Activity 3.1: Power Planning for a CRD

Training Programs & Vertical Jump

> **Note**
>
> Submit via Gradescope, don't forget to assign pages to the questions in the outline!

You are planning a study to evaluate the effect of 5 different training programs (speed, power, agility, endurance, balance) on improvement in vertical jump height (measured in inches).

From previous studies, the experimental error (i.e., σ^2) is estimated to be about 16 inches.

Talking to a PT, the expected treatment means (in inches) are:

Program	Speed	Power	Agility	Endurance	Balance
Expected mean	13	11	17	15	9

We will use a significance level of $\alpha = 0.05$ and we want 90% power. Even though the configuration above shows "equally spaced" mean configuration, you can use "minimial power" configuration throughout this activity.

Setup

a. Identify the study structure:

- Treatment Structure: (name, factor, levels, treatments)
- Design Structure: (name, e.u., m.u.; note, we don't know the reps yet!)
- Response:

b. What is the value of δ in this setting? What does this represent (in words)?

Part 1: Baseline Power

We will treat the δ from above as our *specific alternative*.

c. Use JMP/R to find the required sample size per group r to achieve 90% power.

> What information do you have?
>
> - t = ________
> - $\hat{\sigma}^2$ = ___________
> - δ = ____________ *Use minimal power configuration!*
> - Set α = ____________
> - Desired Power = ____________

Report your result:

- Required r (per group) = _______________

Part 2: What changes the required sample size?

Complete the table below. For each scenario, you do **NOT** need to show steps, just use software and record the new required r.

> Note
>
> The point here is **direction + magnitude**: how design decisions change the planning.

d. Fill in the table

Start with the baseline for each scenario and only make the specified changes (i.e., you always go back to the input information you specified in (c))

Scenario change	What you change	New required r	More / fewer players?
Baseline	$\sigma = 4$, $\alpha = 0.05$, means = (13,11,17,15,9), target power = 0.90	________	
Higher variability	$\hat{\sigma}^2 = 36$ (instead of $\hat{\sigma}^2 = 16$)	________	More / Fewer?
More conservative test	$\alpha = 0.01$ (instead of 0.05)	________	More / Fewer?
Smaller effect	means = (11,10,13,12,9)	________	More / Fewer?
Fewer groups	only 3 programs with means (9,13,17)	________	More / Fewer?

Part 3: What happens to power if we *can't* afford the sample size?

e. Suppose you only have $r = 2$ players per group.

Using the **baseline** setup ($\hat{\sigma}^2 = 16$, $\alpha = 0.05$, baseline means), compute the resulting power.

- Power when $r = 2$ = ________________

f. Interpret the power from (e) in one sentence (in context).

g. Suppose you only have $r = 2$ players per group, what is the difference you could detect at 90% power?

Using the **baseline** setup ($\hat{\sigma}^2 = 16$, $\alpha = 0.05$), compute the difference δ.

- Detectable difference at a power of 90% when $r = 2$: δ = ________________

Part 4: Estimating $\hat{\sigma}^2$

In practice, estimating the experimental error before collecting data is difficult. Two common approaches are:

1. Use previous literature and domain knowledge.
2. Run a pilot study.

h. Use Elicit (https://elicit.org/) to find one paper related to the effect of training programs on vertical jump height.

HINT: Click the "Find papers" tab at the top so it doesn't run a full report.

Provide the following:

- Your search prompt:

- A paper that could be useful for estimating experimental error *(follow the DOI or journal link to the actual paper)*:

- Brief justification (1-2 sentences): Why might this paper be useful for estimating σ^2? *(Think: sample size, number of groups, reported SDs, similar response units.)*