Effect of # of samples and # of subsamples on se(mean)

Notation:

C: number of containers per treatment — P: number of plants per container

σ^2_C: Variance component between containers — σ^2_P: Variance comp. btwn plants in same container

Basic formulae:

$$\begin{aligned} \text{Var(mean)} &= \frac{\sigma^2_C}{C} + \frac{\sigma^2_P}{C \times P} \\ \text{se(mean)} &= \sqrt{\text{Var(mean)}} \end{aligned}$$

Examples:
In all, start with 2 containers, 3 plants per container.
What happens to se(mean) when add more containers, more plants per container, both, or more containers and fewer plants per containter so still 6 total plants?

1. large variability between containers, small variability between plants, $\sigma^2_C = 3.5$, $\sigma^2_P = 0.30$

	C	P	total plants	Var(mean)	s.e. mean	
	2	3	6	1.80	1.34	
more plants	2	6	12	1.78	1.33	s.e. similar
	2	3	6	1.80	1.34	
more cont.	4	3	12	0.90	0.95	s.e. smaller
both	4	6	24	0.89	0.94	no addn. reduction
	2	3	6	1.80	1.34	
more cont., smaller P	6	1	6	0.63	0.79	much smaller

2. small variability between containers, large variability between plants, $\sigma^2_C = 0.2$, $\sigma^2_P = 10.2$

	C	P	total plants	Var(mean)	s.e. mean	
	2	3	6	1.80	1.34	
more plants	2	6	12	0.95	0.97	smaller s.e.
more cont.	4	3	12	0.90	0.95	smaller s.e.
up, down	6	1	6	1.73	1.31	similar to initial

3. large variability between containers, same variability between plants, $\sigma^2_C = 2.7$, $\sigma^2_P = 2.7$

	C	P	total plants	Var(mean)	s.e. mean	
	2	3	6	1.80	1.34	
more plants	2	6	12	1.58	1.26	bit smaller
more cont.	4	3	12	0.90	0.95	smaller s.e.
up, down	6	1	6	0.90	0.95	smaller s.e.