IEOR 150 Midterm 2 Solutions

1. (a)
Approach 1:
2005 Average: 6175
2006 Average: 6600
Difference: 425
Trend: G=425/2=212.5<250, but not too bad an estimate.

Approach 2:

t	St	Actual	Error
1st half, 2005	6000	6000	0
2nd half, 2005	6250	6350	-100
1st half, 2006	6500	6500	0
2nd half, 2006	6750	6700	50
1st half, 2007	7000	7050	-50

Errors are not very bad, so 250 may be reasonable.

(b) Part 1
F_1st Half 2007=0.3(6700)+0.7(6400)=6490
F_2nd Half2007=0.3(7050)+0.7(6490)=6658

Part 2:
If the company has been using a tracking signal since the beginning of 2005, then as of July 1, 2006, 3 periods have elapsed. If MAD was 200, then the total absolute error in those 3 periods was 600.

t	Ft	Dt	Error	SE	MAD	|SE/MAD|
2nd Half '06	6400	6700	-300	0.3(-300)+ 0.7(-100) =-160	(600+300)/4 =225	0.711
1st Half '07	6490	7050	-560	0.3(-560)+ 0.7(-160) =-280	(900+560)/5 =292	0.959

Threshold: $2 * \frac{1.25\sqrt{0.3}}{2-0.3} = 0.8$, and 0.959>0.8, so the tracking signal is out of control.

2. Main errors were:

(a) not stating values of the seasonal factors (c_t values)
(b) confusing seasonal factors with smoothing constants
(c) choosing smoothing constants due to the degree of trend or seasonality and not based on the stability of the trend or seasonality.

3. A few general principles:

(a) Firm orders make scheduling easier.
(b) Forecasts of future demand (even with forecast errors) makes scheduling easier.
(c) Inventory versus shortage costs tradeoffs should be considered when deciding how much to produce for products with uncertain demand.
(d) When setup times are long, producing in batches is usually advantageous.
(e) Products with sporadic demand are more costly because they require greater investments in capacity and inventory to satisfy demand in a timely fashion.

4. Some basic calculations:

(a) labor cost per truckload = 15/5 = 3 so overtime premium is 0.5(3) = 1.50
(b) inventory holding cost per truckload per quarter =
0.8(1000)/.4 + 1500 + 300 = 2000
(opportunity cost of capital + trailer rental + cost of space)
(c) lost profit due to shortage = 2500 per truckload
(d) hiring + firing = 600 + 1800 = 2400
If employee is fully utilized for a full quarter, he/she can load 2400 trailers, so the premium is 2400/2400 = 1 per truckload.

Conclusions: Hiring/firing is cheap. Overtime is slightly more expensive. Inventory is exorbitant but still cheaper than losing a sale.

Quarter	Equiv.Workers Needed	Optimal Schedule
1	24,000/2400 = 10	10 on first shift
2	30	30 on first shift
3	75	30 on first and second shifts with OT*
4	50	30 on first shift, 20 on second shift

*Because only two shifts are allowed, 75-60 = 15 employees worth of work must be done on overtime. This amounts to an average of 10 hours of overtime per week per employee.

There are other schedules with the same cost. For example, we can have 25 people on each shift in Q4.

5. Note that the holding cost per week is 4/4 = 1. One point was taken off if you used h = 4.
(a) We should use the Silver-Meal method since it is not sensitive to demand data after first batch is decided.
C(1)=1500
C(2)=(1500+400*1)/2=950
C(3)=(1500+400*1+250*2)/3=800
C(4)=(1500+400*1+250*2+150*3)/4=712.5
C(5)= (1500+400*1+250*2+150*3+50*4)/5=610
It is cheapest to produce all the demand in the first period since C(i)’s are decreasing.

(b) WW method:

	1	2	3	4	5
1	1500	1900	2400	2850	3050
2		3000	3250	3550	3700
3			3400	3550	3650
4				3900	3950
5					4350

The lowest cost is 3050 which corresponds to producing everything in period 1.

6. (a)

	Table A						Table B				
Week	0	1	2	3	4		0	1	2	3	4
Gross Requirements		10	20	15	5			20	15	25	30
Scheduled Receipts			20	15	5				15	25	30
On-Hand Inventory	10	0	0	0	0		20	0	0	0	0
Planned Order Releases		20	15	5				15	25	30	

	Leg Prod Schedule				
Week	0	1	2	3	4
Gross Requirements		140	160	140	
Scheduled Receipts			200	100	
On-Hand Inventory	160	20	60	20	
Planned Order Releases		200	100		

(b)
Total demand for tables (i.e., 30, 35, 40, 35) is fairly stable, so it might be possible to use a kanban system, but we would need a lot of work-in-process inventory to respond to the changing mix. On the other hand, the mix is not stable, and we have information on future orders, so kanban may not be the best method to ensure that demand is satisfied on time.

Note that the question asked about the assembly of tables. The total demand for legs is fairly stable and there is only one type of table leg, so a kanban system could be used more easily for the legs.