STAT333 Applied Probability

Austin Xia

May 25, 2020

Contents

1 Course Information **3**

1.1 Contact 3

1.2 Grading Scheme 3

1.3 Review of Elementary Probablity 3

1.4 Conditional Distributions and Conditional Expectation 3

1.5 Discrete-time Markov Chain 4

1.6 The Exponential Distribution and the Poisson Process 4

List of Figures

List of Tables

1 Course Information

1.1 Contact

Instructor: Steve Drekic
Email: sdrekic@uwaterloo.ca

1.2 Grading Scheme

4 assignments 100%...

1.3 Review of Elementary Probablity

Definition 1.3.1 (Probability Function)
For each event A of a sample space S, P(A) is defined as the probability of event A, satisfying 3 conditions:

- $0 \leq P(A) \leq 1$
- p(S)=1
- $P(\cup_{i=1}^{n} A_i) = \sum_{i=1}^{n} P(A_i)$ if the sequence of events A_i are mutually exclusive

Definition 1.3.2 (independent)
X and Y are independent rvs if $f(x, y) = f(x)f(y)$

Definition 1.3.3 (multivariate mgf)
$\phi_{x,y}(a, b) = E(e^{ax+by})$

Theorem 1.3.1
if $X_1, X_2 ... X_n$ are independent rvs where $\phi_{X_i}(t)$ is the mgf of $X_i, i = 1, 2, ...n$. then $T = \sum_{i=1}^{n} X_i$ has mgf $\phi_x(t) = \prod_{i=1}^{n} \phi_{X_i}(t)$

Theorem 1.3.2 (Strong Law of Large Numbers)
If $X_1, ..., X_n$ is an iid sequence of rvs, each having mean $\mu < \infty$, then with probability 1, as $n \to \infty$

$$\bar{X}_n = \frac{X_1 + X_2 ... + X_n}{n} \to \mu$$

1.4 Conditional Distributions and Conditional Expectation

Theorem 1.4.1 (Law of total Expectation)
For rvs X and Y,

$$E[g(X)] = E[E[g(x)|Y]]$$

Theorem 1.4.2
For rvs X and Y,

$$Var(X) = E[Var(X|Y)] + Var(E[X|Y])$$

1.5 Discrete-time Markov Chain

1.6 The Exponential Distribution and the Poisson Process