# 12.5 Markov Chain Monte Concerns and Issues

# MCMC Concerns

1. Are we getting coverage of the entire joint distribution?
2. Will we always get the same answer regardless of the arbitrarily chosen starting values?
3. How large should our sample size be?
4. Does the iid assumption conflict with MCMC methods?

# Burn-in length

If chains have converged then means from chains of equal lengths should be equal (sample size of $m$ from $k$ identical distributions – independent Markov Chains)

$H_0 : \mu_1 = ...\mu_k$ vs $H_1$: not all $\mu_i$s are equal $\rightarrow$ ANOVA F-test

F-test: F= (Var between groups)/(Var within groups)

mean/median differences are the same, more statistically significant evidence of the true mean difference if variances are small within groups.

- F=same/little=Big: Evidence of differences among means (Reject null)
- F=same/lots=Small
- F near 1: Means same, do not reject null

# Starting Value/Chain Length

- Can try different starting values – but also consider burn-in length. With a long enough burn-in starting values become less relevant.
- Adjust chain length to investigate convergence properties. We want to make simulation error as small as desired.

# Dependence

- We have positive correlation in our sample
- Using MCMC one sample's dependence in on the previous sample
- This type of dependence is fairly regular. Theorems guarantee convergence of averages and even normality

Goal: Estimate the the mean $\mu$ of function $h(x_1, x_2)$ based on $m$ observations from the Markov chain. $1/m \sum h(x_1^{(i), x_2^{(i)}} \to \mu$

- Convergence is slower than for the iid case. Estimated variance will be smaller than true $\sigma^2$.

- Use $k$ independent Markov chains. Discard burn-in, and continue to sample for $m$ more iterations.

# Other MCMC Concerns

1. What if we don't know $\xi(\mu, \tau | x)$ of if it's not simple?
2. What if we don't know all conditional distributions?

- Computation based solutions (WinBugs and R implementation)

# Sampling Distributions

- What if $n$ is small or population is highly skewed?
- What if statistic of interest has unknown sampling distribution? (median, IQR, percentile, etc.)

Next – Bootstrap for these sorts of situations.