Stat 13, Intro. to Statistical Methods for the Life and Health Sciences.

1. Regression formulas.
2. ANOVA and F-test, ch9.

Read ch9.

http://www.stat.ucla.edu/~frederic/13/W25 .

HW4 is due Wed, Mar12, 1159pm. 10.1.8, 10.3.14, 10.3.21, and 10.4.11.

The final is Wed Mar19, 1130am-230pm, here in Franz 1178, and
will be on ch 1-7, 10, and 1 question on ch9.
Bring a PENCIL or pen and CALCULATOR and any books or notes you want.
No computers.

If you cannot take it because of an emergency or other health reason,
then you will get an incomplete in the course and need to arrange to take the Spring stat 13 final.

The answers to last year's final are DBEAF CBAEA BCAAB ABDBD DADCB CABDE.

Regression facts.

- Suppose $\hat{y}$ = a + bx is the regression line, i.e. the line with minimum sum of squared residuals.
- Residual = observed y-value minus $\hat{y}$.
- The slope b of the regression line is b = r $\frac{s_y}{s_x}$.
- The intercept a = $\bar{y}$ - b $\bar{x}$.
- The SD of the residuals is $\sqrt{1-r^2}\, s_y$.

  This is a good estimate of how much the regression predictions will typically be off by.
- The residuals in linear regression always have mean zero.

- When testing the slope or correlation,

$$t = \frac{r}{\sqrt{\frac{1-r^2}{n-2}}}.$$

Tests of slope and correlation are equivalent.

- The SE for r is $\sqrt{\frac{1-r^2}{n-2}}$.
- The SE for b is $\sqrt{\frac{1-r^2}{n-2}}\ \frac{s_y}{s_x}$.

2. ANOVA and F-test.

Section 9.2

ANOVA

- ANOVA stands for ANalysis Of VAriance.
- Useful when comparing more than 2 means.
- If I have 2 means to compare, I just look at their difference to measure how far apart they are.
- Suppose I wanted to compare three means. I have the mean for group A, the mean for group B, and the mean for group C.

F test statistic

- The analysis of variance *F* test statistic is:

$$F = \frac{\text{variability between groups}}{\text{variability within groups}}$$

- This is similar to the t-statistic when we were comparing just two means. $t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$

Recalling Ambiguous Prose

Example 9.2

Comprehension Example

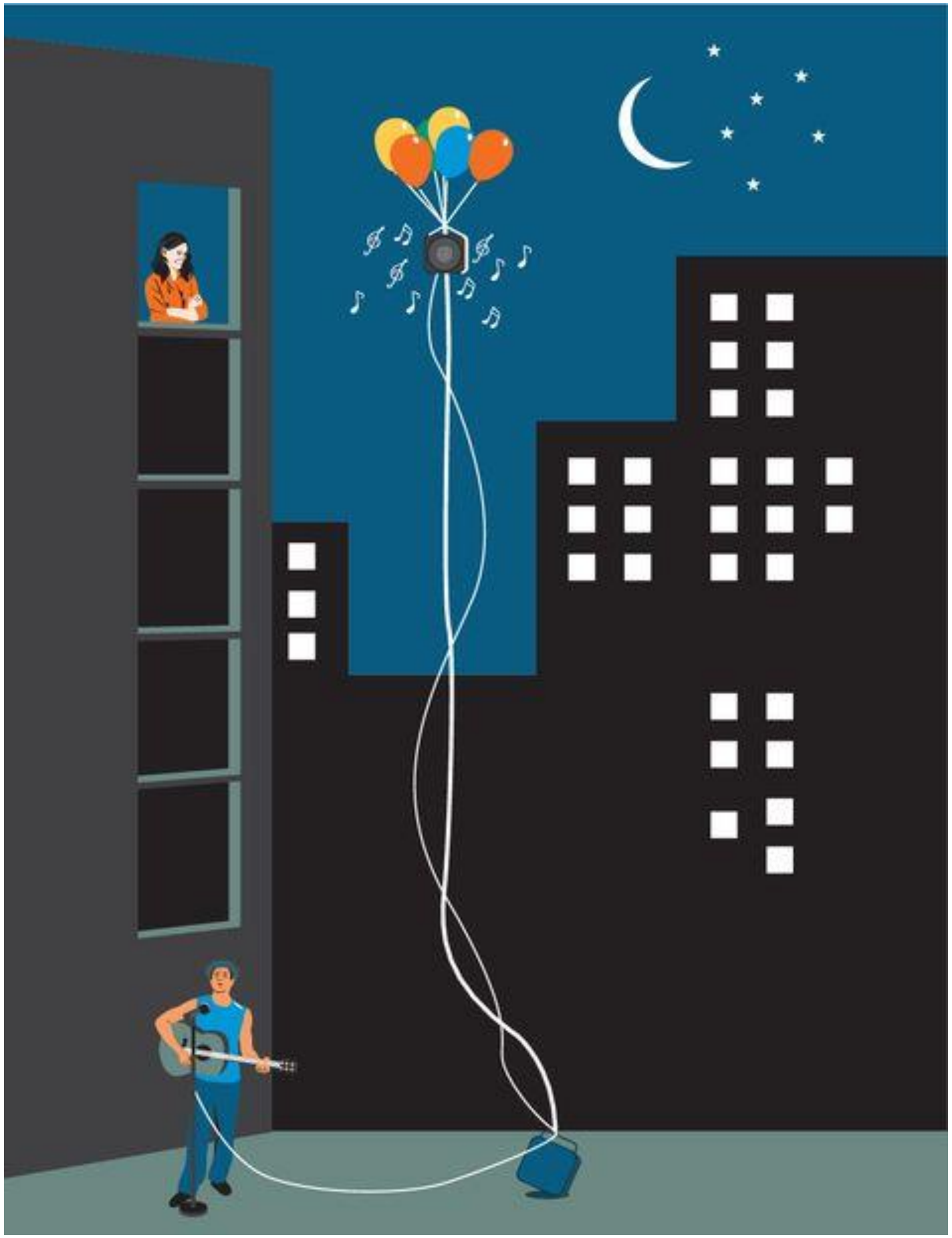
(**Don't** follow along in your book or look ahead on the PowerPoint until after I read you the passage.)

- Students were read an ambiguous prose passage under one of the following conditions:
  - Students were given a picture that could help them interpret the passage **before** they heard it.
  - Students were given the picture **after** they heard the passage.
  - Students were **not** shown any picture before or after hearing the passage.
- They were then asked to evaluate their comprehension of the passage on a 1 to 7 scale.

Comprehension Example

- This experiment is a partial replication done at Hope College of a study done by Bransford and Johnson (1972).
- Students were randomly assigned to one of the 3 groups.
- Listen to the passage and see if it makes sense. Would a picture help?

If the balloons popped, the sound wouldn't be able to carry since everything would be too far away from the correct floor. A closed window would also prevent the sound from carrying, since most buildings tend to be well insulated. Since the whole operation depends on a steady flow of electricity, a break in the middle of the wire would also cause problems. Of course, the fellow could shout, but the human voice is not loud enough to carry that far. An additional problem is that a string could break on the instrument. Then there could be no accompaniment to the message. It is clear that the best situation would involve less distance. Then there would be fewer potential problems. With face to face contact, the least number of things could go wrong.



Hypotheses

- **Null:** In the population there is no association between whether or when a picture was shown and comprehension of the passage
- **Alternative:** In the population there is an association between whether and when a picture was shown and comprehension of the passage

Hypotheses

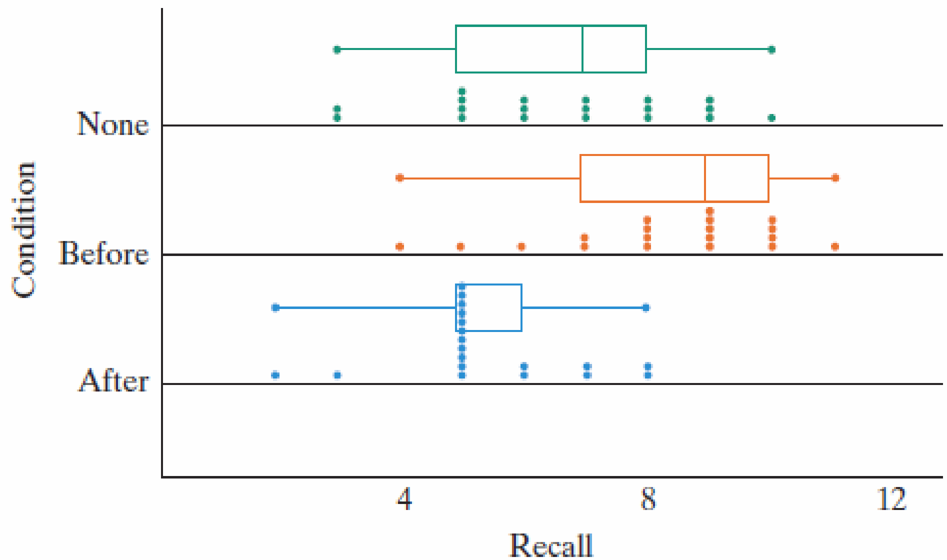
- **Null:** All three of the long term mean comprehension scores are the same.

  $\mu_{\text{no picture}} = \mu_{\text{picture before}} = \mu_{\text{picture after}}$

- **Alternative:** At least one of the mean comprehension scores is different.

Recall Score

- Students rated their comprehension, and the researchers also had the students recall as many ideas from the passage as they could. They were then graded on what they could recall and the results are shown.



Summary Statistics:

	n	Mean	SD
None	19	6.63	2.01
Before	19	8.26	1.82
After	19	5.37	1.46
Pooled	57	6.75	1.78

Observed MAD = 1.930

Validity Conditions

- Just as with the simulation-based method, we are assuming we have independent groups.
- Two extra conditions must be met to use traditional ANOVA:
  - Normality: If sample sizes are small within each group, data shouldn't be very skewed. If it is, use simulation approach. (Sample sizes of at least 30 is a good guideline.)
  - Equal variation: Largest standard deviation should be no more than twice the value of the smallest.

ANOVA Output

- This is the kind of output you would see in most statistics packages when doing ANOVA.
- The variability between the groups is measured by the mean square treatment (40.02).
- The variability within the groups is measured by the mean square error (3.16).
- The F statistic is 40.02/3.16 = 12.67.

Source	df	SS	MS	F	p-value
Treatment	2	80.04	40.02	12.67	0.0000
Error	54	170.53	3.16		
Total	56	250.56			

Conclusion

- Since we have a small p-value we have strong evidence against the null and can conclude at least one of the long-run mean recall scores is significantly different from the others.

Review list.

1. Meaning of SD.
2. Parameters and statistics.
3. Z statistic for proportions.
4. Simulation and meaning of pvalues.
5. SE for proportions.
6. What influences pvalues.
7. CLT and validity conditions for tests.
8. 1-sided and 2-sided tests.
9. Reject the null vs. accept the alternative.
10. Sampling and bias.
11. Significance level.
12. Type I, type II errors, and power.
13. CIs for a proportion.
14. CIs for a mean.
15. Margin of error.
16. Practical significance.
17. Confounding.
18. Observational studies and experiments.
19. Sample size calculations.
20. Random sampling and random assignment.
21. Two proportion CIs and testing.
22. IQR and 5 number summaries.
23. CIs for 2 means and testing.
24. Paired data.
25. Placebo effect, adherer bias, and nonresponse bias.
26. Prediction and causation.
27. Multiple testing and publication bias
28. Regression.
29. Correlation.
30. Calculate & interpret a & b.
31. Goodness of fit for regression.
32. Common regression problems (causation, extrapolation, curvature, heteroskedasticity).
33. ANOVA and F-test.

example problems.

Suppose that among a sample of 100 adults in a given town, the correlation between height (inches) and weight (lbs.) is 0.82, and the mean height is 65 inches, the sd of height is 5 inches, the mean weight is 160 lbs., and the sd of weight is 40 lbs.

1. What does the correlation of 0.82 imply?

a. 82% of the variation in weight is explained by height.

b. The typical variation in people's heights is 82% as large as the typical variation in their weights.

c. There is strong association between height and weight in this sample.

d. For every inch of increase in one's height, we would predict a 0.82 lb. increase in weight.

e. If a person weighs 100 pounds, then we typically would expect the person to be about 82 inches tall.

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2. What is the estimated slope, in lbs/inch, of the regression line for predicting weight from height?

a. 6.56. b. 7.12. c. 8.04. d. 9.92. e. 10.2. f. 11.4.

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$r\ s_y/s_x = .82 \times 40\ /\ 5 = 6.56.$

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3. How much would a prediction using this regression line typically be off by?

a. 12.7 lbs. b. 13.5 lbs. c. 14.4lbs. d. 20.2 lbs. e. 22.9 lbs.

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$\sqrt{(1-r^2)}\ s_y = \sqrt{(1-.82^2)} \times 40 = 22.9$.

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4. If we were to randomly take one adult from this sample, how much would his/her height typically differ from 65 by?

a. 0.05 in. b. 0.1 in. c. 0.5 in. d. 1.0 in. e. 2.5 in. f. 5.0 in.

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5. Why shouldn't one trust this regression line to predict the weight of someone who is 25 inches tall?

a. The sample size is insufficiently large.

b. The sample SD of weight is too small.

c. The value of 25 inches is too far outside the range of most observations.

d. The correlation of the ANOVA is a t-test confidence interval with statistical significance.

e. The data come from an observational study, so there may be confounding factors.

f. The height values are heavily right skewed, so the prediction errors are large.

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