

## Chapter 3 Lecture Notes Theory of Errors in Observations

### 3-1 Introduction

Making observations (measurements) and the subsequent computations and analysis using the measurements, are fundamental tasks of the surveyor. Good measurements require a combination of human skill, mechanical abilities, proper equipment and good judgement.

All observations contain error. Understanding the type and magnitude is just as important as making the measurement itself.

### 3-2 Direct-Indirect Measurements

Measurements can be classified as Direct or Indirect in nature. An example of a direct measurement is applying the tape to the line, turning an angle between two points, reading the rod. Indirect measurements are measurements determined by calculations or by relationship to other direct measurements.

Always use direct measurements when computing another. Avoid using a direct and indirect measurement to compute another indirect if possible. Always use the "given" information or measured information to compute other information.

### 3-3 Errors in Measurements

The definition of an error is the difference between the true value and an observed value.

### 3-4 Mistakes

Human error, blunders difficult to correct...mistakes may be reduced by repetition and increase skill of the person.

### 3-5 Sources of Errors in Making Observations

Natural errors are caused by variations in climate, weather, gravity, and magnetic declination.

Instrumental Errors are caused by imperfections in the equipment being used to make the measurements

Personal Errors are caused by the limitations of the human making the measurements.

### 3-6 Types of errors

Systematic Errors (Natural and Instrumental) are errors that can be corrected or eliminated. Sometimes called cumulative errors.

Random or Accidental Errors (personal errors) are errors that cannot be eliminated or corrected. Sometimes called compensating errors.

### 3-7 Precision and Accuracy

Precision refers to the degree of refinement or consistency of a group of measurements. The degree of precision attainable is dependent on the equipment sensitivity.

Accuracy denotes absolute nearness of values to the true value.

### 3-8 Eliminating Mistakes and Systematic Errors

Systematic errors can be corrected by scientific equations to "correct" natural and instrumental errors.

Mistakes can be reduced by repetition, double checking measurements and by multiple measurements in differing units.

### 3-9 Probability

Probability is defined as the ratio of the number of times a result will occur to its total number of possibilities. In the toss of a die, there is a 1 in 6 chance it will turn up 2.

### 3-10 Most Probable Value

This is another name for the mean of a series of numbers or measurements/

### 3-11 Residuals

Having determined the most probable value, it is possible to determine the residual of any individual measurement. It is the difference between the most probable value and the individual measurement.

### 3-12 Occurrence of Random Errors

We will discuss this topic later in the semester.

### 3-13 General Laws of Probability

See the three laws stated on page 56 of your text.

3-14 Measures of Precision

We will discuss this topic later in the semester.

3-15 Interpretation of Standard Deviation

We will discuss this topic later in the semester.

3-16 The 50, 90 and 95 percent Errors

See equations on page 59 of text.

3-17 Error Propagation

We will discuss this topic later in the semester.

3-18 Applications

We will discuss this topic later in the semester.

3-19 Conditional Adjustment of Observations

We will discuss this topic later in the semester.

3-20 Weights of Observations

We will discuss this topic later in the semester.

3-21 Least Squares Adjustment

We will discuss this topic later in the semester.