

1. Introduction

Reliability-Based Civil Engineering Concept

Low probability, high consequence events

Risk

Structural reliability

Risk and risk perception

2. Role of Probability in Engineering

Introduction

Decisions are required

irrespective of the state of completeness and quality of information

under condition of uncertainty

Many problems in engineering involve natural process and phenomena are naturally indeterminate and random

Uncertainty in Real-world Information

Uncertainty associated with randomness

Many phenomena or processes contain randomness, that is the actual outcomes are unpredictable.

Such phenomena are characterized by experimental observations.

portrayed graphically in the form of histogram, frequency diagram

frequency diagram $\rightarrow$ probability density function

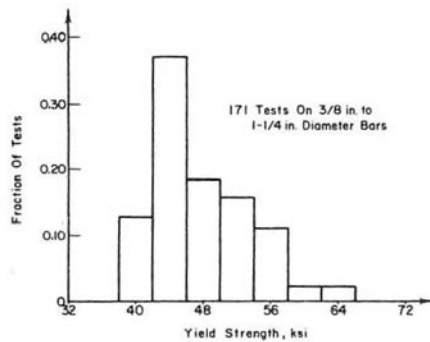


Figure 1.2 Histogram of yield strength of intermediate grade reinforcing bars; data from Julian (1957)

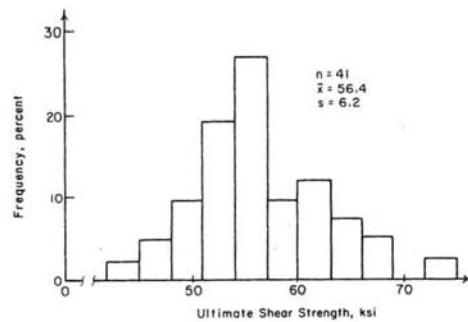


Figure 1.3 Histogram of ultimate shear strength of fillet welds in structural connections; after Kulak (1972)

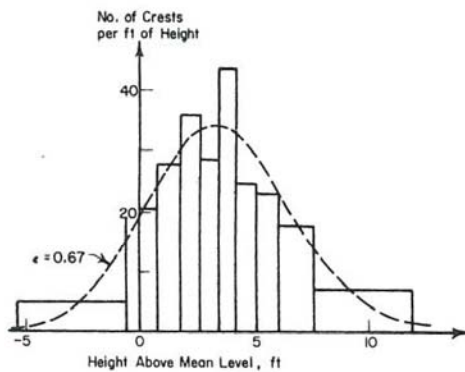


Figure 1.6 Frequency diagram of wave heights above mean sea level; after Cartwright and Longuet-Higgins (1956)

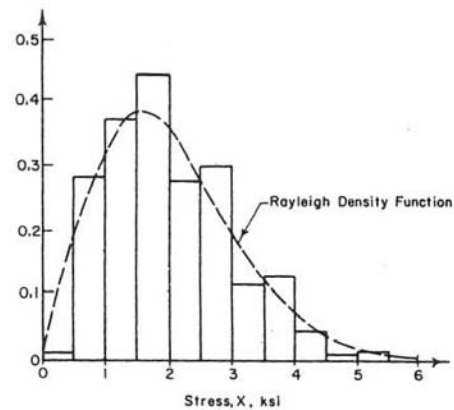


Figure 1.7 Frequency diagram of midship bending stress from one typical record "S.S. Wolverine State"; after Hoffman and Lewis (1969)

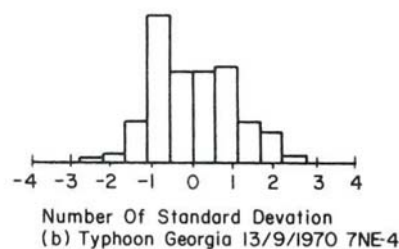
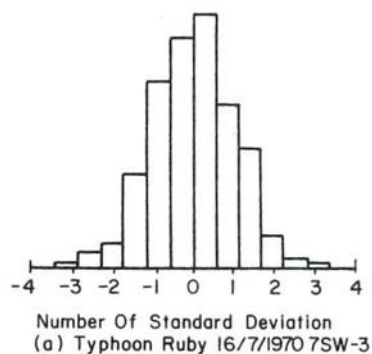


Figure 1.8 Relative dispersions of measured pressure fluctuations on tall buildings during typhoons; after Lam Put (1971)

These figures are from the text book.

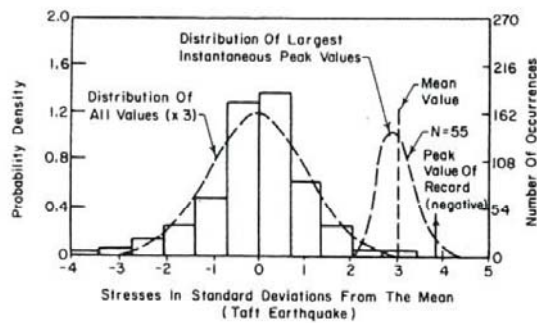


Figure 1.9 Relative dispersion of earthquake-induced shear stresses in soils; after Donovan (1972)

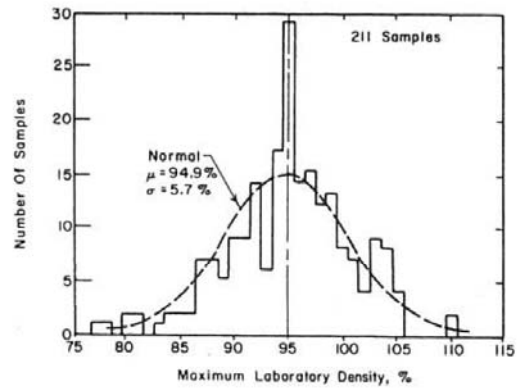


Figure 1.10 Histogram of density of compacted volcanic tuff subgrade; after Pettitt (1967)

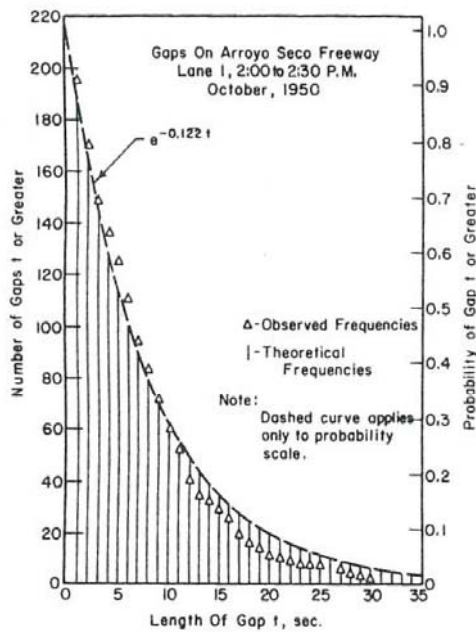


Figure 1.14 Histogram of gap length between cars on freeway; after Gerlough (1955)

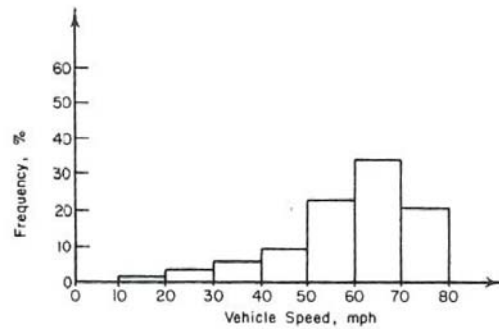


Figure 1.15 Estimated impact speed in 5237 passenger-car single-vehicle accidents; after Viner (1972)

These figures are from the text book.

Uncertainty associated with imperfect modeling and estimation

First

Estimated values of a given variable(such as the mean) based on observed data will not be error-free, especially when data are limited.

Second

The mathematical or simulation models are imperfect representations of reality.

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Prediction and/or calculations made on the basis of there models may be inadequate.

3. Design and Decision Making under Uncertainty

Control and standards

In order to assure some minimum level of quality, or performance, of engineering products, inspections and standards of acceptance are necessary.