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1. d. 2. b 3. c 4. a 5. d 6. a

Problem 1. a) $\begin{cases} H_0: Y \sim T+X \\ H_a: Y \sim T+X+T{:}X \end{cases}$ Use partial F-test
the F-statistic result from table 1 is 0.27729
which larger than $\alpha=0.05$, so we can't reject H_0.
So interaction term is statistically insignificant.

b). i) $Sales = 9.2280 + 0.7400 X + \varepsilon \quad \varepsilon \overset{IID}{\sim} N(0, \sigma^2)$

ii) $Sales = (9.2280 + 10.9320) + 0.7400 X + \varepsilon$

iii) $Sales = (9.2280 + 13.0960) + 0.7400 X + \varepsilon$

iv) They have same slope about X but have different intercepts

Because the slope of X is got by regression whole data and independent about treatment so the slope won't be influence by different treatment.
However different treament will induce different intercept, because the slope of dummy variables are different with 0.

c). Yes. According to Figure 2. the p-value of treatment is $2.753e^{-09}$ which is much smaller than 0.05, then we can say treatment is statistically significant. i.e. Sales will vary according to Treatment.

Problem 2.

a) EFM $y_{ij} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk}, \quad \varepsilon_{ijk} \overset{IID}{\sim} N(0, \sigma^2)$.

y_{ij} is the number of hours in location i, weeks j.

μ is the intercept. α_i is the location i's coefficient. where we set $\alpha_1 = 0$.
$i = 1, 2, 3, 4$.
β_j is the week j's coefficient where we set $\beta_1 = 0$.
$j = 1, 2$
$(\alpha\beta)_{ij}$ is the intercetion term of location i, week j's cofficient, where $i = 1,2,3,4$ $j = 1,2$.
$(\alpha\beta)_{ij} = 0$ if $i=1$ or $j=1$ or both.

b). $\begin{cases} H_0: Y \sim A+B \\ H_a: Y \sim A+B+A{:}B \end{cases}$ Use partial F-test. from Figure 4 we know p-value equals to 0.537593 which is much larger than 0.05
then we can't reject H_0, so the interaction term is statistcally insignificant

(c) $\begin{cases} H_0: Y \sim \_ \\ H_a: Y \sim A \end{cases}$ or $\begin{cases} H_0: \alpha_2 = \alpha_3 = \alpha_4 = \alpha_1 = 0. \\ H_a: \text{Not all of them equal.} \end{cases}$

Ues partial F-test
From Figure 6 we know the p-value is 7.22fe-05 which is much smaller than 0.05, so we can reject H_0. then we can say factor location is statistically significant!

Interpret: Given the same week and other effect same. the location of computer will influence the hours of use.

d). location 2, 1 statistically indifferent.
3, 1 Statistically indifferent.
4, 1 Statisically indifferent if $\alpha = 0.05$ different if $\alpha = 0.1$. (4 larger).
3, 2 Statistically indifferent.
4 Statistically larger than 2.
4 statistically larger than 3.
we can know 4 is statistically highest frequency use location.
4 will incur highest use if other effects same.

e). i) $L = \frac{\mu_{1\cdot} + \mu_{2\cdot}}{2} - \frac{\mu_{3\cdot} + \mu_{4\cdot}}{2}$

ii). $\hat{L} = \frac{1}{2}(\hat{y}_{1\cdot} + \hat{y}_{2\cdot} - \hat{y}_{3\cdot} - \hat{y}_{4\cdot}) = \frac{1}{2}\left(\frac{15.37+16.73}{2} + \frac{11.93+15.97}{2} \frac{11.8+15.61}{2} - \frac{19.07+21.1}{2}\right)$

$= -1.91.$

$S_{\hat{L}}^2 = \frac{MSE}{4}\left(\frac{1}{4} \times 4\right) = \frac{3.389}{4} = 0.84725.$

$L \in \hat{L} \pm 2.093 \cdot S_{\hat{L}} \Rightarrow L \in -1.91 \pm 2.093 \cdot \sqrt{0.84725}$