19MCE401 - PROCESS PLANNING AND PRODUCT DEVELOPMENT

STUDY NOTES

UNIT 5 – PRODUCT IMPROVEMENT

TOPIC 8 – FACTORIAL EXPERIMENTS EXAMPLES

Handled by:

Dr. T. Prakash M.E., Ph.D.,

Professor & Head,

Department of Mechatronics Engineering,

SNS College of Technology,

Coimbatore - 35.

Factorial Experiments:

Factorial experiments involve the simultaneous manipulation of two or more independent variables to study their effects on a dependent variable. These experiments allow researchers to investigate the main effects of each variable, as well as potential interactions between them.

		Independent Variable 2	
		Level 1	Level 2
Independent Variable 1	Level 1	Dependent Variable	Dependent Variable
	Level 2	Dependent Variable	Dependent Variable

Below are a few detailed examples of factorial experiments from different fields:

1. Example in Psychology: Memory Recall Study

Independent Variables:

- Factor A: Presentation Format (Visual vs. Auditory)
- Factor B: Study Time (Short vs. Long)

Dependent Variable:

- Memory Recall Score

Experimental Design:

- Participants are randomly assigned to one of four conditions:
  - Group 1: Visual presentation, short study time
  - Group 2: Visual presentation, long study time

- Group 3: Auditory presentation, short study time

- Group 4: Auditory presentation, long study time

Hypotheses:

- The main effect of Presentation Format (Factor A) on memory recall will be significant.

- The main effect of Study Time (Factor B) on memory recall will be significant.

- There will be an interaction effect between Presentation Format and Study Time on memory recall.

Interpretation:

- Significant main effects indicate that either presentation format or study time independently affects memory recall.

- A significant interaction effect would suggest that the combined effect of presentation format and study time is not simply the sum of their individual effects.

2. Example in Manufacturing: Product Durability Study

Independent Variables:

- Factor A: Material Type (Metal vs. Plastic)

- Factor B: Environmental Conditions (Normal vs. Extreme)

Dependent Variable:

- Product Durability (measured in cycles until failure)

Experimental Design:

- Products are manufactured using both metal and plastic materials and exposed to either normal or extreme environmental conditions.

- Four conditions:

  - Group 1: Metal material, Normal conditions

  - Group 2: Metal material, Extreme conditions

  - Group 3: Plastic material, Normal conditions

- Group 4: Plastic material, Extreme conditions

Hypotheses:

- The main effect of Material Type (Factor A) on product durability will be significant.

- The main effect of Environmental Conditions (Factor B) on product durability will be significant.

- There will be an interaction effect between Material Type and Environmental Conditions on product durability.

Interpretation:

- Significant main effects suggest that either material type or environmental conditions independently affect product durability.

- A significant interaction effect indicates that the combined effect of material type and environmental conditions is not simply additive.

3. Example in Marketing: Advertising Effectiveness Study

Independent Variables:

- Factor A: Advertisement Type (Humorous vs. Emotional)

- Factor B: Target Audience (Adults vs. Teens)

Dependent Variable:

- Purchase Intent

Experimental Design:

- Different advertisements are created, varying in type (humorous or emotional) and targeted either at adults or teens.

- Four conditions:

  - Group 1: Humorous ad, Adults

  - Group 2: Humorous ad, Teens

  - Group 3: Emotional ad, Adults

  - Group 4: Emotional ad, Teens

Hypotheses:

- The main effect of Advertisement Type (Factor A) on purchase intent will be significant.

- The main effect of Target Audience (Factor B) on purchase intent will be significant.

- There will be an interaction effect between Advertisement Type and Target Audience on purchase intent.

Interpretation:

- Significant main effects suggest that either advertisement type or target audience independently affects purchase intent.

- A significant interaction effect indicates that the combined effect of advertisement type and target audience is not simply additive.

4. Example in Agriculture: Crop Yield Study

Independent Variables:

- Factor A: Fertilizer Type (Organic vs. Inorganic)

- Factor B: Irrigation Level (Low vs. High)

Dependent Variable:

- Crop Yield (measured in kilograms per hectare)

Experimental Design:

- Different plots of land receive different combinations of fertilizer type and irrigation level.

- Four conditions:

  - Group 1: Organic fertilizer, Low irrigation

  - Group 2: Organic fertilizer, High irrigation

  - Group 3: Inorganic fertilizer, Low irrigation

  - Group 4: Inorganic fertilizer, High irrigation

Hypotheses:

- The main effect of Fertilizer Type (Factor A) on crop yield will be significant.

- The main effect of Irrigation Level (Factor B) on crop yield will be significant.

- There will be an interaction effect between Fertilizer Type and Irrigation Level on crop yield.

Interpretation:

- Significant main effects suggest that either fertilizer type or irrigation level independently affects crop yield.

- A significant interaction effect indicates that the combined effect of fertilizer type and irrigation level is not simply additive.

These examples illustrate how factorial experiments can be designed in various fields, each with its own set of independent variables, dependent variables, and hypotheses. Factorial designs allow researchers to investigate the complex interplay between different factors and their impact on the outcome of interest.