MGMT-3453-X20: Homework 4-7

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```
library(tidyverse)
```

Problem 4

Homework Problem 4

- A firm that has recently experienced an enormous growth rate is seeking to lease a small plant in either Memphis, Biloxi, or Birmingham. Prepare an economic analysis of the three locations given the following information:
- Annual costs for building, equipment, and administration would be $1,400,000 for Memphis, $1,940,000 for Biloxi, and $1,100,000 for Birmingham. Labor and material are expected to be $10 per unit in Memphis, $6 per unit in Biloxi, and $20 per unit in Birmingham. The Memphis location would increase system transportation costs by $50,000 per year, the Biloxi location would increase them by $60,000 per year, and the Birmingham location would increase those costs by $25,000 per year. Expected annual volume is 60,000 units.

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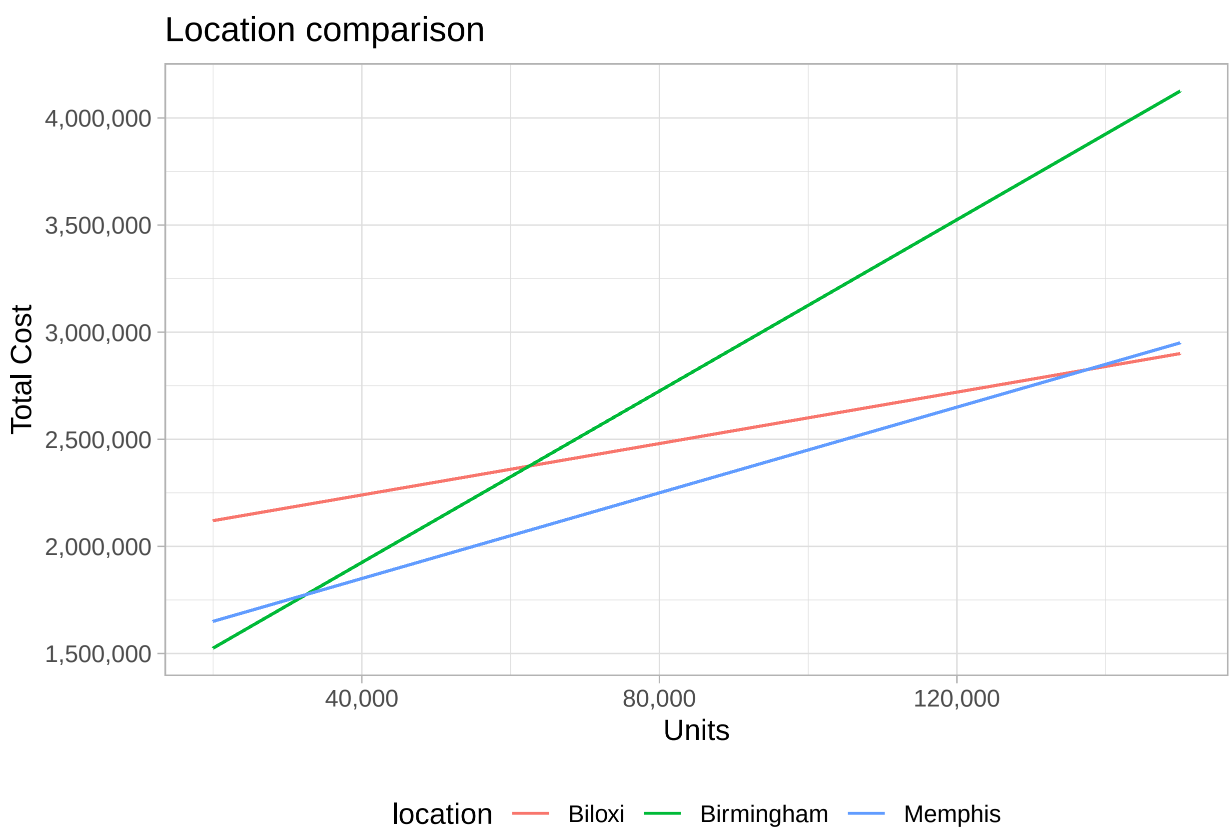
```
# Memphis - increase system transit cost 50,000
m_fixed_cost = 1400000 + 50000
# $10/ unit
m_variable_cost = 10

#  Biloxi - increase system transit cost 60,000
bx_fixed_cost = 1940000 + 60000
# $6/unit
bx_variable_cost  = 6

#  Birmingham - increase system transit cost 25,000
b_fixed_cost = 1100000 + 25000
# $20/unit
b_variable_cost = 20

annual_volume = 60000
```

Break-Even Analysis

`TotalCost = FixedCost + (VariableCost * AnnualUsage)`

```r
tibble::tibble(
  location = c('Memphis', 'Biloxi', 'Birmingham'),
  fixed_cost = c(m_fixed_cost, bx_fixed_cost, b_fixed_cost),
  variable_cost = c(m_variable_cost, bx_variable_cost, b_variable_cost),
) %>%
  group_split(location) %>%
  map_df(~ bind_cols(., tibble(amount = 20000:150000))) %>%
  mutate(total_cost = fixed_cost + (variable_cost * amount)) %>%
  ggplot(aes(amount, total_cost, color = location)) +
  geom_line() +
  labs(title="Location comparison", x = 'Units', y='Total Cost') +
  scale_y_continuous(labels = scales::comma_format()) +
  scale_x_continuous(labels = scales::comma_format()) +
  theme(legend.position = 'bottom')
```



Answer: Birmingham V. Mephis

```r
# < Indifference point:
# Birmingham
# > Indifference point:
# Memphis
# Indifference point:
(b_fixed_cost - m_fixed_cost) / (m_variable_cost -  b_variable_cost )
```

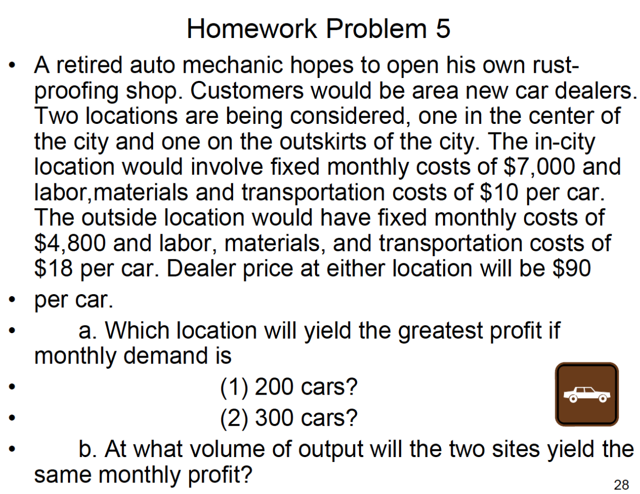
```
## [1] 32500
```

Answer: Memphis V. Biloxi

```r
# < Indifference point:
# Memphis
# > Indifference point:
# Biloxi
# Indifference point:
(bx_fixed_cost - m_fixed_cost) / (m_variable_cost -  bx_variable_cost )
```

```
## [1] 137500
```

Problem 5



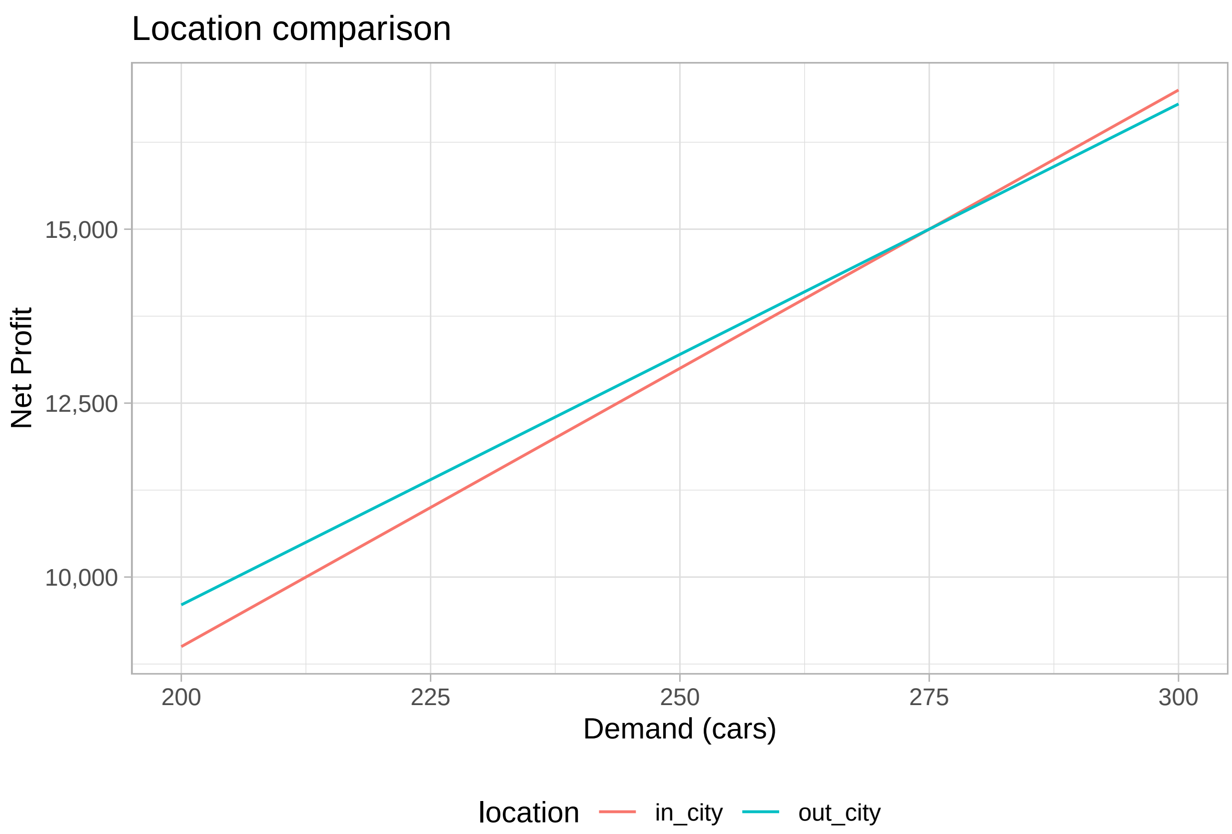

```r
# In City
city_fixed_cost = 7000
city_variable_cost = 10
# Outside City
out_fixed_cost = 4800
out_variable_cost = 18

# Dealer Price
price = 90
demand_1 = 200
demand_2 = 300
```

```r
demand = c(demand_1, demand_2)
resp <- tibble(
  location = c('in_city', 'out_city'),
  fixed_cost = c(city_fixed_cost, out_fixed_cost),
  variable_cost = c(city_variable_cost, out_variable_cost),
  price = price
```

```
) %>%
  crossing(demand) %>%
  mutate(
    total_revenue = price * demand,
    total_variable_cost = variable_cost * demand,
    total_cost = total_variable_cost + fixed_cost,
    net_profit = total_revenue - total_cost
  )

resp %>%
  knitr::kable()
```

location	fixed_cost	variable_cost	price	demand	total_revenue	total_variable_cost	total_cost	net_profit
in_city	7000	10	90	200	18000	2000	9000	9000
in_city	7000	10	90	300	27000	3000	10000	17000
out_city	4800	18	90	200	18000	3600	8400	9600
out_city	4800	18	90	300	27000	5400	10200	16800

```
resp %>%
  ggplot(aes(demand, net_profit, color = location)) +
  geom_line() +
  scale_y_continuous(labels=scales::comma_format()) +
  labs(title = 'Location comparison',
       x = 'Demand (cars)', y = 'Net Profit') +
  theme(legend.position = 'bottom')
```



Answer: Indefference point

```
# > Indifference point:
# Out City
# < Indifference point:
# In City
(city_fixed_cost - out_fixed_cost) / (out_variable_cost - city_variable_cost)
```

```
## [1] 275
```

Problem 6

Operation Homework # 6

- Solve the following transportation problem.

From\To	A	B	C	D	Supply
1	10	10	9	15	360
2	9	8	5	10	250
3	8	5	13	7	300
Demand	260	400	250	300	1210/910

From\To	A	B	C	D	Supply
1	10	10	9	15	360
2	9	8	5	10	250
3	8	5	13	7	300
DUMMY	0	0	0	0	300
DEMAND	260	400	250	300	1210\1210

Note Supply=Demand
Balanced Problem
Final Cost = 6,350
Dummy – D 300

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```
library(lpSolve)

# specifying cost matrix
cost.mat <- matrix(nrow=4,ncol=4)
cost.mat[1,] <- c(10, 10, 9, 15)
cost.mat[2,] <- c(9, 8, 5, 10)
cost.mat[3,] <- c(8, 5, 13, 7)
cost.mat[4,] <- c(0, 0, 0, 0)

# this is a minimization problem
direction = "min"

# capacity may not be exceeded
row.signs <- rep("<=",4)
row.rhs <- c(360, 250, 300, 300)

# demand must be satisfied
col.signs <- rep(">=",4)
col.rhs <- c(260, 400, 250, 300)

solution <- lp.transport(
```

```
  cost.mat = cost.mat,
  direction = direction,
  row.signs = row.signs,
  row.rhs = row.rhs,
  col.signs = col.signs,
  col.rhs = col.rhs
  )

cols_ <- c('A', 'B', 'C', 'D')
rows_ <- c('1', '2', '3', '4')

answer <- solution$solution
rownames(answer) <- rows_
colnames(answer) <- cols_

message('Solution:', solution$objval)
```

```
## Solution:6350
```

```
##     A   B   C   D
## 1 260 100   0   0
## 2   0   0 250   0
## 3   0 300   0   0
## 4   0   0   0 300
```

Problem 7

Operations Homework # 7

From\To	D	E	F	G	H	Supply
A	10	40	10.4	17	10.3	520
B	8.5	25	7.5	2.5	4	200
C	10.5	10	9	8.4	3.5	200
Demand	150	200	250	190	130	920\920

Note: Problem is Balanced

```
library(lpSolve)

# specifying cost matrix
cost.mat <- matrix(nrow=3,ncol=5)
cost.mat[1,] <- c(10, 40, 10.4, 17, 10.3)
cost.mat[2,] <- c(8.5, 25, 7.5, 2.5, 4)
cost.mat[3,] <- c(10.5, 10, 9, 8.4, 3.5)
#cost.mat[4,] <- c(0, 0, 0, 0)
```

```r
# this is a minimization problem
direction = "min"

# capacity may not be exceeded
row.signs <- rep("<=",3)
row.rhs <- c(520, 200, 200)

# demand must be satisfied
col.signs <- rep(">=",5)
col.rhs <- c(150, 200, 250, 190, 130)

solution <- lp.transport(
  cost.mat = cost.mat,
  direction = direction,
  row.signs = row.signs,
  row.rhs = row.rhs,
  col.signs = col.signs,
  col.rhs = col.rhs
  )

cols_ <- c('D', 'E', 'F', 'G', 'H')
rows_ <- c('A', 'B', 'C')

answer <- solution$solution
rownames(answer) <- rows_
colnames(answer) <- cols_

message('Solution:', solution$objval)
```

```
## Solution:7851
```

```
##     D   E   F   G   H
## A 150   0 250   0 120
## B   0   0   0 190  10
## C   0 200   0   0   0
```