PHYSICAL SAMPLE CONSIDERATIONS

CHEM 251 SDSU

SAMPLE SIZE

- The amount of sample necessary for an analysis is an important consideration for any sample plan.
- If too little sample is taken it can be difficult to identify the presence of any analyte.
- If too much is taken it can be problematic for the analysis.

CALCULATING SAMPLE SIZE

- For a given number of particles (n) our analyte (n_A) will occur on a fraction of the time (p).

$$n_{\mathrm{A}} = np$$

$$s_{\mathrm{samp}} = \sqrt{np(1-p)}$$

- With some prior knowledge, or predictions, we can determine the sample size that will be appropriate to get a desired level of relative sampling variance $(s^{\mathrm{rel}}_{\mathrm{samp}})^2$.

$$s^{\mathrm{rel}}_{\mathrm{samp}} = \frac{\sqrt{np(1-p)}}{np}$$

$$n = \frac{1-p}{p} \times \frac{1}{(s^{\mathrm{rel}}_{\mathrm{samp}})^2}$$

SAMPLE SAMPLE SIZE PROBLEM

If the content of mercury in a soil sample is estimated to be close to $1 \times 10^{-7}\%$ of the population, how many particles must be sampled in order to obtain a 1% relative sampling standard deviation?

SAMPLE MASS

- The choice of the number of samples to collect is also crucial in obtaining low sample variance.
- If we treat homogeneous solutions as only having two types of particles (analyte and the non-analyte) we approximate a binomial sampling statistics.
- So in a random grab sampling the mass of the sample (*m*) and the percent relative standard deviation (*R*) yield a sampling constant (K_s).
- As K_s is a constant for each population we can use it to determine the sample mass (*m*) required to obtain a desired percent relative standard deviation (*R*) value.

$$mR^2 = K_s$$

$$m = \frac{K_s}{R^2}$$

$$R = \sqrt{\frac{K_s}{m}}$$

EXAMPLE SAMPLE MASS DETERMINATION

	Sample mass (g)	w/w% Chloride
1	0.5236	33.1
2	0.5264	36.2
3	0.5250	35.7
4	0.5247	34.9
Avg.	0.524925	34.975
STDEV	0.0012	1.3598

What sample size (mass) is necessary to obtain a percent relative standard deviation for the sampling of ±1.5%?

NUMBER OF SAMPLES

- Once we know how large a sample to collect we need to consider how many samples (n_{samp})to collect.

$$\mu = \overline{X} \pm \frac{ts_{samp}}{\sqrt{n_{samp}}}$$

- We can use a desired relative percent sampling error (e) and a desired confidence level to calculate the number of samples.

$$e = \overline{X} - \mu$$

- The process is an iterative calculation.

$$n_{samp} = \frac{t^2 s^2_{samp}}{e^2}$$

- Note **e** and $\boldsymbol{s}_{\mathbf{samp}}$ must be expressed in the same manner (e.g. percent relative standard deviation)

SAMPLE NUMBER PROBLEM

From the prior problem we determined that a sample mass of 3.522g to have a <u>percent relative standard deviation</u> of ±1.5%.

How many samples need to be collected to to have a <u>percent relative sampling error</u> (e) of ±1.0% at the 95% confidence level?