Perfume Engineering

Pure Ambition

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Overview

1. Objective
2. Background
4. Marketing
5. Happiness Function
6. Results
7. Economic Analysis
Objective

The objective of our project is to engineer a new scent of perfume over a 10 year life span. In addition to this, marketing of the product and economic analysis must also be taken into account.
Background
Functions of a Perfume

Functions

- Provide a pleasant odor
- Cover base smell of product
- Give product identity
- Signify product change

Examples

- Air fresheners
- Soaps or lotions
- Banana Boat sunscreen
- New and Improved!
Perfume Construction

Making a scent – Attributes

- Scent – Ingredients
- Color – Aesthetics
- Oiliness of fluid – Concentration of Essential Oils
- Initial strength of fragrance - Concentration
- Endurance - Time

*These attributes’ role in the happiness function will be discussed in later slides.*
Parts of a Perfume

There are three main parts of a perfume:

- **Basics**
  - the basics are the materials in the essential oil that are present at higher percentages

- **Diluent**
  - ingredients in the perfume that dilutes the mixture

- **Solvent**
Emulsion

- Due to the solubility of the essential oils in water, perfume is an emulsion
  - Range from < 1 ppm to 20,000 ppm
  - Not a significant amount

- Oil and aqueous phase
  - Continuous phase
  - Dispersed phase

- A stable emulsion is necessary

http://www.lesestein.de/bildarchiv-vorschau/wissenschaft.htm
Vocabulary

- **Top note** – component of a fragrance with high evaporation rate
- **Middle note** – component of a fragrance with medium evaporation rate
- **Base note** – component of a fragrance with low evaporation rate
- **Odor threshold** – minimum concentration in air at which an odor is detectable by the human nose
- **Odor value** – the concentration in air of an odor
Scent Pyramid Example

<table>
<thead>
<tr>
<th>Type of scent</th>
<th>Typical Percentage of Scent in Fragrance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lemon, Lavender</td>
<td>15-25%</td>
</tr>
<tr>
<td>Hibiscus, Rose</td>
<td>30-40%</td>
</tr>
<tr>
<td>Musk, Vanilla</td>
<td>45-55%</td>
</tr>
</tbody>
</table>

### Types of Perfumes

<table>
<thead>
<tr>
<th>Types</th>
<th>Total (vol %)</th>
<th>Remainder (vol %)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Oil</td>
<td>Alcohol</td>
</tr>
<tr>
<td>Parfum</td>
<td>15 to 30</td>
<td>90 to 95</td>
</tr>
<tr>
<td>Eau de Parfum</td>
<td>8 to 15</td>
<td>80 to 90</td>
</tr>
<tr>
<td>Eau de Toilette</td>
<td>4 to 8</td>
<td>80 to 90</td>
</tr>
</tbody>
</table>

We chose to use Eau de Parfum to reach the “average” market
Plan of Action

- Determine the components of a perfume that maximize the ROI and the Happiness

- To do this:
  - First calculate the market and the demand
  - Next determine the initial composition of perfume
  - Relate attributes of perfume to economics using the scent concentrations as manipulated variables
  - Use Solver in Excel to optimize ROI by varying scent concentrations
Marketing
Target Market

- Female
- Age 25-40
- We chose this market because this group is more likely to have a stable job/income.
Due to investment opportunities, Oklahoma City Metropolitan Statistical Area (MSA) is our choice introduction location.
Advertising

The intended course of action is to advertise to the target market in the MSA. Therefore we have chosen to advertise in the following areas:

<table>
<thead>
<tr>
<th>Advertising</th>
<th>Type</th>
<th>Cost / Week ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Newspapers</td>
<td>1300</td>
</tr>
<tr>
<td></td>
<td>Television</td>
<td>16500</td>
</tr>
<tr>
<td></td>
<td>Direct Mail</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>Radio</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Magazines</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>Online</td>
<td>50</td>
</tr>
</tbody>
</table>
Pricing Model

Budget Model

\[ p_1 d_1 + p_2 d_2 = Y \]

\[ p_1 d_1 = \frac{\alpha}{\beta} p_2 d_2 \frac{d_1^\alpha}{d_2^\beta} \]

Where

- \( p_1 \) and \( p_2 \) are ours and our competitor’s product prices per bottle ($/bottle)
- \( d_1 \) and \( d_2 \) are our and our competitor’s demand (number of bottles sold)
- \( Y \) is the total amount of sales for the product ($).
Pricing Model

■ Fixed Demand Model

\[ d_1 + d_2 = D \]

\[ d_1 = \left( \frac{\alpha}{\beta} \right)^{1-\alpha} (D - d_1)^{1-\beta} \]

■ For our product, the budget model is most appropriate. Although this may be the case, due to demand constraints, the fixed demand model will be implemented accordingly.
Determination of $\alpha$

- $\alpha$ determined through several logical assumptions
- Assume that competition is completely recognized, horizontal fit
- Assume linear recognition fit, then plateau for our recognition
- All of the $\alpha$’s are averaged over time
Graph of $\alpha$ Determination

Graph showing the relationship between time (years) and consumer awareness (alpha). The graph illustrates how consumer awareness increases over time, approaching a level of 1.0 by the end of the 12-year period.
Happiness Function
Perfume Survey

- A survey was used to determine the qualities of a fragrance desired by the target market
- Given to a sample group of target market; females between the ages of 25 and 40
- Asked to rate several perfumes over a period of eight hours
- Asked to define characteristics of ideal perfume
- These values were used to model the “perfect” fragrance
Components

What are consumers looking for in a perfume?

- Scent (60%)
- Endurance (35%)
- Color (3%)
- Initial strength of fragrance (1%)
- Oiliness of fluid (1%)

\[
H(\text{perfume}) = (0.6)y_{\text{scent}} + (0.35)y_{\text{endurance}} + (0.03)y_{\text{color}} + (0.01)y_{\text{viscosity}} + (0.01)y_{\text{init.strength}}
\]
Additional Variables

There were other determinants to consider in a consumer’s initial purchase of a perfume that were not considered directly in the happiness function. These include:

- Skin reaction – Set as a concentration constraint (Each EO cannot exceed 5 vol% of total perfume volume)
- Price – Determined with pricing model
Initial Scent

- How pleasing or displeasing the scent of the perfume on immediate application is to the consumer

\[
y_{\text{scent-0hr}} = z_{\text{citrus}} \left( \frac{x_{\text{have}}}{x_{\text{want}}} \right)_{\text{citrus}} + z_{\text{natural}} \left( \frac{x_{\text{have}}}{x_{\text{want}}} \right)_{\text{natural}} + z_{\text{floral}} \left( \frac{x_{\text{have}}}{x_{\text{want}}} \right)_{\text{floral}} + z_{\text{musk}} \left( \frac{x_{\text{have}}}{x_{\text{want}}} \right)_{\text{musk}} + z_{\text{oriental}} \left( \frac{x_{\text{have}}}{x_{\text{want}}} \right)_{\text{oriental}}
\]

- Where \( z = \) weight each scent carries
- Where \( x = \) mole fraction for each scent
The smell of the perfume after four hours

How pleasing or displeasing to the consumer the scent of the perfume is four hours after application

$y_{\text{scent-4hr}} = z_{\text{natural}} \left( \frac{x_{\text{have}}}{x_{\text{want}}} \right)_{\text{natural}} + z_{\text{floral}} \left( \frac{x_{\text{have}}}{x_{\text{want}}} \right)_{\text{floral}} + z_{\text{musk}} \left( \frac{x_{\text{have}}}{x_{\text{want}}} \right)_{\text{musk}} + z_{\text{oriental}} \left( \frac{x_{\text{have}}}{x_{\text{want}}} \right)_{\text{oriental}}$

Top note is no longer detectable
Scent After Eight Hours

- The smell of the perfume after eight hours
- How pleasing or displeasing to the consumer the scent of the perfume is eight hours after application

\[ y_{\text{scent-8hr}} = z_{\text{natural}} \left( \frac{x_{\text{have}}}{x_{\text{want}}} \right)_{\text{natural}} + z_{\text{musk}} \left( \frac{x_{\text{have}}}{x_{\text{want}}} \right)_{\text{musk}} + z_{\text{oriental}} \left( \frac{x_{\text{have}}}{x_{\text{want}}} \right)_{\text{oriental}} \]

- Top note and middle note are no longer detectable
Color

- The color of the packaging
  - How appealing the color of the perfume packaging is to the consumer

\[ y_{\text{color}} w_{\text{color}} = K \times (0.03) \]

- For our fragrance, the happiness due to color is assigned the number 1
  - The color red was chosen based on the results of the survey which maximizes happiness for color
The oiliness of the perfume was determined using the concentration of the essential oils in the perfume.

\[ y_{oiliness} \times w_{oiliness} = \begin{cases} 1 & \text{low} < c_{oil} < \text{high} \\ 0 & \text{if not met} \end{cases} \times (0.01) \]

The range is determined by the concentration constraints set by the volume percentage of oil allowed in an eau de parfum.

Volume Percent Range: 8% – 15% of total
Initial Strength

- Any unhappiness caused by the initial scent of the fragrance being either too strong or too weak on initial contact

\[ y_{\text{init. strength}} w_{\text{init. strength}} = \left\{ 1 - \left( \frac{|C_A - C_W|}{C_W} \right) \right\} \times (0.01) \]

- Where \( C_A \) is the actual initial concentration in air, and \( C_W \) is the wanted concentration in air determined by survey data and comparison to competition
Endurance

How long the smell will still be noticeable to others after it is applied

- The amount of time that the perfume can still be detected by others in a ten centimeter radius from the person wearing the perfume

\[ v_{endurance} \approx w_{endurance} = \left( \frac{OV_i}{z - Thrs_i} \right) \times (0.17) \]

- With: \( f = 0 \); if \( \left( \frac{OV_i}{z - Thrs_i} \right) \times (0.17) \leq 0 \)

- \( f = 1 \); if \( \left( \frac{OV_i}{z - Thrs_i} \right) \times (0.17) > 0 \)
Diffusion Model

- The endurance parameter in the function has two variables: time, distance
- A diffusion model was used to approximate the change in concentration of the fragrance over time and distance
Activity Coefficients

- Activity coefficients were obtained using the UNIFAC method from The Properties of Liquids and Gases by Reid, Poling, and Prausnitz\cite{1}

- This method was used because it determined activity coefficients due to interactions between structural groups instead of utilizing experimental data

\[ \ln \gamma_i = \ln \gamma_{ii} + \ln \gamma \]

Activity Coefficients

\[ \ln \gamma_i = \ln \gamma_i^c + \ln \gamma_i^R \]

- **Combinatorial** – due to differences in sizes and shapes of the molecules in the mixture
- **Residual** – due to energy interactions between the different groups
Analysis in Excel

Using Excel, we iterated the change in concentration over time up to a distance of 1 ft and a time of 8 hours.

Most data was known with the exception of the concentration change over distance.

This was calculated using a derivation of Fick’s Second Law.
Fick’s Second Law

\[
\frac{\partial c_i}{\partial t} = D \frac{\partial^2 c_i}{\partial z^2}
\]

- Small amount of liquid on surface with concentration changing over time
- Derivation for numerical analysis
- Required assumptions due to lack of experimental data
  - Liquid and gas phases are in equilibrium
  - Unidirectional diffusion
  - Ideal gas law holds
  - Each component diffuses separately
A diffusion model was used to define endurance in the perfume.

Optimum endurance of the scent was defined by using the concentration of the fastest depleting base note at time equal to eight hours.

This concentration must be equal or greater than the threshold of the scent to be considered as “enduring”
Numerical Analysis

Derivation of Fick’s 2\textsuperscript{nd} Law

\[
\frac{(c_{z,t} - c_{z,t-\Delta t})}{\Delta t} = D \left[ \frac{c_{z+\Delta z,t-\Delta t} - 2c_{z,t-\Delta t} + c_{z-\Delta z,t-\Delta t}}{\Delta z^2} \right]
\]

Boundary Conditions:

- \( t = 0, \ C_A(z, 0) = C_{A_0} \) for all \( z \)
- \( z = 0, \ C_A(0, t) = C_{A_s} \) for \( t > 0 \)
- \( z = \infty, \ C_A(\infty, t) = C_{A_0} \) for all \( t \)
From Fick’s 2\textsuperscript{nd} Law

\[
\frac{(c_z^t - c_z^{t-\Delta t})}{\Delta t} = D \left[ \frac{(c_{z+\Delta z}^{t-\Delta t} - c_z^{t-\Delta t})}{\Delta z} - \frac{(c_z^{t-\Delta t} - c_{z-\Delta z}^{t-\Delta t})}{\Delta z} \right]
\]

Expanding we get

\[
c_z^t = c_z^{t-\Delta t} + \frac{D\Delta t}{\Delta z^2} \left[ c_{z+\Delta z}^{t-\Delta t} - 2c_z^{t-\Delta t} + c_{z-\Delta z}^{t-\Delta t} \right]
\]

Simplifying we get

\[
c_z^t = \frac{1}{2} \left[ c_{z+\Delta z}^{t-\Delta t} + c_{z-\Delta z}^{t-\Delta t} \right] \quad \text{with} \quad \Delta z = \sqrt{2D\Delta t}
\]
With these values, we can find the concentration at any time and at any position.

\[\Delta c / \Delta z\]

\[C \bigg|_{z}^{t}\]
Concentration profiles were developed by plotting concentration versus time at distance $z$. The graph shows the concentration vs. $z$ distance for Sandalwood (Linalool) over different times (1 to 8 hours).
The fastest depleting component was determined to be Sandalwood, with a threshold in air of $6.4 \times 10^{-5}$ g/m$^3$, and an endurance time of 9 hours.

Based on these values, the endurance of the perfume was determined.
Happiness Function

- To determine the engineered variables with respect to the consumer variables from the survey, graphs of happiness versus each consumer variable were developed.
- These were then related to intermediate variables which could be manipulated to form the fragrance.
Scent Graphs

Volume fraction vs. Mole fraction
Citrus (0-Hour)
Scent Graph With Intermediate Variable

Happiness vs. Intermediate Variable
Scent 0 HR

- Citrus
- Natural
- Floral
- Musk
- Oriental

Interpretation:
**Determination of $\beta$**

<table>
<thead>
<tr>
<th>Categories</th>
<th>Pure Ambition</th>
<th>Competition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scent</td>
<td>19.9</td>
<td>23.2</td>
</tr>
<tr>
<td>Endurance</td>
<td>8.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Init. Strength</td>
<td>9.9</td>
<td>6.7</td>
</tr>
<tr>
<td>Color</td>
<td>10.0</td>
<td>8.5</td>
</tr>
<tr>
<td>Oiliness</td>
<td>0.50</td>
<td>6.5</td>
</tr>
</tbody>
</table>

**Overall Score**

<table>
<thead>
<tr>
<th></th>
<th>Pure Ambition</th>
<th>Competition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Score</td>
<td>6.90</td>
<td>7.6</td>
</tr>
</tbody>
</table>

**Overall Happiness**

<table>
<thead>
<tr>
<th></th>
<th>Pure Ambition</th>
<th>Competition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Happiness</td>
<td>0.718</td>
<td>0.756</td>
</tr>
</tbody>
</table>

$\beta = \text{Happiness of Competition} / \text{Happiness of Pure Ambition}$
Process Flow Diagram

- Based on demand model

- Production
  - 13300 bottles/year
  - 1.7 oz/bottle
  - 665 liters/year
## Capital Investment

<table>
<thead>
<tr>
<th>Component</th>
<th>Basis for Estimate</th>
<th>Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DIRECT COSTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onsite</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchased equipment:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixer</td>
<td>w/ motor (Fig 12-46) SS Rotary double-cone blender</td>
<td>17,500</td>
</tr>
<tr>
<td>Homogenizer / Emulsifier</td>
<td>Fong Hwang Enterprise Co. Ltd.</td>
<td>5,200</td>
</tr>
<tr>
<td>Storage Tank</td>
<td>0.1 cubic meter (Fig 12-52)</td>
<td>2,700</td>
</tr>
<tr>
<td>Pump</td>
<td>2 pumps (Fig 12-21)</td>
<td>2,600</td>
</tr>
<tr>
<td>Filler/Bottling Machine</td>
<td>Turbofil Packaging Machines, LLC</td>
<td>20,000</td>
</tr>
<tr>
<td><strong>Total Purchased Equipment</strong></td>
<td></td>
<td>48,200</td>
</tr>
<tr>
<td>Installation</td>
<td>47% Purchased equipment cost</td>
<td>22,654</td>
</tr>
<tr>
<td>Instrumentation and controls</td>
<td>36% Purchased equipment cost</td>
<td>17,352</td>
</tr>
<tr>
<td>Piping</td>
<td>68% Purchased equipment cost</td>
<td>32,776</td>
</tr>
<tr>
<td>Electrical</td>
<td>11% Purchased equipment cost</td>
<td>5,302</td>
</tr>
<tr>
<td>Offsite</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building</td>
<td>18% Purchased equipment cost</td>
<td>8,676</td>
</tr>
<tr>
<td>Yard Improvement</td>
<td>10% Purchased equipment cost</td>
<td>4,820</td>
</tr>
<tr>
<td>Service Facilities</td>
<td>70% Purchased equipment cost</td>
<td>33,740</td>
</tr>
<tr>
<td><strong>Total Direct Cost</strong></td>
<td></td>
<td>173,520</td>
</tr>
<tr>
<td><strong>INDIRECT COST</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering</td>
<td>33% Purchased equipment cost</td>
<td>15,906</td>
</tr>
<tr>
<td>Construction</td>
<td>41% Purchased equipment cost</td>
<td>19,762</td>
</tr>
<tr>
<td>Legal expenses</td>
<td>4% Purchased equipment cost</td>
<td>1,928</td>
</tr>
<tr>
<td>Contractor's fee</td>
<td>22% Purchased equipment cost</td>
<td>10,604</td>
</tr>
<tr>
<td>Contingency</td>
<td>44% Purchased equipment cost</td>
<td>21,208</td>
</tr>
<tr>
<td><strong>Total Indirect Plant Cost</strong></td>
<td></td>
<td>69,408</td>
</tr>
<tr>
<td>Fixed Capital Investment</td>
<td>Direct cost + Indirect cost</td>
<td>242,928</td>
</tr>
<tr>
<td>Working Capital</td>
<td>15% of Total Capital Investment</td>
<td>42,870</td>
</tr>
<tr>
<td><strong>Total Capital Investment</strong></td>
<td></td>
<td>285,798</td>
</tr>
</tbody>
</table>
# Production Costs – Max ROI

<table>
<thead>
<tr>
<th>Component</th>
<th>Basis for Estimate</th>
<th>Cost ($/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. MANUFACTURING COST</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>A. Direct production costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Raw materials</td>
<td></td>
<td>99,084</td>
</tr>
<tr>
<td>2. Operating labor</td>
<td>2 men(1 skilled, 1 common)/shift, 2 shifts/day, 260 days/yr, 8 hours/shift, $25/hr for skilled and $15/hr for common</td>
<td>166,400</td>
</tr>
<tr>
<td>3. Direct supervisory and clerical</td>
<td>15% of Operating labor</td>
<td>24,960</td>
</tr>
<tr>
<td>3. Utilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process electricity</td>
<td>50000 kWh, $0.045/kwh</td>
<td>2,250</td>
</tr>
<tr>
<td>Facility electricity</td>
<td>Estimated to be 20000 kWh, $0.045/kwh</td>
<td>900</td>
</tr>
<tr>
<td>4. Maintenance and repair</td>
<td>7% of FCI</td>
<td>17,005</td>
</tr>
<tr>
<td>5. Operating Supplies</td>
<td>15% of Maintenance and repair</td>
<td>2,551</td>
</tr>
<tr>
<td>7. Laboratory charges</td>
<td>15% of Operating labor</td>
<td>24,960</td>
</tr>
<tr>
<td>8. Patents and Royalties</td>
<td>assumed to be zero</td>
<td>0</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td>338,109</td>
</tr>
<tr>
<td><strong>B. Fixed charges</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Local taxes</td>
<td>Average populated area, 2% of FCI</td>
<td>4,859</td>
</tr>
<tr>
<td>2. Insurance</td>
<td>1% of FCI</td>
<td>2,429</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td>7,288</td>
</tr>
<tr>
<td><strong>C. Overhead Costs</strong></td>
<td>50% of Operating labor, Supervision, and Maintenance</td>
<td>104,182</td>
</tr>
<tr>
<td><strong>II. GENERAL EXPENSES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>A. Distribution and selling costs</strong></td>
<td>5% Total product cost</td>
<td>28,236</td>
</tr>
<tr>
<td><strong>B. Research and development</strong></td>
<td>5% of Direct production costs</td>
<td>16,905</td>
</tr>
<tr>
<td><strong>C. Advertisement</strong></td>
<td>Will decide advertisement later</td>
<td>70,000</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td>115,142</td>
</tr>
<tr>
<td><strong>TOTAL ANNUAL PRODUCT COST</strong></td>
<td>Manufacturing cost + General expenses</td>
<td><strong>564,721</strong></td>
</tr>
</tbody>
</table>
Perfume Results
# Formula of Perfume - Max Happiness ~ 80%

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Volume%</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol</td>
<td>76.5</td>
<td>Solvent</td>
</tr>
<tr>
<td>DI Water</td>
<td>8.5</td>
<td>Diluent</td>
</tr>
<tr>
<td>Peony</td>
<td>0.50</td>
<td>Top Note</td>
</tr>
<tr>
<td>Lemon</td>
<td>2.32</td>
<td>Top Note</td>
</tr>
<tr>
<td>Honeysuckle</td>
<td>0.50</td>
<td>Middle Note</td>
</tr>
<tr>
<td>Hibiscus</td>
<td>0.50</td>
<td>Middle Note</td>
</tr>
<tr>
<td>Rose</td>
<td>0.50</td>
<td>Middle Note</td>
</tr>
<tr>
<td>Amber</td>
<td>1.09</td>
<td>Base Note</td>
</tr>
<tr>
<td>Vanilla</td>
<td>1.09</td>
<td>Base Note</td>
</tr>
<tr>
<td>Sandalwood</td>
<td>3.85</td>
<td>Base Note</td>
</tr>
<tr>
<td>African Musk</td>
<td>4.65</td>
<td>Base Note</td>
</tr>
</tbody>
</table>
Maximum Happiness Decision

- Based on project life of 10 years and Max ROI @ 80% Happiness
- Revenue: $600
- Total Capital Investment: $286,000
- Total Annual Production Cost: $500,000
- Total Profit: -$315,000
- Return on Investment: -110.43%
## Formula of Perfume ~ 75% Happiness

### Perfume Formulation

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Volume%</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol</td>
<td>76.5</td>
<td>Solvent</td>
</tr>
<tr>
<td>DI Water</td>
<td>8.5</td>
<td>Diluent</td>
</tr>
<tr>
<td>Peony</td>
<td>0.26</td>
<td>Top Note</td>
</tr>
<tr>
<td>Lemon</td>
<td>2.98</td>
<td>Top Note</td>
</tr>
<tr>
<td>Honeysuckle</td>
<td>0.26</td>
<td>Middle Note</td>
</tr>
<tr>
<td>Hibiscus</td>
<td>0.26</td>
<td>Middle Note</td>
</tr>
<tr>
<td>Rose</td>
<td>0.26</td>
<td>Middle Note</td>
</tr>
<tr>
<td>Amber</td>
<td>1.73</td>
<td>Base Note</td>
</tr>
<tr>
<td>Vanilla</td>
<td>1.73</td>
<td>Base Note</td>
</tr>
<tr>
<td>Sandalwood</td>
<td>6.99</td>
<td>Base Note</td>
</tr>
<tr>
<td>African Musk</td>
<td>0.54</td>
<td>Base Note</td>
</tr>
</tbody>
</table>
Most Profitable Decision

- Based on project life of 10 years and Max ROI @ 75% Happiness
- Revenue: $820,000
- Total Capital Investment: $255,000
- Total Annual Production Cost: $565,000
- Net Profit: $170,000
- Return on Investment: 56.91%
Three economic scenarios in question
- High economic pricing on raw materials
- Average economic pricing on raw materials
- Low economic pricing on raw materials

A standard deviation of 20% was assumed

Raw materials contribute a large percentage of cost for calculating the total product cost
ROI vs. Happiness at differing economic scenarios
Risk Analysis for Max Happiness

Mean ROI: -110.43 %
Probability of Occurrence: ~ 40 %

Cumulative Probability
100% Chance of losing money
Risk Analysis for Maximum ROI

Mean ROI: 59.91%

Probability of Occurrence: ~ 12%

Cumulative Probability
100% Chance of gaining money
A regret analysis was performed on low, medium, and high market values for raw material cost.

Based on MiniMax analysis F7 is the optimum choice.
A regret analysis was performed on the perfume formulations at the three economic scenarios:

- Traditional – F7
- Optimistic – F7
- Pessimistic – F7
Conclusions

Pure Ambition is profitable!

Based on the following parameters:

- 75\% Happiness
- Demand = 13,300 people
- Price = $60/bottle
Questions?