# MST MS5 and ETIIA 3E10, Lent 2009

## Operations Management

## Example Sheet II

1. You have recently been promoted to production manager at Metal Plc., a large manufacturer of welded metal components for the automotive and aerospace industry. Metal Plc. has yearly, monthly and weekly forecasting and production planning meetings, covering rolling periods of five years, twelve months and twelve weeks respectively.

    a) Explain why forecasting is required for various time horizons
    b) For each time horizon, give examples of at least two management decisions that require such sales forecasts.
    c) Can you think of any reasons why your colleagues from the marketing department may give you incorrect forecasts, i.e. why they may deliberately choose to over- or underestimate actual market demand?

2. The demands for a product for weeks 1-20 are as follows:

| Week | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Demand | 15 | 18 | 10 | 12 | 20 | 17 | 22 | 16 | 14 | 20 | 15 | 12 | 16 | 20 | 22 | 17 | 15 | 10 | 16 | 20 |

    Suppose that a forecast is to be produced for the following week in each of the weeks 10-19, so that in week 10 the data up to week 10 are available, in week 11 the data up to week 11 are available, etc.

    a) Compare the results of using a 10-week moving average with an exponential smoothing approach, using a smoothing constant of $\alpha = 0.1$.

    b) What effect would increasing $\alpha$ have on the nature of the forecast? Under what circumstances would one use a larger smoothing constant?

    c) calculate the forecast errors for both forecasts in a)

3. Consider the problem of minimising average tardiness on one machine with the following processing times and due dates:

| Job | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| $p_j$ | 7 | 6 | 8 | 4 |
| $d_j$ | 8 | 9 | 10 | 14 |

Find a production sequence using the MDD rule. Is this solution optimal?

4. There are five jobs. Their processing times on machine A are 6, 7, 5, 14 and 3, respectively, whilst their processing times on machine B are 8, 5, 9, 7 and 2, respectively. Suppose each job is processed first by machine A, then by machine B. Find the minimum makespan for these jobs. Now suppose that the aim is to minimise mean flowtime. Show that the schedule that minimises makespan is no longer optimal by providing an example of a better schedule.

5. A manufacturer has sixty hours to complete the processing of ten jobs. Each job requires the same machine for the first operation which consists of Raw Processing. The technology is such that two jobs cannot be processed together. The Finishing Operation takes longer, for which as many additional workers as required can be brought in, with the proviso that only one worker can work a single job at a time, although - if necessary - jobs can be subcontracted. The cost of subcontracting a job is the same for each job. If the sixty hour deadline is to be met and we are to minimise the total cost of subcontracting jobs, provide the optimal schedule and indicate which jobs have to be subcontracted.

| | Time (hours) | |
|---|---|---|
| Job | Raw | Finishing |
| A | 7 | 6 |
| B | 7 | 12 |
| C | 12 | 0 |
| D | 10 | 18 |
| E | 4 | 9 |
| F | 14 | 25 |
| G | 10 | 14 |
| H | 11 | 7 |
| I | 5 | 13 |
| J | 4 | 10 |

6. In an assembly line operation there are nine separate tasks, and the table below gives the duration of each task, and the immediate precursors of each task.

| Task | Duration(minutes) | Precursors |
|---|---|---|
| A | 5 | - |
| B | 3 | - |
| C | 6 | A |
| D | 8 | A,B |
| E | 10 | C,D |
| F | 7 | D |
| G | 1 | E,F |
| H | 5 | G |
| I | 3 | G |

Balance this line for a cycle time of 16 minutes. If the cycle time could be decreased by 2 minutes, the company could save £200 per week through volume discounts for the raw material. The wage costs are £150 per week for an assembly line worker. Is it worth attempting to speed the line up?