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Module 1: Starting Your Science Fair Project

Introduction to Statistical Methods

What are you trying to prove?

Develop your problem statement & hypothesis

What types of data are you going to collect?

Collecting Data

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Introduction to Statistical Methods

- What is Statistics?
  - Statistics is the collection of data, the analysis of that data, and making decisions or drawing conclusions based on that data.
- What is a “statistic”?
  - A statistic is a fact, or data value from a larger set of data values.

- What is a statistical method?
  - A statistical method is a way to analyze your data, and represent your statistical data.
  - Statistical Methods can be Descriptive Statistics or Inferential Statistics.

- Descriptive Statistics
  - This includes the collection, organizing, analyzing, summarizing, and presenting of the data.
- Inferential Statistics (more advanced!!)
  - This includes making inferences (conclusions based on data sample) , hypothesis testing, determining relationships, and making predictions based on the current data.

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What are you trying to Prove?

- This next step is critical to the success of your science fair project
- After examining what you find interesting, you will explore different aspects of the topic to pick a specific aspect to study and do experiments on
- Once you have selected the aspect to study, you will need to develop a plan for the experiment

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Science Fair Example

- **What are we trying to prove?**
- We write down what we know about Microwave Popcorn:
  - Some Kernels do not pop
  - There are many different Brands of Popcorn
  - There are many different kinds of Popcorn (Kettle, Extra Butter, etc.)

- Since we really like popcorn, we want to know which brand has the highest percentage of popped popcorn kernels from the different brands of popcorn

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Science Fair Example

- **Develop a plan**
- We decide to test 3 Different Brands of Popcorn
- We want to measure the amount of uncooked popcorn kernels
- Then we will calculate the Percentage of kernels that popped

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Sample Plan

	Activity	Responsible Person	Target Date	Completion Date
1)	Determine the Brands of Popcorn to study.	Me	1/10/2014	
2)	Develop the Hypothesis Statement.	Me	1/13/2014	
3)	Determine the type of data needed to prove hypothesis	Me	1/14/2014	
4)	Purchase the Microwave Popcorn.	Mom	1/18/2014	
5)	Develop Data Record Sheet.	Me	1/20/2014	
6)	Perform Experiments	Me	1/21 – 1/28	
6A)	Collect and Record Data	Me		
6B)	Note Observations during the experiment	Me		
7)	Analyze Data	Me	1/20/2014	
8)	Develop tables and graphs for the data	Me	1/24/2014	
9)	Interpret data and graphical results	Me	2/1/2014	
10)	Create Presentation	Me	2/15 - 3/1	
10A)	Get presentation boards	Mom		
10B)	Create report	Me		
10C)	Create Display	Me		
10D)	Display supporting information	Me		
11)	Get Ready for Science Fair	Me	3/1/2013	
	SCIENCE FAIR -- Washtenaw Community College		**3/14/2013**	

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Develop Your Problem Statement and Hypothesis

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The Problem Statement

- Where does a Problem Statement come from?
  - Questions we create:
    - Comes from a process that is not working the way that we want it to or gives us the results we need
    - Comes from our curiosity about the world in which we live, learn and work
  - Scientific research is about:
    - Discovering new information or knowledge
    - Understanding what we observe in the world

The Problem Statement

- Types of questions:
  - Testable questions (hypothesis)
    - Testing variables to see effects on conditions
      - Does it define the problem? Yes
      - Is the statement testable? Yes
      - Are there one or more variables to measure? Yes
  - Information questions
    - Literature searches for information about a topic
      - Does it define our curiosity? Yes
      - Is the statement testable? No
      - Are there one or more variables to measure? No

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The Problem Statement

- Questions and the Process of Science
  - The Problem Statement needs to:
    - Be testable
      - Data gathered in experimentation can be analyzed to create new knowledge and come to a conclusion
      - Has one or more variables to be investigated as they affect an original set of conditions
    - Lead you to a hypothesis statement or question
      - Evaluate possible outcomes of your project
      - Hypothesize what the possible outcome will look like
      - Create a statement about that possible outcome
      - This is your hypothesis or problem statement

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The Problem Statement

- Let's look at our Popcorn science fair project
  - The situation:
    - There are 3 brands of popcorn we are interested in
    - Not all of the popcorn kernels are popped in the bag
    - We get to eat more popcorn from which brand?
  - Our Problem Statement:
    - Which brand of popcorn should we buy if we want the highest percentage of popped corn to eat?

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The Problem Statement

- Let's test our Problem Statement:
  - Does it define the problem? Y/N
    - We want the highest yield popcorn
  - Is the statement testable? Y/N
    - We can measure the amount of corn that pops (or that doesn't pop) and know the percentage of popped corn
  - Are there one or more variables to measure? Y/N
    - We will test 3 of our favorite brands of popcorn
- In each case our answer is "yes"

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Develop our Hypothesis

- What is an Hypothesis?
  - A statement assumed to be true
  - May be based on past experience
- What would be our hypothesis for our popcorn science fair project?
  - Since we really like the taste of brand B, we would like to think that it has the highest yield
  - **Hypothesis: Brand B popcorn has the highest percentage of popped corn kernels.**

Develop the Hypothesis

- Now that we know our Hypothesis we can:
  - Conduct our background research
  - Establish our Experimental Design
  - Create our experimental procedures
  - Conduct our “controlled” experiment
  - Analyze the data
  - Draw conclusions
  - Report results

What is Data?

- Data are (note that this is a plural word):
  - A collection of facts resulting from direct observation in our experiment
  - In other words, our measurements
    - In our popcorn project, it is the numbers of popped and unpopped corn kernels from each bag of popcorn tested

Our Data

- In our Science Fair example we have:
  - 3 brands of popcorn
    - sample popcorn bags for each brand
  - 1 microwave set at the same time for each bag
- We are measuring:
  - Number of popped kernels
  - Number of unpopped kernels
- And we calculate:
  - The percentage of popped kernels in each bag

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Collecting Data

- After deciding on WHAT you want to study, it is important to think about what DATA you need to collect for your study
- Always keep the question “What am I trying to prove?” in your mind so that the data you collect will help answer that question
- Data should be collected in a format that is not only easy to read but makes it difficult to cause errors

Table Format

- Table format is the simplest form of data collection. It works great when your data is a count of something. Let's view our popcorn example.

Popped Kernels	Brand A	Brand B	Brand C
Sample 1	86	88	81
Sample 2	82	85	79
Sample 3	84	96	82
Sample 4	78	101	77
Sample 5	91		75
Sample 6			84

Measured Data

- If your data involves a measurement, carefully keep a record of the result of that measurement and what was measured.
  - For example if you are measuring height of your classmates, you will want both the person's name and their height, to ensure that you have not missed anyone and more importantly, you have not counted the same person twice.