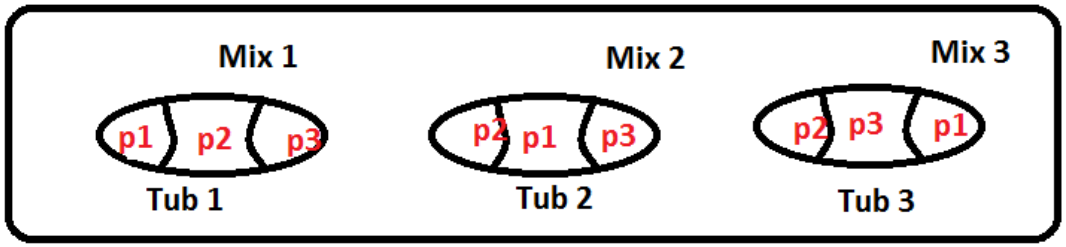
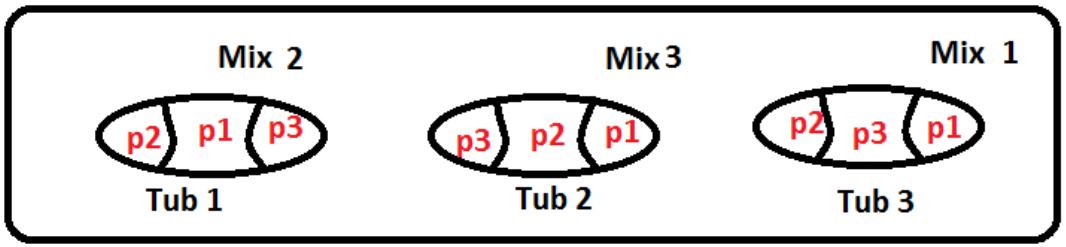
Exam 2 Solutions - Further explanation

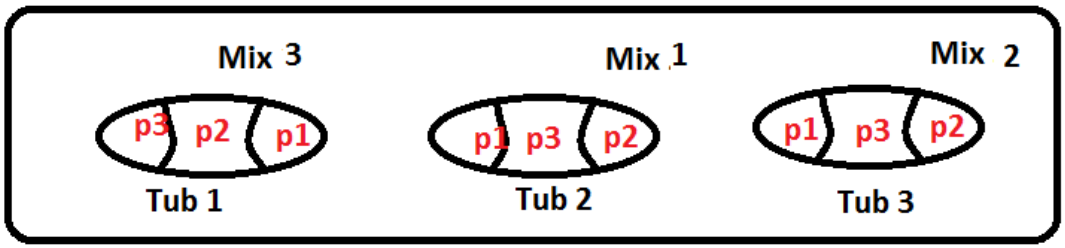
Problem 2



Run 1



Run 2



Run 3

Problem 2

- First and foremost, we identify the two factors of interest to the experimenter as Mix (with 3 levels) and Plasticizer (with 3 levels).
- The two-stage randomization suggests that this may be a split plot design.
- For run 1, the experiment is carried out as follows: Assign the three tubs randomly to the three mixes. This gives us a clue that the tubs are the whole-plot experimental unit and Mix is the whole-plot factor.
- At the second stage, within each tub the three plasticizers are applied. This makes the plasticizer the sub-plot factor.
- Having identified this, our next task is to determine whether this is a split-plot in RCBD or split plot in CRD. Since the runs = replications = block, this means that we have a split-plot in RCBD.

Problem 2

- What would a split-plot in CRD for this experiment look like?
- Say we had 6 tubs. We would first randomly assign the three mixes to the 6 tubs so that each mix is applied to 2 tubs. This replication here is however not a block.
- At the second stage, within each tub the three plasticizers are applied. This makes the plasticizer the sub-plot factor.

Problem 2

- Now let's produce the ANOVA table for the split-plot in RCBD that we have identified for this experiment.
- Before we do that however, it is instructive to produce the ANOVA table that someone who did not correctly identify this as a split-plot will have.
- For this person, this is simply a three-factor classification with say A = Mix with $a = 3$ levels, B = Plasticizer with $b = 3$ levels, C = block or run with $c = 3$ levels.

Problem 2

- This person's ANOVA table will look like this:

Source	DF
A main effect (Mix)	$a-1=2$
B main effect (Plas)	$b-1=2$
C main effect (Run)	$c-1=2$
AB interaction (Mix x Plas)	$(a-1)(b-1)=4$
BC interaction (Plas x Run)	$(b-1)(c-1)=4$
AC interaction (Mix x Run)	$(a-1)(c-1)=4$
ABC interaction (Mix x Plas x Run)	$(a-1)(b-1)(c-1)=8$
Error	0

Table 1:

- However, as we know a proper ANOVA table for split-plot in RCBD should have:

Source
(Whole plot factor)
(Block)
(Whole plot error = block x whole plot interaction)
(sub plot factor)
(whole plot x sub plot interaction)
(Sub plot error = sub plot x block interaction plus whole plot x sub plot x block interaction)

Table 2:

Problem 2

- Rearranging table 1 to look like table 2 gives us the final ANOVA table:

Source	DF
Whole plot factor (Mix)	2
Block (Run)	2
Whole plot error (Mix x Run)	4
Sub plot factor (Plas)	2
Whole plot by Sub plot interaction (Mix x Plas)	4
Sub plot error ((Plas x Run) + (Mix x Plas x Run))	$4 + 8 = 12$

Table 3:

Problem 5

- First and foremost, we identify the two factors of interest to the experimenter as Planting type (with 2 levels) and Cooking type (with 3 levels).
- The two-stage randomization suggests that this may be a split plot design.
- There are no runs. The experiment is carried out as follows: Assign the six rows randomly to the two planting types. This gives us a clue that the rows are the whole-plot experimental unit and planting type is the whole-plot factor.

Problem 5

- At the second stage, within each row (after harvesting . . .) the three cooking types are applied. This makes the cooking type the sub-plot factor.
- Having identified this, our next task is to determine whether this is a split-plot in RCBD or split plot in CRD. Since there are no runs = block, this means that we don't have a split-plot in RCBD. Rather it is a split-plot in CRD because the assignment of the whole-plot experimental units to the whole plot treatment is done completely at random.

Problem 5

- Now let's produce the ANOVA table for the split-plot in CRD that we have identified for this experiment.
- Before we do that however, it is instructive to produce the ANOVA table that someone who did not correctly identify this as a split-plot will have.
- For this person, this is simply a three-factor classification with say A = planting method with $a = 2$ levels, B = cooking method with $b = 3$ levels, C = rows with $c = 3$ levels.
- A and B are crossed and C is nested within A.

Problem 5

- This person's ANOVA table looks like this:

Source	DF
A main effect (Plant)	$a-1=1$
B main effect (Cook)	$b-1=2$
C(A) main effect (Row(Plant))	$a(c-1)=4$
AB interaction (Plant x Cook)	$(a-1)(b-1)=2$
BC(A) interaction (Cook x Row(Plant))	$a(b-1)(c-1)=8$
Error	0

Table 4:

Problem 5

- However, as we know a proper ANOVA table for split-plot in CRD should have:

Source	DF
(Whole plot factor)	
(Whole plot error = whole plot unit(whole plot factor))	
(sub plot factor)	
(whole plot x sub plot interaction)	
(sub plot error = sub plot x whole plot unit(whole plot factor) interaction)	

Table 5:

Problem 5

- Rearranging table 4 to look like table 5 gives:

Source	DF
Whole plot factor (Plant)	$a-1=1$
Whole plot error (Row(Plant))	$a(c-1)=4$
Sub plot factor (Cook)	$b-1=2$
Whole plot by sub plot interaction (Plant x Cook)	$(a-1)(b-1)=2$
Sub plot error (Cook x Row(Plant))	$a(b-1)(c-1)=8$
Error	0

Table 6: