Statistical Literacy for Managers: Analyzing Time Series Data

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Cross section data:

<table>
<thead>
<tr>
<th></th>
<th>Enterprise X</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2010 Unemployment</td>
<td>June 2010 $ Millions</td>
</tr>
<tr>
<td>Men</td>
<td>9.1%</td>
</tr>
<tr>
<td>Women</td>
<td>8.6%</td>
</tr>
<tr>
<td>Both sexes</td>
<td>8.9%</td>
</tr>
<tr>
<td>Sales</td>
<td>20</td>
</tr>
<tr>
<td>Costs</td>
<td>18</td>
</tr>
<tr>
<td>Profit</td>
<td>2</td>
</tr>
</tbody>
</table>

Time series data:

University education:
Statistical science: Cross-section data dominates
Master programme: Very few take a course in time series analysis
Many students of engineering and business administration take courses in statistics, but no applied time-series analysis for their future jobs
More important: A gap between “statistical theory” and statistical literacy = deeper understanding, discussions of real cases etc.

Profit and loss statement for enterprise X, June 2010, $ Millions

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Budget</th>
<th>Previous year</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 2010</td>
<td>June 2010</td>
<td>Jan-Jun 2009</td>
</tr>
<tr>
<td>Sales</td>
<td>20</td>
<td>112</td>
</tr>
<tr>
<td>Costs</td>
<td>18</td>
<td>99</td>
</tr>
<tr>
<td>Profit</td>
<td>2</td>
<td>13</td>
</tr>
</tbody>
</table>

Is this statistics?
Have statistical methods been used? (Good or bad?)

What shall the CEO do?
Increase or decrease the production capacity?
Accumulated sums from different periods are compared
Current prices only – no statistical time series analysis

Profit and loss statement for enterprise X, June 2010, $ Millions

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What shall the CEO do?
Increase or decrease the production capacity?
a) Are sales/costs/profits going up or down?
b) How much is it going up/down?
c) When did a change happen?
d) Why did it happen?
A course in applied time series analysis can start here!
Up or down? How much?

Introduce ARIMA-modeling
Extrapolate the local trend!

Statistical literacy – how are the students trained?

Table 1: Quality?
Average monthly salary
- Sampling errors
- Non-response errors

Men  5 000 $  
Women  4 000 $  
Are these men and women comparable?
- Age
- Level of education
- Occupation

Table 2: Men Women
Private sector  5 400 $  5 600 $  
Public sector  3 400 $  3 600 $  
All:  5 000 $  4 000 $  

Random variation and statistical literacy:
• If you don’t understand random variation, then short term changes will be misinterpreted

Conclusions:
• Time series data are more important than cross section data for managers and many others
• Teaching of time series is often mathematical only, statistical literacy for time series is missing
• Statistical description of time series is not trivial – this is essential for the students future jobs
• Don’t misinterpret change, there can be a hidden factor that is the cause!
• The random component is visible! It must be understood!
• If you teach statistics to students of Business Administration you must have a genuine interest in this subject

Profit and loss statement for enterprise X, June 2010, $ Millions

Outcome Budget Previous year
Sales  20  112  24  123  19  117  
Costs  18  99  18  104  17  105  
Profit  2  13  19  2  12  

a) When did a change happen? 
b) Why did it happen? 

Gross profit margin % 2001

Random variation and statistical literacy:

If you don’t understand random variation, then short term changes will be misinterpreted

Table 1: $ Millions
Year Month NewOrders Seasonally adj TC E stan res
5 11 7.960 6.268 5.516 0.752 0.82
5 12 5.053 4.101 5.541 -1.440 -1.51

The same statistical literacy teaching should be used for time series!