Section 5.1 — Discrete Random Variables

Chris Godbout

Outline

Introduction

Examples

Parameters

MOAR EXAMPLES!!!

Introduction

Definitions

Definition (Random Variable)

A random variable is a variable (typically *X*, *Y*, or *Z*) that has a single numerical value, determined by chance, for each outcome of a procedure.

Definitions

Definition (Random Variable)

A random variable is a variable (typically *X*, *Y*, or *Z*) that has a single numerical value, determined by chance, for each outcome of a procedure.

Definition (Probability Distribution)

A probability distribution is a description that gives the probability for each value of the random variable. It is often expressed in the format of a table, formula, or graph.

2

Random variables

Definition (Discrete Random Variable)

A discrete random variable has a collection of values that is finite or determined by a counting process.

1. There is a numerical random variable *X* and its values are associated with corresponding probabilities.

- 1. There is a numerical random variable *X* and its values are associated with corresponding probabilities.
- 2. $0 \le P(X = x) \le 1$ for every individual value of the random variable x.

- 1. There is a numerical random variable *X* and its values are associated with corresponding probabilities.
- 2. $0 \le P(X = x) \le 1$ for every individual value of the random variable x.
- 3. $\sum P(X = x) = 1$

Examples

Marijuana Legalization

Table 1: Responses to the question "Should marijuana use be legal?"

Response	P(X = x)
Yes	0.409
No	0.520
Don't Know	0.070

Is this a probability distribution?

Salary Discussion

Table 2: Responses to the question "On which interview should a candidate begin salary negotiations?"

Number of Interviews x	P(X = x)
1	0.30
2	0.26
3	0.10

Is this a probability distribution?

Formula

$$P(X = x) = \frac{x}{10}$$
 for $x = 0, 1, 2, 3, 4$

Is this a probability distribution?

Parameters

Expected Value

The expected value for a discrete random variable *X* is equal to the mean of the probability distribution. It is given by

$$E(X) = \mu = \sum (x_i \cdot P(X = x_i))$$

σ , and σ^2

Definition (Variance)

The variance of a probability distribution is either

$$\sigma^2 = \sum \left((x_i - \mu)^2 \cdot P(X = x_i) \right)$$

or

$$\sigma^2 = \sum (x_i^2 \cdot P(X = x_i)) - \mu^2$$

σ , and σ^2

Definition (Variance)

The variance of a probability distribution is either

$$\sigma^2 = \sum \left((x_i - \mu)^2 \cdot P(X = x_i) \right)$$

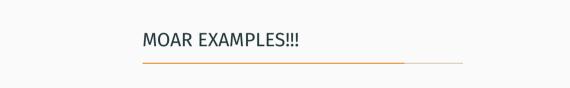
or

$$\sigma^2 = \sum (x_i^2 \cdot P(X = x_i)) - \mu^2$$

Definition (Standard Deviation)

The standard deviation of a probability distribution is

$$\sigma = \sqrt{\sum (X_i^2 \cdot P(X = X_i)) - \mu^2}$$



Genetic Disorders

Four males with an X-linked genetic disorder have one child each. The random variable *x* is the number of children among the four who inherit the genetic disorder.

 Table 3: Number of children among with disorder

X	P(X = x)
0	0.0625
1	0.2500
2	0.3750
3	0.2500
4	0.0625

Texas Pick 3

In the Texas Pick 3 lottery, you can bet \$1 by selecting three digits, each between 0 and 9 inclusive. If the same three numbers are drawn in the same order, you win \$500.

Texas Pick 3

In the Texas Pick 3 lottery, you can bet \$1 by selecting three digits, each between 0 and 9 inclusive. If the same three numbers are drawn in the same order, you win \$500.

· What is the probability of winning?

Texas Pick 3

In the Texas Pick 3 lottery, you can bet \$1 by selecting three digits, each between 0 and 9 inclusive. If the same three numbers are drawn in the same order, you win \$500.

- · What is the probability of winning?
- · What is the expected value of your winnings?