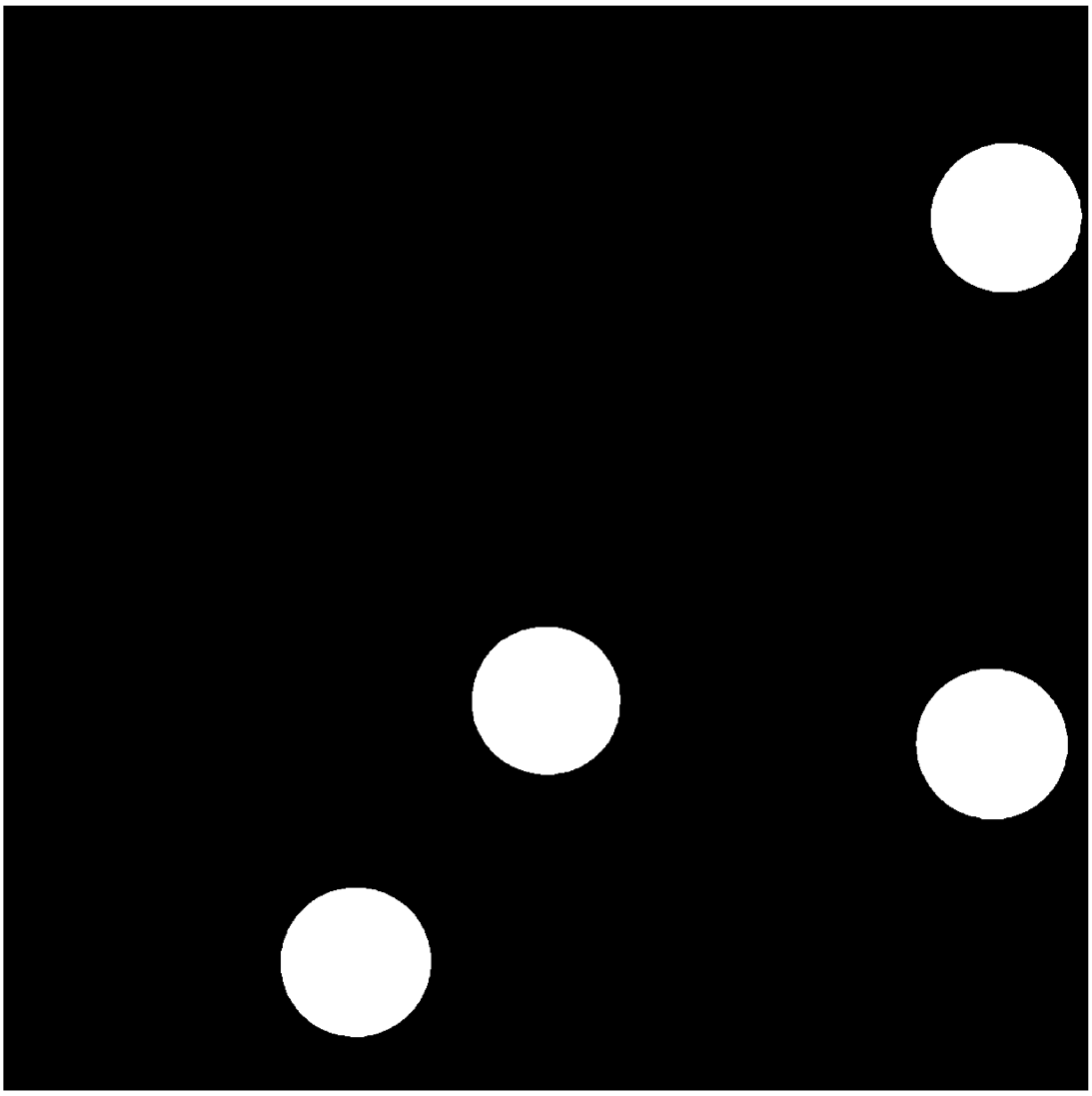



```
%For the single coins
clear;close;
BWL = bwlabel(coinclean('coins.jpeg'));
imshow(BWL==9);
```



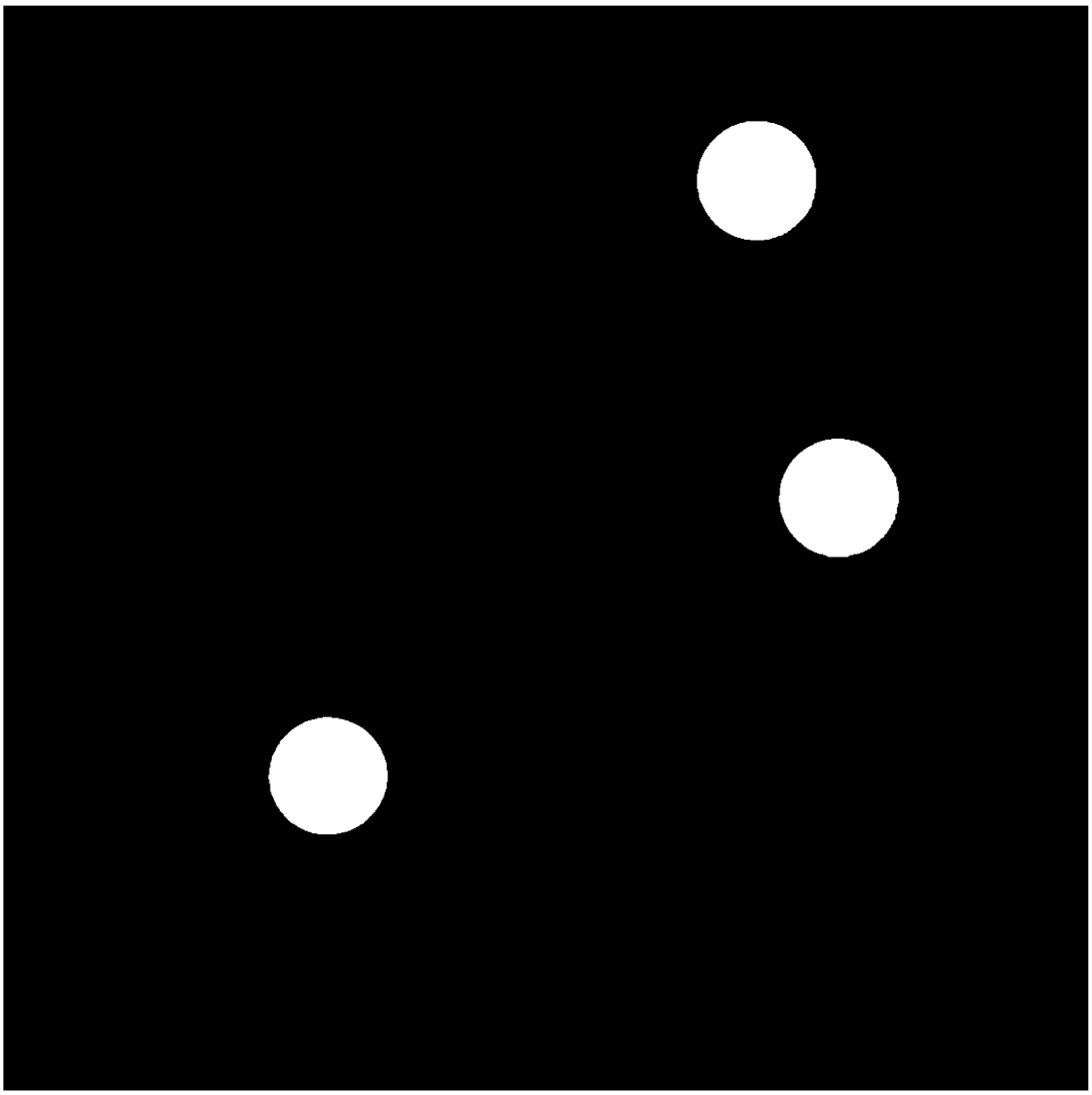
```
clear;close;
%25 centavo coins
BWL = bwlabel(coinclean('coins.jpeg'));
% Read the input image
image = BWL;

% Create a binary mask of the same size as the input image
mask = false(size(image));

% Define the region of interest
% Here, we'll extract a rectangular region defined by the top-left and bottom-right coordinates
roi_top_left5 = [300, 950];  % [x, y] coordinates of the top-left corner of the region
roi_bottom_right5 = [500, 1200];  % [x, y] coordinates of the bottom-right corner of the region
roi_top_left7 = [520, 700];  % [x, y] coordinates of the top-left corner of the region
```

```
roi_bottom_right7 = [700, 880];  % [x, y] coordinates of the bottom-right corner of the region
roi_top_left13 = [1020, 740];  % [x, y] coordinates of the top-left corner of the region
roi_bottom_right13 = [1200, 920];  % [x, y] coordinates of the bottom-right corner of the regio
roi_top_left14 = [1040, 140];  % [x, y] coordinates of the top-left corner of the region
roi_bottom_right14 = [1220, 340];  % [x, y] coordinates of the bottom-right corner of the regio

% Set the pixels within the region of interest to true in the mask
mask(roi_top_left5(2):roi_bottom_right5(2), roi_top_left5(1):roi_bottom_right5(1)) = true;
mask(roi_top_left7(2):roi_bottom_right7(2), roi_top_left7(1):roi_bottom_right7(1)) = true;
mask(roi_top_left13(2):roi_bottom_right13(2), roi_top_left13(1):roi_bottom_right13(1)) = true;
mask(roi_top_left14(2):roi_bottom_right14(2), roi_top_left14(1):roi_bottom_right14(1)) = true;
% Apply the mask to the input image
masked_image = image;
masked_image(~repmat(mask, [1, 1, size(image, 3)])) = 0;

% Display the masked image
imshow(masked_image);
```



```
clear;close;
%5 centavo coins
BWL = bwlabel(coinclean('coins.jpeg'));
% Read the input image
image = BWL;

% Create a binary mask of the same size as the input image
mask = false(size(image));

% Define the region of interest
% Here, we'll extract a rectangular region defined by the top-left and bottom-right coordinates
roi_top_left4 = [280, 780];  % [x, y] coordinates of the top-left corner of the region
roi_bottom_right4 = [460, 960];  % [x, y] coordinates of the bottom-right corner of the region
roi_top_left10 = [750, 100];  % [x, y] coordinates of the top-left corner of the region
```

```
roi_bottom_right10 = [950, 300];  % [x, y] coordinates of the bottom-right corner of the region
roi_top_left11 = [850, 460];  % [x, y] coordinates of the top-left corner of the region
roi_bottom_right11 = [1050, 660];  % [x, y] coordinates of the bottom-right corner of the regio

% Set the pixels within the region of interest to true in the mask
mask(roi_top_left4(2):roi_bottom_right4(2), roi_top_left4(1):roi_bottom_right4(1)) = true;
mask(roi_top_left10(2):roi_bottom_right10(2), roi_top_left10(1):roi_bottom_right10(1)) = true;
mask(roi_top_left11(2):roi_bottom_right11(2), roi_top_left11(1):roi_bottom_right11(1)) = true;

% Apply the mask to the input image
masked_image = image;
masked_image(~repmat(mask, [1, 1, size(image, 3)])) = 0;

% Display the masked image
imshow(masked_image);
```

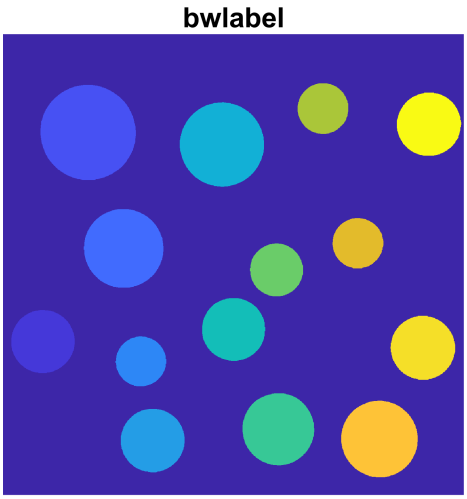


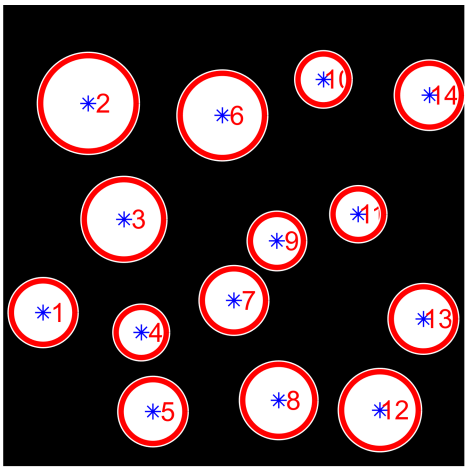
```
BWL = bwlabel(coinclean('coins.jpeg'));
features = regionprops("table", BWL, ...
    "Centroid", "MajorAxisLength", "MinorAxisLength", "Area")
```

features = 14×4 table

	Area	Centroid		MajorAxisLength	MinorAxisLength
1	22110	106.1061	814.3064	168.4535	167.1277
2	50048	225.8262	260.7799	253.7160	251.1687
3	34582	319.9448	567.6158	210.7850	208.9010
4	13802	365.6856	866.9378	133.4076	131.7401
5	22347	396.7794	1.0762e+03	169.5638	167.8124
6	38991	580.2629	292.5869	222.9791	222.6515
7	21935	610.9735	782.1614	167.7260	166.5275
8	28479	729.3852	1.0464e+03	190.9957	189.8633
9	15415	724.6536	624.7766	140.2826	139.9227
10	14202	847.7243	197.3449	134.6432	134.3135
11	14040	940.0476	554.0088	134.3775	133.0468
12	32294	997.1763	1.0723e+03	203.7737	201.7929
13	22629	1.1122e+03	830.9278	170.5960	168.9019
14	22361	1.1282e+03	239.1073	169.9162	167.5719

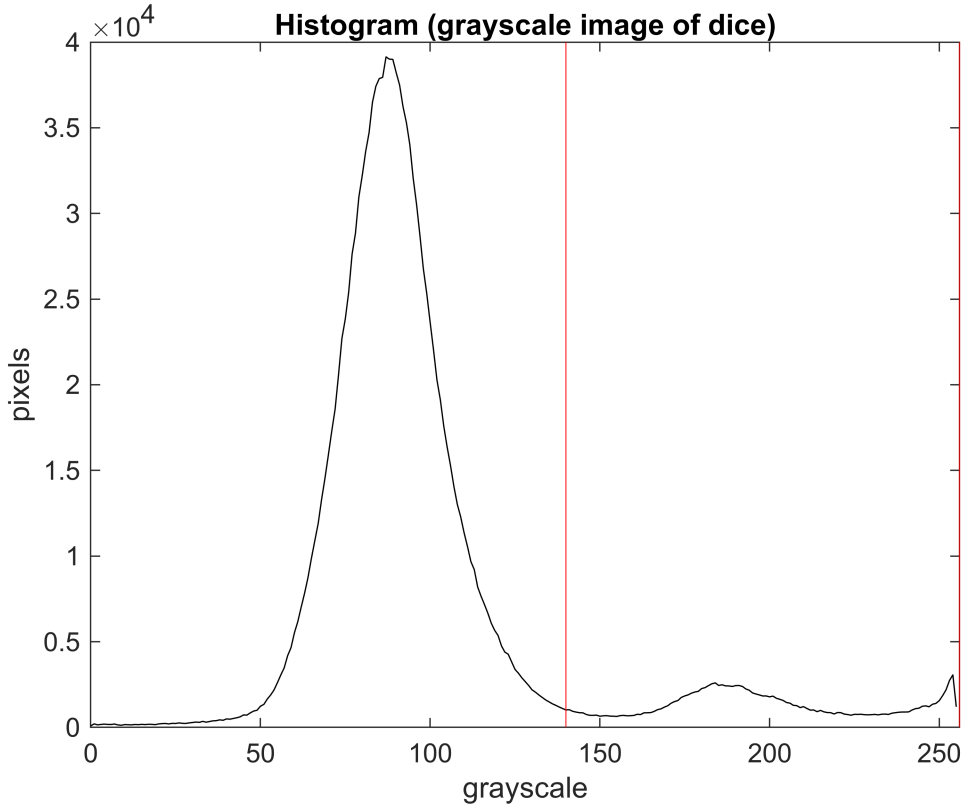
```
subplot(1,2,1);
imagesc(BWL); axis image; axis off; title("bwlabel");
subplot(1,2,2);
coinproperties(BWL, features);
```



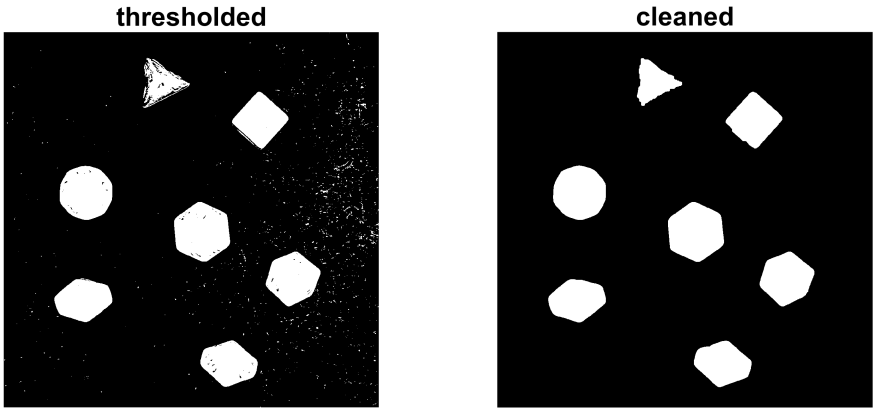


02: Dice

```
clear;close;
I = rgb2gray(imread('dice.jpeg'));
[count, cells] = imhist(I, 256);
plot(cells, count, 'color', 'black'); ylabel('pixels'); xlabel('grayscale'); xlim([0 256]);
hold on; xline(140, 'color', 'red'); xline(256,'color', 'red');
title('Histogram (grayscale image of dice)');
```




```
clear; close;
subplot(1,2,1);
imshow(threshold('dice.jpeg',140,256)); title('thresholded');
subplot(1,2,2); imshow(diceclean('dice.jpeg')); title('cleaned');
```




```
close;clear;
BWL = bwlabel(diceclean('dice.jpeg'));
features = regionprops("table", BWL, "Centroid", "BoundingBox", "Circularity", "MajorAxisLengt
```

features = 7×5 table

...

	Centroid	
1	262.4439	881.2817
2	270.9709	528.5530
3	515.5925	164.7100
4	652.8780	657.7728
5	741.6794	1.0901e+03
6	844.1107	290.3533
7	951.2860	810.7496

```
diameter = mean([features.MajorAxisLength features.MinorAxisLength], 2)/(1220/150)
```

diameter = 7×1

```
   19.6947
   21.6995
   16.7444
   22.9571
   19.8100
   19.8387
```

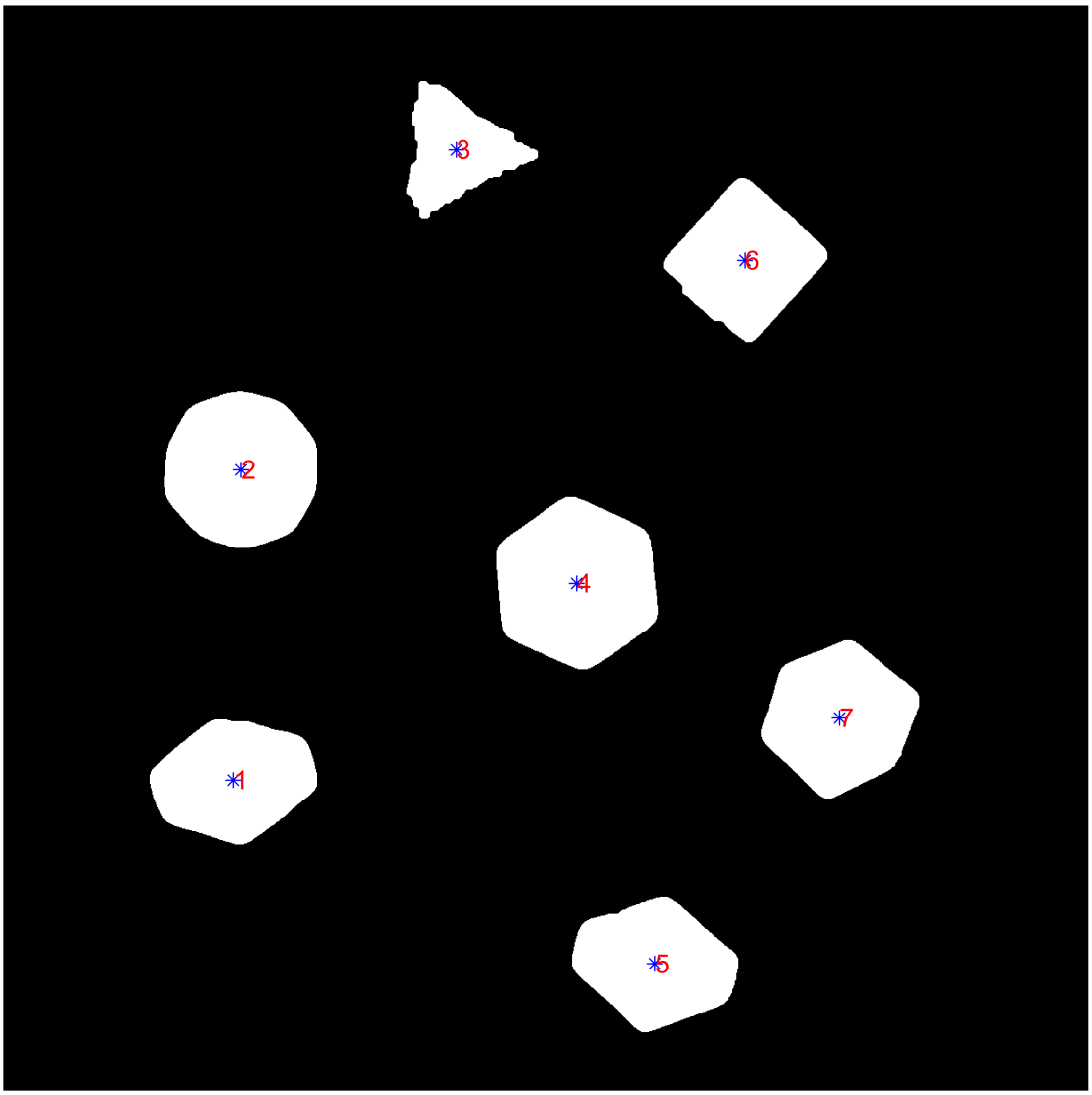
```
    20.6778
```

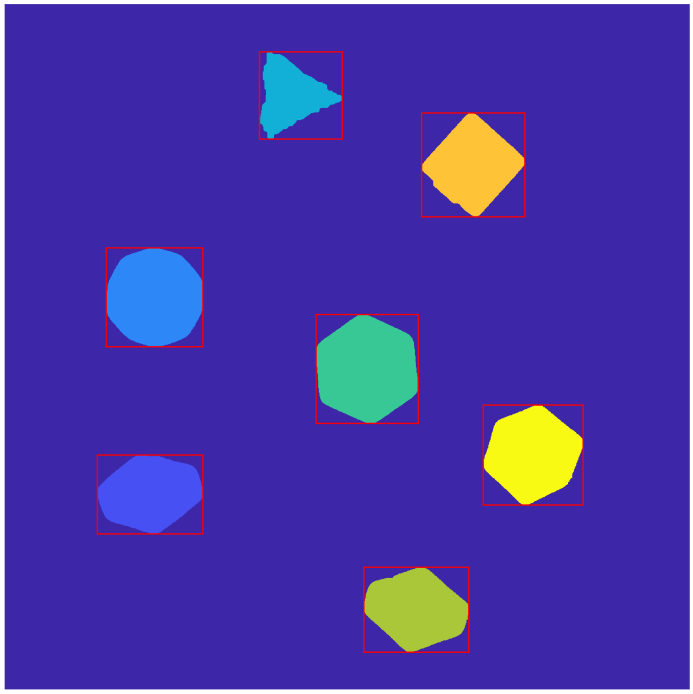
```
T = table(features.Circularity, diameter, VariableNames= ["Circularity", "Diameter"])
```

T = 7×2 table

	Circularity	Diameter
1	0.9243	19.6947
2	1.0026	21.6995
3	0.6156	16.7444
4	0.9642	22.9571
5	0.9079	19.8100
6	0.8594	19.8387
7	0.9427	20.6778

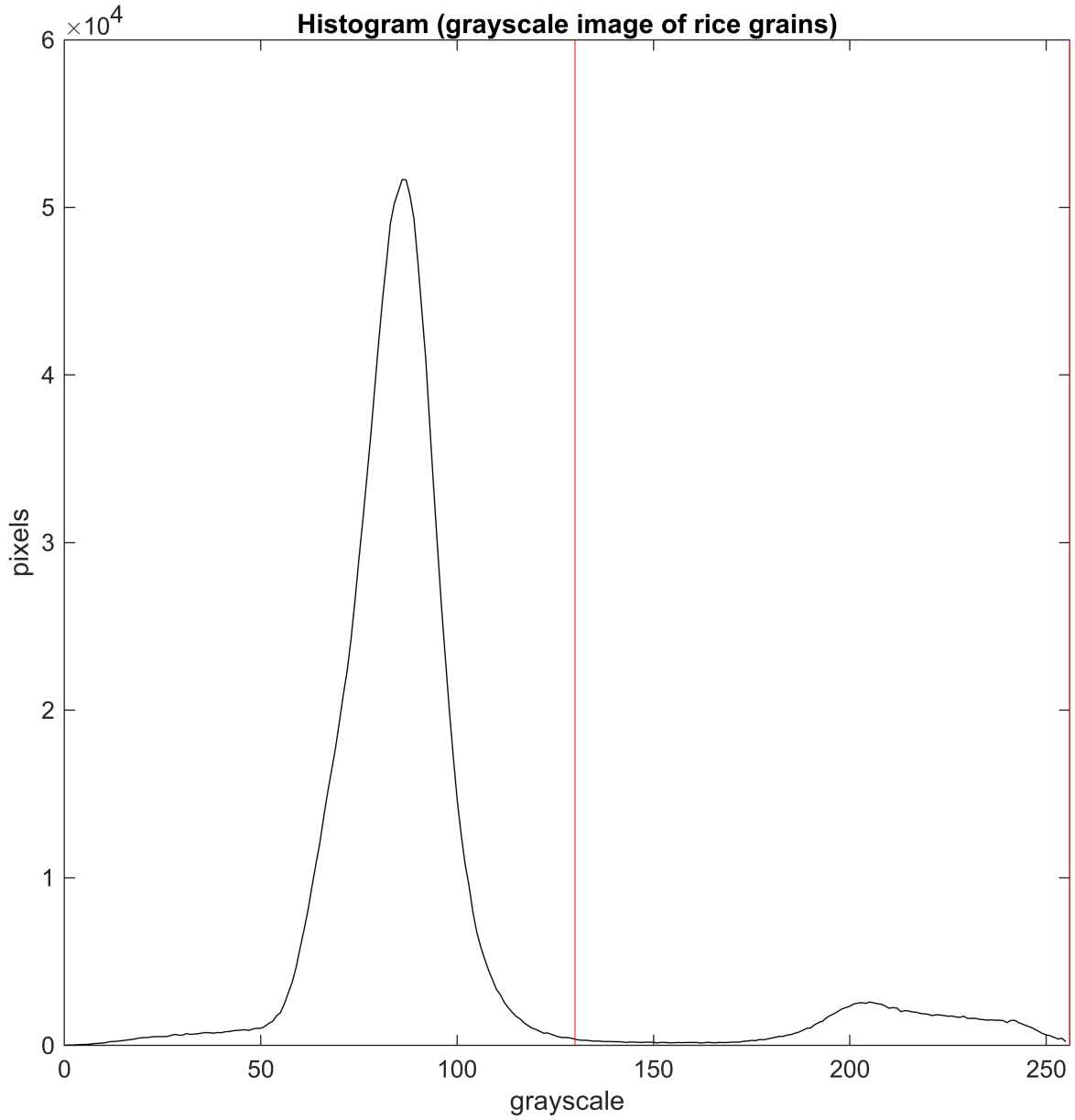
```
properties(BWL, features);
```


3
6
2
4
7
1
5

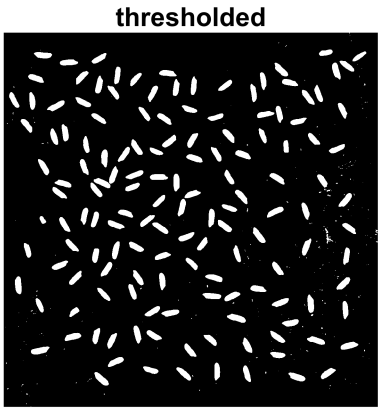


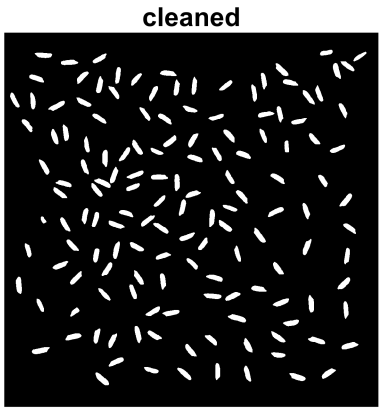
03: Rice Grains

```
clear;close;
I = rgb2gray(imread('ricee.jpeg'));
[count, cells] = imhist(I, 256);
plot(cells, count, 'color', 'black'); ylabel('pixels'); xlabel('grayscale'); xlim([0 256]);
hold on; xline(130, 'color', 'red'); xline(256,'color', 'red');
title('Histogram (grayscale image of rice grains)');
```




```
clear;close;
subplot(1,2,1);
imshow(threshold('ricee.jpeg', 130, 256)); title('thresholded')
subplot(1,2,2);
imshow(riceclean('ricee.jpeg')); title('cleaned');
```






```
%extract features
clear;close;
BWL = bwlabel(riceclean('ricee.jpeg'));
features = regionprops("table", BWL, "Centroid", "BoundingBox", "Perimeter", "Circularity", "Ma
```

features = 145×6 table

...

	Centroid	
1	33.9054	221.0508
2	48.4118	824.0785
3	76.0983	302.5112
4	78.7746	710.4714
5	105.2517	149.2114
6	93.6057	223.8200
7	118.5755	1.0369e+03
8	129.1509	73.7849
9	117.8757	889.0126
10	131.2348	438.6472
11	127.7040	611.6101

	Centroid	
12	172.7840	239.4210
13	164.9553	340.6549
14	183.8601	759.1536
15	181.5070	523.6797
16	195.2821	492.6983
17	198.1851	625.9130
18	212.2652	97.6701
19	200.8826	327.8068
20	226.4055	991.5945
21	222.1671	694.5637
22	235.0068	801.1965
23	230.2308	911.1165
24	259.9163	228.1174
25	254.6044	145.4911
26	262.6388	437.8569
27	264.0203	597
28	269.4522	366.3866
29	301.7856	513.9335
30	298.2736	609.6500
31	310.5655	280.0060
32	311.4905	85.5635
33	299.9303	726.4978
34	301.7989	989.6796
35	322.8869	490.5791
36	319.6263	1.1306e+03
37	311.6880	172.0012
38	327.0813	853.9433
39	337.0765	771.8711
40	329.3813	409.2725
41	359.5196	194.8679
42	353.0084	1.0042e+03
43	365.2818	627.3157
44	366.1019	1.0736e+03

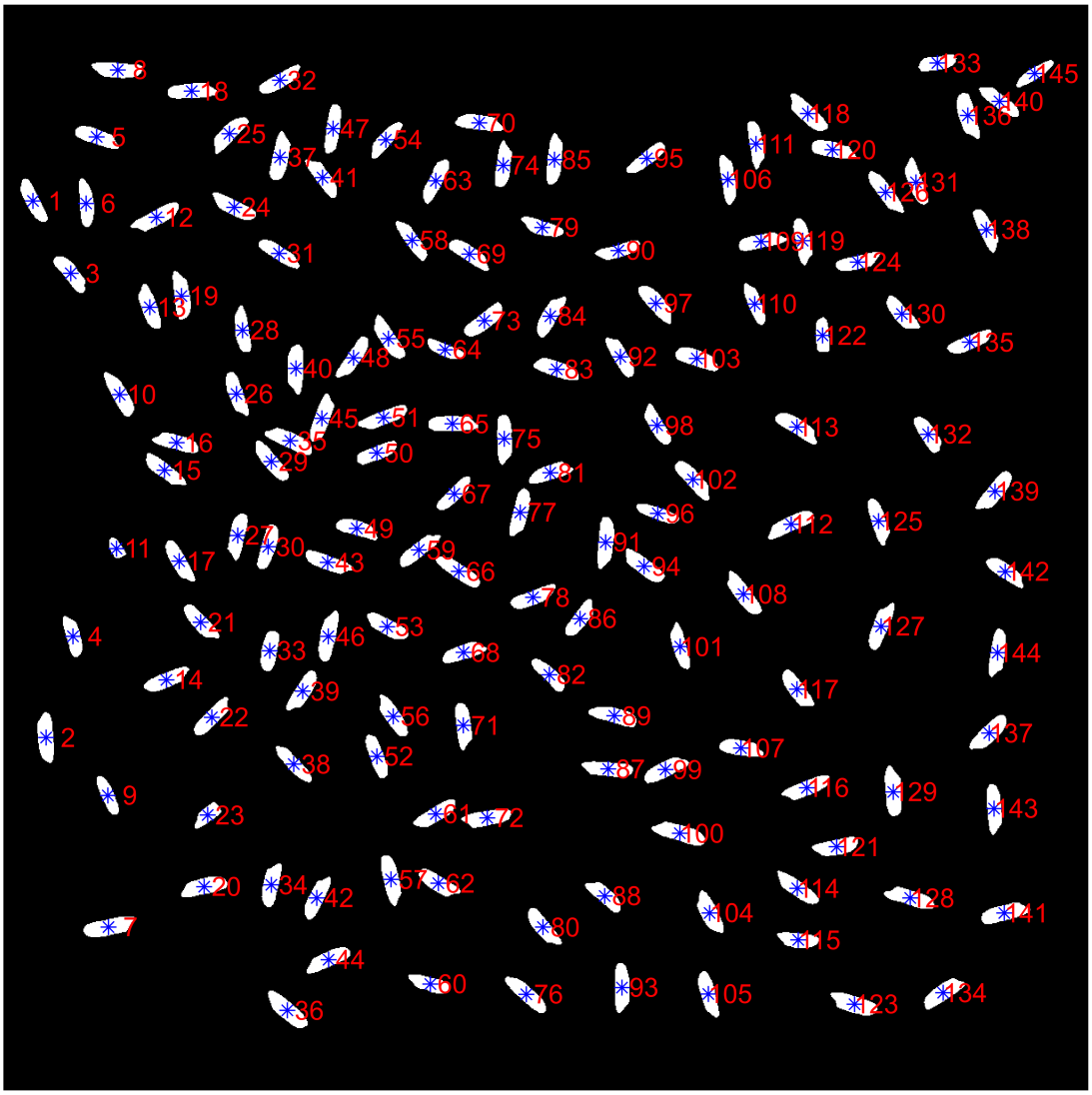
	Centroid	
45	358.6288	465.4937
46	365.8753	710.4484
47	371.1342	139.8849
48	394.1208	397.2417
49	397.9697	589.2595
50	420.5157	504.2226
51	428.2399	464.5013
52	420.3991	845.1105
53	432.2165	699.4357
54	430.4839	152.1768
55	433.6250	375.5713
56	438.7236	800.2412
57	436.4041	983.4502
58	460.1037	265.2576
59	467.7275	613.3721
60	480.5246	1.1010e+03
61	486.7125	909.9734
62	489.5070	987.8120
63	486.6634	198.2282
64	497.2574	388.2792
65	505.3271	471.4969
66	512.6266	637.3708
67	507.6143	550.3371
68	518.0351	728.4094
69	524.3543	280.6867
70	535.5467	133.2693
71	517.7251	810.3771
72	544.6602	914.3049
73	541.4228	355.6342
74	562.5974	180.9957
75	563.9001	488.3191
76	588.7096	1.1125e+03
77	581.6598	571.0668

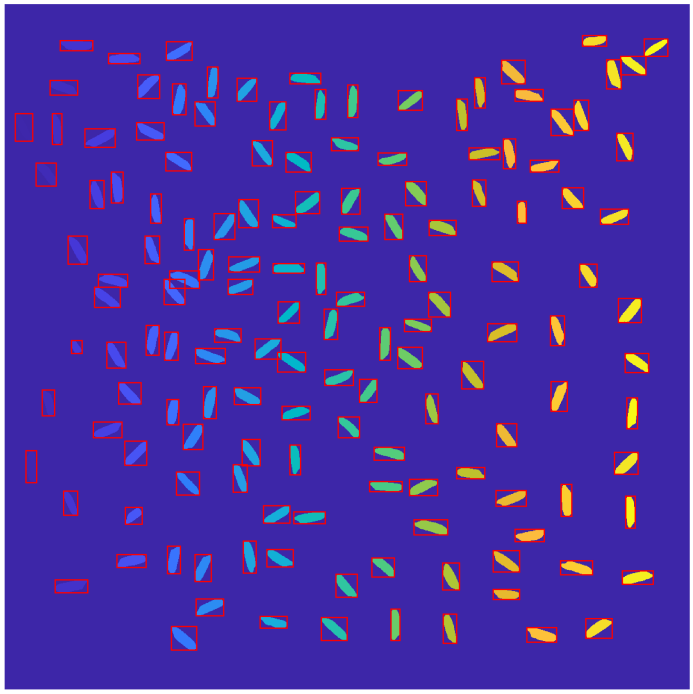
	Centroid	
78	596.1435	666.4485
79	606.5122	250.7780
80	607.4321	1.0371e+03
81	615.4824	526.5956
82	614.2781	753.4839
83	622.7683	410.1212
84	615.5202	350.5310
85	620.1753	174.7364
86	649.0603	690.4405
87	680.6732	859.3800
88	676.5734	1.0020e+03
89	687.5383	799.7211
90	692.2566	276.7171
91	677.6735	604.4692
92	694.4957	396.1823
93	695.9712	1.1049e+03
94	721.1244	631.7043
95	724.0943	173.0479
96	736.5352	572.2905
97	734.4422	336.0839
98	735.7568	473.3161
99	744.9231	860.0942
100	761.3235	931.7683
⋮		

```
diameter = mean([features.MajorAxisLength features.MinorAxisLength], 2)
```

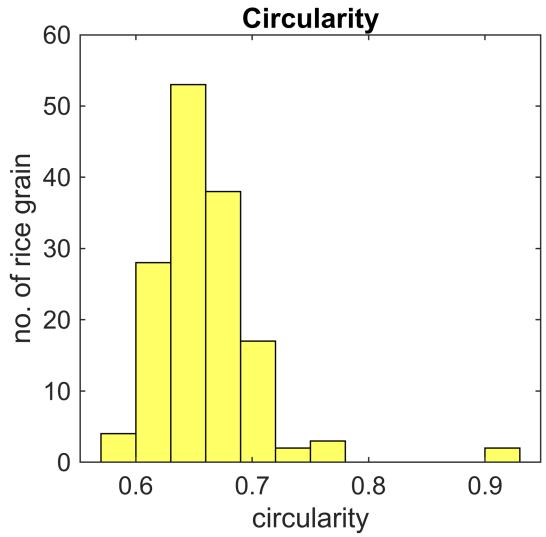
```
diameter = 145×1
   36.2627
   38.3377
   35.1835
   32.8932
   35.4498
   36.2251
   39.6038
   38.2011
   31.8705
   37.5669
      ⋮
```

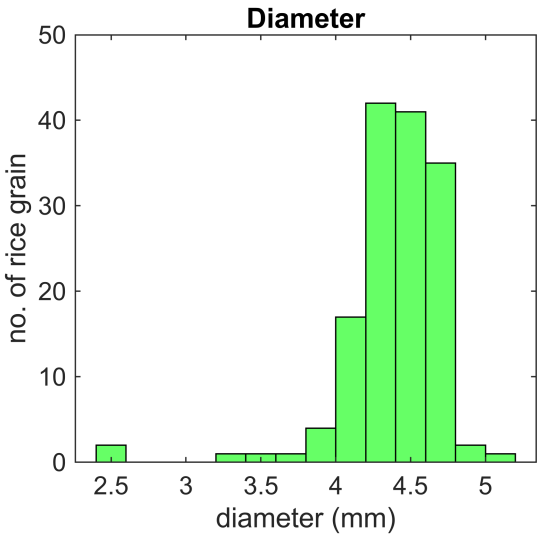
```
properties(BWL, features);
```

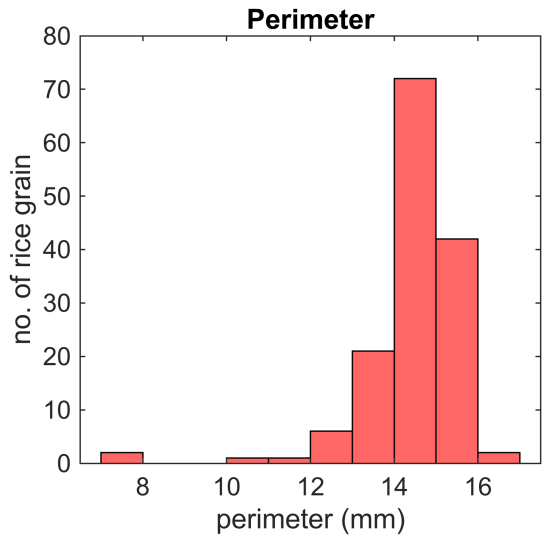




```
clear;close;
rawTable = readtable('feature_extraction.xlsx', 'Sheet', 'Sheet2');

circularity = rawTable.Circularity;
diameter = rawTable.Diametermm;
perimeter = rawTable.Perimetermm;
subplot(2,2,1);
histogram(circularity, "FaceColor", "Yellow"); title("Circularity"); xlabel("circularity"); yla
subplot(2,2,2);
histogram(diameter, "FaceColor", "Green"); title("Diameter"); xlabel("diameter (mm)");ylabel("
subplot(2,2,3);
histogram(perimeter, "FaceColor", "Red"); title("Perimeter"); xlabel("perimeter (mm)");ylabel('
```








```
function BW =threshold(image,threshold1, threshold2)
    I = rgb2gray(imread(image));
    BW = and(I < threshold2, I > threshold1);
end
function BW5 = coinclean(image)
    BW1 = imopen(threshold(image,130,256), strel("disk", 2));
    BW2 = imclose(BW1, strel("disk",2));
    BW3 = imopen(BW2, strel("disk",3));
    BW4 = imclose(BW3, strel("disk",3));
    BW5 = bwmorph(BW4, "fill");
end
function BW5 = diceclean(image)
    BW1 = imopen(threshold(image,125,256), strel("disk", 2));
    BW2 = imclose(BW1, strel("disk",2));
```

```
    BW3 = bwmorph(BW2, "fill");
    BW4 = imopen(BW3, strel("disk",6));
    BW5 = imclose(BW4, strel("disk",6));
end
function BW4 = riceclean(image)
    BW1 = imclose(threshold(image, 160, 256), strel("disk",1));
    BW2 = bwmorph(BW1, 'thin');
    BW3 = bwmorph(BW2, 'fill');
    BW4 = imopen(BW3, strel("disk",1));
end
function centroid = coinproperties(image, x)
    centroid = cat(1, x.Centroid);
    center = x.Centroid;
    diameter = mean([x.MajorAxisLength x.MinorAxisLength], 2);
    radii = diameter/2;
    imshow(image);
    hold on;
    plot(centroid(:,1), centroid(:,2), 'b*');

    % Add label numbers to centroids
    labels = 1:size(centroid, 1);
    text(centroid(:, 1), centroid(:, 2), num2str(labels'), 'Color', 'red');
    viscircles(center, radii);

    hold off;
end
function centroid = properties(image, x)
    centroid = cat(1, x.Centroid);
    imshow(image);
    hold on;
    plot(centroid(:,1), centroid(:,2), 'b*');

    % Add label numbers to centroids
    labels = 1:size(centroid, 1);
    text(centroid(:, 1), centroid(:, 2), num2str(labels'), 'Color', 'red');

    hold off;

    figure(); imagesc(image); hold on; axis off; axis image;
    bounding_box = cat(1,x.BoundingBox);
    for i= 1:size(x,1)
        rectangle('Position', bounding_box(i,:), 'EdgeColor', 'r');
    end
end
```