MORE STATISTICS WITH GAUSSIANS

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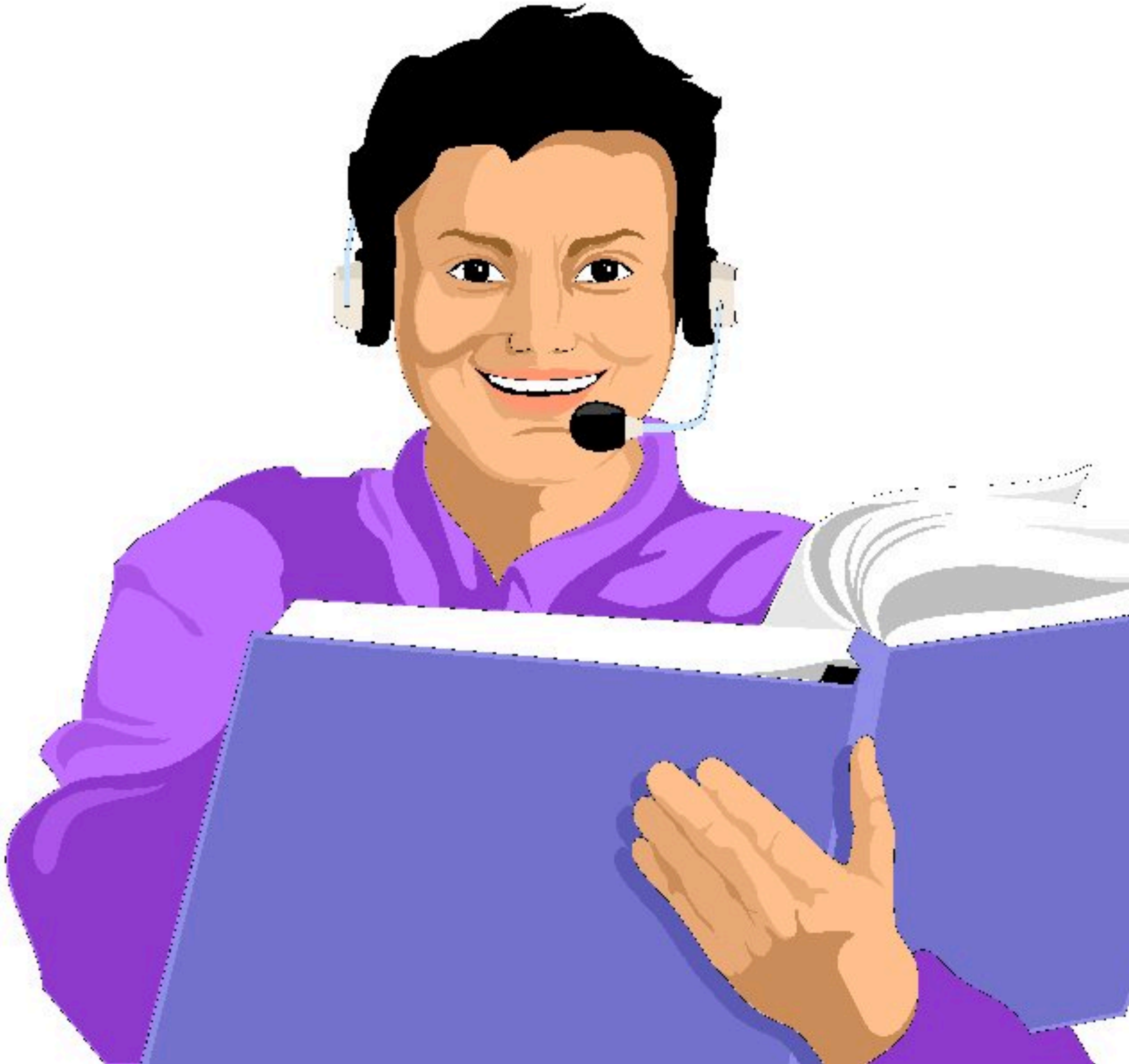
PROBLEM SET 3

* how’s it going?



RECAP

* functions for dealing with a gaussian distribution (pdf, cdf, sf, isf)

* standard error of the mean (another gaussian distribution!)

* gaussian confidence intervals

* gaussian z-test

T-TEST

W. S. Gosset
aka "Student"

* the Z-test assumes that you know exactly what the variance is

* what if you don't, and have to estimate it from your sample?

* then the Z-test doesn't apply, and you must use the t-test!

T-TEST

* the t-test uses the **t statistic**, which is defined as:

$$t = \frac{Z}{s} = \frac{\bar{X} - \mu}{s/\sqrt{n}}$$

T-TEST

* under the null hypothesis, the t statistic follows the t distribution, which has one parameter (the number of degrees of freedom)

T-TEST

* the t-test is implemented in scipy.stats

  * **scipy.stats.ttest_1samp** : tests whether the mean of your sample is different from a given value (assuming your sample has a gaussian distribution)

T-TEST

* scipy.stats also includes other flavors of t-test which are useful

  * **scipy.stats.ttest_ind** : tests whether two different (independent) samples have the same mean

PAIRED T-TEST

* scipy.stats also includes other flavors of t-test which are useful

  * **scipy.stats.ttest_rel** : aka the paired t-test, tests whether two *related* sets of samples have different means

PAIRED T-TEST

* **fMRI example:** suppose you measure the response of each voxel in a given brain area under condition A, and then again under condition B. you now have 2 different samples, but they are related

* testing for the difference of the two populations could obscure a difference between the conditions

PAIRED T-TEST

* **the solution:** compute the difference between resp(A) and resp(B), then do a t-test on whether that difference is different from zero

POWER OF STATISTICAL TESTS

* **power** is defined as the probability of rejecting the null hypothesis if the alternative hypothesis is actually true

* thus power is related to the rate of **false negative** results: how often does the test say “there is an effect” when there is actually an effect

POWER OF STATISTICAL TESTS

* power is related to the p-value threshold that you choose for a test

  * smaller threshold = lower power

* power is also related to whether the assumptions of the test are valid and whether the test is mis-specified

POWER OF STATISTICAL TESTS

* e.g. if you have paired samples but use an un-paired t-test, then that could reduce your power to find a real effect

END