1   Topics from Chapter 4

- Sections 4.1, 4.2, 4.5, 4.6

- Moment Generating Functions

- Sums of Independent Random Variables: Convolution

- Covariance and Correlation

2   Moment Generating Functions

- Grey box on page 219 and on page 210

- Moment Generating Function (MGF), defined for both PDF and for PMF on page 210.

- Example 4.1, 4.2, 4.3, 4.4, 4.5

- Computing the moments, $E[X]$ or $E[X^2]$, ..., $E[X^k]$ and the central moments, e.g. $var[X] = E[X^2] - (E[X])^2$, from the MGF, page 213.

- Example 4.6

- Inverting the MGF to get back the PMF (usually done by inspection): Example 4.7, 4.8

- Mixture of two distributions: Computing MGF of the Mixture: Example 4.9

- MGF of a sum of independent random variables, Page 217

- Examples 4.10, 4.11

3   Sums of Independent Random Variables: Convolution

- Discrete case, page 221

- Example 4.13, also see one of the HW7 problems.

- Continuous case, page 222

- Example 4.14, a few others done in class and in quizzes

4   Covariance and Correlation

- Covariance define: Grey box on page 238-239.

- Uncorrelated rvs have cov(X,Y) = 0

- Independent rvs are always uncorrelated

- Correlation coefficient define: Grey box on page 238-239.

- Variance of a sum of random variables (when not independent): page 239

- Example 4.26

5   Least Squares Estimation

- Read pages 240-247.

- Least squares estimate of X given Y is given by $E[X|Y]$. Grey box on Page 243
  Read the book for the meaning of least squares estimate.

- Linear least squares: Grey boxes on Page 247.

  - $E[X|Y]$ is difficult to compute in many cases.
  - But often we are happy with a sub-optimal solution: the best **linear** least squares estimate, i.e. we say that $\hat{X} = aY + b$ and find the value of a and b that minimizes the expected value of squared error between X and $\hat{X}$

- Grey boxes on page 243 and 247.

- Properties of estimation error (Page 244, 245) will be discussed in Thursday's class.