Due: Mar. 01

Data Analysis and Decision Making

Last name Zhu First name Weijun

Home Work 1 Total marks are **10** which provide 5% to the total assessment. Students could implement the homework using R language or just stat tables. The solutions must be placed on the space allocated in this Home Work form. The additional pages will not be accepted.

The problems will be given from the Exercises Section of the Text book. Topic of this work includes Chapters 2 and 3.

1. **Exercise 2.2 (0.25 + 0.25 + 0.25 + 0.25 = 1 Mark)**

(a). (HHH) (HTH) (HHT) (HTT) (TTT) (THT) (TTH) (THH).

(b). $P(HHT) = \frac{1}{8}$

(c) P(The first two tosses in heads) $= \frac{2}{8} = \frac{1}{4}$

(d). P(two heads in a row among three tosses) $= \frac{3}{8}$

2. **Exercise 2.6 (0.5 + 0.5 = 1 Mark)**

(a) Morning: $1{,}000{,}000 \times 0.4 \times 1\% \times 40 - 120{,}000 = 40{,}000$;
Afternoon: $1{,}300{,}000 \times 0.4 \times 1\% \times 40 - 200{,}000 = 8{,}000$;
Prime time: $3{,}200{,}000 \times 0.4 \times 1\% \times 40 - 400{,}000 = 112{,}000$
Late Evening: $800{,}000 \times 0.4 \times 1\% \times 40 - 150{,}000 = -22{,}00$

Prime time is the highest

(b) One minute Morning & one minute Prime

$40{,}000 + 112{,}000 = 152{,}000$

$P(Positive|HIV)=0.99$ $P(HIV)=0.0022$
$P(neg|N\cdot HIV)=0.99$ $P(N\cdot HIV)=0.9978$

3. Exercise 2.9 (0.5 + 0.5 = 1 Mark)

(1) $P(HIV|Positive)=\frac{P(HIV\cap Positive)}{P(Positive)}=\frac{P(Positive|HIV)\cdot P(HIV)}{P(Positive)}$ $\rightarrow 0.002178$

$P(Positive)=P(HIV)\cdot P(Positive|HIV)+P(N\cdot HIV)\cdot P(Positive|N\cdot HIV)=0.012156$

$\Rightarrow P(HIV|Positive)=17.91\%$

(2). $\begin{cases} P(HIV')=0.0275 \\ P(N\cdot HIV')=0.09725 \end{cases}$ $\begin{cases} P(Positive|HIV')=0.99 \\ P(Negative|N\cdot HIV')=0.99 \end{cases}$ $P(HIV|Positive)=\frac{P(HIV\cap Positive)}{P(Positive)}$

$P(Positive)=P(HIV)\cdot P(Positive|HIV)+P(N\cdot HIV)\cdot P(Positive|N\cdot HIV)=0.036975$

$P(HIV|positive)=P(Positive|HIV)\cdot P(HIV)=0.027225$

$\therefore P(HIV|Positive)=\frac{0.027225}{0.036975}=73.631\%$

4. Exercise 2.16 (0.25 + 0.25 + 0.25 + 0.25 = 1 Mark)

(a). $E(X)=\Sigma X_i P_i=4$ $SD(X)=\sqrt{Var(X)}$ & $Var(X)=E(X^2)-[E(X)]^2=17.7-16=1.7\Rightarrow SD(X)=1.304$

(b) $E=4\times4800+30{,}000=49{,}200$; $SD(4800X+30000)=4800\,SD(X)=4800\times1.304=6259.2$

(c). $E=4\times4800+53{,}000=72{,}200$; $SD=1.304\times4800=6259.2$.

(d). $E=4\times7000+30{,}000=58{,}000$; $SD=1.304\times7000=9128$

5. Exercise 2.23 (1 Mark)

$CORR(X,Y)=\frac{COV(X,Y)}{\sigma_X\sigma_Y}=\frac{-17.7}{-7\times6.2}=0.4078$

? 6. **Exercise 2.24 a) and b) (0.5 + (0.2 + 0.2 + 0.2 + 0.2 + 0.2) = 1.5 Marks)**

(a). $E(0.5X+0.5Y)=0.5\times0.15+0.5\times0.2=0.175$

$SD(0.5X+0.5Y)=\sqrt{Var(0.5X+0.5Y)}$ & $Var(0.5X+0.5Y)=(0.5)^2\cdot(0.05)^2+(0.5)^2\cdot(0.06)^2+2\cdot0.5\cdot0.5\cdot0.05\cdot0.06\cdot0.3$

$=0.04444097$ $\qquad =0.001975$

(b). $0.5X+0.5Y$

$E(0.5X+0.5Y)=0.175$

$SD(0.5X+0.5Y)=\sqrt{Var(0.5X+0.5Y)}$ & $CORR(X,Y)=0.6 \Rightarrow Var(0.5X+0.5Y)=0.002425$

$=0.04924429$

When $\begin{cases} CORR=-0.6 & \sigma=0.025 \\ CORR=-0.3 & \sigma=0.0328 \\ CORR=0 & \sigma=0.039 \end{cases}$

7. (not from the text book) (0.5 + 0.5 = 1 Mark)

A quiz consists of 15 multiple choice questions. Each question has 5 choices, with exactly one correct choice. A student, totally unprepared for the quiz, guesses on each of the 15 questions.

a) How many questions should the student expect to answer correctly? What is the standard deviation of the number of questions answered correctly?

X: correct answers.

$E(X)=np=15\times\frac{1}{5}=3$

$SD(X)=\sqrt{npq}=\sqrt{15\times\frac{1}{5}\times\frac{4}{5}}=\sqrt{\frac{12}{5}}$

b) If at least 7 questions must be answered correctly to pass the quiz, what is the chance the student passes?

$P(X\geq7)=1-P(X\leq6)$

$=1-0.981942$

$\doteq0.0180588$

8. (not from the text book) (0.5 + 0.5 = 1 Mark) $POI(X=K)=\frac{u^k e^{-u}}{k!}$

Students arrive at a health center, according to a Poisson distribution, at a rate of 4 every 15 minutes. Let *x* represent number of students arriving in a 15 minute time period.

a) What is the probability that no more than 3 students arrive in a 15 minute time period?

$P(X<3)=P(X=0)+P(X=1)+P(X=2)\ \lambda\ u=4$

$=\frac{4^0e^{-4}}{0!}+\frac{4^1e^{-4}}{1!}+\frac{4^2e^{-4}}{2!}$

$\doteq 0.43347$

b) What is the probability that exactly 5 students arrive in a 15 minute time period?

$P(X=5)=\frac{u^k e^{-u}}{k!}$

$=\frac{4^5e^{-5}}{5!}=0.1569$

9. Exercise 3.12 (0.5 + 0.5 + 0.5 = 1.5 Marks)

$u=2.03\quad 6=0.08\qquad$ tornao's rate: X

(a). $P(X>2.08)=1-P(X\leq 2.08)=1-P(Z<\frac{2.08-2.03}{0.08})$

$=1-P(Z\leq 0.625)=1-73.4\%=26.6\%$

(b). $P(X<1.85)=P(Z<\frac{1.85-2.03}{0.08})=P(Z<-2.25)=0.01222$

(c). $P(2.00\leq X\leq 2.20)=F_X(2.20)-F_X(2.00)=0.629375$

Due: Apirl. 03

Data Analysis and Decision Making HW#2

Last name Zhu First name Weijun

Home Work 2 Total marks are **10** which provide 5% to the total assessment. Students could implement the homework using R language or just stat tables. The solutions must be placed on the space allocated in this Home Work form. The additional pages will not be accepted.

The problems will be given from the Exercises Section of the Text book. Topic of this work includes Chapters 4 and 6.

1. Exercise 4.2 (0.5 + 0.5 + 0.5 + 0.5 = 2 Marks)

An insurance company would like to estimate the average amount claimed by its policyholders over the past year. A random sample of 300 policyholders was chosen, whose observed sample mean was \$739.98 and whose sample standard deviation was \$312.70. $\begin{cases} u = 739.38 \\ \sigma = 312.70 \end{cases}$

(a) Construct a 95% confidence interval for the average amount claimed by policyholders in the last year. $1-\alpha=0.95 \Rightarrow \frac{\alpha}{2}=0.025$; $\bar{X} \pm Z_{0.025}\frac{S}{\sqrt{n}}$ ∴ $739.98 \pm 1.96\,\frac{312.70}{\sqrt{300}}$ ∴ $[704.594, 775.365]$

(b) Construct a 99% confidence interval for the average amount claimed by policyholders in the last year. $1-\alpha=0.99 \Rightarrow \frac{\alpha}{2}=0.005$; $\bar{X}+Z_{0.005}\frac{S}{\sqrt{n}}$ ∴ $739.98 \pm 2.576 \cdot \frac{312.70}{\sqrt{300}}$ $[693.474, 786.486]$

(c) Determine the required sample size in order to estimate the average amount claimed by policyholders to within ± \$30.00 at the 95% confidence level.

$1-\alpha=0.95 \Rightarrow \frac{\alpha}{2}=0.025$; $-30 \leq Z_{0.025}\frac{\sigma}{\sqrt{n}} \leq 30$ ∴ $-30 \leq 1.96 \cdot \frac{312.70}{\sqrt{n}} \leq 30$.

$n \geq 418$.

(d) The company's primary concern is to avoid underestimating the average amount claimed by its policyholders. Determine a value b so that the insurance company is 95% confident that the average amount claimed by its policyholders is b or less.

$739.98 + Z_{0.05} \times \frac{312.70}{\sqrt{300}}$

$\Rightarrow 739.98 + 1.645 \times \frac{312.70}{\sqrt{300}}$

$b \in [0, 769.678]$

2. Exercise 4.9 (0.5 + 0.5 = 1 Mark)

A soft-drink company would like to estimate the proportion of consumers who like the taste of their new carbonated beverage. In a random sample of 200 consumers, 54 of the consumers liked the taste of the new beverage.

(a) Construct a 99% confidence interval for the proportion of consumers who like the taste of the new beverage. $1-\alpha=0.99 \Rightarrow \frac{\alpha}{2}=0.005$; $\hat{p} \pm Z_{0.005}\sqrt{\frac{\frac{54}{200}\cdot\frac{146}{200}}{200}}$; $\frac{54}{200} \pm 2.576\sqrt{\frac{\frac{54}{200}\cdot\frac{146}{200}}{200}}$ $[0.18, 0.35]$

(b) Determine the required sample size in order to estimate the proportion of consumers who like the taste of the new beverage to within 1% at the 95% confidence level.

$Z_{0.025}\sqrt{\frac{\frac{54}{200}\cdot\frac{146}{200}}{n}} \leq 0.01$; $1.96\sqrt{\frac{0.27\times0.73}{n}} \leq 0.01$

$1.96\sqrt{\frac{0.1971}{n}} \leq 0.01$

$n \geq 7572$

3. Exercise 4.16 (0.5 + 0.5 = 1 Mark)

An information technology service at a large university surveyed 200 students from the College of Engineering and 100 students from the College of Arts. Among the survey participants, 91 Engineering students and 73 Arts students owned a laptop computer.

(a) Construct a 98% confidence interval for the difference between the proportions of laptop owners among Engineering and Arts students.

(b) Can you conclude that the difference between proportions of laptop owners among Engineering and Arts students is significant at 98% confidence level? Justify your answer.

(a). $1-\alpha=0.98 \Rightarrow \frac{\alpha}{2}=0.01$ $\left(\frac{91}{200}-\frac{73}{100}\right) \pm 2.326\sqrt{\frac{\left(\frac{91}{200}\right)\cdot\left(\frac{109}{200}\right)}{200}+\frac{\left(\frac{73}{100}\right)\left(\frac{27}{100}\right)}{100}}$

$[-0.4068, -0.1432]$

(b). Zero does not include in the confidence interval. Therefore, it seems not possible $P_1=P_2$. So we can conclude that there difference between P_1 & P_2.

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4. Exercise 4.17 (0.5 + 0.5 = 1 Mark) Store① $\begin{cases} \bar{X}=41.25 \\ 6=24.25 \end{cases}$ Store② $\begin{cases} \bar{X}=45.75 \\ 6=34.76. \end{cases}$

At two different branches of a department store, pollsters randomly sampled 100 customers at store 1 and 80 customers at store 2, all on the same day. At Store 1, the average amount purchased was $41.25 per customer with a sample standard deviation of $24.25. At Store 2, the average amount purchased was $45.75 with a sample standard deviation of $34.76.

(a) Construct a 95% confidence interval for the mean amount purchased per customer in each of the two stores.

(b) Construct a 95% confidence interval for the difference between the means of purchases per customer of the two stores.

(a). $1-\alpha=0.95 \Rightarrow \frac{\alpha}{2}=0.025$

Store ①: $\bar{X} \pm Z_{0.025}\frac{S}{\sqrt{n}}$; $41.25 \pm 1.96\frac{24.25}{\sqrt{100}}$. [36.497, 46.003].

Store ②: $\bar{X} \pm Z_{0.025}\frac{S}{\sqrt{n}}$; $45.75 \pm 1.96\frac{34.76}{\sqrt{80}}$ [38.133, 53.367] → use calculator

[38.226, 53.274] → use R code.

(b). $(\bar{X}_1-\bar{X}_2) \pm Z_{0.025}\sqrt{\frac{S_1^2}{n_1}+\frac{S_2^2}{n_2}}$

$(41.25-45.75) \pm 1.96\sqrt{\frac{(24.25)^2}{100}+\frac{(34.76)^2}{80}}$

$(-4.5) \pm 1.96\sqrt{\frac{24.25^2}{100}+\frac{34.76^2}{80}}$.

[-13.478, 4.47].

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5. Exercise 6.1 (0.5 + 0.5 + 0.5 + 0.5 + 0.5 = 2.5 Marks)

Table below contains data collected by VARMAX Realty on twenty houses. Column 2 of this table shows the selling price of each house, and Column 3 shows the total area of the house, measured in $(\text{feet})^2$. The fourth column of the table is a rating of the quality of the neighborhood in which the house is located, rated on a scale of 1 through 5 with 1 being the lowest ranking. Similarly, Column 5 of the able contains a rating of the general condition of the house, also rated as a number between 1 and 5 with 1 being the lowest ranking. VARMAX would like to use the data in the Table to develop a linear regression model to predict the price of houses as a function of the area of the house, the neighborhood rating, and the condition rating of the house.

House number	Price ($1000)	Area (feet^2)	Neighborhood Quality Rating (1-5)	General Condition Rating (1-5)
1	350	2100	2	5
2	280	1560	4	4
3	285	2420	4	2
4	210	1201	5	3
5	450	3020	4	3
6	465	4200	3	4
7	405	2100	3	5
8	440	2356	5	3
9	345	4000	3	2
10	375	1980	3	5
11	290	2220	2	3
12	490	4500	5	1
13	250	1450	5	4
14	235	2300	2	4
15	105	1354	1	3
16	310	3560	3	2
17	215	2580	1	3
18	440	2300	5	5
19	415	3890	2	4
20	270	2100	4	1

(a) Construct and run a regression model to predict the price of a house based on the three independent variables for the area, the neighborhood rating, and the condition rating of the house.

(b) Evaluate the regression output of your regression model. Is the regression model overall significant? Answer by formulation the null and alternative hypotheses.

(c) Are the linear coefficients for 3 input variables significant? Answer by formulation the null and alternative hypotheses.

(d) What can you say about predictive power of this model? Answer this question by commenting the coefficient of determination R^2.

(e) What is the predicted price of a house whose area is 3,000 square feet with a neighborhood ranking of 5 and a general condition ranking of 4?

6. Exercise 6.1 (extension) (0.5 + 0.5 + 0.5 = 1.5 Marks)

Use the data from problem 5:

(a) Implement the simple regression Price = $\beta_0 + \beta_1$ xArea + ε. Print the summary of this single regression model.

(b) Is this model significant?

(c) Compare this model with multiple variable regression from question 5. Which model is better for predicting the house prices by VARMAX Realty?

7. Exercise (not from the text book) (0.5 + 0.5 = 1 Mark)

A company manager is interested in the relationship between x = number of years that an employee has been with the company and y = the employee's annual salary (in thousands of dollars). The following MINITAB output is from a regression analysis for predicting y from x for n = 15 data points.

Predictor	Coef	St. Dev	t-ratio	p
Constant	16.8221	0.3887	43.28	0.000
X	0.64983	0.02617	24.83	0.000

s = 0.8081 R^2= 0.979 R^2 (adj) = 0.978

(a) Calculate the correlation coefficient. What sign does it have? Why?

(b) Is the correlation coefficient significant? Justify your answer.

(a). correlation coefficient : $r = \sqrt{R^2} = \sqrt{0.978} = 0.9889388$, and it's positive sign because the coefficient of X is 0.64983

(b). Yes, it is significant. because the p-value is really small. and it almost goes to zero.

DADM

HW#2 Weijun Zhu.

Problem 5

(a). $\hat{y}_i = -166.7433 + 0.08807 \times Area + 39.91312 \times NQR + 42.68713 \times GCR$

(b). $H_0: \beta_1 = \beta_2 = \beta_3 = 0$; H_a: at least one coefficient is non-zero

P-value: 5.346×10^{-6}, and P-value is very small.

We can find at least one coefficient is non-zero.

So, this is overall significant.

(c). Yes. From R code, we can get

Area ***

Neighborhood Quality Rating ***

General Condition Rating ***

So, these three variables are significant because P-value is really small.

(d). Adjusted R^2: 0.7734. Multiple R^2: 0.8092

We know $R^2 \in [0, 1]$, and if R^2 is close to "1", this model is good.

From R code, we know "adjusted R^2: 0.7734", it is close to "1", So we can say this model is accepectable.

(e). $\hat{y}_i = -166.7433 + 0.08807 \times 3000 + 39.91312 \times 5 + 42.68713 \times 4$

$= 467.77977$

DADM

HW#2 Weijun Zhu

Problem 6

(a).

```
Call:
lm(formula = Price ~ Area)

Residuals:
     Min       1Q   Median       3Q      Max
-145.727  -47.425   -6.127   57.699  126.086

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 160.28797   52.11014   3.076  0.00651 **
Area          0.06679    0.01907   3.503  0.00254 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 81.63 on 18 degrees of freedom
Multiple R-squared:  0.4053,	Adjusted R-squared:  0.3723
F-statistic: 12.27 on 1 and 18 DF,  p-value: 0.002541
```

(b). P-value is 0.002541, and it's really small.
So, it's overall significant.

(c). The model in Problem 5 is better. Adjusted $R^2=0.3723$ for Problem 6, and it's smaller than Problem 6. So. Promble 5 is better.

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Data Analysis and Decision Making HW#3

Last name Zhu First name Weijun Due: Apr. 24

Home Work 3 Total marks are **10** which provide 5% to the total assessment. Students could implement the homework using R language or just stat tables. The solutions must be placed on the space allocated in this Home Work form. The additional pages will not be accepted.

The problems will be given from the Exercises Section of the Text book. Topic of this work covers Chapters 7.

1. Exercise 7.1 (1 + 1 + 1 +1 = 4 Marks)

A computer parts manufacturer produces two types of monitors: monochrome and color. There are two production lines, one for each type of monitor. The monochrome monitor line has a daily capacity of 700 units per day. The color monitor line has a daily capacity of 500 units per day. In department A, the tubes are produced for both monitor lines. In department A, the production of a monochrome tube requires one hour of labor, and a color monitor requires two hours of labor. Total daily labor hours in department A is 1,200 hours. In department B, the monitors are inspected. The monochrome monitor requires 3 hours of labor for inspection. The color monitor requires 2 hours of labor for inspection. A total of 2,400 hours of labor are available in department B. The monochrome monitor nets an earnings contribution of $40 per unit. The color monitor nets an earnings contribution of $30 per unit.

In order to maximize the net earnings of the company, we set up a linear optimization model with decision variables M for the daily production of monochrome monitors (in hundreds of monitors), and C for the daily production of color monitors (in hundreds of monitors).

The linear optimization model is:

Maximize $40M + 30C$ subject to:

M capacity: $M \le 7$

C capacity: $C \le 5$

A labor: $M + 2C \le 12$

B labor: $3M + 2C \le 24$

Nonnegativity: $M, C \ge 0$.

(a) Solve the linear optimization model graphically. Show each constraint, the feasible region, and identify the optimal solution.

(b) Which two constraints are binding at the optimal solution? Solve these two constraints in the two unknowns to compute the optimal production plan exactly. What is M? What is C? What is the contribution to earnings?

(c) Consider the labor constraint for department A: $M + 2C \le 12$. Suppose the number 12 was changed to 13, i.e., we had an additional 100 labor hours in department A. Re-solve the two equations in two unknowns to compute the new values of M and C, and the new optimal contribution to earnings.

(d) Compare the new contribution to earnings to the old contribution to earnings of part (b). What does the difference in the earnings indicate about the marginal value of labor in department A?

maximum: $120F + 130C$

$$\begin{cases} 2F + C \le 500 \\ 2F + 3C \le 800 \\ F \le 220 \\ C \le 180 \end{cases}$$

2. Exercise 7.2 (1 + (1 + 1 + 1) + 1 = 5 Marks)

The Magnetron Company manufactures and markets microwave ovens. Currently, the company produces two models: full-size and compact. Production is limited by the amount of labor available in the general assembly and electronic assembly departments, as well as by the demand for each model. Each full-size oven requires 2 hours of general assembly and 2 hours of electronic assembly, whereas each compact oven requires 1 hour of general assembly and 3 hours of electronic assembly. In the current production period, there are 500 hours of general assembly labor available and 800 hours of electronic assembly labor available.

In addition, the company estimates that it can sell at most 220 full size ovens and 180 compact ovens in the current production period. The earnings contribution per oven is $120 for a full-size oven and $130 for a compact oven. The company would like to find an earnings-maximizing production plan for the current production period.

(a) Formulate the above problem as a linear optimization model.

(b) Solve the linear optimization model graphically. Plot the constraints, identify each constraint and the feasible region. Answer the following questions:
   (i) What is the optimal solution?
   (ii) Which constraints are binding at the optimal solution?
   (iii) What is the value of the objective function at the optimal solution (indicate units)?

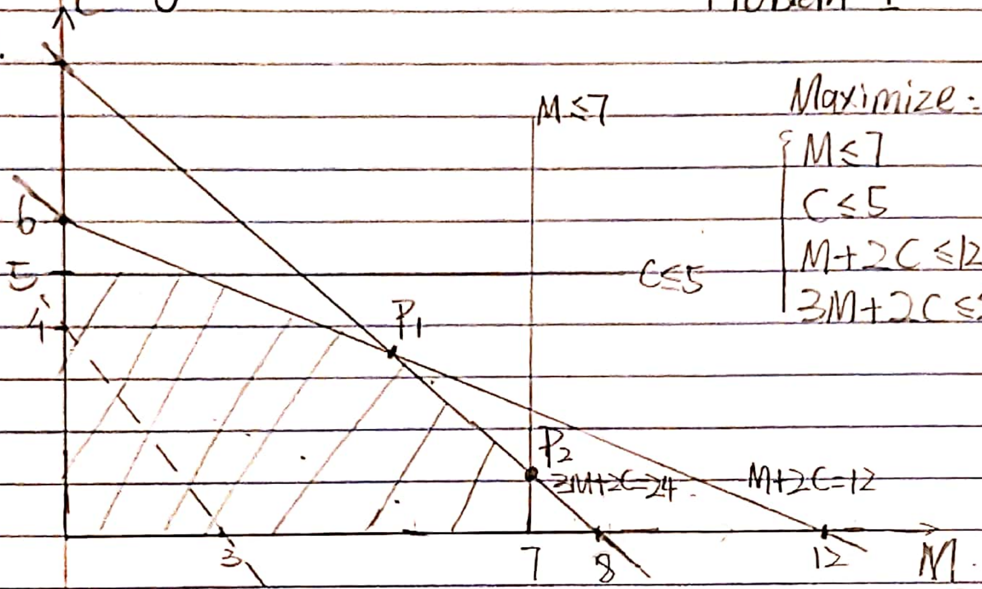
(c) Consider the general assembly labor constraint. Suppose that the number 500 was changed to 510, i.e., the company has an additional 10 hours of general assembly labor. Re-solve the equations of the binding constraints to compute the new optimal solution. How does the new contribution to earnings differ from the contribution to earnings in part (b)? What is the marginal value of general assembly labor?

3. **(1 Mark)** Solve Problem 2 (Exercise 7.2) by computer using either EXCEL or R LP solvers. The detailed instruction on Excel LP solver can be found on the page: https://www.academia.edu/26889036/Solving_Linear_Programming_and_Transportation_Problems_with_Excel_Solver_in_Microsoft_Excel_2010

DADM
HW#3
Weijun Zhu 191004254

Problem 1

1.(a).



Maximize: $40M+30C$

$\begin{cases} M\le 7 \\ C\le 5 \\ M+2C\le 12 \\ 3M+2C\le 24 \end{cases}$

$P_1: \begin{cases} M+2C=12 & ① \\ 3M+2C=24 & ② \end{cases} \Rightarrow$ ②−①: $2M=12 \Rightarrow M=6$ & $C=3$.

$\therefore 40M+30C=40\times 6+30\times 3=240+90=330$.

$P_2: \begin{cases} M=7 \\ 3M+2C=24 \end{cases} \Rightarrow C=1.5$ & $M=7$.

$\therefore 40M+30C=40\times 7+30\times 1.5=280+45=325$

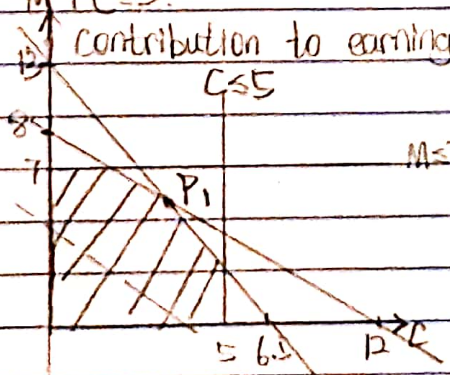
So, the optimal solution is 330 hundards.

(b). The constraints are $\begin{cases} 3M+2C=24 \\ M+2C=12 \end{cases}$

$\begin{cases} M=6 \\ C=3 \end{cases}$

contribution to earning: $40M+30C=40\times 6+30\times 3=330$.

(c).



M≤7

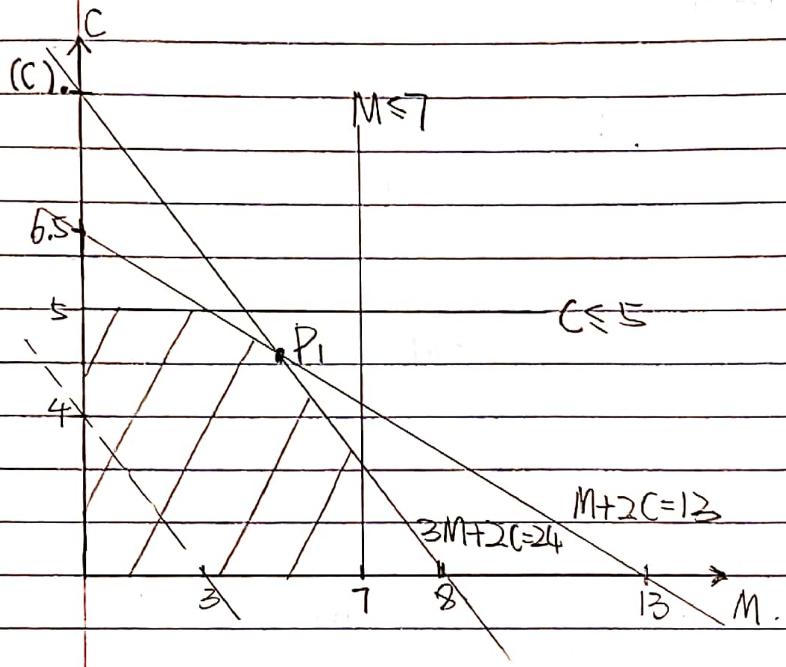
$\begin{cases} 3M+2C=24 \\ M+2C=13 \end{cases}$ $\begin{cases} M=5.5 \\ C=3.75 \end{cases}$

So, the optimal Solution is:

$40M+30C=40\times 5.5+30\times 3.75=332.5$

(d). The Marginal value is:

$332.5-330=2.5$

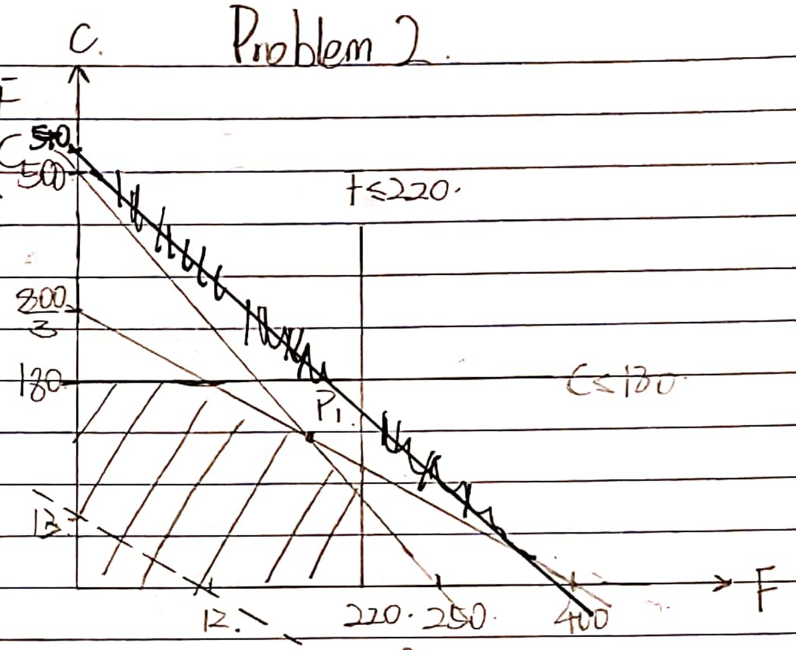

C
(C)
M≤7
6.5
5
C≤5
P1
4
M+2C=13
3M+2C=24
3
7
8
13
M.

Problem 2.

2.(a). Assume that: { Full-Size: F
Compact: C

Maximum: $\$120F + \$130C$

$$\begin{cases} 2F + C \le 500 \\ 2F + 3C \le 800 \\ F \le 220 \\ C \le 180 \end{cases}$$



(b). (i) $\begin{cases} 2F + C = 500 \text{ ①} \\ 2F + 3C = 800 \text{ ②} \end{cases} \Rightarrow ② - ① \; 2C = 300 \Rightarrow C = 150 \;\&\; F = 175$

So, the optimal solution $C = 150 \;\&\; F = 175$.

Maximum $\$120 \times 175 + \$130 \times 150 = 40{,}500$.

(ii) constraints $\begin{cases} 2F + C \le 500 \\ 2F + 3C \le 800 \end{cases}$

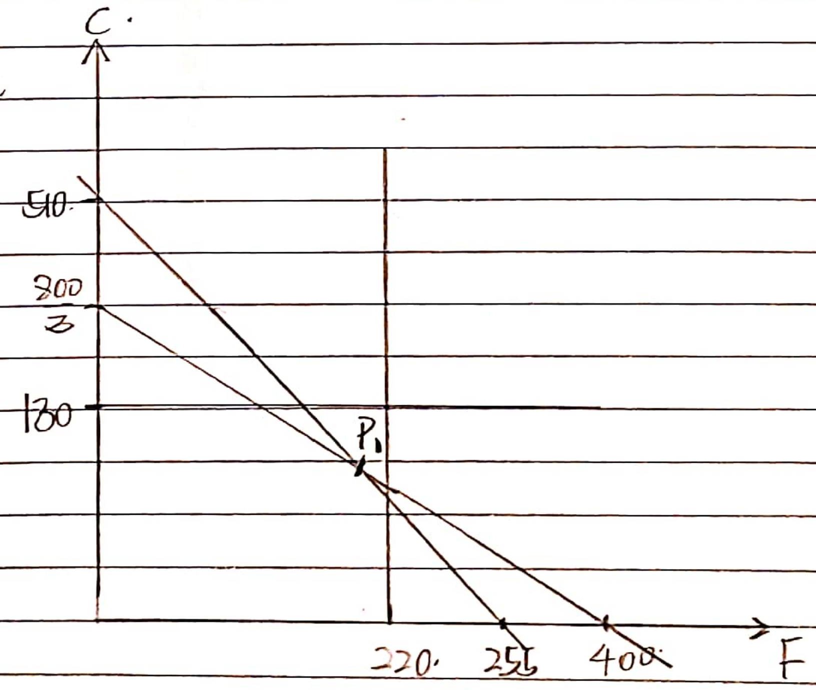
(iii) $\begin{cases} C = 150 \\ F = 175 \end{cases}$

(c). Maximum: $\$120F + \$130C$

$$\begin{cases} F \le 220 \\ C \le 180 \\ 2F + C \le 510 \text{ ③} \\ 2F + 3C \le 800 \text{ ④} \end{cases}$$

Compute ③ & ④. We get:

$C = 145 \;\&\; F = 182.5$



```r
                         ######### Problem_03 #########
library(lpSolve)
# Maximum: 120F + 130C
# 2F + C <= 500
# 2F + 3C <= 800
# F <= 220
# c <= 180

## Set the coefficients of the decision variables
objective.in  <- c(120,  130)

## Create constraint martix
const.mat <- matrix(c(2, 1,
                      2, 3,
                      1, 0,
                      0, 1),  nrow=4, byrow=TRUE) ### [redacted]

const.mat
## define constraints
x1 <- 500
x2 <- 800
x3 <- 220
x4 <- 180

## RHS for the constraints
const.rhs <- c(x1, x2, x3, x4)

## Constraints direction
const.dir  <-  c("<=",  "<=", "<=",  "<=")

## Find the optimal solution
optimum  <-  lp(direction="max",  objective.in, const.mat, const.dir,  const.rhs)

## Display the optimum values
optimum$solution
```

$$\begin{cases} C=150 \\ F=175 \end{cases}$$

```
                    ######### Problem_03 #########
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# Maximum: 120F + 130C
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$\begin{cases} C=145 \\ F=182.5 \end{cases}$