



# ASQ CRE Prep course

Lesson III. A. 7. f.

Design of Experiments

Dealing with Measurements

# Experimental results

| Run | A | B | C | $Y_1$ |
|-----|---|---|---|-------|
| 1   | 1 | 1 | 1 | 35    |
| 2   | 1 | 2 | 2 | 25    |
| 3   | 2 | 1 | 2 | 39    |
| 4   | 2 | 2 | 1 | 27    |

$$MSD = \frac{1/Y_1^2 + 1/Y_2^2 + \dots + 1/Y_n^2}{n}$$

$$S/N = -10\log(MSD)$$

# Mean Response

| Factor | level | $\Sigma Y$ | $\bar{Y}$ | $\overline{MSD}$ | $\overline{S/N}$ |
|--------|-------|------------|-----------|------------------|------------------|
| A      | $A_1$ | $35 + 25$  | 30        |                  |                  |
|        | $A_2$ | $39 + 27$  | 33        |                  |                  |
|        | total |            | 63        |                  |                  |
| B      | $B_1$ | $35 + 39$  | 37        |                  |                  |
|        | $B_2$ | $25 + 27$  | 26        |                  |                  |
|        | total |            | 63        |                  |                  |
| C      | $C_1$ | $35 + 27$  | 31        |                  |                  |
|        | $C_2$ | $25 + 39$  | 32        |                  |                  |
|        | total |            | 63        |                  |                  |

# Mean, MSD & Signal-to-Noise

| Factor | level          | $\Sigma Y$ | $\bar{Y}$ | $\overline{MSD}$ | $\overline{S/N}$ |
|--------|----------------|------------|-----------|------------------|------------------|
| A      | A <sub>1</sub> | 35 + 25    | 30        | 0.00111          | 29.55            |
|        | A <sub>2</sub> | 39 + 27    | 33        | 0.00092          | 30.36            |
|        | total          |            | 63        |                  |                  |
| B      | B <sub>1</sub> | 35 + 39    | 37        | 0.00073          | 31.37            |
|        | B <sub>2</sub> | 25 + 27    | 26        | 0.00148          | 28.30            |
|        | total          |            | 63        |                  |                  |
| C      | C <sub>1</sub> | 35 + 27    | 31        | 0.00104          | 29.83            |
|        | C <sub>2</sub> | 25 + 39    | 32        | 0.00098          | 30.09            |
|        | total          |            | 63        |                  |                  |

# What is important?

Response

A1

A2

B1

B2

C1

C2

30

33

37

26

31

32



# Signal-to-Noise response table

| Factor     | A     | B     | C     |
|------------|-------|-------|-------|
| Level 1    | 29.55 | 31.37 | 29.83 |
| Level 2    | 30.36 | 28.30 | 30.09 |
| Difference | 0.81  | 3.07  | 0.26  |

# Conclusions

| Factor                | Level 1  | Level 2  | Reason                                             |
|-----------------------|----------|----------|----------------------------------------------------|
| A: Injection pressure | 1700 kPa | 2400 kPa | Slightly higher S/N, could go either way           |
| B: Mold temperature   | 65°C     | 95°C     | Significant difference (>3dB)<br>Select larger S/N |
| C: Set time           | 6 sec    | 9 sec    | Slightly higher S/N, could go either way           |

# Next Steps

**Run experiment with  
mold temperature at  
65°C – verify results**





# Steps review

- **State the experiment' s objective**
- **Select factors and levels**
- **Assign factors to array**
- **Select effects & analysis criteria**
- **Select analysis statistics**
- **Plan experiment**
- **Conduct experiment**
- **Results of experiment**
- **Mean & Signal-to-noise ratio**
- **Response table**
- **Conclusions**

How could we  
improve the  
experiment?



# ASQ CRE Prep course

Lesson III. A. 7. g.

Design of Experiments

Interactions & Confounding