### **Decoding Error Probabilities**

A Case for Estimation

#### Prof Hans Georg Schaathun

Høgskolen i Ålesund

7th January 2014



7th January 2014

# **Decoding Error**

- Sending a bit on BSC is a Bernoulli trial.
  - either correct transmission (Success) or bit error (Failure).
- Consider sending a k-bit message word m
  - channel with error control
  - Decoder gives an estimate m̂
  - We get either
    - o correct decoding (Success)
    - decoding error (Failure)
- This is also a Bernoulli trial
  - Success probability p
  - or decoding error probability  $p_e = 1 p$





# **Experiment and Theory**

World of This

World of Forms
Pe

Concrete

Experiment

Observed values

Stochastic variables

Estimate

Things

Abstract

Theory

Probability distribution

Unknown parameters
Unknown value

Ideas

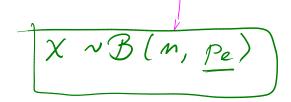
estimate

# A Monte Carlo Experiment

- Recall the Monte Carlo simulator.
  - Test the system n times
  - Record the number X of errors (failures)

#### Exercise

What is the probability distribution of X?



so n Bernoulli trids

## **Experiment and Theory**

Desired values	Observable values
Desired values	Observable values
p <sub>e</sub>	n, X
<del>(</del> 7	$\chi \sim B(n, pe)$
	$E(x) = m \cdot Pe$ $E(x/m) = Pe$
4	4
	15/1.

### Point Estimator

#### Summary

- Error rate: R = X/n a stochastic variable

  Fror probability:  $p_e = E(R)$  unknown parameter
  - Observing enough instances of R X
    - we can make an opinion of the approximate value of  $E(R) = p_e$
  - R ≈ p<sub>e</sub> with high probability ← • R is an estimator of  $p_e$

Note the estimator is a stochastic variable.

