CEG2002: Statistics for Civil Engineers Learning outcomes Chapters1

1. Collecting and presenting data

You should understand the following words:

- Random variable
- Observation
- Sample
- Population
- Representative

You should be aware of the different types of data:

• Discrete vs continuous

You should be away of the different sampling schemes:

- Simple random sampling
- Stratified sampling
- Systematic sampling
- Cluster sampling
- Judgemental sampling

You should be able to construct, for both discrete and continuous data:

- Frequency tables
- Percentage relative frequency tables

2. Summarising data

You should be able to construct, and interpret, the following graphs:

- Stem-and-leaf plots
- Bar charts
- Histograms and % relative frequency histograms
- Time series plots
- Scatter plots
- Box plots

You should be able to make comments on these plots too!

You should be able to calculate the following numerical summaries:

- The mean
- The median

Measures of location

- The mode (or modal group)The range
- The Inter-quartile range
- The variance (and standard deviation)

You should know when it is inappropriate to use certain numerical summaries



Measures of location

The mean

$$\overline{x} = \frac{\sum x}{n}$$
 or $\overline{x} = \frac{\sum xf}{n}$

Raw data

Frequency table

The median

n odd: the position of the median is $\frac{n+1}{2}$ *n* even: the median is the average of the observations in positions $\frac{n}{2}$ and $\frac{n}{2}+1$

The mode

No formula - just the most frequently occurring value!

Measures of spread

The range

Range = max - min

The inter-quartile range (IQR)

$$IQR = Q3 - Q1$$

where the position of Q1 is $\frac{(n+1)}{4}$ and the position of Q3 is $\frac{3(n+1)}{4}$

The variance

$$s^{2} = \frac{\sum x^{2} - n\overline{x}^{2}}{n-1}$$
 or $s^{2} = \frac{\sum f(x^{2}) - n\overline{x}^{2}}{n-1}$

Raw data

Frequency table

CEG2002: Statistics for Civil Engineers Learning outcomes - Chapter 2

1. Probability

You should understand the following statistical concepts:

- Experiment
- Outcome
- Sample space
- Event
- Mutually exclusive
- Independent

You should be able to:

- Find "classical" probabilities
- Find "frequentist" probabilities

2. Probability distributions

You should be able to

- Calculate probabilities based on the binomial distribution
- Calculate probabilities based on the Poisson distribution
- Use a transformation to map any **Normal distribution** onto the Standard Normal distribution
 - Use tables to obtain probabilities from the standard Normal distribution
 - Understand some important properties of a normal distribution
- Uniform distribution
- Calculate the mean and variance for these distributions

Formulae used

Probability

Classical prob.

 $P(Event) = \frac{\text{No. of ourcomes in which event occurs}}{\text{Total no. of possible outcomes}}$

Frequentist prob.

 $P(Event) = \frac{\text{No. of times an event occurs}}{\text{Total no. of times experiment done}}$

P(A or B) = P(A) + P(B) - P(A and B)

 $P(A \text{ and } B) = P(A) \times P(B)$ if A and B independent

Probability distributions

The binomial distribution, $X \sim bin(n, p)$

$$P(X = x) = \frac{n!}{x!(n-x)!} p^{x} (1-p)^{n-x}$$
, mean = np , variance = $np(1-p)$

The Poisson distribution, $X \sim Po(\lambda)$

$$P(X = x) = \frac{e^{-\lambda} \lambda^{x}}{x!}$$
, mean = λ , variance = λ

The Normal distribution, $X \sim N(\mu, \sigma^2)$, $Z \sim N(0,1)$

$$P(X < x) = P\left(Z < \frac{X - \mu}{\sigma}\right),$$
 mean = μ , variance = σ^2

The uniform distribution, X~U(a,b)

 $P(X < x) = \frac{x-a}{b-a} \text{ for any } a < x < b,$ mean=(b-a)/2, variance= $(b-a)^2/12$.