NUMBERS IN BUSINESS AND INDUSTRY
Union College Academy for Lifelong Learning

Class 4 (UCALL)
Necip Doganaksoy
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THE ANSWER
GE Annual Report 2007
- Earnings per share (EPS) of $2.20, an increase of 18%
- Global revenue growth of 22%
- Equipment backlog of $49 billion
- Financial services assets growth of 16%

QUICK REVIEW
The language of business is
a. English
b. Money
c. Numbers
d. All of the above

NUMBERS: BEYOND THE FINANCIALS
- Advances in capture and storage of large data sets
  - Remote tracking of products → Reliability
  - Internet traffic → Marketing, Sales
  - Credit card transactions → Risk management

NUMBERS: PART OF EVERYDAY BUSINESS
- Ease of access to data
- Easy to use tools (e.g., excel)
- Drive for data-based decision making
  “In God we trust; all others bring data”
  or
  “Show me the data”

OUTLINE
Part I
- Illustrations of common misuses

Part II
- Application examples
Part I
• Illustrations of common misuses

Illustration #1: Mars Climate Orbiter
The only image received from the spacecraft before it smashed into Mars (23 Sept 1999)
Project cost in 1999: $125 Million

What Went Wrong?
“One team used English units while the other used metric units for a key spacecraft operation. This information was critical to the maneuvers required to place the spacecraft in the proper Mars orbit.” (MCO Failure Board Report)

“A Generic” Pitch by a Sales Manager

“A ‘Generic’ Pitch by a Sales Manager

“... enabled a dramatic increase in overall sales volume by improving online sales conversion rates and maximizing average order size.”

“Numbers are highly useful”
or
“In God we trust; all others bring data”
or
“Show me the data!..”
... achieved a remarkably flat cost position despite gradual build up in inflationary pressures.

“Numbers are highly useful, but can be readily abused!”

“Be wary of advocates with numbers”
Numbers in product advertising

Who is Your Wireless Provider?

So who is telling the “truth”?

Some questions

Some answers

A Tale of Two Advertisement Claims

“Based on a statistical study, our product has an average life that is longer than that of any of our major competitors.”

“Based on a statistical study, no major competitive product has an average life that exceeds our product’s.”
The 1986 NASA Space Shuttle Challenger Disaster

- To launch or not to launch?
- Potential concern: Impact of cold weather on O-rings
- Data reviewed by NASA management to make decision

Illustration #4

<table>
<thead>
<tr>
<th>Number of O-ring Incidents</th>
<th>Temperature (deg F)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>80</td>
</tr>
</tbody>
</table>

Find out how numbers were obtained

Illustration #4: The 1986 NASA Space Shuttle Challenger Disaster

- To launch or not to launch?
- Potential concern: Impact of cold weather on O-rings
- Data reviewed by NASA management to make decision

Illustration #5: Thermoplastic Resin Manufacturing

<table>
<thead>
<tr>
<th>Plant A (U.S.A.)</th>
<th>Min=965</th>
<th>Max=1160</th>
<th>Range=195</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant B (Japan)</td>
<td>Min=1050</td>
<td>Max=1158</td>
<td>Range=108</td>
</tr>
</tbody>
</table>

“Plant B makes better product than Plant A”

Illustration #5: Thermoplastic Resin Manufacturing

“Plant B makes better product than Plant A”

Process Differences Revealed

“Beware of comparisons”
Part II

• Application examples

QUALITY OF CAPTIONS

• All television broadcast stations in the U.S. are required to caption English-language programming.
• There are no preset quality standards on captioning.

BEHIND THE SCENES: REAL-TIME CAPTIONING PROCESS

• Real-time captioning for live shows by court stenographers
  - News (studio, weather, sports, field reports)
  - Sporting events
  - Game shows

CHALLENGE

How can we “measure” captioning quality beyond “pass/fail”?

COMPONENTS OF CAPTIONING QUALITY

• Complete
• Accurate
• Readable
• Timely
• Other
  - Speaker identification
  - Auditory cues (music effects, whispering, etc)

CAPTION QUALITY MEASUREMENT

Overall Score ➜ 6/8 ➜ 75%
STUDY PLANNING

• New programs
  - Best in class (public channel)
  - 3 network news
  - 2 local news
• 12 news programs (morning and evening) from each over the same 4 week period
• Program length=30 mins
• Commercials and other pre-captioned material excluded

RESULTS

Accuracy (%)

100
90
80
70
60
50

Network A
Network B
Network C
Local News 1
Local News 2

Group means are indicated by lines

NUMBERS...

• Helped localized the problem
• Provided insights on root causes
• Established benchmarks for improvement

PREVENTING FRAUDULENT INTERNET ACTIVITIES

• Illegal distribution of copyrighted files of music, videos, software, games and books on Internet.
• Businesses use various tools to track such activities and then take appropriate action to discourage these.
• Counter-actions range from sending warning letters to launching lawsuits.

Effectiveness of Actions

Are the Actions Effective?

<table>
<thead>
<tr>
<th>Group</th>
<th>Sample Size</th>
<th>Mean Number of Violations per Violator</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-action</td>
<td>52,321</td>
<td>4.2</td>
</tr>
<tr>
<td>After action</td>
<td>42,154</td>
<td>5.3</td>
</tr>
</tbody>
</table>

Violator

A
B
C
D

Time

Violation
Action
"Appreciate limitations of observational studies"

- Highly active violators were more prone to actions than low activity violators
- Action timing differed greatly from one violator to the next

"Controlled, randomized study is gold standard"

Notice Effectiveness: Randomized Trial

- Tagged 3,600 “new” violators
- Randomly assigned to “action” and “no action” treatments
- Tracked activity in both groups

RESULTS

<table>
<thead>
<tr>
<th>Group</th>
<th>Sample Size</th>
<th>% Subjects with One or More Further Violations in 3-Month Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Action</td>
<td>1,200</td>
<td>42</td>
</tr>
<tr>
<td>Action</td>
<td>2,400</td>
<td>12</td>
</tr>
</tbody>
</table>

Relative risk of no-action = 42/12 = 3.5
95% confidence interval = 3.1 to 4.0

COURSE TAKE-AWAYS

- Beware of simple before/after comparisons
- Don’t confuse statistical relationship from observational study with cause and effect
- Controlled, randomized study is “gold standard”
- Find out how numbers were obtained/defined and limitations of study—be wary of number advocates
- Margin of error quantifies statistical uncertainty

NUMBERS ARE HIGHLY USEFUL, BUT CAN BE READILY ABUSED—ASSESS WITH CARE!