Module 3F: ANOVA & Correlation

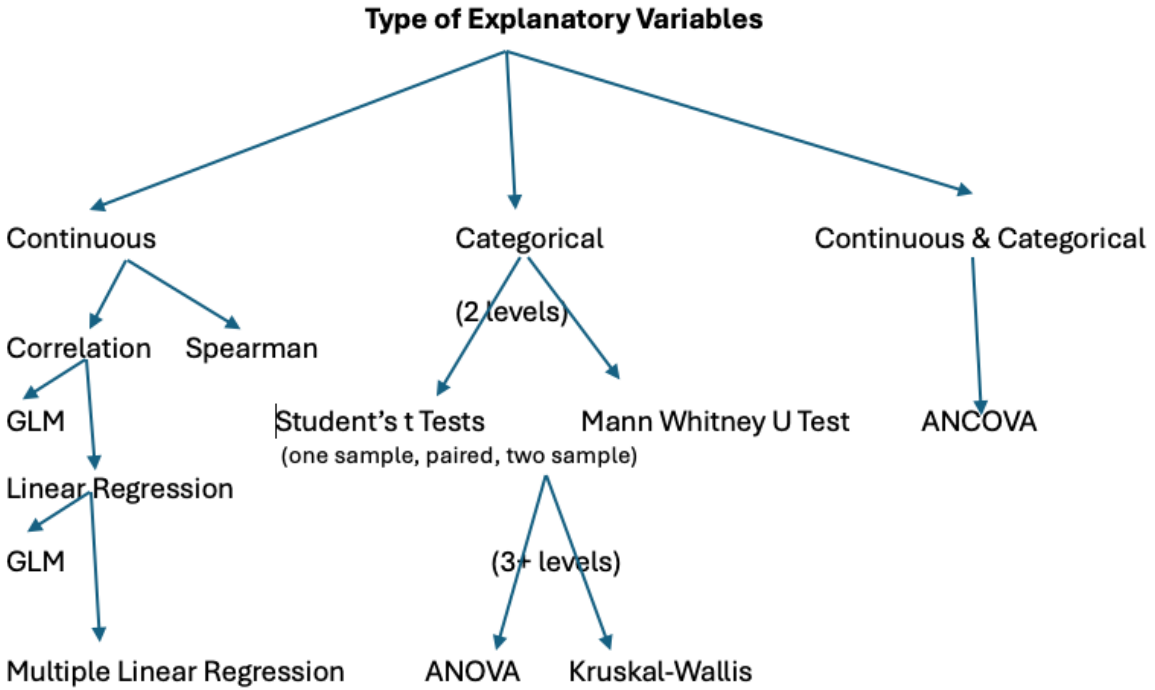
Assigning signal and noise to variation

Agenda:

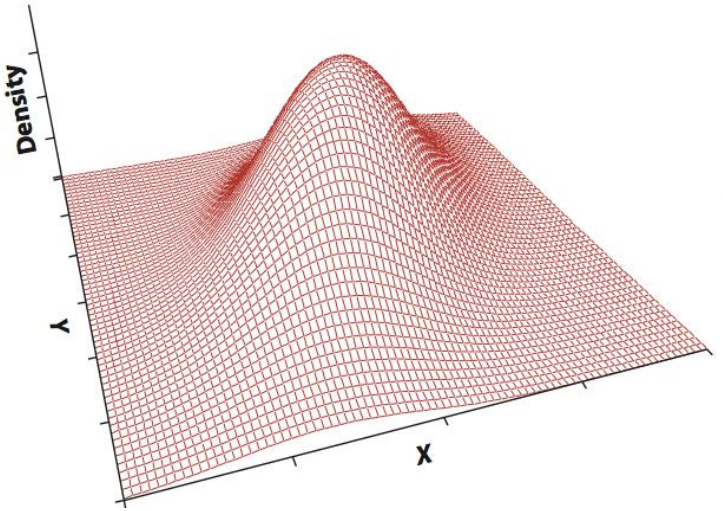
1. ANOVA: Nuts & Bolts

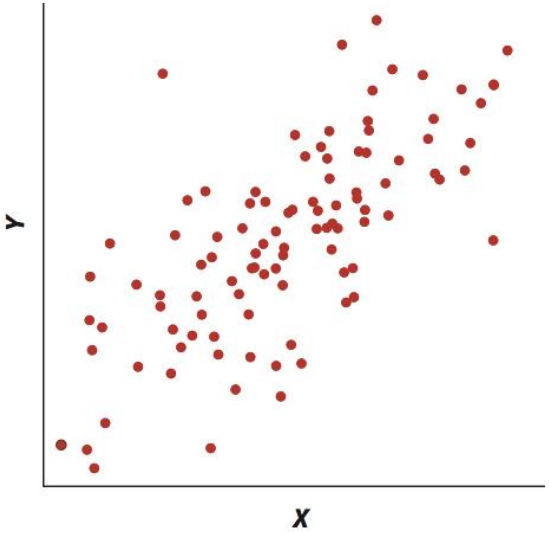
2. Worked Example
   A. One way ANOVA
   B. Post-hoc tests: Tukey-Kramer
   C. Kruskal-Wallis (nonparametric)

3. Linear Correlation
   A. Spearman's rank



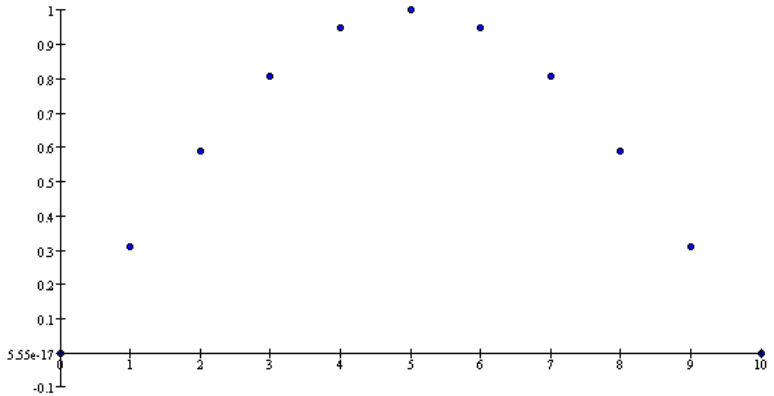
Assumptions:

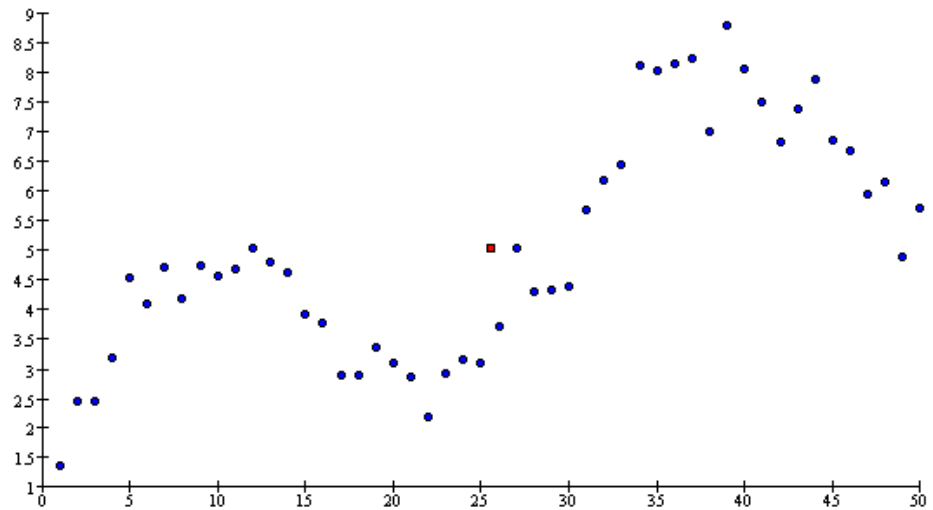




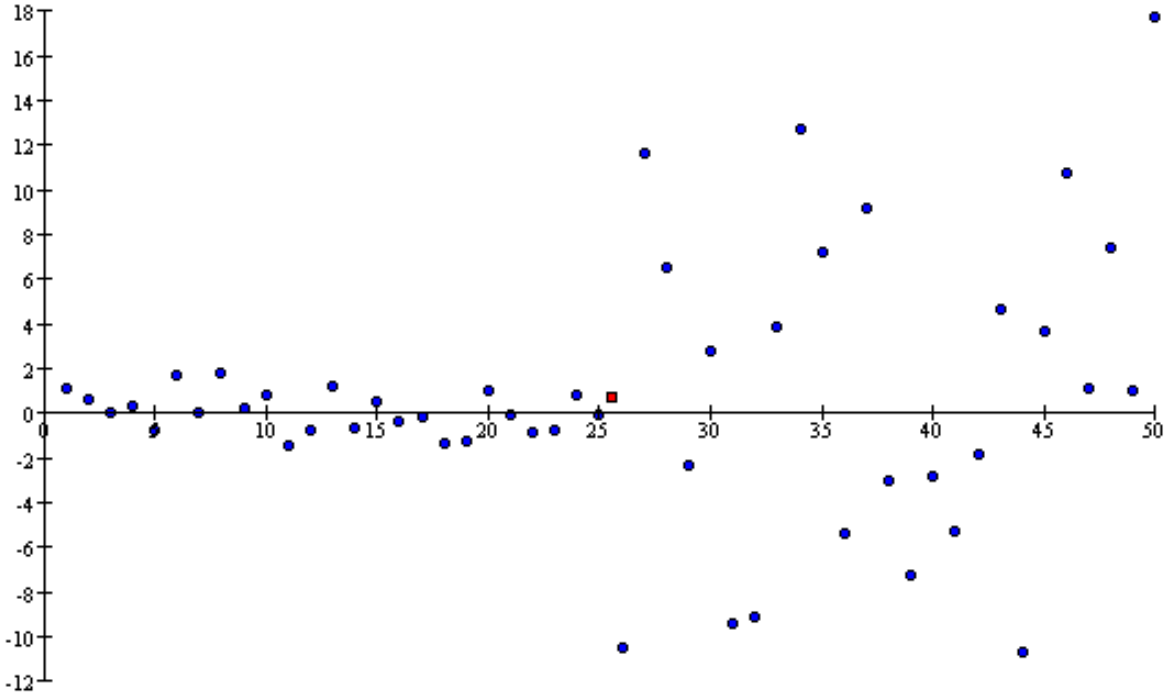
- Random sample
- Linearity
- Correlation depends on range of values
- Homoscedastic variances
- **Bivariate Normal Distribution**
  - X is normally distributed
  - Y is normally distributed
  - X and Y have linear relationship

Non-linearity

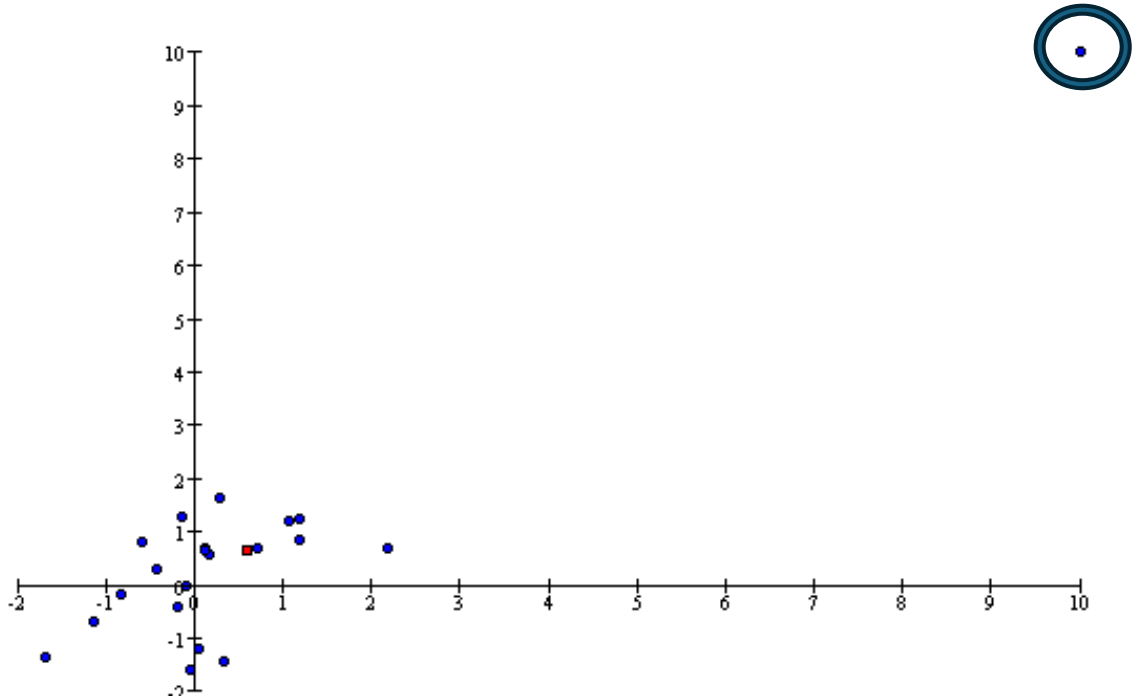




Heteroscedascity



Outliers: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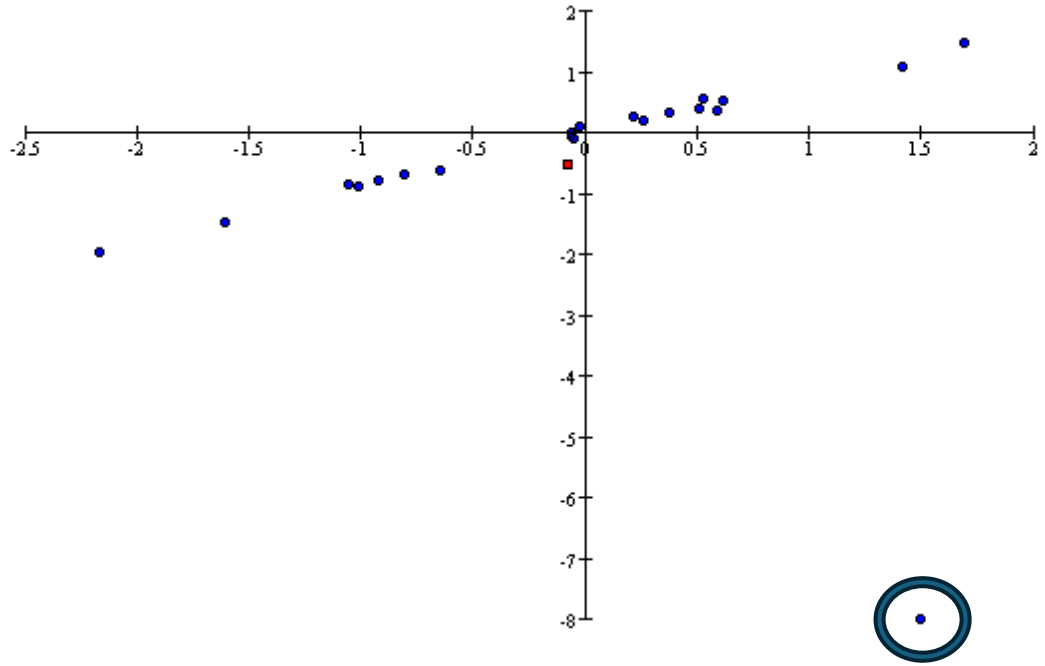
2
1
-1
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-4
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-6
-7
-8
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2

- If data are not bivariate or are not linearly related, try **transformation**
- If data are heteroscedastic or have outliers… try a **non-parametric method**….. But remember non-parametric methods are more conservative (they have less power) than parametric metrics.

Spearman's rank

assumes:

* random sample
* linear relationship

Spearman's rank correlation:

- Measures strength and direction of linear association between the **ranks** of two variables
- Two variables are ranked separately

Parameter: ρ_s; sample estimate: r_s

Spearman's rank correlation:

Test for correlation in the normal way….

Step 1: declare null and alternate

H_0: Zero correlation ($\rho_s=0$)

H_A: Some correlation ($\rho_s\neq0$)

Step 2: test statistic

$$r_s = \frac{\sum (R-\bar{R})(S-\bar{S})}{\sqrt{\sum (R-\bar{R})^2}\sqrt{\sum (S-\bar{S})^2}}$$

Step 3:State α/P-value/Critical value

Table or computer!

Step 4: State conclusion

If n > 100:

$$t = \frac{r_s - \rho_s}{SE_{r(s)}}$$

This is the same procedure as linear Pearsons correlation, but for ranks!

where:

$$SE_{r_s} = \sqrt{\frac{1 - r_s^2}{n - 2}}$$

t is ~*t*-distributed with n - 2 degrees of freedom

Tricky part: reject null hypothesis if

$t \geq t_{0.05(2),n-2}$

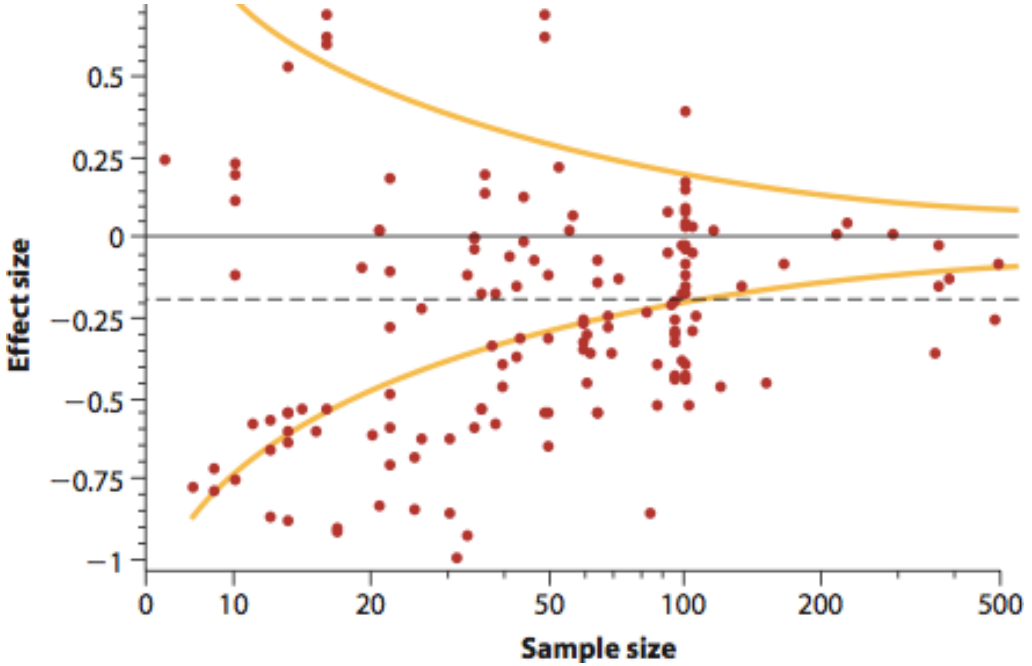
$t \leq -t_{0.05(2),n-2}$

Publication Bias

Papers that:

- Reject null
- Have large effect

tend to be published



http://www.badscience.net/about-dr-ben-goldacre/