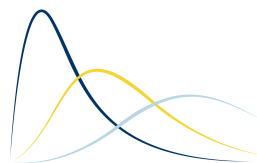


# PROB 140

Fall 2021



Probability for Data Science

## WEEK 10 STUDY GUIDE

### The Big Picture

The normal and gamma families are heavily used in modeling. We study these, along with a generating function that helps understand them better

- We start by establishing some properties of the standard normal that we have taken for granted without proof. We notice connections with gamma distributions. By simulation, we notice key properties of sums: sums of independent normals are normal, and sums of independent gammas (with the same rate) are gamma.
- The two most important branches of the gamma family have integer or half-integer shape parameters.
- The *moment generating function* (mgf) is more powerful than probability generating functions for dealing with sums. This helps us establish the properties of normal and gamma families that we observed by simulation, and indicates why the CLT is true.
- The mgf and *Chernoff's bound* improves on the tail bounds of Markov and Chebyshev.

### Week At a Glance

Mon 10/25	Tue 10/26	Wed 10/27	Thu 10/28	Fri 10/29
	Instructor's Session		Instructor's Session	
		GSI's Sessions <b>Quiz 2</b>		GSI's Sessions
HW 9 Party 12-2PM	<b>HW 9 Due</b> HW 10 (Due Tue 11/2)			
	<b>Lab 6A Due</b> Lab 6B (Due Tue 11/2)			Lab 6B Party 3-6PM
Read Sections 18.1-18.2	Read Ch 18	Read Sections 19.1-19.2	Read Sections 19.3-19.4	Read and review Ch 19

## Reading, Practice, and Live Sessions

Sections	Topic	Live Sessions: Prof. Sahai	Live Sessions: GSIs	Recommended Practice
Ch 18	<b>Normal and gamma families</b> <ul style="list-style-type: none"> <li>- 18.1 establishes the normal density, mean, and variance, and in the process discovers an important fact about sums of squares of standard normals. You <i>have</i> to know the results even if you don't follow some of the proofs.</li> <li>- 18.2 observes by simulation that sums of independent normals are normal, and uses this in exercises</li> <li>- 18.3 observes by simulation that sums of independent gammas with the same rate are gamma, and studies one major branch of the gamma family</li> <li>- 18.4 studies the other major branch</li> </ul>	<b>Tuesday 10/26</b> <ul style="list-style-type: none"> <li>- Fundamental properties of the standard normal</li> <li>- The gamma family and its relation to squares of centered normals</li> </ul>	<b>Wednesday 10/27</b> <ul style="list-style-type: none"> <li>- Ch 18 Ex 4 (simple but crucial)</li> </ul>	<b>Ch 18</b> <ul style="list-style-type: none"> <li>- Ex 1, 2, 3</li> </ul>
Ch 19	<b>Moment generating functions</b> <p>The first two sections parallel the start of Ch 14 on the pgf</p> <ul style="list-style-type: none"> <li>- 19.1 has a formula for the density of a sum, but it's often intractable</li> <li>- 19.2-3 define the mgf and examine its uses including a sort-of proof of the CLT</li> <li>- 19.4 uses the mgf to develop a new tail bound</li> </ul>	<b>Thursday 10/28</b> <ul style="list-style-type: none"> <li>- Convolution formula for the density of a sum</li> <li>- Moment generating functions: definition, main uses, Chernoff's bound</li> </ul>	<b>Friday 10/29</b> <ul style="list-style-type: none"> <li>- Ch 18 Ex 8, 5</li> <li>- Ch 19 Ex 3</li> </ul>	<b>Ch 19</b> <ul style="list-style-type: none"> <li>- Ex 1, 2</li> </ul>