## Single Regression Equations

$$Y = B_0 + B_1 X + e$$

$$\hat{Y} = B_0 + B_1 X$$

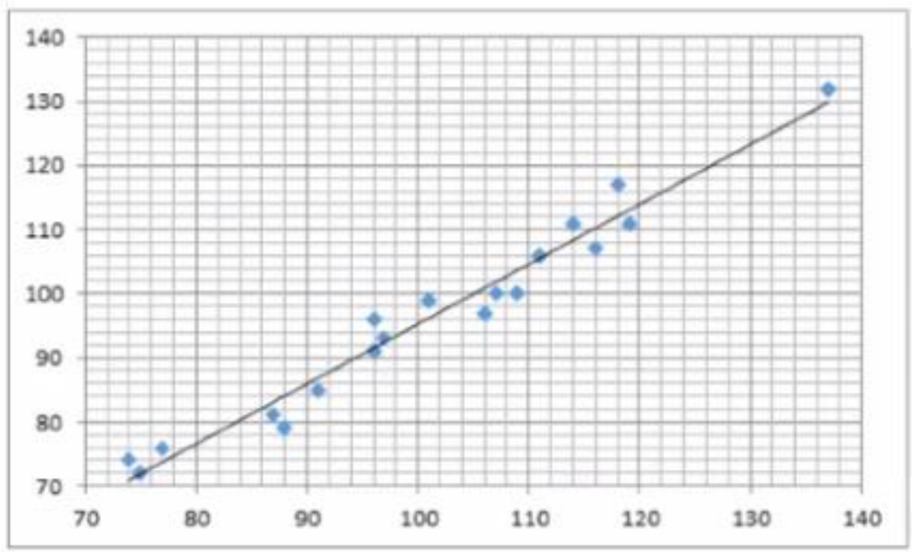
$$e = Y - \hat{Y}$$

$$B_{Y.X} = \frac{Cov_{XY}}{s_X^2}$$

$$r_{XY} = B_{Y.X}\left(\frac{s_X}{s_Y}\right)$$

$$Y = B_1 X + e$$

$$Y = \beta_1 X + e$$



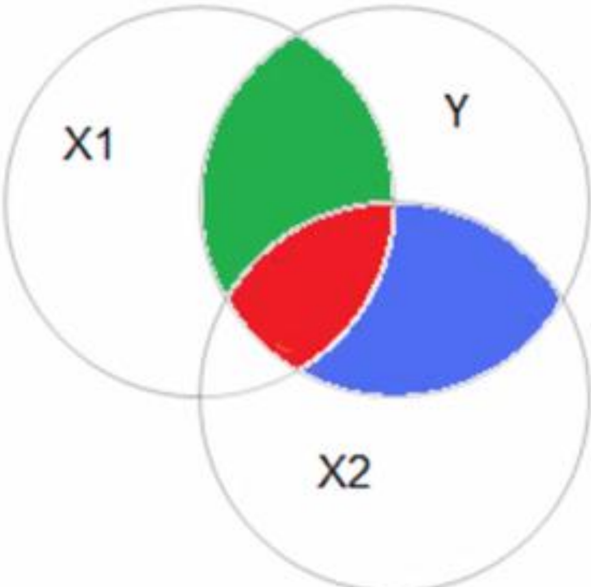
# Multiple Regression Equations

$$Y = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + e$$

$$Y = B_1X + B_2X_2 + B_3X_3 + e$$

$$Y = \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + e$$

Semipartial and Partial Correlation Coefficients, Joint Variance




G $sr^2_{X_1} = R^2_{X_1X_2} - r^2_{X_2}$

B $sr^2_{X_2} = R^2_{X_1X_2} - r^2_{X_1}$

R $JV = \underline{R^2_{X_1X_2}} - sr^2_{X_1} - sr^2_{X_2} = r^2_{X_1} + r^2_{X_2} - R^2_{X_1X_2}$

$$pr^2_{X_1} = \frac{R^2_{X_1X_2} - r^2_{X_2}}{1 - r^2_{X_2}}$$

$$pr^2_{X_2} = \frac{R^2_{X_1X_2} - r^2_{X_1}}{1 - r^2_{X_1}}$$

$r^2_{X_1}: Green + Red$

$r^2_{X_2}: Blue + Red$

$R^2_{X_1X_2}: Green + Blue + Red$

# Dummy, Effects, and Contrast Coding

$Y = B_0 + B_1D_1 + B_2D_2 + B_3D_3 + e$

- $B_0 = \bar{Y}_1$ (in this example, $\bar{Y}_1 = \bar{Y}_r$, or the mean of the referent group)
- $B_1 = \bar{Y}_2 - \bar{Y}_r$
- $B_2 = \bar{Y}_3 - \bar{Y}_r$
- $B_3 = \bar{Y}_4 - \bar{Y}_r$

$R^2$ = Variance in Y attributable to group differences

**Dummy**:

| Group\Variable | $D_1$ | $D_2$ | $D_3$ |
|---|---|---|---|
| Group 1 (referent group) | 0 | 0 | 0 |
| Group 2 | 1 | 0 | 0 |
| Group 3 | 0 | 1 | 0 |
| Group 4 | 0 | 0 | 1 |

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$Y = B_0 + B_1E_1 + B_2E_2 + B_3E_3 + e$

- $B_0 = \bar{Y}$ (unweighted grand mean)
- $B_1 = \bar{Y}_2 - \bar{Y}$
- $B_2 = \bar{Y}_3 - \bar{Y}$
- $B_3 = \bar{Y}_4 - \bar{Y}$
- $\bar{Y}_r = \bar{Y}_1 = B_0 - B_1 - B_2 - B_3$

$R^2$ = Variance in Y attributable to group differences

**Effects**:

| Group\Variable | $E_1$ | $E_2$ | $E_3$ |
|---|---|---|---|
| Group 1 ("referent group") | -1 | -1 | -1 |
| Group 2 | 1 | 0 | 0 |
| Group 3 | 0 | 1 | 0 |
| Group 4 | 0 | 0 | 1 |

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Different contrast code for each comparison/research question

You can have as many contrasts as you need (if you have enough df)

**Contrast**:

| Group\Variable | $C_1$ | $C_2$ | $C_3$ | $C_4$ | $C_5$ |
|---|---|---|---|---|---|
| Group 1 (referent group) | 1 | 1 | 1 | 0 | 2 |
| Group 2 | 1 | 1 | 1 | 0 | 0 |
| Group 3 | -1 | 1 | 0 | 1 | -1 |
| Group 4 | -1 | -3 | -2 | -1 | -1 |

# One-Way ANOVA

| Source | SS | df | MS | F |
| --- | --- | --- | --- | --- |
| Between | $\sum_{1}^{J} n_j(\bar{Y}_j - \bar{Y})^2$ | J-1 | $\frac{SS_B}{df_B}$ | $\frac{MS_B}{MS_W}$ |
| Within (Error) | $\sum_{1}^{J}\sum_{1}^{I}(Y_{ij} - \bar{Y}_j)^2$ | N-J | $\frac{SS_W}{df_W}$ | |
| Total | $\sum_{1}^{J}\sum_{1}^{I}(Y_{ij} - \bar{Y})^2$ | N-1 | | |

# Two-Way ANOVA

| Source | SS | df | MS | F |
|---|---|---|---|---|
| **Variable J** | $\sum_{1}^{J} n_{j.} * \left(\overline{Y_{j.}} - \overline{Y_{..}}\right)^2$ | J-1 | $\frac{SS_J}{df_J}$ | $\frac{MS_J}{MS_W}$ |
| **Variable K** | $\sum_{1}^{K} n_{.k} * (\overline{Y_{.k}} - \overline{Y_{..}})^2$ | K-1 | $\frac{SS_K}{df_K}$ | $\frac{MS_K}{MS_W}$ |
| **JXK Interaction** | $\sum_{1}^{J}\sum_{1}^{K} n_{jk} * \left[\overline{Y_{jk}} - \left(\overline{Y_{j.}} + \overline{Y_{.k}} - \overline{Y_{..}}\right)\right]^2$ | (J-1)*(K-1) | $\frac{SS_{JXK}}{df_{JXK}}$ | $\frac{MS_{JXK}}{MS_W}$ |
| **Within (Error)** | $\sum_{1}^{J}\sum_{1}^{K}\sum_{1}^{I}\left(Y_{ijk} - \overline{Y_{jk}}\right)^2$ | N-(J*K) | $\frac{SS_w}{df_w}$ | |
| **Total** | $\sum_{1}^{J}\sum_{1}^{K}\sum_{1}^{I}\left(Y_{ijk} - \overline{Y_{..}}\right)^2$ | N-1 | | |