Question 1: Fractional Factorials

⋆ Given

1. 2^{5-2}
2. 2^{8-4}
3. 2^{6}

⋆ Find

Runs per replicate needed for each of the above Fractional Factorials

⋆ Solution

1. $2^{5-2} \Rightarrow 2^{3}\frac{runs}{rep} = 8\frac{runs}{rep}$
2. $2^{8-4} \Rightarrow 2^{4}\frac{runs}{rep} = 16\frac{runs}{rep}$
3. $2^{6} \Rightarrow 2^{6}\frac{runs}{rep} = 64\frac{runs}{rep}$

Question 2: Use R to Generate Fractional Factorials

⋆ Given

1. Any 2^{5-1}
2. A 2^{8-3} with the generators F=ABC, G=ABD, H=BCD

⋆ Find

Use R and the FrF2 Package to create the above and display the +1/-1 matrices

⋆ Solution

1.
```
FrF2(nruns=2^(5-1), nfactors=5)
```

2.
```
FrF2(nruns=2^(8-3), nfactors=8, generator=c("ABC", "ABD", "BCD"))
```

Question 3: Aliasing

⋆ Given

1. I=ABCD=EBCD=AE
2. I=ABCDE

⋆ Find

The aliases of 'BC' in each of the above

⋆ Solution

1. I=ABCD=EBCD=AE
   (a) $(BC)I = (BC)ABCD = (BC)EBCD = (BC)AE$
   (b) $BC = ABBCCD = BBCCDE = ABCE$
   (c) $BC = A\cancel{BBCC}D = \cancel{BBCC}DE = ABCE$
   (d) $BC = AD = DE = ABCE$
2. I=ABCDE
   (a) $(BC)I = (BC)ABCDE$
   (b) $BC = ABBCCDE$
   (c) $BC = A\cancel{BBCC}DE$
   (d) $BC = ADE$

Question 4: Resolution

⋆ Find

Explain why a R_{II} fractional experiment is a bad idea? Use an example to illustrate your point.

⋆ Solution

Since the smallest defining word is only 2 characters, main effects would be aliased with other main effects

1. $I = XY$
2. $(X)I = X(XY)$
3. $X = XXY$
4. $X = \cancel{XX}Y$
5. $X = Y$

Question 5: Concepts of Half Fractional

⋆ Given

2^{4-1} Half Fractional Factorial Experiment with the D=ABC generator

⋆ Find

The process to create the 'other' half

⋆ Solution

Use the generator D=-ABC, this is call a folded design [you can do this design afterwards if needed without wasting or duplicating any previous work]

Question 6: Application

⋆ Given

You have been given authorization to study a flame-resistant material. There are 8 key factors, (A,B,C,D,E,F,G,H)

⋆ Find

1. How many samples at a minimum would you need to request to perform a Full Fractional Experiment of any use?
2. You have been authorized only 100 samples at maximum. What are the feasible Balanced Fractional Experiments you could run?
3. For each of the experiments you listed in the last part, what are the engineering trade-offs in the feasible ones?
4. Pick your choice of experiment and state issues with that experiment you would need to keep in consideration during the analysis phase.
5. Assume DE and BC are significant and critical two way interactions, use the FrF2 package to determine generators for your choice above to address these.

⋆ Solution

1. $2^8 = 256$ gives you the smallest possible, but has no degrees of freedom for error, so you need to run that one at least twice, or $2(256) = 512$ samples required to be of any use.
2. (a) Full: $2(2^8) = 512$, Not feasible
   (b) Half: $2(2^8 - 1) = 256$, Not feasible
   (c) Quarter: $2(2^8 - 2) = 128$, Almost, but still not feasible
   (d) Eighth: $3(2^8 - 3) = 96$, Feasible with 3 replications, but leaving money on the table
   (e) Sixteenth: $6(2^8 - 4) = 96$, Feaible with 6 replications, but leaving money on the table, and very difficult to get a good generator set.
3. See above
4. Varies based on selection
5. Confirm no R_{II} designs or DE or BC aliased to each other or a main effect.

END OF ASSIGNMENT