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Homework 7
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Collaboration: None

Question 1

Below is the output of my code for question 1.

```
Triangle sides: 3, 4, 5
Area of triangle: 6
Perimeter of triangle: 12
Doubled perimeter of triangle: 24
Area with doubled perimeter: 24
Parameters of triangle are valid: true
Rectangle sides: 3x4
Area of rectangle: 12
Perimeter of rectangle: 14
Doubled perimeter of rectangle: 28
Area with doubled perimeter: 48
Parameters of rectangle are valid: true
Circle radius: 5
Area of circle: 78.53981633974483
Perimeter of circle: 31.41592653589793
Doubled perimeter of circle: 62.83185307179586
Area with doubled perimeter: 314.1592653589793
Parameters of circle are valid: true
```

The sample side lengths for the triangle are 3, 4, and 5, for the rectangle, the sample side lengths are 3 and 4, and for the circle, the sample radius is 5. I also added a validation portion of the code that ensures that the inputted lengths of the triangle, rectangle, and circle are non-negative values. For other shape types, they are derived from these 3 shapes, so the code for these 3 shapes can be manipulated to give the other parameters for other shapes. Within my code, I have a function called verify parameters that ensures that there are no negative values as the lengths of the sides, and that the triangle inequality will hold for the imputed side lengths.

Question 2

Below is the output for my code that finds the area of a polygon that has 6, 12, 24, 128, 256, 512, 1024, 2048, and 65536 sides with each of those side lengths being 1, 2, or 3. For each of those polygons, I found the perimeter, area, and radius. I then found both the inscribed circle (same apothem which is used as the radius for the circle) and the circumscribed circle (same radius as the radius of the polygon). For both of the area difference, I did the polygon – the circle area; meaning that with the inscribed circle difference, it was a positive value, since the inscribed circle is smaller than the polygon and the difference between the polygon and the circumscribed circle area is negative since the polygon has a smaller area. For both the inscribed and circumscribed circle areas vs the polygon areas, as the number of sides got larger, the closer the area values became. I also added a divider between each of the different dimensions of the polygon (and the acquainted inscribed and circumscribed circle) to make it more readable.

Polygon with 6 sides and radius 1: Perimeter = 6.0000, Area = 1.7321, Apothem = 0.5774, Radius = 1.1547

Inscribed Circle: Radius = 0.5774, Area = 1.0472, Difference from Polygon Area (Polygon- Inscribed Circle) = 0.6849

Circumscribed Circle: Radius = 1.1547, Area = 4.1888, Difference from Polygon Area (Polygon- Circumscribed Circle) = -2.4567

Polygon with 6 sides and radius 2: Perimeter = 12.0000, Area = 6.9282, Apothem = 1.1547, Radius = 2.3094

Inscribed Circle: Radius = 1.1547, Area = 4.1888, Difference from Polygon Area (Polygon- Inscribed Circle) = 2.7394

Circumscribed Circle: Radius = 2.3094, Area = 16.7552, Difference from Polygon Area (Polygon- Circumscribed Circle) = -9.8270

Polygon with 6 sides and radius 3: Perimeter = 18.0000, Area = 15.5885, Apothem = 1.7321, Radius = 3.4641

Inscribed Circle: Radius = 1.7321, Area = 9.4248, Difference from Polygon Area (Polygon- Inscribed Circle) = 6.1637

Circumscribed Circle: Radius = 3.4641, Area = 37.6991, Difference from Polygon Area (Polygon- Circumscribed Circle) = -22.1107

Polygon with 12 sides and radius 1: Perimeter = 12.0000, Area = 10.3923, Apothem = 1.7321,
Radius = 2.0000

Inscribed Circle: Radius = 1.7321, Area = 9.4248, Difference from Polygon Area (Polygon-
Inscribed Circle) = 0.9675

Circumscribed Circle: Radius = 2.0000, Area = 12.5664, Difference from Polygon Area
(Polygon- Circumscribed Circle) = -2.1741

Polygon with 12 sides and radius 2: Perimeter = 24.0000, Area = 41.5692, Apothem = 3.4641,
Radius = 4.0000

Inscribed Circle: Radius = 3.4641, Area = 37.6991, Difference from Polygon Area (Polygon-
Inscribed Circle) = 3.8701

Circumscribed Circle: Radius = 4.0000, Area = 50.2655, Difference from Polygon Area
(Polygon- Circumscribed Circle) = -8.6963

Polygon with 12 sides and radius 3: Perimeter = 36.0000, Area = 93.5307, Apothem = 5.1962,
Radius = 6.0000

Inscribed Circle: Radius = 5.1962, Area = 84.8230, Difference from Polygon Area (Polygon-
Inscribed Circle) = 8.7077

Circumscribed Circle: Radius = 6.0000, Area = 113.0973, Difference from Polygon Area
(Polygon- Circumscribed Circle) = -19.5666

Polygon with 24 sides and radius 1: Perimeter = 24.0000, Area = 44.7846, Apothem = 3.7321,
Radius = 3.8637

Inscribed Circle: Radius = 3.7321, Area = 43.7567, Difference from Polygon Area (Polygon-
Inscribed Circle) = 1.0279

Circumscribed Circle: Radius = 3.8637, Area = 46.8983, Difference from Polygon Area
(Polygon- Circumscribed Circle) = -2.1137

Polygon with 24 sides and radius 2: Perimeter = 48.0000, Area = 179.1384, Apothem = 7.4641,
Radius = 7.7274

Inscribed Circle: Radius = 7.4641, Area = 175.0270, Difference from Polygon Area (Polygon-
Inscribed Circle) = 4.1115

Circumscribed Circle: Radius = 7.7274, Area = 187.5933, Difference from Polygon Area
(Polygon- Circumscribed Circle) = -8.4549

Polygon with 24 sides and radius 3: Perimeter = 72.0000, Area = 403.0615, Apothem =
11.1962, Radius = 11.5911

Inscribed Circle: Radius = 11.1962, Area = 393.8107, Difference from Polygon Area (Polygon-
Inscribed Circle) = 9.2508

Circumscribed Circle: Radius = 11.5911, Area = 422.0850, Difference from Polygon Area
(Polygon- Circumscribed Circle) = -19.0235

Polygon with 128 sides and radius 1: Perimeter = 128.0000, Area = 1302.7499, Apothem =
20.3555, Radius = 20.3800

Inscribed Circle: Radius = 20.3555, Area = 1301.7034, Difference from Polygon Area (Polygon-
Inscribed Circle) = 1.0465

Circumscribed Circle: Radius = 20.3800, Area = 1304.8450, Difference from Polygon Area
(Polygon- Circumscribed Circle) = -2.0951

Polygon with 128 sides and radius 2: Perimeter = 256.0000, Area = 5210.9997, Apothem =
40.7109, Radius = 40.7600

Inscribed Circle: Radius = 40.7109, Area = 5206.8136, Difference from Polygon Area (Polygon-
Inscribed Circle) = 4.1861

Circumscribed Circle: Radius = 40.7600, Area = 5219.3800, Difference from Polygon Area
(Polygon- Circumscribed Circle) = -8.3803

Polygon with 128 sides and radius 3: Perimeter = 384.0000, Area = 11724.7494, Apothem =
61.0664, Radius = 61.1400

Inscribed Circle: Radius = 61.0664, Area = 11715.3306, Difference from Polygon Area (Polygon-
Inscribed Circle) = 9.4187

Circumscribed Circle: Radius = 61.1400, Area = 11743.6050, Difference from Polygon Area
(Polygon- Circumscribed Circle) = -18.8556

Polygon with 256 sides and radius 1: Perimeter = 256.0000, Area = 5214.1419, Apothem =
40.7355, Radius = 40.7478

Inscribed Circle: Radius = 40.7355, Area = 5213.0949, Difference from Polygon Area (Polygon-Inscribed Circle) = 1.0470

Circumscribed Circle: Radius = 40.7478, Area = 5216.2365, Difference from Polygon Area (Polygon- Circumscribed Circle) = -2.0946

Polygon with 256 sides and radius 2: Perimeter = 512.0000, Area = 20856.5677, Apothem = 81.4710, Radius = 81.4955

Inscribed Circle: Radius = 81.4710, Area = 20852.3796, Difference from Polygon Area (Polygon- Inscribed Circle) = 4.1881

Circumscribed Circle: Radius = 81.4955, Area = 20864.9460, Difference from Polygon Area (Polygon- Circumscribed Circle) = -8.3783

Polygon with 256 sides and radius 3: Perimeter = 768.0000, Area = 46927.2774, Apothem = 122.2065, Radius = 122.2433

Inscribed Circle: Radius = 122.2065, Area = 46917.8542, Difference from Polygon Area (Polygon- Inscribed Circle) = 9.4233

Circumscribed Circle: Radius = 122.2433, Area = 46946.1285, Difference from Polygon Area (Polygon- Circumscribed Circle) = -18.8511

Polygon with 512 sides and radius 1: Perimeter = 512.0000, Area = 20859.7095, Apothem = 81.4832, Radius = 81.4894

Inscribed Circle: Radius = 81.4832, Area = 20858.6623, Difference from Polygon Area (Polygon- Inscribed Circle) = 1.0472

Circumscribed Circle: Radius = 81.4894, Area = 20861.8039, Difference from Polygon Area (Polygon- Circumscribed Circle) = -2.0944

Polygon with 512 sides and radius 2: Perimeter = 1024.0000, Area = 83438.8380, Apothem = 162.9665, Radius = 162.9788

Inscribed Circle: Radius = 162.9665, Area = 83434.6493, Difference from Polygon Area (Polygon- Inscribed Circle) = 4.1886

Circumscribed Circle: Radius = 162.9788, Area = 83447.2157, Difference from Polygon Area (Polygon- Circumscribed Circle) = -8.3777

Polygon with 512 sides and radius 3: Perimeter = 1536.0000, Area = 187737.3854, Apothem = 244.4497, Radius = 244.4681

Inscribed Circle: Radius = 244.4497, Area = 187727.9610, Difference from Polygon Area (Polygon- Inscribed Circle) = 9.4244

Circumscribed Circle: Radius = 244.4681, Area = 187756.2354, Difference from Polygon Area (Polygon- Circumscribed Circle) = -18.8499

Polygon with 1024 sides and radius 1: Perimeter = 1024.0000, Area = 83441.9796, Apothem = 162.9726, Radius = 162.9757

Inscribed Circle: Radius = 162.9726, Area = 83440.9324, Difference from Polygon Area (Polygon- Inscribed Circle) = 1.0472

Circumscribed Circle: Radius = 162.9757, Area = 83444.0740, Difference from Polygon Area (Polygon- Circumscribed Circle) = -2.0944

Polygon with 1024 sides and radius 2: Perimeter = 2048.0000, Area = 333767.9184, Apothem = 325.9452, Radius = 325.9514

Inscribed Circle: Radius = 325.9452, Area = 333763.7297, Difference from Polygon Area (Polygon- Inscribed Circle) = 4.1887

Circumscribed Circle: Radius = 325.9514, Area = 333776.2960, Difference from Polygon Area (Polygon- Circumscribed Circle) = -8.3776

Polygon with 1024 sides and radius 3: Perimeter = 3072.0000, Area = 750977.8164, Apothem = 488.9178, Radius = 488.9271

Inscribed Circle: Radius = 488.9178, Area = 750968.3917, Difference from Polygon Area (Polygon- Inscribed Circle) = 9.4247

Circumscribed Circle: Radius = 488.9271, Area = 750996.6661, Difference from Polygon Area (Polygon- Circumscribed Circle) = -18.8497

Polygon with 2048 sides and radius 1: Perimeter = 2048.0000, Area = 333771.0600, Apothem = 325.9483, Radius = 325.9498

Inscribed Circle: Radius = 325.9483, Area = 333770.0128, Difference from Polygon Area (Polygon- Inscribed Circle) = 1.0472

Circumscribed Circle: Radius = 325.9498, Area = 333773.1544, Difference from Polygon Area (Polygon- Circumscribed Circle) = -2.0944

Polygon with 2048 sides and radius 2: Perimeter = 4096.0000, Area = 1335084.2401, Apothem = 651.8966, Radius = 651.8997

Inscribed Circle: Radius = 651.8966, Area = 1335080.0513, Difference from Polygon Area (Polygon- Inscribed Circle) = 4.1888

Circumscribed Circle: Radius = 651.8997, Area = 1335092.6177, Difference from Polygon Area (Polygon- Circumscribed Circle) = -8.3776

Polygon with 2048 sides and radius 3: Perimeter = 6144.0000, Area = 3003939.5402, Apothem = 977.8449, Radius = 977.8495

Inscribed Circle: Radius = 977.8449, Area = 3003930.1154, Difference from Polygon Area (Polygon- Inscribed Circle) = 9.4248

Circumscribed Circle: Radius = 977.8495, Area = 3003958.3897, Difference from Polygon Area (Polygon- Circumscribed Circle) = -18.8496

Polygon with 65536 sides and radius 1: Perimeter = 65536.0000, Area = 341782636.7410, Apothem = 10430.3783, Radius = 10430.3784

Inscribed Circle: Radius = 10430.3783, Area = 341782635.6938, Difference from Polygon Area (Polygon- Inscribed Circle) = 1.0472

Circumscribed Circle: Radius = 10430.3784, Area = 341782638.8354, Difference from Polygon Area (Polygon- Circumscribed Circle) = -2.0944

Polygon with 65536 sides and radius 2: Perimeter = 131072.0000, Area = 1367130546.9641, Apothem = 20860.7566, Radius = 20860.7567

Inscribed Circle: Radius = 20860.7566, Area = 1367130542.7753, Difference from Polygon Area (Polygon- Inscribed Circle) = 4.1888

Circumscribed Circle: Radius = 20860.7567, Area = 1367130555.3417, Difference from Polygon Area (Polygon- Circumscribed Circle) = -8.3776

Polygon with 65536 sides and radius 3: Perimeter = 196608.0000, Area = 3076043730.6692, Apothem = 31291.1350, Radius = 31291.1351

Inscribed Circle: Radius = 31291.1350, Area = 3076043721.2444, Difference from Polygon Area (Polygon- Inscribed Circle) = 9.4248

Circumscribed Circle: Radius = 31291.1351, Area = 3076043749.5187, Difference from Polygon
Area (Polygon- Circumscribed Circle) = -18.8496