

ENED 1100 – Fall 2022

HW 8.1: Measurements and Estimations

Individual Assignment: See the course syllabus for a definition of what constitutes an individual HW assignment.

Estimating techniques can be very helpful in engineering problem solving, as it can frame the bounds of a solution with little or no data. These techniques are often referred as Fermi Problems named after the Italian born physicist and Nobel prize winner. Working on the Manhattan Project during WWII, he was able to closely estimate the strength of the initial atomic blast at the Trinity site by observing the distance small pieces of paper travelled. The Fermi technique can be used in the initial phase of a problem, as it challenges what we know, what we can easily measure, and what are reasonable assumptions to take. It also allows us to think about the resolution of the answer. As the saying goes, “close enough” only counts in horseshoes and atomic bombs.

Task 1 (of 3) Estimating

The following Task has three parts and your solution will provide an estimation of attendance, miles driven, and pigs slaughtered. **You will provide a single Problem Presentation Method (PPM) solution** which will include a Problem Statement, Theory, Assumptions, Solution and Conclusion. No Diagram or Verification is needed. The table given below for Capacity, Years and Winning % should be provided just below the Problem Statement. For each section of the PPM, be sure to label out which part of the problem you are addressing. Basically each section of the PPM should have an *a*, *b* and *c*.

Task 1a.) Nippert Stadium is the fifth oldest stadium in college football, with the original horseshoe shaped stadium being completed in 1924. With the 100th anniversary approaching, the athletic department would like to recognize the many fans that have supported the Bearcats over the years. Unfortunately, there are no accurate records of the attendance.



Estimate the number of fans that have attended the home games at Nippert Stadium, since its first season in 1924. The table below shows the capacity for the various years and the winning percentage.

Capacity	Years	Winning %
12,000	12 (1924 – 1935)	52%
24,000	18 (1936 – 1953)	63%
28,000	38 (1954 – 1991)	44%
35,000	23 (1992 – 2014)	57%
38,000	7 (2015 – 2021)	67%

Task 1b.) Tailgating has been around longer than football. One of the earliest examples in American culture goes back to the beginning of the Civil War, when curious residents of Washington loaded up their carriages and buggies with a picnic lunch and travelled to the Virginia countryside to watch the First Battle of Bull Run.

Estimate the total number of miles fans have driven in their automobiles to Nippert Stadium since 1924. Fans may have walked, used public transport, drove individually or carpooled.

Task 1c.) What would a tailgate party be without brats? Cincinnati has long been associated with the pork industry, and at one time was referred to as Porkopolis. At the time of UC's founding in 1819, 30,000 pigs were being slaughtered in the city. In the peak years just prior to the Civil war, 500,000 pigs were being processed. These animal byproducts led to the growth of the Cincinnati soap industry, current home of Procter & Gamble.

Estimate the total number of pigs that have been slaughtered in the production of brats for the games since 1924.

Task 2 (of 3) Measurement

Many industries are regulated by federal agencies. The FDA in fact, was created in 1906, largely due to the public outcry about the book "The Jungle" by Upton Sinclair which detailed the unhygienic conditions in the Chicago stockyards.

CALIBRATION	
Organization:	_____
ID#:	_____
Date	By: _____
Due Date:	_____

The FDA implemented quality control measures, requiring the manufacturers to measure, record and maintain production records. Also implemented was the requirement for the manufacturers to establish product parameters and monitor each production run. Measuring equipment will typically have certification sticker directly attached to the instrument, confirming the device is calibrated (see image on the right).

The following samples were collected from Abe Froman Sausages in the production of the brats. The *recorded* measurements from the production line are as follows based on digital readings from an electronic gage:

Sample	Weight (oz.)	Length (in.)	Diameter (in.)
1	2.733	6.474	1.302
2	2.720	6.460	1.299
3	2.770	6.196	1.296

As the QA engineering responsible for approving the batch of sausages prior to shipping, you will need to document some of the parameters in each lot. When dealing with calculations involving measured quantities, it is important to understand the accuracy of the measurement device so that you can compute desired values. Each measurement tool has a calibration

document on file, showing the accuracy, date of certification, and when the device needs to be recalibrated. From the calibration document, the accuracy is as follows:

- Scale 0.1 oz.
- Linear Caliper (length) 0.1 in.
- Diameter (micrometer) 0.01 in.

The digital readings should be adjusted based on the accuracy above before doing any calculations. **Answer the following questions by using the provided Answer Sheet Document on the CANVAS Assignment Page.** Rename the answer sheet with the following file name: **HW_8p1_Task2_UCUsername** before submitting to your Canvas Section Page.

Task 2a.) Calculate the volume for each sample, displaying to the answer to the correct significant figures. You can model the brat as a cylinder.

Task 2b.) What process parameter appears to vary the most, leading to an inconsistent product?

Task 2c.) After signing and submitting your report for the FDA documentation, you notice that the weight scale calibration date expired the week before. What actions, if any, should you take?

Task 3 (of 3) Wisdom of the Crowd.

More than a century ago, the famous British scientist Sir Francis Galton researched estimation contests. At a cattle market, visitors could estimate the slaughter weight of an exhibited ox. Galton examined the estimates made by people and found that, surprisingly, the average estimate differed little from reality. The principle that averaging multiple estimates provides a relatively accurate outcome. We will test this concept by averaging the estimates of the ~1500 students taking ENED1100. (See the very short survey link below.) Help calculate the aggregate answer to the first task by taking a short survey to document each team's answer. [Nippert Survey](#)

When Finished

You should be submitting three files:

- Task 1 (PPM Solution): **HW_8p1_Task1_UCUsername.pdf**
- Task 2 Answer Sheet(pdf or word document): **HW_8p1_Task2_UCUsername**