hw 7

1

a

This is a Latin square with 2 blocks, store and weekday; 1 factor, special offers A-E.

b

This is RCBD with 1 block, ground covers, and 1 factor, fertilizer levels. There are 4 observations per combination, and a total of 24 observations.

c

This is a BIBD with 2 blocks, region and patient; 1 factor ointments A-E.

2

a

We can have a BIBD with 6 blocks, 2 levels in each block. Since N = bk = rg, we have 4 treatments and each treatment appears 3 times.

b

Yes, it is a BIBD. First, each tr4eatment appears r=3 times. Second, each treatment appears at most once per block. Third, each pair of treatments appears exactly once without repetition. Also, it satisfies N = bk =rg, where b = 9, k =3, g = 9, r = 3.

```
readRDS("ibd.RDS")
```

```
##    block treatment  y
## 1      1         C 54
## 2      1         H 56
## 3      1         D 53
## 4      2         B 35
## 5      2         G 36
## 6      2         D 40
## 7      3         A 48
## 8      3         G 42
## 9      3         E 43
## 10     4         G 46
## 11     4         H 56
## 12     4         I 59
## 13     5         D 61
## 14     5         E 61
## 15     5         F 54
## 16     6         C 52
## 17     6         I 53
## 18     6         E 48
## 19     7         A 54
```

```
## 20     7         H 59
## 21     7         F 62
## 22     8         B 45
## 23     8         I 46
## 24     8         F 47
## 25     9         A 31
## 26     9         B 28
## 27     9         C 25
```

3

a

See attachment.

b

E = ABCD. We want to ensure that main effects and lower order interactions do not get confounded.

c

See attachment.

d

ABCDE, where all levels are positive. Added to attachment.

4

Since the error is normally distributed, we can construct a t-statistic using the mean between y_{i2kl} and y_{i1kl}. Since the variance in the error is known to be 4, we can calculate the variance of each sample mean, which is $\frac{4+4+4+4}{16} = 1$. Therefore, the variance of $y_{i2kl} - y_{i1kl}$ is 2. As a result our test statistic is $\frac{y_{i2kl} - y_{i1kl}}{\sqrt{2}}$ and this follows the standard normal distribution. We can either use a z-test or t-test to conduct the hypothesis testing.

block design? Explain your reasoning.

3. **(8 Points)** For parts (a) and (c) of this last question, you may simply print and fill out the given tables.

(a) **(2Pts)** Fill in the columns for the following table of contrasts of a full 2^4 design.

	2^4 Design				2^4 factorial design interactions										
levels	A	B	C	D	AB	AC	AD	BC	BD	CD	ABC	ACD	ABD	BCD	ABCD
(1)	−	−	−	−	+	+	+	+	+	+	−	−	−	−	+
a	+	−	−	−	−	−	−	+	+	+	+	+	+	−	−
b	−	+	−	−	−	+	+	−	−	+	+	−	+	+	−
ab	+	+	−	−	+	−	−	−	−	+	−	+	−	+	+
c	−	−	+	−	+	−	+	−	+	−	+	+	−	+	−
ac	+	−	+	−	−	+	−	−	+	−	−	−	+	+	+
bc	−	+	+	−	−	−	+	+	−	−	−	+	+	−	+
abc	+	+	+	−	+	+	−	+	−	−	+	−	−	−	−
d	−	−	−	+	+	+	−	+	−	−	−	+	+	+	−
ad	+	−	−	+	−	−	+	+	−	−	+	−	−	+	+
bd	−	+	−	+	−	+	−	−	+	−	+	+	−	−	+
abd	+	+	−	+	+	−	+	−	+	−	−	−	+	−	−
cd	−	−	+	+	+	−	−	−	−	+	+	−	+	−	+
acd	+	−	+	+	−	+	+	−	−	+	−	+	−	−	−
bcd	−	+	+	+	−	−	−	+	+	+	−	+	−	+	−
abcd	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

(b) **(2Pts)** Assume that you would like to test five two-level factors A, B, C, D, E, and you only can afford 16 experimental units. You would like to do a half-fraction factorial design 2^{5-1} constructed from a full 2^4 factorial design with factors A, B, C and D as in

	2^{5-1} design					2^{5-1} fractional factorial design interactions										
levels	A	B	C	D	E	AB	AC	AD	AE	BC	BD	BE	CD	CE	DE	ABCDE
	−	−	−	−	+	+	+	+	−	+	+	−	+	−	−	+
	+	−	−	−	−	−	−	−	−	+	+	+	+	+	+	+
	−	+	−	−	−	−	+	+	+	−	−	−	+	+	+	+
	+	+	−	−	+	+	−	−	+	−	−	+	+	−	−	+
	−	−	+	−	−	+	−	+	+	−	+	+	−	−	+	+
	+	−	+	−	+	−	+	−	+	−	+	−	−	+	−	+
	−	+	+	−	+	−	−	+	−	+	−	+	−	+	−	+
	+	+	+	−	−	+	+	−	−	+	−	−	−	−	+	+
	−	−	−	+	−	+	+	−	+	+	−	+	−	+	−	+
	+	−	−	+	+	−	−	+	+	+	−	−	−	−	+	+
	−	+	−	+	+	−	+	−	−	−	+	+	−	−	+	+
	+	+	−	+	−	+	−	+	−	−	+	−	−	+	−	+
	−	−	+	+	+	+	−	−	−	−	−	−	+	+	+	+
	+	−	+	+	−	−	+	+	−	−	−	+	+	−	−	+
	−	+	+	+	−	−	−	−	+	+	+	−	+	−	−	+
	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	BCDE	ACDE	ABDE	ABCE	ABCD	CDE	BDE	BCE	BCD	ADE	ACE	ACD	ABE	ABD	ABC	

Aliases