# 1 Introduction

First we start with a roadmap for the course. The subject of **engineering statistics** is defined, its importance is described and basic terminology is introduced.

## 1.1 What is statistics?

Statistics is the science of collecting, presenting, analyzing, and making decisions from data. Often, as an engineer, it is necessary to **collect and interpret data** that will help in understanding how a new system or product works.

Statistics has applications to engineering through quality control, process control, reliability, risk management, system identification, design of experiments, etc.

**Definition 1.1.** *Engineering statistics* is the study of how best to

1. collect engineering data,
2. summarize or describe engineering data, and
3. draw formal inference and practical conclusions on the basis of engineering data,

all while recognizing the reality of variation.

We can break down this study into three main tasks:

1. **Summary:**
2. **Inference:**
3. **Interpretation:**

**Example 1.1** (Heat treating gears, pg. 2)**.** A process engineer is faced with the question, "How should gears be loaded into a continuous carburizing furnace in order to minimize distortion during heat treating?" The engineer conducts a well-thought-out study and obtains the runout values for 38 gears laid and 39 gears hung.

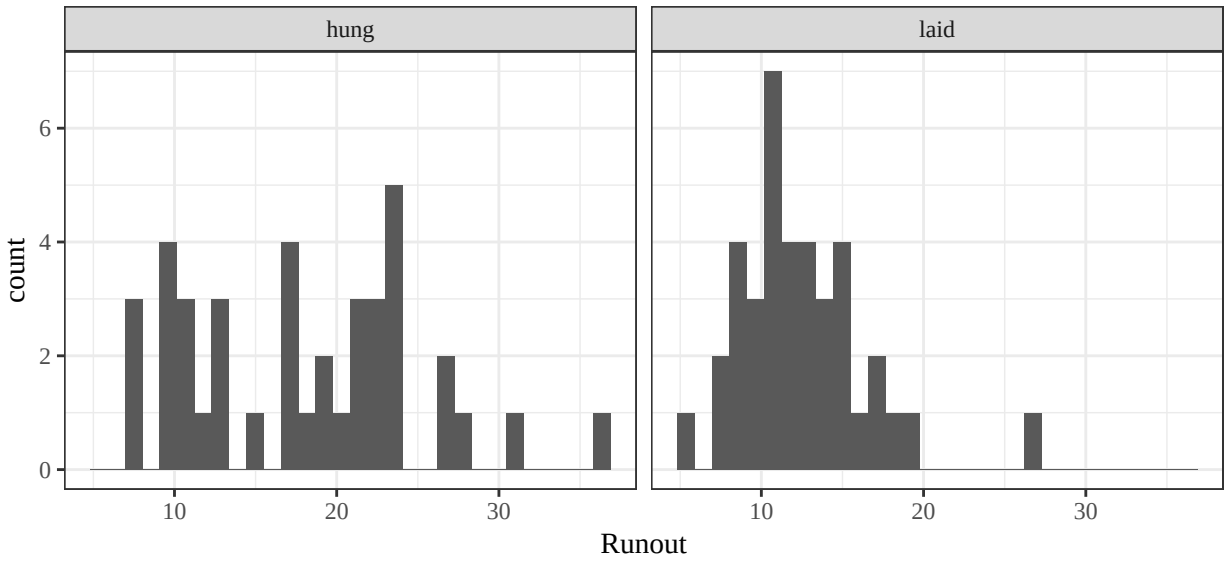
| hung | laid |
|---|---|
| 7, 8, 8, 10, 10, | 5, 8, 8, 9, 9, 9, |
| 10, 10, 11, 11, | 9, 10, 10, 10, |
| 11, 12, 13, 13, | 11, 11, 11, 11, |
| 13, 15, 17, 17, | 11, 11, 11, 12, |
| 17, 17, 18, 19, | 12, 12, 12, 13, |
| 19, 20, 21, 21, | 13, 13, 13, 14, |
| 21, 22, 22, 22, | 14, 14, 15, 15, |
| 23, 23, 23, 23, | 15, 15, 16, 17, |
| 24, 27, 27, 28, | 17, 18, 19, 27 |
| 31, 36 | |

Table 1: Thrust face runouts (.0001 in.)

This data, as is, is hard to get insights from. Should the gears be hung or laid? We still cannot tell by looking at the table.

**Numerical summaries:**

**Variation:**




## 1.2 Populations and samples

## 1.3 Experimental vs. observational studies

## 1.4 Data and measurement

## 1.5 Complete/Fractional factorial designs