# HW15

Zachary Palmore

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## 1

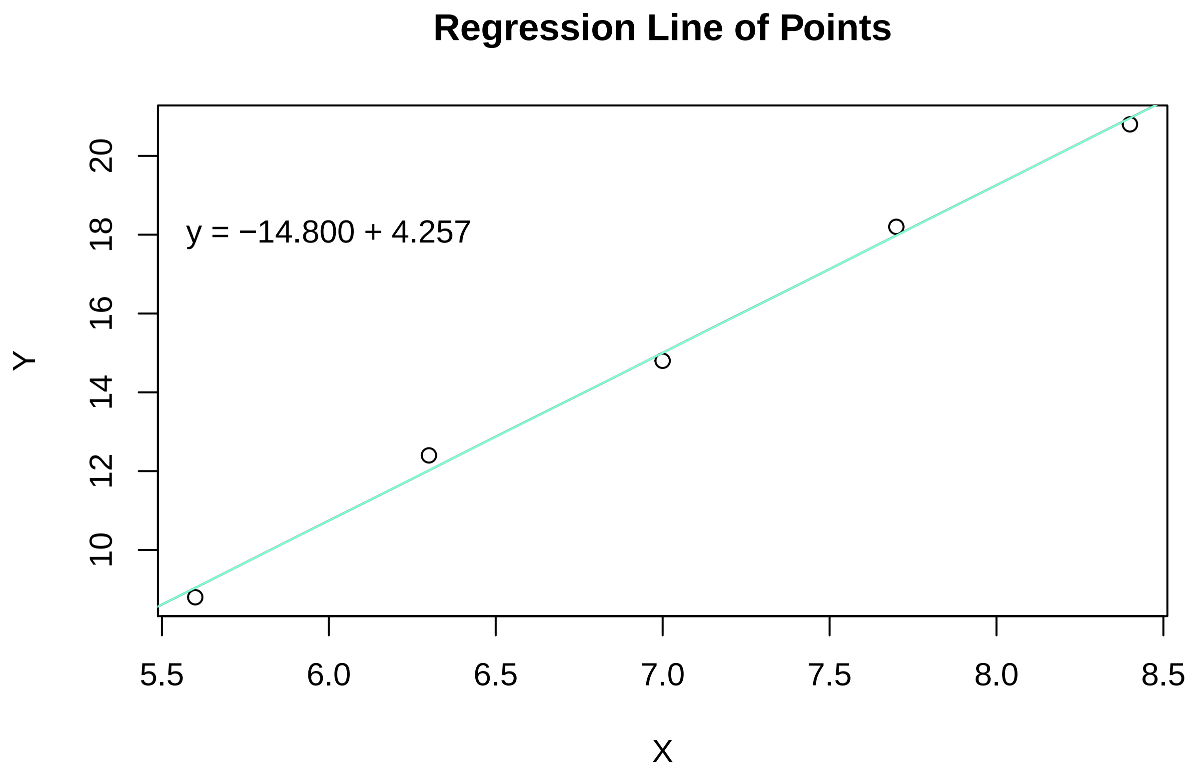
Find the equation of the regression line for the given points. Round any final values to the nearest hundredth, if necessary.

( 5.6, 8.8 ), ( 6.3, 12.4 ), ( 7, 14.8 ), ( 7.7, 18.2 ), ( 8.4, 20.8 )

```r
x = c(5.6, 6.3, 7, 7.7, 8.4)
y = c(8.8, 12.4, 14.8, 18.2, 20.8)
reg <- lm(y~x)
reg
```

```
##
## Call:
## lm(formula = y ~ x)
##
## Coefficients:
## (Intercept)            x
##     -14.800        4.257
```

```r
# Equation of the line based on coefficients: -14.800 + 4.257x
plot(x,y, xlab="X", ylab="Y", main = "Regression Line of Points")
abline(reg)
lines(c(5,9), -14.800 + 4.257*c(5,9), col="aquamarine")
text(6, 18, labels = "y = -14.800 + 4.257")
```




Rounded to the nearest hundreth the equation of the regression line is:

$$y = -14.80 + 4.26x$$

## 2

Find all local maxima, local minima, and saddle points for the function given below. Write your answer(s) in the form ( x, y, z ). Separate multiple points with a comma.

$$f(x, y) = 24x - 6xy^2 - 8y^3$$

$$f_x = 24 - 6y^2$$
$$f_y = -12xy - 24y^2$$
$$-6y^2 + 24 = 0$$
$$-12xy - 24y^2 = 0$$

$$y = \sqrt{\frac{24}{6}} \pm 2$$
$$x = -2y = 4$$

```
fz <- function(x,y){
  z = 24*x-6*x*y^2-8*y^3
  print(paste("x =", x, ",", "y=", y, ",", "z=", z))
}
fz(-4,2)
```

```
## [1] "x = -4 , y= 2 , z= -64"
```

The points separated with a comma in the format (x,y,z) are -4, 2, and -64.

## 3

A grocery store sells two brands of a product, the "house" brand and a "name" brand. The manager estimates that if she sells the "house" brand for x dollars and the "name" brand for y dollars, she will be able to sell $81 - 21x + 17y$ units of the "house" brand and $40 + 11x - 23y$ units of the "name" brand.

Step 1. Find the revenue function R ( x, y ).

$$R(x,y) = (81 - 21x + 17y)x + (40 + 11x - 23y)y$$
$$81x - 21x^2 + 17xy + 40y + 11xy - 23y^2$$
$$81x + 40y + 28xy - 21x^2 - 23y^2$$

Step 2. What is the revenue if she sells the "house" brand for \$2.30 and the "name" brand for \$4.10?

$$R(2.3, 4.1) = 81 * 2.3 + 40 * 4.1 + 28 * 2.3 * 4.1 - 21 * (2.3)^2 - 23 * (4.1)^2 = 116.62$$

## 4

A company has a plant in Los Angeles and a plant in Denver. The firm is committed to produce a total of 96 units of a product each week. The total weekly cost is given by $C(x,y) = \frac{1}{6}x^2 + \frac{1}{6}y^2 + 7x + 25y + 700$, where x is the number of units produced in Los Angeles and y is the number of units produced in Denver. How many units should be produced in each plant to minimize the total weekly cost?

Given: $C(x,y) = \frac{1}{6}x^2 + \frac{1}{6}y^2 + 7x + 25y + 700$

Where x is the units produced in LA and y units produced in Denver, we solve using the total units needed, 96, as shown:

$$\frac{1}{6}(96 - y)^2 + \frac{1}{6}y^2 + 7(96 - y) + 25y + 700$$
$$\frac{1}{6}(y^2 - 192y + 9216) + \frac{1}{6}y^2 + 18y + 25y + 1372$$
$$\frac{1}{3}y^2 - 14y + 2908$$

Then find the minimum value:

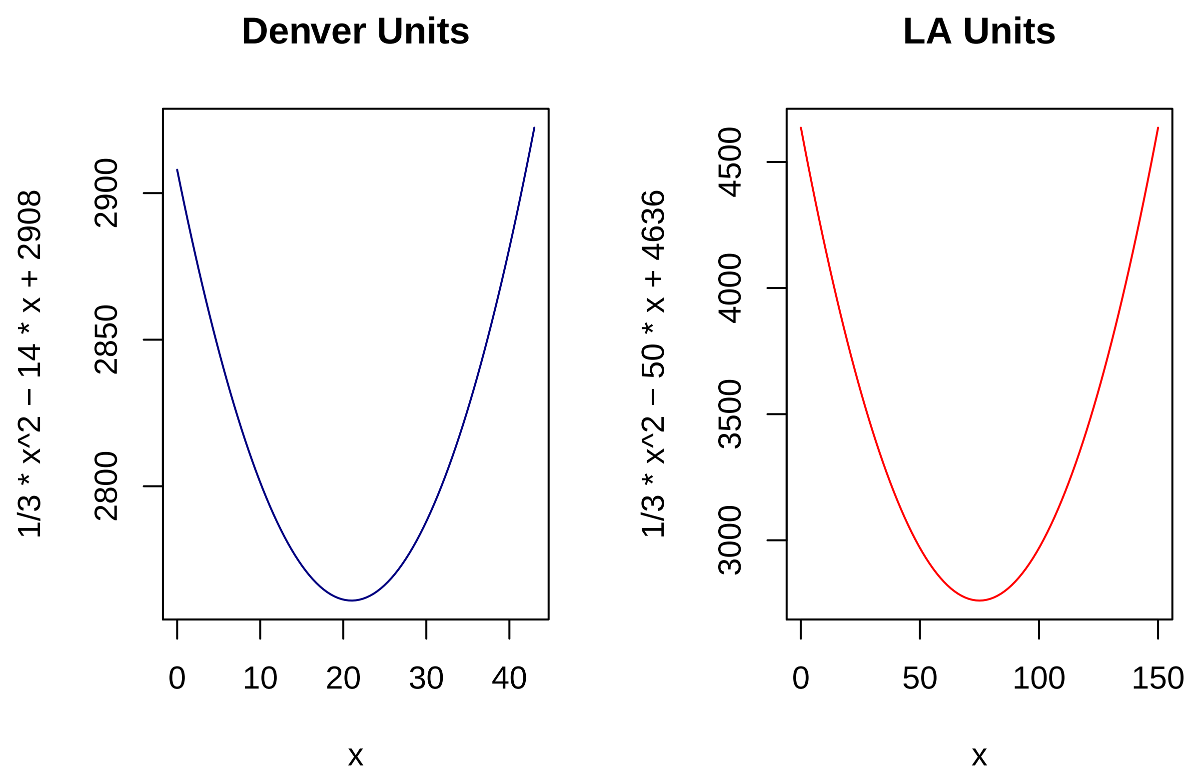
$z = \frac{d}{dy}(\frac{1}{3}y^2 - 14y + 2908$ $z = \frac{2}{3}y - 14$ $y = 21$

Substitute

$x = z - y$ $x = 96 - 21$ $x = 75$

We can also confirm this with the equations and local minima on plots of each location's unit production as shown below:

```r
par(mfrow=c(1,2))
curve(1/3*x^2-14*x+2908 , from = 0, to = 43, col="navy", main = "Denver Units")
curve(1/3*x^2-50*x+4636 , from = 0, to = 150, col="red", main = "LA Units")
```




It looks like our local minima are confirmed. Thus, for LA and Denver we have 75 units and 21 units respectively.

### 5

Evaluate the double integral on the given region.

$\int\int_R (e^{8x+3y})dA, R: 2 \leq x \leq 4 \ and \ 2 \leq y \leq 4$

Write your answer in exact form without decimals.

We have one form as:

```r
1/24*((exp(32)+exp(16))*(exp(12) - exp(6)))
```

```
## [1] 5.341561e+17
```

It could also be left in fractional form without decimals as mentioned:

$$\int_2^4 \int_2^4 (e^{8x+3y})\ dy\ dx \int_2^4 (\frac{1}{3}e^{8x+3y})|_2^4\ dx$$

$$\int_2^4 ((\frac{1}{3}e^{8x+12}) - (\frac{1}{3}e^{8x+6}))\ dx$$

$$\int_2^4 \frac{1}{3}e^{8x+6}(e^6-1)\ dx$$

$$\frac{1}{24}e^{38}(e^6-1) - \frac{1}{24}e^{22}(e^6-1)$$

$$\frac{1}{24}(e^6-1)(e^{38}-e^{22})$$

$$\frac{1}{24}(e^{22}-e^{28}-e^{38}+e^{44})$$

Without any decimals we have $\frac{1}{24}(e^{22}-e^{28}-e^{38}+e^{44})$