

Course Review

Kin 304W

Week 14: April 9, 2013

Today's Outline

- Format of Kin 304W Final Exam
- Course Review
- Hand back marked Project Part II

Kin 304W Final Exam

- Saturday, Thursday, April 18, 3:30 - 6:30 pm
 - I'll write the exam to be about 2.5 hours
- AQ 3182 (double check room number before the exam)
- Closed book. You can bring a non-programmable calculator.
- I prefer you to write in pen, but pencil is OK.
- Exam questions will be based on material in my lecture slides.
- You won't be asked about how to do things in SPSS or Excel.
- You need to know the equations for Z score and SEM. You don't have to memorize any other equations.
- If you are really stuck on a question, make sure you ask. I can't give you the answer, but I can give guidance.

Format of Kin 304W Final Exam

- 10 x 2-mark questions = 20 marks. Combination of fill in the blank, simple calculations, one-word answers.
- 5 x 10-mark questions = 50 marks. 1-page answers. Discuss, describe, and/or define.
- 2 x 15-mark questions = 30 marks. 2-page answers. Integrative. Combine concepts about study design and analysis.

Office Hours

Dr. Mackey

Friday, April 5: 9-10 am

Thursday, April 11: 2:30-4:30 pm

Friday, April 12: 9-10 am

Monday, April 15: 10-11 am

Wednesday, April 17: 2:30-4:30 pm

Perveen Biln

Wednesday, April 10: 12:30-2:30 pm.

Lauren Tindale

Tuesday, April 9: until 2:30 pm

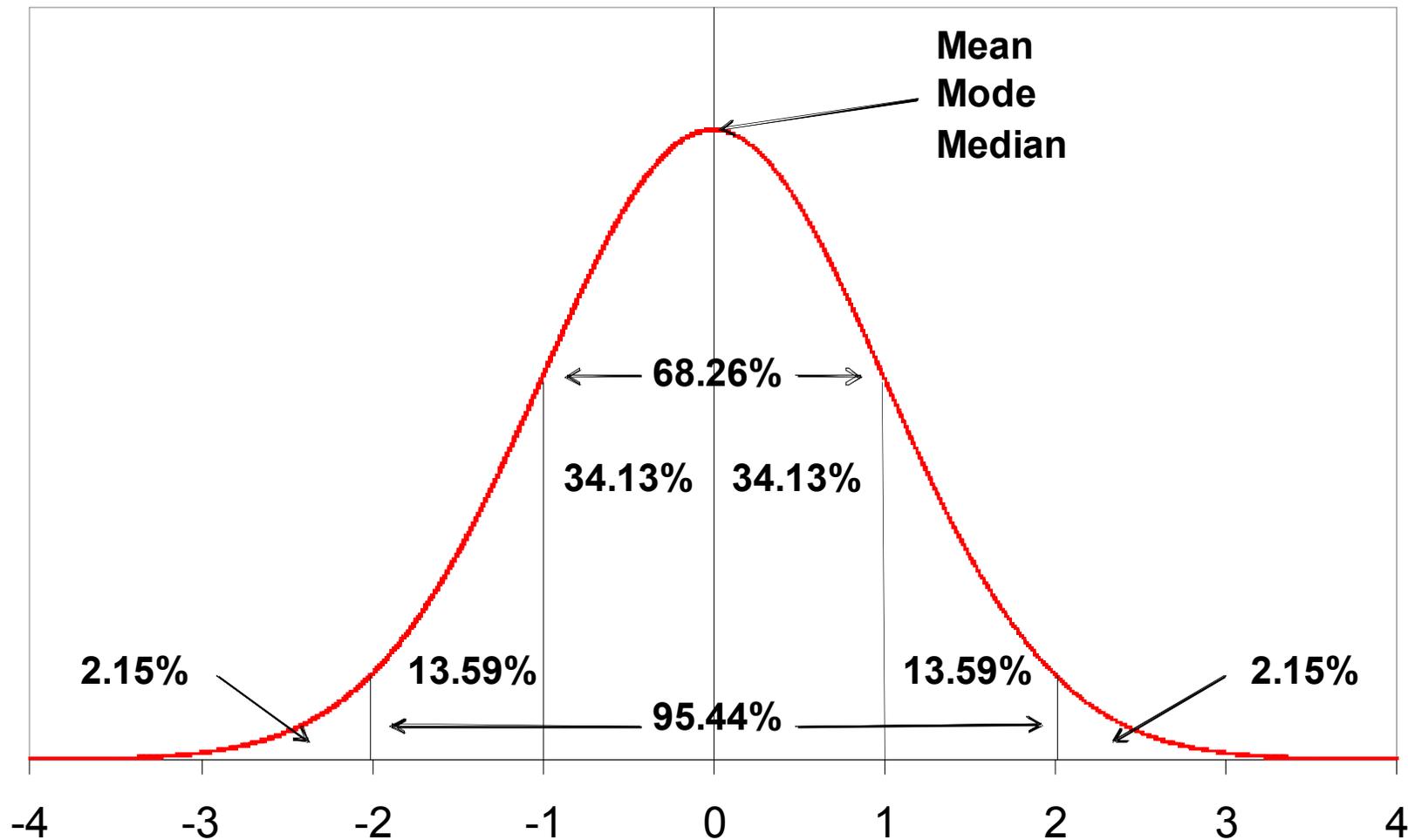
Course Review

- Scientific Method
- Descriptive Statistics and Normal Distribution
- Inferential Statistics
- Tests of Differences in Means: t tests & ANOVA
- Correlation
- Regression
- Nonparametric Statistics
- Modeling
- Analog-to-Digital Data Conversion

Scientific Method

- Define the problem, develop the hypothesis, test the hypothesis, compile the results, communicate the results.
- Measurement tools should be valid and reliable
 - **Valid** (accurate) tools minimize **systematic** measurement error. Calibration improves accuracy.
 - **Reliable** (reproducible) tools minimize **random** measurement error. Objective tools usually more reliable than subjective.
- Types of variables: independent, dependent, covariates.

Normal Frequency Distribution



Testing for normality: histograms, skewness, kurtosis, CFD, Normal probability plot

Descriptive Statistics

- Measures of Central Tendency
 - Mean, Median, Mode
- Measures of Variability (Precision)
 - Variance, Standard Deviation, Range, Interquartile Range
 - Standard error of the mean (SEM): SD/\sqrt{n}
- Standardized scores (e.g., Z scores) $Z = \frac{(X - \bar{X})}{s}$
- Percentiles

Inferential Statistics - Testing for Statistical Significance

1. Collect data from a sample

2. Calculate appropriate test statistic (e.g., t statistic, F statistic)

3. Compare test statistic to its critical value. Critical value depends on sample size and predetermined **significance level, α** . Critical values are found in stats texts and are incorporated into EXCEL and SPSS output.

If **test statistic $>$ critical value**, then p value $< \alpha$. Reject null hypothesis (H_0). Result is 'statistically significant.'

If **test statistic \leq critical value**, then p value $\geq \alpha$. Do NOT reject null hypothesis (H_0). Result is not 'statistically significant.'

Inferential Statistics

You conclude there is no significant effect when there is.	H₀ is False	H₀ is True
Accept H₀	Type II error (β)	1- α
Reject H₀	Power = 1 - β	Type I error (α)

H₀, null hypothesis

Commonly set α to 0.05

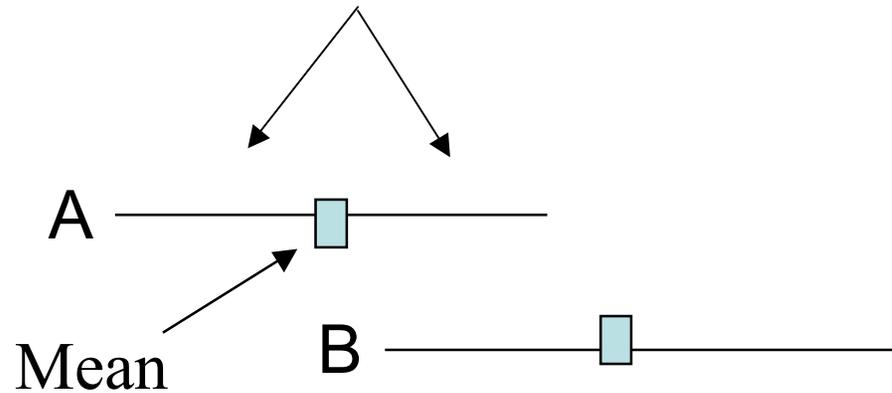
Commonly set β to 0.20, so that power is 0.80

You conclude there is a significant effect when there is not.

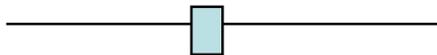
Tests of Difference

1 Standard Error of the Mean

$$SEM = \frac{SD}{\sqrt{n}}$$



Overlapping standard error bars, therefore **no significant difference** between means of A and B



No overlap of standard error bars, therefore a **significant difference** between means of A and B at about 95% confidence

Tests of Differences Between Means

1. t-test

- Independent t-tests and paired t-tests

2. ANOVA - Analysis of Variance

- Randomized groups
- Repeated measures
- Mixed

3. ANCOVA - Analysis of Covariance

Tests of Differences Between Means

- Independent t tests
 - When do you use them?
 - What is the null hypothesis of the test?
 - What is the test statistic called?
 - What leads to a bigger test statistic?
- Paired t tests
 - When do you use them?
 - What is the null hypothesis of the test?
 - What is the test statistic called?
 - What leads to a bigger test statistic?

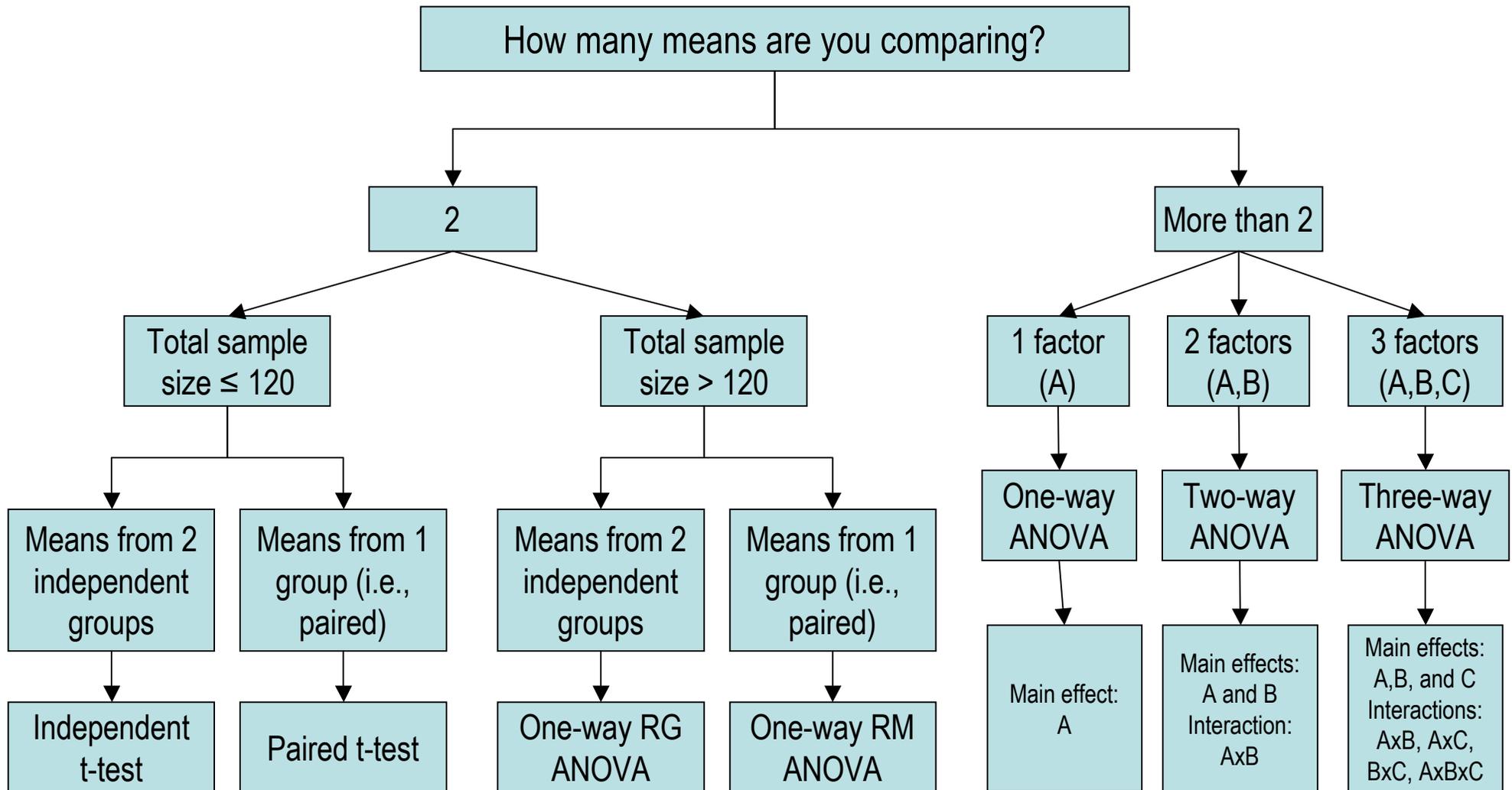
Tests of Differences Between Means

- ANOVA
 - When do you use ANOVA?
 - What is the null hypothesis of the test?
 - What is the test statistic called?
 - What leads to a bigger test statistic?
 - What is a factor?
- In a 2-way ANOVA, how many **main effects** will there be? **Interactions?** **What is an interaction?**
- If you observe a significant main effect from an ANOVA for a factor with ≥ 3 levels, what do you do next?
- What is the difference between a Randomized Groups ANOVA and a Repeated Measures ANOVA? What is a Mixed ANOVA?

Tests of Differences Between Means

- ANCOVA - Analysis of Covariance
 - Compare ≥ 2 means **and** control for covariates
 - E.g., We observed that grip strength was greater in boys than girls.
 - We also observed that muscle size (measured by skinfold-adjusted forearm girth) was greater in boys than girls.
 - Are the differences in grip strength between boys and girls because boys have bigger forearm muscles or due to something else?
 - Use a Randomized Groups ANOVA to compare grip strength between boys and girls and include skinfold-adjusted forearm girth as a **covariate (our analysis then becomes an ANCOVA)**.
 - We found no difference in grip strength between boys and girls after adjusting for muscle size.

Tests of Differences Between Means - What Test Should You Use?



Abbreviations: RG, randomized groups; RM, repeated measures

Learning Checkpoint

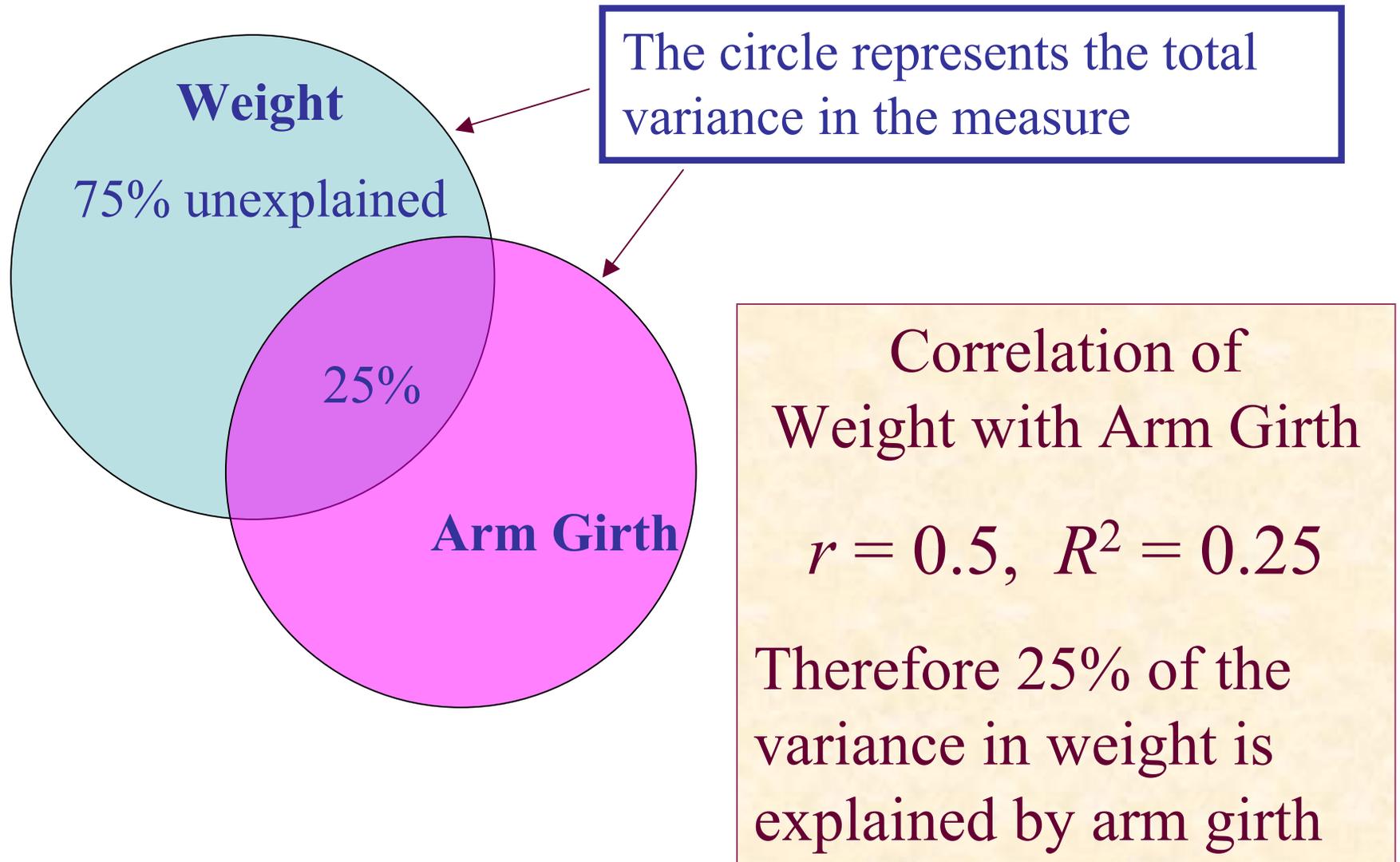
1. A graduate student measured height and weight of 1000 children in a developing country. Some children lived in communities that had water disinfection systems; other children lived in communities without disinfection systems.

Dependent variable(s)? Name and #of levels for each factor?
What statistical test would you apply?

Pearson Correlation Coefficient (r)

- Pearson Correlation Coefficient (r) is a measure of the **linear association** between two variables
- Varies from -1 to +1
- Conceptually, r is a ratio of variability in X to that of Y .
 - 0 = no relationship
 - -1 or 1 = perfect relationship
- There are a number of limitations or “pitfalls” related to correlation.

Coefficient of Determination (R^2)



Linear Regression

- Regression allows you to build prediction equations for a dependent variable of interest from a combination of independent variables.
- $Y = m_1X_1 + m_2X_2 + m_3X_3 \dots\dots + c$
- The regression line is fit by least sum of squares
- The statistic that tells you “how well” your equation predicts is the Standard Error of Estimate (S.E.E.)
 - 68.26% of time the **true score** is within plus or minus 1 S.E.E. of **predicted score**

Nonparametric Statistics

- The parametric statistical tests we covered in this course (t tests, ANOVA, Pearson correlation coefficient, linear regression) require the dependent variable to be continuous and approximately normally distributed.
- When data do not meet these criteria, nonparametric tests are appropriate.

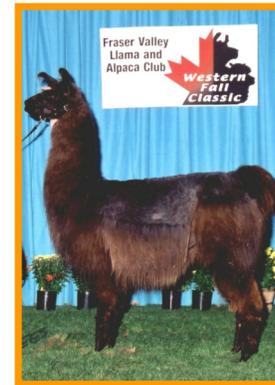
Nonparametric Tests

- **Is There a Difference?**

- **Chi-square:** Analogous to ANOVA, it tests differences in the frequency of observations of categorical data.

- **Is there a Relationship?**

- **Spearman's Rank Order Correlation**



- **Can we predict?**

- **Logistic Regression:** Analogous to linear regression, it assesses the ability of variables to predict a dichotomous dependent variable.

Modelling

- Serial or longitudinal data
- Smoothing, with moving averages, weighted moving averages, and signal averaging.
- Mathematical modeling, whereby one fits a mathematical equation to experimental data and evaluates the fit.
- In studying for the exam, think about how you go about testing a mathematical model. We've covered examples in lecture about skinfold compressibility, human growth curve modeling, and EMG-force relationship.

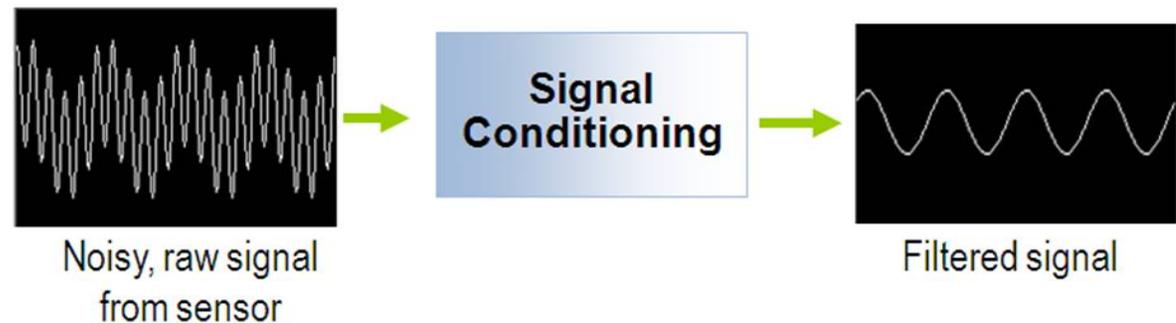
Analog to Digital (A/D) Conversion

1. Analog Signal

- Transducers
 - transforms one form of energy to another form
 - E.g., pizeoelectric crystals turn force into voltage
- Electrodes
 - sense biological signals
 - E.g., EEG, ECG, and EMG electrodes

2. Analog Signal Conditioning - electronic circuitry to modify the signal before it enters the computer for digitization.

- Amplification
- Filtering
- Integration



Analog to Digital (A/D) Conversion

3. AD Conversion board + software
 - Necessary to **digitize** the analog signal
 - **Samples** the analog signal at a set frequency and **stores** it as binary information. Sample at a high enough frequency to avoid aliasing.
 - 12 bit A/D board means 2^{12} (4096) unique values of voltage that can be coded.
 - If you also know the voltage range of a board (e.g., -10 to +10 V) you can calculate resolution (volts per bit).

Final Thoughts

- I have enjoyed having you in class this summer.
- I would like to hear from you in the future.
- If you find yourself using something that you learned in this course, please send me an email or stop by my office to tell me what you are up to.

Were the Course Goals Met?

- As an instructor, I tried to be:
 - Fair, organized, accessible, responsive
- By participating in this course, students built competence and transferable skills in
 - data analysis
 - scientific writing
- I hope this course was fun!