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Scribing Notes for 3/30

1) Today will consist of an exploration of peakdemand data set
2) For a while we will close books on regression analysis until later
3) Today we start new unit on probability & risk modeling, including new tools and vocabulary to learn
4) Professor Scott started with a brief explanation of next homework on environmentally friendly commercial real estate properties; task: recommend action → use regression model and put into context of decision of what should be done; this assignment will incorporate everything we have learned

Import peakdemand.csv
Task: build good predictive model (forecasting) for peakdemand

R Code:

```
summary(peakdemand)

plot(peakdemand$PeakDemand)

# Time or period index
peakdemand$Period = 1:nrow(peakdemand)

lm1 = lm(PeakDemand ~ Period, data=peakdemand)
plot(PeakDemand ~ Period, data=peakdemand)
abline(lm1, col='red', lwd=4)

lm2 = lm(PeakDemand ~ Period + DailyTemp + I(DailyTemp^2) + Sat +
Sun, data=peakdemand)
plot(resid(lm1), type='l')
lines(resid(lm2), col='red')

lm3 = lm(PeakDemand ~ Period + DailyTemp + I(DailyTemp^2) + Sat +
Sun + factor(Month), data=peakdemand)
plot(resid(lm3), type='l')
summary(lm3)
anova(lm3)

lmstep= step(lm3, direction='backward')

plot(resid(lm3), type='l')

# Compare fits
```

```
plot(PeakDemand ~ Period, data=peakdemand,type='l')
lines(fitted(lm3) ~ Period, data=peakdemand, col='red')
```

1) Plot peakdemand over time (time index)→ notice somewhat upward trend (seasonal effect)
2) Hotter months → higher demand
3) Adjusting for dependence of peakdemand on temperature, then we won't see seasonal effects right?
4) What are some other effects besides upward trend and seasonal? Plot peakdemand vs dailytemp → temperature "smile" → energy usage not as high during the fall
5) What do you do with non-linear relationships? (peakdemand vs dailytemp) → add polynomial terms (utilities data set)
6) What are some more effects to consider? Sundays energy usage is lower → people are out of house more, big businesses are closed, industries are less heavily engaged on Sundays, etc.
    a) This suggests micro-cyclical patterns → Must implement dummy variable strategy with Saturdays vs. Sundays
7) **Now that we are addressing these affects, we must build a model that incorporates all of these effects**
8) Let's model trend and seasonal effects
    a) Trend strategy: Regress time index
    b) Seasonal strategy: Incorporate dummy variables
9) As we transition from lm1, to lm2, and to lm3, we see better predictive models
    a) Compare fit (red vs black) between "plot(PeakDemand ~ Period, data=peakdemand,type='l')" and "lm3"

New material

1) Probability → language of uncertainty; coverage intervals; emphasize data exploration; general concept for quantifying uncertainty
2) Must become familiar with terminology
3) Basic Rules (Kolmogorov's Axioms)
    a) Probabilities must sum to 1
    b) Probabilities for disjoint events (cannot occur at once) add together
    c) Probability are numbers between 0 and 1 (will sometimes be a percentage)
4) More complex rules
    a) Addition rule (Union Rule)
        i) P(A U B) = P(A) +P(B) – P(A,B) → (Probability that you are a lady and are from Dallas and you subtract P(A,B) because otherwise you double count ladies from Dallas) → "A&B" joint event otherwise probability is zero
    b) Multiplication rule
        i) P(A,B) = P(A)*P(B|A) → **conditional upon or given**; probability of A and B = Probability of A times Probability of B **given A** → "probability of getting sued and lose at trial," **probability of getting sued times probability of getting sued and probability of losing at trial**

ii) The idea is to build scenarios with preceding sequence of events

5) "But what dos it all mean??"
   a) Frequency interpretation of probability → Vegas interpretation
      i) P(Black 31) = # Times Black 31 comes up/ # spins of roulette wheel
   b) Degree of belief interpretation → formal mathematical argument in course notes if you wish to take a look
      i) What is chance that it will rain today? 10%?
      ii) How do we make it slightly more specific? Talk about behavior not brains
      iii) $100 contract that it will rain between now and 5; how much are you going to pay me to hold this contract? If it rains, you get $100, so you pay $10 to hold contract? Subjective assessment of 10% can become more precise → amount you would pay to hold contract if it comes true; take assessment of your particular belief → revise probability lower if you don't want to pay as much
      iv) Wall Street interpretation → futures contracts are being bought and sold

Non-trivial rule, but most important rule

   c) Bayes' Rule
      i) P(A,B) = P(A)*P(B|A) = P(B)*P(A|B) → isolate this → P(A|B) = P(A) P(B|A)/P(B) = P(A) P(B|A)/P(B)
      ii) "Learning" Rule
      iii) Think of film that is a clear representation of your taste (Hunger Games), then take The Avengers, belief that there is a 7% chance she has watched to avengers (P(A)), her choice (new information → B) was the Hunger Games, now there is a belief that there is a 15% chance that she has watched The Avengers **given new information**

      P(A) → prior probability
      P(A|B) → posterior probability