Data 605: Assignment 15

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Contents

Functions of Several Variables

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)

```
# creating the points into x and y variables
x = c(5.6, 6.3, 7, 7.7, 8.4)
y = c(8.8, 12.4, 14.8, 18.2, 20.8)

# regression model
reg_lm = lm(y~x)

# summary of regression model
summary(reg_lm)
```

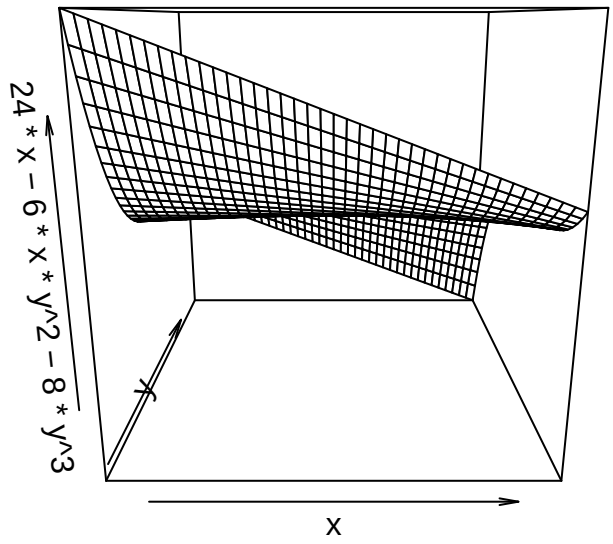
```
##
## Call:
## lm(formula = y ~ x)
##
## Residuals:
##     1     2     3     4     5
## -0.24  0.38 -0.20  0.22 -0.16
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -14.8000     1.0365  -14.28 0.000744 ***
## x             4.2571     0.1466   29.04 8.97e-05 ***
## ---
## 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
```

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

```
#install.packages('emdbook')
library(emdbook)
```

```
curve3d(24*x - 6*x*y^2 - 8*y^3, xlim = c(-5,5), ylim = c(-5,5))
```



f(x) = $24 - 6y^2$ f(y) = $-12xy - 24y^2$

Min and Max:

$24 - 6y^2 = 0$

$y^2 = 4$

y = ± 2

$-12xy - 24^2 = 0$

xy = 8

x = ± 4

The critical points would be (-4, 2)(4, -2)

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). h = number of "house" brand units sold n = number of "name" brand units sold

The revenue function is:

R = h(81 - 21x + 17y) + n(40 + 11x - 23y)

```
x = 2.3
y = 4.1
total <- -21*x^2 - 23*y^2 + 28*x*y + 81*x + 40*y

print(paste0("The revenue is $", total))
```

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

```
## [1] "The revenue is $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? x = number of units to be produced in LA

y = number of units to be produced in Denver

x + y = 96 = total products to be produced by both cities

y = 96 - x

Apply this to the equation : $C(x, y) = \frac{1}{6}x^2 + \frac{1}{6}y^2 + 7x + 25y + 700$

$C(x, y) = \frac{1}{6}x^2 + \frac{1}{6}(96 - x^2) + 7x + 25(96 - x) + 700$

$C(x, y) = \frac{1}{6}x^2 + 1536 - 32x + 7x + 2400 - 25x + 700$

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

$\frac{dc}{dx} = \frac{2}{3}x - 50 = 0$

x = $\frac{3}{2} * 50 = 75$ units when $\frac{dc}{dx}$ is 0

y = 96 - 75 = 21

Solution: There should be 75 units produced in LA and 21 units produced in Denver

5. Evaluate the double integral on the given region $\int\int(e^{8x+3y})dA; R : 2 \leq x \leq 4$ and $2 \leq y \leq 4$

```r
integrand <- function(y) {(1/8) * (exp(1)^16 - 1) * exp(1)^(3 * y + 16)}
volume = integrate(integrand, lower = 2, upper = 4)
print(volume, digits = 17)
```

Write your answer in exact form without decimals.

```
## 534155947497083840 with absolute error < 5930
```

```r
# set e value
e <- exp(1)
# compute
answer <- ((e^44 - e^38)/24) - ((e^28 - e^22)/24)
# print without scientific notation
format(answer, scientific = FALSE)
```

```
## [1] "534155947497083840"
```

References:

- For problem 2 I used code from: https://rpubs.com/nancunjie4560/894748 and https://rpubs.com/tponnada/838565 for the nice graphic from package 'emdbook'