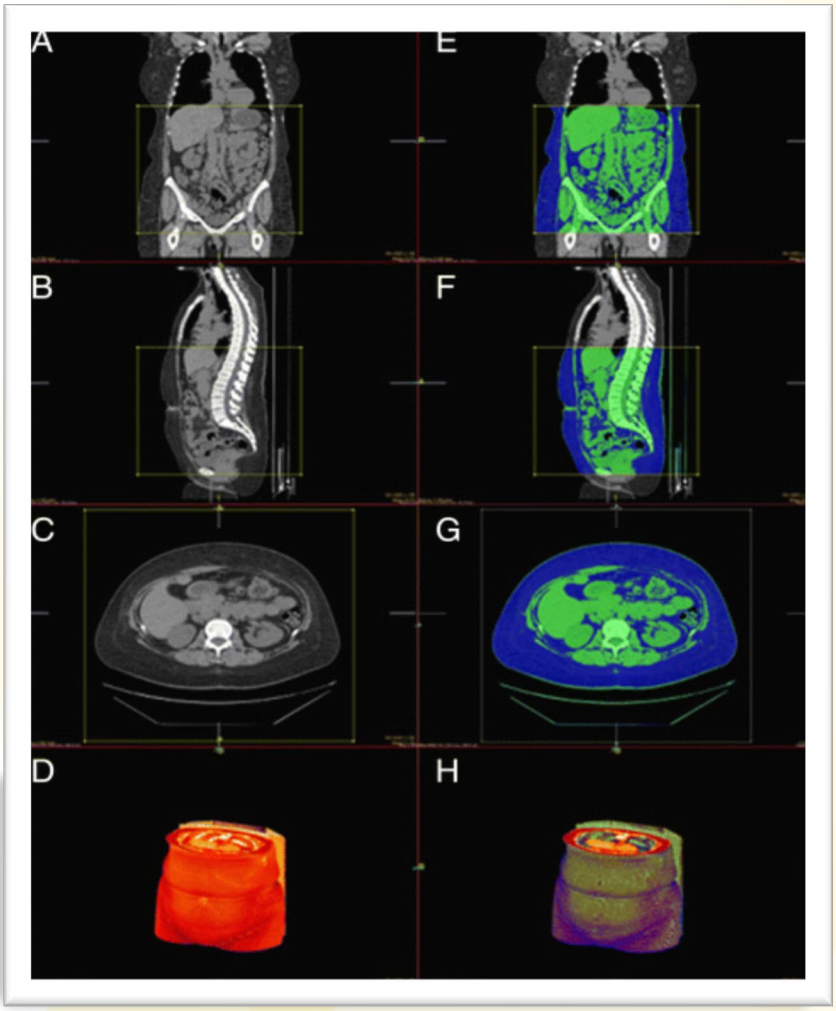
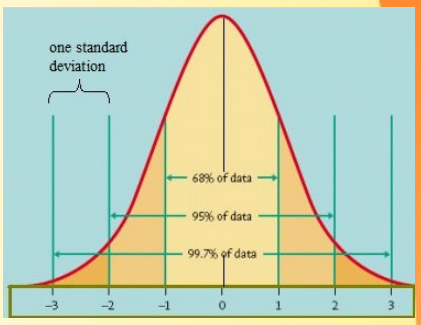
UCF Center for Research in Computer Vision

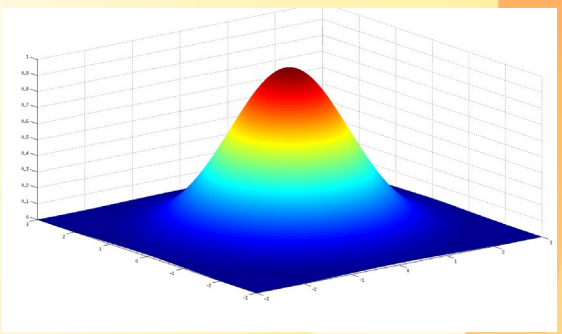
Edge Detection Algorithm: Finding boundaries between visceral fat and subcutaneous fat



https://bmcobes.biomedcentral.com/articles/10.1186/s40608-015-0039-3



Reject or Fail to Reject the Null Hypothesis



Gaussian Curve Smoothing Process

Carol Guthrie Lewis

AP STATISTICS – LIBERTY HIGH SCHOOL KISSISSMEE FLORIDA

RET 2018 PROGRAM AT UNIVERSITY OF CENTRAL FLORIDA

RET Site: Statistical Applications in Computer Vision Lesson/Unit Plan

Course(s): AP Statistics
Grade Level: 9 - 12
Suggested Length of Lesson: 5 days 45 min period

Materials/Technology Needed

- Puzzle pieces
- Computer Access
- 3D Slicer Program

Where this Fits

- This 5 day lesson will follow the unit for inference testing using t-test for 1 and 2 sample data.
- I plan to use this lesson as an in class project while students complete their mid-term review packets at home. I will follow with a week review in class then the mid-term exam.

Lesson Objective(s)/Learning Goal(s)

- To motivate AP Statistics students to purse advanced mathematics and explore career opportunities in computer vision
- Demonstrate understanding of abstract mathematical techniques, and formal mathematical reasoning as they pertain to the area of computer science
- Highlight obesity health factors
- Provide AP Statistics students with a real world application for collecting and testing data
- Recognize role of statistics when testing hypothesis
- Use statistical inferences to drive and improve patient care
- Recognize similarities between the Gaussian Distribution and Normal Distribution Density Curve

Standard(s)/Benchmark(s) Addressed

- **MAFS.912.S-IC.1.1** Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
- **MAFS.7.SP.2.4** Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations.
- **MAFS.912.S-ID.1.4** Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve
- **MAFS.912.S-ID.1.2** Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
- **MAFS.K12.MP.5.1** Mathematically proficient students consider the available tools when solving a mathematical problem.

Instructional Strategies

- Hands on station to describe fat, video for social impacts of obesity, online BMI calculator
- Interactive PowerPoint to view mission and 3D slicer tutorial

Evidence of Learning (Assessment Plan)

- Complete “Mission” Handout for Statistical Analysis and confidence Interval

Description of Lesson Activity/Experiences

- **Day 1: Anticipatory Sets: Familiarize students with the social, emotional, and physical effects of obesity Overview: Introduce computer vison applications in radiology and overview of lesson**

Introduction: AP Statistics Multiple Choice Questions (Per Liberty High School policy. All AP bell work will be AP college board or district approved questions)

Lesson: Students will enter the classroom and divide into 4 stations. After each station student will filling their field report sheet.

Station1: Mystery Box

Students put their hands in a box and feel different types of fat. Next, they write their description down in a Venn diagram on the board. This will give the students an idea of how fat in the body feels.

Station 2: Physical Effects of Obesity Puzzle

Puzzle. Students will put together a puzzle in pairs. One side they have the effects of obesity and the other side they have photos. The goal is connecting long term effects with everyday people. Students may not believe that long terms physical effects have an impact on them.

Station 3 Social Effects of Obesity

Video stations. High school age student talk about how obesity affects their daily life and self-confidence. Video imbedded into PowerPoint.

Station 4: BMI Calculator

Student watch animated video on obesity with more health concerns stressed. At the end of the video, students are prompted to calculate their BMI online.

Overview: The Mission

Next students will group into pairs and few the mission impossible video and gather details about the projects from their intel. (see power point video Stage 1). Students will complete the field report to check for understanding.

Closing/Homework: Classroom discussion to share answers and ask questions about the project. Students can compare their prior knowledge about visceral fat and subcutaneous fat from previous course and attitude they have on obesity. Review sheet for Mid-Term Exam

- **Day 2: 3D Slicer Tutorial Interactive program to familiarize students with basic 3D slicer functions**

Introduction: AP Statistics Multiple Choice Questions (Per Liberty High School policy. All AP bell work will be AP college board or district approved questions)

Lesson: Students work in pairs with 2 computers. One will have the 3D slicer tutorial and the other is the 3D slicer. This is just an exploration day for students to get acquainted with the 3D slicer functions. (See PowerPoint Stage 2)

Closing/Homework: Read, article: Brown Adipose Tissue Detected by PET/CT Imaging Is Associated with Less Central Obesity." Review sheet for Mid-Term Exam

- **Day 3: Data Collection 3D Slicer to segmenting volume of visceral and subcutaneous fat**

Introduction: AP Statistics Multiple Choice Questions (Per Liberty High School policy. All AP bell work will be AP college board or district approved questions)

Lesson: Students view a video model lesson where I demonstrate how to segment the boundary between the visceral fat and subcutaneous fat then threshold the desired region for math analysis. Students then complete the process and acquire the volume for VF and SF for 2 patients to their field report. This is a complex task and required one complete day to collect data.

Closing/Homework: Discuss other statistics application in study. Review sheet for Mid-Term Exam

- **Day 4: Statistical Analysis Identify the null/alternative hypothesis, state assumptions/conditions, and conclusion decision based on p-value**

Introduction: AP Statistics Multiple Choice Questions (Per Liberty High School policy. All AP bell work will be AP college board or district approved questions)

Lesson: Complete field reports in groups of 2/3. Entering in data and complete 2-sample t-test and confidence interval. Explain in detail the conclusion in context to the null hypothesis and within the study.

Closing/Homework: Discuss different p-values for students and if the decision of the p-value should match the confidence interval. Review sheet for Mid-Term Exam

- **Day 5: Exploration Discussion of Neural Networking, Back Propagation, Edge Detection, and Python Coding**

Introduction: AP Statistics Multiple Choice Questions (Per Liberty High School policy. All AP bell work will be AP college board or district approved questions)

Lesson: (Power Point Attachment Stage 5) Have students change partners and explore different aspects of computer vision. Students can go through each tab and get a general overview of the different concepts of computer vision then will need to select one to investigate in dept. After the students have video the tutorial they will create a concept map. (see below)
(http://www.ucolick.org/~max/289/Concept%20Maps/About%20concept%20maps/KindsOfConceptMaps.pdf)

Closing/Homework: Review sheet for Mid-Term Exam

Recommended Assessment(s) and Steps

- Grades students work using the 6 box method for hypothesis testing to determine if students could accurately calculate the volume of the visceral fat and subcutaneous fat, find the p-value using a 2 sample t-test, and explain the results in context. Students will also find the confidence interval and explain why or why not their results were in the range of the mean.

List of Materials/Resources Used
Puzzle pieces
Computer Access
3D Slicer Program

Important Vocabulary

ALL DEFINTIONS BELOW ARE TAKEN FROM https://en.wikipedia.org

Term	Definition
Visceral Fat	Visceral fat or abdominal fat[8] (also known as organ fat or intra-abdominal fat) is located inside the abdominal cavity, packed between the organs (stomach, liver, intestines, kidneys, etc.)
Subcutaneous Fat	Subcutaneous fat is the layer of subcutaneous tissue that is most widely distributed It is composed of adipocytes, which are grouped together in lobules separated by connective tissue
BMI	The **body mass index** (**BMI**) or **Quetelet index** is a value derived from the mass(weight) and height of an individual. The BMI is defined as the body mass divided by the square of the body height, and is

	universally expressed in units of kg/m^2, resulting from mass in kilograms and height in meters.
3D Slicer	**3D Slicer** (**Slicer**) is a free and open source software package for image analysis and scientific visualization. Slicer is used in a variety of medical applications.
Python	**Python** is an interpreted high-level programming language for general-purpose programming.
Computer Vision	**Computer vision** is an interdisciplinary field that deals with how computers can be made for gaining high-level understanding from digital images or videos. From the perspective of engineering, it seeks to automate tasks that the human visual system can do.
Back Propagation	**Backpropagation** is a method used in artificial neural networks to calculate a gradient that is needed in the calculation of the weights to be used in the network It is commonly used to train deep neural networks a term referring to neural networks with more than one hidden layer
Deep Learning	**Deep learning** (also known as **deep structured learning** or **hierarchical learning**) is part of a broader family of machine learning methods based on learning data representations, as opposed to task-specific algorithms. Learning can be supervised, semi-supervised or unsupervised
Neural Networking	The term **neural network** was traditionally used to refer to a network or circuit of neurons.The modern usage of the term often refers to artificial neural networks, which are composed of artificial neurons or nodes
Gaussian Distribution	A random variable with a Gaussian distribution is said to be **normally distributed** and is called a **normal deviate**.
Pixel Intensity	In image processing, **normalization** is a process that changes the range of pixel intensity values. Applications include photographs with poor contrast due to glare, for example. Normalization is sometimes called contrast stretching or histogram stretching.
Kernel	In image processing, a **kernel**, **convolution matrix**, or **mask** is a small matrix. It is used for blurring, sharpening, embossing, edge detection, and more. This is accomplished by doing a convolution between a kernel and an image.

Attachments

Activity attachments not included within this document, such as the following:

- PowerPoints for lecture
- Handouts (Worksheets, Activities, Quizzes, Visual Aids, etc).

Acknowledgements

Authors

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[1] Brown Adipose Tissue Detected by PET/CT Imaging Is Associated with Less Central Obesity." Nuclear Medicine Communications, vol. 38, no. 10, 2017, p. 883., doi:10.1097/mnm.00000000741.

[2] Hussein, Sarfaraz, et al. "Automatic Segmentation and Quantification of White and Brown Adipose Tissues from PET/CT Scans." IEEE Transactions on Medical Imaging, vol. 36, no. 3, 2017, pp. 734–744., doi:10.1109/tmi.2016.2636188.

[3] Robert Collins. CSE486 Computer Vision I." A Collection of Well-Known Software Failures, www.cse.psu.edu/~rtc12/CSE486/

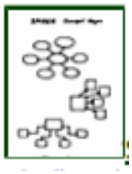
Concept Map Attachment:

(Kinds of Concept Maps. http://classes.aces.uiuc.edu/ACES100/Mind/c-m2.html)

Kinds of Concept Maps

There are four major categories of concept maps. These are distinguished by their different format for representing information.

Four Major Categories of Concept Maps:



SPIDER CONCEPT MAP

The "spider" concept map is organized by placing the central theme or unifying factor in the center of the map. Outwardly radiating sub-themes surround the center of the map.



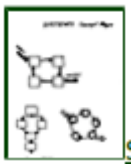
HIERARCHY CONCEPT MAP

The hierarchy concept map presents information in a descending order of importance. The most important information is placed on the top. Distinguishing factors determine the placement of the information.



FLOWCHART CONCEPT MAP

The flowchart concept map organizes information in a linear format.



SYSTEMS CONCEPT MAP

The systems concept map organizes information in a format which is similar to a flowchart with the addition of 'INPUTS' and 'OUTPUTS'.

Special Concept Maps include the following format types:

PICTURE LANDSCAPE CONCEPT MAP 

These maps present information in a landscape format.

MULTIDIMENSIONAL / 3-D CONCEPT MAP 

These describe the flow or state of information or resources which are too complicated for a simple two-dimensional map.

MANDALA / MANDALA CONCEPT MAP 

Information is presented within a format of interlocking geometric shapes. A "telescoping" factor creates compelling visual effects which focus the attention and thought processes of the viewer