Class Prep 9 | 5.1.1 – 5.1.2

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2022-10-31

Section 5.1.1 Finite Differences

```
findiff = function(f, x, h = x*sqrt(.Machine$double.eps)){
  return((f(x + h) - f(x))/h)
}

f = function(x) {3 * x - 1}
findiff(f,4, h=1)

## [1] 3

findiff(f, 4, h=1e-6)

## [1] 3

findiff(sin, pi/4, h=1)

## [1] 0.2699545

findiff(sin, pi/4, h=.5)

## [1] 0.5048857

findiff(sin, pi/4, h=.01)

## [1] 0.7035595

findiff(sin, pi/4, h=1e-6)

## [1] 0.7071064

findiff(sin, pi/4, h=1e-10)

## [1] 0.7071077

findiff(sin, pi/4, h=1e-14)

## [1] 0.7105427

findiff(sin, pi/4, h=1e-15)

## [1] 0.7771561

findiff(sin, pi/4, h=1e-18)

## [1] 0
```

```r
findiff(sin, pi/4)
```

```
## [1] 0.7071068
```

```r
f = function(x) {x^2 + 3 * x - 4}
findiff(f, 2)
```

```
## [1] 7
```

```r
symdiff = function(f, x, h = x * .Machine$double.eps^(1/3)) {
  return((f(x+h) - f(x-h))/(2*h))
}

symdiff(sin, pi/4, h=.01)
```

```
## [1] 0.707095
```

```r
symdiff(sin, pi/4, h=.001)
```

```
## [1] 0.7071067
```

```r
symdiff(sin, pi/4, h=.0001)
```

```
## [1] 0.7071068
```

```r
symdiff(sin, pi/4)
```

```
## [1] 0.7071068
```

Section 5.1.2 The Second Derivative

```
findiff2 = function(f,x,h){
  return((f(x+h) - 2 * f(x) + f(x-h)) / h^2)
}

findiff2(sin, pi/4, h = 1e-4); -sin(pi/4)

## [1] -0.7071068

## [1] -0.7071068

findiff2(sin,3,h=1e-4); -sin(3)

## [1] -0.14112

## [1] -0.14112
```