# Problem Set 3: Differential Calculus CS\&SS Math Camp 2021 

1. Plot the function $f(x)=3 x+2$.
(a) By eye, what is the derivative of $f(x)$ at $x=4$, i.e. what is the slope of the tangent line to the curve at $x=4$ ?
(b) Compute the derivative using the appropriate formula.

Compute the derivative:
2. $f(x)=x^{5}$
3. $f(x)=10 x-30$
4. $f(x)=2 x^{4}+x^{2}$
5. $f(x)=\tan (x)$
6. $f(x)=e^{\sin (x)}$
7. $f(x)=x e^{x}+\log (\sin (x))$

We can also have a function of a different variable besides $x$. This is just changing the variable name and you will see this a lot in your statistics methods classes.
8. Compute the derivative of $g(\theta)=\theta^{2}-\theta^{4}$
9. Find the global minimum of $f(z)=z^{2}-6 z+8$
10. In the following function, treat $x$ as a constant, and differentiate with respect to $\mu$ : $h(\mu)=x \mu^{2}$

Bonus In the following function of $\mu$, treat $X_{1}, X_{2}, \ldots, X_{n}$ (your data) as constants. Maximize the function over $\mu$ (the population mean). In other words, find the value of $\mu$, expressed in terms of $X_{1}, X_{2}, \ldots, X_{n}$, at which the function reaches its global maximum. HINT: review your rules of logarithms and exponents to simplify the expression before taking the derivative.
$L(\mu)=\log \left(\frac{1}{\sqrt{2 \pi}} e^{-\sum_{i=1}^{n}\left(X_{i}-\mu\right)^{2}}\right)$

