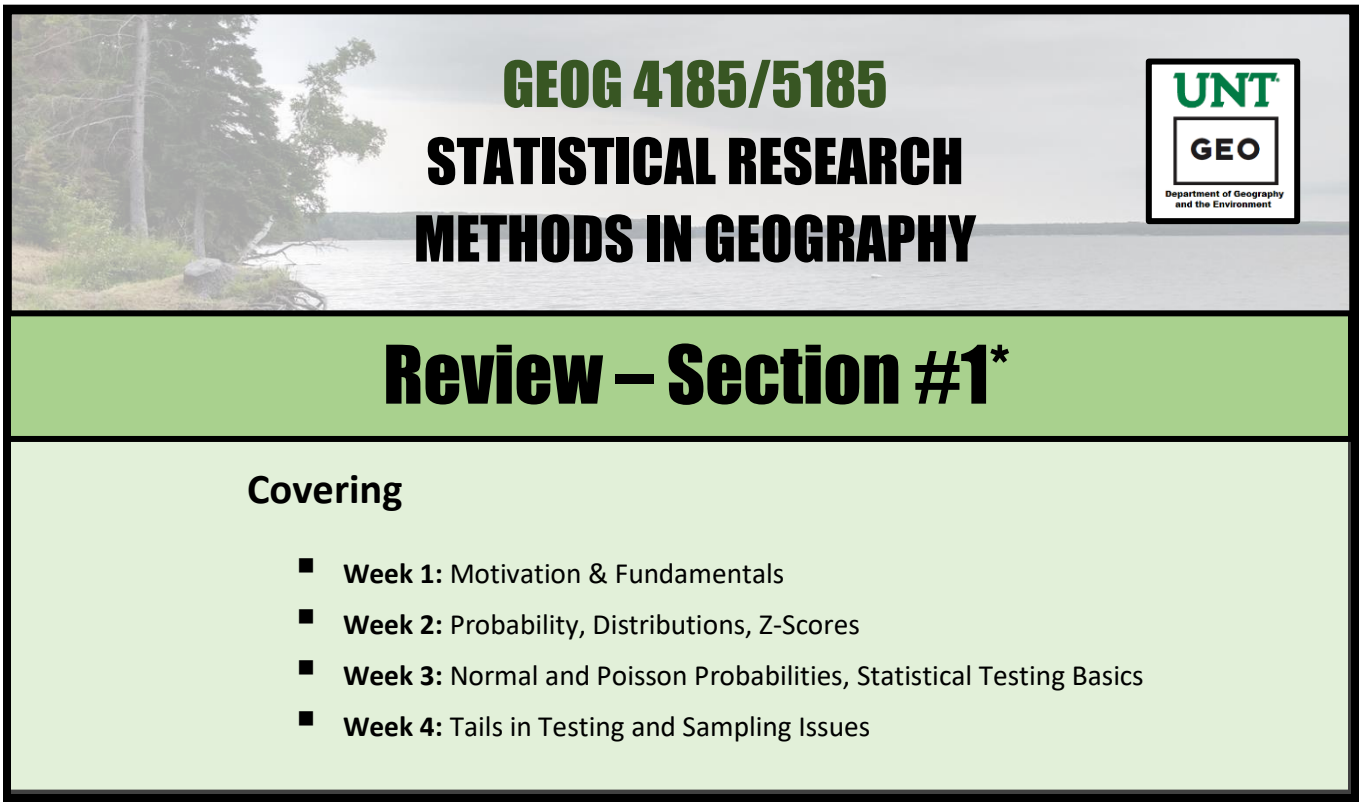


* This content connects with labs done in weeks 1-4 and quiz #1 (week 4).

Week 1: Motivation & Fundamentals

Statistics: Why?

Definition and goal of statistics

Four distinctive uses of statistics
1. Descriptive
2. Inferential
3. Significance
4. Prediction

More terminology
- Element
- Sample
- Population
- Variable

General Sampling Issues
- Randomness
- Sample Size

Specific Problems in Sampling
- Unknown population
- Known population that can't be sampled
- Population too small for sampling
- Sampling bias

Use of Statistics in Context of Samples
- Inferential Applications
- Descriptive Applications

Discussion on Honest Statistics

Scales of Measurement
- Nominal
- Ordinal
- Interval
- Ratio

Conversion Between Scales

Geographical Data Cube

Week 2: Probability, Distributions, Z-Scores

Probability as a Central Idea for the Course

Side Discussion: Math Notation (View Supplemental Video)

Understanding Probability
Two key kinds of probabilities
1. Theoretical Probabilities
2. Empirical Probabilities

Communicating Probabilities

Combining Probabilities

The Frequency Distribution Idea

Theoretical versus Empirical Distributions

Two Common Theoretical Frequency Distributions
1. Normal Distribution
2. Poisson Distribution

General Uses for Theoretical Distributions
- Parametric versus Non-Parametric Methods

Z-Scores
- How to calculate
- What they mean

Week 3: Normal & Poisson Probabilities, and Statistical Testing Basics

The Normal Distribution

Characteristics that Make it Important

Mean = Median = Mode

Area under the Normal Curve = 1.0 (100%)

Fitting the Normal Curve to an Empirical Dataset

Sample Probability Distribution
- Steps to fit a normal curve to an empirical probability distribution
- Table that captures the overall process

Using and Interpreting a Normal Probability Table

The Poisson Distribution

Reminder of Interpretation and Meaning

Example #1: Grid on a Map, Do Counts

Example #2: Hailstorm Observations

Significance Testing

Significance Testing and Statistical Testing

Key Significance Testing Subtopics
1. Hypotheses
2. Assumptions
3. Test Statistics
4. Sampling Distributions/Critical Values
5. Degrees of Freedom
What this looks like in an Example

Week 4: Tails in Testing, Types of Errors, and Sampling Issues

One and Two-Tailed Tests

Difference Between One and Two-Tailed Tests
- Meaning

Two-Tailed Test Case

One-Tailed Test Case

Samples and Sampling

Two Major Types of Sampling Methods
1. Random
2. Systematic

Also, can take a spatial or aspatial approach to each

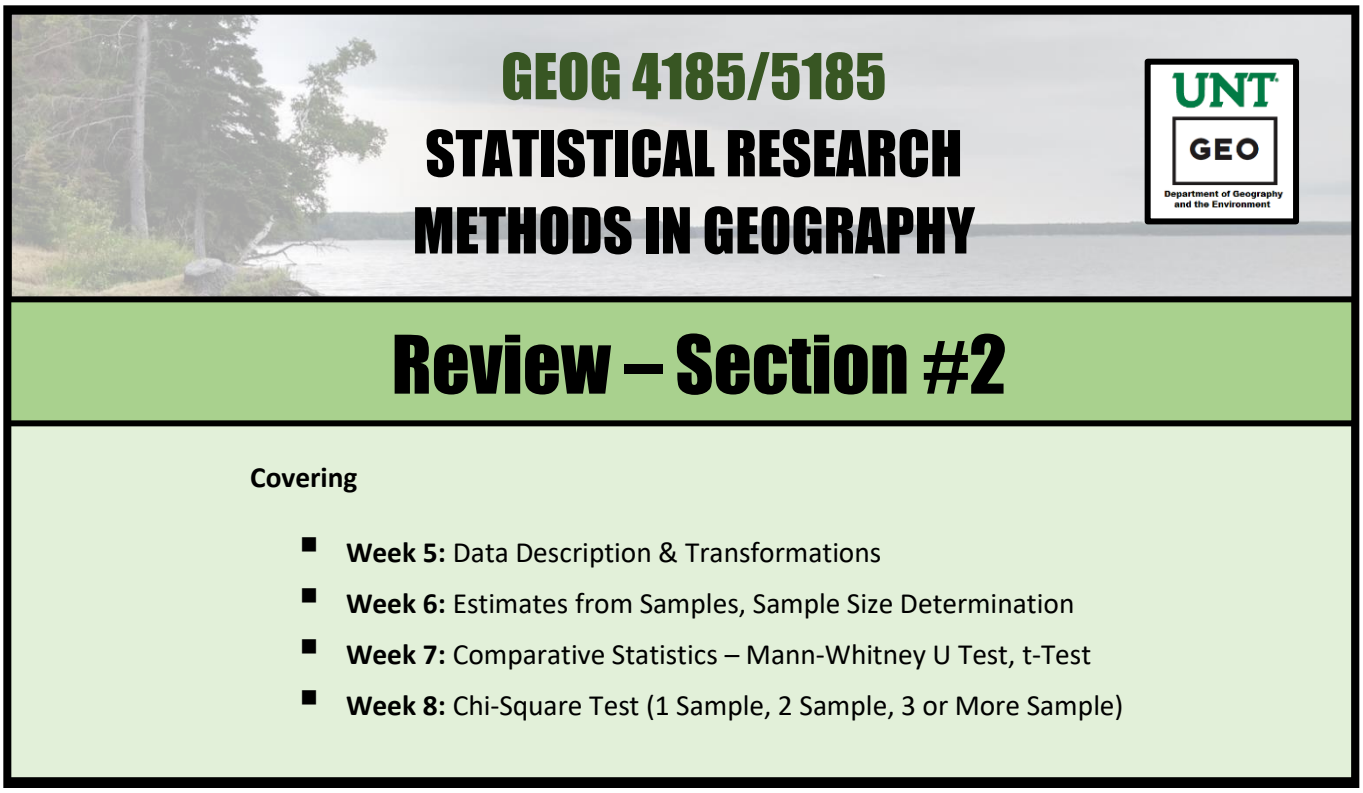
Random Sampling
- Random Sampling as Statistically Most Justifiable
- Issue of Replacement
- Reasons for Not Preferring a Pure Random Approach

Systematic Sampling
- Employing brings issues

Stratified Sampling
- Combination of Random and Systematic

Spatial Sampling
- Simple Random
- Simple Systematic
- Stratified Random
- Cluster Sampling

Overall Thoughts on Sampling



* This content connects with labs done in weeks 5-8 and quiz #2 (week 8).

Week 5: Data Description and Transforming Data Distributions

Description

Central Tendency

Dispersion

Characteristics of Frequency Distributions
- Skewness
- Kurtosis

Transformations

Why Transformations?

Sample Application: Eliminating Skewness

Week 6: Estimates from Samples, Sample Size, and a Start on Comparative Methods

Samples and Sample Size

Estimates from Samples
1. Estimating the Mean
2. Estimating the Standard Deviation
3. Estimates from Small Samples
4. Estimating Proportions
5. Sample Size

Overview of Comparative Tests

The Valley of Statistical Tests
A. K-S Test
B. Runs Test for Randomness
C. Mann-Whitney U Test
D. Student's t Test (One or Two Tailed)
E. Chi-Square Test
F. Kruskal-Wallace H Test
G. Analysis of Variance (ANOVA)

Six Steps of a Formal Statistical Test (Video Supplement)
1. Formulate Hypotheses
2. Select a Test Statistic
3. Select a Significance Level
4. Determine the Critical Value
5. Calculate the Test Statistic
6. Make a Decision

Example of Application of a Formal Statistical Test

Kolmogorov-Smirnov Test of Goodness of Fit
- Basic Overview
- Example: Comparing an Observed Distribution with a Theoretical Distribution (Rainfall)
- Example: Comparing an Observed Distribution with Model Predictions (Tributaries on a Stream)

Week 7: Comparative Statistical Methods, Part I – Mann-Whitney U Test, Student's t Test

Mann-Whitney U Test

Basic Overview

Three Different Use Cases for
    Example: Comparing Two Soil Samples

Properties of the U Sampling Distribution

Student's t Test
Basic Overview
Assumptions

Testing Options
    One-Sample, Paired-Samples, Independent Sample
    A. One-Sample Case
        Example: Calorie Intake Study

    B. Paired-Samples Case
    Example

    C. Independent Sample Case

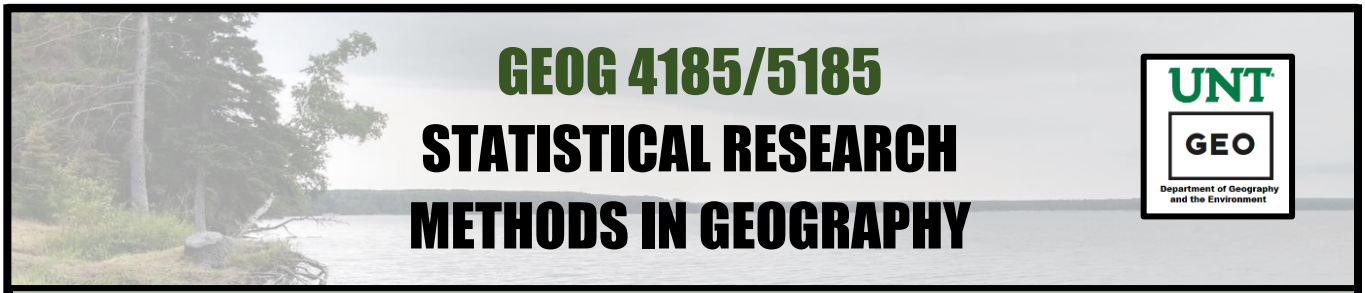
Week 8: Comparative Statistical Methods – Part II, Chi Square Test

Chi Square Test

Basic Overview
One Sample Case
    One Sample Example: Farm Types

Two Sample Case
    Subcase 1: compare two situations with same expectation
        Example: Glacial Features
        Example: Political Affiliations
    Subcase 2: compare two situations with different expectations
        Example: Car Purchases by Metro Area

Three or More Sample
    Example: Land Use/Land Cover
    Overall Summary of Comparative Statistical Tests



GEOG 4185/5185
STATISTICAL RESEARCH METHODS IN GEOGRAPHY

UNT GEO Department of Geography and the Environment

Review – Section #3*

Covering

- **Week 9:** ANOVA, Kruskal-Wallas H Test
- **Week 10:** Relationships – Correlation
- **Week 11:** Trends – Linear Regression
- **Week 12:** Trends – Multiple Regression
- **Week 13:** Spatial Statistics – Point and Areal Patterns
- **Week 14:** Spatial Statistics – Trend Surface Analysis

* There is no quiz that covers this material, but the content in this section connects with the final labs in this course.

Week 9: Comparative Statistical Methods – Part III, ANOVA (One-Way, Two-Way, Three-Way), Kruskal-Wallis H Test

ANOVA

Basic Overview
Use: for 3 or more Samples (interval/ratio data)
Variance Decomposition Concept
Example: July High Temperatures in Texas
ANOVA and Correlation Analysis
Applications for a Significant ANOVA Result

Kruskal-Wallis H Test

Basic Overview
Use: for 3 or more Samples (ordinal data)

Errors in Statistical Testing

Type I Error
Type II Error

Week 10: Correlation

The idea of relationship as we have already studied it in this course

- Parallels with the overall concept
- Ways in which relationship as discussed here is less than satisfactory

Contribution of correlation

- How strong is the relationship?
- We need a measure of relationship strength

Correlation in a bivariate context

- Look at a spectrum of cases
  - Perfect, direct (r = +1.0)
  - Imperfect, direct (r = +0.7)
  - No relationship (r = 0.0)
  - Imperfect, indirect (r = -0.7)
  - Perfect, indirect (r = -1.0)

Correlation versus Causation

- Not equivalent

Week 11: Introduction to Regression

Trends as a general concept

Idea of curve fitting

Simple Linear Regression

Goodness of fit possibilities (from data points to best fit line)

A. Minimize sum of distances, distances measured at a right angle to fitted line)
B. Minimize total area of triangles created between data and line
C. Same as A, but distance measured in vertical direction
D. Same as C, but distance is squared

Regression Subtopics

Calculation
Analysis of residuals
Outliers
Assumptions for simple linear regression
Confidence limits

Week 12: Multiple Correlation and Regression

Introduction to Multivariate Case

- Comparison with topics of past two weeks
- Idea of surface fitting instead of best-fit line
- Visualization of multivariate datasets to set up for multiple correlation and regression

Multiple Correlation

- Partial Correlation Coefficients
- Multiple Correlation Coefficient

Multiple Regression

- Partial Regression Coefficients
- Beta Coefficients
- Multicollinearity: The Problem
- Approaches to Multicollinearity
- Dummy Variables
- Data Issues
- Multiple Regression in a Geographic Context

Week 13: Spatial Statistics

Cases Addressed

- Point
- Area

Point Distributions

- Summary Statistics
  - Examples
- Nearest Neighbor Concept
  - Examples
- Nearest Neighbor Analysis
  - Calculation of Nearest Neighbor Index
  - Question of Significance
  - Geary's C

Areal Patterns

- Introduction
  - Examples
- Dichotomous Case
- Continuous Case

Dichotomous Case: Join Count
- Issues
- Calculations

Continuous Case: Moran's I
- Issues
  - Contiguity Matrix
- Example: Incomes by State

Brief Discussions: Further Methods
- Hot Spot Analysis (Getis-Ord GI*)
- Local Moran's I

Week 14: Spatial Pattern – Smoothing and Trend Surface

Smoothing and Trend Surface
- Basic Ideas

Spatial Smoothing
- Definition of Application
  - Example: Cancer in Belarus
  - Example: Oceanic Air Pressure Map
  - Example: Tijuana River Watershed
- Basic Methods
  1. Interpolation
  2. Running Mean
     a. One Dimension
     b. Two Dimensional Filter Mapping
     c. Problems

Trend Surface Analysis
- Basic Concepts
  - Orders of Equations
    - Planar
    - Quadratic
  - Residual Analysis
    - Example: Settlement Development in Pennsylvania
    - Example: Iowa Weather Stations

Connections to our Spatial Analysis Lab