

## ME 794 - Statistical Design of Experiments

### Tutorial 3

#### Randomized Block and Latin Square Designs [Ungraded]

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##### Section 1: RBCD

1. A medical device manufacturer produces vascular grafts (artificial veins). These grafts are produced by extruding billets of polytetrafluoroethylene (PTFE) resin combined with a lubricant into tubes. Frequently, some of the tubes in a production run contain small, hard protrusions on the external surface. These defects are known as “flicks.” The defect is cause for the rejection of the unit. The product developer decides to investigate the effect of four different levels of extrusion pressure on flicks using a randomized complete block design considering batches of resin as blocks. The RCBD is shown in the table below. Note that there are four levels of extrusion pressure (treatments) and six batches of resin (blocks).
  - a. Analyze the data from this experiment and state whether the extrusion pressure affects mean yield (Use  $\alpha = 0.05$ ).

Extrusion Pressure	Batch of resins					
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
<u>8500</u>	90.3	89.2	98.2	93.9	87.4	97.9
<u>8700</u>	92.5	89.5	90.6	94.7	87	95.8
<u>8900</u>	85.5	90.8	89.6	86.2	88	93.4
<u>9100</u>	82.5	89.5	85.6	87.4	78.9	90.7

*ANOVA table:*

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F <sub>0</sub>
<i>Treatments</i>				
<i>Blocks</i>				
<i>Error</i>				
<i>Total</i>				

## Section 2: Latin Square Design

1. An industrial engineer is investigating the effect of four assembly methods ( $A, B, C, D$ ) on the assembly time for a colour television component. Four operators are selected for the study. Furthermore, the engineer knows that each assembly method produces such fatigue that the time required for the last assembly may be greater than the time required for the first, regardless of the method. That is, a trend develops in the required assembly time. To account for this source of variability, the engineer uses the Latin square design shown below.

Order of Assembly	Operator			
	1	2	3	4
<u>1</u>	C = 10	D = 14	A = 7	B = 8
<u>2</u>	B = 7	C = 18	D = 11	A = 8
<u>3</u>	A = 5	B = 10	C = 11	D = 9
<u>4</u>	D = 10	A = 10	B = 12	C = 14

- a. Analyse the data from this experiment ( $\alpha = 0.05$ ) and conclude whether the assembly method affects assembly time. (*Hint:* complete the below table in the process of analyzing the data)

*ANOVA table:*

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F <sub>0</sub>
<i>Treatments</i>				
<i>Rows</i>				
<i>Columns</i>				
<i>Error</i>				
<i>Total</i>				