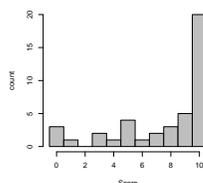


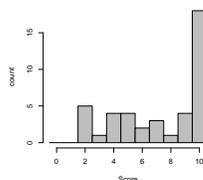
All problems are worth 10 points for a total of 200 points.  
 Partial credit will be given for correct work.  
 Do not simplify your answers unless requested.

1. Use Newton's method with the specified initial approximation  $x_1$  to find  $x_2$ , the second approximation to the root of the given equation. Leave the answer as a fraction.

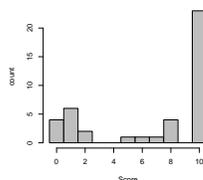
$$x^5 + 4 = 0, \quad x_1 = -1.$$



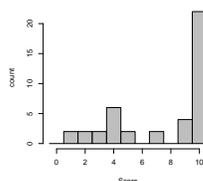
2. Two cars start moving from the same point. One travels south at 60 mi/hr and the other travels west at 25 mi/hr. At what rate is the distance between them increasing two hours later?



3. Find the limit:  $\lim_{t \rightarrow 0} \frac{e^{2t} - 1}{\sin t}$ .



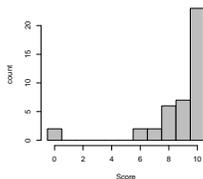
4. Sketch the graph of a function  $f$  that:  
 has a local maximum at  $x = 0$  but is not differentiable there,  
 $\lim_{x \rightarrow 2} f(x) = -\infty$ , is continuous elsewhere, has no inflection points,  
 $\lim_{x \rightarrow +\infty} f(x) = \infty$  and  $\lim_{x \rightarrow -\infty} f(x) = -2$ .  
 Use dashed lines to indicate asymptotes.



5. Differentiate the functions:

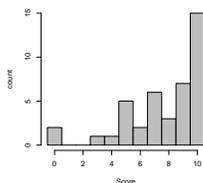
(a)  $z = \frac{A}{y^{10}}$  ( $A$  is a constant),

(b)  $g(x) = \frac{x^3}{1+x^2}$ ,

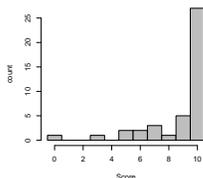


6. Find the derivative of the function:  $y = \sqrt{9-x}$ ,

- (a) using the definition of derivative (i.e. a limit), and,  
 (b) using differentiation rules.



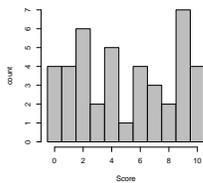
7. Find the derivative of the function:  $f(x) = \sinh(3x-1) + xe^x$ .



8. Consider  $y = f(x)$  restricted to the interval  $-\pi \leq x \leq \pi$ .

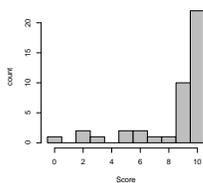
- (a) Find the intervals on which  $f$  is increasing or decreasing.  
 (b) Find the local maximum and minimum values of  $f$ .  
 (c) Find the intervals of concavity and the inflection points.  
 (d) Find any horizontal or vertical asymptotes.  
 (e) Use the information from (a)-(d) to sketch the graph for  $-\pi \leq x \leq \pi$ .

$$y = \frac{\sin x}{1 + \cos x}. \quad \text{Hints: } y' = \frac{2}{(1 + \cos x)^2}, \quad y'' = \frac{4 \sin x}{(1 + \cos x)^3}.$$



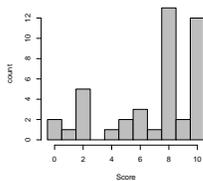
9. Find  $dy/dx$  by implicit differentiation and simplify if possible.

$$4 \cos x \sin y = 1$$



10. The equation of motion of a particle is  $s = t^3 - 3t$ , with  $s$  in meters and  $t$  in seconds. Find

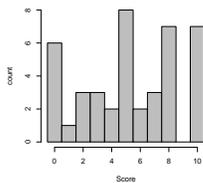
- (a) the velocity and acceleration as functions of  $t$ ,
- (b) the acceleration after 2 s, and
- (c) the acceleration when the velocity is 0.



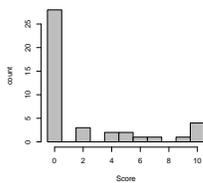
11. Find the derivatives of the functions:

(a)  $f(x) = \ln \frac{1}{x}$

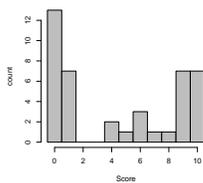
(b)  $h(x) = \int_2^{2x} \arctan(t) dt$



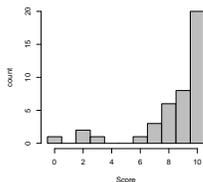
12. Prove (show) that  $\frac{d}{dx}(\sin^{-1} x) = \frac{1}{\sqrt{1-x^2}}$ . Start with the equation:  $\sin^{-1} x = y$ .



13. Find  $\int_0^a x\sqrt{a^2 - x^2} dx$ . ( $a$  is a constant.)

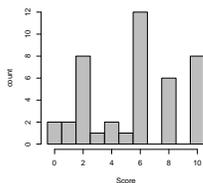


14. Find the absolute maximum and minimum values of the function:  
 $f(x) = 2x^3 - 3x^2 - 12x + 1$  on the interval  $[-2, 3]$ .

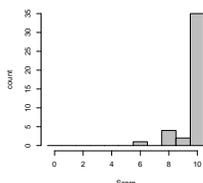


15. Find the value of the integral:

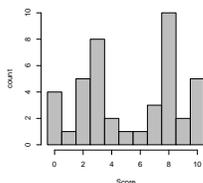
$$\int_0^1 (x^{10} + 10^x) dx$$



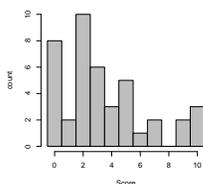
16. Find  $f(x)$  if  $f''(x) = 20x^3 - 12x^2 + 6x$ ,  $f(0) = 1$  and  $f'(0) = 0$ .



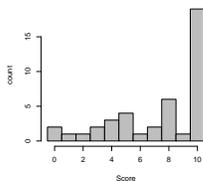
17. Let  $f(x) = 1 - x^{2/3}$ . Verify that  $f(-1) = f(1)$ . Show that there is no number  $c$  in  $(-1, 1)$  such that  $f'(c) = 0$ . Why does this not contradict Rolle's Theorem?



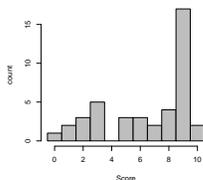
18. The edge of a cube was found to be 30 cm with a possible error in measurement of 0.1 cm. Use differentials or linear approximation to estimate the maximum possible error of (a) the volume of the cube and (b) the surface area of the cube.



19. Find an equation of the tangent line to the graph of  $y = 3e^{x/2}$  at  $x = 4$ .



20. A farmer with 750 ft of fencing wants to enclose a rectangular area and then divide it into four pens with fencing parallel to one side of the rectangle. What is the largest possible area of the four pens and what are their dimensions?



### Total

Count	42
Min.	33.0
1st Qu.	121.2
Median	136.5
Mean	133.0
3rd Qu.	155.2
Max.	197.0

