# 605 HW 15 - Jeff Shamp

2020-05-08

```r
library(ggplot2)
library(dplyr)
```

## Problem 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 )

This can be done easily in R.

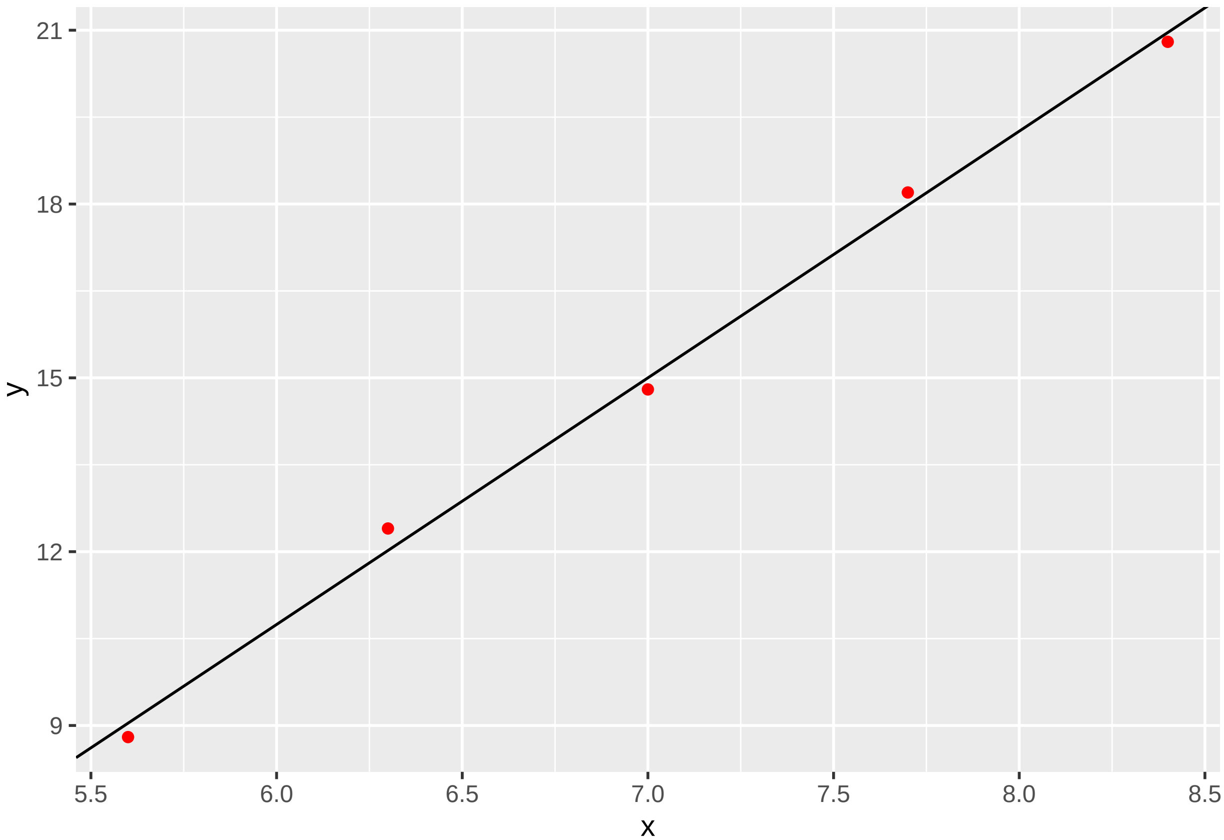
```r
data<- as.data.frame(matrix(c(5.6,8.8, 6.3, 12.4, 7,
                               14.8, 7.7, 18.2, 8.4, 20.8),
                             byrow=TRUE,
                             nrow = 5))
names(data)<- c("x", "y")

lin_reg<- lm(data=data, y ~ x)
summary(lin_reg)
```

```
##
## Call:
## lm(formula = y ~ x, data = data)
##
## Residuals:
##     1     2     3     4     5
## -0.24  0.38 -0.20  0.22 -0.16
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -14.8000     1.0365  -14.28 0.000744 ***
## x             4.2571     0.1466   29.04 8.97e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3246 on 3 degrees of freedom
## Multiple R-squared:  0.9965, Adjusted R-squared:  0.9953
## F-statistic: 843.1 on 1 and 3 DF,  p-value: 8.971e-05
```

```r
paste0("Equation of the line: y= ",
       lin_reg$coefficients[1],
       " + ",
       round(lin_reg$coefficients[2],2),"*x")
```

```
## [1] "Equation of the line: y= -14.8 + 4.26*x"
```

```r
data %>%
  ggplot(aes(x=x, y=y)) +
  geom_point(color="red") +
  geom_abline(slope = lin_reg$coefficients[2],
              intercept = lin_reg$coefficients[1])
```




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

To find the minimum we need the critical points for the partial derivatives. The partial derivatives are.

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

$f'_x(x,y) = \frac{d}{dx}(24x - 6xy^2 - 8y^3) = 24 - 6y^2$

$f'_y(x,y) = \frac{d}{dy}(24x - 6xy^2 - 8y^3) = -12xy - 24y^2$

Critical points are found by setting the partials to zero

$24 - 6y^2 = 0$

$y = \pm 2$

and

$-12xy - 24y^2 = 0$

$x = -2y$

Thus we get the points, $(-4, 2), (4, -2)$ for the xy plane. We can plug these values into the original equation to obtain the 3-space solutions for the minimum.

$24(-4) - 6(-4)(2^2) - 8(2)^3 = -64$

$24(4)6 - (4)(-2^2) - 8(-2)^3 = 64$

So we have critical points of $(x, y, z) = (-4, 2, -64), (4, -2, 64)$

For saddle points we can to the second derivative test for $D(p) < 0$ then p is a saddle point.

$\frac{d^2}{dx}(24 - 6y^2) = 0$

$\frac{d^2}{dy}(-12xy - 24y^2) = -12x - 48y$

$\frac{d^2}{dy}(24 - 6y^2) = -12y$

Since $D(x, y) = f"_x(x, y) * f"_y(x, y) - f"_{xy}(x, y)$ and $f"_x = 0$ D reduces simply to $-(144)^2 = -576$

So D(x,y) is less than zero, and both of these points are saddle points.

# Problem 3

I'm not sure that part of this problem is calculus as it seems like there is an easy answer to this.

**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).**

Revenue is simply the unit sold multiplied by their price per unit. So $x(81 - 21x + 17y) + y(40 + 11x - 23y)$

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

```
x<-2.3
y<-4.1
R<-x*(81- 21*x + 17*y)  + y*(40 +11*x -23*y)
paste("Revenue =", R, "USD")
```

```
## [1] "Revenue = 116.62 USD"
```

# Problem 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 inveach plant to minimize the total weekly cost?**

Since we must produce 96 in total for the two plants we have, $96 = x + y$ thus $y = 96 - x$. If we substitute this into the original equation and do a bunch to arithmetic we get the following equation for cost, C(x,y).

$C(x) = \frac{1}{3}x^2 - 50x + 4636$

Again if we wantt a minimum we can set the critical points to zero and solve.

$C'(x) = \frac{2}{3}x - 50 = 0$

so x = 75. Checking the second derivate for true minimum we get, $C"(x) = \frac{2}{3}$, which is greater than zero.

Since 75 is the number of unit produced in LA, we know that 21 units must be produced in Denver to minimize cost.

# Problem 5

**Evaluate the double integral on the given region.**

$\int_2^4 \int_2^4 e^{(8x+3y)} dA$

**Write your answer in exact form without decimals.**

This is easily separable, which is nice.

$\int_2^4 \int_2^4 e^{(8x+3y)} dxdy$

$\int_2^4 e^{(8x)} dx * \int_2^4 e^{(3y)} dy$

$\frac{1}{24} e^{8x}|_2^4 * e^{3y}|_2^4$

So in exact form we have

$A = \frac{1}{24}(e^{32} - e^{16})(e^{12} - e^{6})$

Which is some astronomical number.